Comments of Powerex Corp. on
Day Ahead Market Enhancements
Revised Straw Proposal

Submitted by	Company	Date Submitted
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Powerex appreciates the opportunity to submit comments on CAISO's June 8, 2020 *Day-Ahead Market Enhancements Revised Straw Proposal* ("Revised Straw Proposal"), including the updated formulation proposed at the stakeholder meeting on June 17 ("Updated Revised Straw Proposal").

The Day-Ahead Market Enhancements ("DAME") stakeholder process represents a major undertaking, as it is exploring what could be the most far-reaching changes to the core engine of the CAISO's day-ahead market ("DAM") since it was first implemented more than a decade ago. Consistent with the magnitude of this effort, the CAISO has committed considerable time of its senior executives, senior policy staff and technical experts over the past two years. Powerex greatly appreciates and commends the sustained engagement of the CAISO to this important initiative, its consideration of a wide range of stakeholder perspectives, and its commitment to finding workable solutions.

I. Summary and Overview of Powerex's Alternative Proposal

The primary goal of the DAME process appears relatively straightforward: ensure that CAISO operators are able to reliably operate the grid in real-time by committing sufficient physical capacity and flexibility on a day-ahead basis.[1]

The various proposals discussed in the DAME initiative differ substantially in their approaches to achieving this goal. The table below recaps the *status quo,* the primary DAME proposals presented to date, as well as a new Alternative Proposal (discussed further in Section I.B) that Powerex believes merits further discussion and consideration with stakeholders.

[1] Historically, this has generally not been necessary, as day-ahead *energy* schedules, together with physical resources that were generally available in real-time, were sufficient to cover the vast majority of operational needs. But the growth of variable energy resources whose real-time output is subject to uncertainty and variability, together with retirements of a substantial fraction of the conventional thermal fleet, now frequently lead to real-time operational needs that are well beyond what can be met by resources that "happen to be available."

Proposal	Key Design Features
Current Market Design *status quo*	• Energy market clears physical and virtual supply against bid-in demand • Sequential RUC process to commit additional physical supply • Extensive operator intervention and out-of-market action to procure additional physical supply to meet real-time needs (insufficient DA capacity and flexibility)
Current Design *plus* Imbalance Reserve Product *suggested by some stakeholders*	• Adds day-ahead Imbalance Reserve Up and Down (IRU/IRD) for flexibility needs • Retains RUC to commit additional capacity needed to meet CAISO day-ahead forecast of real-time demand • Continued (but less) operator intervention and out-of-market action to procure additional physical supply to meet real-time needs (DA capacity insufficient)
CAISO Straw Proposal *February 3, 2020*	• Single co-optimized run simultaneously clears bid-in demand for energy, IRU/IRD, and new Reliability Capacity Up and Down (RCU/RCD) to meet CAISO day-ahead forecast of real-time net demand • Eliminates RUC and should largely eliminate need for operator intervention and out-of-market actions since sufficient capacity and flexibility procured • Distinct market clearing prices and compensation for financial energy, physical energy, stand-alone RCU/RCD and stand-alone IRU/IRD
CAISO Revised Straw proposal *June 8, 2020*	• First pass: co-optimized solution as in Straw Proposal, but market awards and prices not used; only uses first pass to set the procurement target for stand-alone capacity (RCU/RCD) and to commit internal generation • Second pass: clears physical and virtual supply against bid-in demand for energy; procures RCU/RCD and IRU/IRD. • Virtual supply can displace physical supply in second pass, reducing total committed physical capacity (requiring out-of-market actions) • All cleared energy awards (physical and virtual) receive identical compensation at a given location
CAISO Updated Revised Straw Proposal *June 17, 2020*	• Adds additional pass to iteratively increase RCU (or RCD) procurement for physical energy awards displaced by virtual energy awards in second pass
Powerex Alternative Proposal *(not yet discussed with stakeholders)*	• Day-ahead capacity commitment, based on co-optimized solution for energy, capacity and flexibility, resulting in set of must-offer obligations in day-ahead and real-time energy market. Compensation only to resources that do not already have a must-offer obligation (*i.e.,* only for non-RA resources) • Subsequent energy market clears physical and virtual supply against bid-in demand (identical compensation), and procures stand-alone RCU/RCD and IRU/IRD • Energy market cannot unwind must-offer obligations from day-ahead capacity commitment process

A. Evaluating DAME Proposals To Date

A key distinction between the proposals is how—and whether—they recognize and address the need for, and relationship between:

1. **Sufficient capacity commitments:** ensuring the sum of physical energy, RCU and IRU equals the total capacity needed to ensure reliability in real-time; and
2. **Energy dispatch:** ensuring physical and virtual supply is dispatched to meet bid-in physical demand plus virtual demand.

The existing DAM ignores the first objective completely, and only achieves the second one. Under the current DAM design, physical and virtual supply offers are treated identically, and clear against bid-in demand; the CAISO employs an entirely separate RUC process to commit additional units to meet the second objective by "topping up" energy schedules that happen to be awarded to physical suppliers in order to meet its forecast of real-time needs (including "backstopping" virtual supply awards). Since the clearing of energy offers ignores both the CAISO's need for capacity and flexibility as well as the ability of physical resources to meet these needs, this type of fragmented procurement cannot achieve the least-cost use of resources (*i.e.*, market efficiency), nor does it result in energy prices that accurately reflect the value of physical supply (*i.e.*, accurate prices).

The CAISO's three most recent proposals and Powerex's Alternative Proposal all appear to recognize the need for a solution that attempts to meet both of these objectives, and do so in a manner that minimizes total bid-in production costs. The proposals take different approaches, however, with implications for what Powerex views as the three key criteria for a sound market design:

1. **Reliability:** Does the DAM solution include the right quantity and mix of resources needed by CAISO operators to reliability operate the grid in real-time?
2. **Market Efficiency:** Does the DAM solution minimize total bid-in production costs (*i.e.,* is it efficient)?
3. **Accurate Prices:** Does the DAM compensate the products and attributes provided to the grid at prices that accurately reflect the marginal value being provided?

The table below summarizes Powerex's assessment of how well each of the approaches mentioned above meet these market design criteria. The approaches are listed from most consistent to least consistent with sound market design.

Proposal	Reliability?	Efficiency?	Accurate Prices?
Powerex Alternative Proposal	**Yes** Capacity committed to meet expected real-time net demand, uncertainty, and variability.	**Yes** All product needs simultaneously considered when determining day-ahead capacity commitment; ensures energy market includes least-cost mix of available supply.	**Yes** Compensation for non-RA resources that receive a must-offer obligation encourages participation. Market prices for energy reflect substitution between physical and virtual supply, and need for stand-alone RCU/D and IRU/D products.
CAISO Straw Proposal *February 3, 2020*	**Yes**	**Yes** All products simultaneously procured through single co-optimized process.	**Yes** Simultaneous procurement results in product prices that reflect alternative use of resources.
CAISO Updated Revised Straw Proposal *June 17, 2020*	**Yes** Capacity "unwound" in second pass leads to additional RCU procurement.	**Improvement over DAM** Unlike DAM, procures IRU and RCU. However, iterative process procures additional RCU to ensure reliability, which may be more costly than awarding energy to physical suppliers.	**No** Compensation to physical suppliers of energy does not reflect avoided cost of RCU. Creates incentives for physical suppliers to only sell RCU in DAM, and sell energy in real-time market
CAISO Revised Straw proposal *June 8, 2020*	**Improvement over DAM** Unlike DAM, procures additional flexibility and capacity. However, second pass can "unwind" capacity commitments from first pass.	**Improvement over DAM** Unlike DAM, procures IRU and RCU, but subsequent out-of-market procurement may still be needed to ensure reliability.	**No** Compensation to physical suppliers of energy does not reflect avoided cost of RCU.

Beyond the threshold question of whether the proposals meet the sound market design criteria of reliability, efficiency and accurate prices, several stakeholders have expressed concerns regarding aspects of the proposals discussed to date that they view as unworkable or unduly challenging. Powerex believes that a successful DAME proposal will seek to address these additional stakeholder concerns wherever it is possible to do so without sacrificing sound market design principles.

The table below summarizes Powerex's understanding of the key additional concerns that have been expressed regarding each of the most recent DAME proposals:

Proposal	Addition Concerns Raised by Stakeholders
CAISO Straw Proposal	• Additional compensation for "reliability energy" appears duplicative of RA contracts, which already commit physical supply to a must-offer obligation in the CAISO day-ahead and real-time markets. • Some stakeholders perceived demand bids to clear inconsistent with bid prices, or to create impediments to hedging DA vs. RT energy prices. • Market outcomes appear unduly influenced by CAISO operator inputs rather than by interaction of willing buyers and willing sellers
CAISO Revised Straw proposal **CAISO Updated Revised Straw Proposal**	• Non-RA external suppliers object to energy compensation that does not reflect the value of committing physical capacity (avoided RCU). • Will require further modification to be workable in a regional EDAM. • Proposed blunt mitigation of RCU and IRU offer prices at $30
Powerex Alternative Proposal	*Proposal not yet presented or discussed with stakeholders, but proposal appears to address concerns expressed to date*

Powerex believes that the CAISO's current proposal (*i.e.,* the Updated Revised Straw Proposal) is a ***significant improvement over the current CAISO DAM design***. It addresses the need for the DAM solution to include a broader set of capacity and flexibility products, which have become necessary to ensure reliability; and it largely procures those products through a co-optimized process, making it much more likely to minimize bid-in production costs than the current market design.

At the same time, ***Powerex believes there are important limitations to the CAISO's Updated Revised Straw Proposal***, including:

1. It does not fully minimize total bid-in production costs (*i.e.*, market efficiency), due to the iterative process in which physical supply can be displaced by virtual supply, and then subsequently back-filled by additional RCU procurement.
2. It incents (non-RA) physical resources, including imports, to wait to sell their physical energy in the real-time market instead of the DAM (in order to sell RCU and receive RCU revenues); or alternatively to offer physical energy in the DAM at prices that include foregone RCU compensation (*i.e.*, at offer prices that do not reflect the marginal energy cost of the resource); and

3. It requires further enhancements as part of the Extended Day-Ahead Market ("EDAM"), to more efficiently and equitably compensate (non-RA) physical resources for the capacity attributes provided through EDAM transfers.

For these reasons, Powerex believes that further stakeholder discussion would be beneficial to help identify a DAME proposal that both meets the fundamental criteria of sound market design (*i.e.,* reliability, market efficiency, and accurate prices) and adequately addresses the key additional concerns expressed by differently-situated stakeholders.

B. Overview of Powerex's Alternative Proposal

Powerex believes that, with certain modifications, elements of the CAISO's current proposal can form the basis for a workable and efficient DAME proposal. An overview of this **Powerex Alternative Proposal** based on the CAISO's formulations is provided below, with additional discussion in Section III.

The Powerex Alternative Proposal is based on the separation of two actions that appear to be intertwined as part of the day-ahead energy market under prior CAISO proposals, namely:

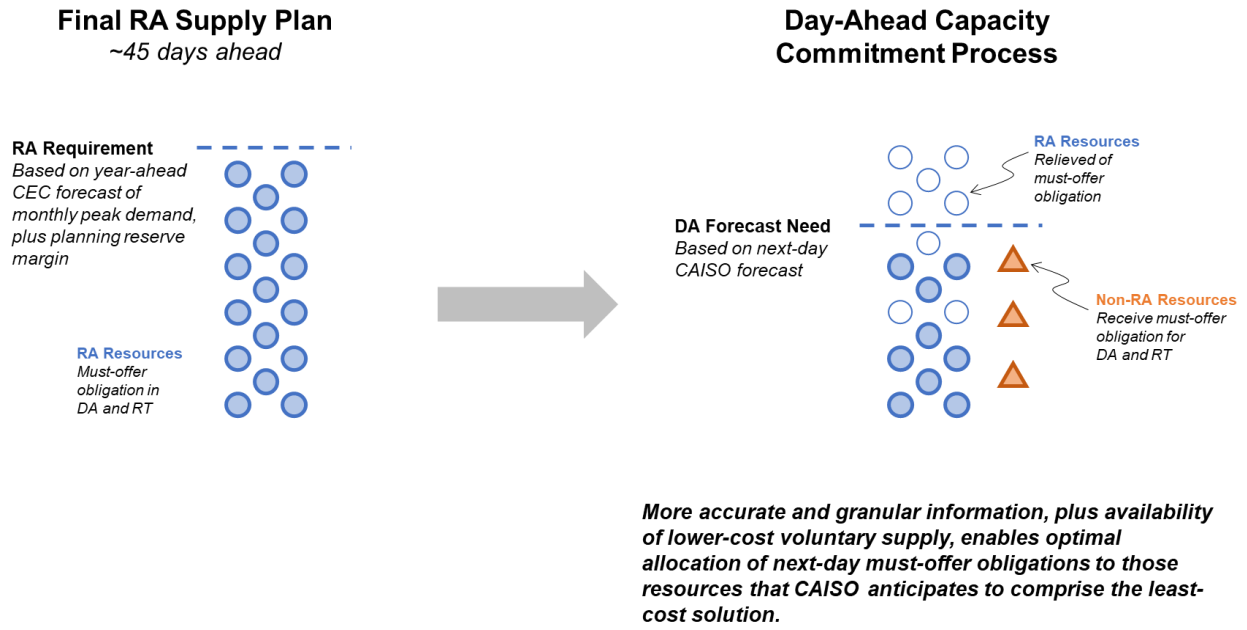
1. Ensuring **sufficient capacity commitments**; and
2. Conducting an efficient **energy dispatch.**

Under Powerex's Alternative Proposal, the day-ahead commitment of sufficient total physical capacity is more appropriately seen as a refinement, in the day-ahead timeframe, of the forward physical capacity commitments that are entered into under California's Resource Adequacy ("RA") program. California's RA program is the key mechanism intended to ensure that sufficient physical capacity will be made available in the CAISO's day-ahead and real-time markets. But the set of resources that commit to a must-offer obligation under the RA program on a *month-ahead* or *year-ahead* basis, with only *monthly granularity*, is unlikely to be the least-cost way of making sufficient resources available to the CAISO markets on a *day-ahead* basis, with *hourly granularity*. To the contrary, tremendous production cost savings are likely to be achieved by adjusting, on a day-ahead basis, which specific resources have a must-offer obligation in the CAISO day-ahead and real-time energy markets in each hour. There are at least two sources of these potential savings:

1. **Not all of the contracted RA capacity is likely to be needed in a given day or hour.** Where CAISO's day-ahead projections give it confidence that the grid's actual needs will be less than the peak needs used to set RA requirements, then a portion of the must-offer obligation can be released while maintaining reliability.

2. **RA resources may be "substituted out" by non-RA resources** that are voluntarily made available on a day-ahead basis and can satisfy the must-offer obligation at lower cost.[2]

The figure below illustrates how the must-offer obligations in the DAM and real-time markets can be optimally re-allocated on a next-day basis, so that the CAISO markets include the least-cost mix of resources, which may differ from the resources under month-ahead and year-ahead forward RA contracts.



The Powerex Alternative Proposal consists of a **day-ahead capacity commitment optimization process** that identifies the least-cost set of *RA and non-RA* physical resources able to meet the CAISO's capacity and flexibility commitment needs, and ensures those resources will be available by allocating a corresponding must-offer obligation in both the CAISO's day-ahead and real-time energy markets. It achieves this using the identical formulation to the first pass of the CAISO's Updated Revised Straw Proposal, but uses this pass for entirely different purposes, namely, to:

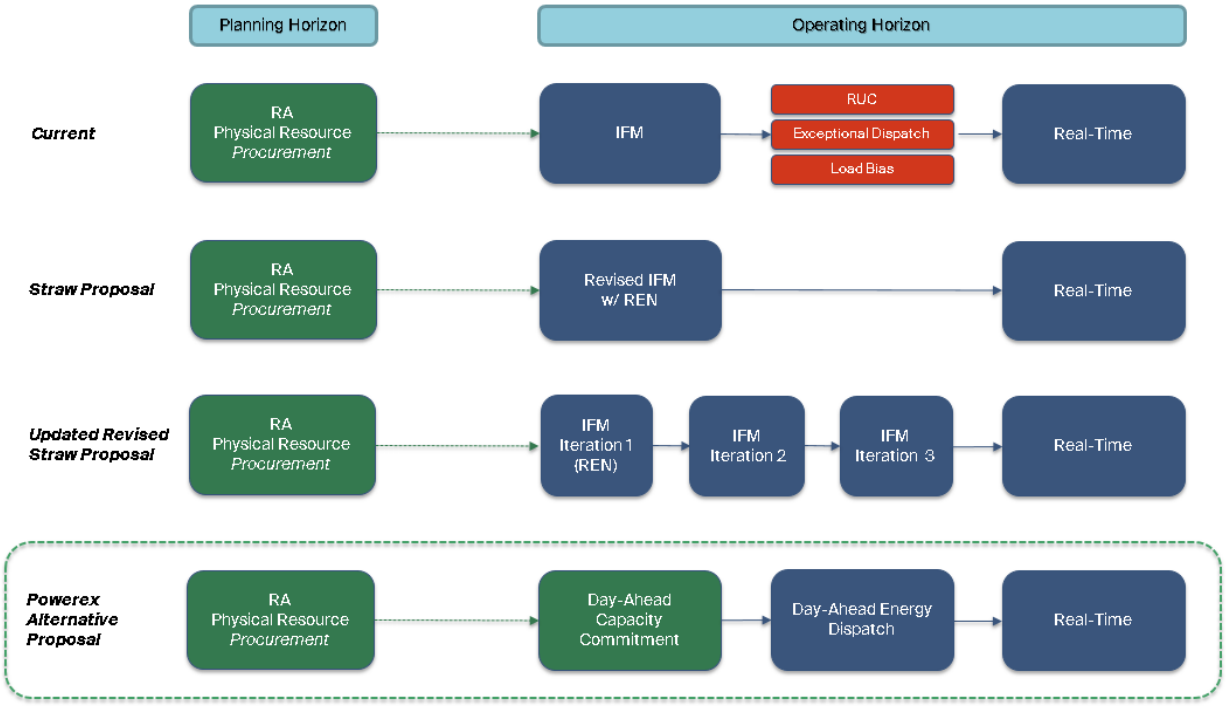
- determine which physical resources will have a must-offer obligation in the CAISO day-ahead and real-time markets; and
- determine the compensation to non-RA resources that take on this obligation.

[2] Under Powerex's Alternative Proposal, voluntary physical supply offers that wish to be treated as "reliable energy offers" in the day-ahead market process—and thus be eligible for additional compensation—must be willing to accept a must-offer obligation through real-time. Those resources that are unable or unwilling to receive a must-offer obligation through real-time would not be treated as "reliable energy offers" in the day-ahead market processes, and would indicate this treatment by selecting an alternative designation.

Importantly, ***the Powerex Alternative Proposal would not result in California LSEs "double paying" for capacity***. First, the Powerex Alternative Proposal would only provide capacity compensation to physical resources that are not already under a must-offer obligation pursuant to an RA contract. Second—assuming that the RA program ensured the CAISO grid was resource sufficient in the aggregate—the compensation for day-ahead capacity commitments of non-RA resources would be funded by:

1. Charges to RA resources that voluntarily choose to offer to "buy out of" their must-offer obligation and benefit from having that obligation assigned instead to a non-RA resource; and
2. Charges to California LSEs that benefit from lower total production costs—including savings in bid cost recovery payments—as a result of committing a lower-cost set of physical resources to be available in the day-ahead and real-time markets.

Immediately following the day-ahead capacity commitment process (which ensures reliability), the **day-ahead energy market** would clear bid-in demand against offered supply from all sources (physical and virtual). This would use the same formulation as the CAISO's second pass of its Updated Revised Straw Proposal. This equivalent treatment of all types of energy offers is possible only because the commitment of physical resources will have already occurred, and—unlike the CAISO's Updated Revised Straw Proposal—cannot be "unwound" by the subsequent clearing of financially-binding energy market awards. The day-ahead energy market would result in the same locational price for all cleared energy bids and offers, providing parity between physical and virtual supply, and more intuitively aligning the clearing of demand bid price and energy prices.



Powerex believes the Alternative Proposal adheres to the core principles of sound market design—ensuring reliability, least-cost dispatch, and accurate pricing and compensation—and also addresses the key concerns expressed by stakeholders regarding a workable approach. For this reason, Powerex believes the Alternative Proposal merits further discussion and consideration by stakeholders and by CAISO staff.

II. CAISO's Updated Revised Straw Proposal Is An Improvement Over The *Status Quo,* But Has Important Limitations

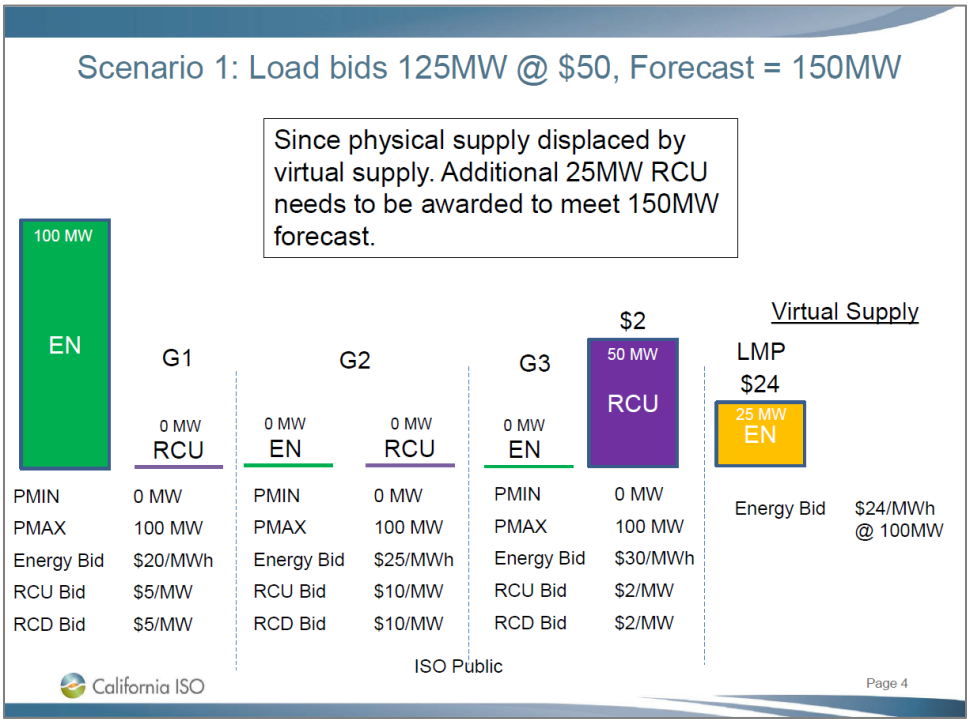
The CAISO's Updated Revised Straw Proposal is comprised of at least two passes:

1. A **first pass**, in which all day-ahead products are co-optimized, and energy awards to physical resources are recognized as helping meet the CAISO's total capacity requirement. The solution from this first pass does not create binding awards or prices, but it does determine the quantity of RCU that the CAISO must procure.
2. A **second pass**, in which all day-ahead products are procured, but the CAISO does not enforce a total capacity requirement (*i.e.*, REN constraint), and thus does not distinguish between physical supply and virtual supply.

In the stakeholder workshops on June 15 and 17, it was recognized that the second pass would not necessarily result in sufficient total capacity being committed to ensure reliability. That is, the sum of energy awards to physical resource, RCU, and IRU could fall short of the quantity calculated by the CAISO as necessary to reliably operate the grid

in real-time. This could occur if, in the second pass, additional virtual supply offers are cleared, displacing physical supply offers. In response to the concern that the result might not ensure reliability, the CAISO proposed an updated formulation in which **additional iterative passes** would be added to procure additional RCU to replace any physical energy awards displaced by virtual supply.

The CAISO provided a hypothetical example to illustrate how the Updated Revised Straw Proposal reaches the solution shown below:



The above solution satisfies two conditions:

1. There is sufficient physical energy (100 MW, from G1) and RCU (50 MW, from G3) to equal the CAISO's forecast demand of 150 MW, thus ensuring reliability; and
2. There is sufficient total energy (100 MW from G1, plus 25 MW from virtual supply) to equal the bid-in energy demand of 125 MW.

The above solution has a total bid-in production cost of $2,700.[3]

Importantly, however, the Updated Revised Straw Proposal's iterative approach results in an inefficient way of achieving a reliable day-ahead solution. Namely, instead of awarding 25 MW of energy to virtual sellers (at $24/MWh), the solution could have obtained 25 MW of energy from G2 (at $25/MWh), ***and saved the cost of procuring***

[3] [100 MW * $20/MWh for energy from G1] + [50 MW * $2/MW for RCU from G3] + [25 MW * $24/MWh for energy from virtual supply] = $2,000 + $100 + $600 = $2,700.

25 MW of RCU from G3. This would have led to a lower-cost (*i.e.,* more efficient) solution, with total bid-in production costs of $2,675.[4]

The CAISO's hypothetical example highlights the inability of the Updated Revised Straw Proposal to properly recognize the tradeoff between:

- Procuring physical energy; and
- Procuring virtual energy *plus* additional RCU.

When this relationship is recognized, it is clear that energy from G2 costs $25/MWh, but replaces both (1) the procurement of virtual energy at $24/MWh; and (2) the associated procurement of additional RCU at $2/MWh.[5] In other words, the true total cost of clearing virtual supply in this example is not $24/MWh at all, but $26/MWh. But because the Updated Revised Straw Proposal does not enforce the REN constraint in the second pass, it incorrectly replaces physical energy from G2 with virtual supply. When the reliability impact is subsequently recognized, the Updated Revised Straw Proposal is forced to procure additional physical capacity inefficiently, and thus ***market efficiency is not achieved.*** This outcome is analogous to today's use of RUC or operator interventions to compensate for the lack of sufficient capacity obtained in the day-ahead market solution.

In addition, under the Updated Revised Straw Proposal, ***accurate prices are not achieved.*** It is clear from the CAISO example discussed above that energy awarded to a physical seller reduces the need to procure RCU, whereas energy awarded to a virtual seller does not. But the cost savings enabled by the physical supplier are not reflected in the compensation under the Updated Revised Straw Proposal, which is identical to the compensation to virtual sellers. Specifically, the price paid to all physical supply is inaccurately reduced to $24/MWh in the pricing run; this is below the efficient price of $25/MWh determined in the first pass, and is also below the full incremental production cost of $26/MWh that is incurred under the Updated Revised Straw Proposal.

This inaccurate pricing outcome has important ramifications, including:

- Weak incentives for participation in the DAM by physical sellers, relative to opportunities in external markets where firm physical attributes are compensated

[4] [100 MW * $20/MWh for energy from G1] + [25 MW * $25/MWh for energy from G2] + [25 MW * $2/MW for RCU from G3] = $2,000 + $100 + $600 = $2,675.

[5] Indeed, this efficient, cost-minimizing solution *is* recognized by the *first pass* of the Updated Revised Straw Proposal, and was also recognized in the CAISO's Straw Proposal approach from February. But the addition of a "second pass" that ignores the impact of physical energy awards on achieving reliable solutions undermines market efficiency.

(*i.e.*, firm supply is compensated for the savings associated with avoided alternative capacity commitments of the buyer).

- Bidding incentives for physical suppliers to offer only RCU in the day-ahead market, and sell their energy in real-time (or to alternatively offer energy in the day-ahead market at prices that include estimated foregone revenue from RCU).
- Requires further enhancements for a regional EDAM, as absent such enhancements, it would result in a large volume of day-ahead firm energy transactions in the bilateral markets being re-valued and compensated the same as non-firm, speculative, or virtual sales.

Powerex believes, however, that the formulation of the CAISO's Updated Revised Straw Proposal can be implemented in a modified approach that overcomes these limitations, potentially paving the way for a workable DAME proposal that receives broad support.

III. The Powerex Alternative Proposal Can Achieve Reliability, Market Efficiency and Accurate Prices While Addressing Legitimate Stakeholder Concerns

This section provides additional detail regarding the Powerex Alternative Proposal based on the formulations of the CAISO Updated Revised Straw Proposal, and demonstrates how it overcomes the limitations identified in the prior section.

A. The Powerex Alternative Proposal in Detail

As described in Section I.B, the Powerex Alternative Proposal is comprised of two steps, utilizing the same mathematical formulation as the CAISO Updated Revised Straw Proposal. Unlike the CAISO proposal, however, the Powerex Alternative Proposal:

1. Uses the Pass 1 formulation to define the set of physical resources with a binding must-offer obligation in the day-ahead and real-time markets;
2. Uses the Pass 2 formulation to determine binding market awards for energy, RCU, and IRU; and
3. Uses the difference between Pass 1 and Pass 2 to determine compensation for physical resources allocated a must-offer obligation, to the extent they have not already accepted such an obligation under an RA contract.

1. Pass 1: Day-Ahead Capacity Commitment Process

The first element of the Powerex Alternative Proposal is the **day-ahead capacity commitment process**, which uses the same formulation as the first pass of the CAISO

Updated Revised Straw Proposal. Namely, this first pass co-optimizes the procurement of all of the following products:

- **Energy:** Physical and virtual energy schedules to meet bid-in physical and virtual demand.
- **Imbalance Reserve Up (IRU) and Down (IRD):** based on CAISO determination of real-time flexibility needs.
- **Capacity: Reliable Capacity Up (RCU)** and **Reliable Capacity Down (RCD)** as necessary to supplement physical energy awards to meet the CAISO's day-ahead forecast of net demand.
- **Ancillary Services and Corrective Capacity.**

This first pass results in a binding must-offer obligation for all physical resources that receive awards for energy, RCU or IRU. This must-offer obligation extends to the day-ahead market that is executed as the second pass in the Powerex Alternative Proposal, and also applies to the CAISO's real-time market for the applicable operating hour.

A key benefit of this first pass is to enable RA resources to voluntarily seek to be relieved of the must-offer obligation they entered into under their RA contracts in exchange for a payment by the RA resource that is relieved. This economic option is available by submitting a bid for RCU at a price greater than $0/MW; the bid price would limit the payment that the RA resource would be required to pay in exchange for being relieved of its must-offer obligations for the applicable operating hour. This creates strong incentives for RA resources to submit bids for RCU at prices that reflect the resource's marginal cost of maintaining the must-offer obligation through the day-ahead and real-time markets.

Powerex notes that this functionality is not available under the current design, in which RA resources are required to submit $0/MW bids into the RUC process, with no opportunity to be relieved of the must-offer obligation, even if there are other resources that could provide the same service at lower cost. It also does not appear that this type of functionality is part of the CAISO's Updated Revised Straw Proposal.

2. Pass 2: Binding Day-Ahead Energy Market

The first pass is immediately followed by the **day-ahead energy market**, which uses the same formulation as the second pass of the CAISO Updated Revised Straw Proposal. Namely, the second pass co-optimizes the procurement of all of the following products:

- **Energy:** Physical and virtual energy schedules to meet bid-in physical and virtual demand.
- **IRU and IRD:** based on CAISO determination of real-time flexibility needs.

- **RCU or RCD:** based on the quantity obtained in the solution to the first pass.
- **Ancillary Services and Corrective Capacity.**

The Powerex Alternative Proposal will produce the identical market prices and market awards as in the second pass of the CAISO's Updated Revised Straw Proposal. Critically, however, the must-offer obligations determined in the first pass of the Powerex Alternative Proposal are not reduced or eliminated based on the results of the second pass. This eliminates the need for additional, iterative passes under the CAISO Updated Revised Straw Proposal, where the displacement of physical energy awards by virtual supply must be back-filled through additional RCU procurement. The difference between the outcomes under the CAISO Updated Straw Proposal and the Powerex Alternative Proposal is explained more fully in Section III.B, below.

3. Compensation of Non-RA Resources Receiving a Must-Offer Obligation

An important result of the Powerex Alternative Proposal is that a physical resource may be assigned a must-offer obligation, but may not receive a binding day-ahead market award.[6] To the extent the resource is already subject to a must-offer obligation under an RA contract, such an outcome does not raise any issues. But where a physical resource is subject to a must-offer obligation in the day-ahead and real-time markets, and has not already accepted such an obligation under an RA contract, then it is both equitable and efficient for the DAM to include compensation for such a commitment. Similarly, compensation is also appropriate for non-RA resources that receive a must-offer obligation and also receive a binding market award, but where the compensation under those market awards has been reduced in the second pass by the removal of the REN constraint that is enforced in the first pass.

The Powerex Alternative Proposal therefore compensates non-RA resources that receive a must-offer obligation in the first pass based on the difference in prices between that first pass and the binding market awards and prices in the second pass. This approach is analogous in concept to the capacity compensation obtained under an RA contract, where expected net revenues in the CAISO day-ahead and real-time markets generally reduce the compensation that needs to be earned under RA contracts in order to provide sufficient total compensation for the forward commitment of a resource. Since the first pass includes all of the information that is used in determining the binding market awards

[6] It should be noted that this must offer obligation—and the associated compensation—is distinct from a market award of RCU, as physical resources that receive a must offer obligation are merely required to offer the same quantity of energy in the applicable hour(s) of the real-time market. They are explicitly *not* required to meet (and/or are *not* limited by) the more robust technical requirements associated with RCU (such as being limited in quantity to the amount the resource can ramp over 60 minutes). All non-RA resources that voluntarily agree to take on a must-offer obligation—and receive the associated compensation—accept the price exposure inherent in the CAISO market processes determining the marginal value of this obligation (*i.e.*, participants do not submit any explicit must-offer obligation offer price).

in the second pass, however, there is no need for sellers from physical resources to estimate or predict energy market revenues; it can be calculated directly from the bids and offers and other information that will be used to perform the market run.

The table below presents one potential approach to calculating this compensation. Further discussion with stakeholders is needed to develop the details of the compensation calculation that provide appropriate and accurate price signals.

Category	Reliability Commitment (Pass 1)	Market Award (Pass 2)	Market Obligation for Reliability Commitment	Compensation for Reliability Commitment
RA	Yes	Any	Must-offer through real-time	*No incremental compensation for RA resources*
Non-RA	Yes	Energy	Must-offer through real-time	Max[\$0, ($Energy_{Pass1}$ + $REN\ Shadow\ Price_{Pass1}$) – $Energy_{Pass2}$]
Non-RA	Yes	RCU	Must-offer through real-time	Max[\$0, RCU_{Pass1} - RCU_{Pass2}]
Non-RA	Yes	IRU	Must-offer through real-time	Max[\$0, IRU_{Pass1} - IRU_{Pass2}]
Non-RA	Yes	No Market Award	Must-offer through real-time	$REN\ Shadow\ Price_{Pass1}$

4. Funding Compensation to Non-RA Resources Assigned a Must-Offer Obligation

The compensation provided to non-RA resources receiving a must-offer obligation is proposed to be funded primarily through charges allocated to the two beneficiaries of the savings enabled by the optimization of must-offer obligations on a day-ahead basis:

1. The RA resources that voluntarily elected to "buy out of" their must-offer obligation (by offering RCU at a price greater than \$0/MW) and thus benefit from having that obligation assigned instead to a non-RA resource; and
2. California LSEs, which benefit from lower total production costs—including savings in bid cost recovery payments—as a result of committing a lower-cost set of physical resources to be available in the day-ahead and real-time markets.

It would appear to be inappropriate to allocate costs to RA resources that offer RCU as a price taker (*i.e.,* at \$0/MW) but that nevertheless do not receive a must-offer obligation equal to its RA commitment. This could occur simply because the aggregate capacity

requirement for a given hour was less than the total RA capacity (so even if all RA resources offer RCU at $0/MW, the first pass will clear a lesser quantity of total must-offer obligations). This could also occur because the day-ahead capacity commitment process is not based solely on the RCU offer price, but on co-optimizing physical capacity with all other products. A resource may offer RCU as a price taker, but still not be part of the optimal cost-minimizing solution (as other costs associated with committing the resource may make it inefficient to do so). In such instances, it appears appropriate to recover the compensation associated with alternative capacity commitments from physical demand, as it receives the benefit of the lower-cost solution that is achieved, including both market clearing prices that reflect the lower cost of the marginal resource but also lower uplift charges needed to fund bid cost recovery payments to generators.[7]

The cost of must-offer obligations to non-RA resources is therefore proposed to recovered through a two-tier allocation:

- **Tier 1** allocation to RA resources with a final must-offer obligation less than its RA quantity, except for any RA resource that offers RCU as a price-taker; and
- **Tier 2** allocation of remaining costs to physical demand.

B. Benefits Of Powerex's Alternative Proposal

Powerex believes that its Alternative Proposal represents a material improvement in the application of the formulations of the CAISO Updated Revised Straw Proposal. In particular, the Powerex Alternative Proposal is significantly more consistent with sound market design (ensuring reliability, market efficiency, and accurate prices) and addresses the additional concerns expressed by stakeholders.

BENEFIT 1: Market Efficiency

While both the CAISO's Updated Revised Straw Proposal and Powerex's Alternative Proposal lead to a reliable day-ahead solution, Powerex's Alternative Proposal achieves a least-cost solution and produces accurate prices, whereas the CAISO's Updated Revised Straw Proposal may not.

Section II explained how the CAISO's Updated Revised Straw Proposal leads to an inefficient solution by allowing physical energy to be displaced by virtual offers without regard to the cost of backstopping the virtual supply with additional RCU. The Powerex Alternative Proposal avoids this inefficient outcome because it is ***designed to permit***

[7] If the underlying assumption that the CAISO BAA is not resource adequate—that is, the actual RA capacity commitments were less than the actual capacity needs of the grid—it would also be appropriate to allocate the cost of additional Day Ahead Reliability Commitment Process obligations to physical load.

virtual supply to displace physical supply without "unwinding" the must-offer obligation of physical resources.

In the CAISO example discussed previously, rather than allowing virtual supply to displace physical energy from G2 altogether, the Powerex Alternative Proposal would allow virtual supply only to displace G2 from obtaining day-ahead price certainty (in the form of a day-ahead market award) for its anticipated real-time energy sales. G2 would still be subject to a must-offer obligation through real-time, and would receive the real-time energy price for its energy sales in real-time.

BENEFIT 2: Accurate Prices

The Powerex Alternative Proposal provides strong price signals for physical resources to commit their supply to the CAISO market, to the extent they have not already done so under an RA contract. A physical resource that submits offers into the DAM under Powerex's Alternative Proposal can expect to receive:

1. Compensation for binding market awards and at the market prices established in pass 2 (just as under the CAISO's Updated Revised Straw Proposal); and
2. Compensation for accepting a must-offer obligation in the day-ahead and real-time timeframes, reflecting the additional value of physical supply (which is not provided under the CAISO's Updated Revised Straw proposal).

In this manner, *all* physical capacity that commits to being available in the CAISO day-ahead and real-time markets receives appropriate compensation. Resources that enter into RA contracts on a month-ahead, year-ahead, or multi-year basis are compensated under those contracts; whereas resources to commit physical supply to the CAISO grid on a day-ahead basis will receive day-ahead capacity commitment revenues under Powerex's Alternative Proposal. This achieves two important benefits:

1. It provides equitable compensation for all suppliers that commit physical capacity to serve the needs of the CAISO grid.
2. It provides a strong market-based price signal to sellers with available and uncommitted physical supply to make that supply available to the CAISO, and thus reduce the need for the CAISO to procure RCU.

As the grid continues its transformation toward a lower carbon fleet, it is imperative that markets also evolve to provide clear and accurate price signals for the commitment of capacity and flexibility, and not just for energy. Powerex's Alternative Proposal meets this need.

BENEFIT 3: EDAM Extension

Potential EDAM entities have repeatedly expressed a concern that a failure to properly compensate for firm energy attributes is likely to create significant challenges for aggregate EDAM benefits to be equitably shared between buyers and sellers across a broad multi-state market footprint. In addition, since an EDAM is also likely to replace a significant quantity of day-ahead transactions entirely outside the CAISO grid, a market design that does not accurately value firm supply could lead to today's bilateral firm transactions being replaced or re-valued at non-firm or virtual prices.

The prospects for an EDAM depend on whether external entities can develop a strong business case for participating in such a market. By providing clear, market-based price signals that accurately reflect the additional value of firm physical supply over non-firm, speculative or virtual supply, the Powerex Alternative Proposal provides a market design better suited to being extended to a future EDAM.

BENEFIT 4: Reduced Market Power Concerns

As an initial matter, it is unclear that material market power concerns for capacity (*i.e.*, RCU) arise under either the CAISO Updated Revised Straw Proposal or under Powerex's Alternative Proposal. Under both proposals, uncompetitively high prices for RCU can be avoided by the alternative procurement of physical energy (which is already subject to mitigation) and RCD.

But the Powerex Alternative Proposal also provides strong incentives for all resources under an RA contract to offer RCU competitively. Specifically, an RA resource that offers RCU at a price greater than $0/MW is exposed to being allocated the cost of compensating non-RA resources that receive a must-offer obligation (which, in turn, is based on the REN shadow price in the first pass). Powerex also notes that—provided the RA program actually ensures sufficient aggregate capacity going into the day-ahead market—the provision of RCU should be structurally competitive, with the total capacity needs of the first pass being able to be met by offers from sellers with no incentive to exercise market power in RCU (*i.e.,* from resources under an RA obligation).

BENFIT 5: Maximizes Market Participation

The CAISO's Updated Straw Proposal appears to unintentionally create undesirable bidding incentives. Specifically, a supplier from a non-RA physical resource can choose either to:

1. Offer energy in the day-ahead market; or
2. Offer only RCU in the day-ahead market, and sell its energy output in the real-time market.

Under the first option, the seller will receive only the day-ahead energy price. But under the second option, the seller will receive both the day-ahead RCU price *and* the real-time energy price, with the latter being expected to converge, on average, to the day-ahead energy price.[8] Since the second option will result in greater total compensation than the first, the CAISO's Updated Revised Straw Proposal would seem to *discourage* non-RA physical suppliers from offering energy into the DAM. And even if physical suppliers do offer energy into the DAM, they will have an incentive to do so at prices that reflect the foregone RCU compensation they could receive under the second bidding approach outlined above. Neither incentive is consistent with promoting the participation of physical resources in the DAM at offer prices that reflect the resource's marginal cost.

Unlike the CAISO's Updated Revised Straw Proposal, Powerex's Alternative Proposal encourages competitive participation of non-RA physical suppliers by providing appropriate compensation for physical resources that are committed in the DAM.

BENEFIT 5: Address Legitimate Stakeholder Concerns

The Powerex Alternative Proposal would lead to the same least-cost outcomes as would be achieved under the CAISO Straw Proposal from February. However, Powerex's Alternative Proposal does not appear to present the same issues about which some stakeholders expressed concern. In particular:

- California LSEs would not be "double charged" for physical capacity. Under Powerex's Alternative Proposal, compensation for physical capacity is limited only to resources that receive a must-offer obligation and are not already subject to such an obligation under an RA contract.
- Clearing of DAM demand bids would be more intuitively aligned with bid prices.
- Energy market awards and prices would be driven by bid-in demand, which can be met equally by physical and virtual supply. The demand for energy would not be driven by CAISO's forecasts of demand, uncertainty or variability.
- Systemic differences between day-ahead and real-time energy prices would be reduced or eliminated, addressing concerns over systemic profits to virtual bidding strategies under the current market design.
- Addresses the concerns of external sellers regarding equitable compensation for their firm supply reflects the savings to the buyer of avoiding alternative capacity commitments.

[8] Indeed, the seller in this example could lock in the day-ahead price for energy by selling virtual supply and self-scheduling its energy delivery in the real-time market.

IV. Conclusions

The CAISO's Updated Revised Straw Proposal would represent a significant improvement over the existing CAISO DAM market design, as it would lead to a reliable day-ahead solution at lower costs and more accurate prices than are achieved under today's sequential procurement processes, out-of-market procurement and systemic operator interventions. But the CAISO's Updated Straw Proposal has important limitations, including an inability to fully achieve a least-cost solution, a failure to fully achieve accurate prices, and a lack of equitable compensation to suppliers of physical energy at prices that accurately reflect the savings from reducing the need to procure additional RCU.

Powerex's Alternative Proposal addresses these limitations using the same mathematical formulations as the latest CAISO proposal, but applying them in a modified way. Both the CAISO's Updated Revised Straw Proposal and Powerex's Alternative Proposal achieve a reliable DAM solution. However, Powerex's Alternative Proposal appears to have numerous key advantages over the CAISO's Updated Revised Straw Proposal, including:

- Fully achieves market efficiency (by minimizing bid-in production costs);
- Results in accurate prices;
- Results in equitable market-based compensation for all products and services provided to the grid, at their marginal value to the grid;
- Creates strong incentives for maximum participation of competitive supply;
- Encourages physical supply and RCU to be offered at marginal costs; and
- Better positions CAISO DAM as the foundation for a future regional EDAM.

Powerex believes its Alternative Proposal merits further consideration, and requests the opportunity to present and discuss the proposal with stakeholders. Further examination of the Powerex Alternative Proposal can help identify the benefits, potential limitations, and possible improvements and refinements to the conceptual approach presented in these comments.