Day Ahead Market Enhancements - Stakeholder Comments

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Southern California Edison (SCE) offers the following comments on the California Independent System Operator (CAISO) Day Ahead Market Enhancements (DAME) 8/19 MSC meeting and 8/13 Workshop[1].

Stakeholders need to explore multiple paths in this initiative

SCE has serious concerns with the CAISO proposal. Therefore, SCE presents an alternative to the CAISO proposal in the following comments. Further, SCE believes that no proposal of such magnitude should be signed off on without market simulations and economic interpretation of the market outcomes even if the simulations approximate reality.

The CAISO's proposal seems to be establishing additional products for which there may be no explicit market settlements. SCE finds that it is unclear what economic signal the CAISO's Financial + Forecast option sends. Are there different LMPs for physical versus virtual transactions? If so, why? What prices will virtual transactions try to converge if paid differently from physical transactions? What does it mean for the capacity price to be included within the energy price when historically the market has treated the capacity cost of a resource as the foregone profit of energy market participation? SCE believes that the goal should be an optimization that includes economics, not one in isolation that produces solutions with unclear or potentially conflicting economic meaning.

Alternatives to the CAISO proposal

SCE presents three alternatives to the CAISO's proposal. The first two alternatives proposed in these comments involve a single product that provides for the system's energy and capacity needs and includes constraints that send a meaningful economic signal. One could label this product as "Slow Regulation Product" (i.e. to mimic how the regulation product is implemented). This product will procure the quantity of power necessary to satisfy the forecast

[1] http://www.caiso.com/Documents/PresentationDayAheadMarketEnhancementsWorkingGroupMeeting81319.pdf
http://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=CB0084BC-EDF2-423D-BA7D-C418EC188243

and uncertainty need within the IFM. Any resource with sufficient ramp rate and dispatchability can provide this product as long as it has the capacity and energy required to meet the measured need.

Alternative 1 – Sequential RUC with Slow Regulation Product

Based on the CAISO's stated needs of meeting uncertainty between DA and RT as well as meeting reliability forecast requirements, SCE proposes a "Slow Regulation Product".

The relationship between the Slow Regulation Product and other elements of the power balance equation may be specified as:

IFM cleared physical energy + Slow Regulation = Load Forecast + Uncertainty

which can be rewritten as:

Slow Regulation Product = Load Forecast + Uncertainty – IFM cleared physical energy

This product is procured in IFM with RUC running sequentially for any additional reliability mechanics. RUC will be used for any ED purposes or further reliability assessments.

Note that substituting the CAISO's own proposed definition of reliability capacity into this formulation, the following holds:

IFM cleared physical = Load forecast – Reliability Capacity[2]

Substituting this into, the Slow Regulation Product equation,

Slow Regulation Product = Load forecast + Uncertainty – (Load forecast + Reliability Capacity)

= Uncertainty – Reliability Capacity

This eliminates reliability capacity from being a function of virtuals thereby ensuring that only physical assessments drive determination of reliability needs. However, there may remain the potential problem of physical cleared energy being priced inclusive of a capacity price (such as in the CAISO Proposed Option 2). One way to avoid this issue is to predefine a separate target for slow regulation, such as by evaluating historical data. Once the target is defined, it will be an input to the optimization so the market clearing price of the slow regulation will not apply to the cleared physical energy.

[2] Second equation, slide 50:
http://www.caiso.com/Documents/PresentationDayAheadMarketEnhancementsWorkingGroupMeeting81319.pdf

Alternative 2 – Concept of Capacity treated as Slow Regulation Product and performance treated as Mileage

This involves approaching the need for Slow Regulation Product using the existing framework of Mileage constrained Regulation[3]. From that stakeholder initiative, the CAISO proposed a robust framework allowing individual resources to be constrained by capacity and mileage performance when providing Regulation. SCE builds on this framework as a viable translation to the CAISO's DA needs as well. In particular, the volume of capacity that's procured to hedge uncertainties, or net load forecast error, or both, can be treated as a target that should be met under the formulation of a Slow Regulation Product. To ensure the capacity can be deployed and actually sourced from resources that can provide the needed ramping capability, the concept of mileage is applied. Thus, we have the Slow Regulation Product procurement minimization (first equation) subject to the constraints (remaining equations):

$$min\left(\sum_i (BSRPC_i \times SRP_i + BSRPM_i \times SRPM_i) + cost\ of\ energy\ and\ other\ AS\right)$$

Such that,

$$\sum_i SRP_i \geq SRPR$$

$$\sum_i SRPM_i \geq \min(SRPMR_{i,t-1}, m \times SRPR, \sum_i m_i \times BCSRP_i)$$

$$m_i \times SRP_i \geq SRPM_i$$

$$0 \leq SRP_i \leq BCSRP_i$$

Where,

i = resource index

$BSRPC_i - Bid\ price\ for\ Slow\ Regulation\ Product\ Capacity$

$SRP_i - Slow\ Regulation\ Product\ Capacity\ award$

$BSRPM_i - Bid\ price\ for\ Slow\ Regulation\ Product\ Mileage$

$SRPM_i - Slow\ Regulation\ Product\ Mileage\ award$

$SRPR - Slow\ Regulation\ Product\ Capacity\ Requirement$

$SRPMR_{i,t-1} - Slow\ Regulation\ Product\ Mileage\ Requirement\ from\ prior\ week$

$m - system\ resource\ multiplier = typical\ mileage\ dispatch\ of\ procured\ RUC\ capacity$

$m_i - resource - specific\ mileage\ multiplier$

$BCSRP_i - Bid\ capacity\ for\ Slow\ Regulation\ Product$

Alternative 3 – Option 1E proposed by the MSC[4]

As noted in the MSC's presentation, there are benefits from doing a reliability determination and locking-in resources determined necessary. IFM and RUC would remain sequential, and "The forecast load pass would be followed by a final bid load dispatch pass in which any long

[3] Page 9 of http://www.caiso.com/Documents/Addendum-DraftFinalProposal-Pay_PerformanceRegulation.pdf

[4] Page of http://www.caiso.com/Documents/DayAheadMarketDesignScottHarvey-Presentation-Aug19_2019.pdf

start resources committed in the forecast load pass would be blocked on at minimum load and dispatched to meet bid load and provide imbalance reserves."
While this option is computationally more intensive, it will likely produce the most economically meaningful results, while maintaining reliability, given all the options presented by the MSC.

CAISO proposal – Financial + Forecast option

There are foundational flaws in this option, causing uncertainty in the economic meaning of the solution as well as containing a potential flaw in the mathematical form. These are individually detailed, after the mathematical setup, below.

Setup[5]

The CAISO presents the following constraints[6]:

$\sum_i EN_{i,t} + \sum_j EN_{j,t} = \sum_i L_{i,t} + \sum_j L_{j,t} + Loss_t$ … Equation 1

$\sum_i REN_{i,t} = \sum_i (EN_{i,t} + RCU_{i,t} - RCD_{i,t}) = D_t$ … Equation 2

Equation 2 can be written as, $\sum_i REN_{i,t} = \sum_i EN_{i,t} + \sum_i RCU_{i,t} - \sum_i RCD_{i,t} = D_t$

Equation 1 can be written as, $\sum_i EN_{i,t} = \sum_i L_{i,t} + \sum_j L_{j,t} + Loss_t - \sum_j EN_{j,t}$

Substituting the value of $\sum_i EN_{i,t}$ from Equation 1 into Equation 2, we get,

$\sum_i REN_{i,t} = \sum_i L_{i,t} + \sum_j L_{j,t} + Loss_t - \sum_j EN_{j,t} + \sum_i RCU_{i,t} - \sum_i RCD_{i,t} = D_t$ … Equation 3

Concerns within the functional form

a. ***Economic***: Reliability capacity is procured to serve virtual schedules. The current reliability design does not procure physical resources to ensure reliability while including virtual bids. Reliability is based upon physical load, resources, and the forecast. Including virtual bids is a deviation from the current practice that SCE does not believe is appropriate.
   Mathematical deficiency: Physical energy schedule is already a function of virtual schedules. Reliability capacity is also a function of virtual schedules, making energy and reliability capacity redundant variables.
   Possible fixes: (1) Separate procurement requirement (RCUR, RCDR) for RC that is a function of available physical resources but not a function of any market variables (cleared load, cleared physicals, cleared virtuals (supply or demand)) (2) Remove physical energy as a variable in Equation 2.

[5] It is more efficient to use mathematical operations on both equations, such as adding them together, as SCE had shown in its prior set of comments. If two equations are true, then any mathematical combination of the two is also true, such as the sum of the two equations.
The exact same conclusion is arrived at using the substitution method, shown in this set of comments. Other methods can also be used but the conclusion will remain the same.

[6] Page 50
http://www.caiso.com/Documents/PresentationDayAheadMarketEnhancementsWorkingGroupMeeting81319.pdf

b. ***Economic***: Virtual bids will determine the shadow price of reliability capacity even though they are not eligible to be paid the reliability capacity price.
Mathematical deficiency: Virtual schedules can drive procurement of reliability capacity since the CAISO forecast is fixed, therefore, virtual bids determine the quantity of physical energy in the optimization's solution.
Possible fixes: (1) Separate procurement requirement (RCUR, RCDR) for RC that is a function of available physical resources but not a function of any market variables (cleared load, cleared physicals, cleared virtuals (supply or demand)) (2) Remove virtual bids from the optimization.
Economic: Why does the CAISO need two products, IR[7] and RC, when both are functions of the same variables (physical and virtual)?
Mathematical deficiency: With dependency on the same variables, the functions IR and RC will be highly correlated, which in turn will affect the feasibility of certain solutions producing artificial scarcity and binding constraints that are representative of the flawed formulation rather than economic reality. Such artificial scarcity and binding constraints will, in turn, feed back into an economic flaw.
Possible fix: Remove either RC or IR from the optimization.

<u>Concerns in treatment</u>

As SCE understands, the CAISO proposes to pay dispatchable physical resources the shadow price from Equation 2 as a reliability payment in addition to the existing energy LMP. If this understanding is correct, that shadow price includes an energy component for capacity (as any reserve product), not a pure capacity component, since all variables in Equation 1 are energy variables.

1. How does any additional payment beyond the LMP framework not violate the nodal model of pricing?
2. How does an energy LMP plus capacity payment represent the marginal cost of energy of a resource? What is the resource supposed to bid as its marginal cost?
3. How does this proposal maintain marginal cost pricing in the energy market when the CAISO is adding a term (shadow price of reliability capacity equation) that is not the marginal cost of energy?
4. With congestion, a ratio share of power procured from various resources may be used to meet a load. Thus, there is a locational component to the energy given congestion. Why is the CAISO proposing regional procurement of the imbalance reserve product but the compensation offered will be based on locational component of capacity?
5. Since IRU/IRD involves zonal procurement with the flexible capacity price being nodal, all nodes within the same zone have the same price.

[7] By definition, IR has to be a function of physical supply and demand and virtual supply and demand. Otherwise, it has no relevance to the DAM. And if it has no relevance to the DAM, how can IR be procured to meet differences between DAM and RTM?

6. A resource receives a capacity opportunity cost when it is paid for providing energy given *ex ante* reservation of its capacity; and the resource is paid an energy opportunity cost when it is paid for providing capacity. What does it mean when a resource is paid for energy and capacity given that no resource can provide both services at the same time within the same market (i.e., either only within DA or only within RT)?
    a. In the case, of DA, a resource can price its energy and capacity according to its beliefs on whether it will clear. Within the DA market, if the CAISO compensates all resources for energy and capacity, then (1) what is the need for two products, IR and RC? (2) why are resources being paid twice their opportunity costs?
    b. A resource may bid high on capacity to influence its energy payment or vice versa. Either way, the trend is upward to the bid cap, and no mitigation has been discussed within this proposal. Existing $0 RUC bidding mitigates upward bidding trend, as shown in the prior point.

The CAISO's presented data analysis does not sufficiently support the CAISO's proposal

Among the points made by the CAISO during the meeting:

1. Correlation exists between CAISO forecast functions and market cleared net load – This implies that the market cleared net load is a reliable proxy for demand estimation. The CAISO also states that Net Load Forecast is strongly correlated with FMM Net Load, rather than either Market Cleared Net Load or Adjusted Net Load Forecast. SCE notes that Net Load Forecast and FMM Net Load are both functions of CAISO forecasts. Thus, the finding here is that CAISO forecasts are simply consistent with other CAISO forecasts. There is no finding of CAISO forecast superiority over market cleared net load as an estimation tool for realized demand in the market.
2. What is the distribution of uncertainty for each hour ending for the data showing the differential between FMM and various measures? SCE notes that the CAISO presented data that shows one value for an entire year which is not a reliable representation. SCE suggests the CAISO provide data for each hour ending for each season to have any reasonable understanding of the situation.

SCE is concerned that the CAISO is yet unable to answer numerous other stakeholder questions

SCE notes that the CAISO failed to answer key questions from PG&E, CPUC, NV Energy, WPTF, etc. A non-exhaustive list of those questions includes:

1. How has the CAISO demonstrated that this proposal is superior to what they are doing now?
2. Since the CAISO claims that the purpose of DAME is to reduce operator actions, how have the developments from the imbalance conformance enhancements reduced operator actions? No data has been presented.
3. The CAISO's financial + forecast option as a proposed does not represent the marginal cost of energy for a resource. What economic interpretation does it represent?

4. Why is the CAISO proposing to replace the RA RT MOO when it states that it does not have enough resources for real-time?
5. What exactly is the role of virtual bidding under option 2 of the proposal given the formulation of the optimization? Is it still price convergence? Market liquidity? Both?
6. Will import resources be eligible to supply reliability or flexible capacity?
7. Can a resource awarded flexible capacity and energy in the day-ahead market buy back its energy position in the real-time market and keep its capacity payment?

SCE is unsupportive of the reliability and flexibility products being priced at the market clearing price for the flexibility product in the fifteen-minute market

The reliability and flexibility products differ in required response timescales and required duration of sustained performance when dispatched to provide energy. These differences reflect the relative quality of the products. The product with the shorter response time, whether the duration of sustained performance is longer or shorter, is a superior product for supporting the CAISO's real-time system operations. Therefore, the market clearing for the products should be independent of each other.

A market design that introduces the same price for products of different quality provides incentives for self-selection by market participants to supply the inferior product that commands lower performance expectations than the higher quality product. This selection by the market participant is an example of hidden information or adverse selection where market participants who have the capability to offer quicker starting resources in the market for the superior product default their selection to supply of the inferior product given the offer of the same price for the product delivered. In addition, the long-start resources are incented to represent their performance characteristics as closely similar or better than the quick start resources for the inferior product initially until actual performance is measured and dictates whether the resource is awarded a schedule for the product.

SCE seeks clarification from the CAISO whether physical resources will receive the same locational marginal price as virtual resources for energy supplied under either design option

While virtual resources are ineligible for a capacity payment for the supply of either flexible or reliability capacity, SCE wishes to understand whether intermittent resources are eligible to compete for awards to supply reliability and flexible capacity under either design. Given the awards of flexible and reliability capacity to physical resources, is their compensation equivalent to the shadow price of the power balance constraint? Is that compensation the same as the compensation to be received by virtual resources when the energy bids from virtual resources clear in the day-ahead market?

SCE asks the CAISO to clarify whether the proposed cost allocation socializes procurement costs for the flexible and reliability capacity across and within load zones

The CAISO's proposal for cost allocation remains unclear whether net demand deviations will be calculated in relation to the current energy settlement process that uses demand load aggregation points to map nodes and how does this approach differ from the regional

deliverability zones being used for the procurement of reliability capacity. Of interest is whether cost shifts are likely to occur when the zones represented by DLAPs do not coincide with the deliverability zones for reliability energy.