Energy Storage and Distributed Energy Resources Phase 4

Straw Proposal

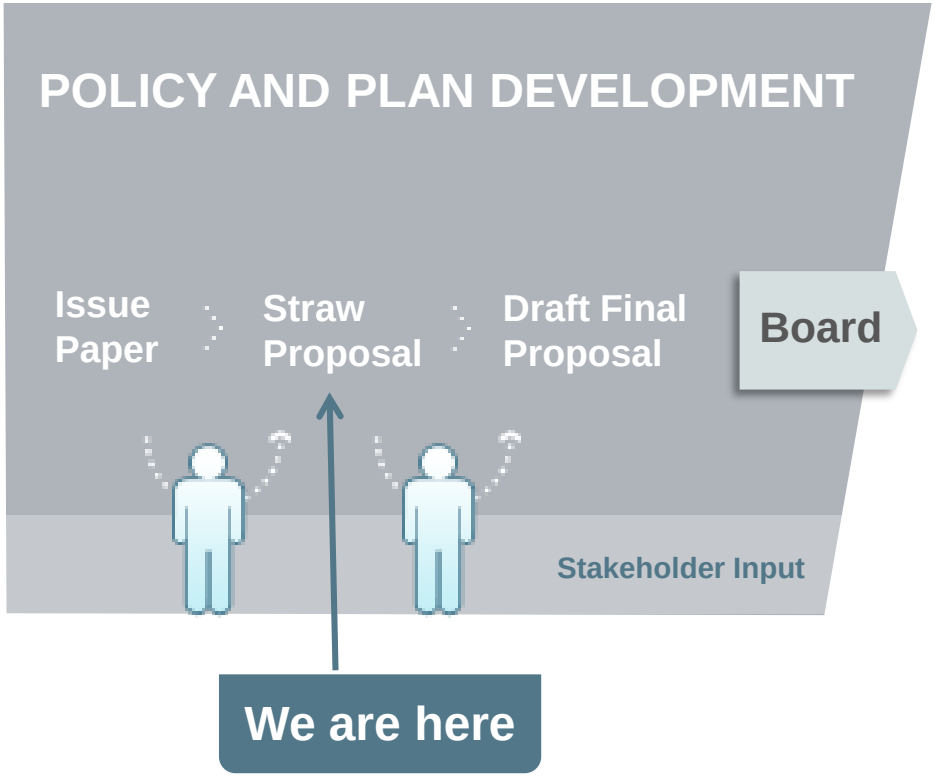
Stakeholder Web conference
May 7, 2019
1:00 p.m. – 4:00 p.m. (Pacific Time)

Agenda

Time	Item	Speaker
1:00 - 1:10	Stakeholder Process and Schedule	James Bishara
1:10 – 1:20	Objectives and Scope	Eric Kim
1:20 – 2:00	Non-Generator Resource Enhancements	Perry Servedio
2:00 – 2:40	Bidding Requirements for Energy Storage	Gabe Murtaugh
2:40 – 3:00	Non 24x7 Settlement of BTM resources	Eric Kim, Jill Powers, Lauren Carr
3:00 – 3:45	Demand Response Resources	Eric Kim
3:45 – 4:00	Next Steps	James Bishara

STAKEHOLDER PROCESS

CAISO Policy Initiative Stakeholder Process



OBJECTIVES / SCOPE

Scope

1. NGR state of charge parameter
2. Market power mitigation measures for energy storage resources
3. Streamlining interconnection agreements for NGR participants
4. Consideration of parameters to reflect DR characteristics
5. Operational process for variable-output demand response resources
6. Consideration of the non-24x7 settlement of behind the meter resources utilizing NGR model

NGR STATE-OF-CHARGE PARAMETER

Stakeholder comments

- Stakeholders generally supported the concept.
- Suggestions made by stakeholders
  - SOC parameter be optional for NGRs
  - Using additional outage cards to address MUA
  - End of day SOC rather than hourly

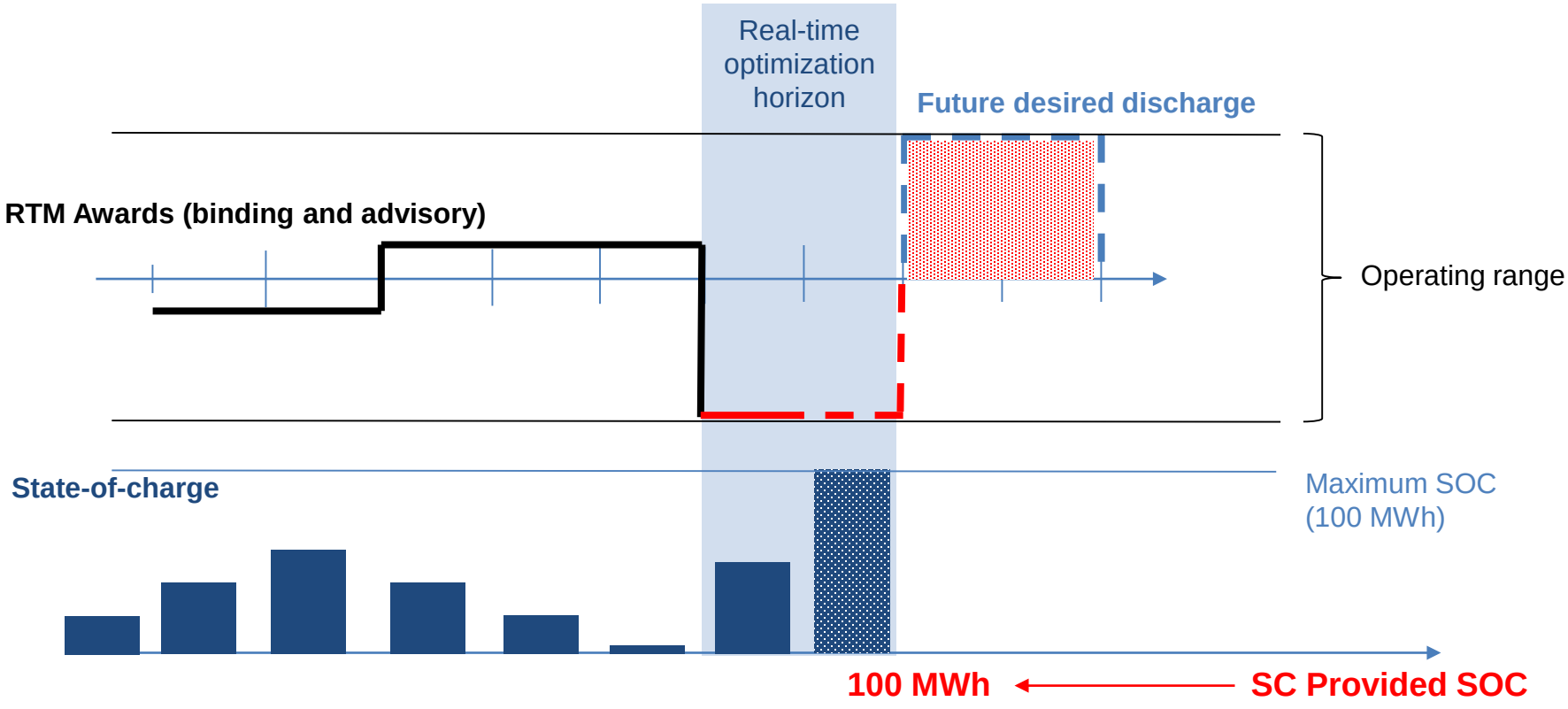
- The ISO is exploring an end of hour or end of day SOC parameter to inform policy design of SATA, MUA, and other needs identified by stakeholders.

Proposal

- Real-time state-of-charge management
  - Scheduling coordinator to submit end-of-hour SOC
  - Bid parameter is optional
  - SOC parameter will take precedence over economic outcomes in the market optimization
  - Market will respect all resource constraints in addition to the SOC parameter
    - SOC to fulfill ancillary service awards will be met

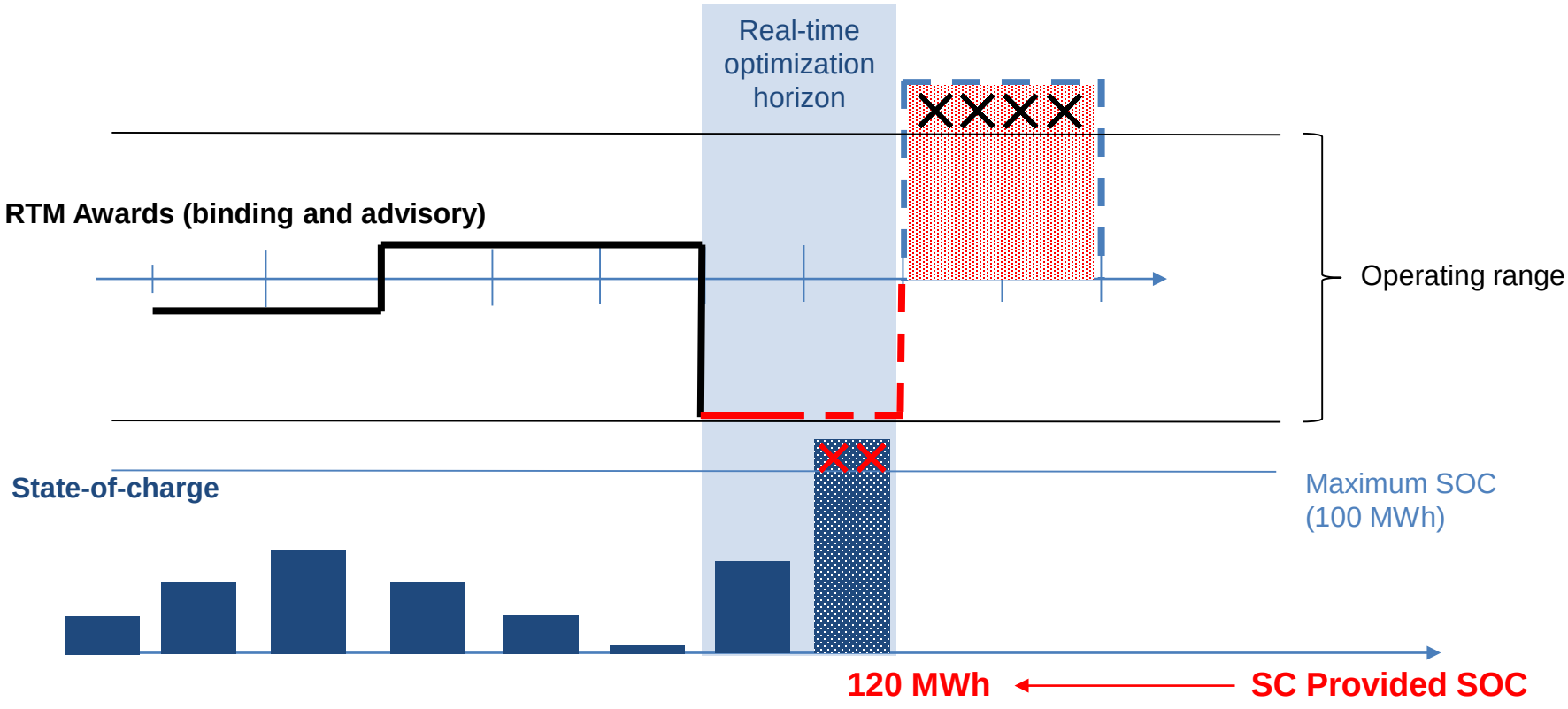
NGR enhancements: real-time SOC management

- In order to meet future desired discharge, NGR provides desired state of charge of 100 MWh in interval prior to discharge.



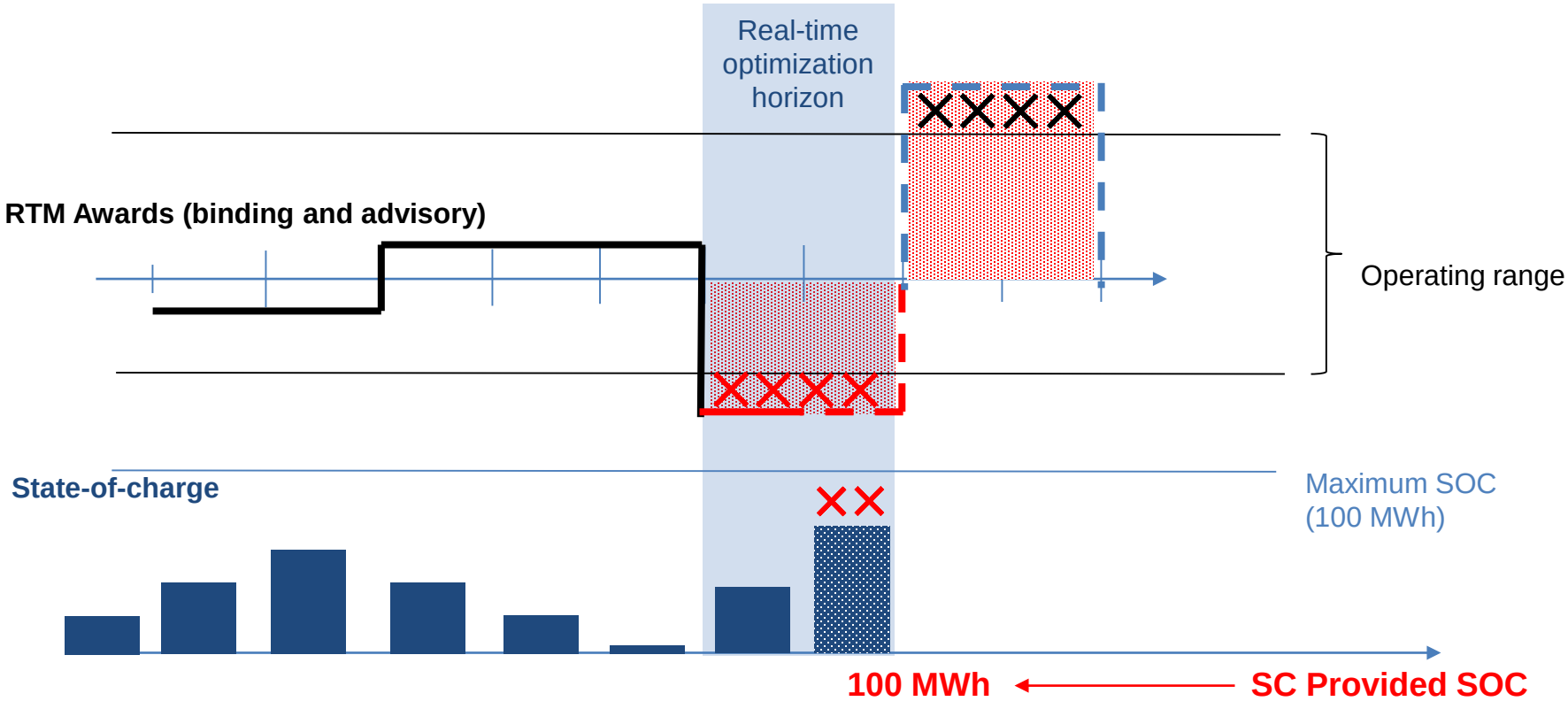
Respecting resource minimum and maximum SOC values

- Market will ignore the hourly SOC values if it falls outside of minimum and maximum SOC values.



Feasible physical minimum dispatch

- Market will respect the SOC parameter up to its ability to charge



NGR will be ineligible to receive bid-cost recovery if dispatched uneconomically due to SOC parameter

- Ineligible for BCR with market award due to SOC bid
  1. Charge or discharge is uneconomic;
  2. SOC bid is greater than the current SOC while the awarded value is at physical maximum; or
  3. SOC bid is less than current SOC while the awarded value is at the physical minimum.

- Similar rule for self-schedules

NGR MULTI-INTERVAL OPTIMIZATION

Stakeholder Comments

- Stakeholder comments were limited
  - NGRs are unable to bid per-MWh costs
  - Optimization may prevent an SC from meeting a contractual obligation outside of the wholesale market

- The ISO will not allow resources to opt-out of the multi-interval economic optimization
  - SCs can bid cost
  - SCs can use new SOC constraint to manage a resource to meet outside needs

MARKET POWER MITIATION FOR ENERGY STORAGE

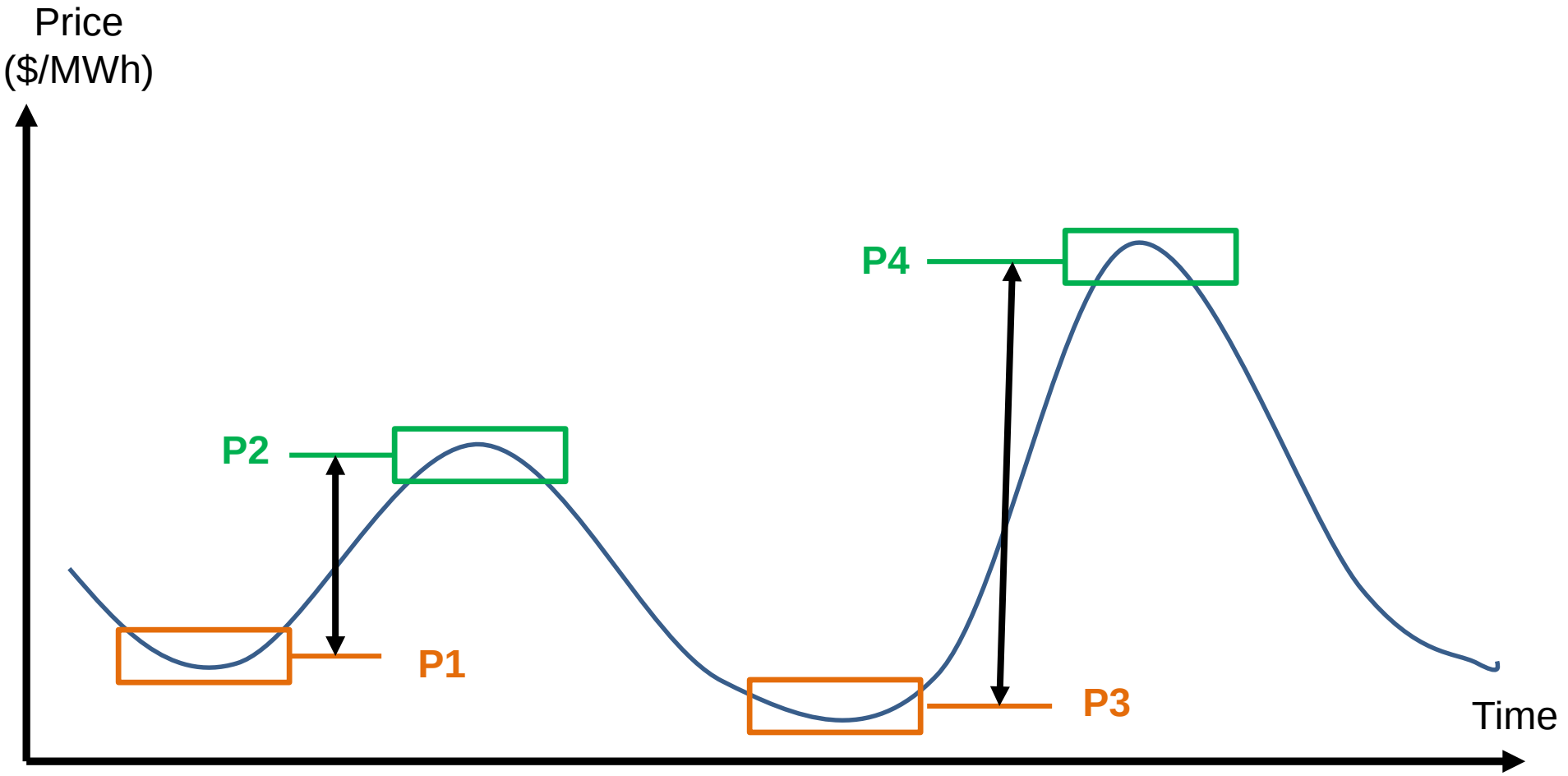
Default energy bids (DEBs) are used for local market power mitigation (LMPM)

- Default energy bids are constructed daily by the ISO to replicate marginal costs for resources to produce energy
  - For gas resources these may include fuel costs, heat rates, O&M, GHG costs, GMC…
  - Storage resources are different because they charge by purchasing energy from the market
- Default energy bids are used by the ISO with local market power mitigation tool to prevent resources from exercising market power
- Currently DEBs are not calculated for storage resources
- ESDER 4 will consider DEBs for storage given the anticipated growth and reliance on storage

This example of a profit maximizing battery makes several simplifying assumptions

- Assume that the resource takes 4 hours to charge and 4 hours to discharge
- There are no costs (or the costs are very low) for the resources to switch from charging to discharging
- The resource is not selling energy as prices are increasing, to potentially increase profit
- The representative day has two peaks and troughs: one in the morning and one in the afternoon

Potential profitable behavior for a 4-hour battery



$$\pi = (P2*Q*loss - P1*Q) + (P4*Q*loss - P3*Q)$$

The ISO identified three primary cost categories for storage resources

- Energy
  - Energy likely procured through the energy market
- Losses
  - Round trip efficiency losses
- Cycling costs
  - Battery cells degrade with each “cycle” they run
  - Cells may degrade more with “deeper” cycles
  - Unclear if these costs should be included in the DEBs
  - Including these costs may not make it efficient for storage resources to capture small price spreads

The ISO has two costs ‘adders’ that function somewhat similar to the cycling costs

- VOM adders cover raw materials consumed from generating energy
  - Applied to all resources of the same fuel type
  - These are applied to energy components of the variable cost DEB
- Major maintenance adders cover maintenance incurred from starting or running a resource
  - Specific to a particular resource
  - Dependent on past/expected maintenance
  - Only applied to start and minimum load costs

The ISO contemplated 3 potential solutions to calculate a default energy bid for storage resources

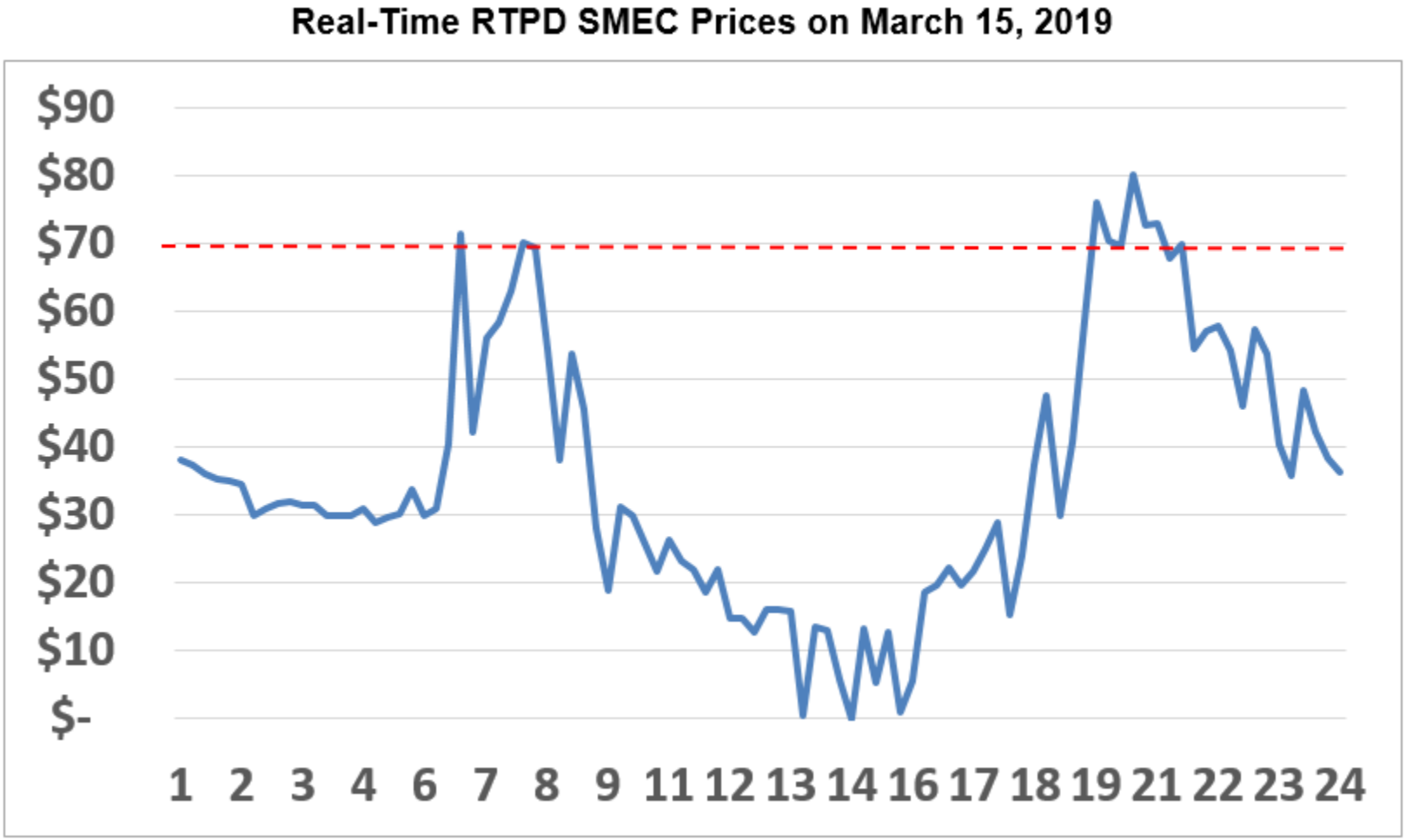
1. The ISO proposes that DEBs for storage resources include expected energy prices and discharge duration
   - Use discharge duration as an input to determine expected prices when storage resources ‘should’ run
   - Use forecast prices for DEB calculation
2. Considered using the variable cost option DEB with a storage resource specific adder
   - Include a new/hybrid adder similar to VOM and MMA
3. Considered using the variable cost option DEB calculating specific costs for individual storage facilities
   - Similar to the methodology we use for gas resources, with costs outlined for storage resources

The proposed default energy bid is semi-customizable for all storage resources

- The ISO will verify the length of discharge for a storage resource based on maximum storage power and PMax
  - The calculation for the default energy bid will be calculated use 50% of the maximum discharge
  - The DEB will contain an additional 10% adder
  - Anecdotally, the ISO found that many LI batteries could operate profitably by cycling once per day
  - The ISO will develop a process to use forecast prices to calculate a default energy bid for storage resources

Example – A resource that can discharge for 4 hours will have a DEB matching the expected price for the second highest hour in the day

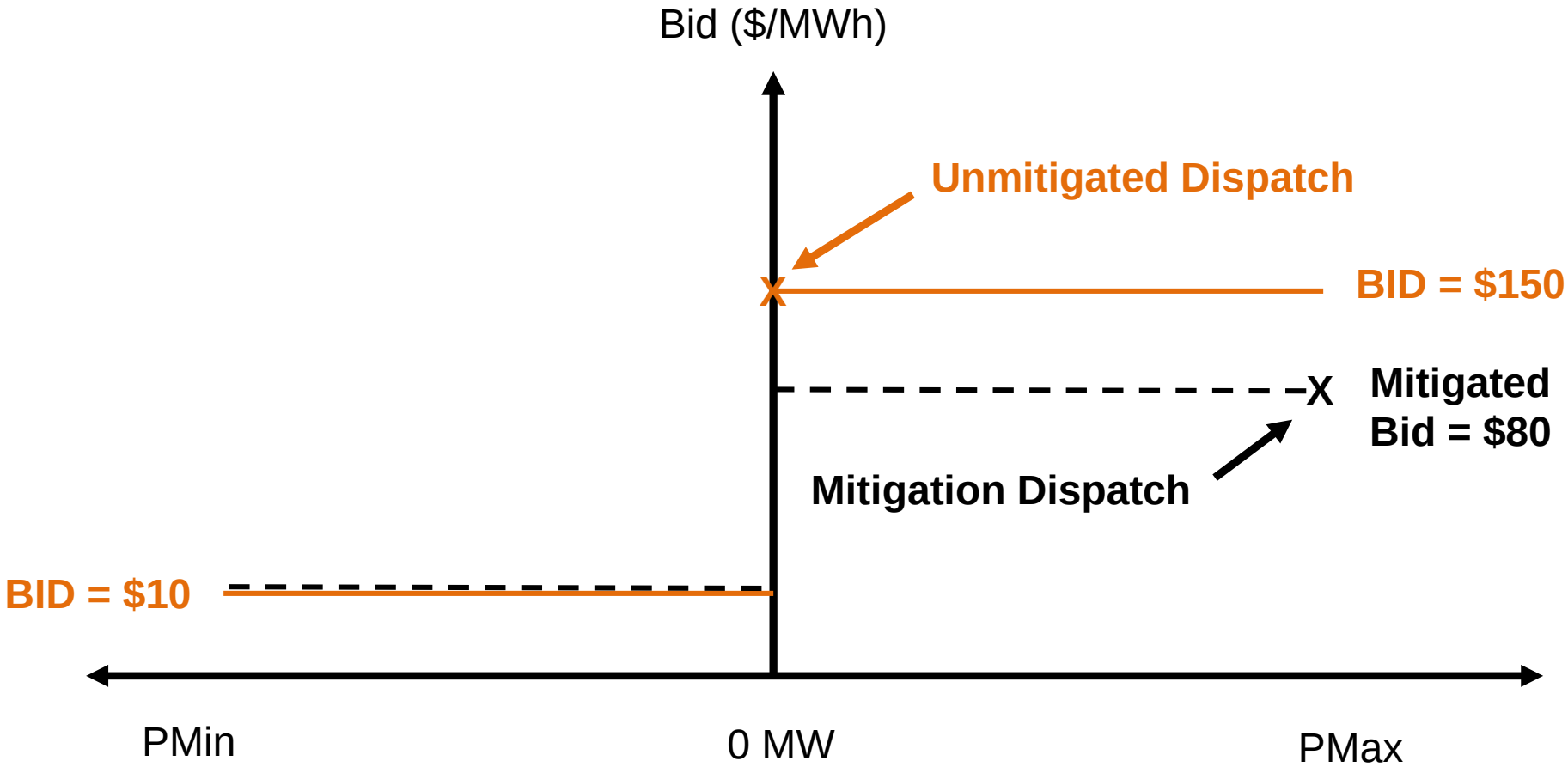
Storage resources with 4 hours of discharge would have a DEB matching the second highest hourly price



The DEBs for the storage resources will be similar to other default energy bids that the ISO calculates

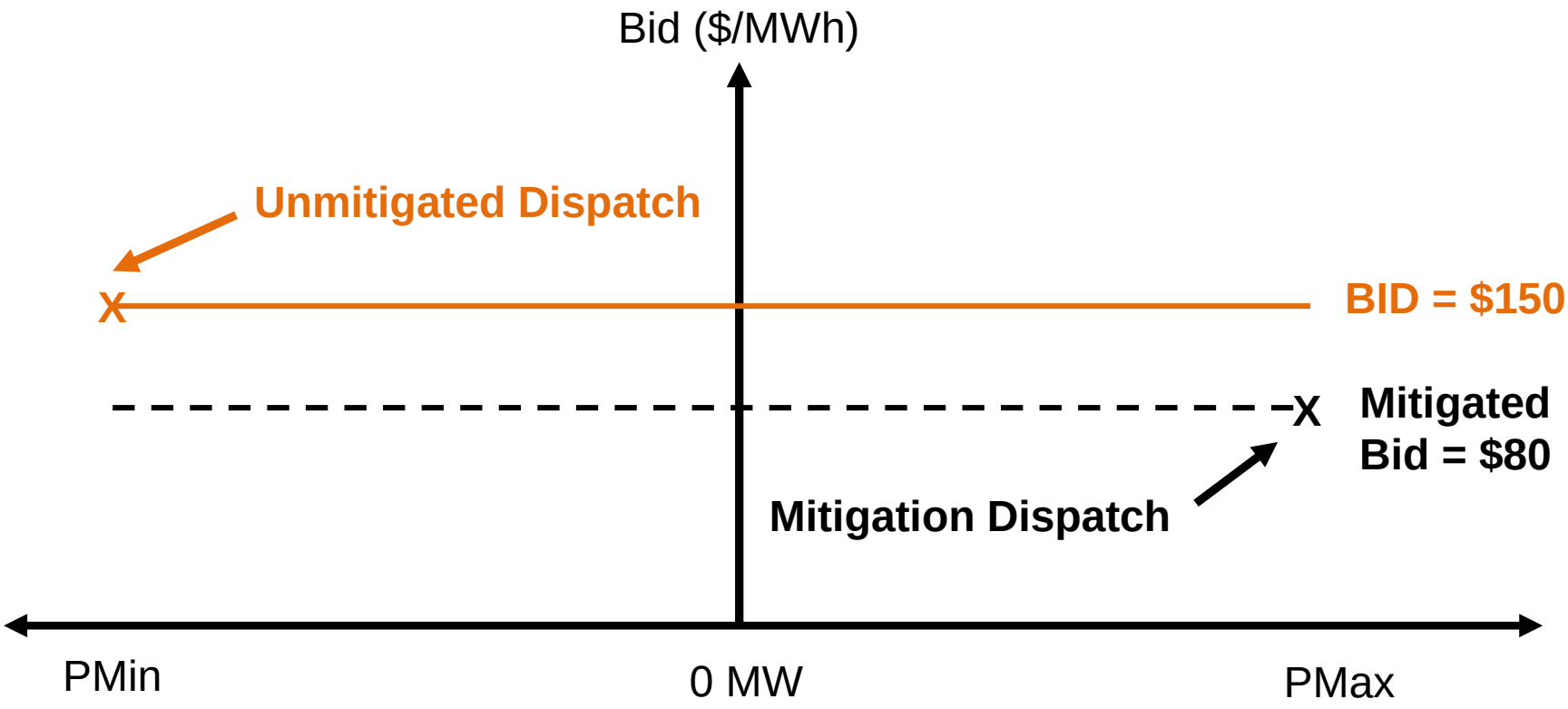
- The proposed DEB is calculated as a single value for the entire range of output (i.e. PMin to PMax)
- Resources are not required to bid in at their default energy bids
  - Expectation is that resources bidding at DEB would run less frequently 1 cycle per day
  - Resources may bid above the DEB, and be dispatched significantly less frequently
- Mitigation only triggers when the possible exercise of the ability to exercise market power is detected
- Resources are still eligible to receive market prices, regardless of calculated default energy bids
- ISO continues to offer negotiated default energy bids

Storage resources may be mitigated, which could change dispatch instructions for resources



Suppose the market clears at $80/MWh, and the resource is mitigated to its DEB. The resource is then instructed to discharge, if ramp capability is available.

Storage may bid in a single value for entire range of operation; mitigation may reduce the entire bid curve



Suppose the market clears at $80/MWh, and the resource is mitigated to its DEB. The resource is then instructed to discharge, if ramp capability is available.

NON-24x7 SETTLEMENT OF BEHIND THE METER

The ISO is considering the non-24x7 settlement of BTM devices participating under the NGR model.

- Currently NGRs are settled for all hours in the wholesale market.
- The ISO considered requests from stakeholders during the March 18 working group to consider a non-24x7 settlement for BTM devices under the NGR model (Non-RA).

The ISO listed the following questions for stakeholders to consider before moving forward with a proposal.

- As a BTM resource under NGR, any wholesale market activity will affect the load forecast. How will LSEs account for changes to the load forecast due to real time market participation?
- How would a UDC prevent settling a resource at the retail rate when the BTM device is participating in the wholesale market?
- If a BTM resource is settled only for wholesale market activity, what would prevent a resource from charging at a wholesale rate and discharging to provide retail or non-wholesale services? How would this accounting work?

DR PARAMETERS

Demand Response: Operational Characteristics

- DR with a Pmin of 0 MW face challenges reflecting operational limitations in ISO market.

1. DR resources receive dispatches to move between Pmin and Pmax but can only provide a single sustained response.
2. Once dispatched, the DR program has a maximum number of hours it can deliver load curtailment.
3. If a resource is committed in RUC, the market will not reflect the characteristics described above.

Option 1: Existing and soon to be implemented functions

- Elect hourly bid option and reflect a non-zero dollar commitment cost at a Pmin of 0 MW.
  - Dependent on the implementation of CCE3, CCDEBE, and ESDER 3A (Fall 2019).
- Stakeholders have expressed hesitation of providing non-zero dollar commitment costs without CAISO guidance.
  - Will commit to working with stakeholders through ESDER 4 on developing guidelines.

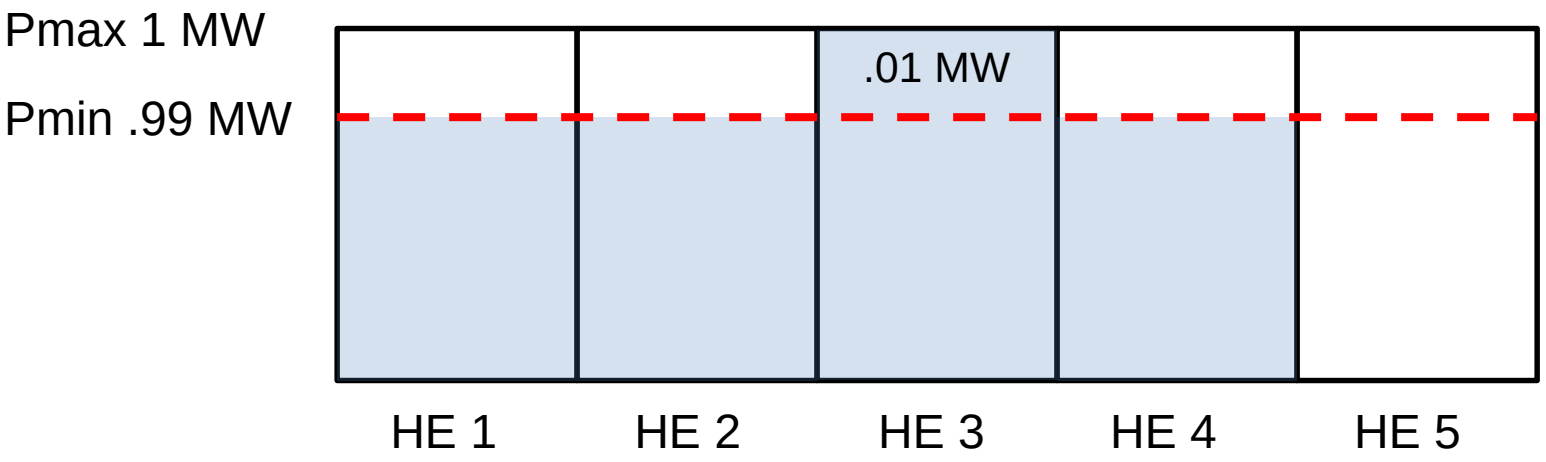
Option 2:Reflecting DR resource with a non-zero Pmin

- A DR resource can use existing parameters
  - Register a Pmin just below its Pmax
  - Identify a minimum load cost (MLC)
  - Define its maximum daily energy limit
  - Choose an hourly bid option in MasterFile

- The DR resource's non-zero Pmin and identified MLC will be optimized in the residual unit commitment (RUC) process.

- If committed in RUC, the DR resource will be instructed to its Pmin (just below Pmax) and the market will honor the minimum run time and maximum daily energy limit.

Illustrative Example



- Pmax = 1 MW
- Pmin =.99 MW
- Minimum Run Time = 1 hour
- Maximum Daily Energy Limit = 4 MWh
- Startup = 1 per day
- Hourly block bid option

Option 3: Maximum run time parameter

- Stakeholders have requested a maximum run time parameter for the optimization to consider the maximum number of hours a PDR can provide curtailment.
- The proposal will prevent PDR's from receiving infeasible dispatches but can lead to a potential issue if it has a Pmin of 0 MW.
  - A PDR may be dispatched to it's Pmin and reach its maximum run time parameter without providing any curtailment to the ISO.

The ISO wants to fully utilize PDRs today

- Option 1 and 2 are functions that exist today or will be available in the Fall of 2019.

- Option 3 can be considered, but stakeholders will need to consider implementation timelines.
  - ISO will need to consider the implications of a max run time with a Pmin of 0 MW.

Variable-Output Demand Response

Variable-output DR with RA capacity may be unable to deliver its full stated capacity in real-time due to its variable nature

- Maximum output of DR resources can vary due to weather sensitivity, solar insolation, product production, etc.
- The central tenet of the RA program is to ensure sufficient energy is available and deliverable when and where needed
- If a DR resource cannot bid its full RA capacity and deliver it under its must offer obligation (MOO) due to its variable nature, the resource may be assessed RAAIM penalties

The CAISO will advance the variable-output demand response issue following two key principles

1. The qualifying capacity (QC) valuation for DR must consider variable-output DR resources' reliability contribution to system resource adequacy needs
   - To help inform and advance CPUC/LRA consideration, the CAISO will discuss how to perform a Loss of Load Expectation (LOLE) study and establish an Effective Load Carrying Capability (ELCC) value for variable-output DR
2. Market participation and MOOs must align with variable-output demand response resource capabilities
   - The CAISO will explore the market participation rules for wind and solar to see if they can also apply to variable-output DR

Determining the Qualifying Capacity value for demand response

- The Local Regulatory Authority establishes QC values
- CPUC adopted Load Impact Protocols (LIPs) to establish QC values for utility DR
  - Based on ex post and ex ante assessments of load impacts to determine demand reduction capability of each DR program during peak hours
  - Rely on regression analysis using independent variables including weather conditions, month, and time of day
- For DRAM resources, QCs are based on a contracted amount

Determining the Qualifying Capacity value for variable energy resources (VERs)

- The Local Regulatory Authority establishes QC values
- CPUC uses ELCC methodology to determine QC values for wind and solar
  - Probabilistic approach used to quantify the reliability contribution of a resource by assessing its ability to reduce LOLE event
  - CPUC uses the ratio of the ability for a resource to avoid LOLE compared to a perfect generator

  ELCC% = (MW of Perfect Generator)/(MW of resource being studied)

  - ELCC value is applied to the nameplate capacity of a resource to determine the QC

The CAISO believes the ELCC methodology can more appropriately assess the reliability impact of variable-output demand response

- Current LIPs:
  - Rely heavily on historical data from past events
  - Do not consider a resource's reliability contribution in all hours
  - Assess the load impact of individual DR programs
- ELCC:
  - Evaluates resource's ability to reduce LOLE
  - Captures the benefit of variable resources across all hours
  - Considers the impact of the variable energy resource portfolio

CAISO requests additional detail and reasoning from stakeholders who believe LIPs on their own provide a *more appropriate* method for determining QC than applying an ELCC

The CAISO believes the ELCC method can and should be applied to variable-output DR to more appropriately define its QC value

- ELCC method could be performed similarly to wind and solar resources
  - Measure DR's ability to avoid LOLE compared to a perfect generator
- CAISO initially proposes to use bids as the data set for the ELCC calculation
  - Would require resources to bid the amount they are physically capable of providing in all hours
  - Aligns with market participation and must offer obligation proposal

The CAISO is considering how to accommodate variable-output DR similar to VERs for market participation and must offer obligations

- VERs to bid the amount they are physically capable of providing as specified through a forecast in order to meet their must offer obligation
- Scheduling coordinators (SCs) for VERs must either use a forecast provided by the CAISO or submit their own CAISO-approved forecast
- This forecast is the upper economic limit on bids
- Wind and solar resources are exempt from RAAIM penalties for generic (local and system) resource adequacy

A similar approach may also be applicable to variable-output DR

- SCs for variable-output DR would submit forecasts
  - CAISO does not have appropriate visibility into individual resource capabilities to forecast
  - LIPs could be modified to develop a profile of load impacts for the purposes of forecasting output
- Forecast would set the must offer obligation for variable-output DR
- CAISO is considering exempting variable-output DR from RAAIM for generic RA, similar to wind and solar
- CAISO should only adopt such bidding options if the Commission adopts an appropriate QC methodology through ELCC

Controls for SC-submitted forecasts

- It is important to establish adequate controls to ensure the forecast accurately reflects resource capability because the forecast impacts a resource's MOO
- The CAISO is considering ways to eliminate any incentives for submitting inaccurate forecasts including auditing provisions, testing procedures, and performance penalties

The CAISO welcomes stakeholder feedback on such controls that should be put in place

NEXT STEPS

Next Steps

Milestone	Date
Straw Proposal posted	April 26, 2019
Stakeholder web conference	May 7, 2019
Stakeholder comments due	May 17, 2019

Written stakeholder comments on the issue paper are due by COB May 17 to InitiativeComments@caiso.com.

All material for the ESDER initiative is available on the ISO website at: http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_DistributedEnergyResources.aspx.