



# Market Simulation Summer 2023 Release

Trang Vo

June 19, 2023

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# Energy Storage Enhancements Track 1 Discussion

## TRACK 1 SCOPE

### Reliability Enhancements

- **Regulation Award Clarifications:** Include expected impacts from regulation in State of Charge (SOC) – **Will not activate TD 7/1/23 (attenuation factors/AS multipliers to be set to 0), to be activated at a later date**
- **Bidding Requirements for AS:** Require storage to bid energy in the opposite direction of Ancillary Service (AS) awards – **Will activate 7/1/23**
  - A resource providing reserves, regulation up, or regulation down must have energy bids to charge/discharge (respectively)
  - Energy bids must be 50% of AS awards

### Reference Level Enhancements

- **DEB Enhancements:** Update DA storage resource default energy bid (DEB) to include storage specific opportunity cost – **Will activate 7/1/23**

# Market Simulation MAP Stage Availability

MAP Stage weekly maintenance window is Friday\*

System	UI	API	Comments
ADS			
ALFS	NA		
BAAOP			
BSAP			
CIRA			
CMRI	<ul style="list-style-type: none"> <li>✓ RSEE2T1 TD 4/17/23</li> <li>✓ ASSOCC Deployed 4/26/23 – Market Active Resource Constraint data available 5/9/23 for TD 5/2 forward</li> </ul>	<ul style="list-style-type: none"> <li>✓ RSEE2T1 TD 4/17/23</li> <li>✓ ASSOCC Deployed 4/26/23 – Market Active Resource Constraint data available 5/9/23 for TD 5/2 forward</li> </ul>	ASSOCC New Market Active Resource Constraint started showing data 5/9/23 for TDs 5/2 forward
CRR		NA	
DRRS			
MF			✓ Deployed RSEE2T1 4/17/23
OASIS	✓ RSEE2T1 TD 4/17/23	✓ RSEE2T1 TD 4/17/23	
OMS	Performance Issues  Fixed after Maintenance 6/12 – 6/15	Performance Issues  Fixed after Maintenance 6/12 – 6/15	<ul style="list-style-type: none"> <li>• Following 5/19 maintenance, slowness reported and <b>is resolved in maintenance 6/12-6/15</b></li> <li>• No direct impact to Summer Release</li> </ul>
RCBSAP			
RIMS		NA	
SIBR			✓ Deployed RSEE2T1 & ESET1 4/17/23
MRIS			✓ Deployed Settlements 4/28/23 effective 5/1/23

AVAILABLE

MAINTENANCE

\*Maintenance may also occur after 1600 PT on other days and may deviate from the weekly maintenance window as necessary

# Market Simulation Activities

	Monday	Tuesday *Settlements	Wednesday	Thursday *Settlements	Friday
June				1	2
	5	6	7	8*	9
	12	13	14	15	16
	19	20	21	22	23
	26	27	28	29	30

Market Simulation  
Forum @1400 PT

# Market Simulation Settlements Calendar



Market Simulation Pre-Summer 2023 Calendar (MAP STAGE)  
May 1, 2023 through May 30, 2023

Calendar Day	Day	CMRI T+1B	Submit Meter Data by T+2B 10:00 for Initial T+9B	Publish Initial Statement T+5B T+9B	Submit Meter Data by T+5B 10:00 for Recalc T+70B	Publish Recalc Statement T+8B T+70B	Publish Market Invoice
10-May-23	Wednesday	9-May					
11-May-23	Thursday		9-May	4-May	4-May		
12-May-23	Friday	11-May		Monthly Initial 2-May - 4-May		2-May	Daily Initial 2-May; Daily Initial 4-May Monthly Initial 2-May - 4-May
13-May-23	Saturday						
14-May-23	Sunday						
15-May-23	Monday		11-May				
16-May-23	Tuesday			9-May	9-May	4-May	
17-May-23	Wednesday	16-May				Monthly Recalc 2-May - 4-May	Daily Recalc 2-May; Daily Recalc 4-May Monthly Recalc 2-May - 4-May
18-May-23	Thursday		16-May	11-May	11-May		
19-May-23	Friday	18-May		Monthly Initial 9-May - 11-May		9-May	Daily Initial 9-May; Daily Initial 11-May Monthly Initial 9-May - 11-May
20-May-23	Saturday						
21-May-23	Sunday						
22-May-23	Monday		18-May				
23-May-23	Tuesday			16-May	16-May	11-May	
24-May-23	Wednesday	23-May				Monthly Recalc 9-May - 11-May	Daily Recalc 9-May; Daily Recalc 11-May Monthly Recalc 9-May - 11-May
25-May-23	Thursday		23-May	18-May	18-May		
26-May-23	Friday	25-May		Monthly Initial 16-May - 18-May		16-May	Daily Initial 16-May; Daily Initial 18-May Monthly Initial 16-May - 18-May;
27-May-23	Saturday						
28-May-23	Sunday						
29-May-23	Monday						
30-May-23	Tuesday		25-May				
31-May-23	Wednesday	30-May		23-May	23-May	18-May	
01-Jun-23	Thursday						
02-Jun-23	Friday		30-May	25-May	25-May	Monthly Recalc 16-May - 18-May	Daily Recalc 16-May; Daily Recalc 18-May Monthly Recalc 16-May - 18-May
03-Jun-23	Saturday						
04-Jun-23	Sunday						
05-Jun-23	Monday					23-May	
06-Jun-23	Tuesday			30-May	30-May		
07-Jun-23	Wednesday			Monthly Initial 23-May - 30-May		25-May	Daily Initial 23-May; Daily Initial 25-May; Daily Initial 30-May Monthly Initial 23-May - 30-May
<b>08-Jun-23</b>	Thursday						
09-Jun-23	Friday	<b>8-Jun</b>				30-May Monthly Recalc 23-May - 30-May	Daily Recalc 23-May; Daily Recalc 25-May; Daily Recalc 30-May Monthly Recalc 23-May - 30-May;
10-Jun-23	Saturday						
11-Jun-23	Sunday						
12-Jun-23	Monday		<b>8-Jun</b>				
13-Jun-23	Tuesday						
14-Jun-23	Wednesday						
15-Jun-23	Thursday			<b>8-Jun</b>	<b>8-Jun</b>		
16-Jun-23	Friday						
17-Jun-23	Saturday						
18-Jun-23	Sunday						
19-Jun-23	Monday						
20-Jun-23	Tuesday					<b>8-Jun</b>	
21-Jun-23	Wednesday						

**TD 6/8 Initial expedited and published 6/13 (ahead of normal 6/15)**



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# WEIM Resource Sufficiency Evaluation Enhancements Phase 2 Track 1

- Structured & Unstructured Market Simulation
  - **Structured scenario TD 5/2: executed, settlements published**
  - **Structured scenario TD 5/4: environment issues in AM, executed for PM, settlements published**
  - **Structured scenario TD 5/9: executed, settlements published**
  - **ISO BAA Opt In for AET TDs 5/2 & 5/4, ISO BAA Opt-Out for AET TD 5/9**
  - **ISO continues to support testing; please contact us for any requests**
- All code changes in MAPSTAGE as of 4/17 & 4/18
- Settlements changes in MAPSTAGE as of 4/28, effective 5/1
- [BRS](#)
- [Market Simulation Scenarios](#)
- Training course held 4/26
  - [Presentation Updated 5/17, please review for any Market Simulation testing impacts](#)
  - Video available on the [Learning Center](#)

# Energy Storage Enhancements Track 1

- Unstructured Market Simulation
- SIBR changes in MAPSTAGE as of 4/17
- Market changes in MAPSTAGE as of 4/27
- No Settlements impacts
- [BRS](#)
- Training course held on 5/2
  - [Presentation](#)
  - Video available on the [Learning Center](#)
- MAPSTAGE is configured to not use telemetry values. This way, the initial conditions for SOC are directly inherited from the solution of the previous optimization.
- **SIBR/Market Known Issues fixed 5/22**
- **Market Known Issue fixed 6/6**
- **ESE refresher Training on 6/22**



# Energy Storage Enhancements Track 1

As announced on the 6/19 market simulation forum, the ISO has confirmed the ESET1 Attenuation Factors for Production will be set to zeros for TD 7/1/23.

The MAP Stage Market Simulation environment Attenuation Factors will be modified to be zeros for target TD 6/22/23. TD and intervals for the update in MAP Stage will be confirmed by the ISO.

# Energy Storage Enhancements Track 1

Area	Summary	Details	Status
Market	Regulation Not Clearing DAM	IFM not considering the negative portion of the operational range when awarding Reg Dn	<b>Presented @ 6/8 Market Simulation Forum</b>
Market	Negative Regulation ASMPs	Observing negative ancillary service marginal prices in market simulation	<b>Presented @ 6/15 Market Simulation Forum</b>
Market	Constraints on regulation awards in BRS	LES RU award is incorrect issue with coverage factor equation	<b>COMPLETE</b> Fix in MAPSTAGE 6/6
SIBR	Rules Modifications  Rules: 32527 32528 32530 32531  New: 32543 32544 32545 32546	For Production if there is a Regulation award there should be a GSS or LSS self-schedule based on existing rules.  We have a software variance for ESE implementation because there will be no way to submit a GSS/LSS if you have a DA Award.	<b>COMPLETE</b> Fixes in MAPSTAGE 5/22

# Ancillary Service State of Charge Constraint

- Unstructured Market Simulation
- CMRI deployed to MAPSTAGE 4/26, **data available 5/9 for TDs 5/2 forward**
- Market code in MAPSTAGE as of 4/27
- Settlements changes in MAPSTAGE as of 4/28 effective 5/1
- [BRS](#)
- Training course held on 5/1
  - [Presentation](#)
  - Video available on the [Learning Center](#)
- **ASSOCC Settlements fix applied 5/30 effective initial TD 5/30 forward and recalcs TD 5/23 forward**
- **See ESE known issues slide as those may impact ASSOCC as well – SIBR/Market Known Issues fixed 5/22; Market Known Issue fixed 6/6**

# Ancillary Service State of Charge Constraint

## Known Issue

Summary	Details	Status
Use of ASSOCC during non-AS Intervals	Clarify validity of the flag in unwarded intervals with no direct charging or discharging necessary in order for unit to meet its AS obligations later in the day, and the presence of the flag and potential unintended impacts on BCR in what should have been economic intervals.	<b>Settlements fix will be available on the new config file for</b>  <b>initials for TD 5/30 forward</b>  <b>And for</b>  <b>Recalcs for TD 5/23 forward</b>

# Hybrid Resources Phase 2C – Settlements

- Unstructured Market Simulation
- Settlements code in MAPSTAGE as of 4/28 (effective TD 5/1) for this to be available for Settlements TDs 5/2 and onward for Tuesday/Thursdays thru May
- [BRS](#)
- CIDI knowledge article available 5/26/23: KAS-23-430 Participating in the ISO Market as a Hybrid Tie-Gen Resource

# URL Changes (Application Delivery Resiliency)

## Plan

- MAP-Stage new API URLs **available as of May 18, 2023** for 60 days to transition
- Please open the entire 45.42.16.0/21 network on ports 80 & 443 for our new IP space to access new API URLs

API	Existing MAPSTAGE	New MAPSTAGE
BAAOP	<a href="https://wsmap.caiso.com/sst/baaop">https://wsmap.caiso.com/sst/baaop</a>	<a href="https://mapstage-ws.caiso.com/sst/baaop">https://mapstage-ws.caiso.com/sst/baaop</a>
BSAP	<a href="https://wsmap.caiso.com/sst/bsap">https://wsmap.caiso.com/sst/bsap</a>	<a href="https://mapstage-ws.caiso.com/sst/bsap">https://mapstage-ws.caiso.com/sst/bsap</a>
CIRA	<a href="https://wsmap.caiso.com/sst/cira">https://wsmap.caiso.com/sst/cira</a>	<a href="https://mapstage-ws.caiso.com/sst/cira">https://mapstage-ws.caiso.com/sst/cira</a>
CMRI	<a href="https://wsmap.caiso.com/sst/cmri">https://wsmap.caiso.com/sst/cmri</a>	<a href="https://mapstage-ws.caiso.com/sst/cmri">https://mapstage-ws.caiso.com/sst/cmri</a>
DRRS	<a href="https://wsmap.caiso.com/sst/drrs">https://wsmap.caiso.com/sst/drrs</a>	<a href="https://mapstage-ws.caiso.com/sst/drrs">https://mapstage-ws.caiso.com/sst/drrs</a>
EIDE	<a href="https://wsmap.caiso.com/sst/eide">https://wsmap.caiso.com/sst/eide</a>	<a href="https://mapstage-ws.caiso.com/sst/eide">https://mapstage-ws.caiso.com/sst/eide</a>
ALFS (& FDR)	<a href="https://wsmap.caiso.com/sst/runtime.asvc">https://wsmap.caiso.com/sst/runtime.asvc</a>	<a href="https://mapstage-ws.caiso.com/sst/runtime.asvc">https://mapstage-ws.caiso.com/sst/runtime.asvc</a>
MF	<a href="https://wsmap.caiso.com/sst/runtime.asvc">https://wsmap.caiso.com/sst/runtime.asvc</a>	<a href="https://mapstage-ws.caiso.com/sst/runtime.asvc">https://mapstage-ws.caiso.com/sst/runtime.asvc</a>
PISOA	<a href="https://wsmap.caiso.com/sst/runtime.asvc">https://wsmap.caiso.com/sst/runtime.asvc</a>	<a href="https://mapstage-ws.caiso.com/sst/runtime.asvc">https://mapstage-ws.caiso.com/sst/runtime.asvc</a>
RCBSAP	<a href="https://wsmap.caiso.com/sst/rcbsap">https://wsmap.caiso.com/sst/rcbsap</a>	<a href="https://mapstage-ws.caiso.com/sst/rcbsap">https://mapstage-ws.caiso.com/sst/rcbsap</a>
RCSERVICES (RCEIDE)	<a href="https://wsmap.caiso.com/sst/rcservices">https://wsmap.caiso.com/sst/rcservices</a>	<a href="https://mapstage-ws.caiso.com/sst/rcservices">https://mapstage-ws.caiso.com/sst/rcservices</a>
SIBR	<a href="https://wsmap.caiso.com/sst/sibr">https://wsmap.caiso.com/sst/sibr</a>	<a href="https://mapstage-ws.caiso.com/sst/sibr">https://mapstage-ws.caiso.com/sst/sibr</a>
STLMT	<a href="https://wsmap.caiso.com/sst/stlmt">https://wsmap.caiso.com/sst/stlmt</a>	<a href="https://mapstage-ws.caiso.com/sst/stlmt">https://mapstage-ws.caiso.com/sst/stlmt</a>
OMS	<a href="https://wsmap.caiso.com/sst/weboms">https://wsmap.caiso.com/sst/weboms</a>	<a href="https://mapstage-ws.caiso.com/sst/weboms">https://mapstage-ws.caiso.com/sst/weboms</a>
ECIC	<a href="https://wsmap.caiso.com/sst/ecic">https://wsmap.caiso.com/sst/ecic</a>	<a href="https://mapstage-ws.caiso.com/sst/ecic">https://mapstage-ws.caiso.com/sst/ecic</a>

# 2023 – Application Delivery Resiliency

## Remaining API Cutovers

- BAAOP
- BSAP
- CIRA
- CMRI
- DRRS
- EIDE
- ALFS
- MF
- PISOA
- RCBSAP
- RCSERVICES (RCEIDE)
- SIBR
- STLMT
- OMS

## Plan

- MAP-Stage and Production will have soft cutovers to have current and new API URLs available in parallel for a window of time of 60 days in each environment
- Current API URLs remain available while new API URLs are introduced as they become verified and ready for customer use
- [MAP-Stage new API URLs available as of May 18, 2023](#)
- Production target later in 2023, schedule to be provided after MAP-Stage activities
- Please open the entire 45.42.16.0/21 network on ports 80 & 443 for our new IP space to access new API URLs

# Flexible Ramping Product Refinements

- Nomogram constraints are now active in MAPSTAGE and available for unstructured testing
- Production activation for the FRP nomogram constraints rescheduled from 6/15 to 7/15



# E-Tagging Procedure Update: Day-Ahead RUC Automated Adjustments

As previously announced, beginning **June 14, 2023, for TD June 15, 2023**, the ISO will be updating its e-tagging procedures in the Production Environment to ensure that the energy profile on day-ahead e-tags reflects each resource's day-ahead award. After the day-ahead market results are published, the ISO will compare the MW in the energy profile on the e-tag against the DA RUC award quantity. If the amount on the e-tag exceeds the DA RUC award, the amount on the e-tag will be adjusted to equal the DA RUC award.

For example, an Scheduling Coordinator (SC) submits an export bid of 150 MW and an e-tag with 200 MW in the energy profile. The e-tag will automatically be adjusted down to 150 MW (assuming that this is the RUC award).

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## Key Points

- Adjustments will be made both on import and export transactions
- This adjustment is not applicable to resources associated with a Contract Reference Number (CRN), for example Existing Transmission Contracts (ETC)
- This is only applicable when the e-tag amount exceeds the DA RUC award; e-tag adjustments in the upward direction will not be considered.
- **Based on feedback from the market simulation, e-tag adjustments will automatically occur only at 15:30 until further notice.**

For background information on this change refer to the following resources:

- Market Operations Business Practice Manual (BPM) section 6.3.2 – Interchange Transactions and E-Tagging
- Presentation – <http://www.caiso.com/Documents/Presentation-Summer-2021-Readiness-Training-Part-3-Jun-24-2021.pdf>
- Video - <https://youtu.be/bsVcadkTJ1I>
- Readiness Note - [California ISO - Learning center \(caiso.com\)](https://www.caiso.com/learning-center)

# Next Steps

- Next forum will be on Thursday, June 22, 2023.

# References

# Market Simulation Support

- Business Days 0900 – 1800 PT
- 24x7 Service Desk: (916) 351-2309
- [marketsim@caiso.com](mailto:marketsim@caiso.com)
- Submit issues to CIDI with ‘Functional Environment’ = “Market Simulation %”
  - For Summer 2023 Release use “Market Simulation Summer 2023”

# Market Simulation Communication

	Monday	Tuesday	Wednesday	Thursday	Friday
<b>May</b>	<b>1</b>	<b>2*</b>	<b>3</b>	<b>4*</b>	<b>5</b>
	<b>8</b>	<b>9*</b>	<b>10</b>	<b>11*</b>	<b>12</b>
	<b>15</b>	<b>16*</b>	<b>17</b>	<b>18*</b>	<b>19</b>
	<b>22</b>	<b>23*</b>	<b>24</b>	<b>25*</b>	<b>26</b>
	<b>29</b>	<b>30*</b>	<b>31</b>		

**ISO Closure**

**Market  
Simulation  
Forum**

**\*Settlements  
Trade Date**

# Summer 2023 Release Overview – System Impacts

Project	CMRI	Master File	OASIS	Settlements	Market	SIBR
Energy Storage Enhancements Track 1					X ✓ MS 4/27/23	X ✓ MS 4/17/23
WEIM Resource Sufficiency Evaluation Enhancements Phase 2 Track 1	X* ✓ MS 4/18/23	X ✓ MS 4/17/23	X* ✓ MS 4/18/23	X ✓ MS 4/28/23	X ✓ MS 4/17/23	X ✓ MS 4/17/23
Hybrid Resources2C – Settlements				X ✓ MS 4/28/23		
Ancillary Service State of Charge Constraint	X* ✓ MS 4/26/23 Deployed  ✓ Data Available 5/9/23 for TD 5/2 forward			X ✓ MS 4/28/23	X ✓ MS 4/27/23	

**X\* = Technical Specifications**

# Overview – System Interface Changes – Summer 2023 Release

System	Project	UI	API	Data	Tech Specs	MAPSTAGE
CMRI	RSEE2T1	<p>No new data publication on 2 reports:</p> <p>EIM &gt; Bid Range Capacity Test Results</p> <p>EIM &gt; Flexible Ramp Requirement Sufficiency Test Results</p>	<p>RetrieveEIMTestResults</p> <p>RretrieveEIMTestResults_DocAttach</p> <p>These will not populate new data for EIMBidRangeCapacityTest and EIMFlexibleRampRequirementSufficiencyTest sections</p>	<p>The historical pre-activation data shall still be available via the UI &amp; API. New data won't be published for these.</p> <p>These data are moved to OASIS reports below (WEIM RSE Capacity Tests, FRR Inputs &amp; Outputs)</p>	4/3/23	4/18/23
CMRI	ASSOCC	<b>New:</b> Real-Time > Market Active Resource Constraint	<p><b>New:</b></p> <p>RetrieveMarketActiveResourceConstraintv1</p> <p>RetrieveMarketActiveResourceConstraintv1_DocAttach</p>	Data retroactive to 9/20/22	4/3/23	<p>Deployed 4/26/23</p> <p>Data available 5/9 for TD 5/2 forward</p>
OASIS	RSEE2T1	<b>New:</b> Public Bids > Market Bid Caps	<b>New:</b> MKT_BID_CAPS_GRP		3/30/23	4/18/23
OASIS	RSEE2T1	Existing: Energy > EIM > WEIM RSE Capacity Tests	Existing: Energy > EIM > WEIM RSE Capacity Tests	<p>&gt; Original data publishing is existing system functionality.</p> <p>&gt; Corrected data publishing is new system functionality that will be published on same existing report as original data.</p> <p>&gt;BAA RSE Capacity Test Failure Upward/Downward Capacity (15-min granularity)</p> <p>&gt;New Column in CSV</p> <p>&gt;New DATA_ITEM in XSD</p>	4/12/23	4/18/23
OASIS	RSEE2T1	Existing: Energy > Flexible Ramping > Flexible Ramp Requirements Inputs and Outputs (WEIM RSE Flexible Ramping Tests)	Existing: Energy > Flexible Ramping > Flexible Ramp Requirements Inputs and Outputs (WEIM RSE Flexible Ramping Tests)	<p>&gt; Original data publishing is existing system functionality.</p> <p>&gt; Corrected data publishing is new system functionality that will be published on same existing report as original data.</p> <p>&gt;BAA RSE Flexible Ramp Test Failure Upward/Downward Capacity (15-min granularity)</p> <p>&gt;New Column in CSV</p> <p>&gt;New DATA_ITEM in XSD</p>	4/12/23	4/18/23

# Overview – System Interface Changes – Summer 2023 Release

System	Project	UI	API	Data	Tech Specs	MAPSTAGE
CIDI	RSEE2T1	BAA Assistance Energy Transfer Opt In/Out Checkbox	NA	NA	NA – Production 4/10/23	NA – Production 4/10/23
MF	RSEE2T1	Existing	Existing	BAA Assistance Energy Transfer Opt In/Out Flag	NA	4/17/23
SIBR	ESET1	Existing	Existing	Rules Only	NA	4/17/23
SIBR	RSEE2T1	NA	NA	Send RTM Bid Cap data downstream	NA	4/17/23
ITS	RSEE2T1	Existing	NA	<p>Exports e-Tagging Submission Requirement</p> <p>&gt; SCs shall be required to e-tag the following as “Firm Provisional Energy (G-FP)”, via utilizing Misc. field:</p> <ul style="list-style-type: none"> <li>o RT economic (RTECON) exports that clear HASP</li> <li>o DA economic (DAECON) exports that clear both RUC and HASP</li> <li>o RTLPT exports that clear HASP</li> <li>o DALPT exports that clear both RUC and HASP</li> </ul> <p>&gt; SCs shall be required to e-tag the following as “Firm Energy (G-F)”:</p> <ul style="list-style-type: none"> <li>o RTPT exports that clear HASP</li> <li>o DAPT exports that clear both RUC and HASP</li> </ul>	NA	NA



# WEIM Resource Sufficiency Evaluation Enhancements

## Phase 2 Track 1: Scenario 1

Scenario Number	Structured Scenario	
1	Description	Facilitate simulation of assistance energy transfer opt-In functionality.
	ISO Actions	Facilitate failure of upward capacity test and/or flexible ramping test for WEIMs signed up for market sim.
	WEIM Market Participant Actions	1) WEIM market participants should opt-in for the assistance energy transfer functionality via CIDI. <b>CIDIs submitted less than 5BD before TD aren't guaranteed, but ISO will try to accommodate.</b> 2) Facilitate conditions to fail upward capacity test and/or flexible ramping test. 3) Submit ETSR Limits
	ISO Market Participant Actions	N/A
	Expected Outcome	When opted in, allow that BAA to receive WEIM assistance energy transfer by not enforcing the BAA Import transfer limit in the base scenario.  Verify the RSE failure capacities and RTM bid cap in CMRI and OASIS.
	Anticipated Settlement Outcome	Verify assistance energy transfer charges and revenue allocation
	Expected Settlement Outcome	BPM CG CC 6476 Real Time Assistance Energy Transfer Surcharge_5.0 BPM CG CC 6479 Real Time Assistance Energy Transfer Allocation_5.0

# WEIM Resource Sufficiency Evaluation Enhancements

## Phase 2 Track 1: Scenario 1 Reminders

- The environment is available for entities to try to cause failures of the tests and increase their own BAA load forecast to create the import situation.
- Reminder: Submit ETSR limits.
- **Please submit CIDs to disable auto-balancing and/or bid insertion/canned bids for desired TDs**
- Review OASIS flex and bid test results for hours with failures
- ISO BAA Opt In for AET TDs 5/2 & 5/4, ISO BAA Opt-Out for AET TD 5/9 onwards
  
- **BPM CG CC 6476 Real Time Assistance Energy Transfer Surcharge\_5.0 (Fee)**
  - Must be opted in to AET to receive assistance
  - If desired to facilitate failures, open CIDI for CAISO to disable your auto-balancing and or bid insertion/canned bids
  - Must fail RSE up test
  - Must be net importing in RT
  - BAA's net imports must be higher than their Reg up
  
- **BPM CG CC 6479 Real Time Assistance Energy Transfer Allocation\_5.0 (Revenue)**
  - Does not need to be opted in to AET, can be opted in or opted out
  - Must pass RSE up test
  - Must be net exporting in RT
  - The allocation/revenue will be spread across all other BAAs that passed RSE and are net exporters in RT
  
- Because the conditions in surcharge and revenue are direct opposites, a BAA can only either receive revenue or get charged a penalty in each interval.
- When validating a few intervals and only seeing one charge code, remember that if you are in one charge code for one interval, it is impossible for you to be on the other charge code for that same interval.
- If you are opted out of AET, you can still receive revenue as long as you pass RSE Up and you are net exporting in RT; opt in election is only for the energy assistance.

# WEIM Resource Sufficiency Evaluation Enhancements

## Phase 2 Track 1: Scenario 1

- Visibility of AET designation
  - BAAOP UI will show that flag for BAA operators; WEIM BAAs able to view “Assistance” column in BAAOP
  - In Settlements, the flag is reportable in the Settlements statement file
- **PRR 1500 updated 5/16/23 in Ver 3: The Assistance Energy Transfer report described as an OASIS report in this PRR has been removed. Assistance Energy Transfer status will be available and visible to all WEIM's if they opt-in or not via BAAOP, not OASIS. Opt-in Status is also visible on ones Settlement statement file. CAISO will send out a notice when CAISO opts-in for AET.**

# WEIM Resource Sufficiency Evaluation Enhancements

## Phase 2 Track 1: Scenario 2

Scenario Number	Unstructured Scenario	
2	Description	Facilitate submission of G-FP Export e-Tagging.
	ISO Actions	N/A
	EIM Market Participant Actions	Market Participants should e-tag several export resources as “Firm Provisional Energy (G-FP)”.
	ISO Market Participant Actions	Market Participants should e-tag several export resources as “Firm Provisional Energy (G-FP)”.
	Expected Outcome	Market Participants verify G-FP e-tags in their own Web Smart Tag system. CAISO will verify ITS for G-FP e-tags.  <b>Please provide list of tag codes or market awards for CAISO verification.</b>
	Anticipated Settlement Outcome	N/A
	Expected Settlement Outcome	N/A

- The required tagging as G-FP or G-F applies to tagging on intertie resources with the ISO (could be market participants and/or WEIM entities) for tags that involve the ISO BA.
- There are no ITS/tagging system changes for RSEE2 Track 1 Summer 2023 Release
  - Tags can be submitted even now with G-FP or G-F
- RSEE2 Track 2 Fall 2023 Release will have ITS/tagging changes to enforce/require the G-FP or G-F in the applicable tags
- References:
  - Tariff: <http://www.caiso.com/Documents/Mar31-2023-Tariff-Amendment-ResourceSufficiencyEvaluationEnhancements-ER23-1534.pdf>
  - BPM: <https://bpmcm.caiso.com/Pages/ViewPRR.aspx?PRRID=1497&IsDIg=0>
  - RSEE2T1Training on 4/26: <http://www.caiso.com/Pages/Calendar.aspx>

# Market Simulation Activities

Initiative	Market Simulation	Comments
RSEE2T1	Structured & Unstructured	Leverage settlements TDs
ESET1	Unstructured	No settlements impacts
HR2C	Unstructured	Leverage settlements TDs
ASSOCC	Unstructured	ISO will monitor and intervene as necessary
URL Changes (ADR)	Connectivity/Unstructured	No settlements impacts
FRP Nomograms	Unstructured	No settlements impacts

# Ancillary Service State of Charge Constraint

ID#	Guidance on Market Participant Impacts	Source System	Sink System	Reason for Potential Scenario
ASSOC-MSIM001	<p>Storage resource SCs shall submit energy bids and competitive regulation bids (to receive regulation awards) to trigger AS SOC constraint to be binding in RTPD, RTD</p> <p>Potential scenarios include: Energy bids to bid cap</p> <p>Both regulation up and regulation down bids</p>	SIBR	<p>RTM</p> <p>Settlements</p> <p>CMRI</p>	Confirm AS SOC constraint binds

- Due to environment constraints, will not be able to simulate retroactive trade dates from Production or otherwise in MAPSTAGE
- MAPSTAGE is configured to not use telemetry values. This way, the initial conditions for SOC are directly inherited from the solution of the previous optimization.
- ISO is providing guidance to cause ASSOC constraints to bind for market simulation
- The bidding strategies are designed so that they should essentially work in the vast majority of situations but ISO will still monitor the market simulation to make sure the market yields the desired outcomes.

# Suggested scenario in DA –Modify storage resource bid so its “lower” AS SOC constraint becomes binding

- HE01 to HE08
  - Submit energy (EN) bids covering the positive EN range (0 to Pmax) at a bid price of  $-\$150/\text{MWh}$  (No bid on EN negative range)
  - No Ancillary Service (AS) bid
  - Reason: Depletes the SOC
- HE09 to HE24
  - Submit EN bids from Pmin/2 to 0 with a bid price of  $+\$1000/\text{MWh}$  (No bid on EN positive range)
  - Bid Reg Up for  $-P_{\text{min}}$  MW at  $\$0/\text{MW}$ .
  - Reason: Help the resource get awarded Reg Up in DA

## Suggested scenario in RT –Modify storage resource bid so its “lower” AS SOC constraint becomes binding

- HE01 to HE08
  - Submit energy (EN) bids covering the positive EN range (0 to Pmax) at a bid price of  $-\$150/\text{MWh}$  (No bid on EN negative range)
  - No Ancillary Service (AS) bid
  - Reason: Depletes the SOC
- HE09 to HE24
  - Submit EN bids from Pmin/2 to Pmax with a bid price of  $-\$150/\text{MWh}$
  - Bid Reg Up for maximum possible amount at  $\$0/\text{MW}$ .
  - Reason: Enables the lower AS SOC constraint to bind



## Suggested scenario in DA – Modify storage resource bid so its “upper” AS SOC constraint becomes binding

- HE01 to HE08
  - Submit EN bids covering the negative EN range ( $P_{min}$  to 0) at a bid price of +\$1,000/MWh. (No bid on EN positive range)
  - No AS bid
  - Reason: Charges the SOC
- HE09 to HE24
  - Submit EN bids from 0 to  $P_{max}/2$  with a bid price of – \$150/MWh (No bid on EN negative range)
  - Bid Reg Down for  $P_{max}$  MW at \$0/MW
  - Reason: Helps the resource get awarded Reg Down in DA

# Suggested scenario in RT – Modify storage resource bid so its “upper” AS SOC constraint becomes binding

- HE01 to HE08
  - Submit EN bids covering the negative EN range ( $P_{min}$  to 0) at a bid price of +\$1,000/MWh. (No bid on EN positive range)
  - No AS bid
  - Reason: Charges the SOC
- HE09 to HE24
  - Submit EN bids from  $P_{min}$  to  $P_{max}/2$  with a bid price of +\$300/MWh
  - Bid Reg Down for maximum possible amount at \$0/MW
  - Reason: Enables the upper AS SOC constraint to bind

# Production Activation

- Customer feedback on timeline received and heard by ISO
- Entire Summer Release moves to 7/1/23 – RSEE2T1, ESET1, ASSOCC, HR2C Settlements
- Deployments to Production by 6/1/23
- [Notices](#) sent 5/19/23

## Summer 2023 Release activation rescheduled from 6/1/23 to 7/1/23

### MESSAGE

The California ISO has moved the Summer 2023 activations for Resource Sufficiency Enhancements Phase 2 Track 1, Energy Storage Enhancements Track 1, Hybrid Resources Phase 2C - Settlements, and Ancillary Services State of Charge Constraint projects to July 1, 2023.

Due to the short development cycle for this Summer Release compared to the typical Fall Release where customers have more buffer time to make final adjustments to their systems based on final findings from market simulation, many ISO customers indicated the need for this buffer time towards the end of market simulation and the activation date of the Summer Release. The ISO understands the importance of giving our market participants this buffer time and decided to reschedule the activation date of Summer Release to July 1, 2023 due to the constraint that this release needs to be activated at the beginning of a month. The new activation date will allow market participants to finish validation of software changes, market rules, settlements statements, and make any final adjustments accordingly.

The release and project information is available in the Release User Group presentation [here](#) and on the Release Planning page [here](#).

- Resource Sufficiency Enhancements Phase 2 Track 1 Impacted Systems: Master File, SIBR, Market, CMRI, OASIS, and Settlements
- Energy Storage Enhancements Track 1 Impacted Systems: SIBR and Market
- Hybrid Resources Phase 2C - Settlements Impacted Systems: Settlements
- Ancillary Services State of Charge Constraint Impacted Systems: Market, CMRI, and Settlements

The Summer 2023 Release functionality for Resource Sufficiency Enhancements Phase 2 Track 1, Energy Storage Enhancements Track 1, Hybrid Resources Phase 2C - Settlements, and Ancillary Services State of Charge Constraint will remain active in the current market simulation MAP Stage environment so that customers can continue to test and prepare for a July 1, 2023 activation. Customers are encouraged to contact [release@caiso.com](mailto:release@caiso.com) for any questions or necessary support regarding impacts of this schedule change.

### CONTACT INFORMATION

Please contact [release@caiso.com](mailto:release@caiso.com) for any questions.

# Energy Storage Enhancements Track 1

- **Attenuation Factors**

- For Market Simulation, we will use the factors in the policy:
  - <http://www.caiso.com/InitiativeDocuments/Presentation-EnergyStorageEnhancements-10-31-2022.pdf>
- These will be further tuned upon ISO study

## Market Simulation values set:

Reg Up	Reg Down
6%	12%
2%	10%
2%	13%
7%	18%
6%	11%
8%	13%
12%	24%
6%	22%
3%	13%
8%	13%
4%	13%
6%	18%
7%	20%
11%	21%
8%	21%
9%	21%
16%	25%
16%	35%
12%	21%
7%	35%
6%	37%
8%	23%
3%	26%
5%	25%

# Energy Storage Enhancements Track 1

The ISO has confirmed the ESET1 Attenuation Factors for Production below. These will be published in an upcoming PRR for the MO BPM and on [www.caiso.com](http://www.caiso.com).

These AS multipliers are different from the ones in the [October 31, 2022 presentation](#) and from what has been in the MAP Stage Market Simulation environment.

The MAP Stage Market Simulation environment Attenuation Factors have been modified to reflect the final values below that will be used for Production. MAP Stage Market Simulation has these final values effective as of:

DA for TD June 10, 2023

RT for:

STU/RTPD June 9, 2023 10:45 binding interval

RTD June 9, 2023 10:00 binding interval

Hour	Reg Up (mRU)	Reg Down (mRD)
1	11%	32%
2	4%	39%
3	4%	36%
4	2%	38%
5	3%	35%
6	4%	33%
7	7%	30%
8	4%	47%
9	4%	51%
10	5%	54%
11	5%	50%
12	6%	44%
13	5%	44%
14	6%	39%
15	6%	40%
16	6%	43%
17	6%	51%
18	8%	50%
19	11%	43%
20	8%	58%
21	5%	63%
22	8%	41%
23	8%	40%
24	3%	43%

# E-Tagging Procedure Update: Day-Ahead RUC Automated Adjustments

Attention: Scheduling Coordinators

Don't miss your opportunity to test the automated adjustment process in MAP Stage. The last date to test in the Market Simulation environment is Friday, June 9, 2023.

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## **Initial notification sent on May 30, 2023:**

Beginning on **June 14, 2023, the ISO will be updating its e-tagging procedures** in the Production Environment to ensure that the energy profile on day-ahead e-tags reflects each resource's day-ahead award. After the day-ahead market results are published the ISO will compare the MW in the energy profile on the e-tag against the DA RUC award quantity. If the amount on the e-tag exceeds the DA RUC award, the amount on the e-tag will be adjusted to equal the DA RUC award.

For example, an SC submits an export bid of 150 MW and an e-tag with 200 MW in the energy profile, the e-tag will automatically be adjusted down to 150 MW (assuming that this is the RUC award).

### **Key Points**

- Adjustments will be made both on import and export transactions
- This adjustment is not applicable to resources associated with a Contract Reference Number (CRN), for example Existing Transmission Contracts (ETC)
- This is only applicable when the e-tag amount exceeds the DA RUC award; e-tag adjustments in the upward direction will not be considered.

# E-Tagging Procedure Update: Day-Ahead RUC Automated Adjustments

## Market Simulation

In support of this change, the MAP Stage Market Simulation environment is currently available for Scheduling Coordinators to test the automated adjustment process, **through June 9, 2023**. We recommend that Scheduling Coordinators take the following steps to test in MAP Stage:

- Submit a CIDI case with 'Functional Environment' of "Market Simulation" to Register resources to participate in this market simulation if they are not already registered in the Map Stage Environment. There is a five business day turnaround time for new participant configuration in the MAP Stage market simulation tagging environment.
- Submit an energy bid or self-schedule in the day-ahead market for an import/export resource.
- Before 14:00, enter an e-tag with an energy profile that exceeds the DA RUC award. The DA RUC award quantity is available in the Day-Ahead Residual Commitment Capacity report found in the Day-Ahead drop down menu in CMRI
- Use the following URL to submit the e-tag in MAP Stage: <https://demo.caiso.tag.oati.com/oati/ets-login.wml>
- E-Tag adjustments will automatically occur at 15:30, 18:30 and 20:30 (PST).
- Review the e-tag to make sure that the expected adjustment occurred.
- WEIM BAAs should review tags that touch or sync in their BA to validate the adjustment to energy profile of the e-tags
- Submit problems or concerns via CIDI ticket with the subject line "DA RUC Adjustment" and functional environment of "Market Simulation".

For background information on this change refer to the following resources:

- Market Operations Business Practice Manual (BPM) section 6.3.2 – Interchange Transactions and E-Tagging
- Presentation – <http://www.caiso.com/Documents/Presentation-Summer-2021-Readiness-Training-Part-3-Jun-24-2021.pdf>
- Video - <https://youtu.be/bsVcadkTJ1I>
- Readiness Note - [California ISO - Learning center \(caiso.com\)](#)



California ISO

# Ancillary Awards for Energy Storage

ISO PUBLIC

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# Agenda

- Ancillary Service Awards Clarification – Provide clarity on the implementation details of the A/S awards for storage resources
- Provide examples/scenarios
- Q&A

# Ancillary Service Award Clarification for Energy Storage - A/S award constraints

- AS awards require 50% of available capacity (DA/RT) and dispatchable energy bid range (RT) in the opposite direction
- The first constraint:  $0.5 (RU_{i,t} + SR_{i,t} + NR_{i,t}) \leq -LCL_{i,t} - RD_{i,t}$   
ensures that a fraction of regulation up (and spin and non-spin awards) do not exceed charging capacity that may be awarded energy bids and ensures that storage resources have capacity to allow bids in the opposite direction of positive ancillary service awards
- The second constraint:  $0.5 RD_{i,t} \leq UCL_{i,t} - RU_{i,t} - SR_{i,t} - NR_{i,t}$   
ensures that a fraction of regulation down does not exceed discharge capacity and ensures that storage resources have capacity to allow bids in the opposite direction of negative ancillary service bids
- Together the equations ensure that storage resources are dispatched in a reliable manner

# Ancillary Service Award Clarification for Energy Storage - A/S award constraints (Real Time)

- Constraint in the Real Time Market ensures deliverability of awards are feasible

$$0.5 (RU_{i,t} + SR_{i,t} + NR_{i,t}) \leq \max(0, -LEL_{i,t})$$

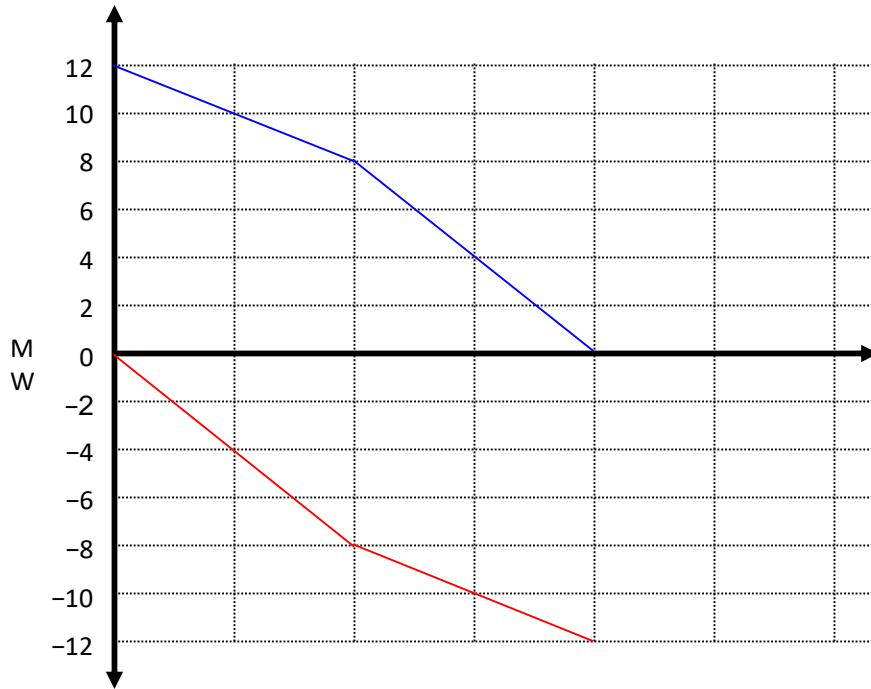
$$0.5 RD_{i,t} \leq \max(0, UEL_{i,t})$$

- Day Ahead Market reserves unencumbered capacity for RT energy bid

# Rationale

- The energy bid in the opposite direction allows the market to optimally replenish the SOC to sustain the AS award
- The capacity limit avoids a forced (potentially uneconomic) dispatch in the opposite direction that would undermine the sustainability of the AS award
- The neutral energy schedule of 0MW must always be feasible
- Resources may not receive ancillary service awards that could result in infeasible dispatch
  - For example: If a storage resource is fully charged, an award for charging energy paired with an award for ancillary services beyond discharge capability would be infeasible

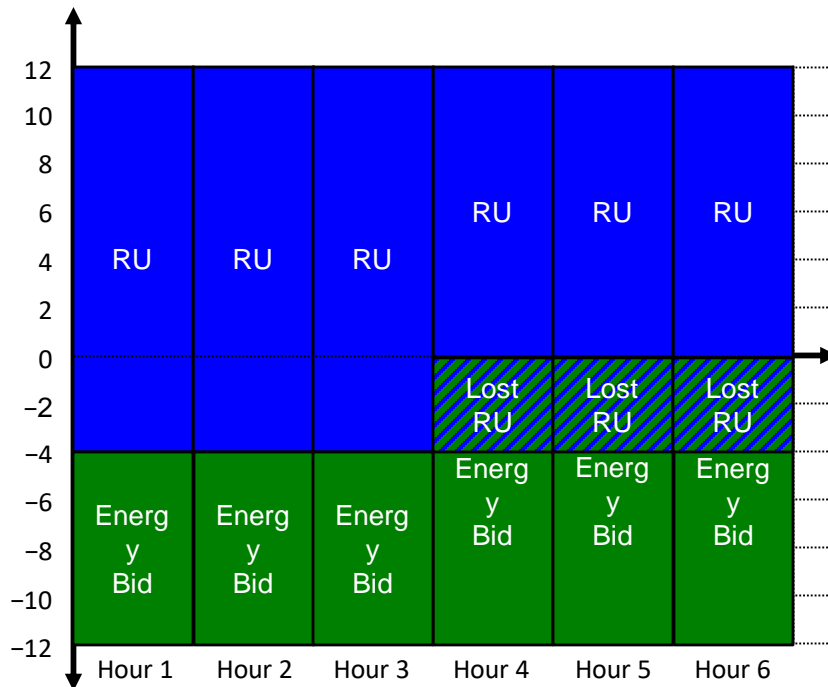
# Example: $\pm 12\text{MW}/48\text{MWh}$ ESR



- Feasible AS award combinations with a full energy bid range of  $[-12, 12]\text{MW}$

RU + SR + NR (MW)	RD (MW)
12	0
11	2
10	4
9	6
8	8
6	9
4	10
2	11
0	12

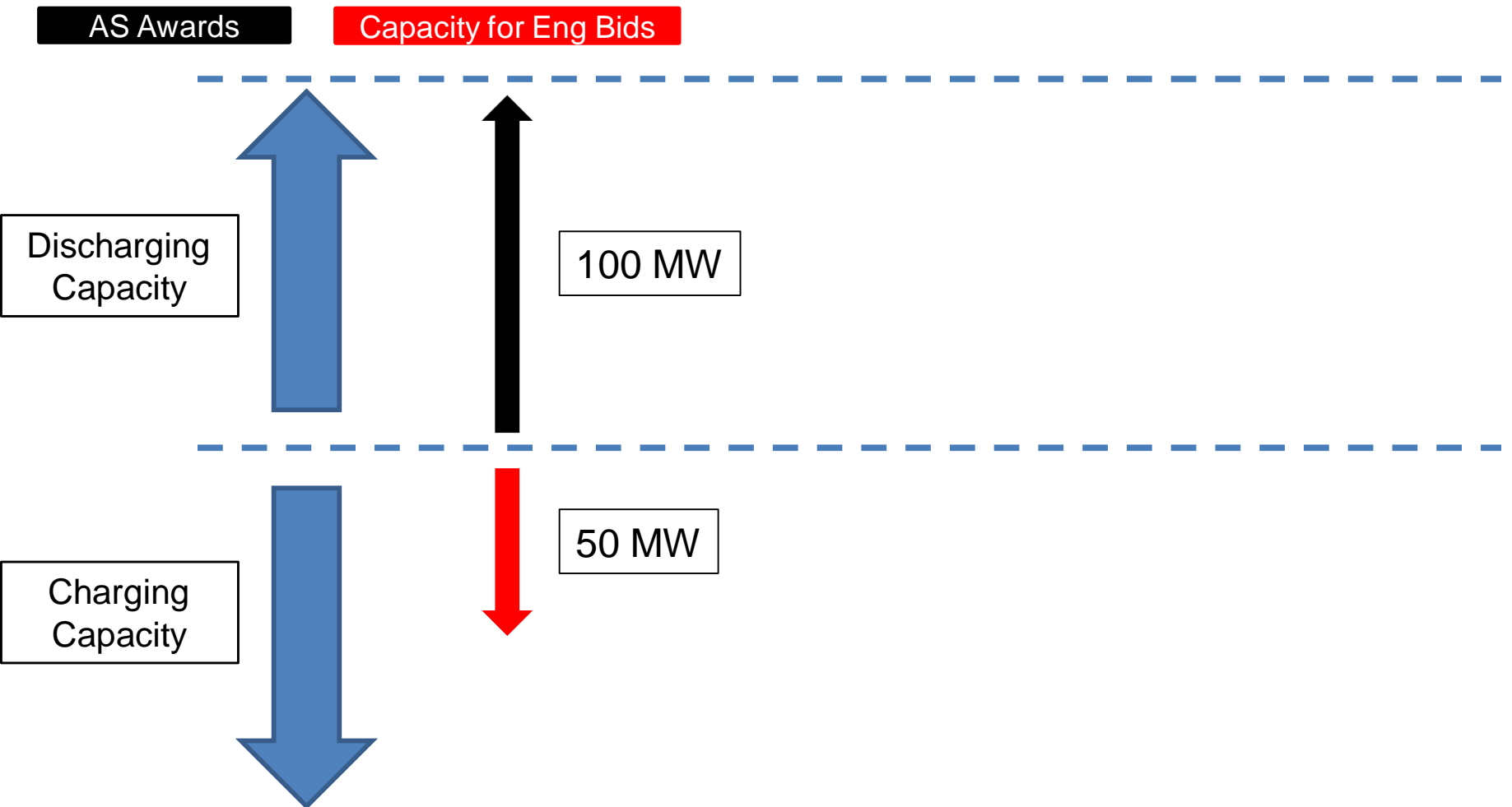
# AS awards are limited by the capacity limit in each direction



## For the $\pm 12\text{MW}/48\text{MWh}$ ESR

- ◆ Why is the combination (16MW RU, 0MW RD) not allowed when there is 8MW of available charging capacity with a charging energy bid?
- ◆ Because it forces a  $-4\text{MW}$  energy schedule
- ◆ If the initial SOC in DAM was at 50% (24MWh), the award can span 6 hours before reaching full charge
- ◆ If the initial SOC in RTM is at 75% (32MWh), the award cannot be sustained after 3 hours

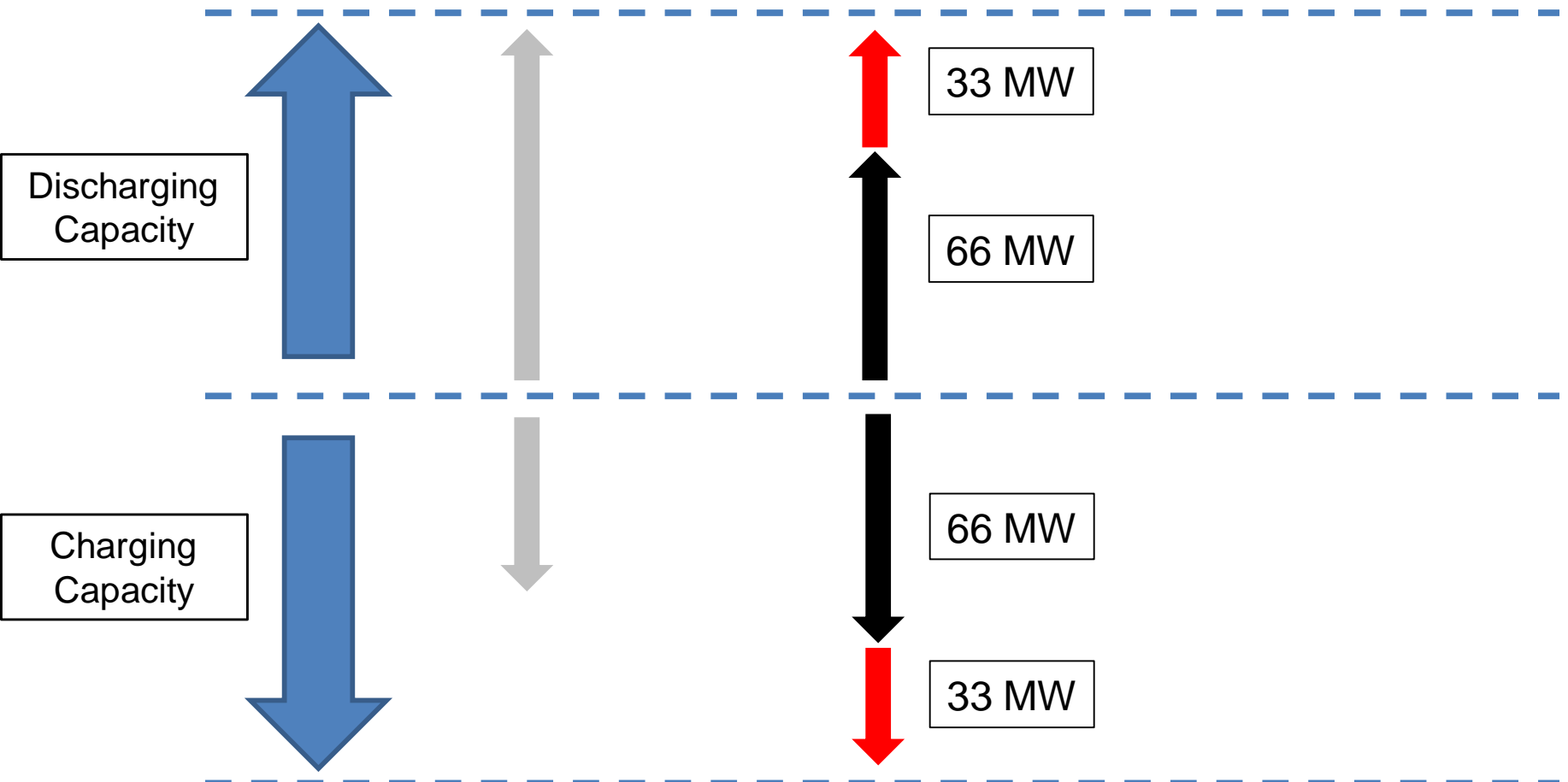
# Ex 1: (Feasible Award) A 100 MW award for regulation up must allow for 50 MW of charging capacity



# Ex 2: (Feasible Award) Awards for 66 MW of regulation up and down must be accompanied by 33 MW of capacity in both directions

AS Awards

Capacity for Eng Bids

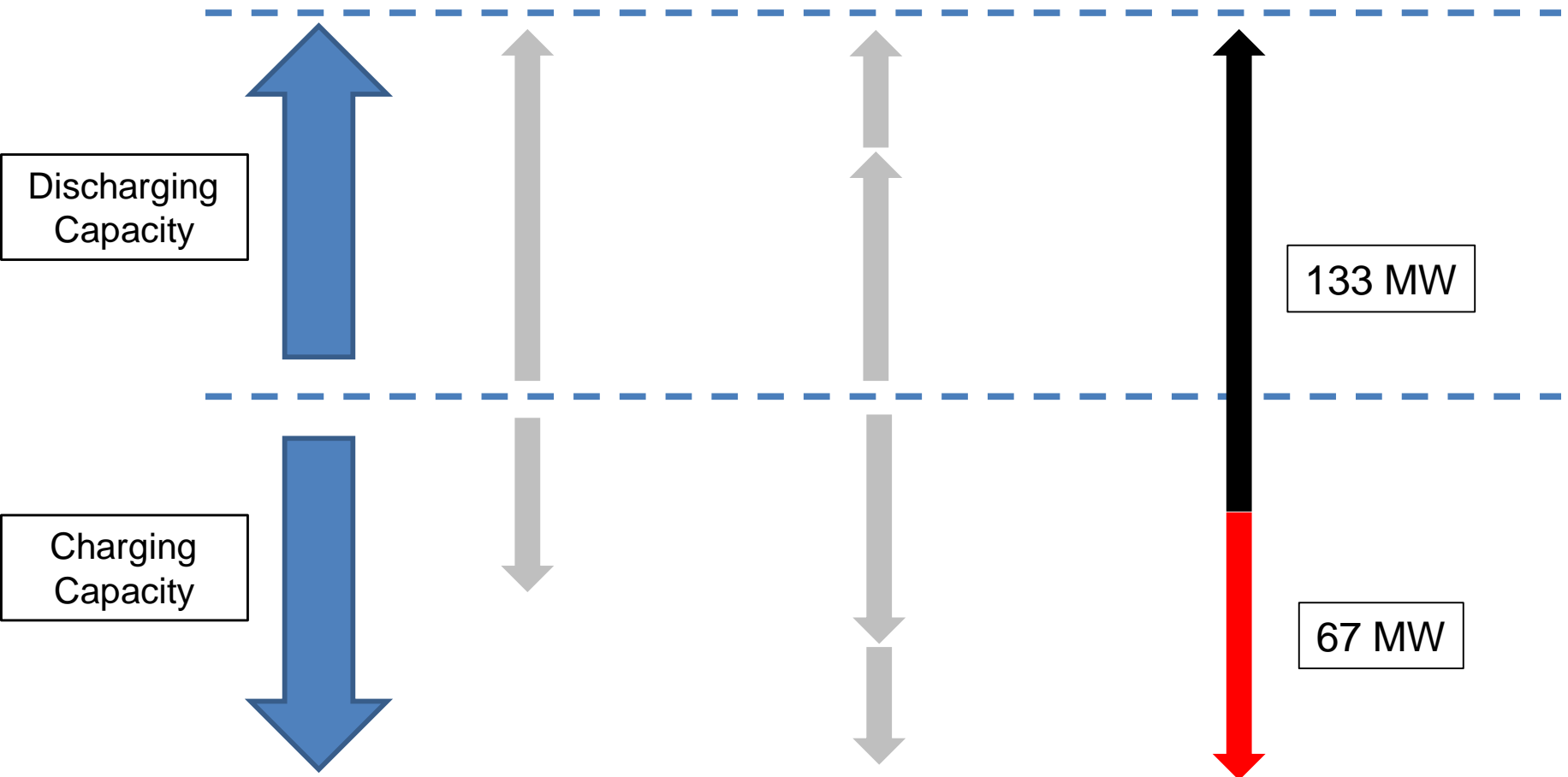




# Ex 3: (Infeasible Award) Awards for 133 MW of regulation up must be accompanied by energy awards for -33 MW or less, which could be infeasible in RT

AS Awards

Capacity for Eng Bids



## Example: A resource with an infeasible energy award in real-time dictated by day-ahead a regulation award

- Assume this resource has an award in hour ending 1 for 133 MW of regulation up (from the day-ahead market) and receives consecutive -33 MW awards for energy in real-time
  - As noted, the market will ensure that the resource starts the hour with 50 MWh of energy (Assume resource begins the hour with 380 MWh state of charge)
- Now make the extreme assumption that none of the regulation is converted to energy
  - Before interval 11 the resource will be fully charged at 400 MWh
  - Once at full state of charge, this resource will no longer be able to follow energy dispatch awards, and will not be able to follow any automatic generator control (AGC) instructions from the ISO between the range of 0 and -33 MW, a requirement for the ancillary service award

# Real-time energy awards necessitated by day-ahead ancillary service awards can lead to inability to perform

- Proving that a storage resource could receive an infeasible dispatch
- Storage resources are required to hold state of charge in real-time to provide an ancillary service
  - State of Charge must exceed 30 minutes \* regulation up award

## Example Resource

- +/- 100 MW resource
- 4-hour battery: 0-400 MWh of state of charge
- 100% round trip efficiencies

# Q&A



California ISO

# ESE Track 1 Attenuation Factors

Guillermo Bautista Alderete

# Energy Storage Enhancements Track 1

The ISO has confirmed the ESET1 Attenuation Factors for Production below. These will be published in an upcoming PRR for the MO BPM and on [www.caiso.com](http://www.caiso.com).

These AS multipliers are different from the ones in the [October 31, 2022 presentation](#) and from what has been in the MAP Stage Market Simulation environment.

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8	4%	47%
9	4%	51%
10	5%	54%
11	5%	50%
12	6%	44%
13	5%	44%
14	6%	39%
15	6%	40%
16	6%	43%
17	6%	51%
18	8%	50%
19	11%	43%
20	8%	58%
21	5%	63%
22	8%	41%
23	8%	40%
24	3%	43%



# Negative Regulation Down Prices ESE Track 1

Presented by Yannick Degeilh, Ph.D.  
Sr. Power Systems Engineer – Development  
Power Systems Technology Development  
June 2023

# ESE-Track 1 – Regulation awards impact on SOC

- ESE-Track 1 changes the formulation of the constraint that updates SOC from one interval to the next:

$$SOC_{i,t} = SOC_{i,t-1} - \left( EN_{i,t}^{(+)} + \eta_i EN_{i,t}^{(-)} + ATRU_t RU_{i,t} - ATRD_t \eta_i RD_{i,t} \right) \frac{\Delta T}{T_{60}}$$

- The final policy of ESE-Track 1 introduced the terms in red (Final Proposal page 11):
  - for every MW of RU awarded, we assume that the storage resource ends up being called upon to serve part of the RU award and, as a result, discharges the value of the RU award times the attenuation factor ( $ATRU_t$ ) times  $\Delta T/T_{60}$ .
  - for every MW of RD awarded, we assume that the storage resource ends up being called upon to serve part of the RD award and, as a result, charges the value of the RD award times the attenuation factor ( $ATRD_t$ ) times the charging efficiency ( $\eta_i$ ) times  $\Delta T/T_{60}$ .



# The DA optimization finds it economical to charge the storage resource by relying on RD awards only

Interval End	RegDN		ATRD	SOC	Delta SOC	Energy	
	MW	ASMP				MW	LMP
1	0	7.14	0.12	0	0	0	88
2	0	8	0.1	0	0	0	80
3	0	6.33	0.13	0	0	0	73.77
4	0	6.33	0.18	0	0	0	76.37
5	0	8	0.11	0	0	0	82
6	0	8	0.13	0	0	0	83.27
7	0	8	0.24	0	0	0	90
8	180.31	-3.98	0.22	34.87	34.87	0	81.77
9	181.54	-0.01	0.13	55.61	20.74	0	74.9
10	175.79	-0.01	0.13	75.7	20.09	0	74.88
11	171.54	-0.01	0.13	95.3	19.6	0	70.09
12	171.54	-3.17	0.18	122.44	27.14	0	70
13	74.27	-4.37	0.2	135.5	13.06	0	66.88
14	76.39	-5	0.21	149.6	14.1	0	69.39
15	82.62	-5	0.21	164.85	15.25	0	70.88
16	56.56	-5	0.21	175.29	10.44	0	79.4
17	165.66	-5.27	0.25	211.69	36.4	0	89.7
18	0	6.72	0.35	3.64	-208.05	208.05	92.07
19	0	6.11	0.21	0	-3.64	3.64	92.07
20	0	6.72	0.35	0	0	0	90
21	0	8	0.37	0	0	0	89.7
22	0	8	0.23	0	0	0	89.7
23	0	8	0.26	0	0	0	78.48
24	0	6.33	0.25	0		0	78.48

The storage resource “cheaply” charges through RD awards only

**Arbitrage Opportunity**

The charged energy is discharged during peak hours, thereby displacing expensive energy

# Same case but with attenuation factors set equal to 0 – the negative Reg Dn prices disappear

Interval End	RegDN		ATRD	SOC	Delta SOC	Energy	
	MW	ASMP				MW	LMP
1	0	7.14	0	0.00	0.00	0.00	88.00
2	0	6.33	0	0.00	0.00	0.00	80.05
3	0	6.33	0	0.00	0.00	0.00	73.77
4	0	6.33	0	0.00	0.00	0.00	75.21
5	0	5.00	0	0.00	0.00	0.00	80.05
6	0	4.04	0	0.00	0.00	0.00	86.85
7	0	8.00	0	0.00	0.00	0.00	90.00
8	0	8.00	0	0.00	0.00	0.00	77.05
9	0	7.16	0	0.00	0.00	0.00	77.00
10	0	7.16	0	0.00	0.00	0.00	74.88
11	0	8.00	0	0.00	0.00	0.00	70.09
12	0	8.00	0	0.00	0.00	0.00	69.68
13	0	8.10	0	58.25	58.25	-66.27	67.86
14	0	8.00	0	58.25	0.00	0.00	69.39
15	0	8.00	0	58.25	0.00	0.00	74.88
16	0	8.00	0	58.25	0.00	0.00	75.00
17	0	10.40	0	58.25	0.00	0.00	89.70
18	0	7.99	0	0.00	-58.25	58.25	97.12
19	0	8.96	0	0.00	0.00	0.00	95.88
20	0	7.99	0	0.00	0.00	0.00	93.66
21	0	8.00	0	0.00	0.00	0.00	90.00
22	0	8.00	0	0.00	0.00	0.00	90.00
23	0	9.95	0	0.00	0.00	0.00	77.53
24	0	6.33	0	0.00		0.00	80.77

Some charging (via EN) in the cheapest hour of the day

Stored energy discharged in the hour with highest LMP

No more Reg Dn awards; Reg Dn prices are positive again

# Reg Dn Price formation

- The RD price reflects the system net cost (when everything is accounted for) of providing 1 more MW of RD.
- The fact that it is negative shows that the system would actually benefit from providing one more MW of RD. How? Because the storage resource would have another opportunity to charge up “for cheap” via RD and therefore displace more expensive energy during peak hours (arbitrage opportunity).
- For example, in HE17:

Interval End	RegDN			ATRD	SOC	Delta SOC	Energy		
	MW	Bid Price	ASMP				MW	Bid Price	LMP
17	165.66	10.54	-5.27	0.25	211.69	36.4	0	89.7	
18	0		6.72	0.35	3.64	-208.05	208.05	Discharge @20.09 92.07	

Cost of providing 1 more MW of RD @10.54

Cost of procuring the resulting 0.22 MWh during peak hours @20.09

Cost of providing 0.22 MWh during the peak hours if procuring @ Market price (LMP = 92.07)

$$RD\ price = 10.54 \times 1 + (20.09 \times 1 \times 0.25 \times 0.879) - (92.07 \times 1 \times 0.25 \times 0.879) = -5.27$$

RD bid price → 10.54  
 RD award → 1  
 EN discharge bid price → 20.09  
 Energy obtained from RD award → 0.22  
 ATRD (attenuation factor for RD) → 0.25  
 Charging Efficiency → 0.879  
 LMP during peak hours → 92.07  
 Energy now displaced by that obtained from RD award → 0.22

Market would save \$5.27 per additional MW of RD provided. This is by exchanging expensive energy @LMP for cheap energy obtained from RD award.

## To recap...

- The RD price reflects Market's net cost of providing 1 more MW of RD.
- As such, it captures the cost of procuring that 1 MW of RD from the storage resource, at the submitted RD bid price of 10.54.
- But it also encapsulates the benefits of acquiring  $1 \times 0.25 \times 0.879 = 0.22$  MWh of stored energy from the 1 MW of RD, as a byproduct of the updated SOC equation.
- The Market minimizes its procurement costs by "swapping" 0.22 MWh of energy normally procured at the LMP rate of 92.07 by those 0.22 MWh of energy obtained from the 1 MW of RD.
- Indeed, in total the Market will have spent  $10.54 + 20.09 \times 0.22 = 14.96$  to purchase the 1 MW of RD, obtain the 0.22 MWh of stored energy (as a byproduct), and re-purchase during peak hours the 0.22 MWh of energy from the storage resource, at the submitted EN bid price of 20.09.
- By comparison, the Market stands to save  $92.07 \times 0.22 = 20.26$  by no longer having to procure the 0.22 MWh at LMP rate.
- Hence the net cost of procuring one more MW of RD comes down to:

$$RD \text{ Price} = 14.96 - 20.26 = -5.30 \quad (-5.27 \text{ when correcting for rounding errors})$$

# Concluding Remarks

- The software is working as expected considering the new SOC equation introduced by ESE track 1.
- Negative Reg Dn prices are more likely to occur:
  - In DA, where there usually are more arbitrage opportunities (24 hours over which the Reg Dn bid prices and LMPs may show the appropriate spread).
  - When Reg Dn attenuation factors are high (more MWhs charged per MW of Reg Dn award).



# AS Capacity Constraints in ESE Track 1

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June 2023

# Final Proposal (October 27<sup>th</sup>, 2022): Language

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This final proposal, **relaxes the prior requirement to only require energy bids in the real-time market equal to 50% of the ancillary service award from the day-ahead market.** **The proposal also relaxes the requirement for energy bids in the day-ahead market.** Returning to the prior example, a +/- 12 MW storage

- Page 13:

The proposed rules will not require bids in the **day-ahead market** from the storage resource, but **ancillary services will not be awarded in the day-ahead market that cannot accommodate the required energy bids in the real-time market.** Further, numerical examples are provided in the sub-section below.

# Final Proposal (October 27<sup>th</sup>, 2022): Examples

- Page 12:  
day-ahead market. Returning to the prior example, a +/- 12 MW storage resource with an ancillary service schedule of 12 MW of regulation up would be required to bid a 6 MW range of charging capability in the real-time market alongside the ancillary service award. This could be a bid from in the operating range of the resource from 0 MW to -6 MW. The same resource could be awarded up to 8 MW of regulation up and 8 MW of regulation down at the same time, as long as these awards were accompanied by bids of a 4 MW range to charge and a 4 MW range to discharge energy. However, this resource could not be awarded to provide 9 MW of regulation up and 9 MW of regulation down during the same hour. If this was awarded the resource could not provide the required energy bids in real-time. This requirement is less burdensome than the
- From the language and these examples, the concept is that the energy bid in the opposite direction along with the AS awards must fit between the upper and lower capacity range

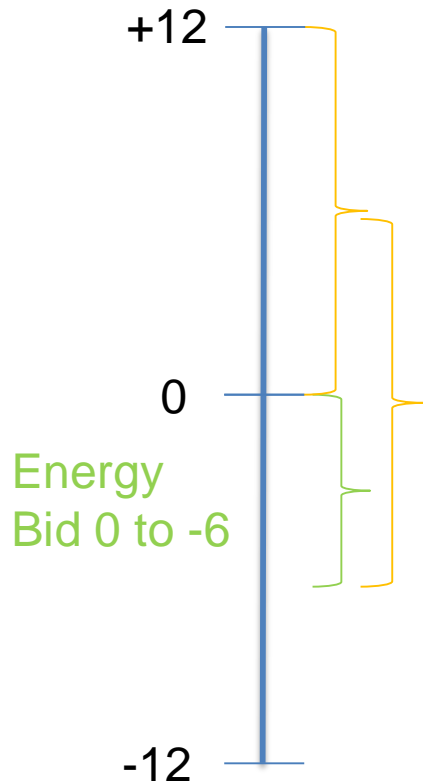


# Implementation:

$$\left. \begin{array}{l}
 \text{IFM/RUC: } \left\{ \begin{array}{l}
 CF (RU_{i,t} + SR_{i,t} + NR_{i,t}) \leq -LCL_{i,t} - RD_{i,t} \quad (1) \\
 CF RD_{i,t} \leq UCL_{i,t} - RU_{i,t} - SR_{i,t} - NR_{i,t} \quad (2)
 \end{array} \right\} \\
 \\
 \text{RTM: } \left\{ \begin{array}{l}
 CF (RU_{i,t} + SR_{i,t} + NR_{i,t}) \leq -LCL_{i,t} - RD_{i,t} \quad (1) \\
 CF RD_{i,t} \leq UCL_{i,t} - RU_{i,t} - SR_{i,t} - NR_{i,t} \quad (2) \\
 CF (RU_{i,t} + SR_{i,t} + NR_{i,t}) \leq \max(0, -LEL_{i,t}) \quad (3) \\
 CF RD_{i,t} \leq \max(0, UEL_{i,t}) \quad (4)
 \end{array} \right\}
 \end{array} \right\} , \forall i \in S_{LESR} \wedge t = 1, 2, \dots, T$$

- Equations (1) and (2) are the capacity constraints
- Equations (3) and (4) are the energy bid constraint in the opposite direction of the AS awards.
- Our focus is on equations (1) and (2)

# Example A : RU=12, RD=0, EB 0 to -6



RU = 12

$$CF (RU_{i,t}) \leq -LCL_{i,t} - RD_{i,t}$$

$$0.5 (12) \leq 12 - 0 \rightarrow \text{True}$$

$$CF RD_{i,t} \leq UCL_{i,t} - RU_{i,t} - SR_{i,t} - NR_{i,t}$$

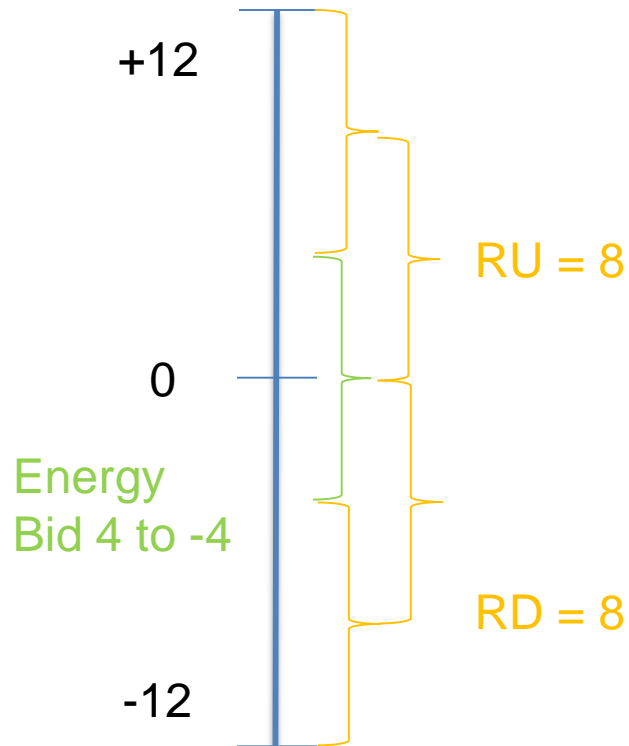
$$0.5 * 0 \leq 12 - 12 \rightarrow \text{True}$$



Model can award RU=12, Rd=0

- Implementation results are in alignment with the approved Final Policy

# Example B : RU=8, RD=8, EB 4 to -4



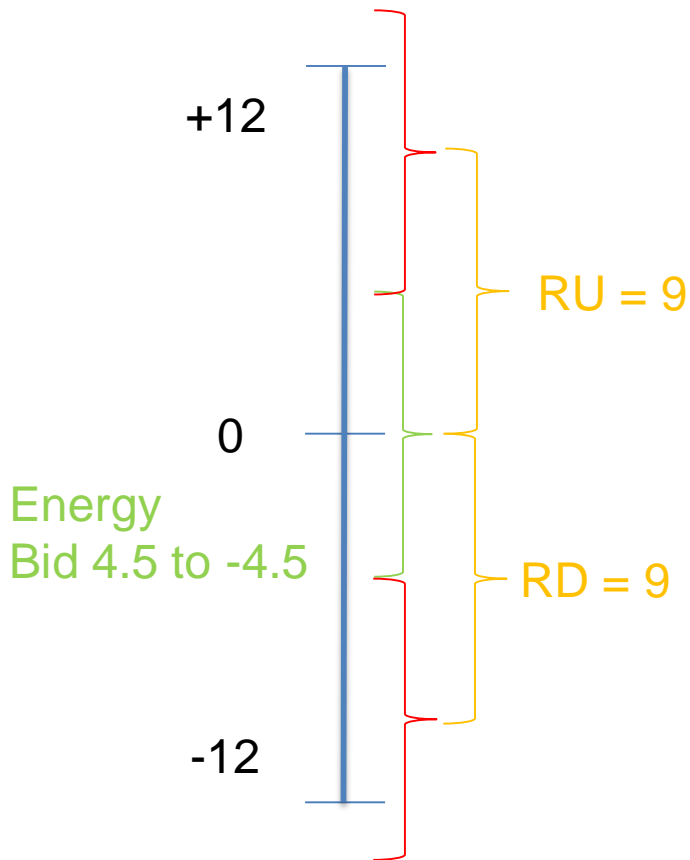
$$CF(RU_{i,t}) \leq -LCL_{i,t} - RD_{i,t}$$
$$0.5(8) \leq 12 - 0 \rightarrow \text{True}$$
$$CF(RD_{i,t}) \leq UCL_{i,t} - RU_{i,t} - SR_{i,t} - NR_{i,t}$$
$$0.5 * 8 \leq 12 - 8 \rightarrow \text{True}$$



Model can award RU=8, Rd=8

- Implementation results are in alignment with the approved Final Policy

# Example C : RU=9, RD=9, EB 4.5 to -4.5



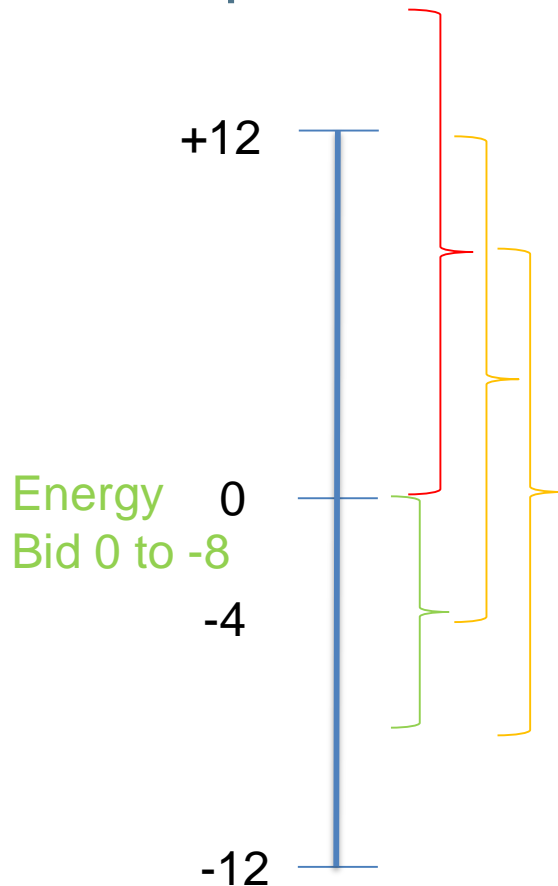
$$CF (RU_{i,t}) \leq -LCL_{i,t} - RD_{i,t}$$
$$0.5 (9) \leq 12 - 9 \rightarrow \text{False}$$
$$CF RD_{i,t} \leq UCL_{i,t} - RU_{i,t} - SR_{i,t} - NR_{i,t}$$
$$0.5 * 9 \leq 12 - 9 \rightarrow \text{False}$$



Model will not award RU=9, Rd=9

- Implementation results are in alignment with the approved Final Policy

## Example D : RU=16, RD=0, EB 0 to -8



$$CF(RU_{i,t}) \leq -LCL_{i,t} - RD_{i,t}$$

$$0.5(16) \leq 12 - 0 \rightarrow \text{True}$$

$$CF(RD_{i,t}) \leq UCL_{i,t} - RU_{i,t} - SR_{i,t} - NR_{i,t}$$

$$0.5 * 0 \leq 12 - 16 \rightarrow \text{False}$$



Model will not award RU=16, Rd=0  
 Example is not explicitly listed in Final Policy Paper

***If this award is allowed by the model in Day-Ahead:***

- ***Real-time Market would be forced to dispatch energy to 0MW when resource is fully charged regardless of economics***
- ***Results do not address the operational concerns regarding sustainability of Day-Ahead regulation awards in real-time***