



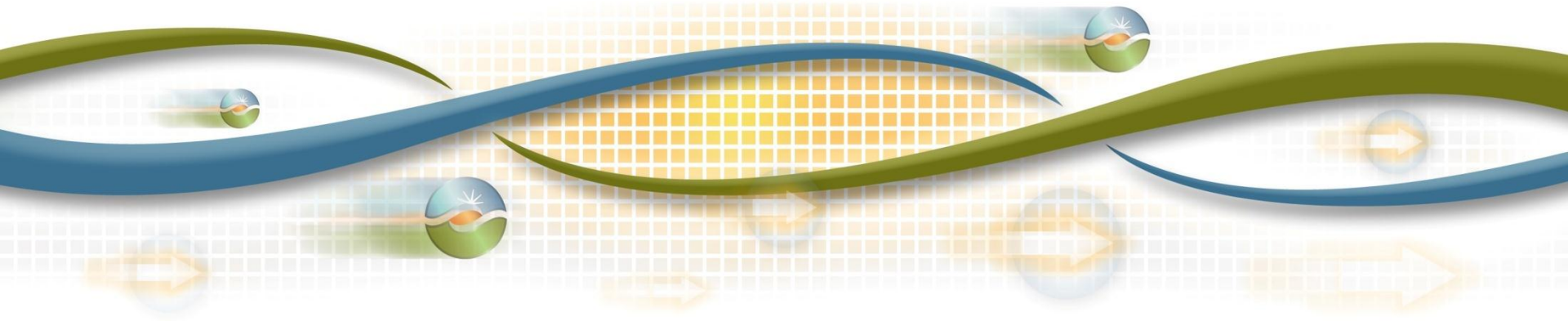
# Bid cost recovery and variable energy resource settlements

Straw proposal discussion

April 15, 2015

Delphine Hou

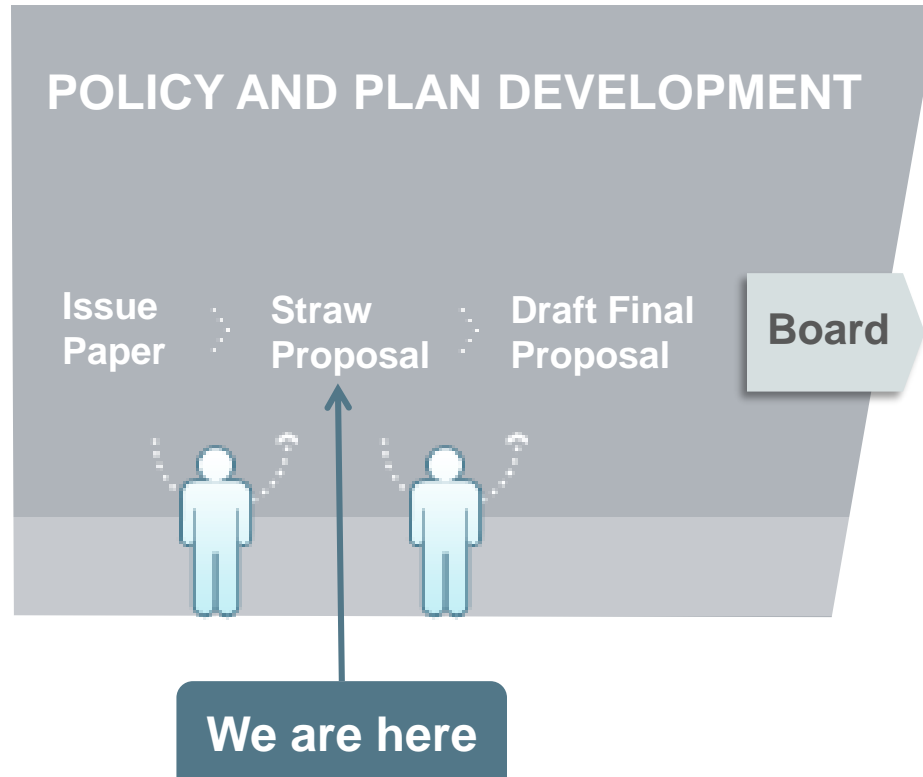
Lead Market Design and Regulatory Policy Developer



# Agenda

Time	Topic	Presenter
9:00 – 9:05	Introduction	Kim Perez
9:05 – 9:15	Ramp rate for variable energy resources	Delphine Hou
9:15 – 10:00	Residual imbalance energy settlement for economic bidding variable energy resources	Delphine Hou
10:00 – 10:15	Persistent deviation metric applied to variable energy resources	Delphine Hou
10:15 – 10:30	Default energy bids for economic bidding variable energy resources	Delphine Hou
10:30 – 11:30	Day-ahead metered energy adjustment factor	Delphine Hou
11:30 – 11:45	Tariff clarifications following market issues bulletin [forthcoming]	Delphine Hou
11:45 – 12:00	Next steps	Kim Perez

# ISO Policy Initiative Stakeholder Process



# Summary of proposals

Section in paper	Topic	Proposal	Type of change
5	Ramp rate for variable energy resources	Ramp rates are physical characteristics and should not be “9999 MW/min”	Clarification on existing policy
6	Residual imbalance energy settlement for economic bidding variable energy resources	Residual imbalance energy due to the forecast changes across intervals shall be settled based on LMP rather than bid. Residual imbalance energy due to economic dispatch across intervals shall continue to be settled based on the reference bid.	Tariff
7	Persistent deviation metric applied to variable energy resources	Continue to apply	Clarification on existing policy
8	Default energy bids for economic bidding variable energy resources	If no cost is provided, will use variable cost option. If LMP option is selected, the variable cost option will be used until the LMP option can be calculated.	Clarification on existing policy
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# Ramp rate for variable energy resources

- Scheduling coordinators should not enter “9999 MW/min” in Master File
- Best operational ramp rate should reflect the maximum for an upward or downward ramp
- For self-scheduling VERs, ISO market will automatically calculate
- For economically bidding VERs, the ISO market will use Master File ramp rate

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# Residual imbalance energy settlement for economically bidding variable energy resources

- Issue statement:
  - Market issues bulletin clarified the existence of residual imbalance energy
  - When there is no bid, the RIE is settled on LMP
  - When there is a bid, the RIE is settled on the bid in the reference hour
  - However, economically bidding VERs may be ramping due to a forecast change, not a change in LMP. Settlement will be on the reference hour bid, which is often negative.

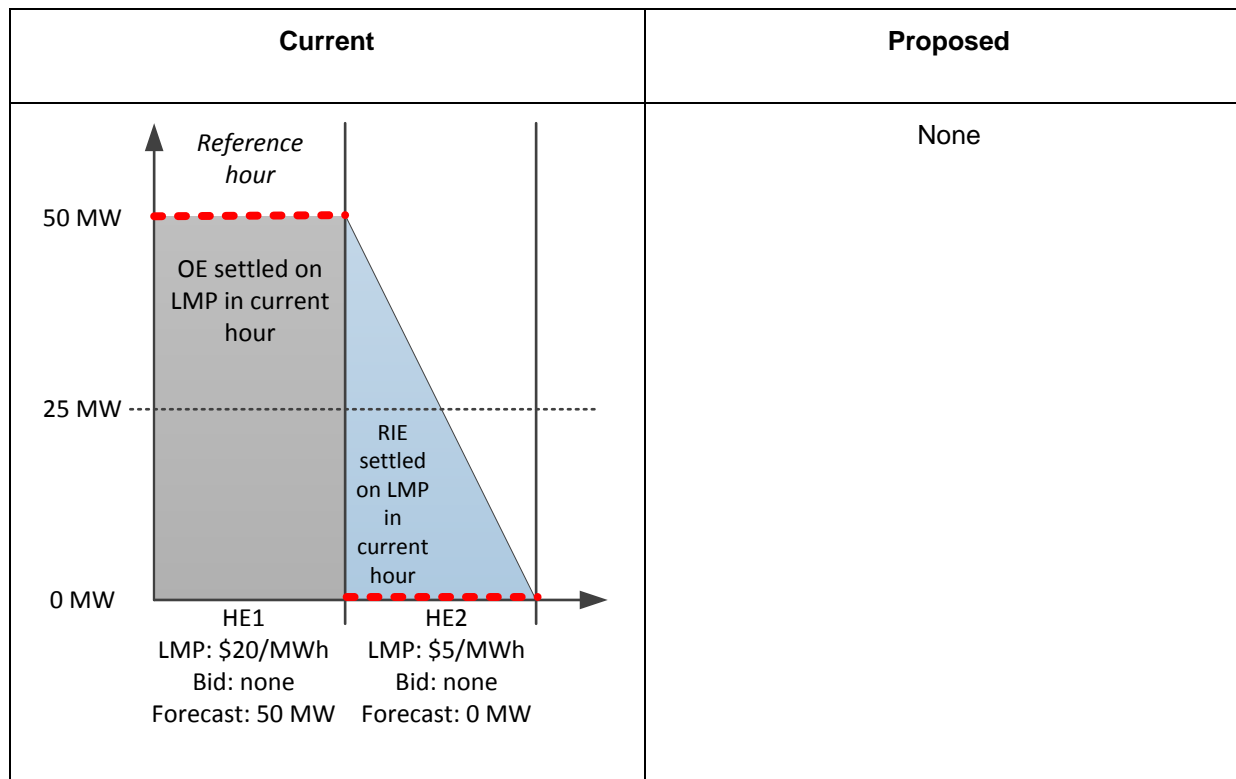
# Residual imbalance energy settlement scenarios for variable energy resources

	Scenario	Settlement	Issue	Proposed solution
1	Self-scheduled with forecast change	Residual imbalance energy settled on LMP	None	None
2a	Economic bidder and forecast increase (no LMP change)	Optimal energy settled on LMP in current hour.	None	None
2b	Economic bidder and forecast decrease (no LMP change)	Residual imbalance energy settled on reference hour bid.	Bid did not drive change in energy.	Settle at LMP in current hour (analogous to derate).
3a	Economic bidder and LMP less than bid (no forecast change)	Residual imbalance energy settled on reference hour bid.	None	None
3b	Economic bidder and LMP higher than bid (no forecast change)	Optimal energy settled on LMP in current hour.	None	None
4a	Economic bidder and LMP less than bid and forecast decrease	RIE settled on reference hour bid.	Portion of RIE not driven by bid.	Settle at LMP for energy above forecast (analogous to derate); settle at reference hour bid for energy within forecast.
4b	Economic bidder and LMP higher than bid and forecast increase	OE settled on current hour LMP.	None	None



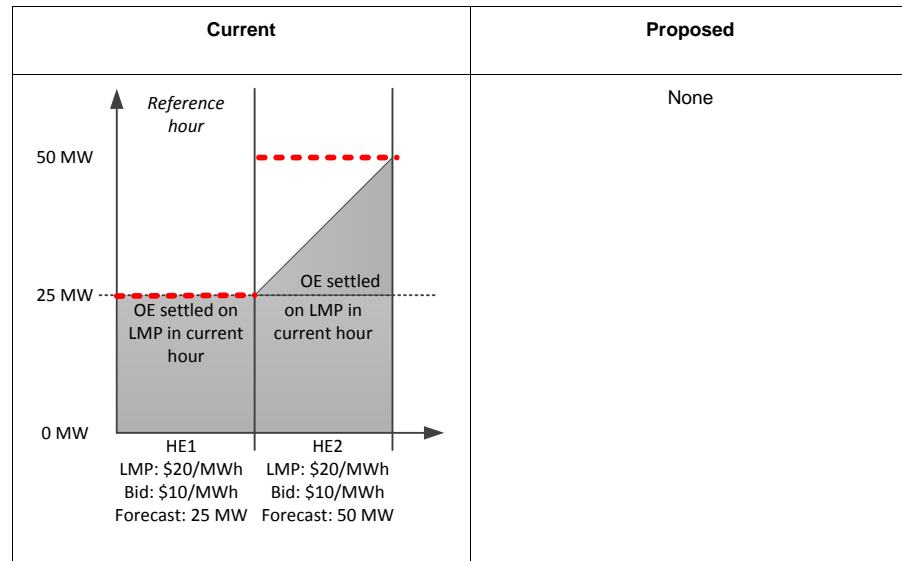
# Residual imbalance energy settlement scenarios for variable energy resources

## Scenario 1: Self-scheduled with forecast change

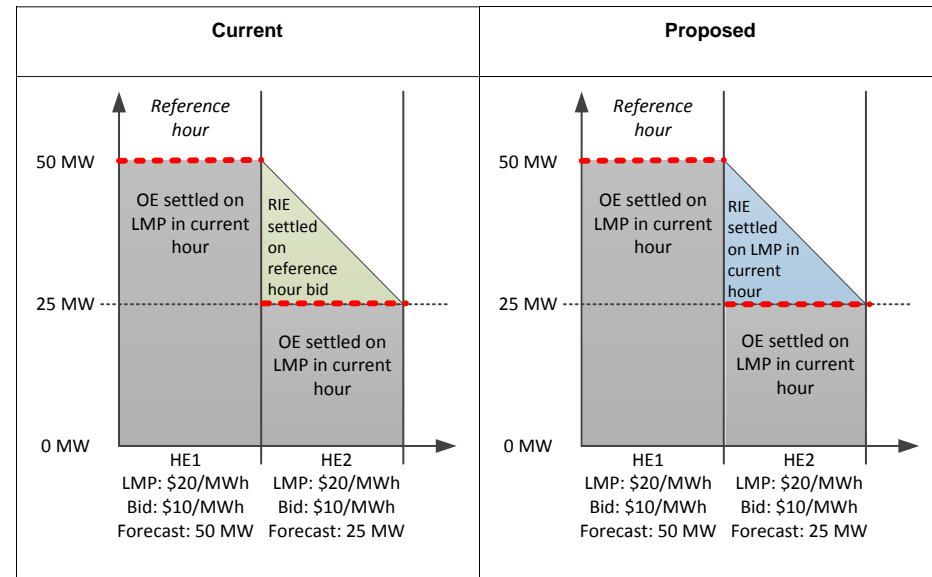


# Residual imbalance energy settlement scenarios for variable energy resources

Scenario 2a: Economic bidder and forecast increase (no LMP change)

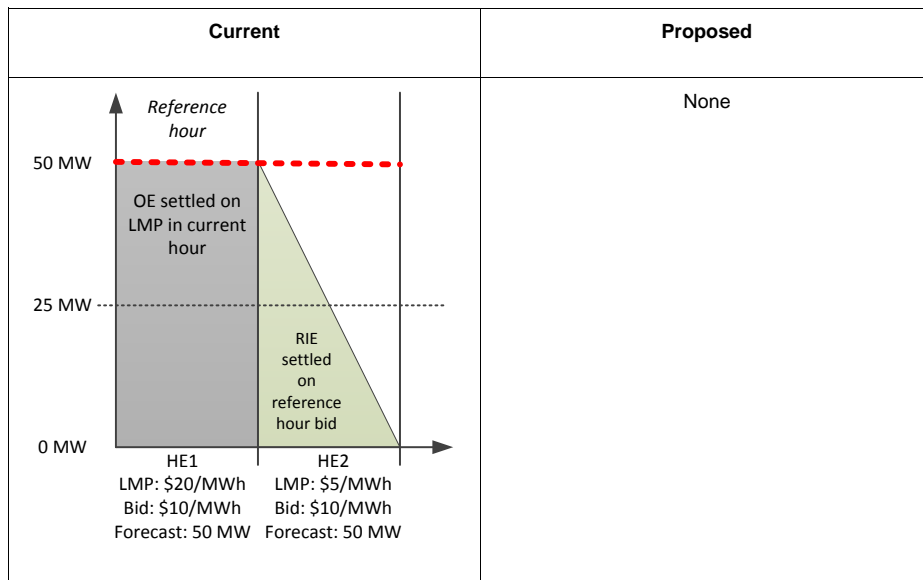


Scenario 2b: Economic bidder and forecast decrease (no LMP change)

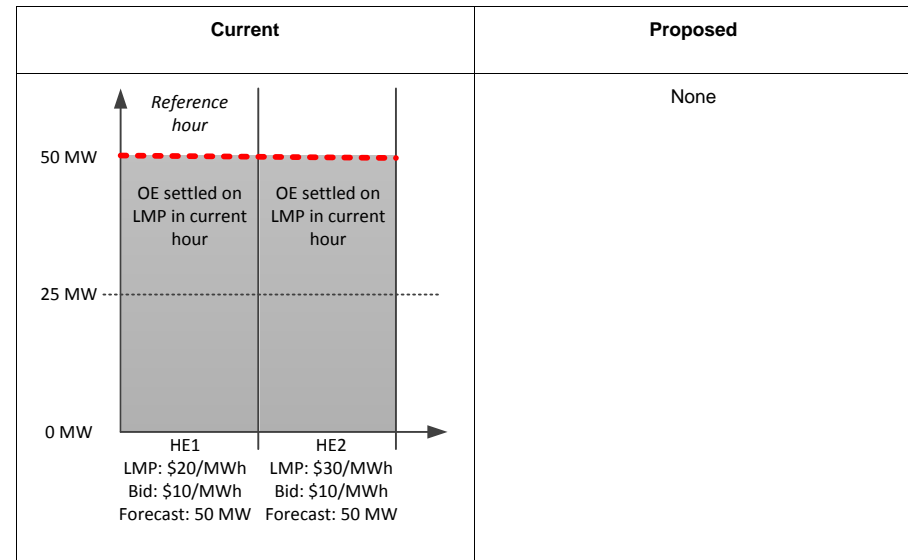


# Residual imbalance energy settlement scenarios for variable energy resources

**Scenario 3a: Economic bidder and LMP less than bid (no forecast change)**

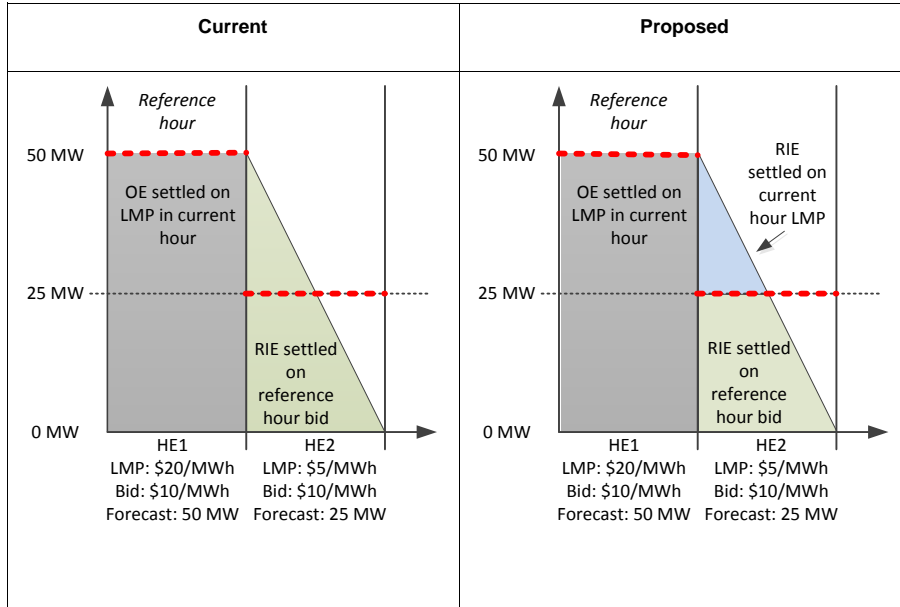


**Scenario 3b: Economic bidder and LMP higher than bid (no forecast change)**

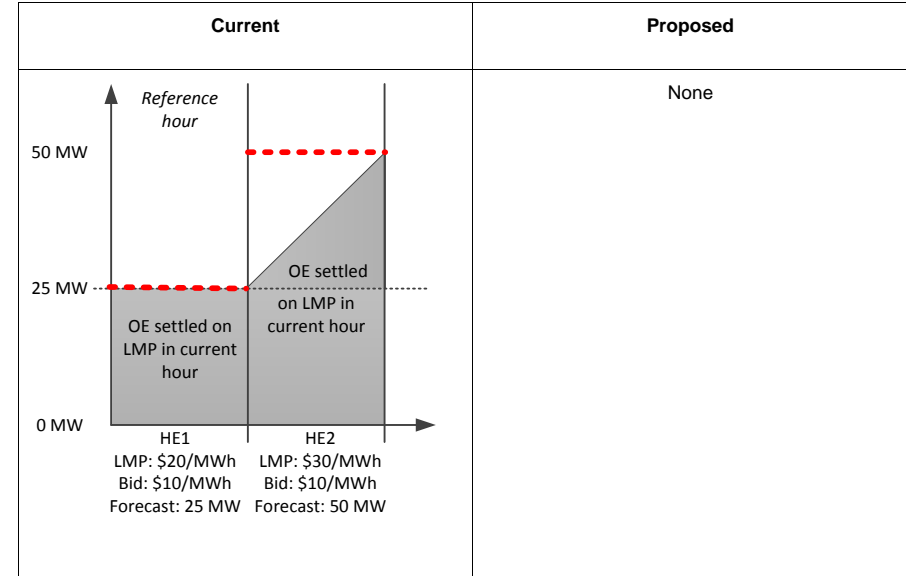


# Residual imbalance energy settlement scenarios for variable energy resources

**Scenario 4a: Economic bidder and LMP less than bid and forecast decrease**

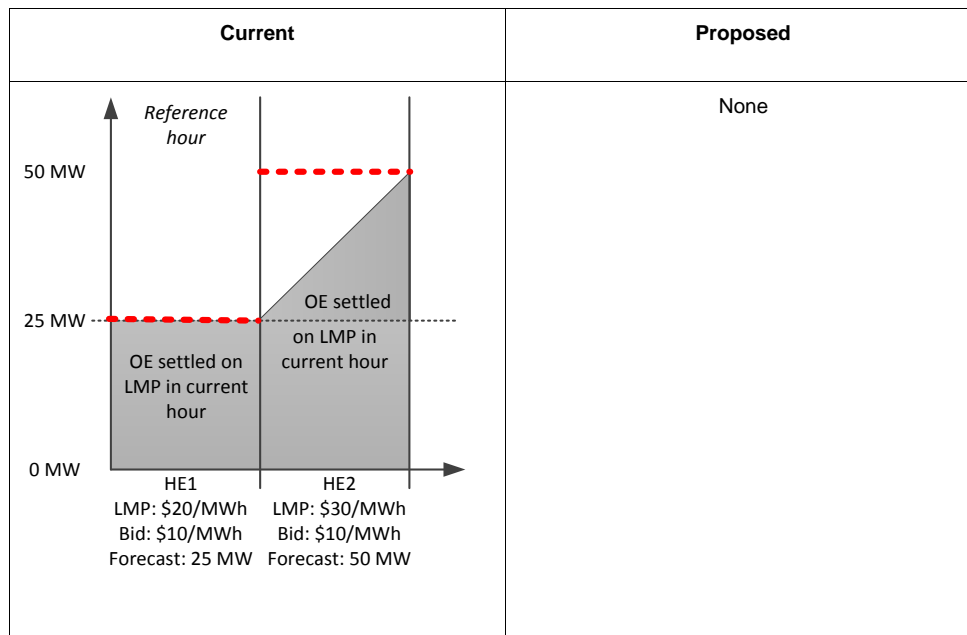


**Scenario 4b: Economic bidder and LMP higher than bid and forecast increase**

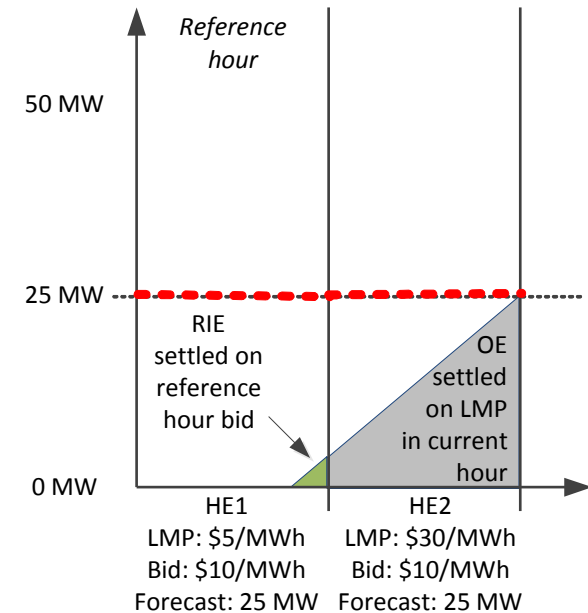


# Residual imbalance energy settlement scenarios for variable energy resources

**Scenario 4b: Economic bidder and LMP higher than bid and forecast increase**



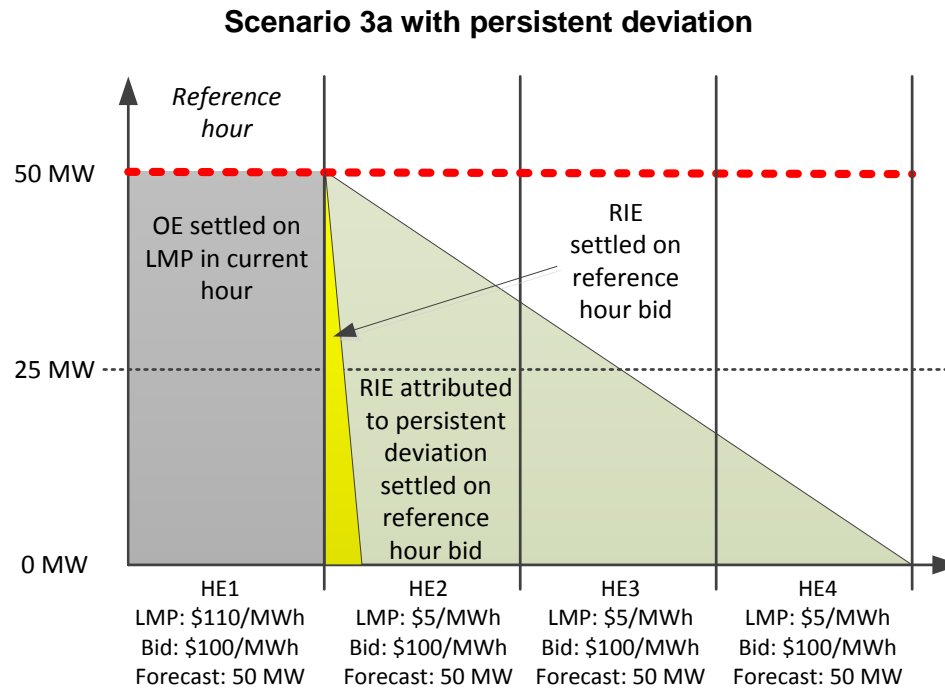
*Economic bidder and LMP higher than bid  
Additional example not in paper (no proposed  
change from current settlement)*



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# Persistent deviation metric for economically bidding VERs (example 1)



# Persistent deviation metric for economically bidding VERs (example 2)

## Illustrative deviation from day-ahead schedule

Market	Bid cost	Revenue	Rev minus Cost	BCR?
Day-ahead	100 MW x $-\$1/\text{MWh} =$ $-\$100/\text{h}$	100 MW x $\$3/\text{MWh} =$ $\$300/\text{h}$	$\$300 - (-\$100) =$ $\$400$	No
Real-time	$-90 \text{ MW} \times -\$1/\text{MWh} =$ $\$90/\text{h}$	$-90 \text{ MW} \times \$5/\text{MWh} =$ $-\$450/\text{h}$	$-\$450 - \$90 =$ $-\$540$	Yes



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# Default energy bids for economic bidding variable energy resources

- Clarify existing policy:
  - All resources should provide information to calculate DEB
  - Default is variable cost option (if resource selected LMP-based option, variable cost will be used until the LMPs are established)
- Market Surveillance Committee discussion (April 17<sup>th</sup>)
  - Alternative methods to calculating DEBs for VERs

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# Day-ahead metered energy adjustment factor

- Issue statement:
  - The current formula may produce a ratio between 0 and 1 even when the resource is not officially “On” (*i.e.*, below  $P_{min}$ ). A resource not “On” should not have a factor greater than zero.
  - The current formula will produce a zero ratio even if the resource is following dispatch instructions, such as decrementing to  $P_{min}$ . A resource following dispatch, even to  $P_{min}$ , should have a factor equal to one.
  - The current formula relies on absolute value calculations, which mask when a resource is far below its  $P_{min}$  and should have a factor equal to zero.

# Day-ahead metered energy adjustment factor

- Proposed solution:
  - The proposed enhancements define certain boundary scenarios before the actual factor is applied.
  - The absolute value calculation has been removed from the formula.
  - All proposed changes will apply going forward.

# Day-ahead metered energy adjustment factor

Step	Conditions and Actions
[1]	<p>If (Expected <u>Energy</u><sup>i</sup> <math>\geq</math> DA Minimum Load Energy) and Expected Energy <math>&gt; 0</math></p> <p>Then</p> <p>    If ((Metered Energy – Regulation Energy <math>&lt;</math> DA Minimum Load Energy – Tolerance Band) Or (Metered Energy – Regulation Energy <math>\leq 0</math>))</p> <p>    Then</p> <p>        DA MEAF = 0</p>

*i. The term Expected Energy, for purpose of the calculations in the following tables, is defined to be the minimum of the real-time expected energy and the day-ahead expected energy.*

# Day-ahead metered energy adjustment factor

	200 MW Pmax			
	3% Tolerance band percentage			
	6 MW Tolerance band			
	<b>(MW)</b>	<b>1a</b>	<b>1b</b>	<b>1c</b>
	Metered energy (ME)	40	0	10
	Regulation energy (Reg)	0	0	0
	DA minimum load energy (DA MLE)	50	50	50
	Tolerance band	6	6	6
	PM Tolerance	7	7	7
	Expected energy (EE)	50	50	75
	DA scheduled energy (DA SE)	50	50	75
<b>Step 1</b>				
	ME - Reg	40	0	10
	DA MLE-Tolerance Band	44	44	44
<b>NEW</b>	<b>If (ME - Reg) &lt; (DA MLE - Tolerance Band), then DA MEAF = 0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Current</b>	$\min(1, \text{abs}((\text{ME} - \text{DA MLE} - \text{Reg}) / ((\min(\text{EE}, \text{DA SE}) - \text{DA MLE})))$	0	0	1

# Day-ahead metered energy adjustment factor

Step	Conditions and Actions
[2]	<p>Else</p> <p>If (Abs (Metered Energy – Regulation Energy - Expected Energy) &lt;= Performance Metric Tolerance)</p> <p>Then</p> <p>DA MEAF = 1</p>





# Day-ahead metered energy adjustment factor

Step	Conditions and Actions
[3]	<p>Else (noting from Step 1 that Expected Energy should be <math>\geq</math> DA Minimum Load Energy here, first test to determine if Expected Energy = DA Minimum Load Energy to avoid a divide by zero condition in the next "Else" statement below...)</p> <p style="padding-left: 40px;">If (Expected Energy – DA Minimum Load Energy <math>\leq</math> Zero Tolerance<sup>ii</sup>)</p> <p style="padding-left: 40px;">Then</p> <p style="padding-left: 80px;">DA MEAF = 1</p>

ii. The term Zero Tolerance is a constant that equals the (very small) number  $1 \times 10^{-10}$ .



# Day-ahead metered energy adjustment factor

Step	Conditions and Actions
[4]	<p>Else</p> <p>If (Metered Energy – Regulation Energy &lt; DA Minimum Load Energy)</p> <p>Then</p> <p>(over the range for which DA Minimum Load Energy &gt; Metered Energy – Regulation Energy &gt;= DA Minimum Load Energy – Tolerance)</p> <div style="border: 1px solid black; background-color: yellow; padding: 5px; width: fit-content; margin: 10px auto;"> <math display="block">\text{Min} \left[ 1, \text{Max} \left( 0, \left( \frac{\text{Metered Energy} - \text{DA Minimum Load Energy} - \text{Regulation Energy} + \text{Tolerance Band}}{\text{Expected Energy} - \text{DA Minimum Load Energy}} \right) \right) \right]</math> </div> <p>Else</p> $\text{Min} \left[ 1, \text{Max} \left( 0, \left( \frac{\text{Metered Energy} - \text{DA Minimum Load Energy} - \text{Regulation Energy}}{\text{Expected Energy} - \text{DA Minimum Load Energy}} \right) \right) \right]$ <p>End if</p> <p>End if</p> <p>End if</p> <p>End if</p>

Formula is redundant.  
Will remove from proposal.

# Day-ahead metered energy adjustment factor

(MW)	1a	1b	1c	2a	2b	3	4a	4b	4c
Metered energy (ME)	40	0	10	45	96	60	60	75	120
Regulation energy (Reg)	0	0	0	0	0	0	0	0	0
DA minimum load energy (DA MLE)	50	50	50	50	50	50	50	50	50
Tolerance band	6	6	6	6	6	6	6	6	6
PM Tolerance	7	7	7	7	7	7	7	7	7
Expected energy (EE)	50	50	75	50	100	50	100	100	100
DA scheduled energy (DA SE)	50	50	75	50	100	50	100	100	100
<b>Step 1</b>									
ME - Reg	40	0	10	45	96	60	60	75	120
DA MLE-Tolerance Band	44	44	44	44	44	44	44	44	44
<b>NEW</b> If (ME - Reg) < (DA MLE - Tolerance Band), then DA MEAF = 0	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a
<b>Current</b> $\min(1, \text{abs}((\text{ME} - \text{DA MLE} - \text{Reg}) / ((\min(\text{EE}, \text{DA SE}) - \text{DA MLE}))))$	0	0	1	0	1	0	0.2	0.5	1
<b>Step 2</b>									
Abs(ME - Reg - EE)				5	4	10	40	25	20
PM Tolerance				7	7	7	7	7	7
<b>NEW</b> If (abs(ME-Reg-EE)<=PM Tolerance, then DA MEAF =1				1	1	n/a	n/a	n/a	n/a
<b>Current</b> $\min(1, \text{abs}((\text{ME} - \text{DA MLE} - \text{Reg}) / ((\min(\text{EE}, \text{DA SE}) - \text{DA MLE}))))$	0	0	1	0	1	0	0.2	0.5	1
<b>Step 3</b>									
EE - DA MLE						0	50	50	50
Zero tolerance						1E-10	1E-10	1E-10	1E-10
<b>NEW</b> If (EE - DA MLE) < zero tolerance, then DA MEAF =1						1	n/a	n/a	n/a
<b>Current</b> $\min(1, \text{abs}((\text{ME} - \text{DA MLE} - \text{Reg}) / ((\min(\text{EE}, \text{DA SE}) - \text{DA MLE}))))$	0	0	1	0	1	0	0.2	0.5	1
<b>Step 4</b>									
ME - DA MLE - Reg							10	25	70
EE - DA MLE							50	50	50
<b>NEW</b> $\text{Min}(1, \text{max}(0, (\text{ME} - \text{DA MLE} - \text{Reg}) / (\text{EE} - \text{DA MLE})))$							0.2	0.5	1
<b>Current</b> $\min(1, \text{abs}((\text{ME} - \text{DA MLE} - \text{Reg}) / ((\min(\text{EE}, \text{DA SE}) - \text{DA MLE}))))$	0	0	1	0	1	0	0.2	0.5	1

# Day-ahead metered energy adjustment factor

Step	Conditions and Actions
[5]	<p><i>This condition occurs after all of the other IF, Else statements from above</i></p> <p>Else</p> <p style="padding-left: 40px;">If Expected Energy &gt;= 0</p> <p style="padding-left: 80px;">Then</p> <p style="padding-left: 120px;">DA MEAF = 1</p> <p style="padding-left: 80px;">Else</p> <p style="padding-left: 40px;">(for the case of a BCR-Eligible Resource such as a pump-storage device from which negative DA energy is expected)</p> <p style="padding-left: 40px;"><i>DA MEAF =</i></p> $\text{Min} \left[ 1, \text{Max} \left( 0, \frac{\text{Metered Energy}}{\text{Expected Energy}} \right) \right]$ <p style="padding-left: 40px;">End if</p> <p>End if</p>

This is the current formula for pumped storage and no changes are proposed. Included here for completeness.

# Summary of proposals

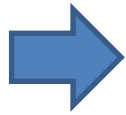
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# Tariff clarifications following market issues bulletin

- [Forthcoming]
  - Additional tariff clean-ups may be needed to address older sections such as 34.17.4 and 34.17.5, which are long-standing tariff provisions that precede the Spring 2014 release and were not modified with the adoption of the new settlement rules for residual imbalance energy on May 1, 2014.
  - Changes may be proposed in this policy stakeholder initiative or in the tariff stakeholder process.



# Next steps



Date	Event
Thu 4/9/15	Straw proposal posted
Wed 4/15/15	Stakeholder call
Thu 4/30/15	Stakeholder comments due
Wed 5/20/15	Draft final proposal posted
Wed 5/27/15	Stakeholder call
Wed 6/10/15	Stakeholder comments due on draft final proposal
Thu/Fri 7/16-7/17/15	Board of Governors meeting

The ISO will announce an additional working group session to review settlement examples. Examples will be posted before the session.

Please submit comments to [initiativecomments@caiso.com](mailto:initiativecomments@caiso.com)