

Attachment P

Energy Bid Caps

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P Energy Bid Caps

This attachment discusses the following topics:

- Energy bid caps for all resource types that can submit energy bids into the CAISO markets, and treatment of energy bids in excess of the Soft Energy Bid Cap (\$1,000/MWh).
- Calculation and application of the Maximum Import Bid Price in the CAISO's market processes.
- Examples to illustrate how the energy bid cap is applied under various conditions.

P.1 Energy Bid Caps

For applicable resource types, the energy bid cap for energy bids into the CAISO markets may be set between \$1,000/MWh and \$2,000/MWh on an hourly basis depending on two specific market conditions:¹

1. Whether the CAISO-calculated Maximum Import Bid Price (MIBP)² exceeds \$1,000/MWh for the trade hour in question, or
2. Whether the CAISO has accepted a cost-verified energy bid from a resource-specific resource above \$1,000/MWh for the trade hour in question.

Energy bid caps by resource type

As explained in Table P.1 below, the energy bid cap differs depending on which types of resources are submitting energy bids. The CAISO's systems determine the energy bid cap on an hour-by-hour basis, so the market conditions are assessed separately for each hour and the energy bid cap is determined based on that assessment. There are effectively two scenarios that can exist: situations when the energy bid cap remains at \$1,000/MWh (scenario A) or situations when the energy bid cap exceeds \$1,000/MWh (scenario B).

¹ References to the energy bid cap generally refer to the soft energy bid cap, as the hard energy bid cap of \$2,000/MWh is fixed.

² The calculation of the MIBP is discussed in greater detail in the next section.

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Table P.1 Energy Bid Caps per Resource Type

Resource Type	Market Conditions	Energy bid cap Details
Resource-Specific Resources (i.e. generators, Participating Load)	N/A	<p>At any time, resource-specific resources may submit bids above \$1,000/MWh and up to \$2,000/MWh. However, bids above \$1,000/MWh must be cost-justified through the submission of a Reference Level Change Request to the resource's Default Energy Bid (DEB).</p> <p>Bids above \$1,000/MWh will be reduced to the higher of \$1,000/MWh and the resource's Revised DEB as modified by an approved Reference Level Change Request. The Revised DEB cannot exceed \$2000/MWh, meaning that the CAISO will reject bids that are submitted above \$2,000/MWh.</p> <p>The Reference Level Change Request process is explained in greater detail in Attachment O. Note that manual and automated Reference Level Change Requests differ by time granularity: approved manual requests apply to the entire trade date/market, whereas automated requests apply only to specific trade hours.</p>
Non-Resource-Specific System Resources that are Resource Adequacy (RA) (i.e. RA imports)	<p>Scenario A:</p> <ul style="list-style-type: none"> - CAISO-calculated MIBP does not exceed \$1,000/MWh for the applicable trade hour, <u>and</u> - CAISO has not accepted a cost-verified energy bid above \$1,000/MWh for the applicable trade hour 	These resources can submit bids up to \$1,000/MWh.
	<p>Scenario B:</p> <ul style="list-style-type: none"> - CAISO-calculated MIBP exceeds \$1,000/MWh, <u>or</u> - CAISO has accepted a cost-verified energy bid above \$1,000/MWh, for the applicable trade hour 	For the applicable trade hour, these resources can submit bids above \$1,000/MWh. Bids above \$1,000/MWh will be reduced to the greater of the MIBP or the highest-priced energy bid from a Resource-Specific System Resource. The MIBP or the highest-priced energy bid cannot exceed \$2000/MWh, meaning that the CAISO

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		will reject bids that are submitted above \$2,000/MWh.
Non-Resource-Specific System Resources that are not RA (i.e. imports and exports)	Scenario A: - CAISO-calculated MIBP does not exceed \$1,000/MWh for the applicable trade hour, <u>and</u> - CAISO has not accepted a cost-verified energy bid above \$1,000/MWh for the applicable trade hour	These resources can submit bids up to \$1,000/MWh.
Virtual Resources		
Exports	Scenario B: - CAISO-calculated MIBP exceeds \$1,000/MWh, <u>or</u> - CAISO has accepted a cost-verified energy bid above \$1,000/MWh for the applicable trade hour	For the applicable trade hour, these resources can submit bids up to \$2,000/MWh.
Demand Resources (i.e. Non-Participating Load)		
Non-Generating Resources (NGRs)	Scenario A: - CAISO-calculated MIBP does not exceed \$1,000/MWh for the applicable trade hour, <u>and</u> CAISO has not accepted a cost-verified energy bid above \$1,000/MWh for the applicable trade hour	These resources can submit bids up to \$1,000/MWh.
	Scenario B: - CAISO-calculated MIBP exceeds \$1,000/MWh, <u>or</u> - CAISO has accepted a cost-verified energy bid above \$1,000/MWh for the applicable trade hour	These resources can submit bids up to \$1,000/MWh. ³

³ Energy bids submitted by resource-specific resources that exceed \$1000/MWh must be cost-verified. Because the CAISO does not currently have the ability to cost verify the energy bids of NGRs, these resources are subject to the Soft Energy Bid Cap of \$1,000/MWh.

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Under scenario B, the energy bid cap also differs slightly between the Day-Ahead market (DAM) and the Real Time market (RTM).

- For the Day-Ahead market (DAM), the energy bid cap will be increased for any hour in which the DAM MIBP exceeds \$1,000/MWh or any hour in which the CAISO accepts a DAM cost-verified energy bid greater than \$1,000/MWh.
- Similarly, for the Real-Time market (RTM), the energy bid cap will be increased for any hour in which the RTM MIBP exceeds \$1,000/MWh or any hour in which the CAISO accepts a RTM cost-verified energy bid greater than 1,000/MWh. The energy bid cap in the RTM will be also be increased for the hours that were increased in the DAM.

Communications regarding increases to the energy bid cap

The CAISO will communicate to Scheduling Coordinators in its bidding platform, SIBR, when the energy bid cap has been raised from \$1,000/MWh to \$2,000/MWh for each trading hour. The energy bid cap can differ on an hourly basis and by market, so the communication specifies the trade hours and market for which the energy bid cap has been increased. There are also situations when the energy bid cap could have been increased above \$1,000/MWh, then is subsequently revised down to \$1,000/MWh before the market closes. This will be communicated to Scheduling Coordinators as well.

Because of these time constraints, this communication will be provided as soon as feasible prior to the applicable market close. The energy bid cap is dependent on the submission of cost-verified bids and cost-verified bids can be submitted up to market close. In situations where cost-verified bids are submitted near to market close, the CAISO will consider whether to keep the market bidding period open when feasible.⁴ The examples in section P.3 include details of various scenarios.

After-market cost recovery of costs that exceed the hard bid caps

The Scheduling Coordinator may determine that their incremental energy costs or minimum load costs exceed the Hard Energy Bid Cap (\$2,000/MWh) or the Minimum Load Cost Hard Cap (\$2,000 per Pmin MW per hour), respectively. In such cases, the SC may be eligible for after-the-fact cost recovery. To be eligible, SCs must follow the After-Market Cost Recovery Request

⁴ Because of the tight time constraints in the RTM, it is not feasible to keep the bidding window open past the typical RTM market close for each hour.

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process in Attachment O.3. Because that process relies on the ability to verify a resource's costs, only resource-specific resources can recover such costs.

Per Attachment O.3, requests must be submitted within 30 business days after the operating day on which the resource incurred the unrecovered costs. Please refer to Attachment O.3.1 for more information on the specific items that should be submitted with this request and how the CAISO will apply the revised costs in its post-processing systems.

P.2 Maximum Import Bid Price Calculation

The Maximum Import Bid Price (MIBP) is intended to approximate the prevailing energy prices outside the CAISO's BAA on an hourly basis, and is used to screen bids from specific resource types that are submitted in excess of the Soft Energy Bid Cap of \$1,000/MWh. If the MIBP is calculated above the Soft Energy Bid Cap, bids for Non-Resource-Specific Non-Resource Adequacy imports, demand/non-participating load, exports, virtual resources, and Non-Resource-Specific Resource Adequacy imports will be subject to the logic outlined in section P.1.

The MIBP is also used to calibrate market penalty prices in conjunction with the availability of a cost-verified energy bid. More information about the market penalty prices can be found in the Market Operations BPM Section 6.6.5.

The CAISO calculates the Maximum Import Bid Price separately for the DAM and RTM for the applicable on-peak and off-peak hours. If for any reason the CAISO is unable to calculate the MIBP for a specific trade date and/or market, the CAISO will use the most recently available calculated MIBP.

The CAISO calculates the Maximum Import Bid Price (MIBP) as an index-based price multiplied by an hourly shaping factor and a multiplier of 110%.

The Maximum Import Bid Price (MIBP) is calculated as:

$$\text{MIBP} = (\text{Electric Hub Price} * \text{Hourly Energy Price Shaping Factor}) * 1.1$$

Where:

Electric Hub Price = max(Mid-C, PV DA bilateral price)

Hourly Energy Price Shaping Factor = $1 + \frac{\text{CAISO Hourly DA SMEC} - \text{CAISO Average DA SMEC}_{\text{on or off-peak hrs}}}{\text{CAISO Average DA SMEC}_{\text{on or off-peak hrs}}}$

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The Electric Hub Price represents day-ahead (DA) bilateral electric price data from the Mid-Columbia (Mid-C) and Palo Verde (PV) hubs, for both peak and off-peak periods.⁵ The higher of each hub price for both peak and off-peak periods is used in the calculation.

The Hourly Energy Price Shaping Factor is calculated using the CAISO day-ahead system marginal energy cost (DA SMEC) for both the applicable trade date and for a recent high-priced day, where at least one hour of CAISO DA SMEC exceeds \$200/MWh. The logic for finding the recent high-priced day is explained below.

Example of MIBP Calculation:

This example will review the steps for calculating the Day-Ahead Maximum Import Bid Price for sample trade date 9/25/2020.

1. Select the maximum of the Mid-C and PV electric hub prices for each on-peak and off-peak period that apply for the trade date for which the CAISO is performing the MIBP calculation. In this example, the Mid-C on-peak price and PV off-peak price will be used in the calculation.

CAISO Trade Date	Hub/TOU	Price (\$/MWh)
9/25/2020	Mid-C DA On-Peak	150
9/25/2020	Mid-C DA Off-Peak	75
9/25/2020	PV DA On-Peak	120
9/25/2020	PV DA Off-Peak	90

2. Select the most recent high-priced day within the applicable season. For the MIBP calculation, the Summer Season is April 1 – October 31 and the Winter Season is November 1 – March 31. For the applicable season in which the trade date of the calculation falls, choose the most recent day from the trade date in which any hour of the DA SMEC exceeded \$200/MWh.⁶ This is considered the most recent high-priced day. If there is no day within the

⁵ For the DAM calculation, the day-ahead electric hub index prices are a snapshot of the volume weighted average electric hub prices from the Intercontinental Exchange (ICE). The CAISO captures these prices on non-holiday weekdays between 8 AM – 9 AM Pacific Time. If the ICE electric hub prices are not available between 8 AM – 9 AM Pacific Time for the DAM calculation for any reason, the CAISO will use the most recently available price. For the RTM calculation, the day-ahead electric hub index prices are obtained from the settled volume weighted average electric hub prices from ICE, available the evening prior to the trade date.

⁶ For days that are chosen as the most recent high-priced day but are designated as entirely off-peak (e.g. Sundays), the average of all off-peak hours is taken to formulate the average DA SMEC for off-peak. The next most recent day where an on-peak hour is above \$200/MWh is found and the average of those on-peak hours are taken to formulate the average DA SMEC for on-peak.

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season in which DA SMEC prices exceed \$200/MWh, the CAISO looks back to the same season in the previous year and up to three previous years in order to find the most recent high-priced day above \$200/MWh. If no such day exists within the three previous years, choose the next highest-priced day within the current season.

In this example, the applicable season is summer because the trade date is within April 1 – October 31. The most recent high-price day is 9/15/2020, where hour 19 DA SMEC was \$215/MWh.

3. Next, take the average DA SMEC for each on-peak and off-peak periods. For this example, the average on-peak DA SMEC is \$58.47/MWh and the average off-peak DA SMEC is \$36.29/MWh. The average taken is a simple hourly average that doesn't consider the MWh volume of energy traded on the day in question.
4. Source the hourly DA SMEC for the trade date, 9/25/2020. Both the DAM and RTM calculations use the most recently available DA SMEC values. In this example, the MIBP is being calculated for DAM TD 9/25/2020. The calculation occurs the morning prior to the trade date, before the DAM has closed and produced DA SMEC prices for trade date 9/25/2020. So, the next most recent DA SMEC values from the previous trading day are used. In this example, the 9/24/2020 DA SMEC price for HE 20 is \$380/MWh.
5. Calculate the Hourly Shaping Factor for each hour of the trade date. A sample calculation for HE 20 is shown below:

$$\text{Hourly Shaping Factor}_{\text{HE20}} = 1 + \frac{380 - 58.47}{58.47} = 6.499$$

2. Calculate the final MIBP by multiplying the Hourly Shaping Factor and the on-peak or off-peak bilateral electric price from step 1, then multiplying by a scaling factor set to 1.1 for this example. A sample calculation for HE 20 is shown below:

$$\text{MIBP}_{\text{HE20}} = 6.499 * \$150/\text{MWh} * 1.1 = \$1072.33/\text{MWh}$$

For DAM 9/25/2020, the calculated Hourly Shaping Factor and MIBP are shown at an hourly granularity below. For this example, the MIBP will exceed \$1,000/MWh for hours 19 and 20.

Hour-ending	Peak flag	DA SMEC (\$/MWh)	Hourly Shaping Factor	Electric Hub Price (\$/MWh)	MIBP (\$/MWh)
1	Off-Peak	28	0.772	90.00	76.39
2	Off-Peak	30	0.827	90.00	81.85
3	Off-Peak	31	0.854	90.00	84.58

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4	Off-Peak	33	0.909	90.00	90.04
5	Off-Peak	31	0.854	90.00	84.58
6	On-Peak	37	0.633	150.00	104.41
7	On-Peak	40	0.684	150.00	112.88
8	On-Peak	41	0.701	150.00	115.70
9	On-Peak	40	0.684	150.00	112.88
10	On-Peak	46	0.787	150.00	129.81
11	On-Peak	45	0.770	150.00	126.99
12	On-Peak	40	0.684	150.00	112.88
13	On-Peak	47	0.804	150.00	132.63
14	On-Peak	75	1.283	150.00	211.64
15	On-Peak	80	1.368	150.00	225.75
16	On-Peak	120	2.052	150.00	338.63
17	On-Peak	125	2.138	150.00	352.74
18	On-Peak	250	4.276	150.00	705.48
19	On-Peak	400	6.841	150.00	1128.77
20	On-Peak	380	6.499	150.00	1072.33
21	On-Peak	290	4.960	150.00	818.36
22	On-Peak	150	2.565	150.00	423.29
23	Off-Peak	140	3.858	90.00	381.97
24	Off-Peak	100	2.756	90.00	272.83

P.3 Examples

DAM examples included herein cover scenarios that may occur prior to the close of the DAM on the morning prior to the trade date. RTM examples cover scenarios that may occur prior to the close of the first hour's RTM market run (e.g., 75 minutes prior to the hour); however, the RTM examples can be applicable to any hour in the RTM. The following examples are not meant to cover every scenario that may occur between DAM and RTM, but are meant to illustrate how the energy bid cap may be raised between markets.

This section also focuses primarily on the energy bid caps for imports because the energy bid caps do not change for resource-specific resources (including NGRs) depending on the MIBP or the cost-verified bids of other resources.

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The Market Operations BPM section 6.6.5.1 contains examples that describe how penalty prices are set for the DAM and RTM depending on the applicable market conditions (e.g., value of MIBP, price of highest cost-verified bid).

Example 1: DAM MIBP exceeds \$1,000/MWh

For the trade date, the DAM MIBP is calculated as \$1,250/MWh for only HE 19. There are no cost-verified DAM energy bids in excess of \$1,000/MWh for any hour.

Result: The energy bid cap is raised to \$2,000/MWh in both the DAM and RTM for HE 19; the CAISO will indicate to participants the bid cap has been raised for HE 19 in both markets, prior to the close of each respective market.

- RA imports can submit DAM and RTM energy bids up to the MIBP of \$1,250/MWh for HE 19
- Non-RA imports, exports, virtual bids, and demand resources can submit DAM and RTM energy bids up to \$2,000/MWh for HE 19

Example 2: RTM cost-verified bid above \$1,000/MWh

For the trade date, the RTM MIBP does not exceed \$1,000/MWh for any hours. There is a RTM cost-verified bid of \$1,400/MWh for HE 17 through 20.

Result: The energy bid cap is raised to \$2,000/MWh in the RTM for HE 17 through 20; the CAISO will indicate to participants the bid cap has been raised for HE 17-20 in RTM, prior to the close of each RTM hour.

- RA imports can submit RTM bids up to \$1,400/MWh for HE 17-20
- Non-RA imports, exports, virtual bids, and demand resources can submit RTM energy bids up to \$2,000/MWh for HE 17-20.

Example 3: DAM and RTM MIBP exceed \$1,000/MWh, DAM and RTM cost-verified bids above \$1,000/MWh

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For the trade date, the DAM MIBP is calculated as \$1,250/MWh for HE 17 and there is a DAM cost-verified energy bid of \$1,100/MWh for HE 14. Later on, the RTM MIBP is calculated as \$1,300/MWh for HE 18 and \$1,325/MWh for HE 19, and there is an RTM cost-verified energy bid of \$1,500/MWh for HE 19.

Result: The energy bid cap is raised to \$2,000/MWh in the DAM for HE 14 and 17. The energy bid cap is raised to \$2,000/MWh in the RTM for HE 14, 17, 18, and 19. The CAISO will indicate to participants the bid cap has been raised for the affected hours in both markets, prior to the close of each respective market.

- RA imports can submit:
 - o DAM energy bids up to \$1,100/MWh for HE 14 and up to \$1,250/MWh for HE 17
 - o RTM energy bids up to \$1,100/MWh for HE 14, up to \$1,250/MWh for HE 17, up to \$1,300/MWh for HE 18, and up to \$1,500/MWh for HE 19.
- Non-RA imports, exports, virtual bids, and demand resources can submit DAM energy bids up to \$2,000/MWh for HE 14 and 17, and can submit RTM energy bids up to \$2,000/MWh for HE 14 and 17 through 19.

Example 4: DAM cost-verified bid above \$1,000/MWh, then revised down below \$1,000/MWh

For the trade date, the DAM MIBP does not exceed \$1,000/MWh for any hour. There is only one DAM cost-verified bid of \$1,200/MWh for HE 15. However, prior to the DAM market close, the SC revises the bid down to \$900/MWh.

Result: For the short time in which the \$1,200/MWh bid is effective, the energy bid cap is raised to \$2,000/MWh in the DAM and RTM for HE 15. However, when the bid is revised down to \$900/MWh, the energy bid cap is lowered back to \$1,000/MWh in the DAM and RTM for HE15. At this point, any bids submitted above \$1,000/MWh will be invalidated and will need to be resubmitted at or below \$1,000/MWh. The CAISO's communication to participants regarding changes to the energy bid cap will reflect these changes as soon as practicable.