

N Opportunity Cost Calculation for Use-Limited Resources

Pursuant to Section 30.4.1.1.6 and Appendix A of the CAISO Tariff, a Use-Limited Resource is defined as a resource that meets all three of the following conditions:

- Has one or more limitation affecting its number of starts, run-hours, or energy output due to design considerations, environmental restrictions on operations, or qualifying contractual limitations.¹
- Cannot reflect the limitation within the market optimization horizon (e.g., monthly limitations that extend beyond the day-ahead market 24-hour horizon).
- Can select hours of operation, and is not dependent on an energy source outside of the resource's control.

The inclusion of an opportunity cost adder to the commitment costs or the default energy bid (DEB) is intended to ensure a more efficient participation of Use-Limited Resources in the CAISO market. The CAISO will perform opportunity cost adders on a monthly basis. If for any reason the CAISO cannot perform the opportunity cost calculation for a resource for the upcoming month, the CAISO will perform its processes subject to schedule in Section N.3.

N.1 Eligibility for Opportunity Cost Adder

The Use-Limited Resource designation in the Master File (MF) allows the Scheduling Coordinator (SC) to be eligible to establish an opportunity cost adder to its start-up, transition, and/or minimum load commitment cost bid caps under the proxy cost option² and/or to its default energy bid under the variable cost option, with the exception of resources with use limitations that have a daily granularity. The calculated or negotiated opportunity cost adder methodology will be filed at FERC when initially established. Resources under negotiated rate option for the default energy bid filed prior to April 1, 2019 are not eligible for opportunity cost adders for any component of the three-part bid.

If the resource and its limitations can be modeled as an energy output, start, or run-hour limitation applicable on a monthly, annual, or rolling-12 month period, the opportunity cost adder will be determined by modeling the market commitment of the resource based on projected LMPs. Section N.2 below has details of the opportunity cost model. Use-Limited Resources

¹ Qualifying contractual limitations will only be accepted as an eligible use limitation until November 2021 as a transitional measure.

² Commitment cost bid caps include the start-up bid cap, transition bid cap, and minimum load bid cap, as a function of which use-limit type is associated with the resource.

with limitations that cannot be modeled utilizing the method described below will be considered for a negotiated opportunity cost adder pursuant to Section N.4 below.

N.2 Methodology for Calculated-Based Opportunity Cost Adders

The opportunity cost model will be able to model limitations on the number of starts, run-hours, and/or energy output in MWh. Limitations may be applicable for a month, year, or rolling-12 month period. A resource with more than one limitation type which can be modeled will have a calculated opportunity cost for each limitation type. Each modeled limitation has two components that will be submitted in the Use Limit Plan Data Template (ULPDT):

- **Limitation type:** This refers to the operating component which is limited as registered in the ULPDT as the use limit type, i.e., starts, run-hours, or energy output.
 - **Start-up limitation:** The calculated opportunity cost for a limitation on the number of start-ups will be determined by the estimated profits foregone if the resource had one less start in the relevant time period. This will be a \$/start-up value.
 - **Run-hour limitation:** The calculated opportunity cost for a limitation on the number of run-hours will be determined by the estimated profits foregone if the resource had one less run-hour in the relevant time period. This will be a \$/hour value.
 - **Energy/Output limitation:** The calculated opportunity cost for a limitation on the energy output of the resource will be determined by the estimated profits foregone if the resource had one less MWh to generate in the relevant time period. This will be a \$/MWh value added to every segment of the default energy bid calculated under the variable cost option. Opportunity cost will not be added to the negotiated rate option or locational marginal price option for the default energy bid.

- **Applicability:** This refers to the timeframe for which the limitation is applied as registered in the ULPDT as the granularity, i.e., monthly, annual, or rolling 12-month.

Table N.1 below provides an overview of the major components needed to calculate the opportunity cost adder, including the inputs, calculation procedures, outputs, and the usage of the outputs. As an input, the optimization model will rely on validated limitations registered in the ULPDT, Master File characteristics registered in the Generator Resource Data Template (GRDT), and pre-calculations for estimated costs for start-up, minimum load and energy, and forecasted LMPs. The details of the calculation of estimated costs and forecasted LMPs are provided in Section N.2.1 below. These inputs are used in a unit commitment optimization model to determine resource-specific opportunity cost adders for each registered limitation type of the resource. This cost is based on calculating the profit (or gross margin) that is foregone if one less start, one less operating hour, and/or one less MWh is available, as applicable. Lastly, the opportunity cost adder will be reflected in commitment cost bid caps under the proxy cost option or added to the resource's variable cost option for the default energy bid.

The opportunity cost calculator will be run on a monthly basis, in the month prior to the time period for which the resource limitations are applicable³. An opportunity cost will be calculated for each validated limitation that can be modeled.

Table N.1 Overview of Opportunity Cost Methodology

Model Input Submitted Values	Model Input Pre-Calculations	Opportunity Cost Calculation	Model Output
<ul style="list-style-type: none"> • Use limitations (ULPDT) • Resource characteristics (GRDT) • Actual market starts, run-hours, or energy output values incurred within the limitation period to account for remaining limitation availability. For example, if a resource has a registered limitation of 300 starts per year and has incurred the 100 market starts in the months of January-April, the OC calculation for the months of May-December will consider the available limitation as 300 starts minus 100 starts = 200 starts. 	<ul style="list-style-type: none"> • Estimated costs for start-up, transition (if applicable), minimum load, and energy calculated using MF parameters, future gas prices, and greenhouse gas (GHG) prices at resource’s pricing node (PNode) or aggregated PNode • Resource’s PNode or aggregated PNode forecasted LMPs calculated using historical LMPs and gas prices and a power price conversion factor based on future power prices. 	<p>Unit commitment model that maximizes resource’s profit over the validated limitation period (e.g., monthly) based on defined inputs and the reserve margin factor.</p> <p>This profit maximization model is run for the base case with the limitation applied versus a run with one limitation less use available (i.e., foregone profits of one less use).</p>	<p>Resource-specific opportunity cost adders for start-up, transition, minimum load, and energy, as applicable.</p> <p>The adders will be reflected in commitment cost bid cap(s) under proxy cost options or as an adder to resource’s DEB under variable cost option.</p>

N.2.1 Model Input for Opportunity Cost Calculation

As an input, the optimization model will rely on limitations provided to the CAISO through the Use-Limited Resource registration process in the ULPDT, Master File characteristics registered in the GRDT, and pre-calculations for estimated costs for start-up, minimum load and energy,

³ If for any reason the ISO cannot perform the opportunity cost calculation for a resource for the upcoming month, the ISO will perform its processes subject to schedule in Section N.3.

and forecasted LMPs. Each of these is discussed in more detail below.

N.2.1.1 Resource Characteristics and Limitations

The CAISO will rely on templates submitted to the ULPDT to determine the resource's validated limitation(s). The CAISO will also use Master File characteristics of the resource such as its minimum generation capacity (i.e., minimum load),⁴ maximum generation capacity (i.e., maximum load),⁵ minimum up time,⁶ and minimum down time.⁷ For a Multi-Stage Generating resource with a limitation on the number of starts, the implied starts registered in the GRDT will be used as the basis to count the number of resource starts. The documentation provided during the use-limited registration process should support the limit on starts in the ULPDT as well as the implied starts in the GRDT.

N.2.1.2 Estimated Costs

The model requires as inputs estimates of the monthly variable energy cost, minimum load cost, and start-up cost of the resource. Transition cost is derived as the difference of the start-up costs of the "TO-configuration" and the start-up costs of the "FROM-configuration" for feasible transitions. The commitment cost estimates are based on the proxy cost formulas as described in Attachment G.2 of the Business Practice Manual (BPM) for Market Instruments⁸ with adjustments necessary to forecast the costs for future months. The variable energy cost calculation will be megawatt-weighted and the cost based on the DEB formulation, or equivalent, as described in Attachment D of the BPM for Market Instruments.

In order to determine these future estimated costs for gas resources, a monthly futures gas price index is used. Depending on the specific fuel region, a future gas price index can be used from different providers such as ICE, Platts, SNL and NGI. The transportation cost will be calculated using the transportation cost configuration parameters that include fuel reimbursement rate, marginal transportation rate, cap-and-trade credits, and miscellaneous transportation costs in effect at the time of calculation. For resources with greenhouse gas obligations, the most recent daily greenhouse gas price available at the time of calculation will be used. These details will be documented in the opportunity cost filings made at FERC.

⁴ Generator Resource Data Template field MIN_GEN.

⁵ Generator Resource Data Template field MAX_GEN.

⁶ Generator Resource Data Template field MIN_ON.

⁷ Generator Resource Data Template field MIN_OFF.

⁸ Refer to Attachment G.2 for proxy cost formulas at <https://bpmcm.aiso.com/Pages/BPMDetails.aspx?BPM=Market Instruments>.

N.2.1.3 Forecasted LMP

The CAISO will generate hourly real-time prices for future months by calculating an hourly implied marginal heat rate at each Use-Limited Resource's PNode or aggregated PNode based on fifteen-minute real-time energy prices from the same hour the previous year.

The LMPs will be estimated by executing the following equations in the order shown below:

(1) For each future hour, calculate an hourly implied heat rate at each applicable PNode or aggregated PNode for a Use-Limited Resource based on the hourly average of the fifteen-minute real-time LMPs from the same hour the previous year, the greenhouse gas allowance price from the same day of the previous year, and the gas price index of the applicable fuel region from the same day of the previous year.

$$ImpHR_{k,y-1} = \frac{LMP_{k,y-1}}{GPI_{k,y-1} + (GHGas_{k,y-1} * EmRate)}$$

Where:

$LMP_{k,y-1}$ is the hourly average of the fifteen-minute real time energy price at PNode or aggregated PNode of resource (k) from the same hour of the previous year (y-1)

$GHGas_{y-1}$ is the daily greenhouse gas allowance price from the same day of the previous year (y-1)

$EmRate$ is the greenhouse gas content of natural gas, which is .0531148mtCO₂e/MMBtu₆

$GPI_{k,y-1}$ is the daily gas price index of the fuel region of resource k from the same day of the previous year, y-1

(2) For each future month, calculate a monthly future implied heat rate based on the applicable wholesale future power price of the applicable power-trading hub, the most recent greenhouse gas allowance price, and the natural gas future commodity price of the applicable fuel region.

$$ImpHRF_{k,m} = \frac{PPF_{k,H,m}}{NatGasF_{k,m} + (GHGas_{m-1} * EmRate)}$$

Where:

$PPF_{k,H,m}$ is the ICE future peak power price at power price hub (H) of resource (k) for future month (m) based on mapping each resource to a power trading hub based on the power price hub location. The mapping is found in the GRDT in the POWER_PRICE_HUB field.

$NatGasF_{k,m}$ is the natural gas futures price of the fuel region of resource (k) for month (m)

GHGas_{m-1} is the average greenhouse gas allowance price from the previous month (m-1)

EmRate is the greenhouse gas emissions rate per MMBtu of natural gas, which is .0531148mtCO₂e/MMBtu

(3) For each future month, calculate a monthly historical implied heat rate based on the wholesale historic power price of the applicable power trading hub for the same month in the previous year, the average greenhouse gas allowance price for the same month in the previous year, and the average natural gas commodity price of the applicable fuel region for the same month in the previous year.

$$ImpHRH_{k,m-12} = \frac{PPH_{k,H,m-12}}{NatGas_{k,m-12} + (GHGas_{m-12} * EmRate)}$$

Where:

PPH_{k,H,m-12} is the ICE future peak power price at the power price hub (H) of resource (k) from the same month of the previous year (m-12) based on mapping each resource to a power trading hub based on the power price hub location. The mapping is found in the GRDT in the POWER_PRICE_HUB field.

NatGas_{k,m-12} is the monthly average of daily natural gas price indices inclusive of transportation costs from the fuel region of resource (k) from the same month of the previous year (m-12)

GHGas_{m-12} is the monthly average greenhouse gas allowance price from the same month of the previous year (m-12)

EmRate is the greenhouse gas content of natural gas, which is .0531148mtCO₂e/MMBtu

(4) For each future month, calculate a monthly power price conversion factor as the ratio of the future implied heat rate calculated in (2) and the historical implied heat rate calculated in (3)

$$PPConv_{k,m} = \frac{ImpHRF_{k,m}}{ImpHRH_{k,m-12}}$$

(5) For each future hour, scale the hourly implied marginal heat rate calculated under equation (1) by the power price conversion factor calculated under equation (4).

(6) For each future hour, calculate the LMPs by applying the gas price index of the future month and the most recent greenhouse gas costs to the scaled implied heat rates calculated under equation (5).

$$LMP_{k,h} = ImpHR_{k,y-1} * PPConv_{k,m} * (GPIF_{k,m} + (GHGas_{m-1} * EmRate))$$

Where:

- $LMP_{k,h}$ is the estimated hourly real time price at resource's PNode (p) or aggregated PNode (A) represented as resource (k) for hour (h)
- $ImpHR_{k,y-1}$ is the calculated hourly implied heat rate at the resource PNode or aggregated PNode
- $PPConv_{k,m}$ is the calculated monthly power price conversion factor for each future month
- $GPIF_{k,m}$ is the Gas Price Index for the future month (m) for fuel region of resource (k)
- $GHGas_{m-1}$ is the average greenhouse gas allowance price from the previous month (m-1)
- $EmRate$ is the greenhouse gas content of natural gas, which is .0531148mtCO₂e/MMBtu

The result is a set of resource-specific estimated hourly real-time energy prices at the resource's PNode or aggregated PNode. These estimated prices will be used in the opportunity cost model, along with the estimated resource costs and characteristics to estimate the dispatch of the resource over the study time period.

N.2.2 Opportunity Cost Calculation

N.2.2.1 Optimization Model

The opportunity cost is the estimated profits foregone if the resource has one less start, one less run-hour, and/or one less MWh to generate. The foregone profit, or opportunity cost, is calculated as the difference between estimated profits of a "base" model run with all limitations enforced and the estimated profits from the case with a "limit" model run with the remaining limitation reduced by one. An adjustable reserve margin factor set at 90% also applies to the limitations. The CAISO will evaluate the corresponding application of this factor to the required constraints based on evaluation of the opportunity cost calculation results prior to production implementation and will consult with the corresponding Scheduling Coordinator on the applicability of this factor to any of the constraints. Based on the CAISO's evaluation of the opportunity costs calculation, certain constraints as pertaining to the condition of each specific resource can have the reserve margin set to 90%.

For example, if a resource has an annual limitation of 300 starts, the opportunity cost will be the non-negative difference in estimated profits of the following two model runs:

Base model run: Optimization model run with start limitation set to 270 per year (90% of 300)

Limit model run: Run the model with one less start, i.e., 269 starts per year

The resource profit is calculated using an optimization model which will estimate a resource's hourly dispatch, over a given study period, using estimated resource specific costs and characteristics against the forecasted hourly LMPs. The objective cost of the optimization model is to maximize the profit over the study period, where the profit is calculated as the difference in revenue and costs. The formulation of the profit maximizing objective cost function based on hourly prices is as follows:

$$\begin{aligned} \text{Max } \pi_w = & \sum_{h=1}^n \left\{ \sum_{k=1}^b \langle (\text{Online}_{h,k} * [(LMP_{k,h} * MWh_{k,h}) - (VEC_{k,m} * (MWh_{k,h} - Pmin_k)) - MLC_{k,m}]) \right. \\ & \left. - (\text{Starting}_{k,h} * SUC_{m,g,k}) \rangle - \sum_{p=1}^c \langle \text{Transitioning}_{h,p} * TC_{m,p} \rangle \right\} \end{aligned}$$

Where:

- h denotes hours within the analysis time horizon
- n is the number of hours in the analysis time horizon
- w denotes plant for multi-stage generating (MSG) resources or same as (k) for non-MSG resources, (k) denotes non-MSG resource or non-MSG configuration
- b is the number of MSG configurations for MSG resources ; 1 for non-MSG resources.
- t denotes MSG transition
- c is the number of MSG transitions for MSG resources ; 0 for non-MSG resources.
- k denotes PNode at non-MSG resource or non-MSG configuration (k)
- $\text{Online}_{k,h}$ is the optimal commitment (0/1) flag to indicate if resource or MSG configuration (k) is online (1) (active) or offline (0) at hour (h)
- $\text{Starting}_{k,h}$ is the 0/1 flag to indicate if resource or active MSG configuration (k) and optimal segment (g) is starting (1) at hour (h); otherwise (0)
- $\text{Transitioning}_{t,h}$ is the 0/1 flag to indicate if active MSG transition (t) has occurred at hour (h) (1); otherwise (0)
- $LMP_{k,h}$ is the estimated hourly LMP, for hour (h), at the resource's PNode (p) or aggregated PNode (A) or MSG configuration (Y) represented as (k)

$MWh_{k,h}$	is the optimal dispatch of the of the resource's PNode (p) or aggregated PNode (A) or MSG configuration (Y) represented as (k) during hour (h) ⁹
$VEC_{k,m}$	is the estimated variable energy cost of the resource's PNode (p) or aggregated PNode (A) or MSG configuration (Y) represented as (k)
$MLC_{k,m}$	is the estimated minimum load cost of the resource's PNode (p) or aggregated PNode (A) or MSG configuration (Y) represented as (k)
$SUC_{k,g,m}$	is the estimated start-up cost of the resource's PNode (p) or aggregated PNode (A) or MSG configuration (k) for the optimal start segment (g)
$TC_{t,m}$	is the estimated transition cost of the MSG resource for transition (p)

Subject to:

C1) $MIN_GEN \leq MWh \leq MAX_GEN$, if committed

C2) $Count(h, \text{ where resource is online during consecutive hours}) \geq MIN_ON$

C3) $Count(h, \text{ where resource is offline during consecutive hours}) \geq MIN_OFF$

Additional constraints for modeled limitations

If the resource, MSG plant (w), or MSG configuration (Y) represented as resource (k) has a limitation on starts,

C4) $SUM(Startups_k) \leq Start_Limit_k$ over the limitation granularity horizon¹⁰

For the base model run:

$$Start_Limit_k = x * (MaxSTRT_k - ActSTRT_k)$$

Where,

x is the reserve margin (90% or 0.9)

$MaxSTRT_k$ is the maximum permissible implied starts registered in the ULPTD in the limitation field applicable for the limitation granularity horizon

⁹ The model uses a single variable energy cost estimate, therefore the MWh value will either be 0, minimum operating point, or maximum operating point.

¹⁰ If the resource, MSG plant (w), or MSG configuration (Y) represented as resource k has more than one limitation for a given use limit type, the optimization granularity horizon will apply based on the longest granularity. For example, if resource (k) has a start limitation on a monthly granularity and a start limitation on annual granularity, the limitation granularity horizon will be 12 months.

$ActSTRT_k$ is the actual implied starts already incurred in the limitation granularity horizon

For the limit model run:

$$Start_Limit_k = [x * (MaxSTRT_k - ActSTRT_k)] - 1$$

If the resource has a limitation on run-hours,

C5) $Count(h, \text{where the resource is online in the limitation horizon}) \leq Runhour_Limit_k$ over the limitation granularity horizon

For the base model run:

$$Runhour_Limit_k = x * (MaxHRS_k - ActHRS_k)$$

Where,

X is the reserve margin (90% or 0.9)

$MaxHRS_k$ is the max permissible run-hours registered in the ULPTD in the limitation field applicable for the limitation granularity horizon

$ActHRS_k$ is the actual run-hours already incurred in the limitation granularity horizon

For the limit model run:

$$Runhour_Limit_k = [x * (MaxHRS_k - ActHRS_k)] - 1$$

If the resource has a limitation on energy output,

C6) $Sum(MWh_h) \leq Energy_Limit_k$ over the limitation granularity horizon

For the base model run:

$$Energy_Limit_k = x * (MaxMWH_k - ActMWH_k)$$

Where,

x is the reserve margin (90% or 0.9)

$MaxMWH_k$ is the maximum permissible MWh output registered in the ULPTD in the limitation field applicable for the limitation granularity horizon

$ActMWH_k$ is the sum of actual energy output already incurred in the limitation granularity horizon

For the limit model run:

$$\text{Energy_Limit}_k = [x * (\text{MaxMWH}_k - \text{ActMWH}_k)] - 1$$

The last three constraints (C4-C6) represent the limitations for which an opportunity cost needs to be calculated. These can be enforced together for a resource with more than one limitation type applicable on the same limitation granularity. For example, if a resource has a monthly limitation of 30 starts per month, and a monthly limitation of 20 run-hours per month, and based on the 90% reserve margin the model runs will be as follows:

Base model run with starts limited to 27 (90% of 30) and run-hours limited to 18 (90% of 20)

Start limit model run with starts limited to 26 and run-hours limited to 18

Run-hour limit model run with starts limited to 27 and run-hours limited to 17

The start-up opportunity cost is calculated as the non-negative difference of the monthly profit from the base model run and the profit from the start limit model run. The run-hour opportunity cost is calculated as the non-negative difference of the monthly profit from the base model run and the profit from the run-hour limit model run.

N.2.2.2 Nested Limitation

A resource may have more than one limitation of the same type, i.e., limitation on starts applicable on different granularities (monthly and annually). The estimated opportunity costs due to these two limitations are simultaneously enforced so the optimization can maximize the resource's profits across the limitation granularity horizon¹¹ to produce an opportunity cost adder that combines the impact of enforcing the limitations into one value. The opportunity cost adder can then be reflected in the bid cap of the applicable commitment cost bid cap under the proxy cost option or the DEB under the variable cost option. For example, if a resource has a monthly limitation on starts of 20, and an annual limitation on starts of 140, and the reserve margin is 90%, the opportunity cost for each month will be calculated using the annual profits from the following two runs:

Base model run: Limit the annual starts to 126 (0.9*140), and the monthly starts to 18 (0.9*20)

Limit model run: Limit annual starts to 125 and limit the month for which an opportunity cost is being calculated to 17; the remaining months are still limited to 18 starts

¹¹ The limitation granularity horizon for nested limitations will be set at the granularity with the longest time horizon. If the resource has a nested monthly start limit and annual start limit, the limitation granularity horizon will be the balance of the annual period. The same logic will apply for nested limitations of different use limit types.

N.2.2.3 Opportunity Cost Calculation for MSG Resource

MSG resources may be use-limited if they meet the criteria set forth in Section 30.4.1.1.6.1.1 of the CAISO Tariff and complete the Use-Limited Resource registration process.¹² Some limitations on MSG resources apply to the resource in its entirety, i.e., at the parent resource level or plant level, while others apply to the configurations and transitions between configurations. As part of the registration process, the CAISO will determine if an MSG resource can be modeled in the opportunity cost calculation or if it must instead be subject to the negotiated opportunity cost process.

Limitations that apply to the plant resource level will have one opportunity cost calculated for each limitation type that will be applied to the configurations. For example, an MSG resource with a parent resource level limitation on run-hours will have an opportunity cost calculated that will be reflected in the minimum load cost bid cap under the proxy cost option of every configuration. Similarly, an opportunity cost due to an energy limitation on the parent resource level will be added to the DEB under the variable cost option of each configuration. Limitations that apply to a given configuration will have an opportunity cost for each limitation, for that configuration¹³. For example, the opportunity cost due to a run-hour limitation on a given configuration will be reflected in the minimum load cost bid cap of that configuration.

In cases where a transition between configurations is considered a start to which the limitation applies, an opportunity cost will be calculated for each feasible transition as the start-up opportunity cost of the to-configuration. The transition cost bid cap under proxy cost option is calculated as follows:

$$TC_{From \rightarrow To} = [1.25 * (SUC_{To} - SUC_{From})] + SU_OC_{To}$$

Where:

$TC_{From \rightarrow To}$	Transition cost bid cap for transition from from-configuration to to-configuration
SUC_{To}	Proxy start-up cost of to-configuration
SUC_{From}	Proxy start-up cost of from-configuration
SU_OC_{To}	Start-up opportunity cost of to-configuration

¹² To complete the process, the Scheduling Coordinator must submit a use-limited registration request, complete all internal processing, receive notification the ISO will designate the resource as Use-Limited Resource based on registering a qualifying limitation and ISO will set the USE_LIMIT_FF will be set to 'Y' in the GRDT and submit the ULPDT via the Master File User Interface.

¹³ SC should denote the limitation is on the configuration level by including the configuration ID value in the ULPDT. If the limitation is at the parent resource level, the configuration ID field should be blank.

For MSG configuration starts and transitions, the start-up opportunity cost is calculated per implied start for each configuration. This value is multiplied by the number of implied starts registered in the GRDT, to derive the opportunity cost to be added to the start-up cost bid cap or transition cost bid cap, as applicable. See Section 2.1.15 of Business Practice Manual for Market Instruments for more detail on registering implied starts in the GRDT.

N.3 Schedule of Updating Opportunity Cost Adder

The opportunity cost of each limitation will be calculated in advance of the limitation granularity effective start time. The CAISO will make the opportunity cost adder and a summary of model results available to the Scheduling Coordinators via the CAISO Market Results Interface (CMRI) prior to the month for which the opportunity costs become effective.

Additionally, a daily report will be published on CMRI with the opportunity cost adders used in each market (day-ahead and real-time) for each trade date. In the event that the opportunity cost adder is updated during a trade month, the update will only be visible on the daily report since the monthly report is published prior to the trade month.

In the event that the CAISO is unable to perform such calculations or updated calculations for all Use-Limited Resources, the CAISO will give priority to performing such calculations or updated calculations for those Use-Limited Resources that are currently on pace to reach their maximum allowed numbers of starts, maximum allowed numbers of run-hours, or maximum allowed energy output more quickly than the most recent calculations of opportunity costs indicated.

To the extent that the CAISO is unable to perform such calculations or updated calculations for a Use-Limited Resource, the CAISO will utilize the most recently calculated or updated opportunity costs that have been set or are advisory for the Use-Limited Resource, where the advisory prices are the previously calculated opportunity costs for the binding trade month.

N.4 Negotiated Opportunity Cost Calculation

Resources with complex limitations that cannot be modeled utilizing the method described in Section N.2 above will be contacted by the CAISO to pursue a negotiated opportunity cost adder. Under this option, the CAISO would use documentation provided by the market participant and its discretion to pursue establishing the negotiated opportunity cost.

N.4.1 Information Needed

In order to establish a negotiated opportunity cost adder for a Generating Unit, the Scheduling Coordinator for the Generating Unit must provide the CAISO with the following information:

1. The proposed negotiated opportunity cost adder to be used for the Generating Unit. The Scheduling Coordinator must identify whether the opportunity cost adder it is requesting is being requested as an adder to the start-up bid cap, minimum load bid cap, and/or energy bids (generated energy bid or default energy bid under the variable cost option)¹⁴.
2. The applicability horizon of the limitation including impacted market(s) and time periods for which the proposed opportunity would be applicable (day-ahead market and real-time market; peak and off-peak hours; start and end dates).
3. A descriptive explanation and justification of the basis or need for the proposed opportunity cost and why the opportunity cost model cannot capture the resource's complex limitations, including numerical calculations, input variables, values used, values that will vary during applicability horizon, and methodology and supporting documentation for arriving to input values including the Generating Unit's operating costs (e.g., fuel costs, operation and maintenance costs) and opportunity costs. The descriptive explanation and the methodology description should include formulas, simulation models, or historical analyses.
5. If applicable, the Scheduling Coordinator may propose two alternative costs: (a) a preferred opportunity cost reflecting the Scheduling Coordinator's opportunity cost, and (b) a temporary opportunity cost that could be utilized on an expedited basis pending more detailed review, discussion and negotiation concerning the preferred opportunity cost for the Generating Unit.
6. The proposed frequency of updates to the negotiated opportunity cost adder values. The frequency of updates proposed should be a function of the approved methodology where more formulaic approaches will allow more frequent updates compared to less transparent approaches.

N.4.2 Review of Information Submitted to the CAISO

The CAISO will review the information and assess the cost and/or formulas proposed by Scheduling Coordinators. Additional information may be requested from the Scheduling Coordinator as necessary to assess the reasonableness of the proposed opportunity cost and other potential opportunity costs. To expedite this process, the Scheduling Coordinator shall make representatives available to explain and discuss the rationale and supporting documentation for the proposed opportunity cost with the CAISO. All information provided by a Scheduling Coordinator shall be subject to the confidentiality provisions of the CAISO Tariff. Negotiated opportunity cost requests and communications should be sent to NOC@caiso.com

¹⁴ ISO will not support negotiated opportunity cost adders that apply only to the transition cost bid cap. The Scheduling Coordinator must establish a negotiated start-up opportunity cost adder and the adder will be included in the transition cost bid cap.

N.4.3 Effective Date of a Negotiated Opportunity Cost

Any opportunity cost proposed in writing by the CAISO to a Scheduling Coordinator shall become effective first trade date of the next calendar month after acceptance by the Scheduling Coordinator is received by the CAISO.

Any negotiated opportunity cost value and methodology agreed upon by the CAISO and a Scheduling Coordinator as an opportunity cost adder to the variable cost option for the default energy bid or as an adder to the commitment cost bid caps shall be filed at FERC within the first seven (7) days of the next calendar month. The opportunity cost shall remain in effect unless:

1. The opportunity cost is modified by FERC;
2. The opportunity cost is modified by mutual agreement of the CAISO and a Scheduling Coordinator; or
3. The CAISO or Scheduling Coordinator provides written notification that the opportunity cost is no longer acceptable for use under the negotiated rate option.

If the CAISO and the Scheduling Coordinator reach a mutual agreement to either (i) terminate the negotiated opportunity cost and pursue the calculated opportunity costs or (ii) waive use of the opportunity cost adder, the CAISO will file at FERC by the next calendar month following the first trade date for which the negotiated opportunity cost is no longer in effect in its market.

N.4.4 Applicable Opportunity Cost Pending Agreement of a Negotiated Opportunity Cost

Pending any agreement between the Scheduling Coordinator and the CAISO with respect to an opportunity cost to be used as an opportunity cost adder to the variable cost option for the default energy bid or as an adder to the commitment cost bid caps, the Resource's opportunity cost shall be based on either:

1. The opportunity cost calculated by the methodology described in Section N.2 above;
or
2. A temporary opportunity cost proposed by the CAISO.

A temporary opportunity cost established by the CAISO would be applicable only in the event that the CAISO determines that market or operational conditions warrant establishing a temporary opportunity cost (or modifying an opportunity cost) pending any agreement or resolution of the opportunity cost proposed by the Scheduling Coordinator as an opportunity cost adder to the variable cost option for the default energy bid or as an adder to the commitment cost bid cap. The CAISO may also need to establish an opportunity cost under this option in the event that sufficient data is not available to calculate an opportunity cost under any of the other options for establishing an opportunity cost under the CAISO tariff.

N.4.5 Dispute Resolution

If a Scheduling Coordinator and the CAISO cannot reach mutual agreement on an opportunity cost to be used as an opportunity cost adder to the variable cost option for the default energy bid or as an adder to the commitment cost bid cap, the Scheduling Coordinator may file at FERC pursuant to Section 205 of the Federal Power Act for approval of an opportunity cost to be used as an opportunity cost adder to the variable cost option for the default energy bid or as an adder to the commitment cost bid cap after 60 days from the commencement of initial negotiations on the proposed opportunity cost.

N.4.6 Possible Scenarios Leading to Renegotiation of an Opportunity Cost Adder

Each approved opportunity cost adder to the variable cost option for the default energy bid, start-up bid cap, and/or minimum load bid cap will only be applicable to the specific resource or configuration (if the resource is an MSG resource) that is active in the Master File and an associated Scheduling Coordinator who negotiated the opportunity cost with the CAISO. A negotiated opportunity cost will be reviewed and potentially renegotiated or terminated under the following non-exhaustive list of circumstances:

1. Change in Scheduling Coordinator
 - a. The resource switches from the Scheduling Coordinator which negotiated the opportunity cost to another Scheduling Coordinator.
 - b. The resource is acquired by a different Scheduling Coordinator through a merger or acquisition but keeps the same Scheduling Coordinator identifier in the Master File.
2. Change in resource attributes/status
 - a. The resource changes ID/name in the Master File.
 - b. The resource switches to being an MSG resource from being a non-MSG resource or the resource switches from being an MSG resource to being a non-MSG resource.
 - c. The resource switches the type of fuel it uses.
 - d. The resource's air permit restriction changes.
 - e. The resource or a configuration within it (for an MSG resource) retires.
3. Change in negotiated elements
 - a. Conditions underlying the resource's negotiated opportunity costs are no longer applicable or accurate.
 - b. Vendor data is no longer available to use for a negotiated element in the negotiated opportunity cost calculation.
 - c. Change/expiry of the tariff rates/fees/taxes/adders included in the negotiated opportunity cost calculation.

4. Change in any other material item which might affect the opportunity cost approved as an opportunity cost adder to the variable cost option for the default energy bid or as an adder to the commitment cost bid cap.

It is the responsibility of the Scheduling Coordinator to: (1) ensure that the conditions and data underlying any opportunity cost created as an opportunity cost adder to the variable cost option for the default energy bid or as an adder to the commitment cost bid caps for a resource accurately reflect current conditions; and (2) notify the CAISO of any changes that may affect their negotiated opportunity cost. To the extent that any opportunity cost created as an opportunity cost adder to the variable cost option for the default energy bid or as an adder to the commitment cost bid cap for the resource or MSG configurations require modification or reinstatement after termination, they will be re-established under the process for creating negotiated opportunity costs. To the extent that a negotiated opportunity cost is terminated, the negotiated opportunity cost will default to zero until a new negotiated default energy bid is established.

N.5 Opportunity Cost Calculation for New Use-Limited Resources with Insufficient Data

A new Use-Limited Resource without 12 months of fifteen-minute LMPs for energy at the resource's PNode or aggregated PNode may elect to use the registered cost option (see Sections 30.4 and 30.4.1.2 of the CAISO Tariff) and remain on that option for up to 14 months after the resource is established in the market. Pricing data includes fuel region and the resource's PNode or aggregated PNode LMP data.

The alternative to electing the registered cost option is to elect the proxy cost option (see Sections 30.4 and 30.4.1.1 of the CAISO Tariff), pursuant to which the calculation of opportunity costs of foregone profits under the equations set forth in Section N.2.2 above will be based on energy revenues at a comparable PNode or aggregated APNode. If the CAISO can identify a comparable PNode or aggregated APNode that is comparable to the new resource's node, the CAISO will use this pricing location as a reference in the calculation.

As of 14 months after a new resource is established in the market, the Scheduling Coordinator will no longer be able to select the registered cost option and must instead use the proxy cost option.