EIM Greenhouse Gas Enhancements

2nd Revised Draft Final Proposal

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1 Introduction and Background

Energy generated in California or imported into the state to serve California load is subject to California's greenhouse gas (GHG) regulations adopted by the Air Resources Board (ARB).[1] Under these regulations, the compliance obligations apply to first deliverers – generation owners or electricity importers. In the context of the western Energy Imbalance Market (EIM), participating resource scheduling coordinators are considered electricity importers if their resource(s) are dispatched to serve load in the California ISO (CAISO). These entities have a GHG compliance obligation under California's GHG regulations.

To address ARB's regulations, the CAISO developed a mechanism to reflect GHG compliance costs within locational marginal prices for resources serving CAISO load. Inside the CAISO balancing authority area, the price for energy includes the cost of GHG compliance. Outside the CAISO, the energy price does not include GHG compliance costs when external resources are serving load outside the CAISO. However, external resources do receive a payment for GHG compliance costs when they are dispatched to serve CAISO load. The CAISO market can identify the price difference because resources outside the CAISO balancing authority area bid a GHG compliance cost adder separately from their energy bids. When dispatching resources to serve load outside the CAISO, the market optimization considers only the energy bid. When dispatching resources to serve load inside the CAISO, the market optimization considers the energy bid plus the GHG compliance cost adder.

1.1 GHG Bids at the start of EIM

As part of the initial design of the western Energy Imbalance Market in 2014, EIM participating resource scheduling coordinators submitted a bid adder on a daily basis for each of their EIM participating resources. The bid adder allowed the CAISO to attribute EIM transfers to serve CAISO load to specific EIM participating resources based on least cost dispatch. CAISO load paid the EIM participating resource the marginal energy price and the marginal GHG price. EIM participating resources serving load outside of the CAISO received only a marginal energy payment. In this way, GHG costs did not affect the locational marginal price in the EIM Entity balancing authority area outside of California.

At the outset of the EIM, the CAISO did not mitigate the GHG bid adder or restrict the quantity of output from EIM participating resources that the market dispatch attributed as serving CAISO load.

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[1] *See generally* California Air Resource Board website relating to Cap and Trade program: https://www.arb.ca.gov/cc/capandtrade/capandtrade.htm.

See also Title 17, California Code of Regulations sections 95801-96022.

The only restriction was that the combined energy bid and GHG adder had to be less than or equal to the $1000 per MWh maximum energy bid price. Under this approach, EIM participating resource scheduling coordinators that did not want to comply, or who were legally barred from complying, with California's GHG regulations could use a high bid adder to signal the market that their resource(s) was not available for dispatch to serve CAISO load, and thus, avoid GHG compliance costs. The Federal Energy Regulatory Commission accepted these market design elements but directed the CAISO to submit a compliance filing in one year to implement a bid flag to preclude the market from dispatching an EIM participating resource to serve CAISO load.[2] Since the bid flag mechanism would obviate the need for the EIM participating resource scheduling coordinator to use a high GHG bid adder to signify that the market should not dispatch an EIM participating resource to serve CAISO load, the Commission also directed the CAISO include revisions implementing a cost-based GHG bid adder.

1.2 GHG Bids under EIM Year One Enhancements

As part of the CAISO's year one enhancements for EIM, the CAISO proposed revisions to address the Commission's directives. Specifically, the CAISO proposed to allow EIM participating resource scheduling coordinators to submit a bid quantity and an hourly GHG bid adder for each resource at or below the resource's daily maximum GHG cost cap as determined by CAISO, but not less than zero.[3] Under this approach, an EIM participating resource scheduling coordinator submits a single megawatt quantity and single bid price on an hourly basis for its resource(s) to express its interest in serving CAISO load. The CAISO's tariff revisions recognize that the GHG bid adder covers the costs of compliance with ARB's regulations plus any financial risk between the actual cost and the daily cost of compliance. If the EIM participating resource scheduling coordinator does not submit a bid adder for its resource(s), or submits a bid adder with a zero MW quantity, the market will not dispatch the EIM participating resource to serve CAISO load. FERC accepted these revisions to the CAISO's GHG design for EIM.[4] The CAISO implemented these bidding rule changes without making changes to the market optimization algorithm in production since the start of the EIM.

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2 *California Indep. Sys. Operator Corp*., 147 FERC ¶ 61,231 (2014) at PP 238-240.

3 The CAISO calculates a daily maximum GHG cost using a process similar to the process the CAISO uses to calculate the GHG cost included in the default energy bids of CAISO resources. This includes a variable cost option and a negotiated rate option. However, rather than calculating a cost curve as is done for default energy bids within the CAISO, the CAISO calculates a single daily maximum cap for the EIM participating resource.

Under the variable cost option, on a daily basis, the CAISO proposes to calculate each unit's maximum GHG cost based on the unit's maximum heat rate as registered with the CAISO, the applicable GHG allowance price, and the resource's emission rate. These are the same three components that the CAISO uses to calculate the greenhouse gas cost included in the default energy bid curves of CAISO resources. The standard GHG emission rate is documented in the US EPA Subpart C default emission factors. Similar to the default energy bids of CAISO resources, the CAISO applies a 10 percent adder to the calculated maximum cost.

4 *California Indep. Sys. Operator Corp*., 153 FERC ¶ 61,087 (2015) at PP 57-58.

1.3 Identifying the emissions impacts of secondary dispatch

Over the last year and a half, the CAISO has worked with ARB and stakeholders in ARB's rulemaking process to address a concern that the EIM GHG design is not fully capturing the impact to the atmosphere that occurs in connection with EIM transfers to serve CAISO load. Briefly, this concern relates to CAISO dispatches of EIM participating resources to serve CAISO load based on minimizing total costs of energy and GHG bid adders. The CAISO's least-cost dispatch can have the effect of attributing transfers to serve CAISO load to lower-emitting EIM participating resources because these resources face fewer or no costs to comply with ARB's regulations. In some instances, higher-emitting resources will need "to backfill" this dispatch to serve EIM load outside of the CAISO. The CAISO refers to this phenomenon as secondary dispatch.

Through its rulemaking process, ARB has adopted a method to account for the GHG effects from secondary dispatches associated with the dispatch of EIM resources to serve CAISO load.[5] This accounting rule took effect January 1, 2018. ARB's approach retires unsold allowances equal to the estimated difference in emissions between what the CAISO's optimization identifies from resources dispatched to serve CAISO load and the unspecified source emission rate applied to imports at CAISO scheduling points. ARB adopted this approach as an interim rule pending the CAISO's development of EIM design changes to address emissions from secondary dispatches.

2 Energy Imbalance Market Governing Body Classification

The Energy Imbalance Market (EIM) is a real-time market used to economically dispatch participating resources to efficiently balance supply, transfers between balancing authority areas (BAA), and load across its footprint. The greenhouse gas design ensures that when load outside of the CAISO's balancing authority area is served by generation outside CAISO, the cost of greenhouse gas should not be reflected in the non-CAISO balancing authority area prices. The rules that underlie this greenhouse gas design are EIM-specific, and would not exist without EIM.

Therefore, this policy initiative involves market design changes that fall entirely within the EIM governing body's primary authority.

The EIM Governing Body will have primary authority in approving the following policy proposals:

- Revisions to CAISO's existing GHG bid adder
- Support multiple GHG programs in the West

Stakeholders are encouraged to submit a response to the EIM categorization in their written comments, particularly if they have concerns or questions.

[5] 17 California Code of Regulations, Section 95852(b)(1)(D).

3 Proposal

3.1 The CAISO's revised proposal builds on existing GHG bid adder design

The CAISO has reviewed potential design changes to address emissions that result from secondary dispatch; most recently a proposed two-pass optimization that would identify the secondary dispatch emission effects when the market dispatches EIM participating resources to serve CAISO load.[6] Under the proposed two-pass optimization, the CAISO would identify resources to serve load in the combined EIM area in order to establish an allocation base for EIM participating resources to serve CAISO load in the second pass of the optimization. Stakeholders expressed significant concerns with the two-pass optimization solution, including that it is creates complexity and price inconsistency issues between each pass of the optimization.[7] In addition, stakeholders raised concerns that the proposal could result in EIM participating resources bidding at more than their marginal costs in an attempt to avoid a dispatch in the first pass of the optimization in order to be available to serve CAISO load in the second pass of the optimization. This element of the design raises concerns with efficient dispatch and potential pricing impacts on load outside of the CAISO.

Based on feedback received during the CAISO's stakeholder process, the CAISO proposes to adjust its solution to address emissions associated with secondary dispatch. The CAISO's proposal builds on its existing market design optimization algorithm. Specifically, the CAISO proposes to use EIM participating resources' GHG bid quantity and GHG bid price to help mitigate and track the atmospheric effects of secondary dispatch. Under this approach, the CAISO would limit the GHG bid quantity of EIM participating resources to the MW value between the EIM participating resource's base schedule and the resource's upper economic level. EIM participating resource scheduling coordinators would continue to submit cost-based GHG adders if they wish to offer their output of their EIM participating resources to serve CAISO load as they do today. However, EIM participating resource scheduling coordinators would also submit a positive GHG bid price for all EIM participating resources offering their output to serve CAISO load, including non-emitting EIM participating resources. This requirement will reflect the potential that emissions may occur as a result of a secondary dispatch.

Under the proposal described herein, the CAISO's market will compensate EIM participating resource scheduling coordinators for EIM participating resources at a locational marginal price that reflects at least the secondary emission rate, even if the

[6] *See* ISO Revised Draft final Proposal Energy Imbalance Market Greenhouse Gas Enhancements dated June 27, 2017 http://www.caiso.com/Documents/RevisedDraftFinalProposal-EnergyImbalanceMarketGreenhouseGasEnhancements.pdf

[7] *See* materials for December 4, 2017 web-conference regarding GHG Attribution Accuracy Report Demonstration http://www.caiso.com/informed/Pages/StakeholderProcesses/RegionalIntegrationEIMGreenhouseGasCompliance.aspx

resources supporting the transaction may not have emissions consistent with that rate. In turn, and dependent on ARB modifying its regulations, these EIM participating scheduling coordinators will submit allowances to ARB that reflect the secondary emission rate. Under this proposal, the CAISO will not change its current market optimization but will instead recognize submitted GHG bid adders in a single optimization and limit the MW value that the optimization attributes to an EIM participating resource serving CAISO load to the resource's GHG bid quantity.

Table A reflects how the CAISO has addressed and proposes to address EIM participating resource's GHG bid quantities and GHG bid prices.

Table A: GHG Bid quantities and prices

	GHG Bid Quantity	GHG Bid Price
At outset of EIM	Pmax of resource	≤ $1,000 less Energy bid
Year One Enhancement	0 MW to Pmax	≤ Resource daily GHG cost[8] plus 10%
Current Proposal	Upper economic limit less base schedule	≤ Resource daily GHG cost plus 10% But, subject to minimum bid price at secondary emission GHG cost[9]. ~~≤ MAX (Secondary emission GHG cost[10], Resource daily GHG cost) plus 10%~~

The secondary emission rate could be defined by ARB through its regulatory process. It is expected that the secondary emission rate will range between 0.000 mTCO2/MWh

8 The resource daily GHG bid cost is calculated by multiplying the emission rate and the daily GHG compliance obligation index price.

9 EIM participating resources are compensated at the marginal GHG price when attributed to serving load. If a resource must use the secondary emission rate, the resource will be compensated to cover the cost of GHG compliance at the secondary emission rate.

and 0.428 mTCO2/MWh (the unspecified source emission rate). The secondary dispatch rate used by the CAISO could be a configurable parameter for the market.

The CAISO proposes that it could perform an analysis on a periodic basis to support the determination of ARB's secondary emissions rate. An approach for this analysis would seek to identify the average emissions rate in the EIM that occurs as a result of EIM dispatches. The CAISO recognizes that resources operating in the EIM will change based on the time of day and the season of the year as well as the addition of new EIM Entities. For these reasons, the CAISO proposes that a secondary emission rate could be calculated for both peak and off-peak hours on a quarterly basis. The exact timing and frequency of changes in the secondary emission rate will need to balance accuracy with predictability. The CAISO requests input from stakeholders on the frequency with which the secondary dispatch emission rate should be updated.

One approach to calculate the secondary dispatch emission rate is to use results from the market optimization from the previous quarter. In support of this approach the CAISO could calculate the difference between EIM base schedules and the real-time dispatch (incremental and decremental) and calculate the emissions for the incremental or decremental dispatch above EIM base schedules divided by the total difference in demand above or below EIM base schedules. The calculation attempts to identify those resources the CAISO dispatched in real-time to address the increase or decrease in real-time demand. The CAISO proposes to perform this calculation only for intervals when there are EIM transfers to serve CAISO load and reduce by the emissions of resources attributed to support the transfer.

The following example reflects the above approach:

Base Schedule = 100 MW

RTD = 150 MW so an increase of 50 MW occurs as a result of EIM dispatch

Increase/Decrease in Dispatch by Resource Type:

Solar = 10 MW increase

Wind = 20 MW increase

Coal = 20 MW increase

Gas1 = 10 MW increase

Hydro = 10 MW increase

Gas2 = 20 MW decrease

Emission of attributed resources is 0 mTCO2.

Calculate emissions for the incremental dispatch based upon the changes from base schedules of all emitting resources.

Coal Emissions = 20*0.91 = 18.2 mTCO2

Gas1 Emissions = 10*0.5315 = 5.315 mTCO2

Gas2 Emissions = -20*0.5315 = -10.63mTCO2

Calculate the rate by dividing the total emission by the total dispatch.

Absolute Value of Total Emissions = ABS (18.2+5.315-10.63) = 12.885 mTCO2

Average Secondary Emission Rate = 12.885/50MW = 0.2577 mTCO2/MW

The application of a secondary dispatch emission rate to all offers from EIM participating resources to serve CAISO load will ensure the CAISO's market optimization recognizes that secondary emissions can occur when lower emitting resources are dispatched to serve CAISO load and high-emitting resources backfill to serve EIM load. The resulting GHG bid price will also ensure that locational marginal prices for energy reflect the secondary dispatch effects and compensate EIM participating resource scheduling coordinators for any additional cost of GHG compliance they may incur under ARB's regulations. In addition, the proposed GHG bid quantity limit will reduce the quantity of secondary dispatch emissions by not allowing attribution to output that cannot be incrementally dispatched by the market optimization.

This proposal raises questions with respect to bidding rules for EIM participating resources seeking to serve CAISO load and whether a secondary dispatch emission rate should apply to non-emitting resources that have contracted to sell their supply to a California load serving entity. The CAISO seeks comment on the proposed GHG bidding rules for EIM participating resources set forth in **Table B**.

Table B: GHG bidding rules for EIM participating resources[11]

[11] EIM participating resources are located in balancing authority areas outside the CAISO.

Resource Type	GHG Bid Quantity	GHG Bid Emission Rate
California supply	Upper economic level less base schedule[12]	Resource-specific emission rate
Solar/Wind	Upper economic level less base schedule	Secondary dispatch emission rate
Hydro	Upper economic level less base schedule	Secondary dispatch emission rate
Asset controlling suppliers (if emission rate is less than bid floor)	Upper economic level less base schedule	Secondary dispatch emission rate
Asset controlling suppliers (if emission rate is higher than bid floor)	Upper economic level less base schedule	Asset controlling supplier rate
System imports[13]	Upper economic level less base schedule	Unspecified source emission rate
Natural gas	Upper economic level less base schedule	Resource-specific emission rate

12 It is assumed that the EIM participating resources base schedule is equal to the CAISO day-ahead import schedule. Under the extended day-ahead market, the resources full output can be attributed and will result in imbalance settlement of GHG awards for changes in schedule/dispatch between the day-ahead market, 15-minute market and 5-minute real-time dispatch. Under EIM this imbalance settlement occurs between the 15-minute market and 5-minute real-time dispatch.

13 Currently intertie bidding is not allowed in the EIM. If imports were bidding at intertie scheduling points outside the CAISO, the imports would include a separate GHG bid to be used for attribution.

Resource Type	GHG Bid Quantity	GHG Bid Emission Rate
Coal	Upper economic level less base schedule	Resource-specific emission rate

As explained earlier in this stakeholder initiative, "California Supply" refers to resources outside the CAISO that have a contract with a load serving entity in the CAISO for serving CAISO load. The determination of which resources will qualify as California supply necessarily requires coordination with ARB regarding the rules that define external specified resources. The CAISO, however, solicits feedback from stakeholders on what criteria may guide the identification for California supply for purposes of this proposal.

3.2 The CAISO's proposal will require accompanying changes to ARB's regulation

In order to implement the proposal contemplated in this paper, the CAISO and ARB will need to ensure alignment between the CAISO's market rules and ARB's regulations. If the CAISO proceeds with this proposal, ARB will also need to initiate its own rulemaking process to modifying its regulations.

The CAISO anticipates ARB and stakeholders will need to consider these changes in the context of ARB's rulemaking proceedings. This proposal in no way prejudges the outcome of that process.

3.3 Support for multiple GHG programs in the West

Currently, California is the only western state with a GHG compliance program. The CAISO recognizes this fact may change in the near future. Accordingly, the CAISO has proposed a solution that is scalable to other areas. If another state proposes a GHG program that places a GHG compliance obligation on supply from outside its state (*i.e.* on imports or transfers for other states within a multi-state balancing authority area), the CAISO can apply the proposal discussed herein to the new GHG compliance area. Under this proposal, the market optimization can more accurately track the primary and secondary emissions associated with an EIM participating resource serving load within that area. Of course, the CAISO would need to coordinate any market design changes with that state's GHG program to ensure alignment. If another state does place a GHG compliance obligation on external supply, then external resources seeking to serve load in that are or in the CAISO will now have to submit a separate GHG bid adder to cover the costs of compliance obligations in both the new state's GHG program and the California's GHG program. The ability for an external resource not subject to GHG

regulations to opt out of either the new GHG program or the California GHG program would remain unchanged. Any new GHG program will also result in an additional component of the LMP outside of the new GHG program region. If the new GHG program only places a compliance obligation on generation located within its state or has a carbon tax, these costs would be reflected in the resources' energy bids similar to what is done by resources in the CAISO today.

3.4 Extending EIM GHG design to support regionalization

The proposed enhancement to the GHG design for EIM discussed in this paper can also apply to the day-ahead market. If, subject to regulatory approvals, EIM entities elect to participate in the day-ahead market, the CAISO anticipates applying a similar GHG bid design in those market processes to minimize and account for secondary dispatches associated with external resources serving CAISO load. The CAISO notes that it has yet to initiate a stakeholder process to explore extending the day-ahead market to EIM Entities. Although the CAISO would develop market rules for an extended day-ahead market in that initiative, the CAISO solicits comments on this topic here.

4 Next Steps

Table C outlines the proposed schedule to complete the stakeholder process changes for the EIM GHG Enhancements.

Table C: Stakeholder Process Schedule

Stakeholder Process Schedule	
Date	**Milestones**
Feb 16	Post 2nd Revised Draft Final Proposal
Feb 22	Stakeholder conference call
Mar 1	Stakeholder comments due
Apr 24	EIM Governing Body decision
May 16-17	Board of Governors Consent Agenda

The CAISO plans to discuss this straw proposal with stakeholders during a stakeholder call to be held on February 22, 2018. The CAISO requests comments from

stakeholders on the 2nd revised draft final proposal. Stakeholders should submit written comments by March 1, 2018 to InitiativeComments@caiso.com.