



California ISO

Regional Integration California Greenhouse Gas Compliance

Issue Paper

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1 Introduction

As part of exploring the expansion of the ISO's balancing authority area into additional western states, the ISO will need to modify how the market determines which resources are serving load in the various states. Under a multi-state balancing authority area, energy flows within the balancing authority area will not use e-tags to identify their contract path or for interchange management. In order to determine energy flows based upon geographical boundaries within the new multi-state balancing authority area, the ISO must modify the different tracking approach. Such an approach is needed so that the ISO market can reflect the costs associated with compliance with the California Cap-and-Trade Program in energy prices for transactions subject to that program, but not in energy prices for transactions that are not subject to the program.

Imports of energy into California and generation of energy within California are subject to the California Cap-and-Trade Program. Energy generated outside of California that is not used to serve load in California is not subject to this program. As a result, generators within the current ISO footprint embed their greenhouse gas (GHG) compliance costs within their energy bids used in the day-ahead and real-time markets. The generator's GHG compliance obligation is based upon the actual output of that resource. Importers into the current ISO also embed their GHG compliance costs within their energy bids. An import's GHG compliance obligation is based upon its ISO schedule as determined by the market and the e-Tag supporting the schedule.

With introduction of the Energy Imbalance Market (EIM), the ISO developed a mechanism to reflect GHG compliance costs within the locational marginal prices. Inside of the ISO balancing authority area, the energy price would include GHG compliance costs of generation. Outside of the ISO, if the load was met with generation outside of the ISO, the energy price would not include GHG compliance costs. The price difference can be determined by the market because resources outside the ISO balancing authority area bid a GHG compliance cost adder separately from their energy bids. When serving load outside of the ISO, the market optimization would consider only the energy bid. When serving load inside the ISO, the market optimization would consider the energy bid plus the GHG compliance cost adder. The ISO is currently working with California Air Resources Board (CARB) and stakeholders through their rulemaking process to address concerns that the EIM GHG market design is not capturing the impact on the atmosphere that occurs in connection with EIM transfers into the ISO to serve ISO load. Resolution of those concerns may inform how to address similar concerns in connection with a day-ahead GHG market design

2 Stakeholder process and timeline

The ISO plans to present its proposal developed through this initiative to the ISO's Board of Governors at their February 2017 meeting. A proposed schedule for the policy stakeholder process leading up to this Board of Governors' meeting is below.

Item	Date
Post Issue Paper	August 29, 2016
Stakeholder Conference Call	September 6, 2016
Stakeholder Comments Due	September 20, 2016
Post Straw Proposal	October 6, 2016
Stakeholder Conference Call	October 13, 2016
Stakeholder Comments Due	October 27, 2016
Post Revised Straw Proposal	November 10, 2016
Stakeholder Conference Call	November 17, 2016
Stakeholder Comments Due	December 8, 2016
Post Draft Final Proposal	December 22, 2016
Stakeholder Conference Call	January 5, 2017
Stakeholder Comments Due	January 19, 2017
Board of Governors Decision	February 15-16, 2017

Table 1 - Schedule for Greenhouse Gas Compliance Market Design Changes Stakeholder Initiative

3 Current GHG design for ISO energy markets

Imports of energy into California and the generation of energy within California are subject to the California Cap-and-Trade Program. The cost of GHG compliance is generally reflected in the system marginal energy cost of the current ISO balancing authority area by virtue of the fact that scheduling coordinators contain the cost of this compliance in their energy bids. The system marginal energy cost component of locational marginal prices (LMP) is the same for all nodes. Load pays for GHG compliance costs at its load aggregation point price and generation is compensated for its GHG compliance costs at its LMP. At intertie scheduling points, exports pay for GHG costs through the LMP and imports receive the applicable LMP.

No changes to the market optimization were needed to reflect the California Cap-and-Trade Program since the ISO market compensates resources for GHG compliance costs through the energy settlement. Generators within the ISO embed their GHG compliance costs within their energy bids used in the day-ahead and real-time markets. Importers into the ISO balancing authority area at ISO intertie scheduling points also embed their GHG compliance costs within their energy bids. The ISO also allows for the inclusion of GHG compliance costs in start-up and minimum load costs for generators. The market optimization then uses these energy bids to determine the least cost dispatch to serve ISO load.

Generators and importers can submit energy bids up to the \$1000/MWh bid cap. In the event market power mitigation is triggered, generators' energy bids are replaced with default energy bids. These cost based bid curves are calculated by the ISO and when a transmission element is non-competitive, the mitigated bids are used by the market for determining LMPs. The ISO estimates cost of GHG compliance and includes this cost in the default energy bid. For imports, the ISO does not use default energy bids since the ISO does not mitigate bids at intertie scheduling points.

Under the California Cap-and-Trade Program, the generator's GHG compliance obligation is based upon the actual annual output of the resource, not the final dispatch instruction from ISO's market. An importer's GHG compliance obligation is based upon its ISO schedule as determined by the ISO market and the e-Tag supporting the schedule.

4 GHG design for EIM

The ISO designed the Energy Imbalance Market (EIM) so that the GHG compliance costs will not affect the price in an EIM balancing authority area when load is met from generation external to the ISO. Through its market optimization, the ISO calculates the marginal cost difference between EIM generation serving load in the ISO balancing authority area and EIM generation serving load outside of the ISO. This difference reflects the marginal GHG compliance cost component of the LMP.¹ It is also the rate the market uses to calculate a

¹ As discussed above, the system marginal energy cost component is the same across all nodes in the EIM footprint. Since the system market energy component is based upon the ISO balancing

payment to each generator in an EIM balancing authority area for its output that is determined to serve ISO imbalances. This payment is funded through the price paid within the ISO for imbalance energy embedded in the system marginal cost of energy.²

In the ISO, all generation and imports embed the cost of GHG compliance within their energy bid. For resources in an EIM entity's balancing authority area, there is no GHG compliance cost when the resources serve load outside of the ISO. These resources, therefore, cannot include GHG compliance costs in their energy bids. The design allows EIM participating resources to submit two bids: (1) an energy bid and (2) a GHG bid adder. The combination of the energy bid and the GHG bid must not exceed the \$1000/MWh bid cap.

The market optimization minimizes the total cost to serve load across all balancing authority areas in the EIM, this includes the ISO. When evaluating the least cost dispatch to serve load in the ISO, the optimization considers the energy bids which can include GHG costs of generation in the ISO and the GHG cost of attributed resources for the EIM transfers into ISO to serve ISO load. When serving load outside of the ISO, only the energy bid, both ISO resources and EIM participating resources, will be considered by the market optimization.

The initial EIM design allowed a participating resource to submit a GHG bid adder to reflect its willingness to be deemed delivered to the ISO when there is an EIM transfer into the ISO. The GHG bid adder was independent of the energy bid curve submitted, thus the total output of the EIM participating resource was eligible to be deemed delivered to the ISO. The GHG bid adder was not mitigated, with the only restriction being that the combined energy bid and GHG bid adder must be less than or equal to the \$1000/MWh energy bid cap. A participating resource could submit a high GHG bid adder to reduce the probability that the output of the resource will not be deemed delivered to the ISO. However, a high GHG bid adder did not guarantee that the resource would not be deemed delivered to the ISO and as a result subject to the California Cap-and-Trade Program. In FERC's June 19, 2014 Order³ approving the EIM design, FERC directed the ISO to include a flag which would allow an EIM participating resource to opt out completely from consideration for EIM transfer into the ISO. In addition, FERC directed the ISO to design the GHG bid adder to be based upon the expected cost of GHG compliance obligations.

authority area, it includes GHG compliance costs. Therefore, the GHG compliance cost component of the LMP is a negative value and is only included in the LMP of nodes in the EIM footprint outside of the ISO balancing authority area if there is an EIM transfer into the ISO; otherwise, the value is zero.

² The EIM draft final proposal includes detailed examples on how the GHG compliance costs are reflected in prices in the EIM footprint. Although changes were made to the bidding rules for GHG compliance costs, the fundamental market optimization has not changed since the EIM went live on November 1, 2014. See section 3.9 of the draft proposal available at <http://www.caiso.com/Documents/EnergyImbalanceMarket-DraftFinalProposal092313.pdf>

³ See pages 86-89 of the order available at http://www.caiso.com/Documents/Jun19_2014_OrderConditionallyAcceptingEIMTariffRevisions_ER14-1386.pdf

In response to FERC's order, the ISO and stakeholders developed several modifications to the bidding rules for GHG compliance costs as part of the *EIM Year 1 Enhancements Phase 1* stakeholder initiative. After FERC approval, the ISO implemented these modifications on November 1, 2015. The changes allowed an EIM participating resource to submit a single MW quantity and single bid price expressing its willingness to be deemed delivered to the ISO on an hourly basis. The MW quantity bid is independent of the energy bid curve submitted, thus the total output of the EIM participating resource up to the MW quantity bid is eligible to be deemed delivered to the ISO.⁴

The ISO did not propose an explicit flag that would prevent an EIM participating resource's output from supporting an EIM transfer to the ISO. However, an EIM participating resource can, through its bid, accomplish the same objective of not being considered for EIM transfers into the ISO by bidding zero MW GHG bid. In addition, the ISO sets the default MW quantity of the GHG bid to zero. If an EIM participating resource, does not submit a GHG bid, the ISO market will not consider energy from the resource for EIM transfer into the ISO because the MW quantity will be set to zero. This satisfied FERC's directive for a flag and allowed participants enhanced flexibility to make adjustments on an hourly basis.

To address FERC's requirement that bid caps for GHG bid adders be cost based, the ISO uses a process similar to establishing the GHG costs included in the default energy bids of ISO resources.⁵ This includes a variable cost option and a negotiated rate option⁶. However, rather than calculating a GHG cost curve, the ISO calculates a single daily value based upon the maximum heat rate of the EIM participating resource.

Under the variable cost option for calculating the GHG bid adder cap, the ISO will calculate a single GHG cost for each resource each day. The ISO calculates each resource's GHG emissions cost based on the resource's heat rate characteristics, as registered with the ISO, the applicable GHG allowance price, and the resource's GHG emission rate. Similar to the default energy bids of ISO resources, there will be a 10% adder to the calculated cost.

An EIM participating resource must submit a GHG bid price equal to or less than its daily maximum GHG cost, but not less than zero. If an EIM participating resource submits a GHG bid price above the GHG cost of the EIM participating resource, the ISO sets the GHG bid to the calculated daily GHG cost. If a resource submits a MW quantity, but fails to submit a GHG bid price, the ISO rejects the bid.

⁴ It is important to note that market optimization will limit EIM transfers into the ISO to the bid in MW quantity from all EIM participating resources in the EIM footprint even if transmission to support EIM transfers was available.

⁵ For additional information, please review section 39.7.1 of the ISO tariff available at <http://www.caiso.com/rules/Pages/Regulatory/Default.aspx>

⁶ The negotiated rate option, which has not been used to date, is for resources that either can't file the necessary input data or can prove to Department of Market Monitoring that the GHG bid cap, as calculated below, is not a reasonable measure of their GHG compliance cost.

Although economic bidding on interties of an EIM entity balancing authority area is not currently allowed, the EIM GHG design includes rules for the cost based GHG bids of imports on EIM interties with surrounding balancing authority areas. Importers on these interties would submit an hourly GHG MW quantity and bid price similar to participating resources within an EIM balancing authority area. Currently, if the import is registered as a resource specific resource, the ISO will use the GHG emissions rate authorized by CARB for the specific resource to calculate the daily maximum GHG cost that may be bid. If the import is registered as a system resource, the ISO will use the GHG emission rate of the highest emitting resource outside the EIM footprint to calculate the maximum GHG cost that may be bid.

After NV Energy joined the EIM last November, EIM transfers occurred across multiple EIM balancing authority areas. Under the ISO's market optimization, a transfer from NV Energy balancing authority area to the ISO could occur while no transfers from PacifiCorp West balancing authority. However, the resource identified as supporting the EIM transfers from the EIM footprint to the ISO may be located within the PacifiCorp West balancing authority area. The reason for this outcome is that the optimization solves for the lowest cost resources – including the cost of GHG bid adders – to serve ISO load. A physical explanation for this outcome is that the energy from the resource in the PacifiCorp West balancing authority area is routed through the NV Energy balancing authority area to serve ISO load, whereas energy from the NV Energy balancing authority area is routed in the opposite direction to serve PacifiCorp West balancing authority area load.

CARB expressed concern that this outcome did not fully reflect the atmospheric effect of ISO load being served by resources external to the ISO balancing authority area in all instances. CARB's concern is the market optimization's least cost dispatch can deem or attribute low emitting resources to the ISO, but not account for the resulting "secondary" dispatch or backfill of other resources to serve external demand. The ISO believes this concern should be considered in the context of the atmospheric effect of the EIM dispatch also when it exports renewable output from California. However, the current CARB regulation does not account for the emission reducing effects that occur when there are EIM transfers out of the ISO supported by excess renewable generation in the ISO. When this happens, the renewable generation is displacing output from external GHG emitting resources that would otherwise be generating to serve external demand.

CARB and the ISO have been discussing how to address the leakage concerns resulting from the "secondary" dispatch⁷. CARB, through its rulemaking process, is proposing changes to

⁷ The market optimization simultaneously solves to serve load in the ISO and the other balancing authority areas in the EIM footprint. The term "secondary" dispatch is used to illustrate the backfill effect of lower GHG cost resources to support EIM transfers to the ISO with higher GHG cost resources, and should not be used to infer that the market optimization has multiple distinct steps.

address concerns of leakage that may result from the current EIM design. The ISO discussed the issue and how it can occur at CARB's June 24 workshop.⁸

Several options have been considered to address leakage concerns by potentially modifying the market optimization. However, each option has legal/regulatory risk and market inefficiency impacts that need careful evaluation. The ISO is currently working with CARB and stakeholders through the CARB rulemaking process to consider alternatives to address the concerns identified with the EIM GHG market design. Resolution of those concerns will inform how to address similar concerns about leakage through the day-ahead GHG market design.

5 State boundary versus balancing authority area paradigm change

In the ISO's current day-ahead and real-time markets, the market optimization treats supply serving any load located within the ISO balancing authority area⁹ as subject to the California Cap-and-Trade Program. This paradigm, that the ISO balancing authority area is sufficiently analogous to California's geographical boundary, was maintained when the EIM GHG market design was developed.¹⁰

As the ISO explores a transition from a predominantly single state balancing authority area to a multi-state balancing authority area, the ISO will need to model and identify market flows between market nodes subject to GHG compliance and nodes that are not subject to GHG compliance.

The ISO seeks stakeholder comments on other market rules or modeling that it may need to be clarified to support tracking energy flows between regions within a multi-state balancing authority area. For example, does the ISO need a rule to prohibit load aggregation points from crossing state boundaries or a rule requiring that all energy self-schedules in the non-California zone serve only load outside of California?

⁸ See presentation for June 24, 2016 Public Workshop on Mandatory GHG Reporting and Cap-and-Trade Program Electricity and Natural Gas Sectors
http://www.arb.ca.gov/cc/capandtrade/meetings/062416/arb_and_caiso_staff_presentations_update_d.pdf

⁹ It should be noted that currently the ISO does include Valley Electric Association load that is located in Nevada, within its balancing authority area. The decision to maintain the existing balancing authority area structure was chosen to minimize the implementation complexity when the California Cap-and-Trade Program was established.

¹⁰ During the EIM stakeholder process, the potential was recognized for a balancing authority area that is located solely within California may seek to join the EIM. In this scenario, the resources in this balancing authority would bid in the same manner as resources in the ISO. The resource would submit a single energy bid and not have separate bid costs submitted for energy and GHG costs. The locational marginal prices in this balancing authority area, as in the ISO, would not include a separate GHG component.

In modifying the existing EIM approach for tracking GHG compliance obligations¹¹ to support a multi-state balancing authority area, the design must be mindful of the potential need to support multiple GHG trading programs in the West. As more trading models are supported, the complexity¹² will increase and transparency will decrease, which is very likely to lead to a less efficient achievement of carbon reduction goals.

The ISO seeks stakeholder comments on design elements that can foster regional collaboration.

6 Imports/exports under a multi-state balancing authority area

Under the current paradigm, an import to the ISO balancing authority area is considered to serve load within California, an export from the ISO is sourced from generation within California, and a wheel may serve load outside of California with generation outside of the ISO balancing authority area. Thus the market model assumes that all market nodes used to represent intertie scheduling points for imports and exports with the ISO involve either imports serving load in California or exports sourced from generation within California. Since the system marginal energy cost component of the locational price is the same at all nodes, there is no net energy settlement for wheels. Wheels are only exposed to congestion and losses between the point the import enters the ISO balancing authority area and the export exits. Under a multi-state balancing authority area, the intertie scheduling points may or may not be modeled as being located in a specific state's geographical boundary.

For discussion purposes below, we assume there are two regions within the multi-state balancing authority area, a California zone and non-California zone. Imports into the multi-state balancing authority area could support both load within the California zone and within the non-California zone. Unlike a load node or generation node, the intertie scheduling point cannot be identified as located within a single zone based upon its geographical location. Therefore, bidding rules would presumably have to allow imports to provide separate energy bids and GHG bid adders. With separate bidding, similar to a supply resource in the non-California zone, the import would be deemed to have supported load in the California zone. The use of e-Tags for determining the GHG compliance obligation would likely have to be replaced by a similar mechanism used today for EIM participating resources that support EIM transfers into the ISO balancing authority area. In this case, the ISO market would determine which imports are supporting load in the California zone and consequently have a GHG compliance obligation.

In addition, generation within the California zone or within the non-California zone could support an export out of the multi-state balancing authority area. It is anticipated that the system marginal energy cost will continue to be based upon the California zone as is done currently

¹¹ In this paper, the phrase GHG compliance obligation is used as shorthand for California Cap-and-Trade Program compliance obligations.

¹² The EIM GHG design added a fourth component to the locational marginal price to differentiate pricing between the ISO and EIM balancing authority areas. If additional programs required further price differentiation between, the number of components of the locational marginal price have the potential to become unmanageable.

within the EIM. Since, intertie scheduling points are not considered part of the California zone, the LMP at these scheduling points will include a GHG compliance cost component. In the event that there are flows from the non-California zone to the California zone, the GHG compliance cost component would be negative. If there are flows from the California zone to the non-California zone, then the GHG compliance cost component would be zero.

As a result, the California zone GHG compliance obligation will be the higher of California zone load or California zone generation. The current market optimization assumes all imports to ISO balancing authority area are serving California load. Under the multi-state balancing authority, it will not be assumed that all imports serve California load. The market optimization will attribute which internal resources of the multi-state balancing authority area and imports to the entire footprint that serve California load.

The ISO seeks stakeholder comments on potential issues or bidding rule changes needed for imports and exports. Also, should existing ISO intertie scheduling points that remain after creation of a multi-state balancing authority area still be considered as within the California zone and treated in the same manner as currently done.

7 Next Steps

The ISO plans to discuss this issue paper with stakeholders during a stakeholder conference call to be held on September 6th. The ISO requests comments from stakeholders on the proposed areas of GHG market design changes described in this issue paper. Stakeholders should submit written comments by September 20th to InitiativeComments@caiso.com.