California ISO

EDAM
EXTENDED DAY-AHEAD MARKET

Greenhouse Gas Accounting and Costs

WORKING GROUP 3 FINAL SUMMARY REPORT

March 30, 2022

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1 Preamble

The CAISO launched the *Extended Day Ahead Market (EDAM)* initiative in November 2021 to design the framework for extending the Day Ahead Market across balancing authority areas (BAA) in the western interconnection to derive the efficiencies and benefits through optimized resource commitment and build upon the Western Energy Imbalance Market (WEIM) collaboration. As part of the overall stakeholder process, the CAISO sought to leverage the stakeholder perspectives and ideas early in the process to help inform development of a comprehensive straw proposal. To that end, the CAISO introduced three stakeholder working groups on critical components of an EDAM.

Working Group 1: Resource Sufficiency and Supply Commitment. The working group focused on discussing different design elements of the resource sufficiency evaluation in the Day Ahead Market under which each participating EDAM BAA would bring forward sufficient capacity to meet their expected demand and associated uncertainty. The discussion included consideration of the consequences for failing to pass the resource sufficiency evaluation as well as how sufficiency, and other components of the EDAM framework, should be considered in establishing the level of confidence in market transfers.

Working Group 2: Transmission Commitment and Congestion Rent Allocation. The working group focused on a framework for how transmission could be made available to the market to support transfers between EDAM BAAs and the allocation of congestion review and compensation for the associated transmission. The discussion also included focus on the ability of the market to respect and allow for the exercise of transmission rights independent of the EDAM. Finally whether or how entities outside of the EDAM footprint could interact with the market were considered.

Working Group 3: GHG Accounting. The working group focused on designing a framework for accurate GHG accounting and reporting requirements arising out of Day Ahead Market commitment and market participation to facilitate compliance with current and emerging greenhouse policy requirements in states adopting GHG regulation polices across the EDAM footprint while also respecting states that are not adopting GHG regulations.

The stakeholder working groups met over an eleven week period, from January 3rd to March 17th, through an open and inclusive process to foster dialogue, the sharing of

ideas, presentations and perspectives.[1] In the initial meetings, each working group reviewed and ratified a list of scope items to discuss over the course of the meetings, reviewed the relevant *Extended Day Ahead Market Common Design Principles and Concepts,*[2] and developed a general schedule of when topics would be covered in the working groups to facilitate stakeholder engagement. As part of working group process stakeholders in addition to CAISO developed presentations to share their perspectives, ideas, or frameworks for consideration and vetting through the process.

The working group summary reports attempt to capture the summary of the discussion across each one of the working groups, and are not intended to capture all positions or points of discussion heard during the meetings.[3] While these summaries, and the more detailed working group discussions, will help inform the CAISO comprehensive straw proposal on the initiative which is targeted for publication the last week of April 2022, the summaries are not intended to be a representation or indication of the direction of the CAISO straw proposal.

2 Introduction

Accounting for greenhouse gas (GHG) costs and reporting requirements is an important component of the overall EDAM design. Over an eleven week period, working group 3 (WG-3) focused on robust, open, and inclusive stakeholder discussions on different elements of the GHG accounting design with various stakeholders putting forward ideas and presentations for consideration. At the onset of the discussions, the group reviewed an initial list of scope items and developed design objectives for consideration throughout the discussion. Through these discussions, two general frameworks

[1] Each working group met twice per week, with a two hour duration for each meeting. Over the eleven week period, the three working groups totaled 60 meetings.

[2] The *Extended Day Ahead Market Common Design Principles and Concepts* were developed by a group of WEIM Entities and California Participating Transmission Owners, facilitated by the CAISO, in an effort to provide an initial point for consideration on various topics that would need to be considered further in designing an EDAM. Link: https://www.caiso.com/Documents/EDAM-Common-Design-Principles-Concepts.pdf

[3] Each working group meeting has been recorded and is accompanied by a weekly written summary that can be found no each working group web page. For a more detailed view into each meeting, stakeholders are encouraged to access these documents. Link: https://stakeholdercenter.caiso.com/StakeholderInitiatives/Extended-day-ahead-market

emerged on GHG accounting for consideration which were further vetted through the working group discussions: (1) resource specific approach, and (2) zonal (unspecified) approach. Stakeholders also put forward variations to elements of the resource specific approach that were also discussed. These approaches, their variations, and other elements are further described in this working group summary report which will help inform development of the EDAM comprehensive straw proposal.

In addition, for working group #3 (WG-3), an initial set of Scope Items was developed by CAISO policy and subject matter teams as a starting point for detailed design discussions throughout the 11 weeks of WG-3 sessions.[4]

3 Summary of Working Group 3 Progression

Following is a high level summary of the structure and progression of the 11 weeks of WG-3 sessions:

- **Weeks 1-2:** Background and level-setting; Design Objectives initial Scope Items reviewed and revised for participants input.
- **Weeks 3-4:** Review and discuss the two primary design approaches, (i) Resource Specific and (ii) Zonal, referred to as Version 1.0 design elements. A "homework assignment" requested participants to raise three questions on each proposal.
- **Weeks 5-7:** Outside perspectives and regulatory agencies presentations (California Air Resources Board [CARB], Washington Utilities and Transportation Commission [UTC], Washington Department of Ecology [WA DOE], Western Resource Advocates [WRA)].
- **Weeks 7-8:** Revise scope items document with participant feedback from "homework assignment".
- **Weeks 8-9:** Revisit each of the two primary design approaches, (i) Resource Specific and (ii) Zonal, referred to as Version 2.0 design elements.
- **Weeks 9-11**: Close-out the WG outstanding design elements, primarily on the Zonal approach.

[4] Initial/Draft List of Scope Items – Extended Day-Ahead Market (EDAM) Stakeholder Working Group 3: Greenhouse Gas Accounting and Costs – Dec 14, 2021,
http://www.caiso.com/InitiativeDocuments/InitialandDraftIScopeItems-ISOProposed-EDAMWorkingGroup3-GreenhouseGas-GHG-AccountingandCosts.pdf

Supporting these discussion topics, multiple participants presented their perspectives followed by a question and answer session. Following is a summary of these presentations (all are posted on the EDAM initiative WG-3 website on the corresponding session dates):

- 1/18/2022 *Applying EIM Greenhouse Gas Regulation Model* (George Angelidis, CAISO)
- 1/20/2022 *Powerex Perspective on EDAM GHG Approach* (Jeff Spires, Powerex)
- 1/26/2022 *Exploring a Potential Two-Zone Approach* (Jeff Spires, Powerex and Mary Wiencke, PGP)
- 1/27/2022 *E-Tags, data reporting and CAISO markets* (Kevin Head, CAISO)
- 2/1/2022 *Climate Commitment Act Cap-and-Invest Rulemaking Overview* (Kathy Taylor, Washington Department of Ecology, Air Quality Program)
- 2/1/2022 *Washington State Clean Energy Transformation Act* (Commissioner Ann Rendahl)
- 2/8/2022 *Greenhouse Gas Accounting in Regional Electricity Markets* (Dr. Vijay Satyal, Western Resource Advocates)
- 2/15/2022 *CARB Electricity Sector Greenhouse Gas Accounting* (Abajh Singh, CARB)
- 2/22/2022 *Current Framework for Greenhouse Gas (GHG) Accounting within CAISO Markets* (Abhishek Hundiwale, CAISO)
- 2/24/2022 *Resource Specific Option Version 2.0* (Anja Gilbert and George Angelidis, CAISO)
- 3/1/2022 *Exploring a Potential Zonal Approach for EDAM GHG (2.0)* (Jeff Spires, Powerex and Mary Wiencke, PGP)
- 3/15/2022 *EDAM GHG Accounting and Costs: Additional Resource Specific Option* (Kallie Wells, Gridwell Consulting)

4 Initial Level Setting in WG-3

The first three WG-3 sessions focused on: (i) background of relevant GHG principles and activities in the western region, (ii) review and participant revisions to the GHG Design Principles, and (iii) review and participant revisions to the WG-3 Scope Items.

4.1 Establish Common Agreement on EDAM GHG Design Objectives

Stakeholders recommended updating the initial set of GHG design objectives from the EDAM Common Design Principles and Concepts document[5] to include:

- Factoring in regional gas price indexes (this was requested to be added as a scope item);
- Accommodating potential linkage of different state-level GHG pricing programs;
- Considering whether GHG design would be impacted by cross-country boundary transactions from US to Canada or Mexico (this was requested to be added as a scope item);
- Allowing the market design to be flexible to respond to future GHG policies;
- Recommending approaches such as: (i) don't let perfect be enemy of the good, and (ii) try not to re-invent the wheel; focus on incremental improvements (to WEIM); and
- Focusing on simplicity and technical feasibility.

These revisions yielded the following **WG-3 Design Objectives**, from which the relevance and priority of the detailed design elements may be based:

1. No inappropriate or unacceptable GHG impact in non-GHG zone;
2. Leakage should be minimized;
3. Enable similarly situated or similar technology resources in non-GHG zone to compete on a level playing field with resources inside GHG zone and vice versa;
4. Do not inadvertently undermine renewable portfolio standards (RPS) and clean energy standards (CES) policies;
5. Allow for market efficiency by accurately reflecting relevant GHG compliance costs;
6. Seek simple solutions where possible while balancing precision and implementation feasibility and simplicity to support state policy objectives; and
7. Durability of the market design including but not limited to allowing for future policy designs and potential linkage.

[5] EDAM Common Design Principles and Concepts, https://www.caiso.com/Documents/EDAM-Common-Design-Principles-Concepts.pdf

4.2 Establish Common Agreement on EDAM GHG Scope Items

The initial set of draft WG-3 market design **Scope Items** developed by the CAISO policy and subject matter expert teams was reviewed and revised based on WG participant discussion and comment. The revised set of Scope Items is posted in the January 6 section of the WG-3 EDAM initiative website.[6]

Following the first pass through design Scope Items (version "1.0"), at the January 27 WG session, participants were assigned "homework" to provide three questions related to each proposal's design elements. There was considerable response to this assignment, and these priority topics were used as a guide for the second deep-dive into the proposal discussions (version "2.0").[7]

As the WG-3 sessions progressed, these **Scope Items** were revisited multiple times, updated to reflect the ongoing participant discussions and refinement of market design elements, and differentiated with a focus on specific design approaches. The Scope document became a template to consider different design proposals. In total, there are four iterations of the original (January 6) **Scope Items** document:

1. Updated to reflect participant submitted focus areas (responses to the "homework assignment")[8];
2. Annotated with references to current WEIM market design elements[9];

[6] Revised List of Scope items: EDAM WG 3: Greenhouse Gas Accounting and Costs – Jan 6, 2022 http://www.caiso.com/InitiativeDocuments/RevisedListofScopeItems-EDAMStakeholderWorkingGroup3%E2%80%93GreenhouseGasAccounting-Costs-Redlined-Jan6-2022.pdf

[7] The summary of homework responses – EDAM WG 3: Greenhouse Gas Accounting and Costs – Feb 17, 2022, http://www.caiso.com/InitiativeDocuments/HomeworkResponses-ExtendedDay-AheadMarket-WorkingGroup3-GreenhouseGasAccounting-Costs-Feb17-2022.pdf

[8] Revised List of Scope Items – EDAM WG 3: Greenhouse Gas Accounting and Costs – Feb 17, 2022, http://www.caiso.com/InitiativeDocuments/RevisedList-ScopeItems-ExtendedDay-AheadMarket-WorkingGroup3-Greenhouse%20GasAccounting-Costs.pdf

[9] Current WEIM Model – EDAM WG 3: Greenhouse Gas Accounting and Costs – Feb 22, 2022, http://www.caiso.com/InitiativeDocuments/Revised%20Scope%20-%20Current%20WEIM%20Model-Feb22-2022.pdf

3. Annotated to reflect the specific market design elements associated with the Resource Specific approach[10];
4. Annotated to reflect the specific market design elements associated with the Zonal approach[11];

5 Two Design Approaches

Early in the WG-3 sessions, the discussion on the specific design **Scope Items** resulted in two fundamental design approaches. Both of the approaches rely on a framework of GHG areas (also referred to as GHG zones/compliance areas/regulation areas i.e. geographic areas that, if energy were to be transferred into them, the transferred energy would have a GHG price imposed on it) and non-GHG areas (also referred to as non-GHG zones/compliance areas/regulation areas, i.e. geographic areas that have no GHG price imposed).

1. Resource Specific approach
    - An extension of the existing WEIM market design to the day-ahead time horizon;
    - For EDAM generating resources outside the GHG areas, the market optimization would use a least-cost optimized dispatch to deem generation to serve load in GHG areas based on resource-specific GHG bid adder.
2. Zonal approach
    - Originally proposed for WEIM consideration prior to the inception of the working groups;
    - For EDAM generating resources outside the GHG areas that are not otherwise obligated to serve load in the GHG areas, the market optimization would allow transfers from a non-GHG area to a GHG area if the price differential between the areas exceeds a "hurdle rate;"

[10] Summary – Resource Specific Approach – Mar 3, 2022, https://www.caiso.com/InitiativeDocuments/Summary-Resource-Specfic-Approach-Mar3-2022.docx
[11] Summary – Unspecified Zonal Approach – Mar 8, 2022, http://www.caiso.com/InitiativeDocuments/SummaryofUnspecifiedZonalApproach-Mar8-2022.pdf

- This approach would also include “source-specific” pathways for generating resources to self-schedule or bid to serve load into the GHG areas, depending on meeting certain criteria.

6 Summary Review of EDAM WG-3 Design Elements

The following sections capture the primary design elements discussed throughout the workshops. Common elements to both approaches are captured, as are design elements specific to the Resource Specific approach and the Zonal approach.

6.1 General Issues Applicable to Both Approaches

- Both proposals received feedback on the durability of the market design, and the need to consider the impact of the proposed EDAM design approach in the scenario when all or most BAA/states adopt some form of GHG policy and with potentially different compliance obligation costs. For the Resource Specific approach, this includes having potentially different GHG bid costs specific to each GHG zone. For the Zonal approach, this entails the challenge of having multiple hurdle rates.

  There was a focused discussion on what role an expanded Western Renewable Energy Generation Information System (WREGIS) could serve in this EDAM design context; focusing on the primary challenge of associating specific resources to load served (in the market) for REC accounting, and rolling this up to the BAA level. Another challenge or requirement of this approach is to expand WREGIS to include all generating resources. Today, WREGIS tracks only renewable energy generation from units that register in the system by creating RECs for this generation, some stakeholders suggested expanding this functionality to track all generation. It was generally observed that this would be a parallel or auxiliary process to the EDAM market design.

6.2 GHG Area Definition

The purpose of discussing the GHG area was to determine how best to represent a GHG area in the CAISO’s optimization. In the WEIM today, the CAISO BAA footprint is equivalent to California’s GHG area. However, the early 2023 introduction of Washington’s GHG program and the potential for other state GHG pricing programs that may not align with BAA boundaries, might necessitate a change to how the CAISO models a GHG area.

With both proposals, it was generally agreed that each GHG area's boundary would not necessarily be equivalent to BAA boundary; the GHG area definition would instead be independent from the BAA boundary (i.e., a BAA could span multiple GHG areas and multiple GHG areas may be defined within a BAA), and could include international areas, as applicable. The GHG area definition objective is to accurately reflect compliance obligations of resources (energy bids in the case of the Resource Specific approach, and hurdle rates in the case of the Zonal approach).

Early on in the working group, a participant suggested the potential need for alignment of transmission boundary concepts developed in Transmission working group. However, it was discussed that those concepts are not relevant for either approach as GHG transfers are distinct from BAA transfers and transmission boundary issues.

6.2.1 Resource Specific approach

In the WEIM today, the GHG area is currently defined at the BAA level. Early in the working group, it was generally agreed that the modeling of the GHG areas should change to be independent from the BAA level.

WG participant questions and discussion topics included:

- *Question*: How specifically does this work for multi-state BAAs, e.g. how will the WA load in BPA's BAA be identified (nodes?) and how will the volume of resources deemed delivered to those loads be calculated? And how will BPA's resources be modeled (under WA cap and trade, BPA's system – and generating units – are all considered imports to the state).

  Answer: The GHG area is a defined group of nodes that can partially overlap with a BAA. The CAISO is proposing defining GHG areas independently from BAAs. This will facilitate a BAA spanning multiple states and GHG areas to accurately reflect bids/compliance obligations. This would be done via a node group definition in the Master File. CAISO's understanding from WA DOE is that imports must use the unspecified rate. The CAISO could provide WEIM Entities with their specific market data to assist them with reporting obligations under Washington's Cap and Invest program. The CAISO may also be able to provide aggregate information to help Washington state and reporting entities ensure accurate accounting of power obtained from the WEIM.

- *Question:* How would CAISO determine GHG net exports for a single state in a multi-state BA for the purposes of limiting GHG attribution (in the resource-specific GHG attribution enhancement)?

Answer: Modeling the GHG area as independent from the BAA would allow CAISO to attribute GHG net exports for a single state in a multi-state BAA. The net import into a GHG area (not necessarily, but probably a state) would be determined as the net of scheduled demand minus scheduled supply in that GHG area.

6.2.2 Zonal approach

As with the Resource Specific approach, the GHG area criteria must be consistent with the relevant state environmental program requirements. In-state loads and resources are assumed to be within the GHG area; the market design will also provide external resources of entities that span state boundaries to be treated in a manner that is consistent with the established criteria set by program requirements. For the source-specific pathways in the Zonal approach, the criteria for external resources to be considered within a GHG area is further in this report below.

Similar to the Resource Specific approach, this approach carries these same GHG area definitions over to the WEIM.

6.3 Multiple GHG Compliance Areas

The purpose of discussing multiple GHG areas was to determine how the EDAM market design could scale as the number of GHG areas increased, and meet the principle that, "to the maximum extent possible, market design should fairly reflect and be consistent with state policy objectives."

At the onset of EDAM, expected in January 2024, the Washington and California GHG programs will not be linked. This means that the allowances used to comply in one program cannot be used to meet the compliance obligation in the other. An implication of this is that there will be different GHG allowance prices for both programs. As such, it was generally agreed that each approach would need to accommodate multiple GHG areas.

Both approaches developed designs that would be able to support multiple GHG areas. However, the working group also discussed that each approach has outstanding design and implementation challenges related to transactions between GHG areas, namely that each requires a separate input based on the GHG zone (i.e., potentially different GHG bid costs specific to each GHG zone in the Resource Specific approach and multiple hurdle rates for the Zonal approach).

6.3.1 Resource Specific approach

The Resource Specific approach supports multiple GHG areas by allowing separate GHG bids to be submitted for each GHG area. In other words, a resource located outside of the GHG areas could submit separate GHG bids: one to indicate its willingness to serve load in California and one to indicate its willingness to serve load in Washington. The market would then co-optimize using these GHG bids and the resource's energy bid and deem generation to load within the GHG zones based on the merit order.

The working group generally agreed that further policy and implementation discussions are needed to work out how to support cross-regulation area GHG transactions. Specifically, the issue of how resources within one GHG zone could be deemed to serve load in the other GHG zone was not resolved. Functionality that allows a resource in one GHG area to submit a GHG bid to serve the load in the other GHG area might enable these transactions. While the initial Version 2.0 presentation did not include functionality to support cross-regulation area GHG attribution, this was later updated in the March 3, 2022 summary of Version 2.0 as an issue subject to further policy and implementation discussions. This conversation is expected to progress and evolve through the EDAM policy development process.

6.3.2 Zonal approach

The Zonal approach supports multiple GHG areas by having two GHG zones with two separate hurdle rates. Resources outside of the GHG zones would submit their energy bids (excluding any GHG compliance costs). The market then would allow transfers (if the GHG zone is a net importer) from the non-GHG zone based on the price differential between the non-GHG zone and the GHG zone exceeds the area-specific hurdle rate.

Similar to the Resource Specific approach, the working group generally agreed further policy and implementation discussions are needed work out how to support cross-regulation area GHG transactions. Specifically, it is not clear whether transfers between the two GHG areas would be subject to a hurdle rate or not. No functionality was discussed to enable these transactions. This conversation is expected to progress through the EDAM policy development process.

6.4 Availability and Eligibility to Serve Demand in the GHG Compliance Area

The purpose of discussing availability and eligibility to serve demand in the GHG area was to reflect how operationally the market design could meet the GHG principle that states "jurisdictions have not adopted a GHG or renewable procurement policy should not be improperly affected, directly, or indirectly by policies in other jurisdictions". Both approaches seek to provide optionality for EDAM Participating Resources to submit bids on a voluntary basis to make their output available to serve demand in a GHG area, but in distinct ways.

6.4.1 Resource Specific approach

The availability for a particular Participating Resource to serve load in a GHG area would be optional and based on hourly GHG bids submitted.

WG participant questions and discussion topics included:

- *Question:* How will this allow a utility to direct where energy is accounted for?

  Answer: The working group discussed that, under the Resource Specific approach load serving entities would not be able to direct where their energy serving their load would come from for a few reasons. First, the load resources in CAISO's market and EDAM have wide aggregations (i.e., the entire BAA for WEIM BAAs) which does not provide sufficient granularity for a supply to load matching system. To increase the granularity of load would impose severe performance issues to IFM, but more importantly, it would be detrimental to load settlement and CRRs because of the myriad of different load aggregation point LMPs. Furthermore, it was mentioned that it would be very challenging, or impossible, to separate load customers at the same node, or load aggregation point (LAP), and track load migration among the various LAPs.

- *Question:* How will this preserve the ability to sell non-emitting surplus into a GHG zone?

  Answer: Within EDAM, a resource would indicate a GHG compliance cost and quantity, and make its non-emitting surplus available for the GHG zone via its GHG bid based on co-optimized results.

6.4.2 Zonal approach

The working group generally agreed that, except for the source-specific pathways discussed below, individual resources external to the GHG area would not be individually identified when a net transfer occurs between the non-GHG area and the GHG area. Individual resources external to the GHG area would not elect to be eligible for attribution to the GHG area load. See "Reporting and settlements" section below for more details on compliance with reporting obligations.

For the source-specific pathways, it appeared that the working group agreed that eligibility would be determined consistent with relevant state policy requirements. See "Source-specific pathways to serve GHG zone" section below for more details.

6.5 Participation Options

The purpose of discussing participation options was to understand if any of these options challenged the market design or required special use cases. At the start of the working group process, a range of participation options were raised to clarify GHG treatment. These use cases included: imports at the EDAM boundaries, pseudo-ties, wheels through a GHG area, virtual bids, energy storage, jointly-owned units, and self-scheduled resources.

It was generally agreed that both approaches would take a common approach for:

- GHG pseudo-tied resources being included in the GHG area into which they are pseudo-tied. GHG pseudo-tie resources are physically outside of their BAA's boundaries but are contractually treated as internal generation for the purposes of the market optimization.
- The discharge portion of battery storage resources being included for both approaches, subject to the same bidding differences between the two approaches, as outlined above.
- Not addressing GHG attribution from imports at EDAM Boundaries, as this would be contingent on WG-2 discussions on external resource participation.

6.5.1 Resource Specific approach

The Resource specific approach clarified:

- GHG attribution would be limited to physical supply. Virtual supply does not have GHG attribution, even though their schedules outside of GHG areas may contribute to net import transfers into GHG areas.
- Jointly-owned units would be included if the parent resource is located within a GHG area. If the resource is located outside of all GHG areas, its JOU child resources would submit separate GHG bids for attribution to specific GHG areas.
- Self-scheduled resources would be included if they submit a GHG bid and energy bid.

6.5.2 Zonal approach

The Zonal approach clarified:

- Treatment of JOU resources may be included in the Source Specific pathway #2 (see the "Source-specific pathways to serve the GHG zone" below for details),
- Self-scheduled resources would be included and treated same as any other resource for transfers into the GHG areas.
- Treatment of virtual bids was not discussed.

6.6 Alternative Pathways to Serve the GHG Compliance Area (Zonal Approach Only)

Another key feature of the Zonal approach is the ability for certain resources physically located in the non-GHG zone to utilize a source-specific pathway to serve the GHG zone. This would obviate the need for these particular resources to clear the hurdle rate. There were two pathways discussed for how this could work:

6.6.1 Path #1 Define the GHG Area to include resources outside of physical state boundaries (GHG area)

It was offered that this path would be used by resources with a longer-term commitment to meeting load within the GHG area. The proposal suggested the EDAM market optimization would simply treat the resources as if they are physically located within the GHG areas.

Discussion topics and questions on this topic included:

- **Implementation.** Functionally, it was generally agreed that this could be implemented in CAISO's Master File. The alternative is to have a third party or the regulators themselves take this ex-post verification responsibility.
- **Long Term vs. Additional Availability.** The working group discussed at length a scenario in which a resource is 70% committed with long-term obligation (to serve a particular GHG zone) and 30% available for additional GHG attribution, or any other market award. A CAISO subject matter expert suggested that this scenario may best be supported by the jointly-owned unit (JOU) model, the 70% and 30% portions represented as independent "children" resources, each with respective schedules/bids. However, it was cautioned that this model is currently in pilot status, and likely will not fully implemented in alignment with the EDAM timeline. The alternative to this would be to break this hypothetical 70% GHG-obligated resource into independent resources. In this alternative, it was explained that this would create a challenge of how to treat the split resource in the optimization because the market could not take the resource's physical constraints (e.g. ramp rates, minimum operating level) into account. The working group did not reach resolution on how this might work.

6.6.2 Path #2 Once the GHG zone is defined, some imports may be treated on specified or entity-specific basis

This second path is conceptually similar to current the approach for specified-source imports in bilateral markets. It would rely on shorter term commitments to serve the GHG zone. It would explained that it would likely be applicable to entities with surplus non-emitting supply in some periods and not others.

Discussion topics and questions on this topic included:

- Regarding functionality, several options were discussed:
    1. The resource would submit self-schedules with E-Tags ahead of the EDAM run.
    2. The resource would submit GHG bids into the EDAM and then some form of ex-post audit could occur to verify that the shorter-term contractual obligations were adequately reflected in the bids.
    3. Perform a preliminary market run, like the RSE discussed in the Resource Specific approach, using a GHG bid adder that is based on each resource's emissions rate.
- The working group recognized the source-specific cross-over from these approaches for Path 2 to the Path 1 scenario. There was discussion of creating a

"Path 3" that combined elements of Path 1 and Path 2, but this was ultimately found not necessary as it was not intended by the introduction of the two original paths that they are not necessarily exclusive of one another, but rather two concepts that may be combined.

- An implementation concern was raised that the E-tag timing posed challenges, as E-tags are due at 3PM and the day ahead market runs would occur well before that deadline.
- A concern was expressed that the Path 2 scenario within the overall Zonal approach may be problematic from a market design perspective. No clear conclusions were reached, but the challenges were identified, mainly on how the optimization would treat such a resource-specific self-schedule as exempt from the hurdle rate and be carved out from power transfer calculations.

6.7 Costs Optimized in the Market

The purpose of discussing the costs optimized in the market was to align on what the CAISO market would optimize to account for GHG policies. GHG prices are optimized in both approaches, but treated substantially differently in the optimization. However, there appeared to be agreement that neither approach should optimize for RPS/CES programs; both approaches viewed these policies as procurement policies and not costs to be optimized by the market.

6.7.1 Resource Specific approach

For resources external to the GHG zones, the cost of GHG compliance would be expressed explicitly in the bid as an optional and separate GHG bid component (bid adder), for each hour of the market run. This includes a bid for the GHG quantity (MW) and the GHG price ($/MWh). These GHG bids are then used by the market in arriving at a least cost optimized dispatch.

When considering GHG pricing, there are two issues that were flagged that would require further discussion for each new GHG area that joined, including the GHG allowance index prices and gas fuel regions. The Resource Specific approach suggested that each new GHG area may need to update to the use of indices, as today the indices used to determine the cap on GHG bids are the California allowance price indices. Second, the Resource Specific approach flagged that each new GHG area may need to determine if they would make any adjustments to gas prices similar to the

approach taken with California. Today, CA gas prices are adjusted downward to account for GHG compliance costs reflected in energy.

Concerns expressed by participants for the Resource Specific approach included:

- Challenges in accurately identifying which specific resources serve which specific loads.
- Imperfect mechanism with counter-intuitive results to "deem" energy that attributes to GHG area loads.
- Consequences of inaccuracy (of GHG attribution) under a regional day-ahead market might be greater than WEIM because of increased volume of transactions in the day ahead timeframe.
- Hourly granularity of participation election may lead to strategic bidding and gaming opportunities.

6.7.2 Zonal approach

It was discussed that GHG prices would be imbedded implicitly in the energy bid for resources within the GHG areas, including resources participating in the source-specific pathways, and not included (implicitly or explicitly) in the energy bids for resources external to the GHG areas. GHG prices would instead be reflected in the hurdle rate for transfers into the GHG areas.

6.8 Hurdle Rate Calculation (Zonal Approach Only)

Except in cases where resources use a source-specific pathway, for the non-GHG zone to serve the GHG zone, the price in the GHG zone has to exceed a certain value: the hurdle rate. If the transfer between the non-GHG zone to the GHG zone were to occur, revenue would be based on the hurdle rate ($/MWh) and the MW transfer. It was generally agreed that the hurdle rate would be the product of an emissions rate (e.g. tons/MWh) and a GHG allowance price (e.g. $/ton).

Similar to how compliance obligations are allocated, it was noted that the calculation of the hurdle rate is connected to how the various state agencies determine the unspecified emissions factor. This is because the level of the hurdle rate determines the number of compliance allowances that would be created from the transfer into the GHG zone. Because of this connection, it was noted that the decision on the hurdle rate is subject to the regulatory rulemaking processes and is outside of the purview of CAISO's authority.

Understanding that, there were several options discussed the unspecified rates might be structured:

1. Pre-defined, static for all market intervals, and not adjusted on a daily basis (equivalent to using the current agency-established emissions factor of 0.428 $mTCO_2e$/MWh).
2. Pre-defined based on some analysis of likely marginal resources on a daily basis; varies by hour within the market run.
3. Dynamically determined from the baseline run to better reflect system conditions, varies by hour within the market run.

Discussion topics and questions on this alternative baseline approach included:

- The working group discussed that hurdle rate should incent clean resources to loads in GHG areas, but also must be fair to resources inside the GHG zone. One scenario that was discussed: a battery outside the GHG zone could charge without a hurdle rate but deliver to GHG zone and receive the hurdle rate. The hurdle rate should mitigate these kind of shifts.
- One participant characterized the choices as (i) static for all market intervals would be good, (ii) static but varying by market interval would be better, (iii) dynamically determined by marginal resource would be best. It was noted that, as the choices increased in desirability, the impracticality of the implementation also increased.
- There was also discussion of whether the hurdle rate should consider marginal versus average emissions rates. While it was noted that using the emissions rate of the marginal resource may over-count the GHG attribution into the GHG zone, the working group also acknowledged that the CAISO's market is premised on marginal cost pricing. Furthermore, the working group acknowledged that this would be a decision of the state agencies.
- The hurdle rate would use the allowance prices that the CAISO receives from external vendors. There will be two GHG allowance market prices at the inception of EDAM (expected in Jan 2024) because WA's and CA's GHG programs will not be linked. Because of this, it was generally acknowledged that there will have to be two GHG zones and two GHG hurdle rates.
- *Question:* Can EDAM SCs negotiate their own specified emissions rate? Would self-scheduled power qualify for a resource specific emission rate?

  Answer: The working group noted that ACS emissions rate treatment would need to be approved by CARB and that resource-specific treatment within the GHG zone must meet any applicable state-required criteria.

6.9 Baseline for Evaluation of Attribution (Resource Specific Approach Only)

A primary characteristic of the Resource Specific approach is that it relies on an algorithm to attribute MW of generation to serve load within the GHG zone. In this approach, only a portion of the resource's MW are eligible for attribution. The eligible MW would be calculated as the difference between a ceiling and a floor/baseline. It was discussed that the ceiling would the resource's Upper Economic Limit (UEL, this can be thought of as the maximum bid-in capacity). The working group discussed two variations on how the floor could be calculated:

i) Resource Sufficiency Evaluation (RSE) results as the baseline

This variation would rely on the RSE solution at 10AM as a baseline reference for the floor, similar to how the base schedule is used in the WEIM. The RSE optimization model is run prior to the IFM to assess if there is sufficient supply in an EDAM BAA to meet the respective demand forecast and uncertainty requirements.

The RSE optimal schedule minimizes bid costs for meeting BAA requirements without transfers between the EDAM BAAs and as such it can be used as a counterfactual for resource-specific GHG attribution. This model accounts of power balance requirements, imbalance reserve requirements, ancillary service requirements, unit commitment inter-temporal constraints, capacity constraints, ramp capability constraints, VER forecasts, and energy limitations for hydro and battery resources.

This variation would also involve limiting the total MW eligible for attribution from a non-GHG zone to the maximum export capacity from that non-GHG zone. It was discussed that this approach could result in differential GHG locational marginal price (LMP) components across the non-GHG zone. Some concerns were raised about certain non-GHG areas receiving $0/MWh GHG LMP components.

ii) Optimized baseline targeting incremental dispatch

This variation for use in the Resource Specific approach was offered for consideration by WPTF[12]. The key elements of this alternative approach (as compared to the Resource Sufficiency Evaluation (RSE) approach, above) are:

1. Include internal transmission in baseline schedule. This is in contrast to the RSE optimization which does not include internal transmission. Because of this

[12] Presentation - Greenhouse Gas Resource Specific Approach - Gridwell Consulting - Mar 15, 2022 http://www.caiso.com/InitiativeDocuments/Presentation-GreenHouseGasResourceSpecificApproach–GridwellConsulting–Mar15-2022.pdf

additional element, it was discussed that the RSE optimization results cannot be used and a separate market run would be required.

2. Limit eligible MW to incremental dispatch above the baseline schedule. It was mentioned that this would involve the market solving the eligible MW for GHG attribution and the broader market solution simultaneously.

Discussion topics and questions on this alternative baseline approach included:

- This approach would require additional binary variables and an additional market run. It was discussed that this could be problematic for the feasibility of the implementation because the day-ahead market could take more time to run than it does currently. Additionally, it was discussed that this could result in the resource receiving a LMP below its energy bid, which was considered by some as a sub-optimal solution. That said, the working group generally agreed that this variation would more accurately estimate calculate secondary dispatch. If the market were to attribute GHG MW based on this more accurate calculation, this variation could better limit leakage.
- The working group discussed that the attribution constraint related to the incremental dispatch could carry over to the WEIM market.
- Participants commented on the potential for reduced optimality in this approach compared to the above approach, and also for potential bid strategies (gaming) need to be evaluated. Working group participants requested a quantitative analysis of the relative frequency of cases where the situation discussed above (i.e. the resource receiving a LMP below its LMP) might occur. Due to the time constraints of the working group, this quantitative analysis could not be provided during the working group. However, it was generally agreed that a successful EDAM design would balance the calculation accuracy of the GHG attribution against the efficiency of the overall market solution.

6.10 GHG Emission Attribution

The purpose of discussing GHG emissions attribution was to understand how any design related to attribution could reflect state policies and support associated state reporting requirements.

6.10.1 Resource Specific approach

The working group discussed that the CAISO would use a resource-specific emissions rate for resources within EDAM BAA. The emissions rate for non-EDAM BAA resources

deemed to GHG area(s), would use either (i) unspecified rate as determined by respective GHG area regulator, or (ii) average emissions rate based on their areas, as approved by the state regulators (e.g. CARB) for Asset Controlling Supplier (ACS).

6.10.2 Zonal approach

This approach does not require resource-specific emission attribution determined from the market run, or by the market operator.

6.11 Leakage Minimization Mechanism

The purpose of discussing minimizing leakage was to understand how various market design approaches could minimize the potential of higher emitting resources backfilling for any low emitting resources that were dispatched to serve a GHG area.

As background, state-level GHG pricing programs attempt to limit emissions leakage to jurisdictions that do not have a GHG price. One way that they do this is by subjecting GHG-intensive imports to a GHG price. To the extent possible, the CAISO would attempt to design its EDAM to not conflict with this goal. However, an EDAM based on least cost dispatch will inherently send cleaner resources to a GHG zone because low emitting resources face either fewer or no costs to comply with GHG regulations. In some instances, higher-emitting resources will need to backfill this dispatch to serve load in a non-GHG zone. This backfill is referred to as secondary dispatch and is a type of leakage.

Any GHG accounting proposal in EDAM will have to solve the issue of secondary dispatch. The relative success of each approach in doing so is qualitatively discussed below. The CAISO recognized that working group participants requested a quantitative analysis of the relative amounts of leakage. Due to the time constraints of the working group, this quantitative analysis could not be provided during the working group.

6.11.1 Resource Specific approach

The working group discussed that secondary dispatch would be limited by:

1. EDAM BAA net export transfer schedule (Note: this is also an enhancement that would apply to the WEIM)

2. The difference between the Upper Economic Limit and a reference baseline (see "Baseline for evaluation of attribution" section for the two baseline variations discussed in the working group)

The CAISO does not have estimates of secondary dispatch in EDAM, but recognizes that the volume of MW will be higher than the imbalance in WEIM.

6.11.2 Zonal approach

The working group discussed that secondary dispatch would be limited by ensuring resource-specific treatment is limited to resources or surplus energy that is committed or available to serve load within the GHG zone and meets the applicable criteria for that claim. Secondary dispatch would be further addressed by applying an "unspecified" hurdle rate to imports that do not meet the criteria for resource-specific treatment. This is necessary to prevent inefficient dispatch and potential increases in GHG emissions.

6.12 Reporting and Settlements

The purpose of discussing reporting and settlements was to clarify how CAISO could support reporting to states and align on a market design settlements structure.

WEIM entities (and potential future EDAM entities) operate in states that have a variety of GHG reduction policies. The conversation for how the EDAM market design could support or enable or support those policies was largely split into two categories: (i) GHG pricing programs such as those in California and Washington (expected in 2023), and (ii) RPS and CES programs.

For (i), the EDAM market results form a primary input in the reporting programs that support the GHG pricing policies and hence the conversation was more in depth in this area. For (ii), the EDAM market results are effectively separate from these policies, except for a few areas where a potential overlap may exist. Because of this, the conversation around (ii) was more focused on those potential areas of overlap.

Ultimately, the reporting requirements for these programs will be determined by the rulemaking processes of the state agencies that administer these programs. However, for (i), the financial settlement of the GHG transactions in the EDAM is related to the compliance requirements and thus will be discussed in the EDAM GHG market design.

WG participant questions and discussion topics included:

- *Question:* The data that feeds into the states' GHG reporting systems is based on RTM results, so why is it relevant to discuss compliance and reporting in the day ahead market?

  Answer: First, the proposed changes for both approaches are intended to apply to the RTM as well as the DAM. Second, the EDAM is expected to clear and settle some of the transactions that are currently conducted bilaterally. Once the transactions are cleared through the EDAM, these transactions would flow into the WEIM RTM. Thus the volume of WEIM RTM transactions (that ultimately originated in the EDAM) would be relatively higher than today's levels, making the EDAM design relevant for reporting.

6.12.1 Resource Specific approach

i) Reporting for GHG pricing programs

For GHG compliance, the discussions indicated that the EDAM would follow the approach of the WEIM. It would do so by deeming energy delivered to a GHG zone which would then create a compliance obligation for the respective state's programs. The CAISO would then provide EDAM/WEIM Entities with their specific market data to assist them with reporting obligations under GHG reporting programs. The CAISO may also be able to provide aggregate information to help state and reporting entities ensure accurate accounting of power obtained from the final results from the WEIM.

ii) Reporting for RPS and CES programs

It was discussed that this approach would not have special functionality to provide information for the purposes to support EDAM entities in complying with RPS and CES regulations. For RPS/CES programs that rely on RECs for reporting, depending on the reporting requirements developed, it was discussed that the CAISO could potentially support sharing GHG resource specific information with WREGIS. It was also discussed that the CAISO could also support the concept of WREGIS moving to all generation tracking system, subject to approval by state agencies' rulemaking processes.

iii) Settlement of GHG revenues

It was generally agreed that the entity bearing the compliance obligation should also receive the GHG revenue so that it can have the financial resources to procure the associated GHG allowances. To do so, this approach would settle based on the GHG day ahead GHG attribution followed by an incremental GHG attribution settlement for any deviation in the RTM.

WG participant questions and discussion topics included:

- *Question:* Multiple participants expressed that a reporting obligation lies not only with WEIM Participating Resource Scheduling Coordinators but also with the load serving entities (LSEs) in California.

  Answer: There appeared to be agreement that the EDAM design should be focused on what data is required to be produced by the market to support LSE reporting obligations as well as supply-side resources.

6.12.2 Zonal approach

i) Reporting for GHG pricing programs

As discussed above, the authority to decide which entity will bear the GHG compliance and reporting obligation sits with the relevant state agencies (e.g. CARB, WA DOE). As such, the working group could only explore hypothetical situations of how compliance and reporting might work. Because this approach would be more of a departure from the current reporting framework, the working group more fully explored the hypothetical situations for this approach.

For GHG compliance, this approach has two ways that the non-GHG zone could serve load in the GHG zones: source-specific pathways and by clearing the hurdle rate.

- For the former, the discussions indicated that the entities making elections for source-specific treatment in GHG zone could potentially be responsible for reporting. These source-specific pathways were intended to allow these transactions to be treated consistent with the reporting treatment of transactions cleared through the bilateral market today.
- For the latter, the working group discussed two hypothetical ways that the reporting obligations could be allowed.

  First, the reporting obligation could be allocated to supply resources in the non-GHG zone. This was not discussed in further detail because it would considered to be contrary to the purpose of the Zonal approach; namely that individual supply resources in the non-GHG zone aren't deemed to have served the GHG zone.

  Second, the working group discussed hypothetical situation where the compliance obligation is allocated to load. A large portion of the discussion was focused on two scenarios: (i) allocate compliance obligations on a load ratio share basis with an adjustment (reduction) for the portion of load served by source specific resources, or (ii) no such adjustment. The debate between these two scenarios was extensive, but at a conceptual level. There was a significant number of participants advocating the non-adjustment option, suggesting that the

concerns expressed by the advocates for the opposing approach could be alleviated by specific case studies. No such case studies are available for review in this session.

ii) Reporting for RPS and CES programs

No substantial discussion was held on this topic.

iii) Settlement of GHG revenues

It was generally agreed that the entity bearing the compliance obligation should also receive the GHG revenue so that it can have the financial resources to procure the associated GHG allowances. This would include hurdle rate revenue that would be allocated to the entity that is responsible for reporting emissions, purchasing and retiring allowances with the necessary data will be obtained from CAISO's markets.

WG participant questions and discussion topics included:

- It was recognized that with this Zonal approach, there will need to be substantial changes to the real time market WEIM), and potential implications on the RUC reliability run. These may illuminate whether the approaches lead to bidding incentives that need to be further examined.

7 Conclusion

This report concludes the Working Group process and deliverables as outlined in the December 16th EDAM stakeholder meeting.

As these WG-3 sessions drew to a close, questions were raised regarding next steps. In particular, three questions were discussed:

1. As the Zonal approach is still under development, working group participants asked what opportunity there would be for continued stakeholder engagement on the Zonal approach and WG-3 topics in general. The CAISO responded that, while there are is not any plan to host additional WG-3 sessions, any continued dialogue on these design items are welcomed, and participants are encouraged to reach out directly to the CAISO policy team through the established channels in the EDAM initiative forum. While not discussed in the working group, the CAISO has since clarified it can accept further design details on the Zonal approach through April 7. Afterwards, any feedback may be provided through comments submitted in response to the EDAM Straw Proposal.
2. Participants requested that an analytical assessment of these two approaches (including the two variations to the Resource Specific approach) using

load/generation modeling scenarios would be helpful to evaluate potential impacts to (i) LMP in and out of GHG zones, (ii) transfers between zones, and (iii) emissions in and out of GHG zones. This would help provide a quantitative basis on which to assess the merits of each approach. These may also illuminate whether the approaches lead to bidding incentives that need to be further examined.

3. In the next phase of the EDAM initiative, it was clarified that the CAISO will include both approaches (Resource Specific and Zonal) in the development of the straw proposal.