California ISO

Greenhouse Gas Accounting in the Extended Day Ahead Market (EDAM) and Western Energy Imbalance Market (WEIM)

Informational Presentation, Department of Ecology's Electricity Markets Rulemaking, Chapters 173-441 WAC and 173-446 WAC

September 12, 2023

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CAISO facts

As a federally regulated nonprofit organization, CAISO manages the high-voltage electric grid California and a portion of Nevada.

52,061 MW record peak demand Sept. 6, 2022)

224.8 million megawatt-hours of electricity delivered (2020)

75,747 MW power plant capacity

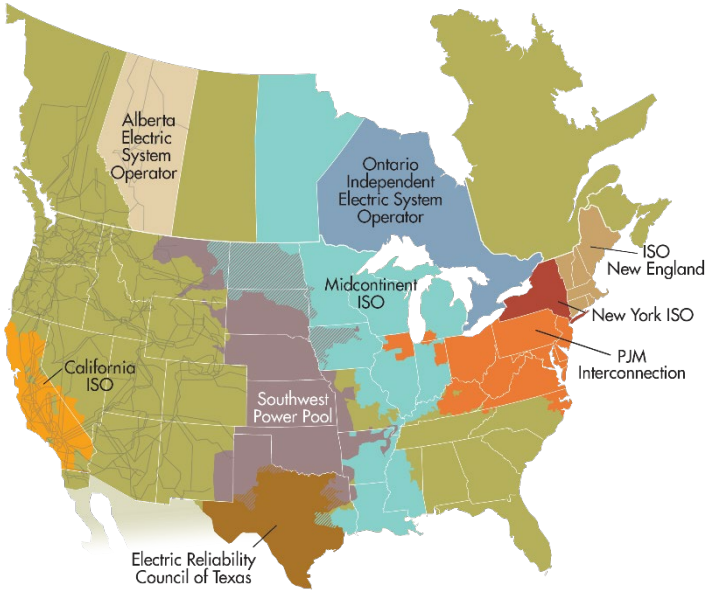
Source: California Energy Commission

1,119 power plants

Source: California Energy Commission

32 million people served

One of **9** ISO/RTOs in North America



Western Energy Imbalance Market (WEIM)

Since its launch in 2014, the WEIM has enhanced grid reliability, generated billions of dollars in benefits for participants, and improved the integration of renewable energy resources.

- 22 participating entities
- Gross benefits exceeds $3 billion
- Reduced about 800,000 metric tons of CO_2

*Avangrid office; generation-only BAA with distribution across multiple states.
Map boundaries are approximate and for illustrative purposes only.

GHG Accounting in the WEIM and EDAM

- Reflects state cap-and-trade/cap-and-invest programs

- Allows generators that are subject to a GHG cost of compliance to reflect the cost in their bid:
  - Specified resources responsible for their specific emission rate
  - Unspecified resources responsible for GHG compliance based on default emission rate set by the state
  - Asset Controlling Supplier (ACS) responsible for GHG compliance based on their area's average emission rate

- CAISO optimizes transfers to a GHG area based on a voluntary GHG bid adder and the energy bid

GHG Accounting Context

- CAISO dispatch is a least cost security constrained dispatch; it dispatches resources based on costs and constraints

- GHG accounting does not determine what specific resource is serving what specific load; instead, it determines if a dispatched resource is serving a GHG Regulation Area

Elements of GHG Accounting Design

Element	Purpose	Why it Matters
Geographic Boundary	Identifies regulated resources independently of BAA boundaries	- Supports accurate accounting - Ensures that the cost of GHG only applies to areas with a cost of carbon - Gives regulators flexibility to determine covered resources in their jurisdiction
Bid Adder	Allows resources to reflect their cost of state GHG compliance	- Ensures efficient dispatch by reflecting participant costs for separately priced jurisdictions
Counterfactual	Approximates how load outside a GHG area would be served without GHG transfers	- Identifies surplus demand for attribution - Helps identify and mitigate the potential for secondary dispatch
Attribution	Determines what resources are economic to serve GHG Regulation Area load	- Determines which resources receive a GHG award - Impacts state climate policy
Market Constraints	Constrains which resources can be attributed to serve load in a GHG Regulation Area	- Decreases secondary dispatch by limiting attribution - Can increase costs by limiting efficient attribution

Secondary Dispatch

Least cost dispatch with GHG accounting can result in low emitting resources serving a GHG Regulation Area, while not accounting for higher emitting resources serving demand in non-GHG Regulation Area.

- Secondary dispatch is a **'potential'** effect of attribution
- Limiting attribution limits the potential for secondary dispatch
- State regulation can determine how to account for the secondary dispatch and have done so in the past
- Least cost dispatch can also result in avoided curtailment of GHG Regulation Area low emitting resources by displacing higher emitting resources in the WEIM and EDAM

CAISO's design reduces the potential for secondary dispatch, but does not eliminate it. Key enhancements include:

1.) Optimized counterfactual; and 2.) GHG net export constraint.

WEIM and EDAM GHG Design

	WEIM Today	WEIM +EDAM Tomorrow*	WEIM only Tomorrow*
Geographic Modeling	No	Yes	Yes
Bid Adders	For California	For multiple GHG Areas (CA and WA)	For multiple GHG Areas (CA and WA)
Limits to attribution and secondary dispatch			
Counterfactual	Base Schedules	Optimized Reference Pass	Base Schedules
Bidding Constraints	Yes	Yes	Yes
Net Export Constraint	No	Yes	Yes

Geographic Boundaries

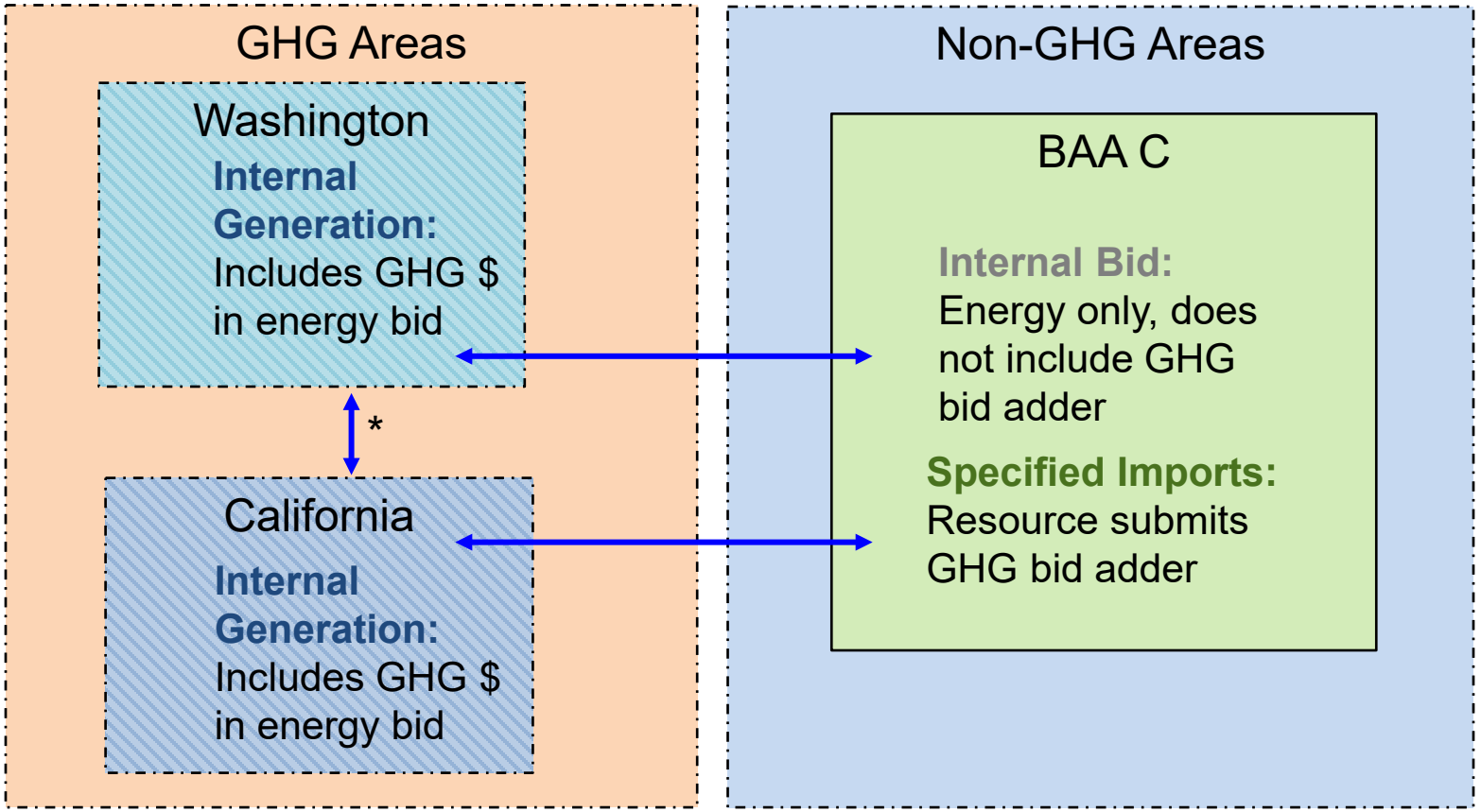
Reflects state policy as a “GHG Regulation Area”

Allows CAISO to reflect the costs associated with GHG pricing program compliance but not reflect these costs in the dispatch of resources not subject to these programs

CAISO will define the GHG regulation areas based on pricing nodes within state geographical boundaries (Washington and California) as opposed to balancing authority area boundaries

Resource Specific Overview with Multiple GHG Areas

Uses resource-specific GHG bid adders to optimize dispatch. Supports compliance and reporting by resources in non-GHG regulation areas if they receive an attribution.



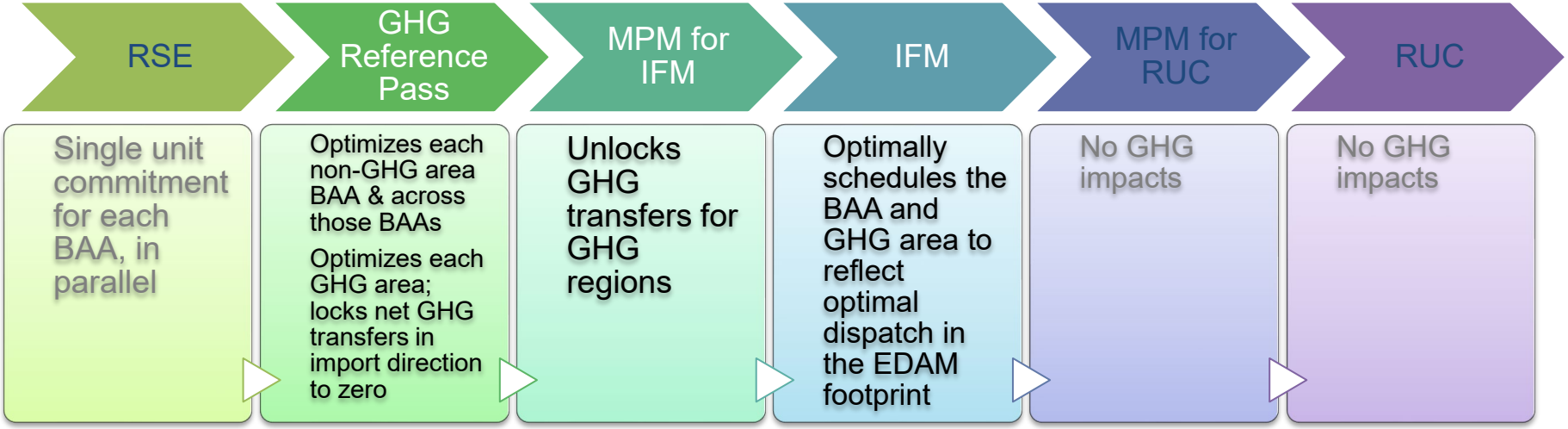
* **Between GHG regions:** unlinked (GHG bid adder); linked (energy bid includes GHG $)

GHG Attribution

- Attribution is the least cost market selection of resources to serve a GHG Regulation Area. The resource is scheduled optimally to:
  - Serve demand outside a GHG Regulation Area using the resource energy bid; and
  - Serve demand inside a GHG Regulation Area using the resource GHG bid for that GHG Regulation Area
- Attribution is limited in a few ways:
  - At the resource level due to the energy bid (e.g., bidding constraints which include ramping constraints) and;
  - At the GHG Regulation Area as a result of the relative energy bid prices of resources in and out of a GHG Regulation Area as well as other constraints (e.g., transmission constraints)

Optimized Counterfactual

The GHG Reference Pass approximates how a balancing authority area will meet their own load with internal generation and BAA to BAA transfers



GHG Accounting Constraints to Limit Attribution

Measures to limit attribution could also limit transfers to serve demand in a GHG Regulation Area

- Bid constraint (used in WEIM, updated to reflect Reference Pass in EDAM)
  - Takes the **lower of** the GHG bid capacity, the difference between the upper economic limit (UEL) and the Base Schedule/GHG Reference Pass, or the optimal dispatch
- Net transfer constraint (New for EDAM and the WEIM)
  - Limits GHG attribution to resources in a BAA in the non-GHG area to the higher of the optimal net transfer or the aggregate available "committed" capacity in that BAA
  - Market does not enforce the constraint when a BAA that overlaps with a GHG Regulation Area fails the resource sufficiency evaluation

GHG Net Transfer Constraint Example

Scenario	Description	Total Attribution to BAA 1 Resources with GHG Bid Adders
Net Importer	BAA 1* is a net importer for the hour	None
Net Exporter	BBA 1's net transfer limit is 100 MW	Up to 100 MW
Accounting for Committed Capacity	BAA 1 has a 100 MW resource, of which 20 MW is committed capacity to BAA 2**	20 MW may receive full attribution. Remaining 80 MW may received an attribution so long as the BAA 1 is not a net importer and so long as this does not exceed net transfer limit

* BAA 1 is in a non-GHG Regulation Area

** BAA 2 is in a GHG Regulation Area

Putting it All Together

	NV gas resource (100 MW) bidding to serve WA
Geographic Boundary	Washington State
Bid Adder	Energy bid = 100 MW @ $30/MWh GHG Bid = 40 MW @ $6/MWh The NV resource includes the WA cost of GHG compliance in a GHG bid to WA at $6/MWh for a natural gas unit with a UEL of 100 MW and an emissions factor of 0.42 MTCO2/MWh
Counterfactual	The counterfactual identifies 40 MW of surplus capacity
Attribution	The resource had an energy award and was thus able to be attributed at least cost based on its GHG bid. The resource is attributed 40 MW.
Market Constraints	N/A
GHG Payment to EDAM Participating Resource SC	Payment = 40 MW X $6/MWh = $240 Or $240/12 = $20 for RTD **Assumes the resource also sets the GHG marginal price*
Reported Emissions	40 MW/12 = 3.33 MWh @ 0.42 MT CO_2/MWh for RTD

Q&A