California ISO

Western Energy Markets

Benefit Methodology

Effective Q2 2026

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Introduction

The California ISO implemented Extended Day-Ahead Market (EDAM) operations on May 1, 2026, marking a significant transition from a single-BAA day-ahead market to a broader, multi-BAA EDAM footprint. Concurrently, new features were introduced as part of the day-ahead market enhancements (DAME).

Prior to Q 2026, the ISO maintained a document with the current methodology to estimate the western energy imbalance market (WEIM). With the launch of EDAM, there are estimates for EDAM benefits based on a methodology developed through a working group effort.

This document consolidates both the existing real-time benefit methodology and the brand-new methodology for EDAM. This document is intended to provide a general description of the key elements of the methodologies.

EDAM Benefit Methodology

The total EDAM benefit is the cost saving of the EDAM dispatch compared with a counterfactual (CF) dispatch without EDAM transfer between EDAM entities. Both EDAM and CF dispatches are achieved using state-of-the-art technology to find and deliver low-cost energy to meet the same day-ahead load forecast.

For each hour, the EDAM benefits are calculated as:

EDAM benefit for a BAA=CF production costs - EDAM production costs

The components of the benefits are for energy, Imbalance reserves, Reliability capacity and GHG component.

Expanding for all these components, the EDAM benefits for a given hour are composed of the following terms:

EDAM benefit for a BAA = (CF_dispatch_cost + CF_commitment_cost + CF_energy_transfer_cost + CF_IR_transfer_cost + CF_IR_cost + CF_RC_transfer_cost + CF_RC_cost) – (dispatch_cost + commitment_cost + energy_transfer_cost + GHG_revenue + GHG_cost + IR_transfer_cost + IR_cost + RC_transfer_cost + RC_cost).

Then the hourly level EDAM benefits are summed up over each month.

EDAM Benefit Calculation Data Input

The following data are used to calculate the various EDAM benefit components.

Market dispatch data

The market dispatch data includes dispatch MW (schedules or awards) at the resource level for various products:

-energy,

-imbalance reserve (IR),

-reliability capacity (RC), and

-GHG.

Bids

The production costs are based on cost submitted by participants for their supply resources. The methodology uses bid-in information at face value to estimate production costs. Bid information includes each segment bid MW and bid price for

-energy,

-imbalance reserve,

-reliability reserve.

-GHG

For a hydro resource, if an energy economic bid price exceeds the DEB price, it is replaced with the DEB price. This comparison is performed independently for each bid segment. If a bid segment price is greater than the DEB price, it is set equal to the DEB price for that segment. If the bid segment price is less than or equal to the DEB price, it remains unchanged.

The market dispatch data also includes energy commitment costs, such as start-up costs, no-load costs, and transition costs. These are the commitment costs used in the market optimization. The commitment costs submitted by participants through SIBR are subject to caps determined by the CAISO system. Because the market optimization uses these capped commitment costs, the same capped values are also used in the benefit estimation.

Both dispatch costs and energy commitment costs are included in the benefit estimation only when the resource is online, has been started, or has been transitioned up. Commitment costs may be incurred in either the IFM or the RUC. The benefit calculation includes the applicable commitment costs from either the IFM or the RUC, depending on where the commitment occurred

Transfer

Transfer data includes resource level energy transfer, IR transfer and RC transfer between EDAM entities.

Prices

Price data includes GHG prices, SP tie prices for energy, ELAP energy prices for PACE and PACW, SP tie prices for IR, IR prices for PACE and PACW, and RC prices for CAISO, PACE and PACW.

EDAM Benefit Calculation Components

EDAM Dispatch Cost

The total energy dispatch cost for a BAA for a given hour is the sum of the EDAM dispatch costs for all eligible resources dispatched in the IFM within that BAA. EDAM dispatch costs are calculated only for resources that are online in the IFM and have economic bids. Virtual resources are excluded from the dispatch cost calculation.

For all BAAs, the dispatch cost includes only the variable dispatch cost based on the economic bids submitted by the corresponding Scheduling Coordinator. For each online resource, the EDAM dispatch cost is calculated by multiplying the bid segment price by the bid segment MW associated with the dispatch increment between the bid lower limit and the IFM dispatch. The calculation begins at the bid lower limit and sequentially evaluates each bid segment along the bid curve up to the IFM dispatch level. If the IFM dispatch falls within a bid segment, only the portion of that segment up to the IFM dispatch is included in the dispatch cost calculation.

If a resource's IFM dispatch is equal to its bid lower limit, its EDAM dispatch cost is zero. If, for any reason, a resource's IFM dispatch falls outside its bid range, the dispatch value is adjusted in the benefit calculation to ensure it remains within the bid limits. For example, if the IFM dispatch is below the bid lower limit, it is adjusted to the bid lower limit. Similarly, if the IFM dispatch exceeds the bid upper limit, it is adjusted to the bid upper limit.

For resources with self-scheduled energy, the self-scheduled portion is excluded from the dispatch cost calculation because it is generally not optimized by the market based on economic bids. Only the portion of the IFM dispatch that exceeds the self-scheduled MW is included in the dispatch cost calculation.

For battery resources, hybrid resources, and pumped-storage resources, the dispatch cost is calculated only for the supply side, that is, when the IFM dispatch is greater than 0 MW. Accordingly, the EDAM dispatch cost is calculated for battery and hybrid resources only when they are operating in discharging mode, and for pumped-storage resources only when they are operating in generation mode.

For an MSG resource, the EDAM dispatch cost is calculated at the configuration level for the configuration that is dispatched. If an MSG configuration is online in the IFM, the economic bid curve associated with that configuration is used to calculate the dispatch cost using the methodology described above. An MSG configuration that is in a transition period is also treated as an online configuration, and its dispatch cost is calculated in the same manner. During a transition period, the dispatch cost is calculated only for the *from* configuration based on its economic bid. If an MSG configuration is offline in the IFM, it is excluded from the dispatch cost calculation

Commitment cost
In addition to dispatch cost, the production cost also includes the commitment cost for each hour. Commitment cost for a resource is the sum of start-up cost, no load cost and transition cost if the resource is online in IFM or RUC. Then the resource commitment costs from IFM or RUC are summed up at BAA level for each hour.

Energy Transfer Cost
By convention, the importing direction is defined as the positive direction for an energy transfer. Accordingly, imports are represented as positive transfer MW and exports as negative transfer MW. The energy transfer cost is calculated as the IFM transfer MW multiplied by the transfer price; that is, the net energy transfer multiplied by the transfer price for each BAA and each hour.

The net energy transfer is the sum of the import and export energy transfers for Transfer System Resources (TSRs) at the BAA level. Self-scheduled transfers are excluded from the net energy transfer calculation because they are not economically optimized by the market. If a BAA has energy transfers with multiple BAAs, its total energy transfer cost is the sum of the transfer costs associated with each interconnected BAA. The transfer price is calculated as the simple average of the energy prices in the two BAAs involved in the transfer.

The energy prices used in the transfer cost calculation are the corresponding full LMPs, including ELAP prices, for each EDAM area. For transfers involving CAISO, the calculation uses the energy LMP at the applicable CAISO scheduling point associated with either the Malin or MDWP intertie. The scheduling point selected depends on the specific EDAM area involved in the transfer. For example, the Malin scheduling point price on the CAISO side is used to calculate the transfer cost between PAC West and CAISO, while the MDWP scheduling point price on the CAISO side is used to calculate the transfer cost between PAC East and CAISO.

GHG Revenue

Greenhouse gas (GHG) revenue for a resource is equal to its GHG allocation MW times the GHG price. In EDAM, the GHG price is positive and assigned to the resources in CASIO area. Therefore, the revenue is

GHG revenue = GHG allocation MW*(- GHG price).

The sign of the GHG price is reversed in the GHG revenue calculation.

GHG Cost

GHG cost for a resource is equal to its GHG allocation MW times GHG bid price.

Imbalance Reserve Transfer Cost

The calculation of the imbalance reserve transfer cost is similar to the energy transfer cost calculation, except that it includes both imbalance reserve up (IRU) and imbalance reserve down (IRD) transfers. By convention, the importing direction is defined as the positive direction, while the exporting direction is defined as the negative direction. The imbalance reserve transfer cost is calculated as the net imbalance reserve transfer multiplied by the corresponding imbalance reserve transfer price for each BAA and each hour.

The net imbalance reserve transfer is the sum of the import and export imbalance reserve transfers for Transfer System Resources (TSRs) at the BAA level. If a BAA has imbalance reserve transfers with multiple BAAs, its total imbalance reserve transfer cost is the sum of the transfer costs associated with each interconnected BAA. For transfers between two BAAs, the transfer price is calculated as the simple average of the imbalance reserve prices in the two BAAs.

The transfer cost for imbalance reserve up (IRU) is calculated as the net imbalance reserve up transfer multiplied by the imbalance reserve up transfer price. Similarly, the transfer cost for imbalance reserve down (IRD) is calculated as the net imbalance reserve down transfer multiplied by the imbalance reserve down transfer price. The total imbalance reserve transfer cost for each BAA in each hour is the sum of the IRU and IRD transfer costs.

The imbalance reserve transfer cost calculation uses the corresponding imbalance reserve prices for each EDAM area. For transfers involving CAISO, the calculation uses the imbalance reserve prices at the applicable CAISO scheduling point associated with either the Malin or MDWP intertie. The scheduling point selected depends on the specific EDAM area for which the transfer cost is being calculated.

For example, the Malin scheduling point price on the CAISO side for imbalance reserve up (IRU) and imbalance reserve down (IRD) is used to calculate the imbalance reserve transfer cost between PAC West and CAISO. Similarly, the MDWP scheduling point price on the CAISO side for IRU and IRD is used to calculate the imbalance reserve transfer cost between PAC East and CAISO.

Imbalance Reserve Cost

The imbalance reserve cost for a resource is calculated as the product of its IFM imbalance reserve award (MW) and the corresponding imbalance reserve bid price. The calculation is performed separately for imbalance reserve up (IRU) and imbalance reserve down (IRD), as follows:

Imbalance Reserve Up (IRU): The imbalance reserve up cost is calculated as the product of the imbalance reserve up award (MW) and the imbalance reserve up bid price.

Imbalance Reserve Down (IRD): The imbalance reserve down cost is calculated as the product of the imbalance reserve down award (MW) and the imbalance reserve down bid price.

The resource-level IRU and IRD costs are then aggregated at the BAA level for each hour. The total imbalance reserve cost for a BAA in a given hour is the sum of the imbalance reserve up cost and the imbalance reserve down cost.

Reliability Capacity Transfer Cost

For the calculation of reliability capacity transfer cost, the importing direction is defined as the positive direction, while the exporting direction is defined as the negative direction. The reliability capacity transfer cost is calculated as the net reliability capacity transfer multiplied by the corresponding reliability capacity transfer price for each BAA and each hour.

The net reliability capacity transfer is calculated at the BAA level by first determining the net transfer in each direction. Specifically, for both imports and exports, the difference between reliability capacity up (RCU) transfer and reliability capacity down (RCD) transfer is calculated (i.e., RCU minus RCD). The net import and net export values are then summed to obtain the net reliability capacity transfer for the BAA in each hour.

If a BAA has reliability capacity transfers with multiple BAAs, its total reliability capacity transfer cost is the sum of the transfer costs associated with each interconnected BAA. For transfers between two BAAs, the reliability capacity transfer price is calculated as the simple average of the reliability capacity prices in the two BAAs.

The reliability capacity transfer cost calculation uses the corresponding marginal RC prices of each EDAM area in RUC.

Reliability Capacity Cost

The reliability capacity cost for a resource is calculated as the product of its RUC reliability capacity award (MW) and the corresponding reliability capacity bid price. The calculation is performed separately for reliability capacity up (RCU) and reliability capacity down (RCD), as follows:

Reliability Capacity Up (RCU): The reliability capacity up cost is calculated as the product of the reliability capacity up award (MW) and the reliability capacity up bid price.

Reliability Capacity Down (RCD): The reliability capacity down cost is calculated as the product of the reliability capacity down award (MW) and the reliability capacity down bid price.

The resource-level RCU and RCD costs are then aggregated at the BAA level for each hour. The total reliability capacity cost for a BAA in a given hour is the sum of the reliability capacity up cost and the reliability capacity down cost.

Counterfactual Benefit Calculation Data Input

The counterfactual dispatch for an EDAM BAA mimics the logic used in the EDAM scenario without importing or exporting between CAISO and PAC through the EDAM transfers. The counterfactual dispatch dispatch units inside the BAA to meet the same day-ahead load forecast as the EDAM dispatch based on economic merit order and transmission constraints. For PacifiCorp, the transfer limit between PACE and PACW is also enforced in the counterfactual dispatch.

The following data are used to calculate various counterfactual costs.

Market dispatch data

The market dispatch data includes dispatch MW at resource level for various products: energy, imbalance reserve (IR), and reliability reserve (RC). The market dispatch data for energy also includes start-up cost, no load cost and transition cost and BAA level cleared demand. The market data comes from counterfactual rerun instead of original EDAM production.

Bids

These are the same bids used in EDAM scenario

Transfer

Transfer data includes resource level energy transfer, IR transfer and RC transfer between EDAM entities. All the transfers come from counterfactual rerun.

Prices

Price data includes SP tie prices for energy, ELAP prices for PACE and PACW, SP tie prices for IR, IR prices for PACE and PACW, and RC prices for CAISO, PACE and PACW. All the prices come from counterfactual rerun.

Counterfactual Benefit Calculation Components

The counterfactual benefit calculation includes the same cost components as the EDAM benefit calculation, except that it does not include GHG revenue or GHG cost components. This is because there are no transfers between CAISO and PAC in the counterfactual scenario; therefore, no GHG allocation is required.

In addition, the counterfactual calculation does not include energy transfer cost, imbalance reserve transfer cost, or reliability capacity transfer cost components for CAISO. These transfer cost components remain applicable for PAC because transfers between PAC East and PAC West still occur in the counterfactual scenario.

The calculation methods for counterfactual dispatch cost, commitment cost, PAC energy transfer cost, PAC imbalance reserve transfer cost, imbalance reserve cost, PAC reliability capacity transfer cost, and reliability capacity cost are the same as those used for the corresponding cost components in the EDAM scenario.

Adjustment of Counterfactual Cost Components

After the counterfactual dispatch cost, commitment cost, imbalance reserve cost, and reliability capacity cost are calculated, these costs are adjusted using a pro-rata approach.

The EDAM benefit represents the difference in production costs between the EDAM scenario and the counterfactual (CF) scenario, where the CF scenario assumes no transfer between CAISO and PAC. However, the counterfactual solution may result in different levels of bid-in demand cleared in the IFM, which can consequently lead to different levels of reliability capacity (RC) procurement. Similarly, the amount of imbalance reserve (IR) cleared in the counterfactual scenario may differ due to the economic clearing of demand curves.

As a result, when production costs are estimated based on the supply required to meet bid-in demand, IR requirements, and RC requirements, the EDAM and counterfactual scenarios may reflect different levels of demand, IR and RC procurement. These differences can introduce cost variations that are not attributable to EDAM benefits, but instead result from differences in the amount of supply dispatched.

To align the production costs between the two scenarios, the counterfactual production costs are adjusted using a pro-rata approach based on the relative levels of demand and procurement in the EDAM and counterfactual scenarios.

The pro-rata logic applies the same way to the costs for energy, IR and RC.

Counterfactual Dispatch Cost Adjustment
The counterfactual dispatch cost in each hour is adjusted at BAA level using the formula:

Adjusted CF dispatch cost = CF dispatch cost * (EDAM cleared demand/ CF cleared demand)

Both EDAM and CF cleared demand are the BAA level cleared demand for energy.

Counterfactual Commitment Cost Adjustment
The counterfactual commitment cost in each hour is adjusted at BAA level using similar formula as counterfactual dispatch cost:

Adjusted CF commitment cost = CF commitment cost * (EDAM cleared demand/CF cleared demand)

Counterfactual Imbalance Reserve Cost Adjustment
The imbalance reserve up cost and imbalance reserve down cost at BAA level in each hour are adjusted using the formula:

Adjusted CF IRU cost = CF IRU cost * (EDAM IRU requirement/CF IRU requirement)

Adjusted CF IRD cost = CF IRD cost * (EDAM IRD requirement/CF IRD requirement)

Then the adjusted CF IRU and IRD costs are summed up for each hour to get adjusted counterfactual imbalance reserve cost. IRU and IRD requirements are BAA level requirements.

Counterfactual Reliability Capacity Cost Adjustment
The reliability capacity up cost and reliability capacity down cost in each hour are adjusted at BAA level using the formula:

Adjusted CF RCU cost = CF RCU cost * (EDAM RCU cleared value/CF RCU cleared value)

Adjusted CF RCD cost = CF RCD cost * (EDAM RCD cleared value/CF RCD cleared value)

Then the adjusted CF RCU and RCD costs are summed up for each hour to get adjusted counterfactual reliability capacity cost. RCU and RCD cleared value are BAA level cleared value. In some hours, the counterfactual RCU or RCD cleared value for some BAA may be 0. The corresponding counterfactual RCU or RCD cost is also 0. But the pro-rata ratio of EDAM RCU (or RCD) cleared value over CF RCU (or RCD) cleared value does not exist. In this case, there is no adjustment to the counterfactual RCU or RCD cost, which remains 0.

After the adjustment of the counterfactual dispatch cost, commitment cost, imbalance reserve cost and reliability capacity cost, the EDAM benefit for each hour is defined as follows:

EDAM benefit for a BAA = (Adjusted CF_dispatch_cost + Adjusted CF_commitment_cost + CF_energy_transfer_cost + CF_IR_transfer_cost + Adjusted CF_IR_cost + CF_RC_transfer_cost + Adjusted CF_RC_cost) – (dispatch_cost + commitment_cost + energy_transfer_cost + GHG_revenue + GHG_cost + IR_transfer_cost + IR_cost + RC_transfer_cost + RC_cost).

WEIM Benefit Methodology

The total EIM benefit is the cost saving of the EIM dispatch compared with a counterfactual (CF) without EIM dispatch. The counterfactual dispatch meets the same amount of real-time load imbalance in each BAA without EIM transfers between neighboring EIM BAAs. For an EIM BAA, the benefit can take the form of cost savings or profit or their combination. A BAA will be likely to have energy cost savings when the BAA is importing energy economically, or its base schedules are being optimized by the EIM. To the extent an entity base schedule is optimized prior its submission into the EIM, the benefits may be lessened when compared to an entity that has not submitted optimized base schedules into the EIM. A BAA will be likely to have an energy profit when the BAA is exporting energy economically to other BAAs and being paid a price higher than the bid cost. A BAA other than the ISO may also have a GHG profit when the resource is allocated GHG MWs and is receiving GHG revenue based on marginal GHG cost that is likely higher than its own GHG bid cost.

For each 5-minute interval, the EIM benefit by BAA is:

EIM benefit for a BAA = counterfactual dispatch cost – (EIM dispatch cost + transfer cost + flex ramp transfer cost) + GHG revenue – GHG cost.

The 5-minute level EIM benefits are then aggregated each month with a multiplier 1/12 to convert ($/5 min) to a dollar amount.

EIM Benefit Calculation Components

EIM Dispatch Cost

The total dispatch cost for a BAA for an interval is the sum of all the unit level EIM dispatch costs for that BAA for that interval.

For all BAAs other than CAISO and PAC, the dispatch cost only includes variable dispatch cost, i.e. the bids submitted by the corresponding Scheduling Coordinator. After the start of EDAM, there is no EIM dispatch cost for PAC area.

Transfer Cost

As a convention, select the importing direction as the default direction for a transfer, so the importing transfer is positive and the exporting transfer is negative. The transfer cost is equal to the transfer MW times the transfer price. For transfers involving two BAAs, the transfer price is the simple average of the prices for these two BAAs. The transfer could occur in both the 15-minute market and the 5-minute market. In this case, the transfer cost for each 5-minute interval is

15-minute transfer * 15-minute transfer price + (5-minute transfer – 15-minute transfer) * 5-minute transfer price

For the prices (LMPs) used in the EIM benefits, the calculation uses the corresponding ELAP prices of each EIM area. For CAISO prices, the calculation uses the prices associated at the corresponding scheduling points at the Malin, Palo Verde, El Dorado or Rancho Seco interties. The specific scheduling price to be used among these intertie locations is in relationship to the benefit calculated to a specific EIM area. For instance, when calculating the benefits between PAC West and CAISO, the calculation will use Malin scheduling point price (CAISO side).

Flex Ramp Transfer Cost

In 2016, the ISO implemented the flexible ramping products to replace flexible ramping constraints. The flexible ramping products are available capacities to handle future load and generation uncertainties, and include both the upward ramping capacity and downward ramping capacity. They may be put aside in RTD to enhance dispatch flexibility. One BAA’s flexible ramping capacities in RTD may be helping other BAAs. In this case, the BAA that exports flexible ramping products should receive payment from other BAAs to compensate the dispatch cost of keeping flexible ramping capacities, and the BAA that imports flexible ramping products should pay other BAAs to reflect its dispatch cost to handle future uncertainties. This is similar to how energy transfer is treated in the EIM benefit calculation. Energy transfer is explicitly modeled in EIM, while flexible ramping transfer is not. We need to calculate a BAA’s flexible ramping transfer. First, we allocate the system flex ramp award to each BAA in proportion to its individual BAA requirement. Then we calculate the flex ramp transfer as the BAA’s RTD flexible ramping award minus its allocated share. The flex ramp transfer cost is equal to the flex ramp transfer multiplied by the EIM whole footprint flex ramp shadow price.

Counterfactual Dispatch Cost

The counterfactual dispatch for an EIM BAA mimics the market operations without importing or exporting through the EIM transfers. The counterfactual dispatch moves units inside the BAA to meet the same real-time load imbalance as the EIM dispatch based on economic merit order without considering transmission constraints. For PacifiCorp, the transfer limit between PACE and PACW is enforced in the counterfactual dispatch.

Neglecting transmission constraints in a BAA tends to underestimate the EIM benefit. The magnitude depends on how significant the congestion is. Severe congestion impacting EIM benefits was not observed until October 2017, where transmission congestion happened between the generation in Wyoming and PACE's load in PacifiCorp. The impact of this congestion to the EIM benefit calculation can be demonstrated with the following example.

Assume in PACE, load increased 10 MW from the base schedule, generation decreased 100 MW from the base schedule, and PACE imported 110 MW in EIM. Note that energy is balanced in PACE with 110 MW of transfer import replacing 100 MW of generation and serving 10 MW of load above the base schedule. Assume the decremented generation cost is $20/MWh, and the import cost is $120/MWh. From an economic standpoint, the EIM dispatched the resources out-of-merit with high cost supply being incremented and low cost supply being decremented. If we were to calculate the EIM benefit ignoring the congestion effect, the benefit will be negative. The calculation is as follows:

> EIM dispatch cost = -100 MW * $20 = –$2,000.
>
> EIM transfer cost = 110 MW * $120 = $13,200.
>
> Counterfactual dispatch cost = 10 MW * $20 = $200.
>
> For simplicity, ignore flex ramp and GHG. The EIM benefit is calculated as $200 – (–$2,000 + $13,200) = –$11,000.

To better understand the root cause of the negative benefit, we break the calculated benefit into two components: infeasible base schedule and infeasible counterfactual.

1. Infeasible base schedule: In the EIM, the imported $120 transfer replaced 100 MW of $20 internal generation, and produced a negative benefit equal to 100*($20-$120) = -$10,000. The extra dispatch cost in EIM is not due to economics, but due to infeasible base schedules for certain constraints, which forces the EIM to mitigate congestion, and incurs additional cost. For this reason, we need to add the congestion management cost to the counterfactual dispatch cost to reflect the need to perform the same congestion management dispatch as in the EIM. In the example, we add $10,000 to the counterfactual dispatch cost.

2. Infeasible counterfactual: In the counterfactual, the merit order dispatch did not know that dispatching up the $20 generation would overload the transmission, and produced a negative benefit equal to 10*($20-$120) = -$1,000. The counterfactual should recognize the economic $20 supply is subject to transmission congestion, and cannot be dispatched. Therefore, in the counterfactual dispatch, for increased net load, we dispatch only supply offers with a bid price >= the transfer LMP. For decreased net load, we dispatch down only supply offers with a bid price <= the transfer LMP. In the example, the net load is 10 MW, so we only dispatch resources that bid above $120, assume these supplies cost $125/MWh.

With these two enhancements, we revise the benefit calculation as follows:

EIM dispatch cost = -100 MW * $20 = –$2,000.

EIM transfer cost = 110 MW * $120 = $13,200.

Counterfactual dispatch cost = 10 MW * $125 + $10,000 = $11,250.

The new EIM benefit is calculated to be $11,250 – (–$2,000 + $13,200) = $50.

These enhancements only apply when we detect significant congestion indicated by the LMP difference between the BA's ELAP and DGAP greater than a tolerance setting. Currently, the tolerance is set to $5/MWh.

The counterfactual dispatch makes unit commitment decisions only for the ISO's short start units. The unit commitment decisions are based on the generic three-part variable cost formula, which has converted startup cost and no load cost into variable dispatch cost, so unit commitment can be determined by the economic metric order of the three-part cost.

Prior to the 2016 Q4 report, we used the resources' RTD dispatching limits from the EIM in the counterfactual. The EIM dispatching limits are 10-minute ramp limited in RTD, and they may be overly constraining for the counterfactual theoretically. The counterfactual will replace the transfers with internal dispatches, but it does not need to do it within 10-minute timeframe. When EIM transfer volumes are moderate relative to the EIM dispatching range, this limitation may not be a real problem, because the EIM dispatch range is mostly sufficient to replace the transfers. As the EIM footprint increases, the transfer volume between BAAs also increases. We observed that some EIM transfers exceeded 1,000 MW frequently. The EIM dispatching range started to show its limitation. In Q4 of 2016, we expanded the resources' dispatching range to base schedule and FMM dispatching limits. From Q2 of 2017, we decided not to use EIM calculated limits and instead construct the dispatching range based on the resource's economic bid range to discount the capacity that is not available due to ancillary services provisions, and in the case of variable energy resources, limit the maximum bid range by the forecasted output. This logic was based on bids and forecast available from the FMM market.

Starting in Q4 2025, the bid range logic has been enhanced to rely on RTD market data instead of the previous approach. This adjustment offers a more accurate reflection of actual market conditions in two key ways. Dispatches and transfers from WEIM solution are based on the RTD markets and using bids from RTD market will better align. Second, the forecasted output for variable energy resources often differs between the FMM and RTD markets. By using the RTD forecast to estimate load imbalance in the benefit calculation, it more accurately reflects actual RTD conditions. It also eliminates imbalances that reflect forecast differences and focus on imbalances from actual market redispatches.

To illustrate the logic prior to the Q4 2025 enhancement, consider the following example:

A wind resource has a base schedule of 100 MW. Its FMM forecast is 73 MW, while its RTD forecast is 16 MW.

In the FMM market, a range will be made available for the resource up to the 73 MW forecast. Similarly, in the RTD market, a range will be made available up to the 16 MW forecast. In both markets, the dispatches will most likely occur at their respective maximum levels of 73 MW for FMM and 16 MW for RTD. In the benefit calculation the base schedule was originally adjusted to the FMM forecast of 73 MW and the load imbalance estimated for this resource was

$$\text{RTD dispatch-adjusted base schedule} = 16\text{ MW} - 73\text{ MW} = 57\text{ MW}$$

As a result, the cost estimate for the WEIM case will reflect an imbalance of 57 MW. However, this imbalance does not represent an actual market redispatch; t's simply a measure of the forecast differences between FMM and RTD. In reality, the WEIM market was not dispatching the resource down by 53 MW from its base schedule; instead, it was acknowledging that the resource could only produce up to the RTD forecast of 16 MW.

With the enhanced logic, the calculation for this resource now better reflects the actual conditions in the RTD market. Since the bid range available in RTD is capped at 16 MW, the adjusted base schedule is now 16 MW.

The estimated load imbalance for this resource is calculated as:

$$\text{RTD dispatch-adjusted base schedule} = 16\text{ MW} - 16\text{ MW} = 0\text{ MW}$$

This 0 MW imbalance reflects the scenario where the market is not redispatching the resource down. Instead, it simply accounts for the adjustment in the forecast available in RTD. Therefore, there is no WEIM cost associated with this resource

As the mix of market resources in the WEIM footprint continues to evolve, the ISO has identified a second enhancement aimed at improving the modeling of storage resources in the counterfactual calculation.

Prior to Q4 2025, storage resources were modeled like any other conventional resource: an available dispatch range was estimated, and based on the resource's price, a counterfactual dispatch was determined. However, storage resources have unique limitations that must be considered in the counterfactual, particularly those related to managing the state of charge.

This enhancement addresses three key areas:

1. Adjusting the Maximum Bid Limit Based on State of Charge: The maximum bid limit for storage resources will now account for their available state of charge. While a storage resource may be dispatched according to its price-quantity bid, any dispatch must be supported by sufficient state of charge.

2. Respecting the Minimum State of Charge: Storage resources can define a minimum state of charge. The counterfactual dispatch will now respect this constraint, ensuring that the resource is dispatched in a way that maintains its state of charge above this minimum level.

3. Enforcing End-of-Hour Constraints: Storage resources may also define an end-of-hour constraint, ensuring that the resource is dispatched in a way that allows it to stay within this constraint by the end of the hour. This constraint is now considered in the determination of the counterfactual dispatch.

In cases where a counterfactual dispatch does not have sufficient supply offers to meet net load imbalance, we assign a penalty cost for procuring more energy. If the BA does not import from EIM, we extend its last economic bid segment. If the BA imports from EIM, we compare its last economic segment against the EIM LMP, and set the penalty price to the higher of the two. In summary, the penalty price per MWh is

- The highest offer price from the BA if the BA does not import from EIM,
- Max (the highest offer price from the BA, the transfer LMP) if the BA imports from EIM.

An EIM BAA may restrict the pool of dispatchable units in the counterfactual dispatch if that the BAA's practice prior to joining EIM was to balance real-time load from a limited pool.

ISO Counterfactual Dispatch

The ISO would need to meet load without EIM transfers in the counterfactual dispatch. The counterfactual dispatch is constructed in the following way:

1. Calculate the ISO's net EIM transfer;
2. Economically dispatch resources from the ISO to replace the transfer
   A. If the ISO is importing from the EIM,
      a. Find the ISO's undispatched supply with the variable cost (bid) greater than or equal to the reference transfer price;
      b. Sort and stack the supply by the variable cost from low cost to high cost; and

c. Clear the supply stack from low cost to high cost up to the transfer megawatts

B. If the ISO is exporting to the EIM,

   a. Find the ISO's dispatched supply with the variable cost (bid) less than or equal to the reference transfer price;

   b. Sort and stack them by the variable cost from high cost to low cost; and

   c. Clear the supply stack from high cost to low cost up to the transfer megawatts

The reference transfer price for the ISO is the maximum price of the incoming transfer points if the ISO is a net transfer importer, and the minimum price of the outgoing transfer points if the ISO is a net transfer exporter in RTD. Undispatched supply at lower bid cost than the reference price is dispatched out of merit when the ISO is importing transfer at the reference price. Dispatched supply at higher bid cost than the reference price is also dispatched out of merit when the ISO is exporting transfer at the reference price. The ISO has complex networks and constraints that are modeled in the EIM but not in the counterfactual. For example, supplies can be locally transmission constrained and undispatched in the EIM, which have available supply at lower bid cost than the LMP of the rest of the ISO. They should remain undispatched in the counterfactual even they have lower supply cost, because they are constrained by transmission. In the ISO's counterfactual dispatch, we only consider supplies above the reference transfer price to replace incoming transfer into the ISO, and thus preventing the transmission constrained lower cost supply being dispatched. Vice versa for the supplies below the reference transfer price to replace outgoing transfer. The counter factual dispatch (applies for whole EIM, not just the ISO) was based on 5-minute dispatch capability, and the reference price is the RTD price.

Counterfactual Dispatch

All EIM entities, with the exception of Pacificorp, have their counterfactual dispatch constructed in the following way. We will use NVE as an example.

1. Calculate the real-time net load imbalance for NVE;
2. Economically dispatch resources from NVE on top of the base schedules to meet NVE's net load imbalance

   A. If the net load imbalance is positive,

      a. Dispatch NV Energy's bid-in supply above base schedules;

      b. Sort and stack them by the variable cost from low cost to high cost; and

      c. Clear the supply stack from low cost to high cost up to the net load imbalance.

   B. If the net load imbalance is negative,

      a. Dispatch NV Energy's bid-in supply below base schedules;

b. Sort and stack them by the variable cost from high cost to low cost; and

c. Clear the supply stack from high cost to low cost up to the net load imbalance.

PacifiCorp Counterfactual Dispatch

PacifiCorp East BAA and PacifiCorp West BAA would need to meet demand without intra-hour transfers between PacifiCorp and the ISO, but transfers could occur between PACE and PACW in the counterfactual dispatch.

After EDAM, PacifiCorp participates in both Day-Ahead and Real-Time markets. There are no base schedules or base transfer for PacifiCorp in RT. Therefore, PacifiCorp counterfactual dispatch is the same as CAISO counterfactual dispatch except that there is still transfer between PACE and PACW in the counterfactual dispatch. Since Q2 2026, PacifiCorp counter factual dispatch will be constructed in the following way:

1. Calculate the net EIM transfer for each BAA;
2. Economically dispatch resources from PacifiCorp to replace the transfer without violating the transfer limitations between PACE and PACW.

   A. If the net transfer is positive,

      a. Find PacifiCorp's undispatched supply with the variable cost (bid) greater than or equal to the reference transfer price;

      b. Sort and stack them by the variable cost from low cost to high cost; and

      c. Clear the supply stack from low cost to high cost up to the net transfer subject to the transfer limit between PACE and PACW

   B. If the net transfer is negative,

      a. Find PacifiCorp's dispatched supply with the variable cost (bid) less than or equal to the reference transfer price;

      b. Sort and stack them by the variable cost from high cost to low cost; and

      c. Clear the supply stack from high cost to low cost up to the net transfer subject to the transfer limit between PACE and PACW

GHG Revenue

Greenhouse gas (GHG) revenue for a resource is equal to its GHG allocation MW times the GHG price. After EDAM, the calculation of GHG revenue for PAC also takes into account of the GHG allocation from Day-Ahead market. The formula of the GHG revenue for PAC becomes

(FMM_GHG_MW-DA_GHG_MW) *(-FMM_GHG_ price)+(RTD_GHG_MW-FMM_GHG_MW)*(-RTD_GHG_ price).

For other WEIM entities except CAISO and PAC, the formula is

FMM_GHG_MW*(-FMM_GHG_price)+(RTD_GHG_MW-FMM_GHG_MW)*(-RTD_GHG_ price)

The GHG price is positive now and assigned to the resources in CAISO area. Therefore, the sign of the GHG price is reversed in the formula. The GHG component associated with any California location is used as a reference to be used for WEIM resources.

GHG Cost

GHG cost for a resource is equal to its GHG allocation MW times its GHG bid.

Example

This example illustrates how the EIM benefit is calculated.

The transfers out of the EIM optimization are listed in Table 1. Base scheduled transfers have been excluded in the FMM transfers and RTD transfers.

From BAA	To BAA	FMM transfer	FMM transfer price	RTD incremental transfer	RTD transfer price	Transfer cost
PACE	NEVP	140	$26	10	$25	$3,890
NEVP	CISO	160	$26	20	$30	$4,760
PACE	PACW	190	$26	10	$25	$5,190
PACW	CISO	110	$26	-10	$30	$2,560

Table 1. An example of BAA to BAA transfers and prices

Assume the EIM energy imbalance and prices are as follows. Every BAA is balanced with Gen + Transfer – Load = 0. Assume the EIM optimization results in $1 GHG price, which means the ISO's LMP is $1 higher than the neighboring BAA (NEVP and PACW), because there is no congestion going into the ISO in the example. In the table below, positive transfer MW means the BAA is importing and negative transfer MW means it is exporting. Also, transfers in the table are sum of the transfers occur in both the FMM and the RTD with base scheduled transfer being excluded.

BAA	Gen	Load	Net transfer in MW	LMP	GHG price
CISO	0	280	280	$31	$1
NEVP	50	20	-30	$30	
PACE	150	-200	-350	$20	
PACW	100	200	100	$30	

Table 2. EIM energy imbalance and prices by BAA for one 5-minute interval

Transfer Cost

The transfers occur in both FMM and RTD, and their volume and prices are listed in Table 3. They are calculated from applying the convention that importing is positive and exporting is negative the BAA to BAA transfers, and summing them over all the neighboring BAAs.

BAA	transfer cost
CISO	$7,320 = $4,760+$2,560
NEVP	($870) = $3,890-$4,760
PACE	($9,080) = -$3,890-$5,190
PACW	$2,630 = $5,190-$2,560

Table 3. EIM transfer cost by BAA

For flex ramp, we calculate its transfer and transfer cost in Table 4.

BAA	Direction	Req.	Award	Allocation	Flex ramp transfer in	Flex ramp price	Flex ramp transfer cost
CISO	upward	150	100	75	-25	$1	-$25
NEVP	upward	10	0	5	5	$1	$5

PACE	upward	20	0	10	10	$1	$10
PACW	upward	20	0	10	10	$1	$10
CISO	downward	0	0	0	0	$2	$0
NEVP	downward	10	10	2	-8	$2	-$16
PACE	downward	20	0	4	4	$2	$8
PACW	downward	20	0	4	4	$2	$8

Table 4. Flex ramp transfer example

EIM Dispatch Cost

Now calculate the total bid cost associated with the EIM dispatches (delta from base schedules). The EIM dispatch costs are listed in Table 5.

BAA	Gen_EIM	EIM dispatch cost
CISO	0	$0
NEVP	50	$1,450
PACE	150	$2,700
PACW	100	$2,800

Table 5. EIM dispatch cost by BAA

Counterfactual Dispatch Cost

Then construct the counterfactual dispatches as described in the previous section, and sum up the counter factual dispatch cost for each BAA as shown in Table 6.

BAA	Gen_CF	Counterfactual dispatch cost
CISO	280	$9,240
NEVP	20	$640
PACE	-200	($3,800)
PACW	200	$6,200

Table 6. Counterfactual dispatch cost by BAA

GHG Cost and Revenue

The GHG costs associated with the 280 MW of importing transfer into CISO, and the revenues received by the GHG allocated MWs in both FMM and RTD are listed in Table 7.

BAA	GHG FMM MW	GHG RTD MW	GHG cost	GHG revenue
CISO	270	280	$0	-$280
NEVP	0	0	$0	$0
PACE	200	200	$20	$200
PACW	70	80	$75	$80

Table 7. GHG cost and revenue by BAA

EIM Benefit

With all the cost and revenue for each BAA available, we can use the formula EIM benefit for a BAA = counterfactual dispatch cost – (EIM dispatch cost + transfer cost + flex ramp transfer cost) + GHG revenue – GHG cost to calculate EIM benefit for each BAA. The results are shown in Table 8.

BAA	CF dispatch cost	EIM dispatch cost	Transfer cost	Flex transfer cost	GHG cost	GHG revenue	EIM benefit
CISO	$9,240	$0	$7,320	($25)	$0	($280)	**$1,665**
NEVP	$640	$1,450	($870)	($11)	$0	$0	**$71**
PACE	($3,800)	$2,700	($9,080)	$18	$20	$200	**$2,742**
PACW	$6,200	$2,800	$2,630	$18	$75	$80	**$757**

Table 8. EIM benefit for one 5-minute interval

This calculation is performed for each 5-minute interval with unit $/hr. We convert the $/hr benefit into the dollar benefit by multiplying 1/12. Then the 5-minute interval benefits in dollar amount can be aggregated into the monthly benefit by summing all the 5-minute intervals in the month.