



California ISO Market Overview

Body of State Regulators – Training Session
December 11, 2024

Today's Trainer:
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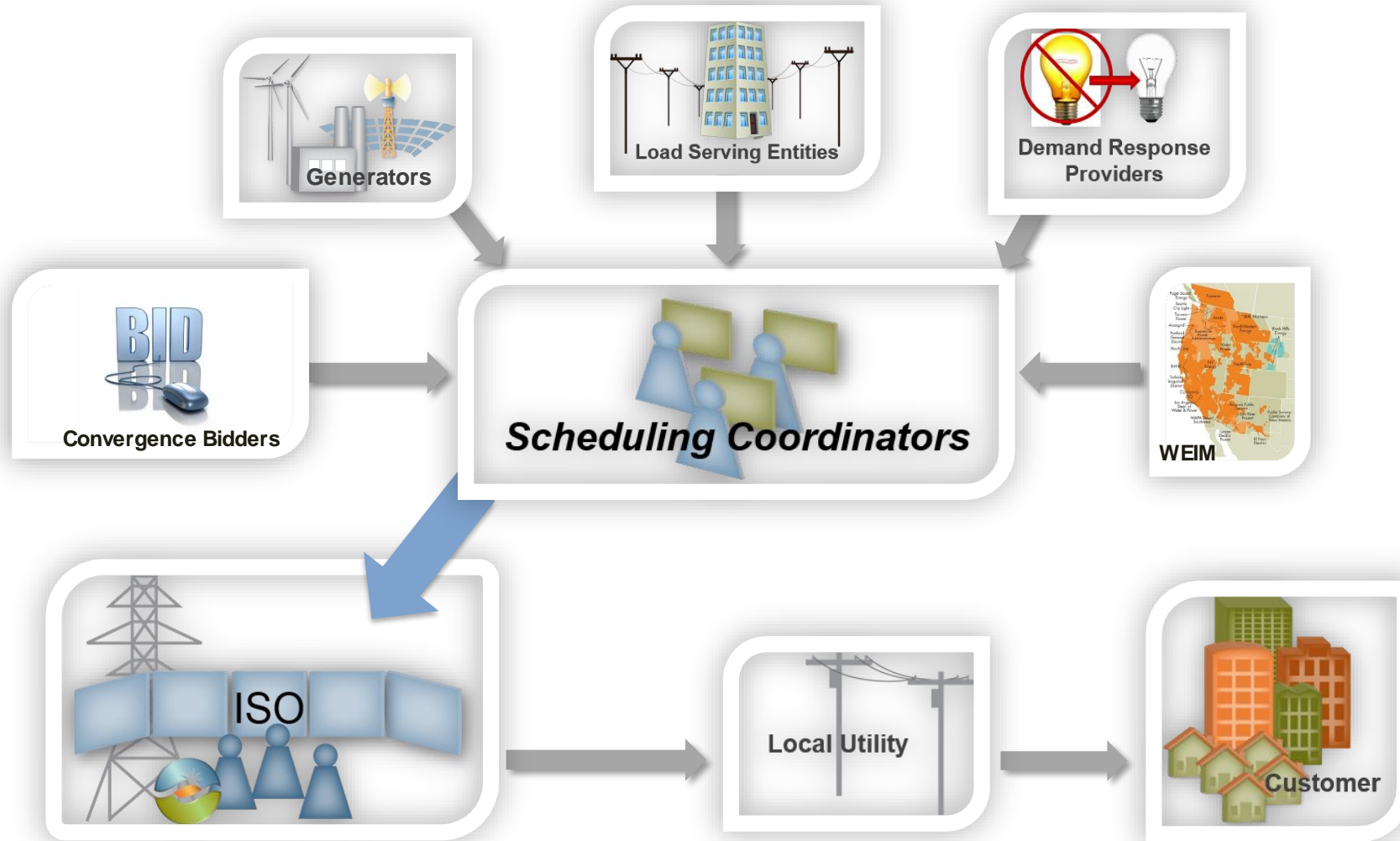
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What will I be learning about in today's market overview session?

- Day-Ahead and Real-Time Markets
- Market Pricing
- Review of EDAM and DAME projects
- Market Settlements



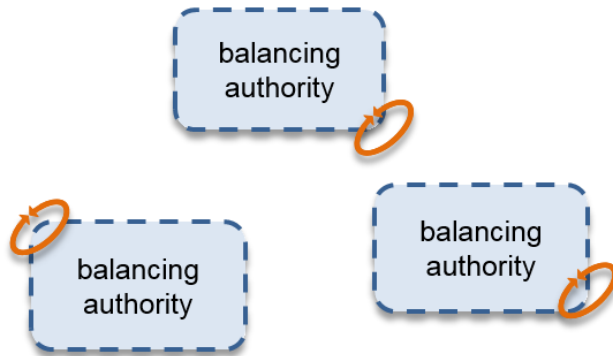
Participation with the ISO depends on the service to be provided



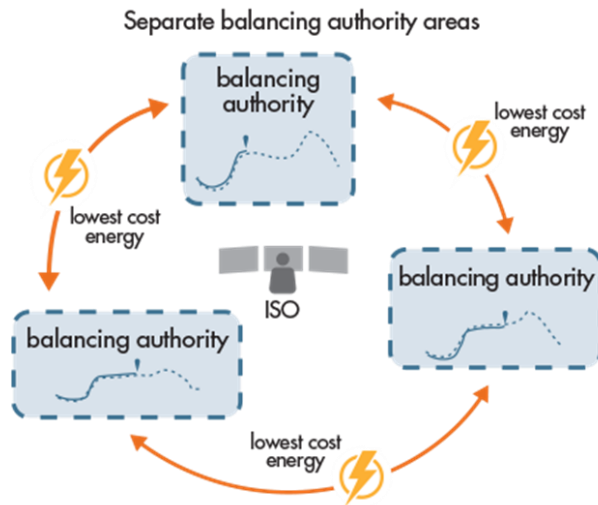
How is the ISO Market evolving?

First, let's look at how
things work today...

BA of today outside of a market vs. market participation



- Focused on balanced schedules
- LSEs within BA identify their supplies
- BA ensures sum of LSEs demand equals the sum of supplies
- BA ensures each LSE is sufficient
- Some drawbacks of this construct are:
 - LSEs lose economic benefits of regional supply
 - Supply may have limited number of LSEs to serve



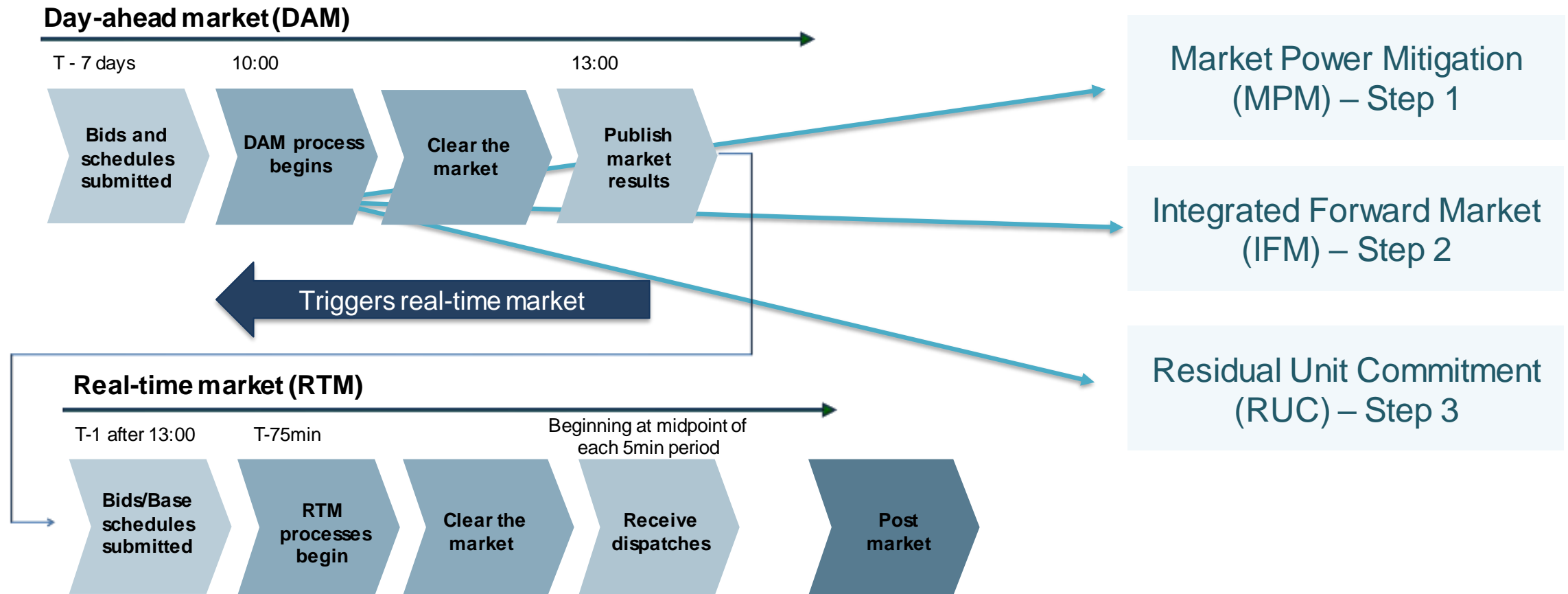
- Market changes concept of LSE coming in with balanced schedule
- Instead, LSEs independently bid in demand and resources independently bid in supply
- Gives LSEs access to larger supply footprint and resources access to larger pool of demand customers
- Market finds the most economic supply to meet demand at least cost while respecting transmission constraints



ISO Market Operation

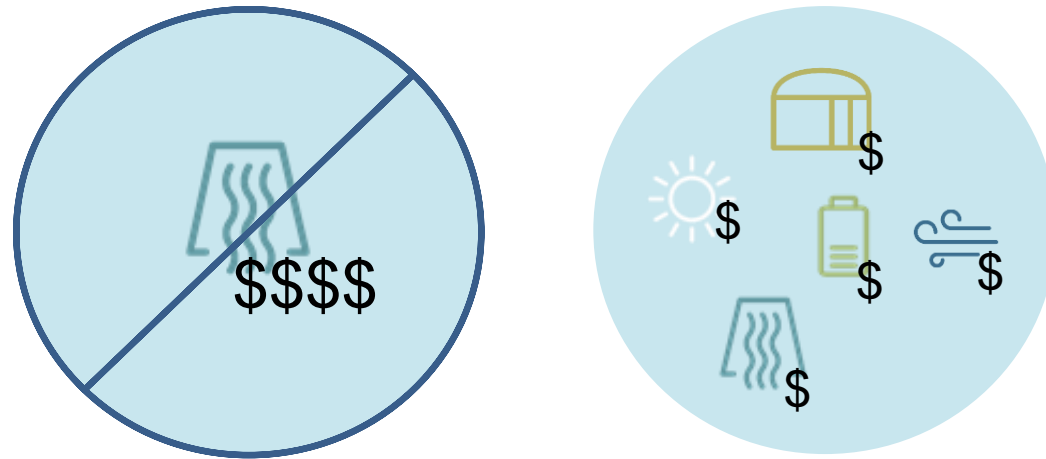
Day-Ahead Market Processes

Today's ISO market operates in a day-ahead and real-time scope



Market power mitigation (MPM)

- Ensures units cannot exercise market power by nature of where they reside



- NOTHING is scheduled or dispatched as a result of this process
- May result in mitigated bids based on predetermined calculations

DAM Processes Step 1

What do we do if Market power is determined?

ISO replaces bid with the higher of their default energy bid or the competitive LMP for generating resources and participating loads

ISO Tariff
Section
39.7.1

Calculation of
default energy bid

- Variable Cost Option | LMP Option
- Negotiated Rate Option | Variable Cost Option + Bid Adder
- Temporary Default Energy Bid | DEB for RMR
- Hydro DEB | Storage Resource Option

DAM Processes Step 1

Elements of the ISO's **day-ahead market** - Integrated forward market (IFM)

Clears bid-in supply against bid-in demand

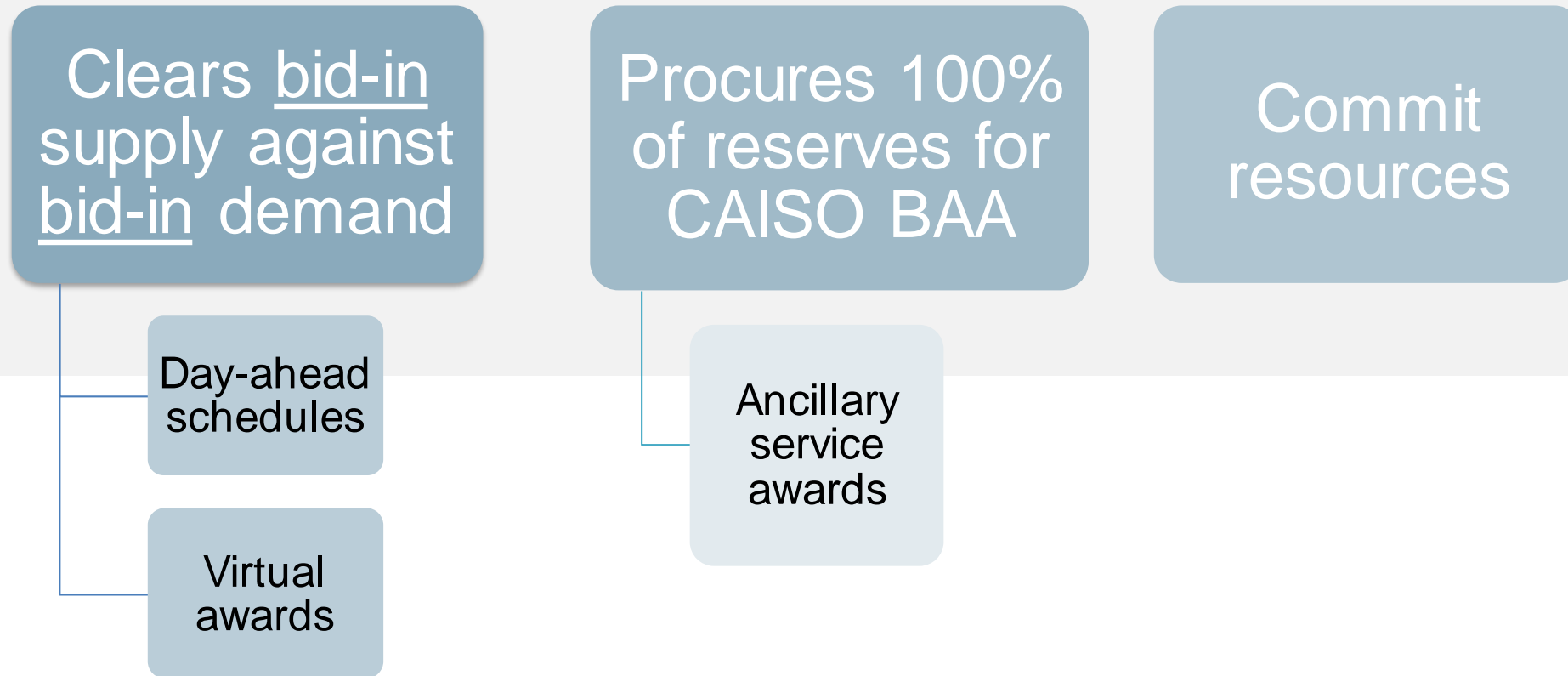
Day-ahead
schedules

Virtual
awards

- As a result, sufficient capacity may not be committed to meet forecast demand
- More on this during Step 3 (RUC)

DAM Processes Step 2

Integrated forward market (IFM)

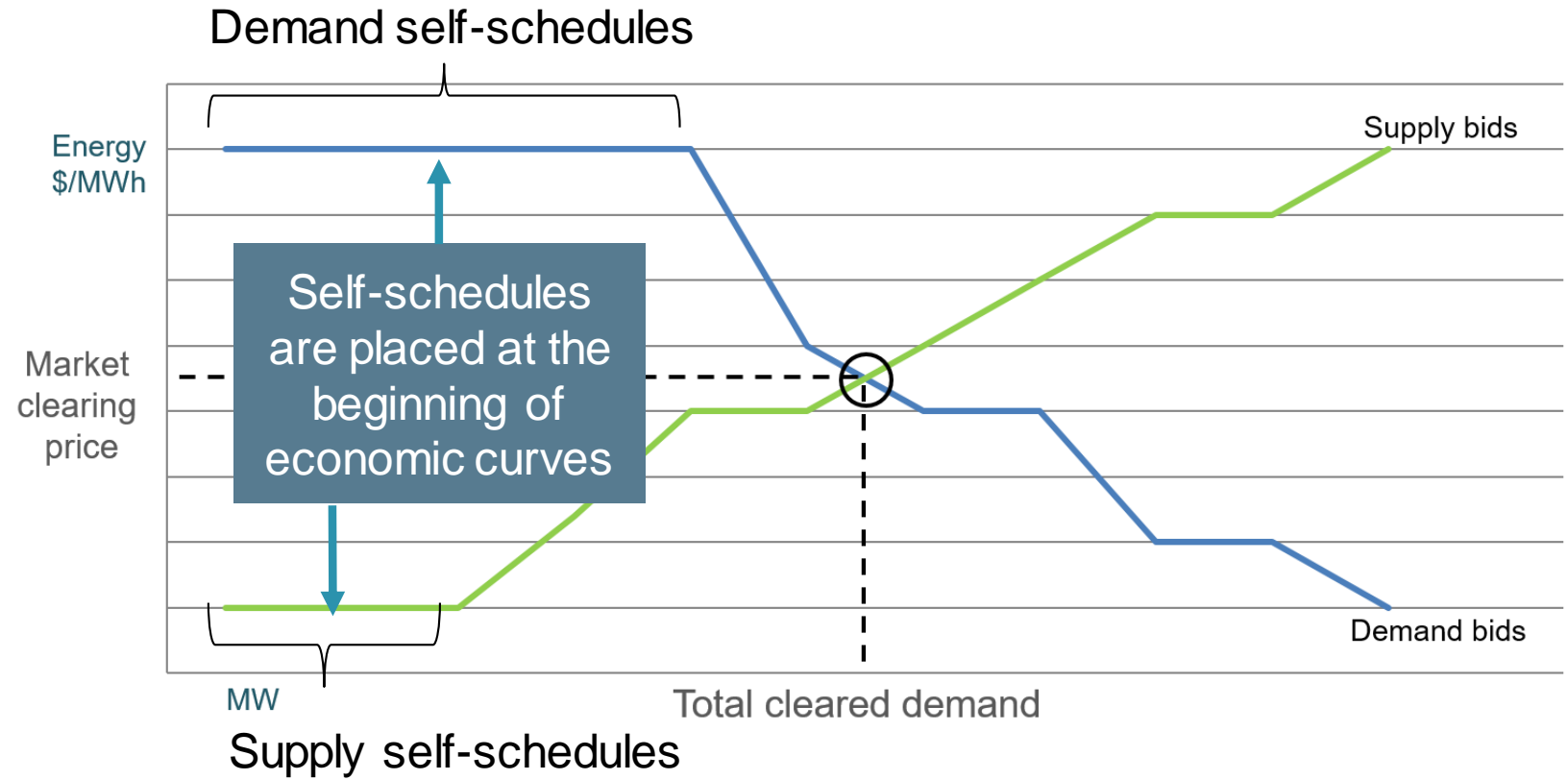


DAM Processes Step 2

What clears in the IFM?

Day-ahead supply bids clear against demand bids

Real-time supply clears against ISO load forecast



DAM Processes Step 2

How does the Market decide which resources to commit?



Three-part energy bid includes:

- Start-up cost (one time)
- Minimum load cost (hourly)
- Energy bid curve above minimum load (\$/MWh)

**Security Constrained
Unit Commitment**

Residual unit commitment (RUC)

Reliability

Ensures grid reliability

Resource Sufficiency

Selects from resource adequacy and other capacity bids

Capacity Procurement

Capacity procurement from additional Day-Ahead supply for Real-Time

Real-Time Energy Market

Awarded resources must submit an energy bid in the Real-Time Markets

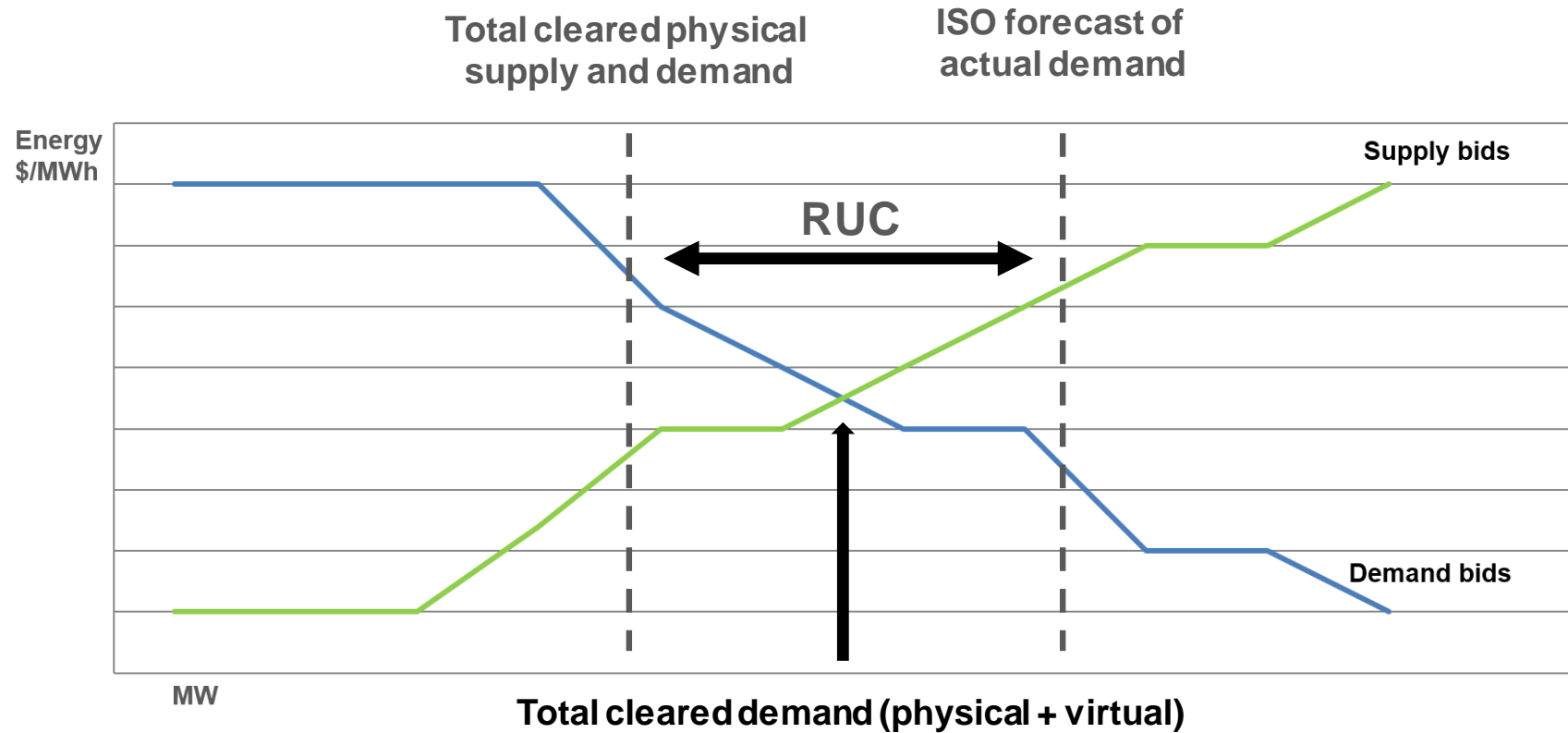
DAM Processes Step 3

Residual unit commitment (RUC)

- Uses the same SCUC optimization as IFM
- Set up to meet high confidence demand forecast
- Removes virtual supply & demand bids from calculation
- Introduces ISO forecast for variable energy resources

How does RUC work?

Ensures sufficient capacity is available to meet **forecast demand** that was not committed in IFM



DAM Processes Step 3

RUC looks out further than the next trade date

- Extremely long-start commitment (ELC) process applies to:
- Resources with start times >18 hours
- Contractual intertie resources that must receive commitment instructions by 0600 hours one day ahead
- Commitments are generated by RUC or manually notified by the ISO operator and the process considers bids in the Day-Ahead Market up to two days out





ISO Market Operation

Real-Time Market Processes

Elements of the ISO's real-time market

Hourly
Resource
Sufficiency
Evaluation

- Larger market footprint that includes WEIM participants
- WEIM participation is for energy only and does not include ancillary services
- Load forecasts for each entity drive market awards
- Each entity ensures sufficiency of resources available for their area on an hourly basis



Balancing



Bid Capacity



Flex Ramp



Feasibility

Real-Time Market

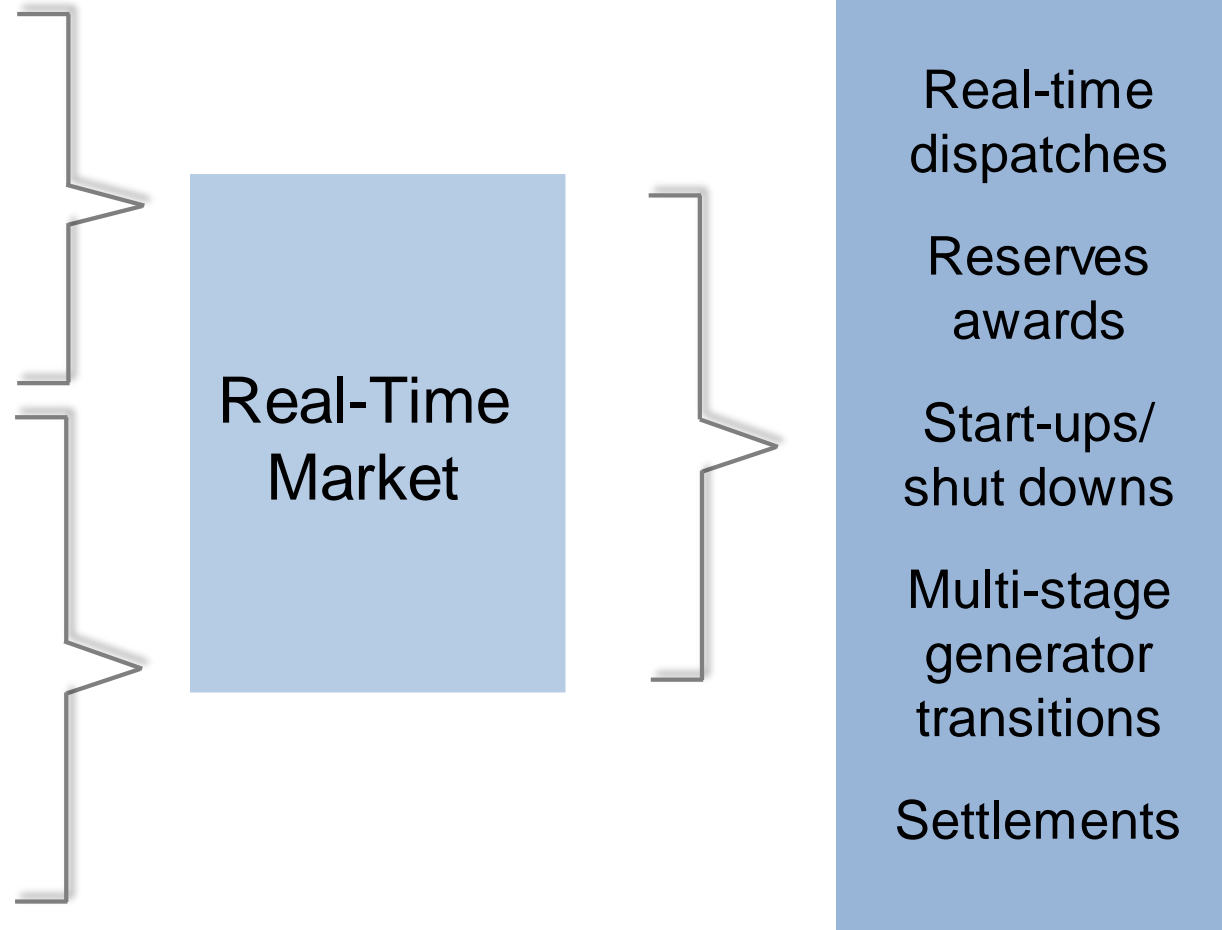
Inputs and outputs of the Real-Time Market

From **Day-Ahead**:

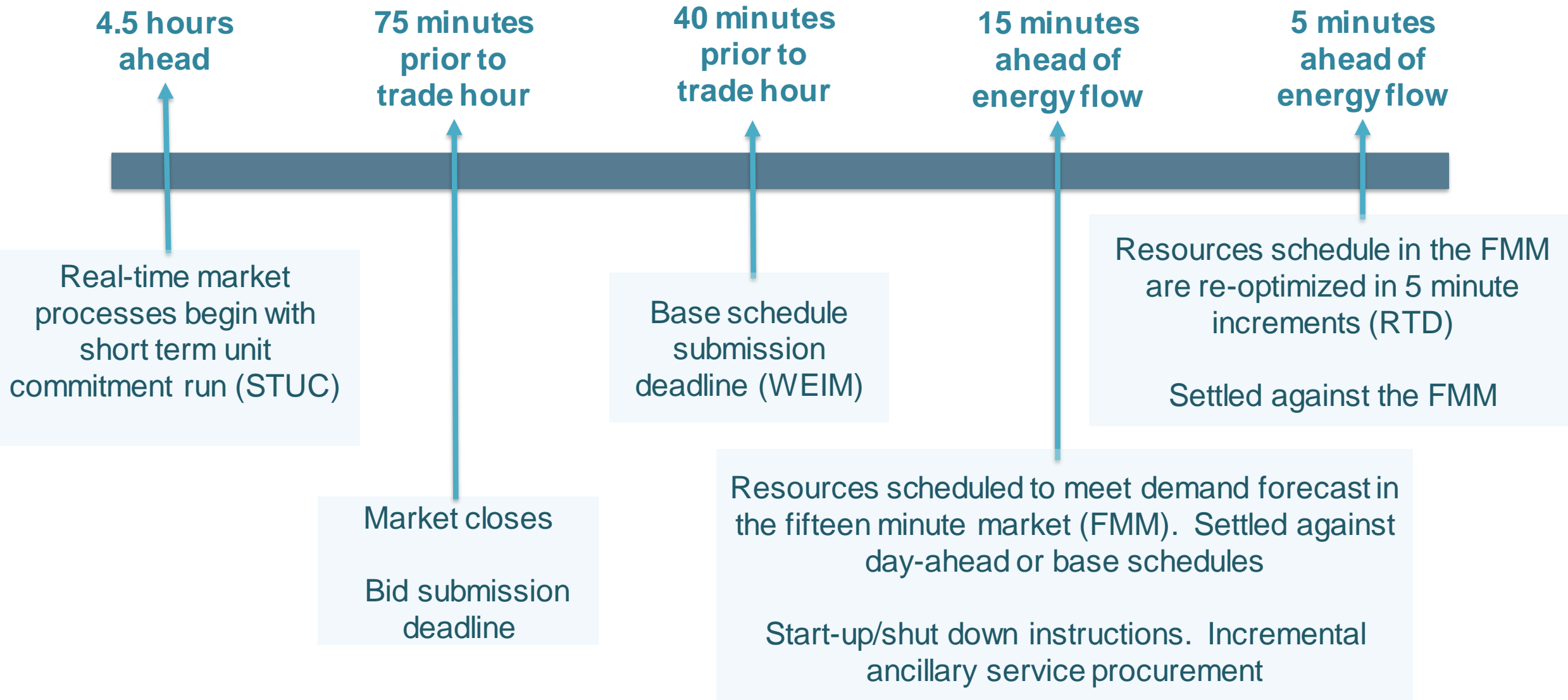
- System info
- Energy schedules
- Reserves awards
- Master file

From **Real-Time**:

- State estimator
- Supplemental energy & ancillary service bids
- Base schedules
- Outages
- Transmission limits



Real-time milestones



Market process timelines: Real-Time

Short Term Unit Commitment (STUC)	<ul style="list-style-type: none">• Occurs once per trade hour• Examines the potential demand requirements for the next 4 ½ trade hours• Issues start up/shut down instructions to short start resources to meet anticipated demand
Hour Ahead Scheduling Process (HASP)	<ul style="list-style-type: none">• Produces HASP advisory schedules and advisory AS awards• Binding HASP intertie schedules with hourly block bids• Advisory schedules for internal resources and intertie resources that do not have hourly block bids/schedules
Fifteen Minute Market (FMM) / Real-Time Pre-Dispatch (RTPD)	<ul style="list-style-type: none">• Issues start-up/shut down instructions to short and fast start units, and transition instructions to multi-stage generators• Procures ancillary services as needed• Provides advisory instructions for as many as 7 future 15-min intervals
Five-Minute Market / Real-Time Dispatch (RTD)	<ul style="list-style-type: none">• Occurs every five minutes to meet energy imbalances• Resources dispatched in real-time• Provides advisory dispatch instructions for as many as 12 future dispatch intervals



Pricing and Bidding

Locational Marginal Pricing, Scarcity Pricing & Transmission Constraints

What does the Tariff say?

ISO Tariff
Appendix A

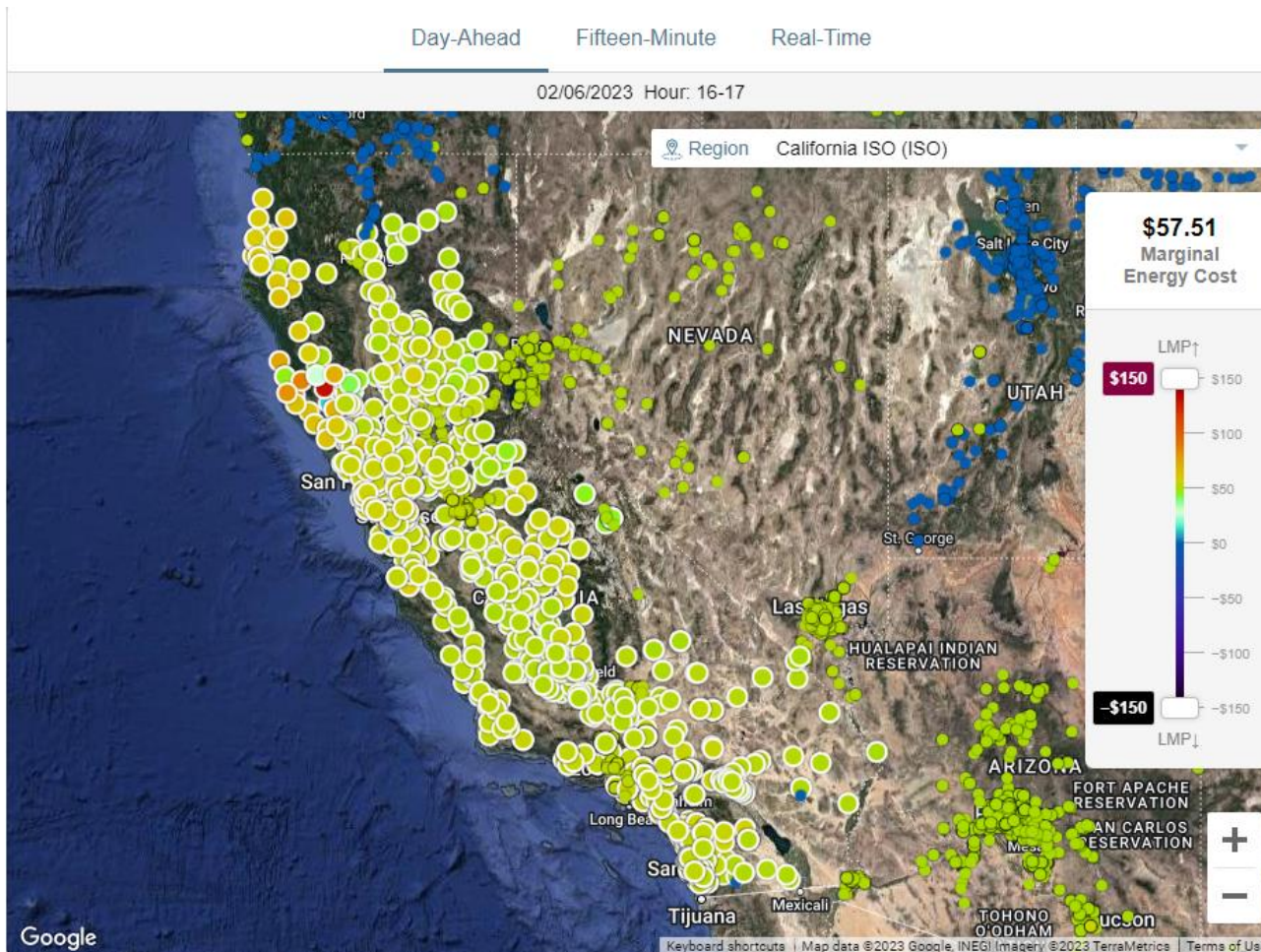
California Independent System Operator Corporation
Fifth Replacement Tariff

Locational Marginal Price (LMP)

The marginal cost (\$/MWh) of serving the next increment of Demand at that PNode consistent with existing Transmission Constraints and the performance characteristics of resources.

ith

There are thousands of price nodes throughout the system



SUPPLY RESOURCES

Price calculated based on their location on the system

DEMAND

Generally charged at a price associated with a load aggregation point (LAP), an average of the demand node prices within specific zones

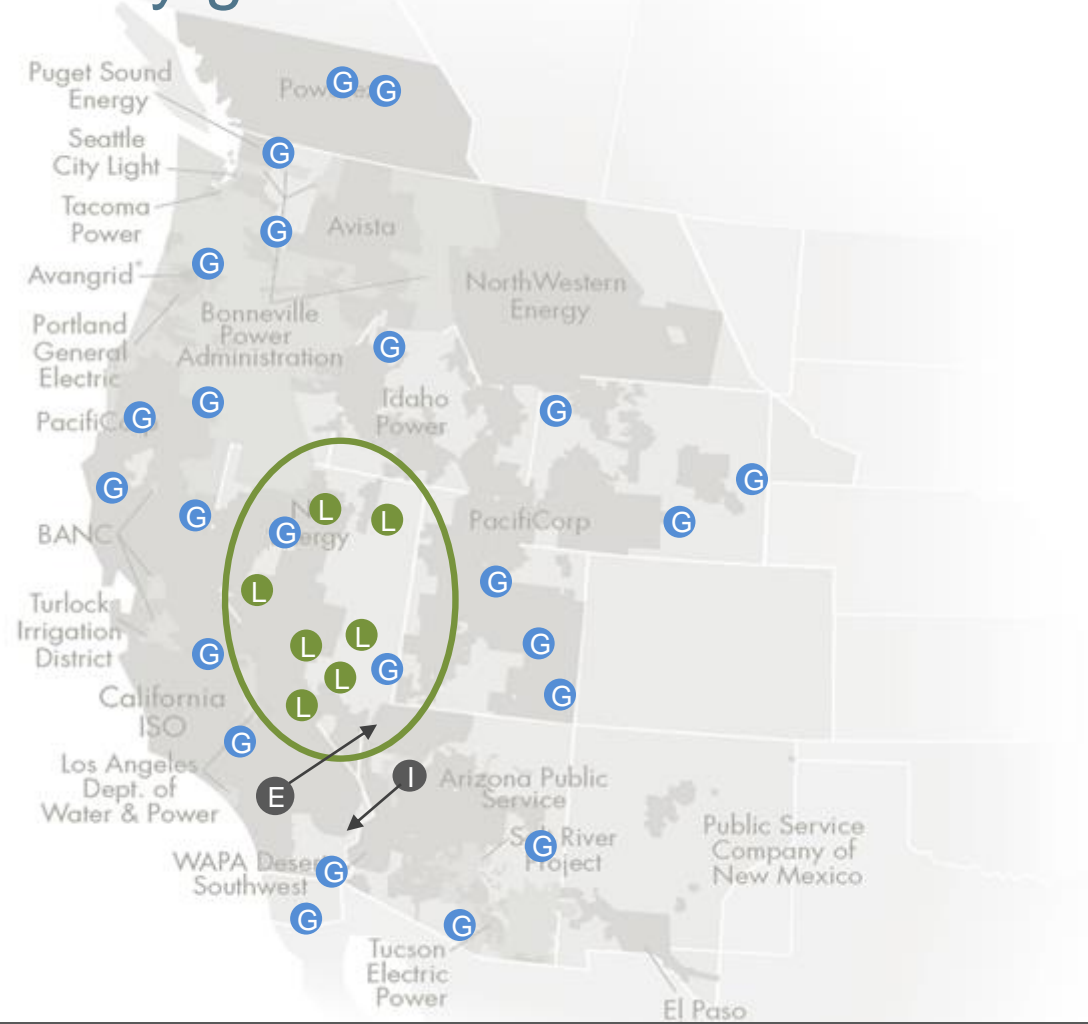
ISO Price Map on Today's Outlook

Nodal pricing is the price paid for electricity generated or consumed at a specific location

Resources are paid the nodal price

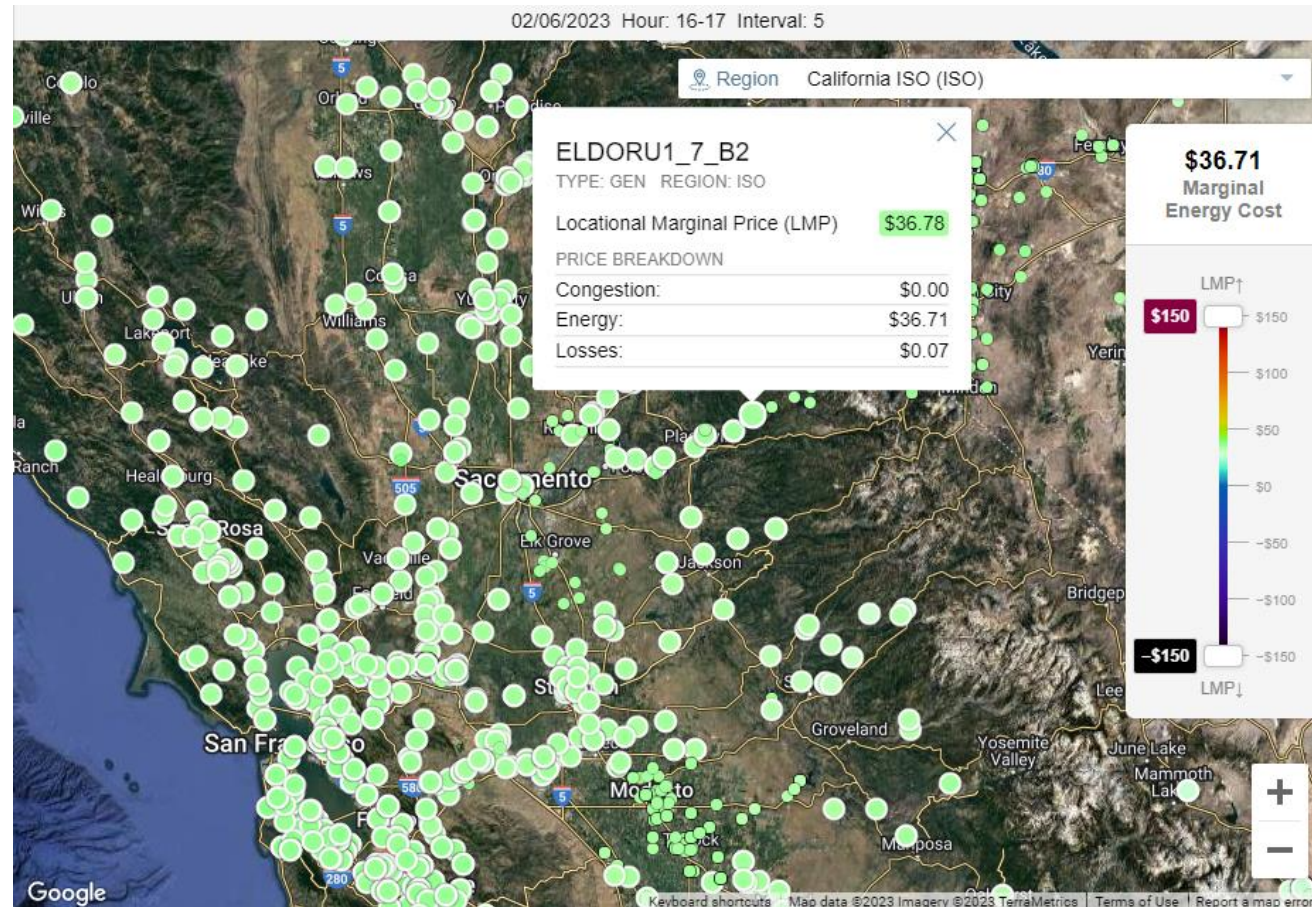
Load pays the weighted average price of all load nodes in the service territory

Imports and exports are paid, or pay, the price at the scheduling point



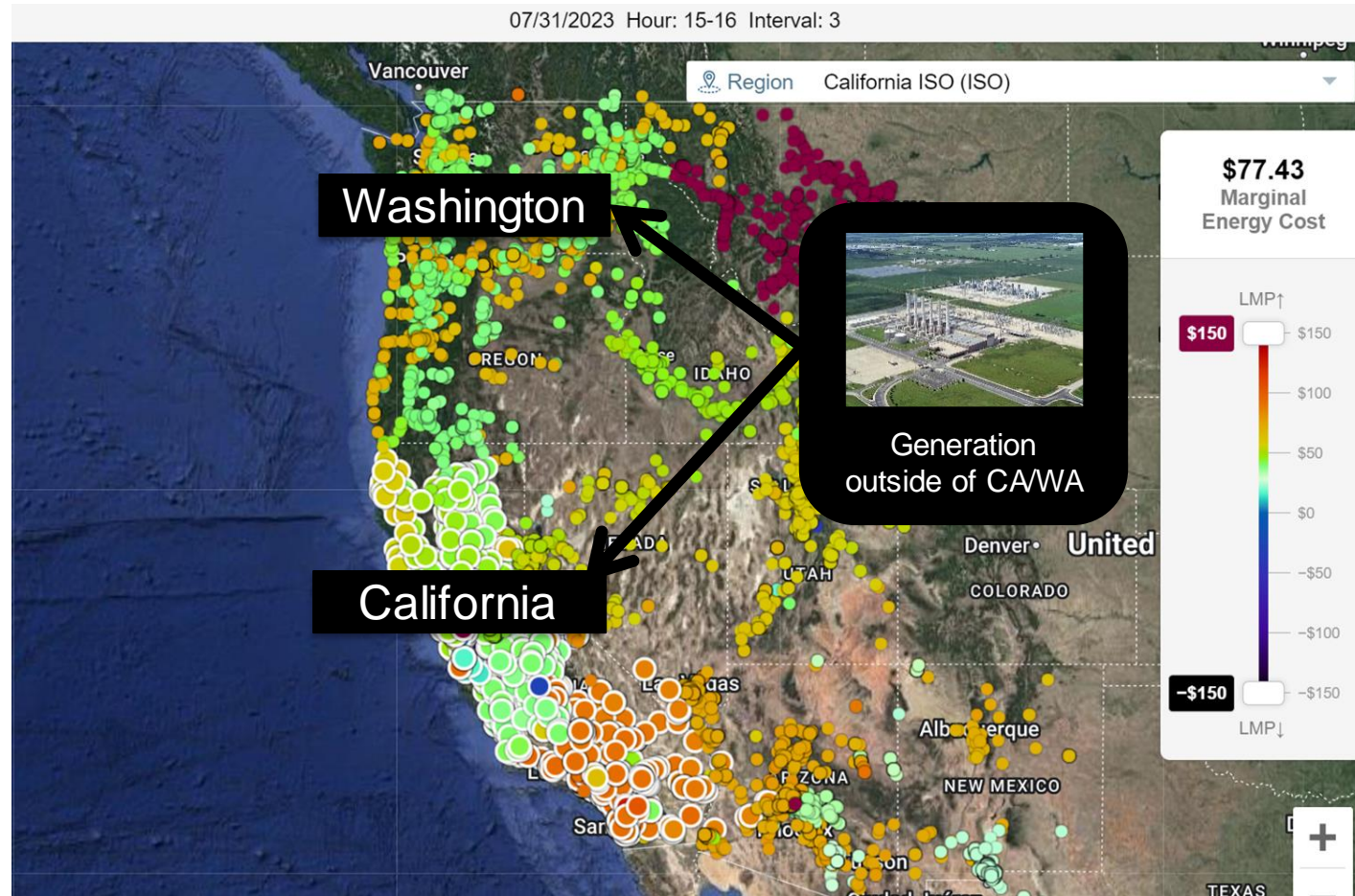
Components of the locational marginal price

$$\frac{\text{Energy} + \text{Congestion} + \text{Losses}}{\text{LMP}}$$



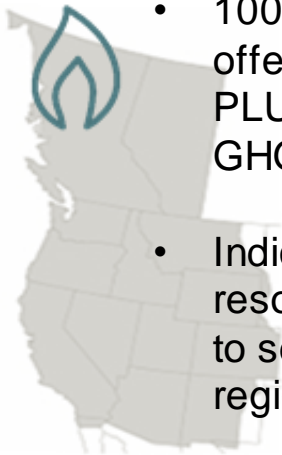
LMP with greenhouse gas component

$$\frac{\text{Energy Congestion Losses} + \text{GHG}}{\text{LMP}}$$



WEIM's approach for GHG emissions accounting is a voluntary, resource-specific framework

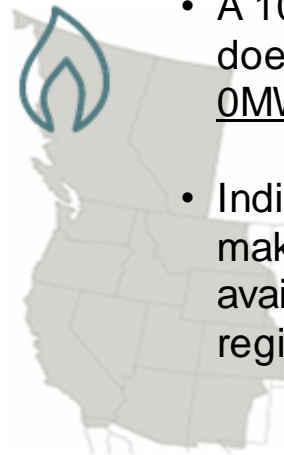
G
H
G



- 100 MW gas unit offers a 50 MW bid PLUS \$15/MWh GHG bid adder
- Indicates half of its resource is available to serve to a GHG region

Example 1

Gas partial unit available w/GHG bid adder



- A 100 MW gas unit does not bid or bids 0MW
- Indicates they are not making that resource available to a GHG region

Example 2

Gas w/NO GHG bid adder



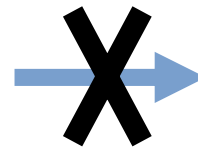
- A 100 MW wind resource bids 100 MW at \$0/MWh GHG bid adder
- Indicates they are making the whole resource available to a GHG region but do not face a GHG cost of compliance

Example 3

Clean resource with \$0 GHG bid adder

Scarcity pricing intends to reward available suppliers during tight system conditions

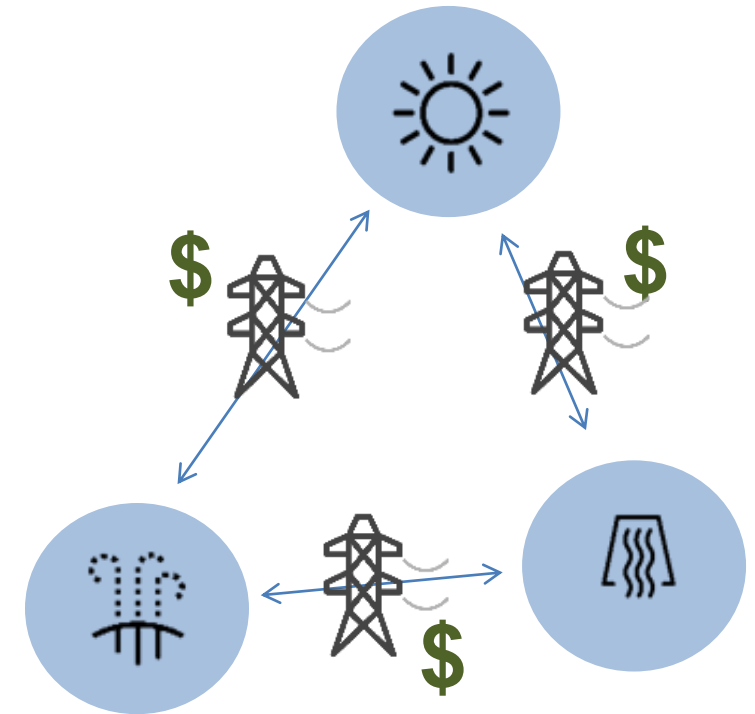
Occurs when the next available MW will not help relieve congested area



How transmission constraints effect pricing

Transmission Constraints

- Pricing mechanism to reduce congestion to avoid overloading a transmission line
 - What is the line rating?
 - What is the cost of the next MW?



Now, let's look at how things are changing...



Upcoming Market Changes

Extended Day-Ahead Market (EDAM)

Day-Ahead Market Enhancements (DAME)

Implementation of an extended day-ahead market

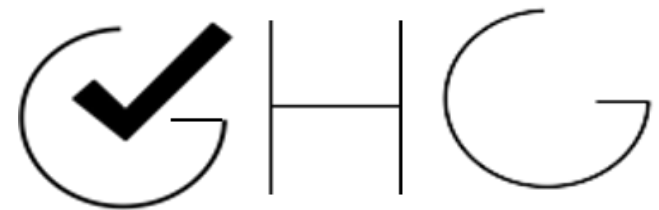
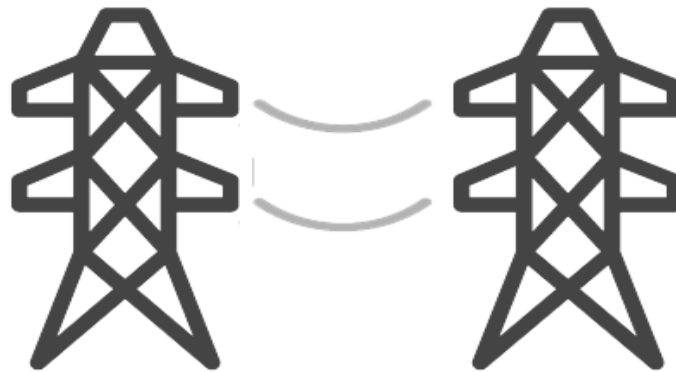


- Day-ahead capabilities extended to WEIM participants who voluntarily opt in, providing additional benefits
- ISO market will manage energy schedules and optimize efficient transfers of energy between balancing areas
- Expands access to full complement of wholesale energy market services and builds upon WEIM to optimize commitment of generation a day in advance

Extended Day-Ahead Market (EDAM)

Elements of the EDAM program

- Daily resource sufficiency evaluation (RSE) across full 24-hour time horizon
 - RSE is universal adaptor that connects entities with varying resource adequacy programs to efficiently commit/dispatch resources
- Transmission capability on internal system and interties with other EDAM BAs made available to optimize transfers between participating areas
- Bidding and attribution to multiple state greenhouse gas regulation areas as well as accommodation for non-priced GHG programs





Day-Ahead Market Enhancements

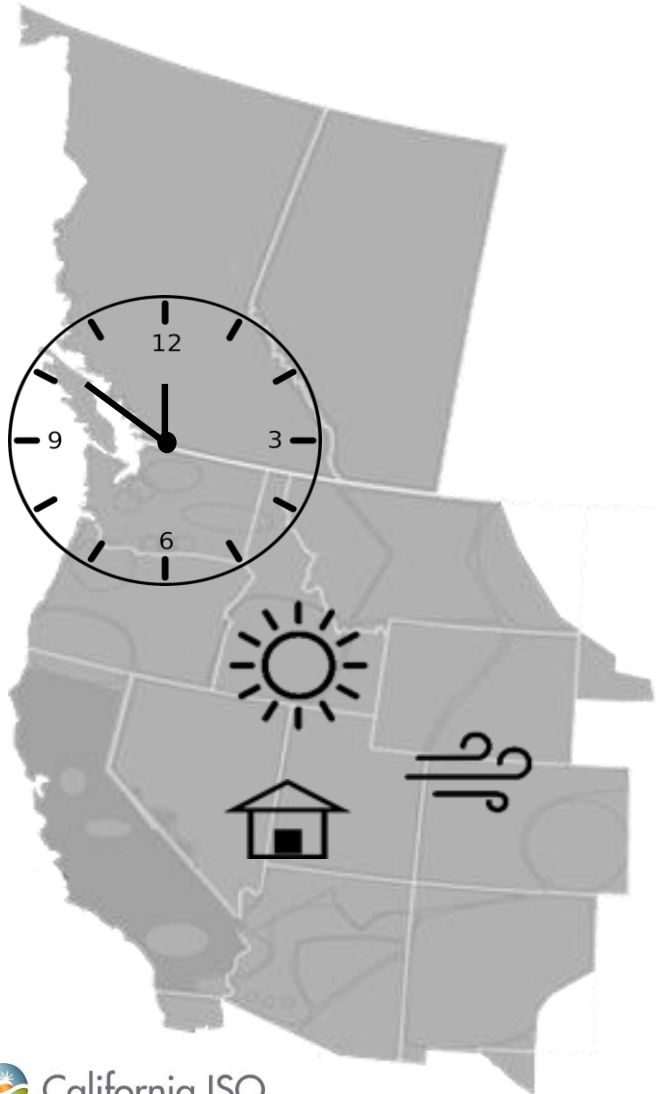
Parallel effort: Day-ahead market enhancements (DAME)

DAME
enhancements
automatically
included in
EDAM
participation

- ISO day-ahead market will undergo a series of enhancements as part of the DAME initiative
- DAME establishes two new market products:
 - Imbalance Reserves
 - Reliability Capacity

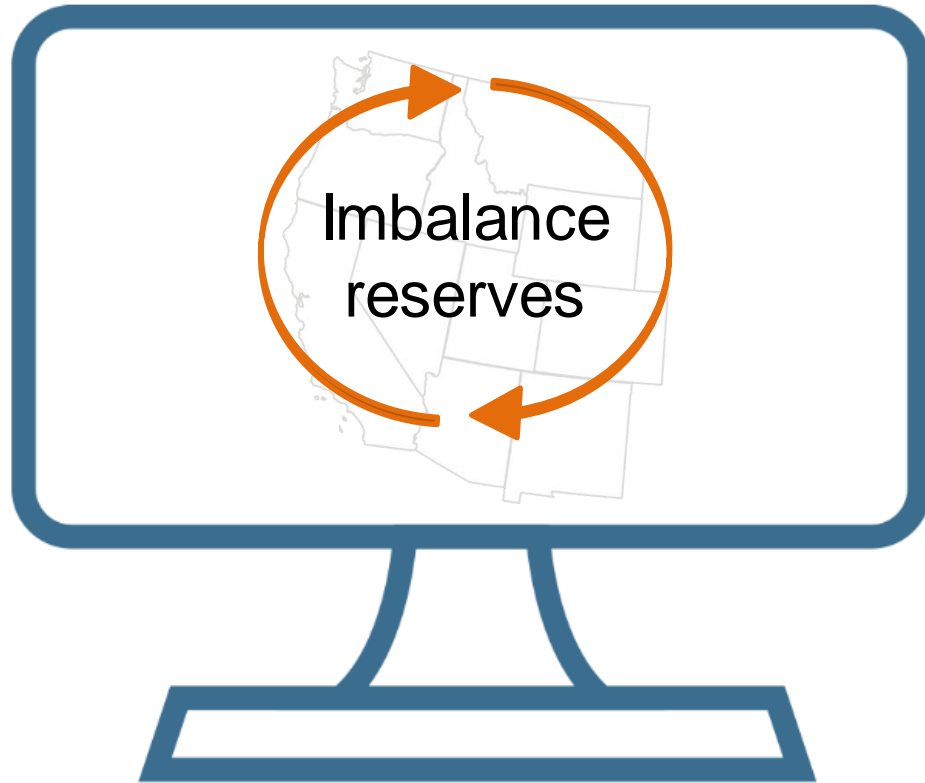
Day-Ahead Market Enhancements (DAME)

New IFM imbalance reserve products provide consistent method for evaluating & addressing uncertainty needs in each BA



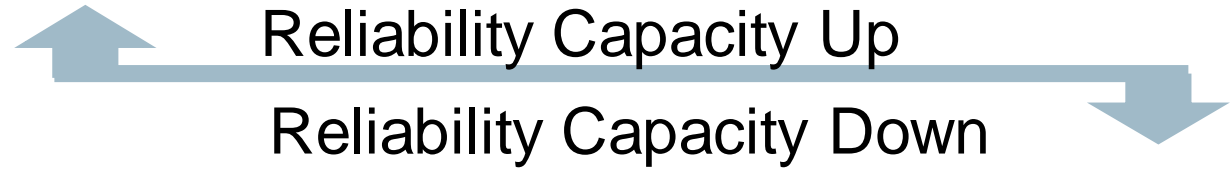
- Reserves procured on an hourly basis for each area
- Requirements based on tomorrow's forecast as well as historical uncertainty in the day-ahead
- Bids for imbalance reserves will come from participants throughout the market footprint which maximizes diversity benefit

Imbalance reserves address expected range of load/supply uncertainties between day-ahead and real-time markets



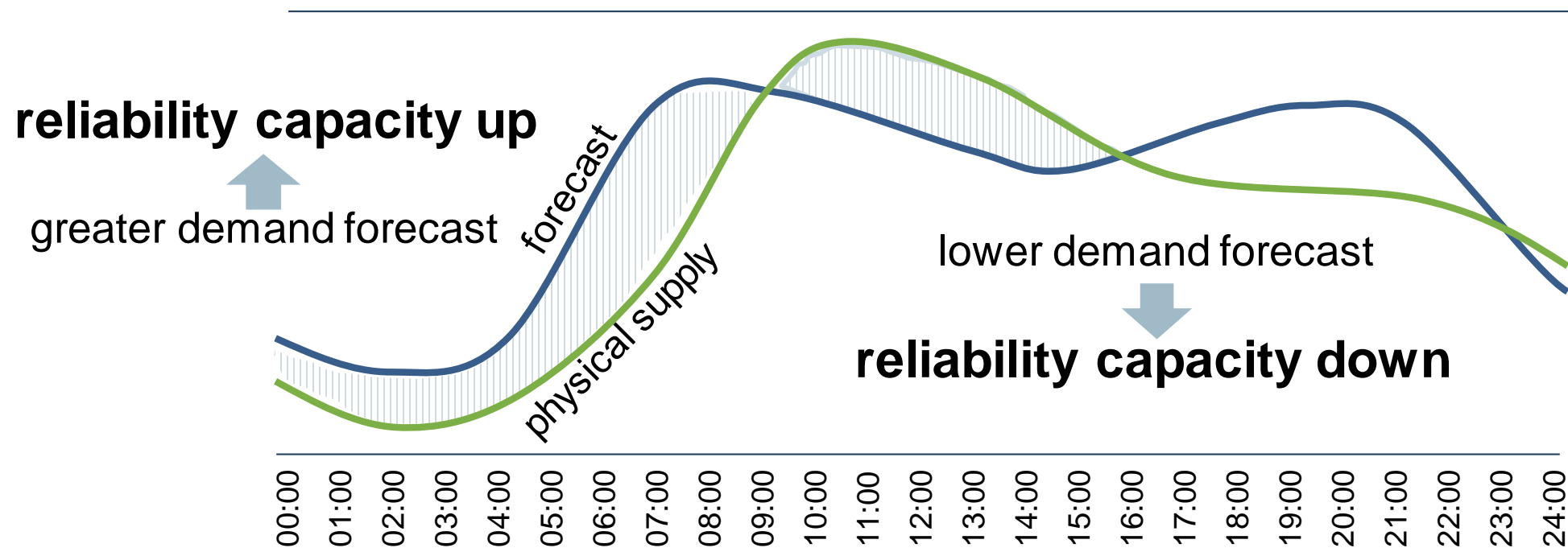
- Hourly analysis compares advanced energy purchases to real-time energy needs
- Differences determine reserve types needed for each area
- Reserve types can vary from hour-to-hour across the day

New RUC reliability capacity products ensure sufficient physical supply scheduled in day-ahead



- Existing RUC process procures additional capacity to meet forecasted demand
- Reliability capacity provides both upward and downward dispatch capability
- Hourly requirement at the BA level, awarded at the resource level
- Reliability capacity bids from across the market footprint

RUC compares demand forecast to physical supply that clears the market



What are some of the ways EDAM and DAME will provide benefit to participants?



- Economic benefits through commitment of least-cost generation
- Improved situational awareness across BAs
- Enhanced reliability
- Lower greenhouse gas emissions

What should I keep in mind when preparing for EDAM?

What changes?

- All loads and resources in EDAM area submit offers (economic or self-schedule)
- No more base schedules
- No more “non-participating” resources
- Settlement of Day-Ahead Market Transactions

What stays the same?

- EDAM entities continue to retain their resource planning, transmission planning and reliability functions





Market Settlements

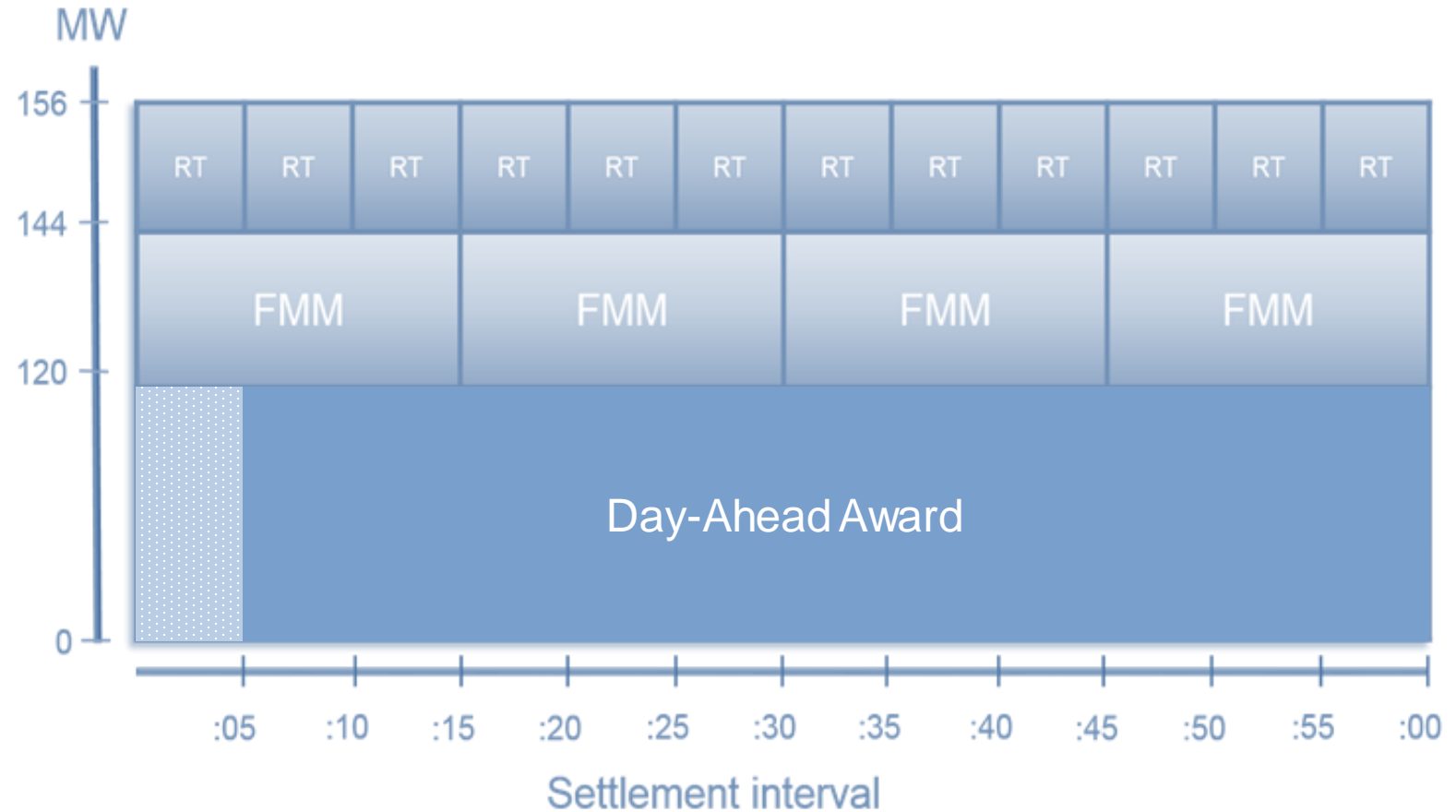
Market Settlements

Market transactions are settled directly with SCs who represent market participants

- Settlements are conducted directly between the ISO and the respective SC for loads/resources that bid into and are awarded by the market
- Other aspects of settlements occur directly with the EDAM entity SC (entity may need to allocate these settlements within its balancing area)
- Information on the allocation of ISO settlements can be found in the EDAM entity's tariff

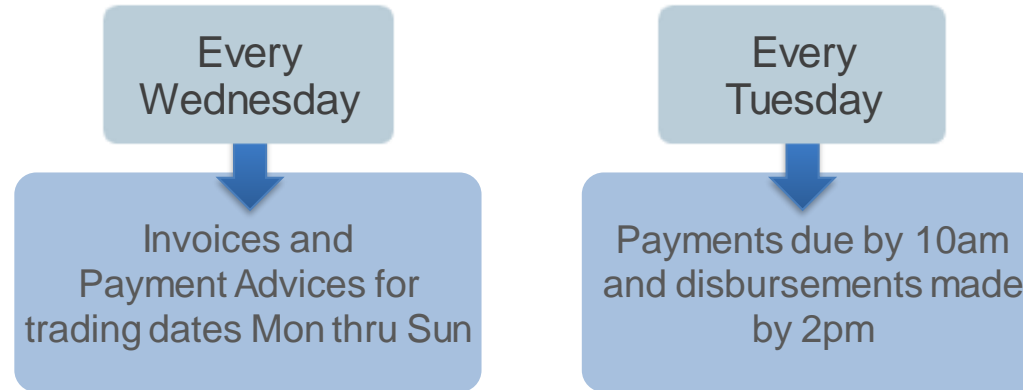
Energy settlements occur in day-ahead, the fifteen-minute and real-time markets

Energy settlements are calculated in 5 minute intervals

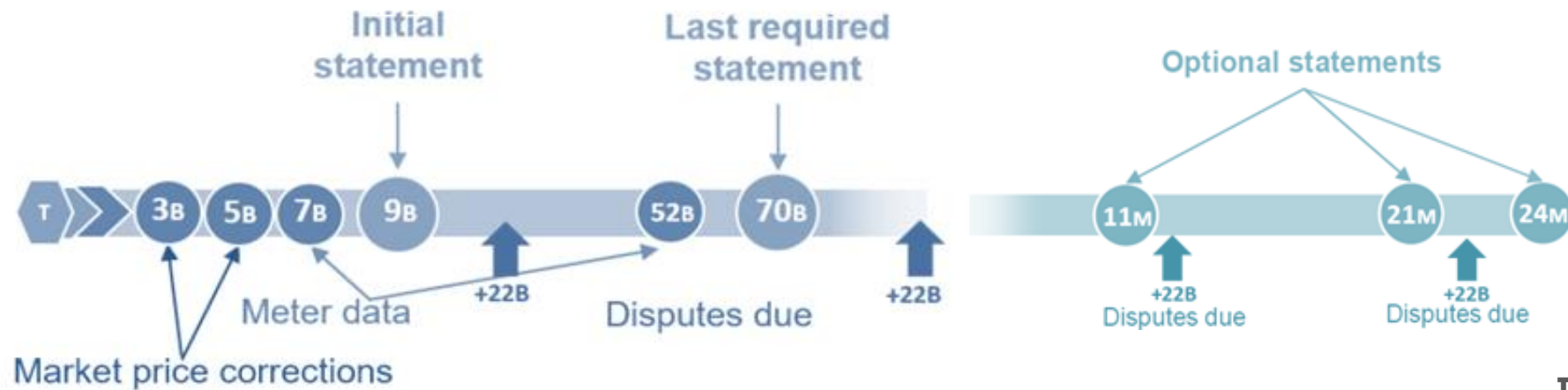


Key Settlement Dates

Invoices & payment advices

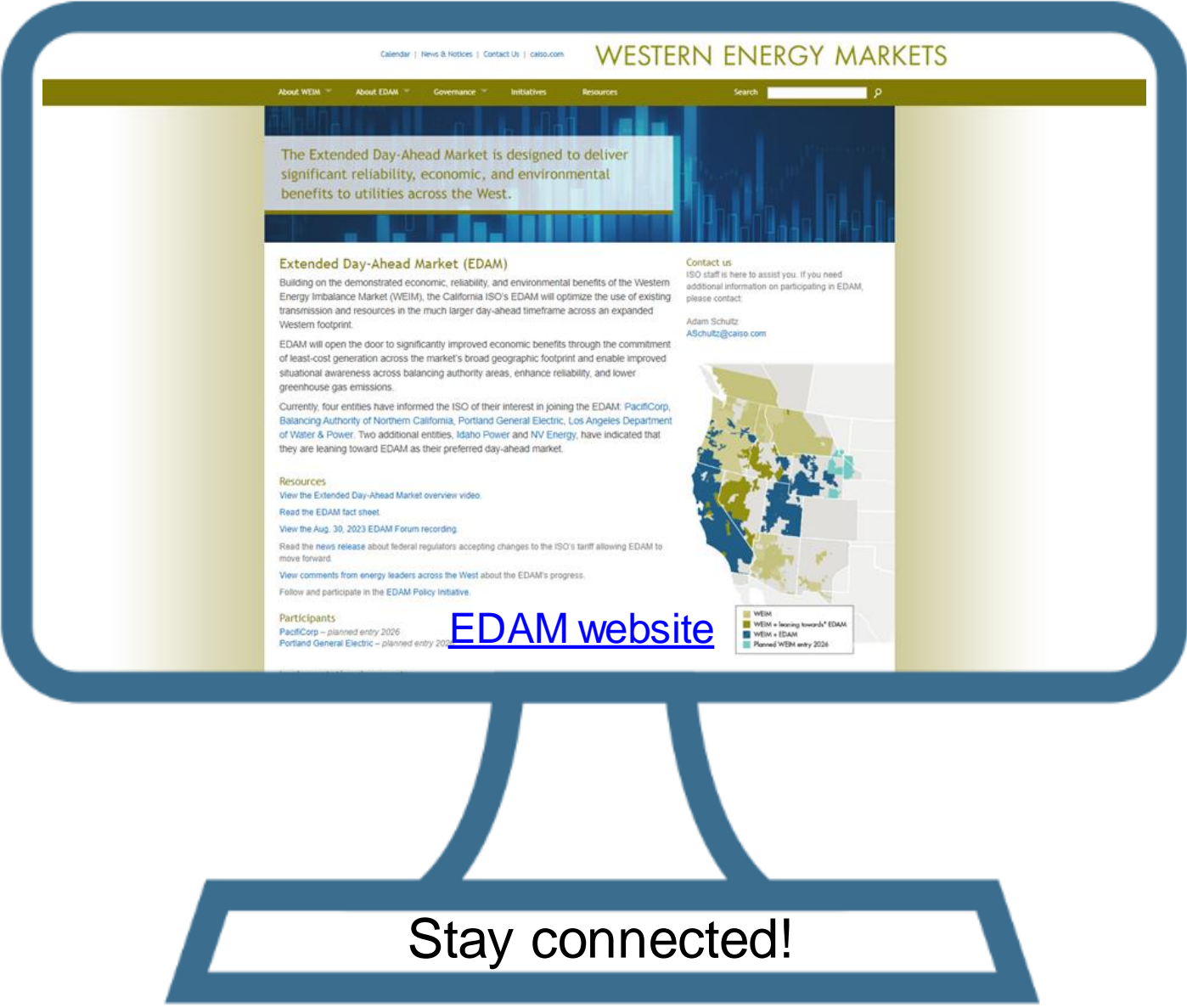


Settlement Timeline



T = Trade Date
B = Business Days
M = Months

EDAM/DAME implementation in spring
2026 





Thank you for your participation!

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