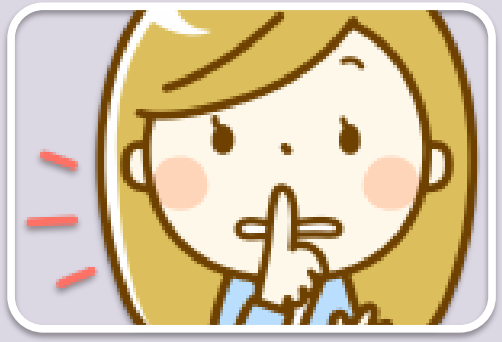
California ISO Market Transactions

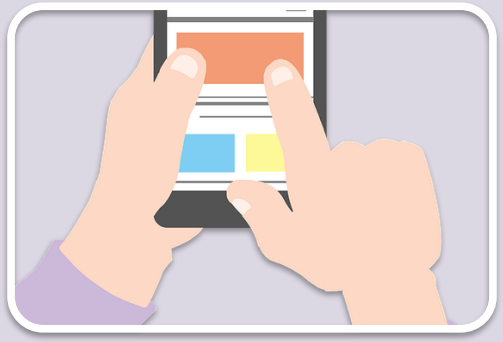
October 19, 2022

Updated 10/16/2022

Housekeeping



Keep yourself muted to minimize background noise



Unmute to ask verbal questions or write questions in the chat pod

Raise your hand using WebEx interactivity tools

Course Overview

Agenda

- ISO Market Participation
- Bidding in the Day-Ahead Market
- Moving from Day-Ahead to Real-Time
- Bidding in the Real-Time Market
- Other Potential Market Outcomes

Materials

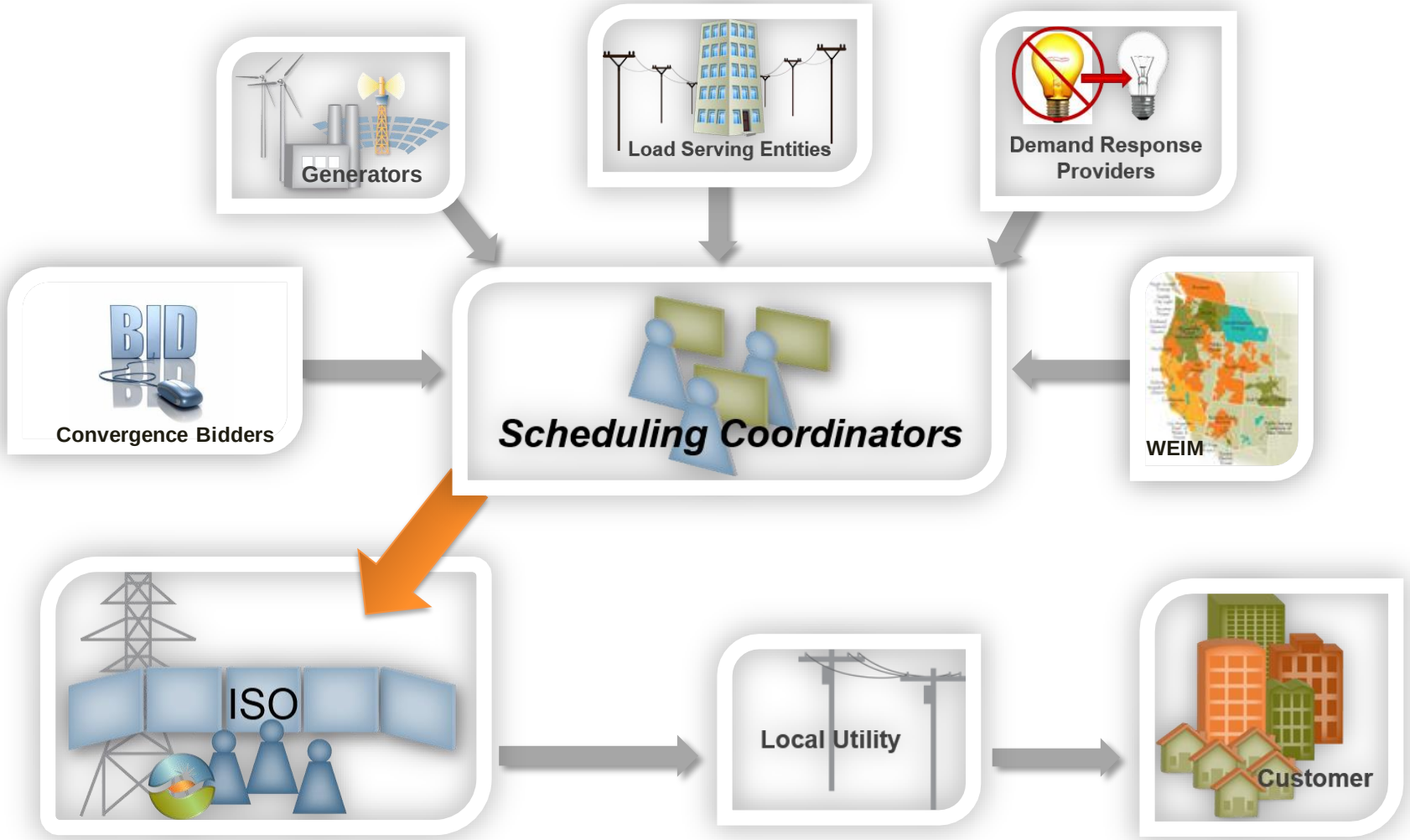
- Course slides
- Learning activities

Course Objectives

- Explore day-ahead bidding process
- Explore real-time bidding process
- Explore potential market outcomes

ISO MARKET PARTICIPATION

Participation with the ISO depends on the service to be provided



BIDDING IN THE DAY-AHEAD MARKET

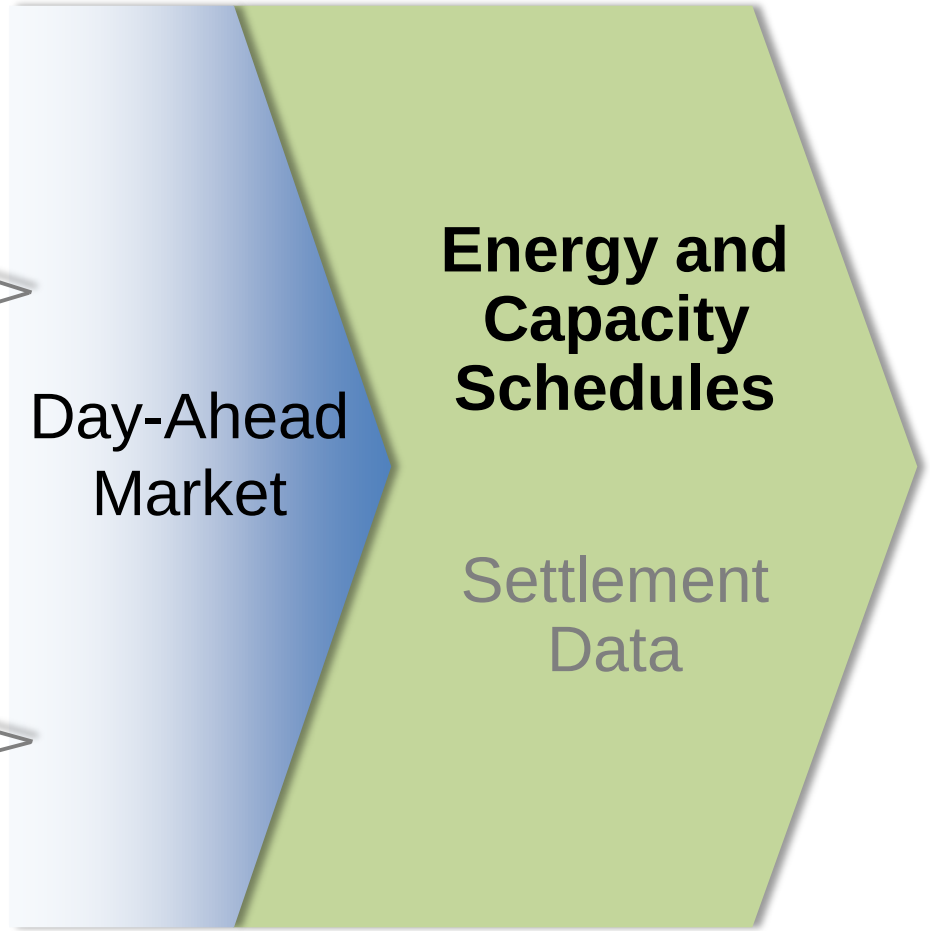
Market Transactions course focuses on:

Data:

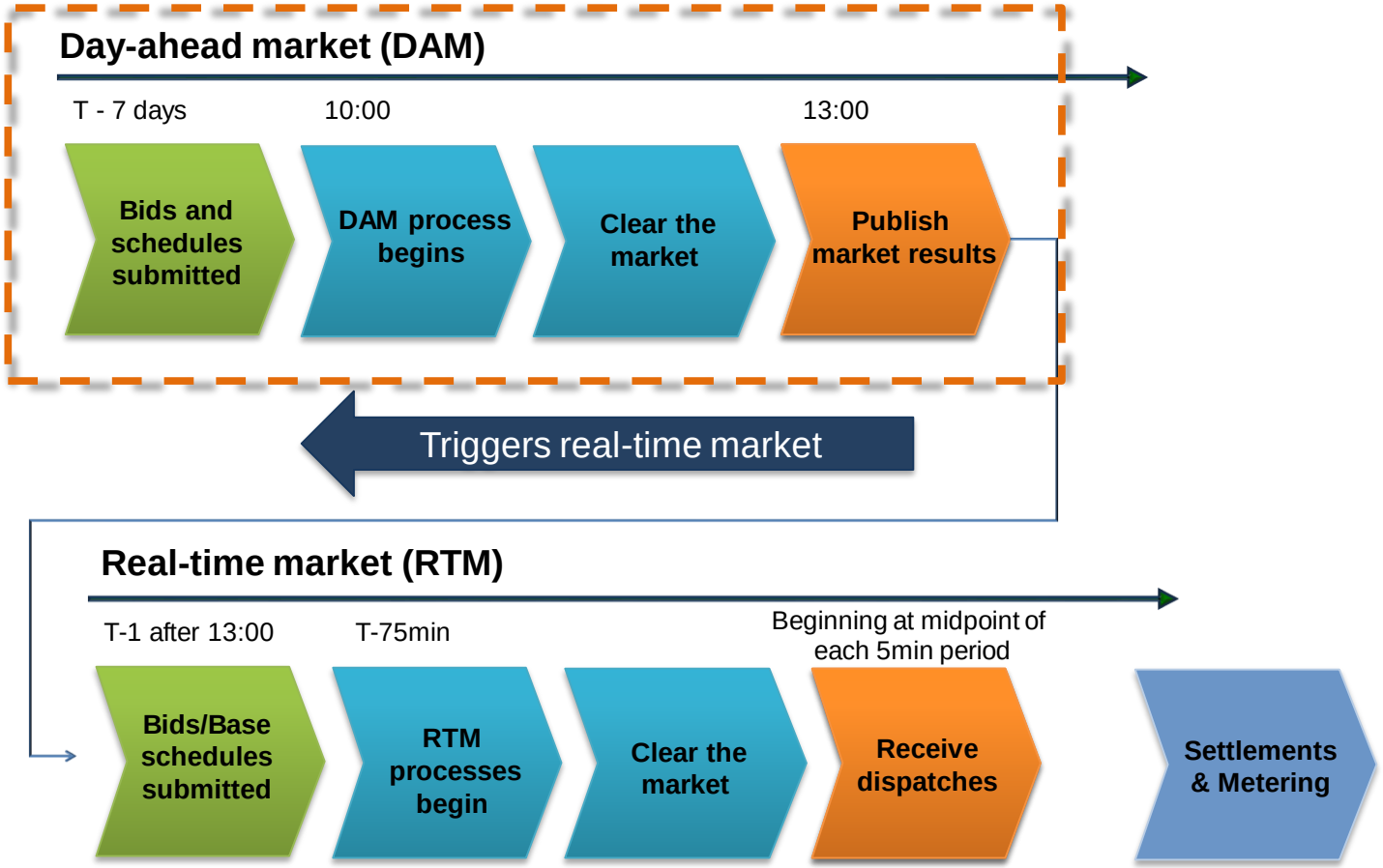
- System parameters
- Resource parameters
- Outage information
- **Bid information**
- ISO forecast of demand
- Transmission interface limits

Requirements:

- Reserves
- **Residual unit commitment**
- Energy to serve demand

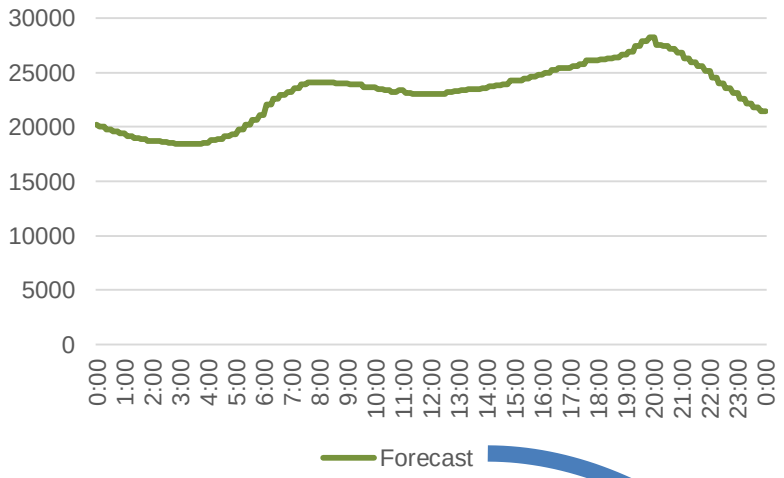


Participants adhere to day-ahead timelines



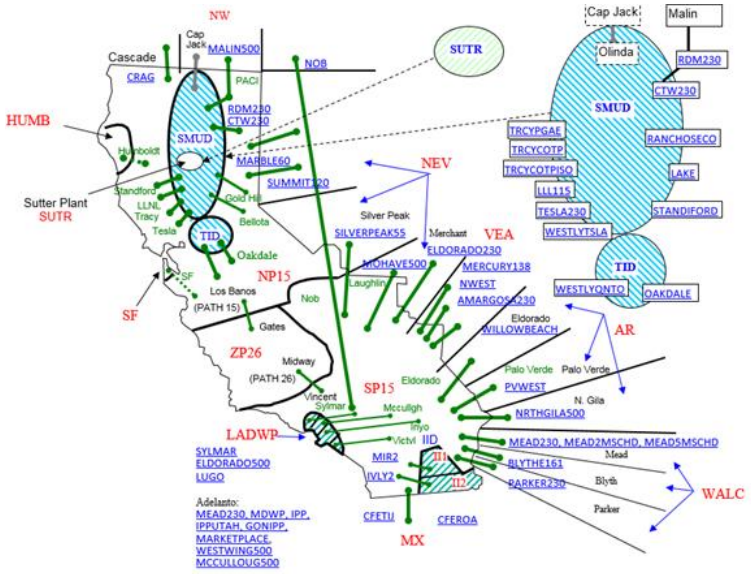
Day-ahead market processes

Meeting the Residual Unit Commitment (RUC) target



- RUC distributes the ISO's demand forecast over the FNM's connectivity nodes using system load distribution factors

- RUC Bids are a single quantity and price
- RUC bids must be $0 for all MWs that have been designated resource adequacy capacity



Full Network Model

DAY-AHEAD BIDDING EXAMPLES & POTENTIAL MARKET OUTCOMES

Day-Ahead Market Bidding Examples

- Demand Bids
- Supply Bids
- Battery (Storage)
- Convergence Bids

Demand: Day-ahead bidding activity

Energy bids:

- 3000 MW self-schedule
- 2000 MW economic bid

BIDS

ISO Market Systems

RESULTS

Demand: Potential Market Outcome
Report: Day-Ahead Demand Market Results

Trade Date	Product	Schedule type	HE11 [MW]
04/01/2019	Energy	Cleared	5,000.00
04/01/2019	Energy	Market	2,000.00
04/01/2019	Energy	Self	3,000.00

Supplier: Day-ahead bidding activity

PMAX = 140 MW

PMIN = 50 MW

Economic Bids
70 MW
Energy

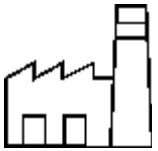
40 MW
Ancillary
Service

10 MW
RUC

Self-Schedule
70 MW
Energy

- Supplier offers resource into applicable products
- Market determines best way to use the resource
- RUC bids are processed separately, after market clears energy and A/S

Supplier: Potential Market Outcome
Report: Day-Ahead Generation Market Results



Trade Date	Product	Schedule type	HE11 [MW]
04/01/2019	A/S Spinning	Cleared	43.00
04/01/2019	A/S Spinning	Market	40.00
04/01/2019	A/S Spinning	Self	3.00
04/01/2019	Energy	Cleared	80.00
04/01/2019	Energy	Market	10.00
04/01/2019	Energy	Self	70.00
04/01/2019	RUC Capacity	Market	10.00

Supplier: Real-time bidding activity

Trade Date	Product	Schedule type	HE11 [MW]
04/01/2019	A/S Spinning	Cleared	43.00
04/01/2019	A/S Spinning	Market	40.00
04/01/2019	A/S Spinning	Self	3.00
04/01/2019	Energy	Cleared	80.00
04/01/2019	Energy	Market	10.00
04/01/2019	Energy	Self	70.00
04/01/2019	RUC Capacity	Market	10.00

Day-Ahead Awards

Real-time bids submitted:
53 MW Economic bids for energy

Submit Real-Time energy bid to cover these awards

By doing nothing, this becomes a self-schedule in Real-Time

Submit Real-Time energy bid for this award

Bidding nuances for battery (storage) resources

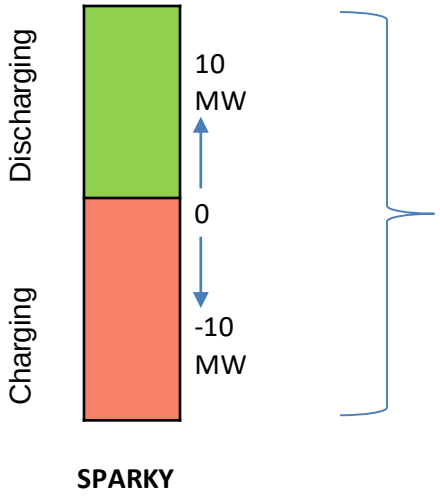
Economic Bids

- Economic bid curve can combine “charging” and “discharging” in same bid curve

Self-Schedules

- **Load**
  - Self-schedule submitted for load can only be “charging”
- **Supply**
  - Self-schedule submitted for supply can only be “discharging”

Supplier: Battery (Storage)



The PMAX value is positive, the PMIN value is negative.

- A resource's MAX SOC is provided in MWh
- This resource has a MAX SOC of 40 MW/h
  - PMAX is 10 and PMIN is -10

Example: Battery (Storage)

Convergence Bidding: Dynamic Credit Check

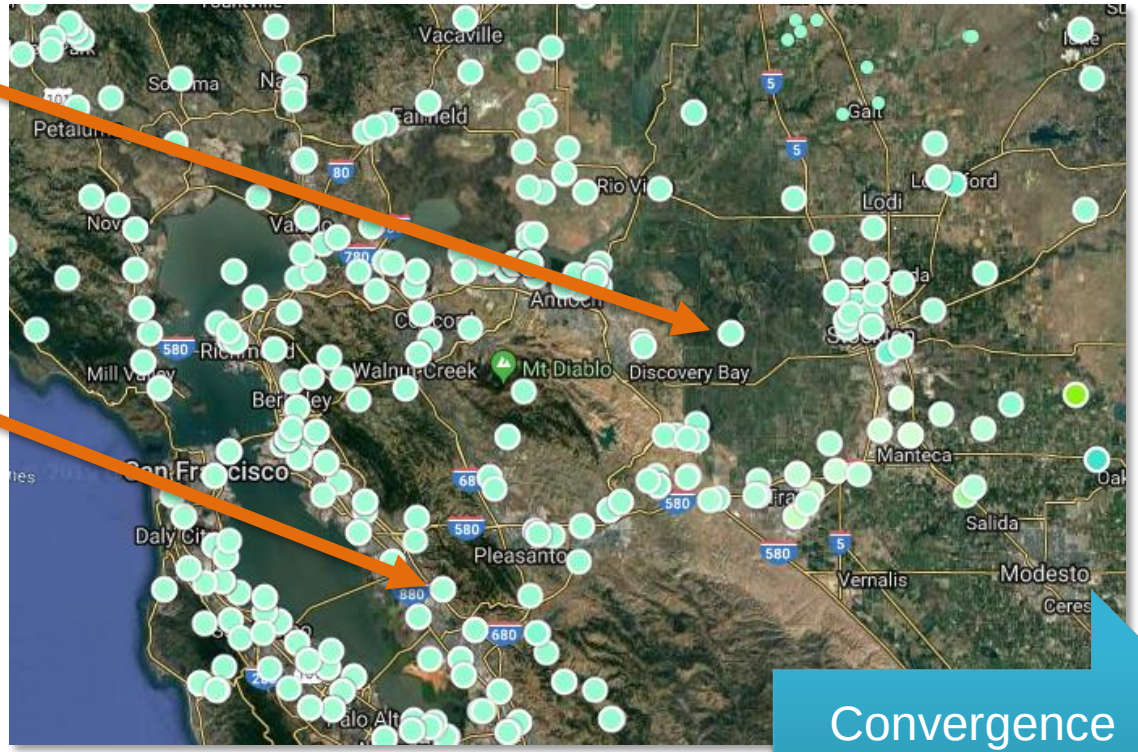
- For virtual bidding, a **dynamic credit check** is performed at bid submission:

- Available credit limit =
  (aggregate credit limit) – (estimated aggregated liability)

Convergence Bidding: Day-ahead bidding activity

10 MW
Supply Bid

15 MW
Demand Bid



Convergence Bidding Nodes

Convergence Bidding – Potential Market Outcome
Day-Ahead Report: Convergence Bidding Awards

Trade Date	Node ID	Supply/ Demand	HE11 [MW]
04/01/2019	GENRESOURCE_NODE1	Demand	15.00
04/01/2019	POD_NODE2	Supply	10.00

Prices are available on OASIS
Prices Tab > Locational Marginal Prices

Convergence Bidding – Potential Market Outcome
Real-Time Report: FMM Locational Marginal Prices

OASIS > Prices tab > FMM Locational Marginal Prices

California ISO | OASIS

ATLAS REFERENCE | REPORT DEFINITION | **PRICES** | TRANSMISSION | SYSTEM DEMAND | ENERGY | ANCILLARY SERVICES | CONG

Date From: 04/01/2019 **To:** 04/01/2019 **Group Type** SELECT_NODE **Node** 0096WD_7_N001

Download XML **Download CSV**

FMM Locational Marginal Prices (LMP)

Market	Opr Date/Hour	Node	LMP Type	INTERVAL01	INTERVAL02	INTERVAL03	INTERVAL04
RTPD	04/01/2019 - Hour Ending 11	0096WD_7_N001	LMP	27.81656	31.54396	27.00109	22.69955
RTPD	04/01/2019 - Hour Ending 11	0096WD_7_N001	Congestion	1.83413	1.76636	1.54212	1.29520
RTPD	04/01/2019 - Hour Ending 11	0096WD_7_N001	Energy	25.98243	29.77760	25.45897	21.40435
RTPD	04/01/2019 - Hour Ending 11	0096WD_7_N001	Loss	0.00000	0.00000	0.00000	0.00000
RTPD	04/01/2019 - Hour Ending 11	0096WD_7_N001	Greenhouse Gas	0.00000	0.00000	0.00000	0.00000

Bids liquidate at the average of the four FMM LMPs

MOVING FROM DAY-AHEAD TO REAL-TIME

How does the day-ahead award affect a resource's real-time position?

- The day-ahead market is a financial position only
- However, the day-ahead award directly affects the real-time position
- Scheduling Coordinators are expected to deliver their day-ahead award in real-time or bid something else
  - If they do nothing, the day-ahead award becomes a self-schedule in real-time
  - Or they can choose to take a different position in the real-time market, and bid accordingly

Ancillary Services Requirements

- Resources with awards for A/S must submit real-time energy bids for those awards

- Nuances for Regulation:
  - Regulation Down must submit a self-schedule in real-time (we need to ensure that they are at the top of the Regulation range to bring them down)

  - Regulation Up can submit a self-schedule or an economic bid

Requirements: Commitment costs

Registered Cost

Proxy Cost

- Accepted parameters for Start-up and Minimum Load values are outlined in the BPM for Market Instruments
- For the proxy cost option, the start-up and minimum load costs can be set in the day-ahead as a daily component
  - Any day-ahead awarded hours will be at the day-ahead costs
- In real-time bids for hours that weren't previously awarded in day-ahead can have new daily bids for SUC and MLC
  - Bids can vary across a series of hours, but once that resource is awarded in real-time, the costs associated with that hour are locked in for the rest of the day

Outages are treated differently in Day-Ahead vs. Real-Time

Day-Ahead

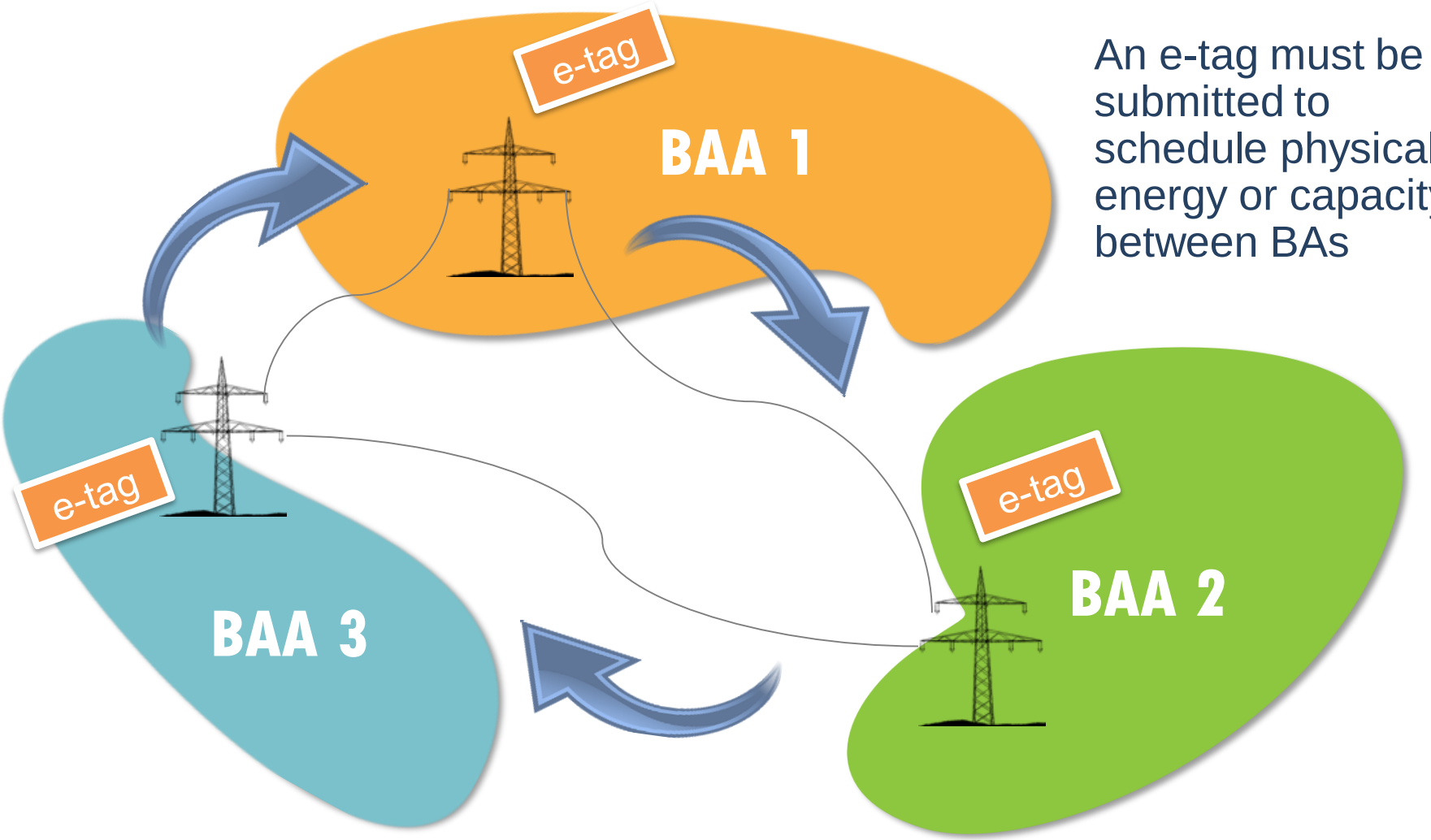
- After the outage's planned end time, the market adds the start-up time to the end of the outage, before awarding the unit

Real-Time

- The market assumes that start-up time is part of the outage

If an outage ends at 6:59am and there's a bid for HE8 (7am – 8am) the market could dispatch the resource

What is interchange scheduling & e-tagging?



An e-tag must be submitted to schedule physical energy or capacity between BAs

BIDDING IN THE REAL-TIME MARKET

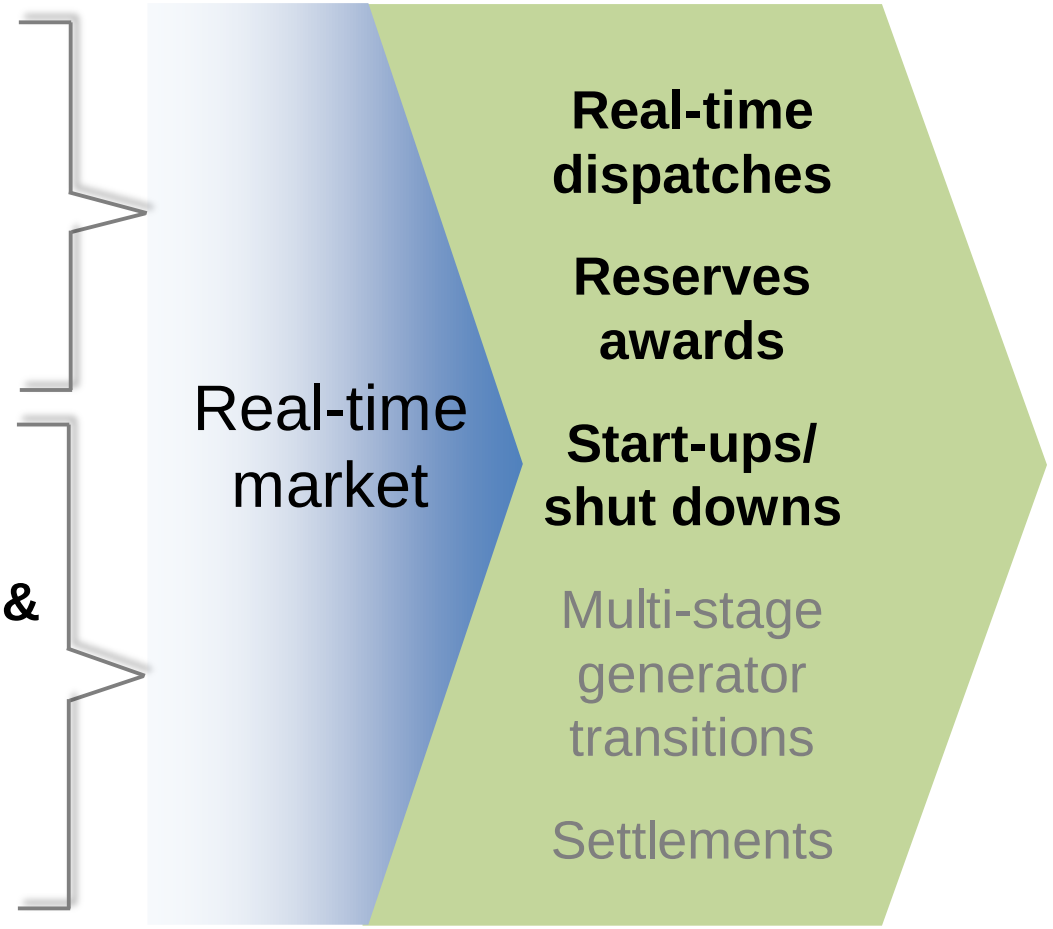
Market Transactions course focuses on:

From **day-ahead**:

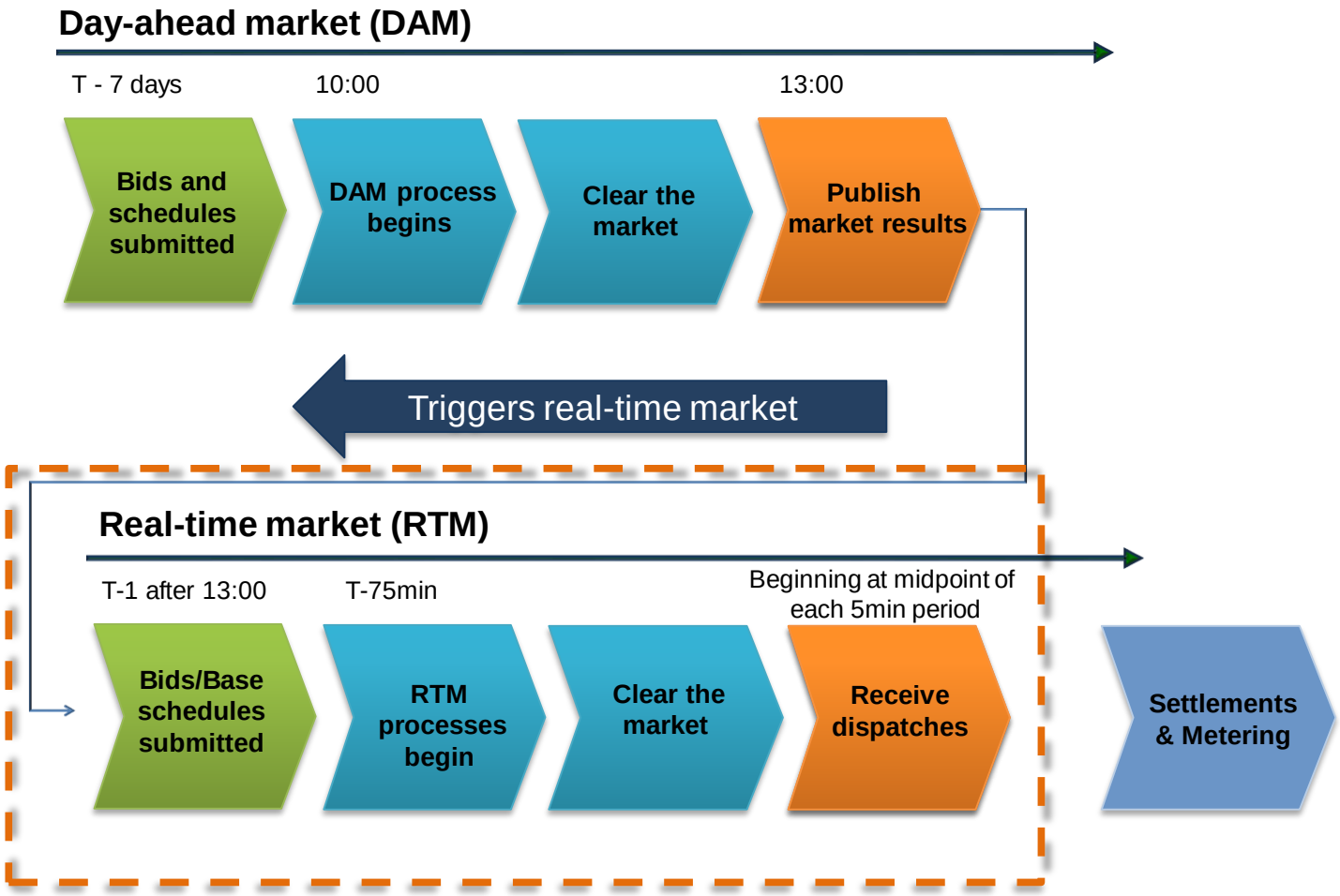
- System info
- **Energy schedules**
- **Reserves awards**
- Master file

From **real-time**:

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

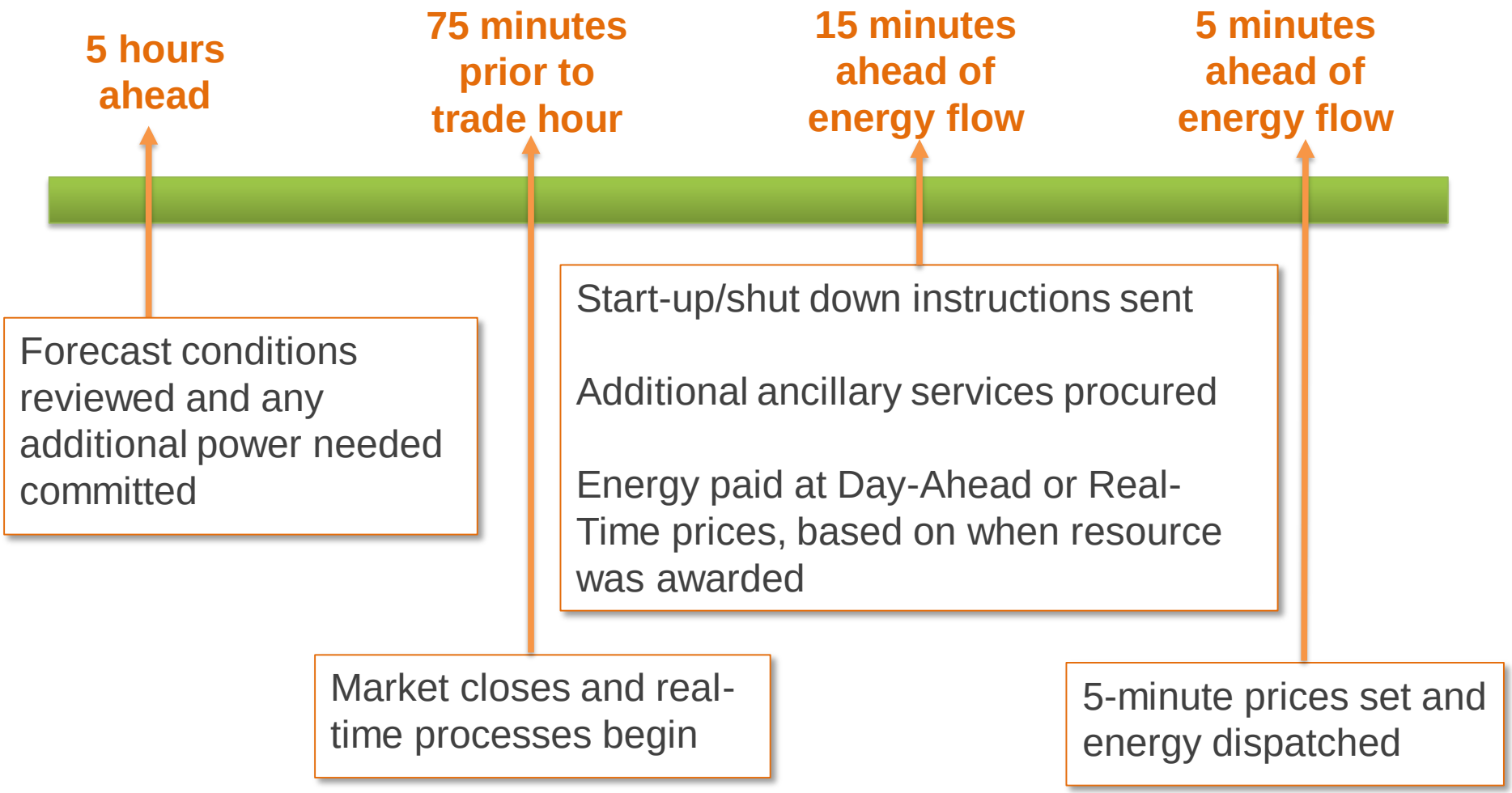


Participants adhere to real-time timelines



Real-time market processes

Real-time milestones



Real-time market instructions: All suppliers

- Resources receive instructions via Automated Dispatch System (ADS)
- For each **fifteen minute interval** the market is determining unit commitment:
  - Starting-up or shutting down resources
  - Transitioning multi-stage generators
- For each **five minute interval** the market is issuing real-time dispatch instructions

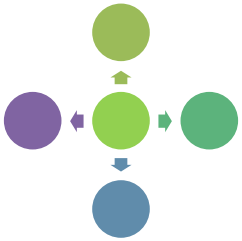
REAL-TIME BIDDING EXAMPLES AND POTENTIAL MARKET OUTCOMES

Real-Time Market Bidding Examples

WEIM Participation

VER With Forecast Interplay

WEIM Participating Resource: Who is participating and what does that mean?



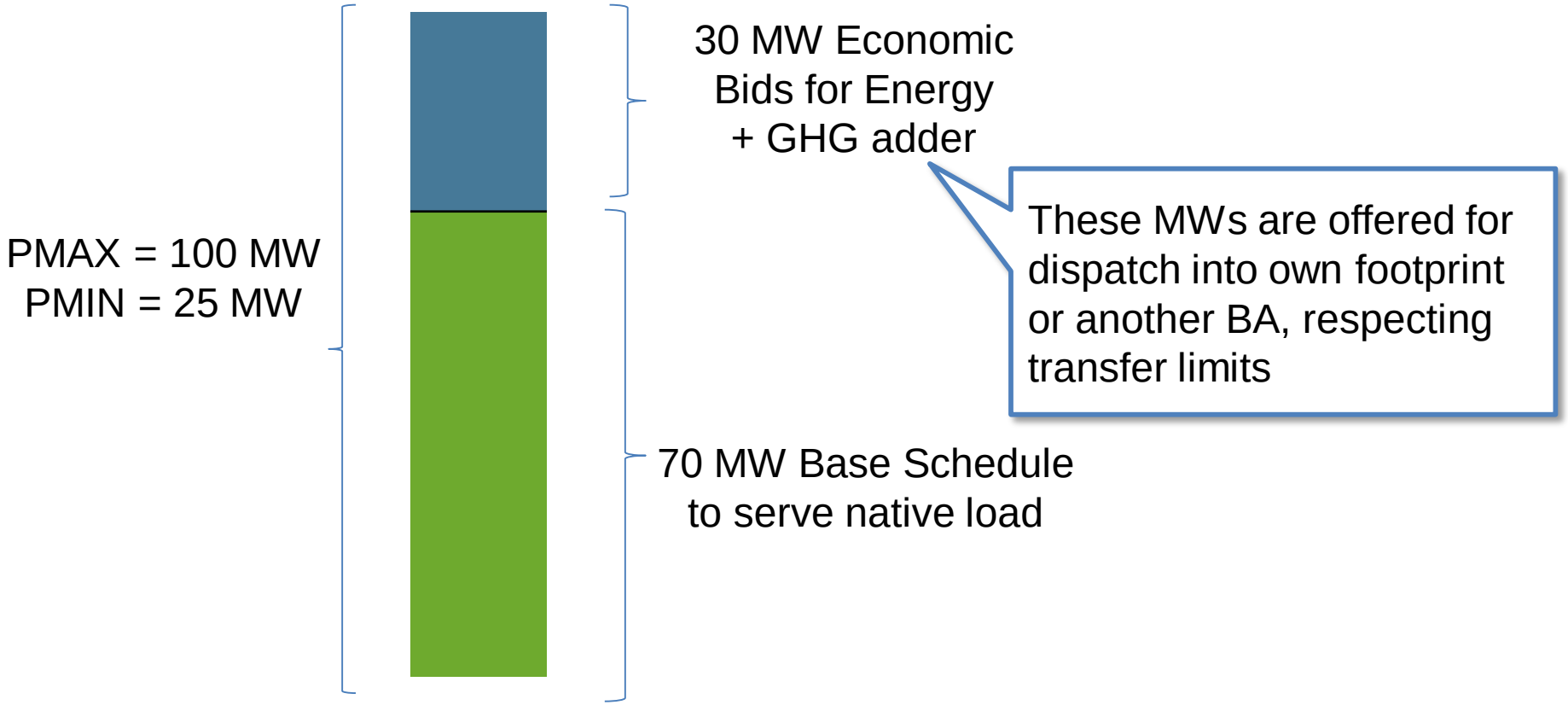
- A resource that operates in the WEIM BA but **does not** elect to participate in the real-time market
  - Does not require an agreement
  - Resource information provided for the Full Network Model
  - Base schedule data provided

Non-Participating Resource

- An WEIM resource that elects to participate in the real-time market
  - Requires an agreement
  - Detailed information provided to Master File
  - Bid and base schedules provided

Participating Resource

Supplier: Real-time bidding activity WEIM Participating Resource



Treatment of variable energy resource (VER) forecasts in Day-Ahead vs. Real-Time

Day-Ahead

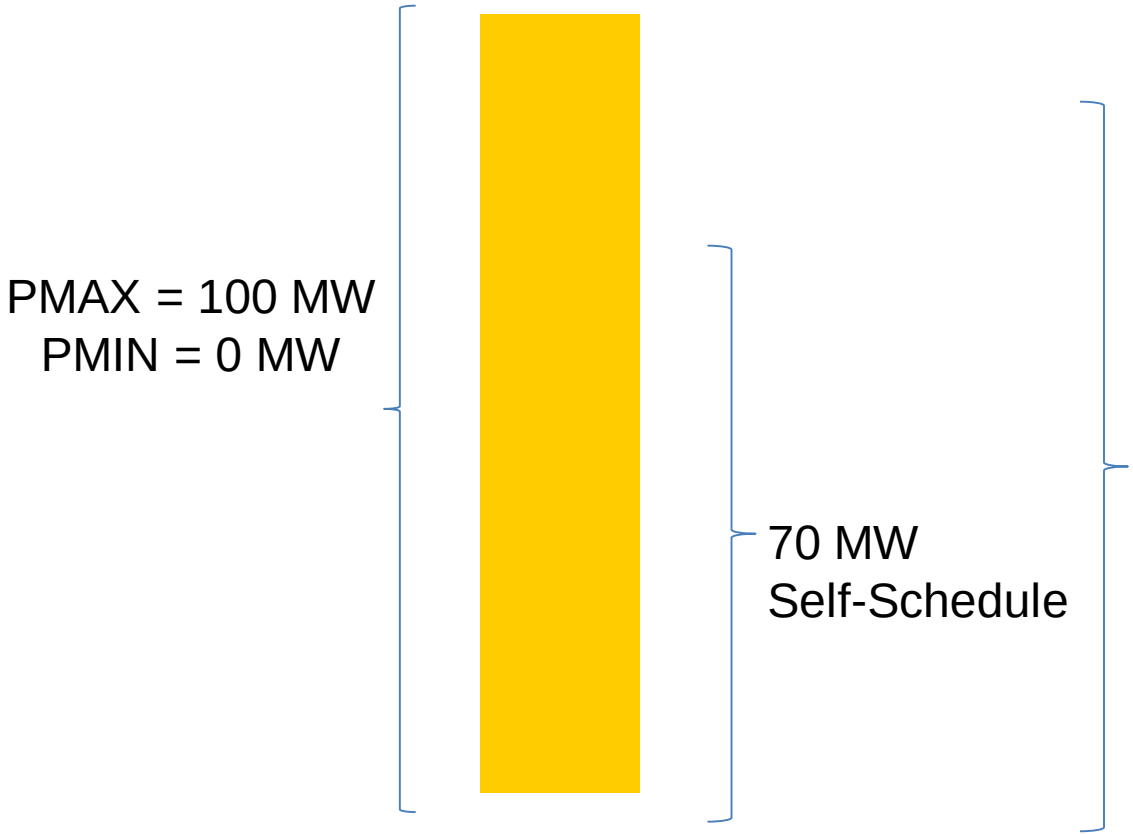
- The forecast is advisory and the market doesn't consider the forecast when awarding/ optimizing

Real-Time

- For self-schedules, the market defaults to the forecast amount
- For economic bids, the market will cap or extend the awarded MWs to the forecasted amount, or to the MW amount that respects the bid curve

The market assumes the economic bid extends to the PMAX of the resource

Supplier: Real-time bidding activity Variable Energy Resource



The market award extends the Self-Schedule quantity to match the forecast amount

Exercise: Variable Energy Resource with forecast interplay

OTHER POTENTIAL MARKET OUTCOMES

Day-Ahead and Real-Time Market: Potential market outcomes

Day-ahead awards can be for:

- Energy
- Ancillary Services
- Residual Unit Commitment

Real-time awards can be for:

- Energy
- Ancillary Services
- Flexible Ramping Product

Day-Ahead and Real-Time Market: Unexpected outcomes

Unexpected outcomes:

- Awarded below bid price
- Resource partially awarded
- Resource not awarded

Why wasn’t my resource awarded?

- Outage
- Minimum on-time exceeds planning horizon
- Commitment costs too high
- Other scenarios?

Takeaways…

What did you learn?

Post your answers in the chat pod!

Evaluation Survey

- Please take a moment to complete the end-of-course survey
- Link is provided in the chat pod

For more detailed information on anything presented, please visit our website at:
www.caiso.com

Or send an email to:
CustomerReadiness@caiso.com