

On the Horizon: Energy Imbalance Market

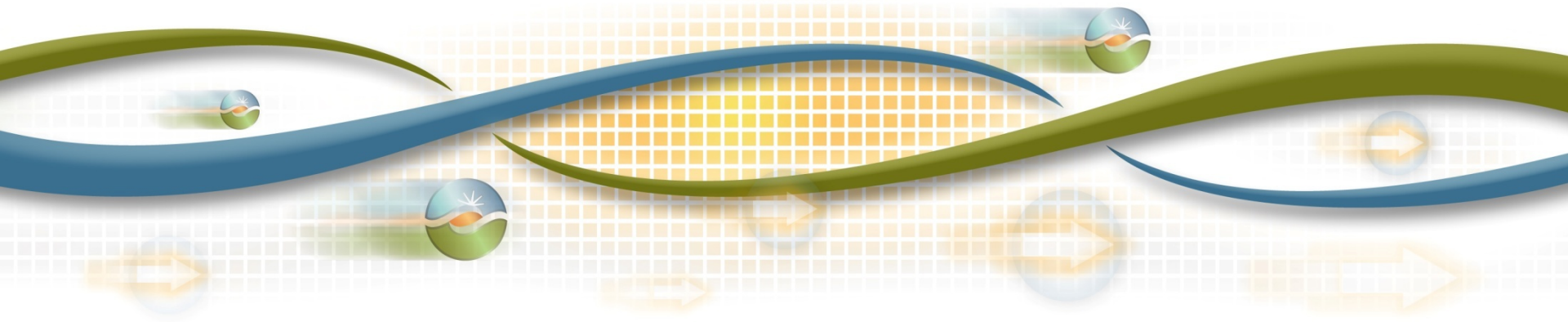
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Energy Northwest Member Forum

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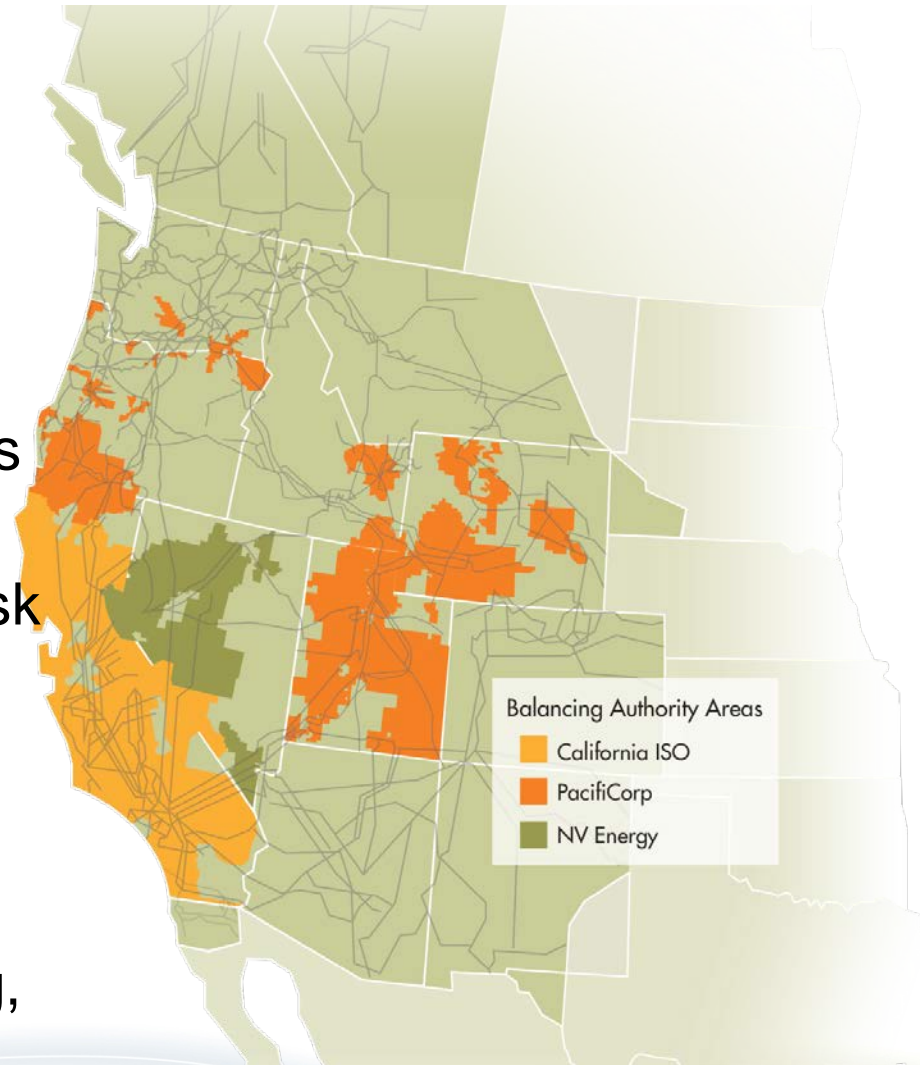
- Status:
 - 10/1/2014: In parallel operation with PacifiCorp
 - 11/1/2014: Full operation including settlements
 - 10/1/2015: Operation expands to NV Energy
 - Discussions in progress with other participants
- Background and benefits
- EIM governance
- Appendix – Additional slides
 - FERC orders and compliance filings
 - EIM functions and operations
 - EIM benefit metrics

Why do we need an EIM?

- Video link: [Balancing Act: A Modern Energy System for the Northwest](#)
- Synopsis, by RenewableNW (<http://www.rnp.org>)
 - “Today, the Northwest has an opportunity to capture significant cost savings and other benefits made available through advances in communications and technology. Applying modern tools to the utility industry is reaping benefits across the rest of the country. It is time for the Northwest to modernize its electricity system and create an Energy Imbalance Market.”

Energy Imbalance Market offers real-time market functions to the Western Interconnection

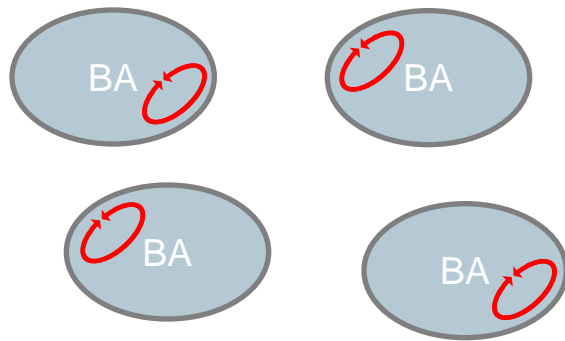
- Builds on existing market – automated dispatch every 5 minutes resolves imbalance, avoids congestion, manages renewable generation
- Situational awareness enhances reliability for whole region
- Easily scalable, low-cost, low risk option for new participants
- No critical mass required, and no exit fees
- Preserves BAA autonomy, including compliance, balancing, and reserve obligations



Today vs. EIM: Coordinating balancing authorities (BAs) and balancing authority areas (BAAs)

Today:

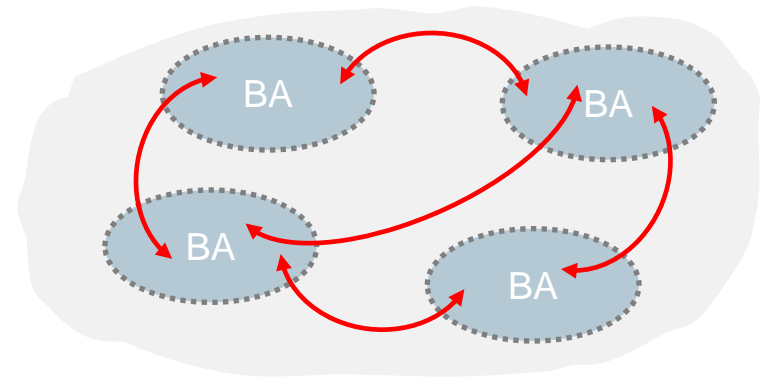
Each BA must balance loads and resources w/in its borders.



- Limited pool of balancing resources
- Inflexibility
- High levels of reserves
- Economic inefficiencies
- Increased costs to integrate wind/solar

In an EIM:

The market dispatches resources across BAs to balance energy



- Diversity of balancing resources
- Increased flexibility
- Decreased flexible reserves
- More economically efficient
- Decreased integration costs

What is “imbalance” and how does EIM help?

- Inter-regional and intra-regional dispatch:
 - BAAs start the hour with matched generation and forecasted load
 - Imbalances are load and generation deviations within hours
 - Security constrained economic dispatch automatically resolves imbalance & avoids congestion, at least cost
 - Optimization of unused physical transmission capacity within ownership or rights of participants
 - Greatest savings with single combined footprint, but can function even without transfers between subregions
- Flexibility reserves and renewable curtailment:
 - All BAs maintain reserves for contingency events
 - Most BAs procure extra flexibility reserves to balance variable supply and demand
 - EIM combines geographical diversity of load and resources

EIM yields several types of annual benefits for EIM and ISO participants

Transfer capability

Detail: PacifiCorp	Low (100 MW)		Medium (400 MW)		High (800 MW)	
	Low	High	Low	High	Low	High
Interregional dispatch	\$14.1	\$11.0	\$22.3	\$17.7	\$22.4	\$17.8
Intraregional dispatch	\$2.3	\$23.0	\$2.3	\$23.0	\$2.3	\$23.0
Flexibility reserves	\$4.0	\$20.8	\$11.0	\$51.3	\$13.4	\$77.1
Renewable curtailment	\$1.1	\$10.8	\$1.1	\$10.8	\$1.1	\$10.8
Total benefits	\$21.4	\$65.6	\$36.7	\$102.8	\$39.2	\$128.7

\$10.5 million to PacifiCorp customers
\$10.9 million to CAISO customers

Post-implementation benefit analyses will show benefits actually achieved

EIM's significant net benefits add up quickly

	ISO/PacifiCorp study (in millions)	ISO/NV Energy study on incremental benefits (in millions)
Annual benefits	\$21.4 - \$129.0	\$9.0 - \$18.0 (2017)
		\$15.0 - \$29.0 (2022)
Start-up costs (about \$0.03/MWh of annual demand)	approx. \$20.0 (\$2.5 to ISO)	approx. \$11.20 (\$1.10 to ISO)
Annual on-going costs (\$0.19/MWh of imbalance energy)	approx. \$3.00	approx. \$2.60

- FERC staff paper assessed reliability benefits of EIM:
 - <http://www.caiso.com/Documents/QualitativeAssessment-PotentialReliabilityBenefits-WesternEnergyImbalanceMarket.pdf>

Key roles in EIM reflect functional separation

EIM Entity is a balancing authority, representing one or more EIM Transmission Service Providers that make transmission available to EIM, that enables the EIM to occur in its balancing authority area (BAA). By enabling the EIM, real-time load and generation imbalances within its BAA will be settled through the EIM.

- EIM Entity determines eligibility of resource types, and required transmission service, within its BAA. (15-minute economic bids on its interties? Dynamic transfers? Demand response? Load aggregation?)

EIM Participating Resource is a resource located within the EIM Entity BAA that is eligible and voluntarily elects to participate in the EIM.

- In the 5-minute market, eligible resources may include generators, participating loads & demand response, non-generator resources (e.g., storage), and dynamic transfers.
- In the 15-minute market, imports and exports may also be eligible.

Building on FERC Order 764 with financially binding 15- and 5-minute functions promotes market efficiency

CAISO

Day Ahead Schedule

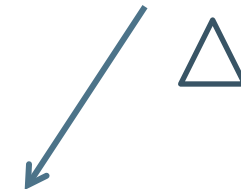


15-Minute Unit Commitment
& Energy Schedule, and
Incremental AS Awards



EIM

Base Schedule
(basis of financial
settlement)



15-Minute Unit Commitment
& Energy Schedule



Real-Time Dispatch

Resource sufficiency evaluation is key to integrating scheduling processes

1. Under- and over-scheduling incentives promote balanced base schedules
 2. Real-time congestion balancing account isolates the cost of infeasible base schedules to the BAA
 3. Flexibility requirement ensures EIM Entity can meet their requirements, based on diversity benefit, independently before start of market optimization across EIM footprint – before EIM shares benefits of reduced flexibility requirements
- Ancillary service provision is separate but consistent with EIM, including interaction with reserve sharing groups

Governance proposal is designed to give regional entities a voice in decision-making

STEP 1 – 2014-2015

STEP 2

Go live

Organize sectors
nomination/ranking

Board decision
& committee
start-up

Advise on early operational phase of
EIM

Develop independent EIM
governance proposal

Long term EIM
governance structure

Transitional Committee

- Advisory committee to ISO Board
- 11-12 members
- Open, public meeting policy

Active activity

- Three meetings to date + webinar
- Two working groups: Scoping, Structure
- Two meetings in 2015 to be in Portland

Transitional Committee appointed in May 2014

1. *Chair - Rebecca Wagner, Commissioner, Public Utilities Commission of Nevada*
2. *Stephen Beuning, Xcel Energy, Inc.*
3. *Tony Braun, Braun Blaising McLaughlin & Smith, PC (representing CMUA)*
4. *Dede Hapner, Pacific Gas and Electric Company*
5. *Natalie Hocken, Representative from EIM Entity PacifiCorp*
6. *Travis Kavulla, Commissioner, Montana Public Service Commission*
7. *Kevin Lynch, Iberdrola Renewables*
8. *Mark Smith, Calpine Corporation*
9. *Walter Spansel, Representative from EIM Entity NV Energy*
10. *Robert Weisenmiller, Chair, California Energy Commission*
11. *Carl Zichella, Natural Resources Defense Council*

More information is available

- **Computer based training:** “Introduction to the Energy Imbalance Market”, and “How the Energy Imbalance Market Works”

<http://www.caiso.com/Documents/Markets%20training/Energy%20imbalance%20market>

- **EIM BPM – draft July 1, current version 1: Oct 2**

http://bpmcm.caiso.com/BPM%20Document%20Library/Energy%20Imbalance%20Market/BPM_for_Energy%20Imbalance%20Market_V1_clean.docx

- **CAISO EIM stakeholder process** (proposals, benefit assessments, tariff development, etc.)

<http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyImbalanceMarket.aspx>

- **PacifiCorp EIM information** (fact sheets, memorandum of understanding, link to OASIS for stakeholder process, etc.)

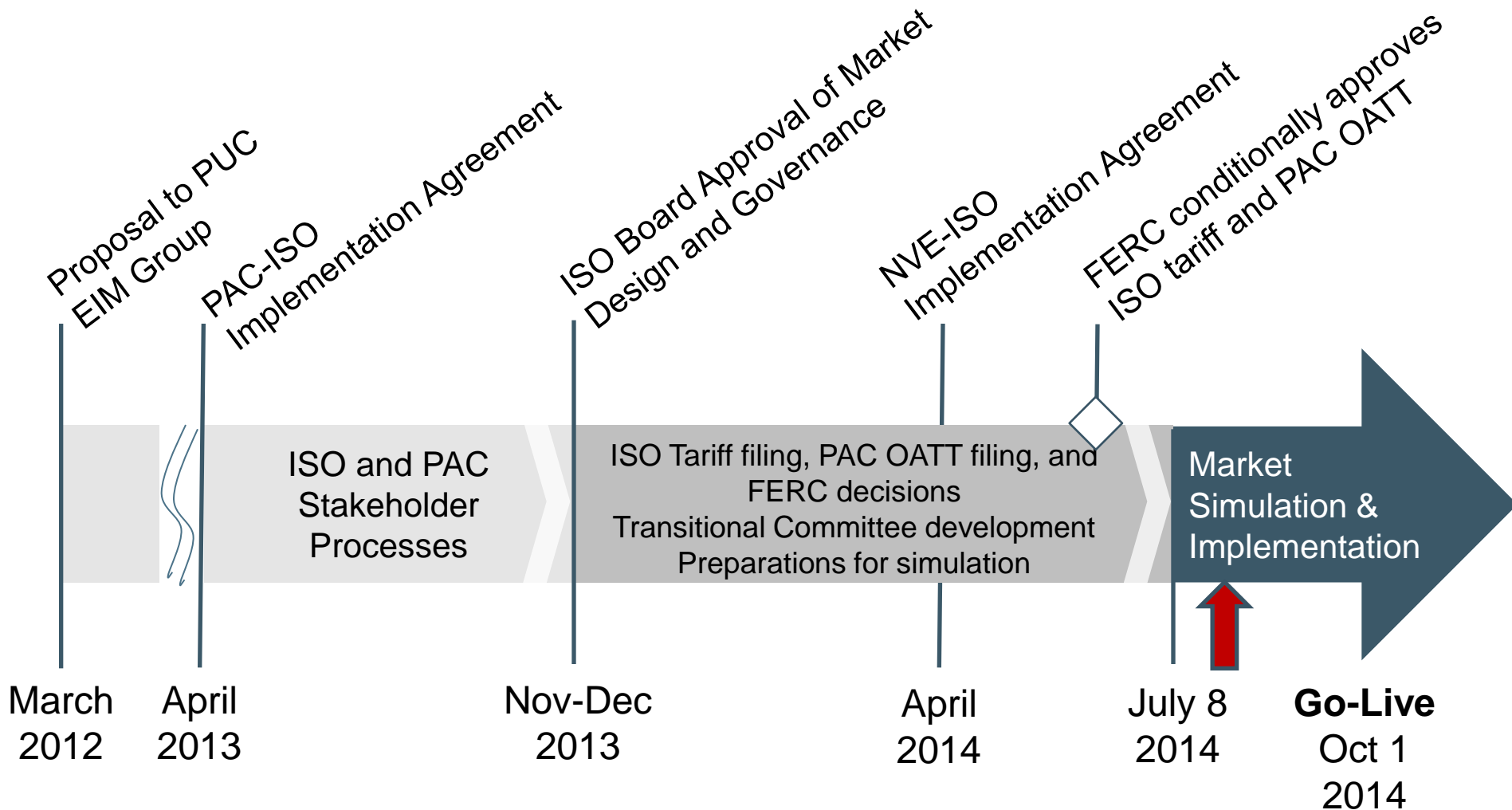
<http://www.pacificorp.com/about/eim.html>

Questions?

Appendix – Additional Slides



EIM history and process

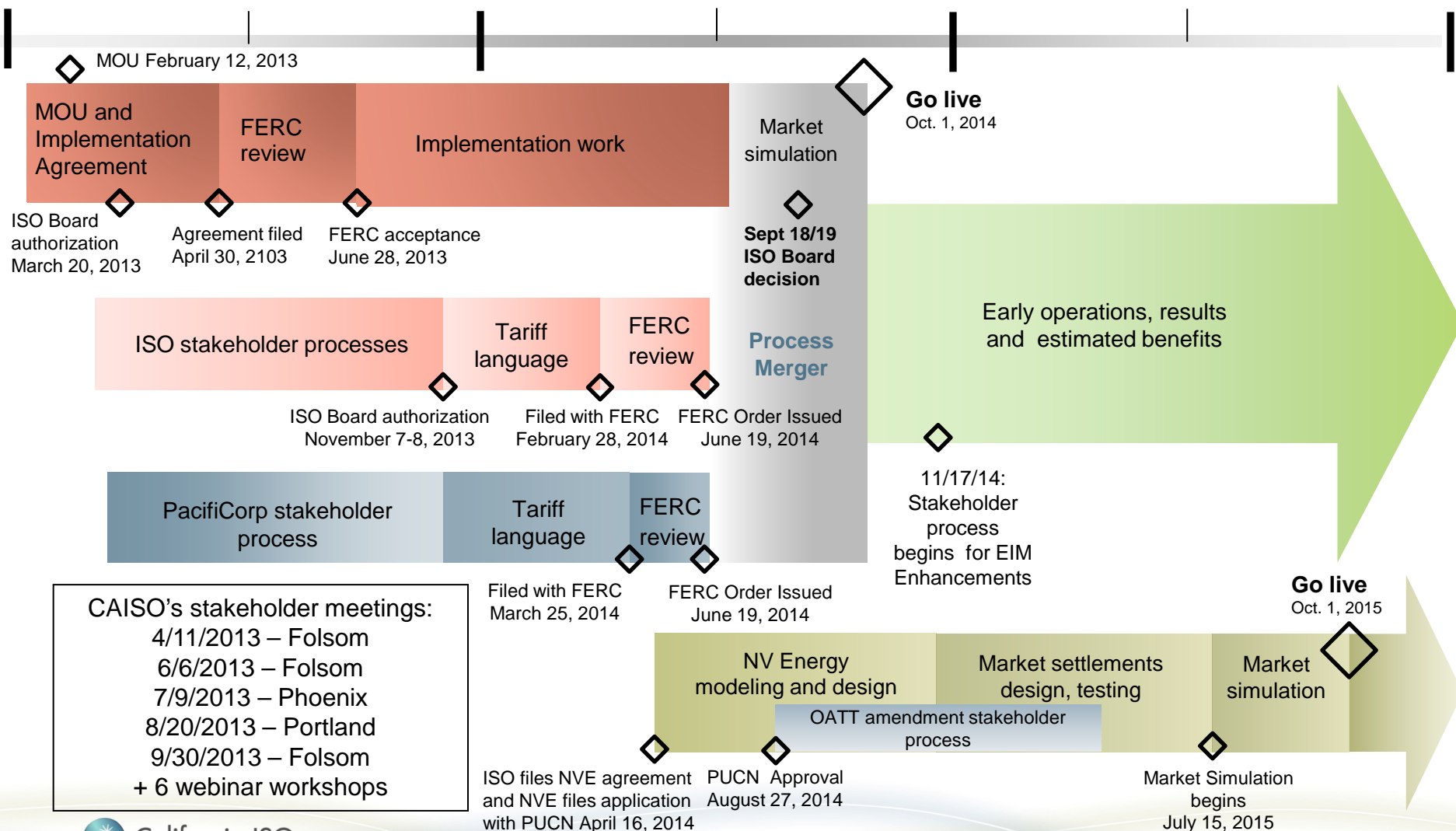


EIM's design has used a robust stakeholder process, and tracking of implementation milestones and status

2013

2014

2015



June 2014 FERC decisions approved EIM framework and support implementation for PacifiCorp and other participants

- Accepted proposal not to impose a separate transmission charge for EIM transfers
- Rejected Board discretion to include EIM intertie transfer constraints in market power mitigation procedures
- Directed implementation of a flag for EIM resources to opt out of transferring energy to California
- Accepted the CAISO's approach to address concerns that the EIM raised seams issues
- Accepted the CAISO's governance and market monitoring function as appropriate for the EIM
- Directed information filing for structural competitiveness

FERC accepted several other important items without condition

- Resource sufficiency or “leaning”
- Allocation of uplift charges based on EIM transfers
- Virtual bids allocated cost contribution to EIM constraints
- Settlements and billing according to the CAISO tariff
- Administrative fee charged to EIM participants
- Treatment of confidential information
- Other items not challenged in the proceeding

FERC conditionally accepted several items subject to compliance filings

- Compliance filing completed
 - Central counterparty role clarification
 - Administrative fee calculation clarification
 - Congestion offset charge clarification
 - Other miscellaneous clarifications
- Business Practice Manual (BPM) development
 - CAISO worked with stakeholders through change management process to develop EIM BPM
 - Completed version published 10/2/2014

EIM Administrative Fee is cost-based from CAISO's Grid Management Charge (GMC)

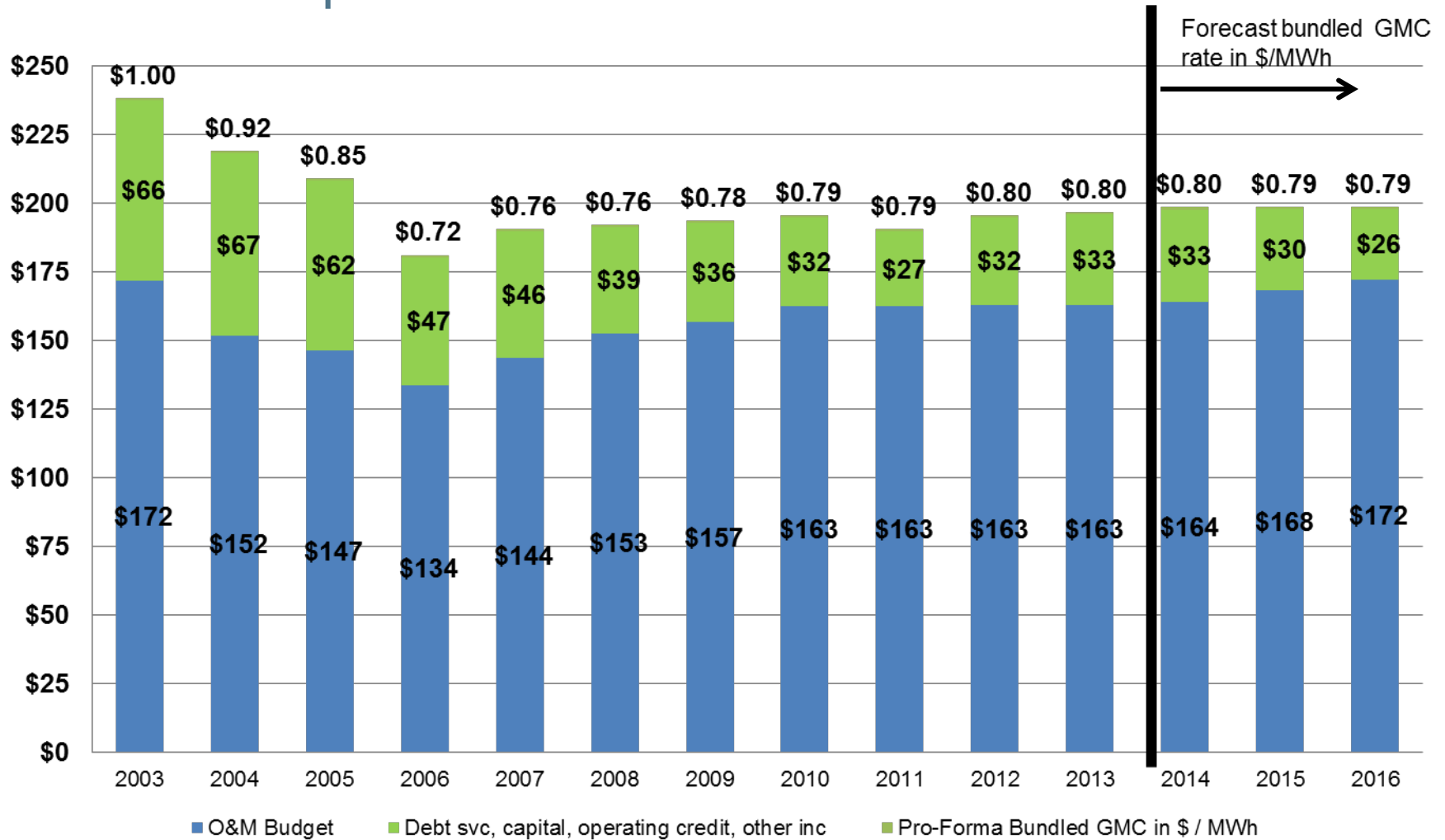
EIM Fees	
Sign-up Fee	\$0.03 * Net Energy for Load
Volumetric Charge	\$0.19/MWh

EIM volumetric charge is based on CAISO Grid Management Charge (GMC), for services used by EIM

Net Annual Energy for Load MWh	One time sign up fee @ \$.03/MWh	Assume 10% total deviation (5% load and 5% gen) MWh	Estimated annual cost @ \$.19/MWh
25,000,000	\$750,000	2,500,000	\$475,000

Note: Estimate does not include bid segment fee @ \$0.005/bid segment or monthly SCID fee of \$1,000/Month

CAISO remains committed to a stable GMC (& EIM) revenue requirement



Start of market operation: input data

- As needed
 - Resource operational characteristics
 - Network model topology
 - Static contingencies observed
- Prior to operating hour (T-75 minutes)
 - Economic bids and hourly base schedules
- Ongoing
 - Transmission and generation outages
 - 15-minute base schedules
 - Load and VER forecasts
 - Dynamic contingency list
 - Actual ETC/ATC scheduling limits and ETC uses

Load Scheduling

- Options for load forecast for establishing base schedule:
 - Use ISO forecast, or
 - Use EIM Entity's forecast, subject to under- & over-scheduling charges when errors exceed 5% threshold
- EIM Entity defines Load Aggregation Points (LAPs)
 - For example, internal to the CAISO LAPs are defined by large utility service territories
 - The number of LAPs must be weighed against the availability of multiple granular load forecasts
- CAISO will determine Load Distribution Factors (LDFs) using its state estimator
 - CAISO uses LDFs to distribute LAP forecast to individual nodes within the network model.

Base schedule should be balanced prior to start of real-time market

Load forecast from prior slide

=

Resource plans: base schedules

- Self-scheduled resources
- Intertie schedules
- Base generation schedules

Resource plans also include:

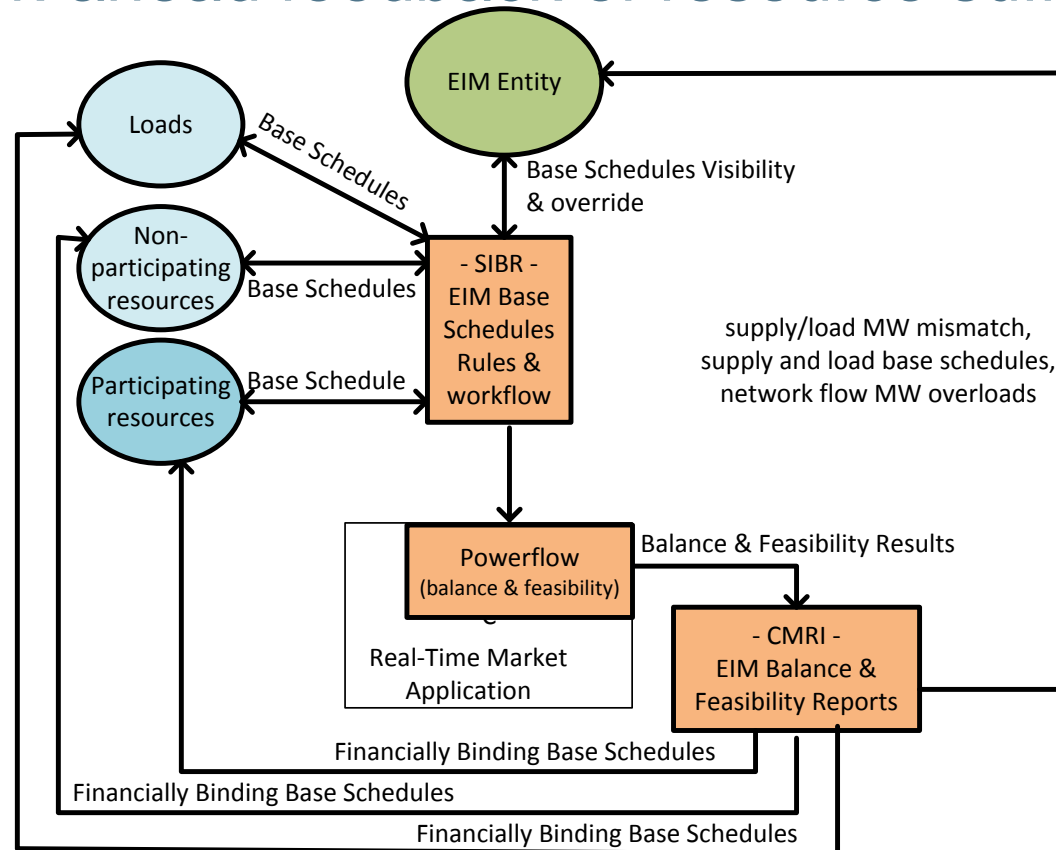
- Ancillary services reservations protected from dispatch
- Operational characteristics (e.g., ramp rate)
- Economic Bids

Base schedule must be balanced or they will be adjusted prior to start of EIM.

Ancillary service requirements

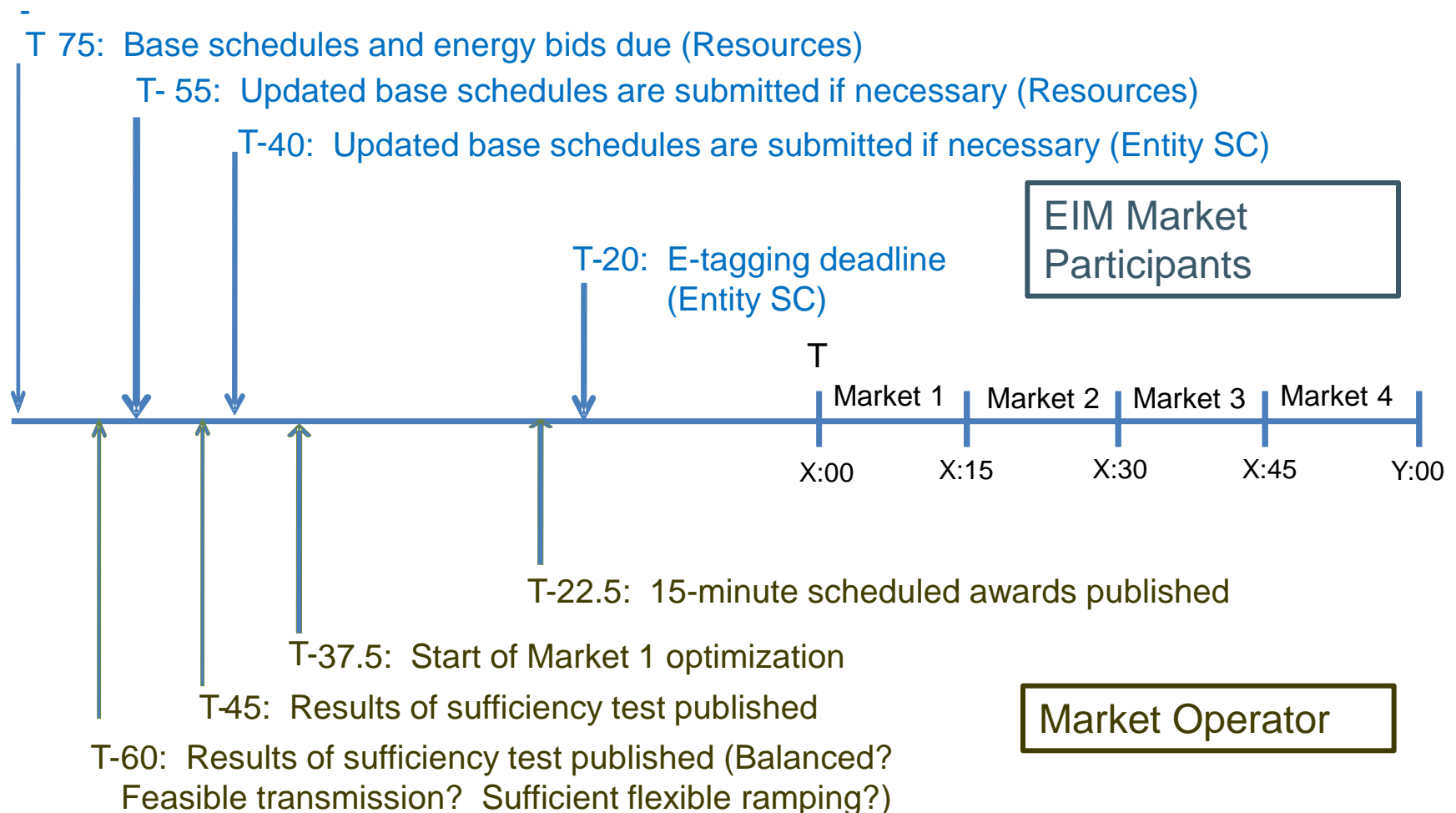
- EIM Entity remains responsible for meeting ancillary services requirements per NERC and WECC, dispatching contingency reserves, and managing load reductions
- Reserve deployment & sharing schedules
 - Capacity to meet reserve sharing obligations is included in the resource plans used for base schedules. The capacity is protected for dispatch through EIM.
 - EIM Entity is responsible for its share of DCS compliance
 - EIM Entity deploys operating reserves and regulation in conformance with NERC, WECC, and reserve sharing group policies
 - If reserves are dispatched, they will be subject to EIM imbalance settlement until reflected in the base schedule

EIM begins as participants submit resource plans to initiate the market – day-ahead, then with multi-hour look-ahead feedback of resource sufficiency



EIM Entity Scheduling Coordinator has full visibility of all base schedules.

After advisory feedback period, final submission of hourly base schedules and resource plans is interactive

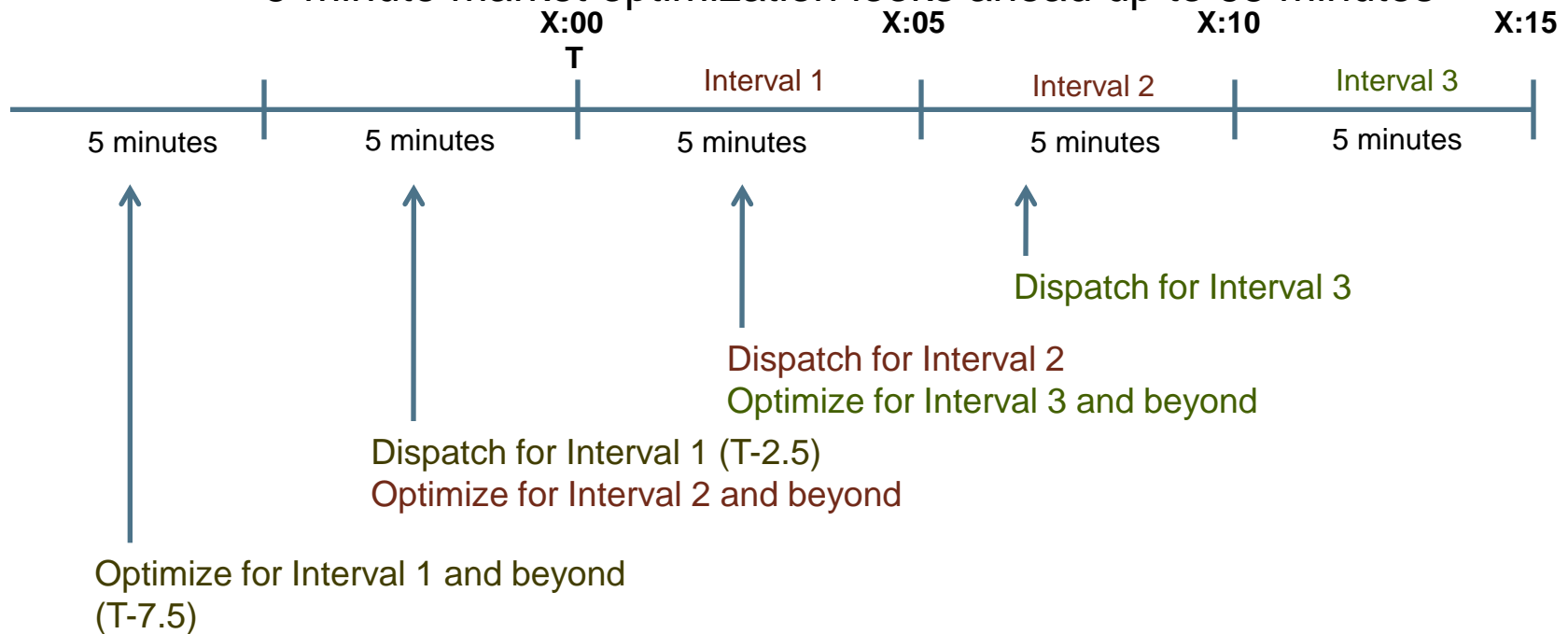


(T = start of the hour)

Dispatch for 5-minute interval & beyond works together with 15-minute market

Look-ahead horizons:

- 15-minute market optimization looks ahead up to 4.5 hours
- 5-minute market optimization looks ahead up to 65 minutes



Resource sufficiency prevents “leaning” without imposing unnecessary restrictions

- Specific requirements for EIM Participating Resources, such as must-offer bid requirements, are determined by EIM Entities or regulators.
 - EIM does not disrupt existing contractual relationships between BAs and market participants within BAAs, which may have arranged for BA to support participants’ resource adequacy or load serving obligations.
 - California regulations require resource adequacy resources to offer bids, but not non-RA resources.
- NERC and WECC standards and State RA requirements, but not EIM design, determine ancillary services (imbalance capacity) for variable resources.

EIM Entity identifies resource constraints to address reliability issues which cannot be modeled

- CAISO will not issue exceptional dispatch instructions to EIM Entity resources
- CAISO's dispatch will reflect reliability constraint within EIM area until the base schedule can be updated
- Any resource constraint for reliability will be settled at the EIM LMP

Keys to information exchange

California ISO
A Renewed Future

EIM Entities (PACW and PACE)

Market
Operator
(CAISO)

EIM Entity
Scheduling
Coordinator

EIM
Participating
Resource
Scheduling
Coordinator

EPR

EPR

Pac EIM
Portal

Interchange

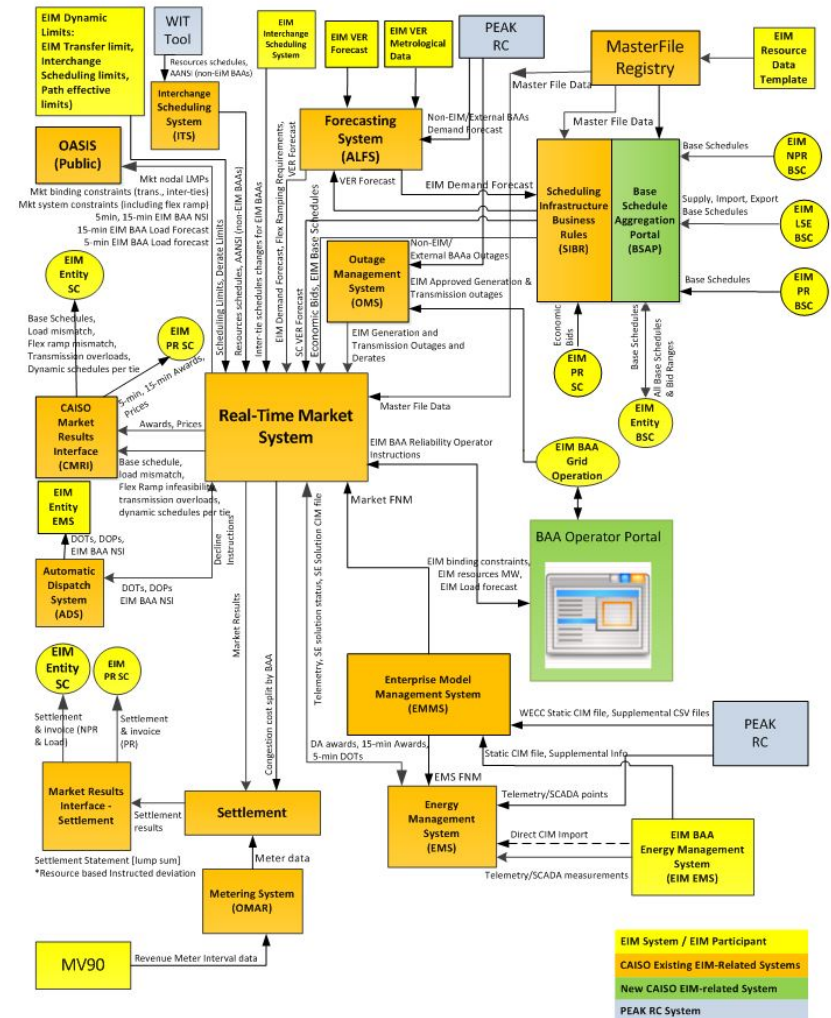
Loads

Non-
Participating
Resources

- 1 – Base schedule forecasts for all resources and interchange to PAC EIM SIBR Portal (Market Operator produces load forecast)
- 2 – MW bid range and economic bids
- 3 – MW bid range
- 4 – Resource plan, including balanced base schedule information
- 5 – Planned resource outages and after-the-fact forced outages (including estimated return time); revenue meter data (also applicable to Loads)
- 6 – Approved outages (all resources & transmission, real time and scheduled); revenue meter data
- 7 – Market Operator advisory schedules
- 8 – Dispatch instructions and imbalance settlement for participating resources
- 9 – Imbalance settlement for loads, interchange and non-participating resources, including BAA neutrality & uplift charges
- 10 – EIM Entity sub-allocation settlement for loads, interchange and non-participating resources; including BAA neutrality & uplift charges

EIM network model and system changes have affected multiple systems

- New systems:
 - Base schedule aggregation portal (BSAP)
 - EIM Reliability Operator User
- Network model includes PacifiCorp region
- Integration and functional testing is a multi-step process



Last change: 7/29/2014

Publication of prices and other information

- Locational marginal prices for 15-minute market and RTD will be published on OASIS for all nodes and LAPs.
- Binding transmission constraints and shadow prices will be published on OASIS
 - LMP marginal cost of congestion component reflects congestion contribution from binding network constraints
- Additional market data will be published as in ISO market
 - Some data are subject to a non-disclosure agreement

Modeling of EIM & ISO market resources will evolve to provide future needs such as dispatch flexibility

Resources	Traditional Use	Future grid	Value
Conventional generation	Baseload Peaking	<ul style="list-style-type: none">• Ability to start and stop frequently• Low minimum operating levels	<ul style="list-style-type: none">• Supports ramping needs• Mitigates overgeneration
Renewable generation	Must take	<ul style="list-style-type: none">• Ability to modify output	<ul style="list-style-type: none">• Decreases ramping needs• Provides voltage support
Demand response	Emergency	<ul style="list-style-type: none">• Frequent, short duration events• Automated response	<ul style="list-style-type: none">• Defers or offsets generation or transmission investment• Mitigates overgeneration
Energy storage	Peak-shifting	<ul style="list-style-type: none">• Ability to start and stop frequently• Frequent, short duration events	<ul style="list-style-type: none">• Supports ramping needs• Mitigates overgeneration• Provides frequency response
Electric vehicles	Not applicable	<ul style="list-style-type: none">• Frequent, short duration events• Automated response	<ul style="list-style-type: none">• Mitigates overgeneration• Provides frequency response

Key points: EIM extends CAISO's experience with real-time market functions to EIM participants

- Dispatch accounts for operating characteristics and constraints of participating resources
- Optimized 15- and 5-minute interval dispatch allows financial stability of market
- Congestion management is most effective using multi-interval look-ahead horizons
- Short-term unit commitment allows efficient economic dispatch, recognizing factors including hydro limits and complexity of resources like combined-cycle
- CAISO offers advanced variable energy resource (VER) forecasting and scheduling
- Efficient use of transmission offered by EIM participants

EIM's congestion management is parallel to the Unscheduled Flow Mitigation Plan

- EIM will manage congestion on transmission made available through EIM Entities, and notify them if available bids cannot resolve congestion.
 - EIM Entities then determine further steps, as done now (also applies to CAISO management of COI).
 - EIM Entities may act before EIM exhausts bids.
 - EIM will adjust its schedules for UFMP or other manual dispatch.
- EIM will not manage constraints outside its market area (e.g., Path 36 - TOT3, from Wyoming to Colorado).
 - Existing processes remain available to path operators.

Dispatch and settlement facilitates California greenhouse gas compliance

- Optimization process efficiently schedules resources at least cost, recognizing compliance obligations for energy transferred to California.
- Market dispatch compensates resources, and does not assign costs to non-CA load.
- EIM Participating Resources may submit a separate bid for GHG compliance costs.
- Energy generated outside California that is not imported is not subject to GHG obligation.

Transmission service only requires simple principles

- EIM Entities make transmission capacity available through dynamic e-Tag and transmission registry:
 - EIM Participating Resources can offer their contracted capacity
 - Network service within EIM Entities allows redispatch up to available network capacity
- Reciprocity: Since transfer capability will be limited, as made available through EIM Entities, initial design proposes no charge for transmission for EIM transfers between EIM Entities
 - EIM maintains existing transmission rate structures within EIM Entities

CAISO will continue to review EIM benefits after implementation, through specific metrics

- EIM benefit is characterized by the economic surplus difference of EIM and without EIM (counter factual)
- Inputs to the benefits calculation
 - EIM dispatch
 - The factual production EIM dispatch
 - Without EIM dispatch
 - The counter factual dispatch (automated market rerun) after making changes to reflect business as usual before EIM
- Metric testing during market simulation