

EnergyImbalanceMarket

EIM Operations and Impacts



*PUGET
SOUND
ENERGY*

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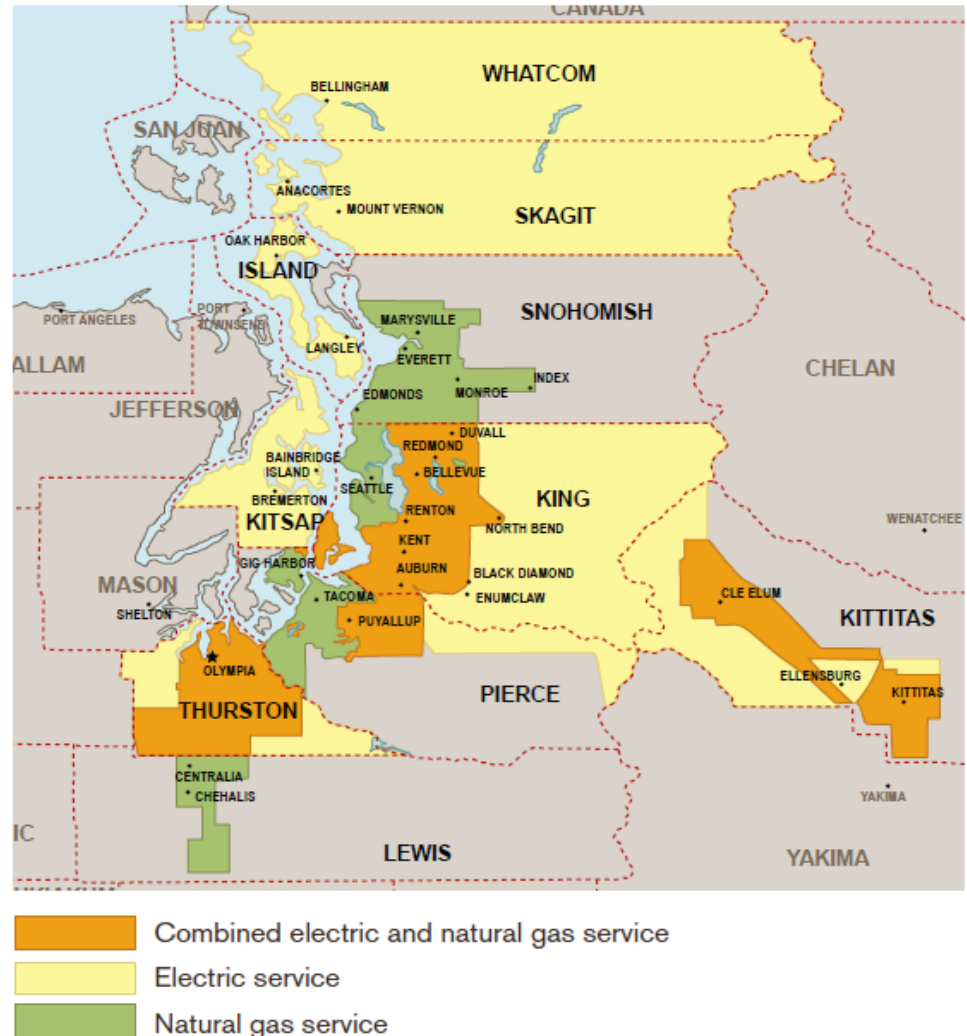
Manager, Load Office:
Transmission Operations and Balancing
Puget Sound Energy

Brief Outline

- Puget Sound Energy Overview
- Why EIM?
- EIM Overview
- PSE EIM Implementation and role changes
- EIM related changes to operations
- Conclusion

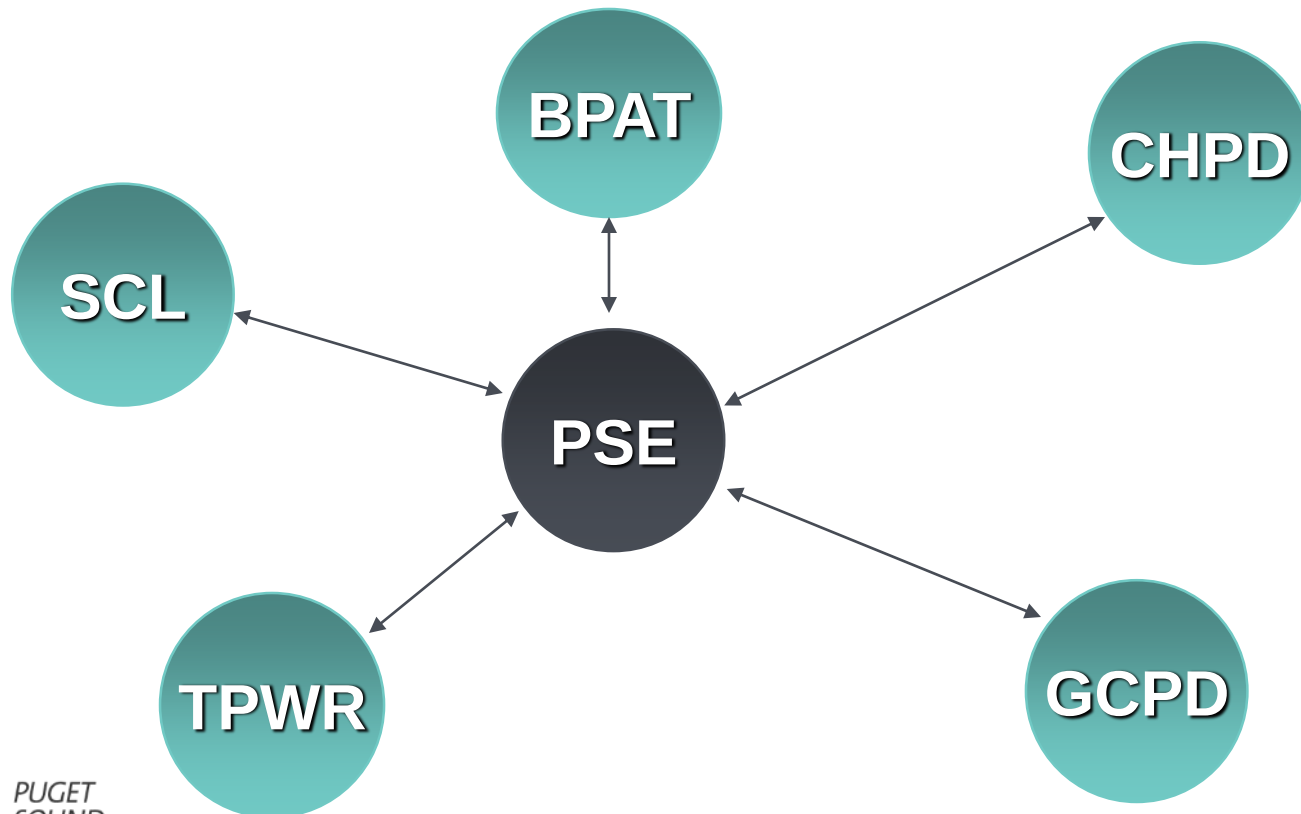
PSE Overview and Service Area

- Headquarters: Bellevue, Wash.
- Revenues: \$3.19 billion
- Assets: \$10.8 billion
- Employees: 2,700
- Customers:
 - More than 1 million electric
 - More than 770,000 natural gas
- Electric Load
 - Average 2,560 MW
 - Peak 4,912 MW
- Gas Load
 - Average 295,000 MMBTU
 - Peak 838,834 MMBTU



PSE Transmission System

PSE has 45 transmission tie lines with 5 Adjacent Balancing Authorities



PSE control room operations

Functions include BA and TOP, plus real-time activities as assigned (e.g., GOP and TSP)

14 Power Dispatchers

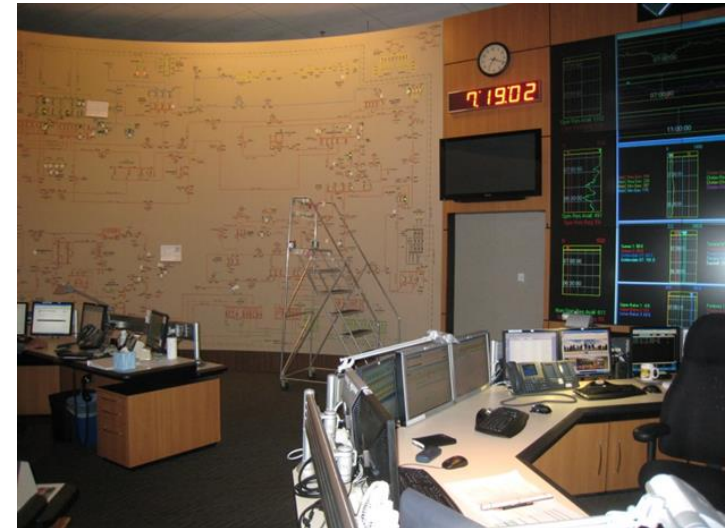
- NERC-Certified
- Coordinate balancing activities and transmission system operations (typically 55kV, 115kV and 230kV facilities), including switching
- Operate balancing desk (focus on BA functions) and transmission desk (focus on TOP functions)

10 Other Real-Time Personnel

- Generation Operators and Transmission Schedulers

14 Support Staff

- Load Office Manager, Supervisor Power Dispatch, Supervisor Transmission Services, Power Systems Trainer, Operations Engineers, Applications Analyst, Compliance Program Manager, Compliance Analyst, Engineering Trainee, and Administrative Specialist

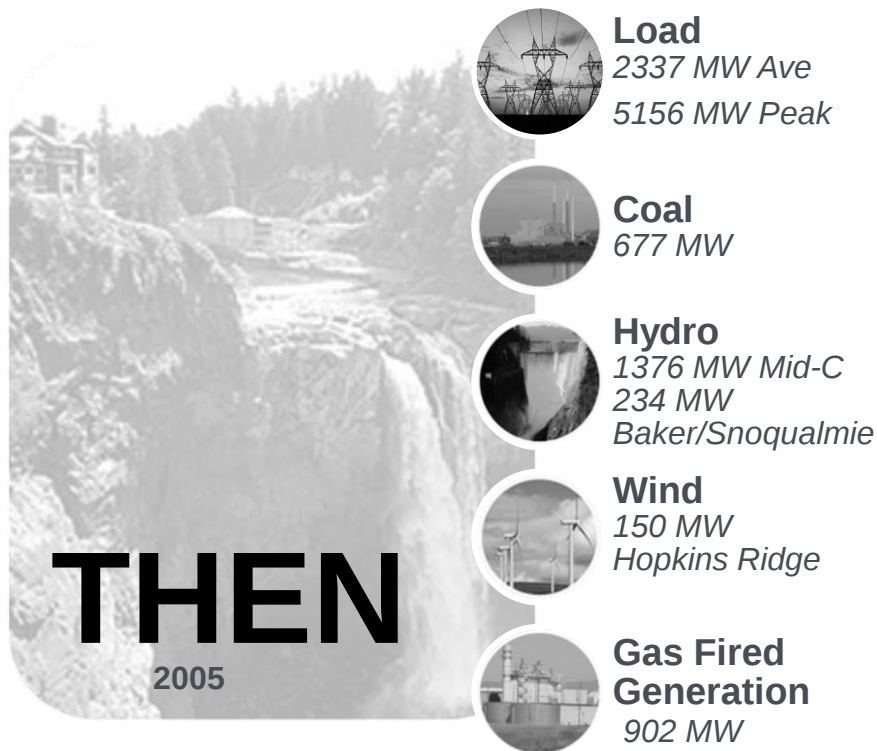


- Located in Eastside Operations building (ESO) in Redmond, WA
- Backup Control Center (BUCC) located six miles away in Bellevue (EST building)

Challenges we face in the Pacific Northwest

- Differing priorities and regulatory treatment for interconnected entities.
- Loss of hydro flexibility.
- Large amounts of wind generation with little diversity.
- Strong, organized opposition to new transmission projects.
- High home values, cost of living, and traffic congestion in the metro areas make recruiting difficult.

PSE's Changing Resource Mix

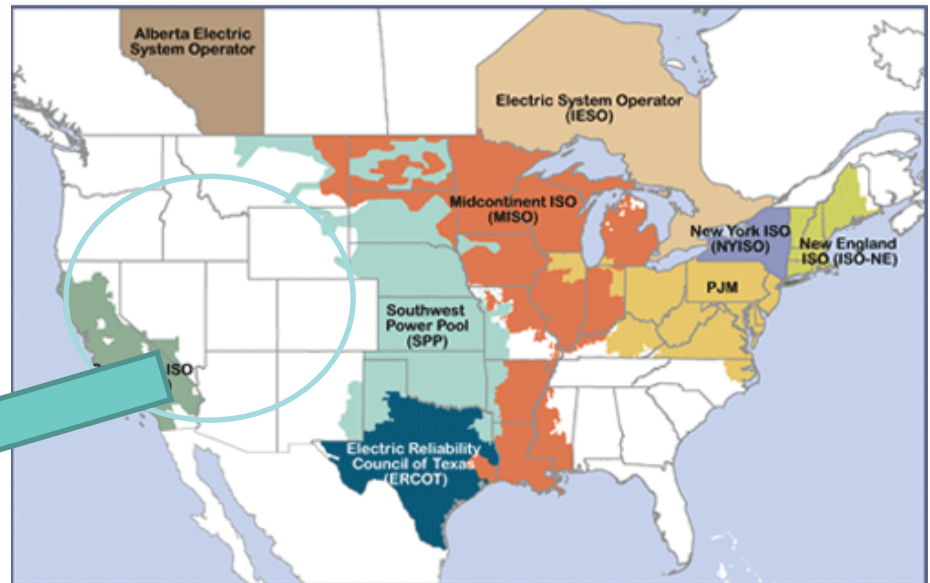
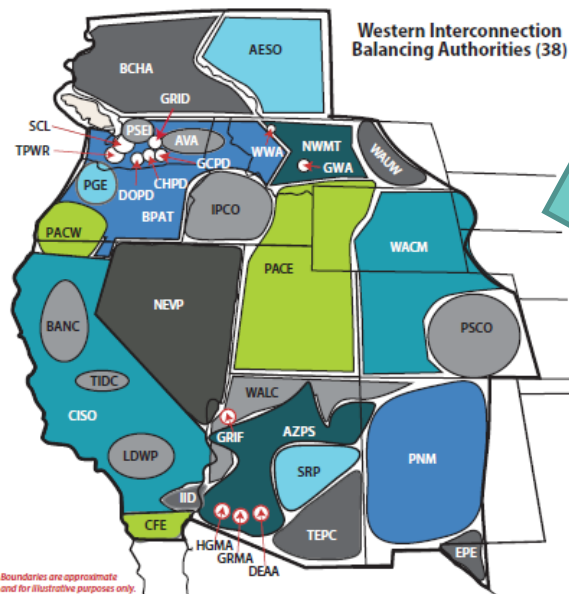


Why EIM?

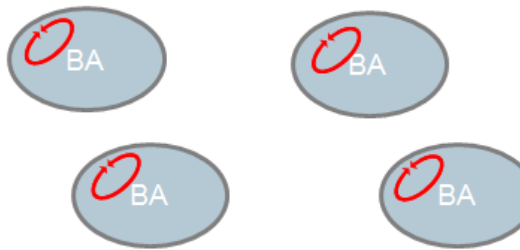
- EIM allows miss-matches from forecast to actuals in generation and load to be handled in the most efficient manner given system configuration, including constraints and available resources.
- It is particularly focused on maximum utilization of renewables.
- It allows renewables to begin to supply ancillary services.

Grid Efficiency Opportunity in the West

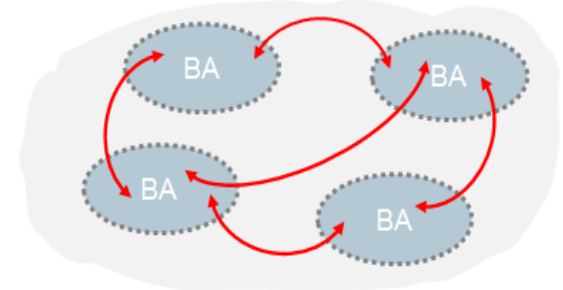
Western Balancing Authorities



Pre-EIM



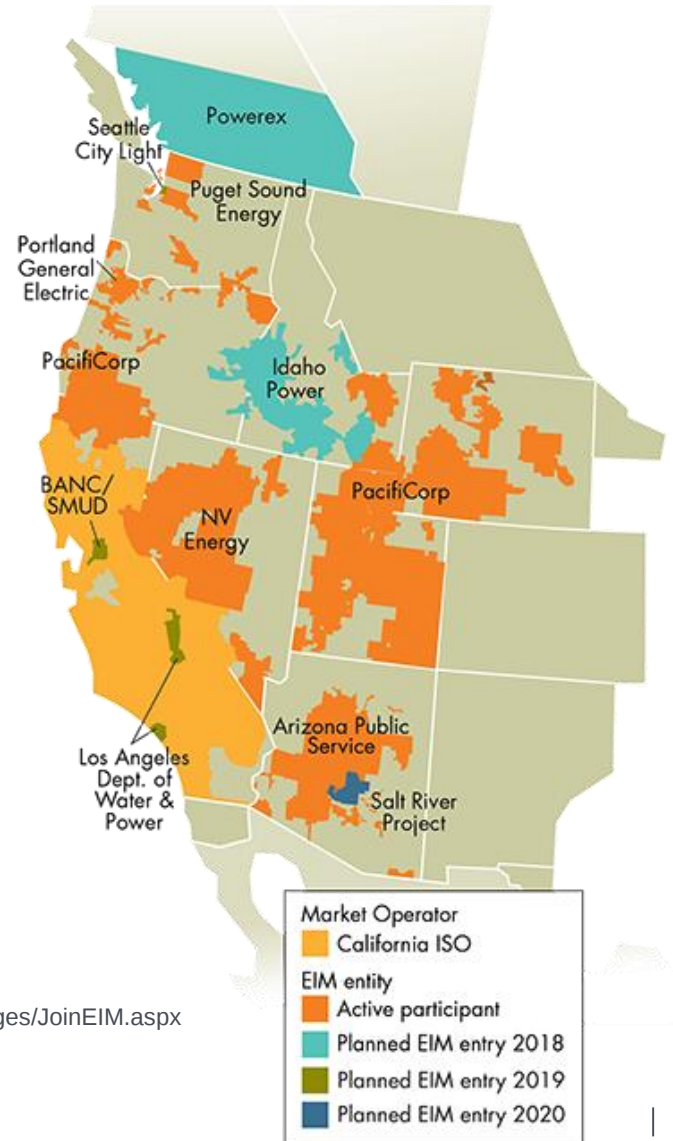
In the EIM



EIM Expansion

Energy Imbalance Market Expansion

11 entities have joined or signed implementation agreements with CAISO to date

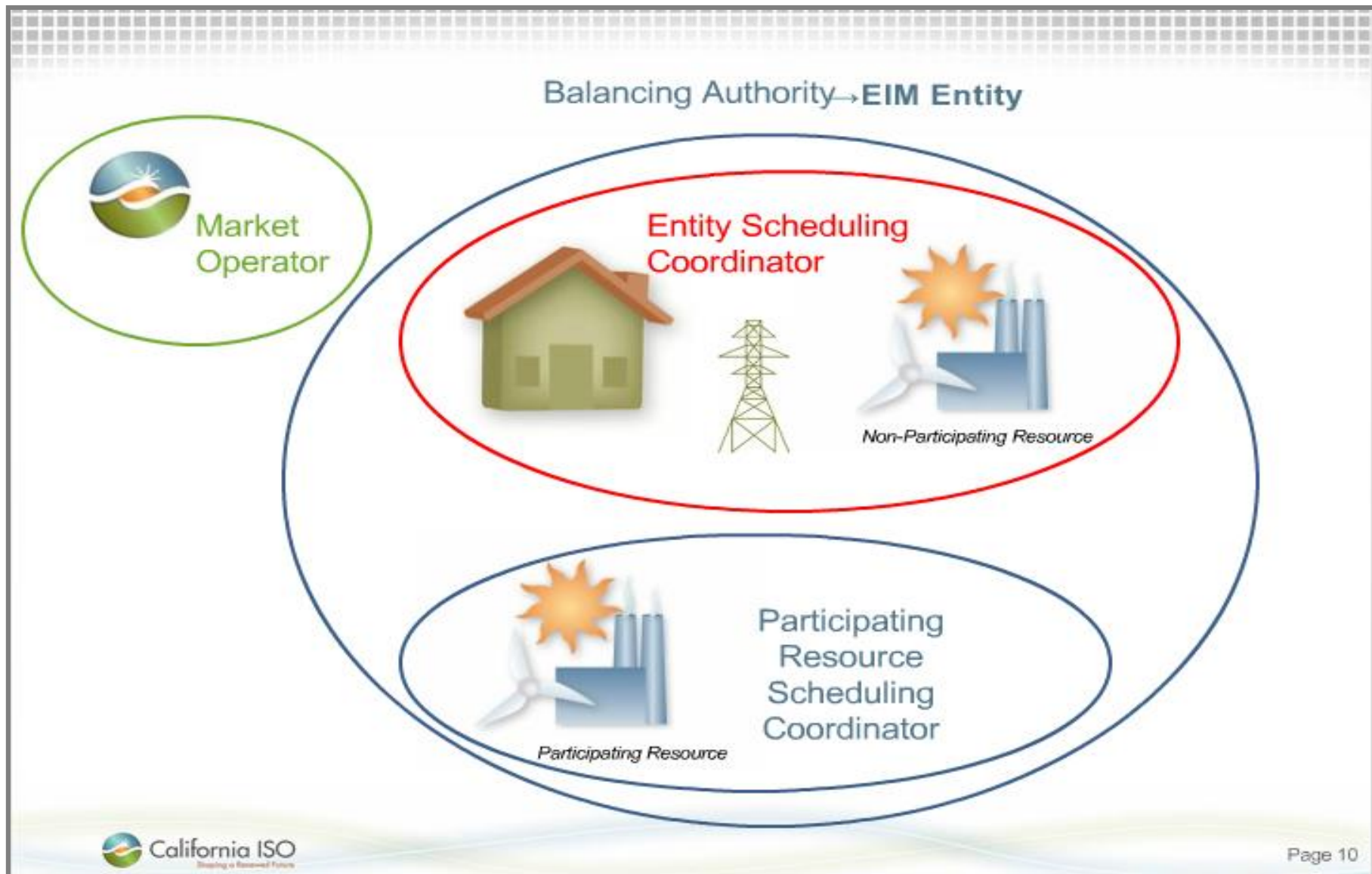


<https://www.westerneim.com/Pages/JoinEIM.aspx>

EIM Overview

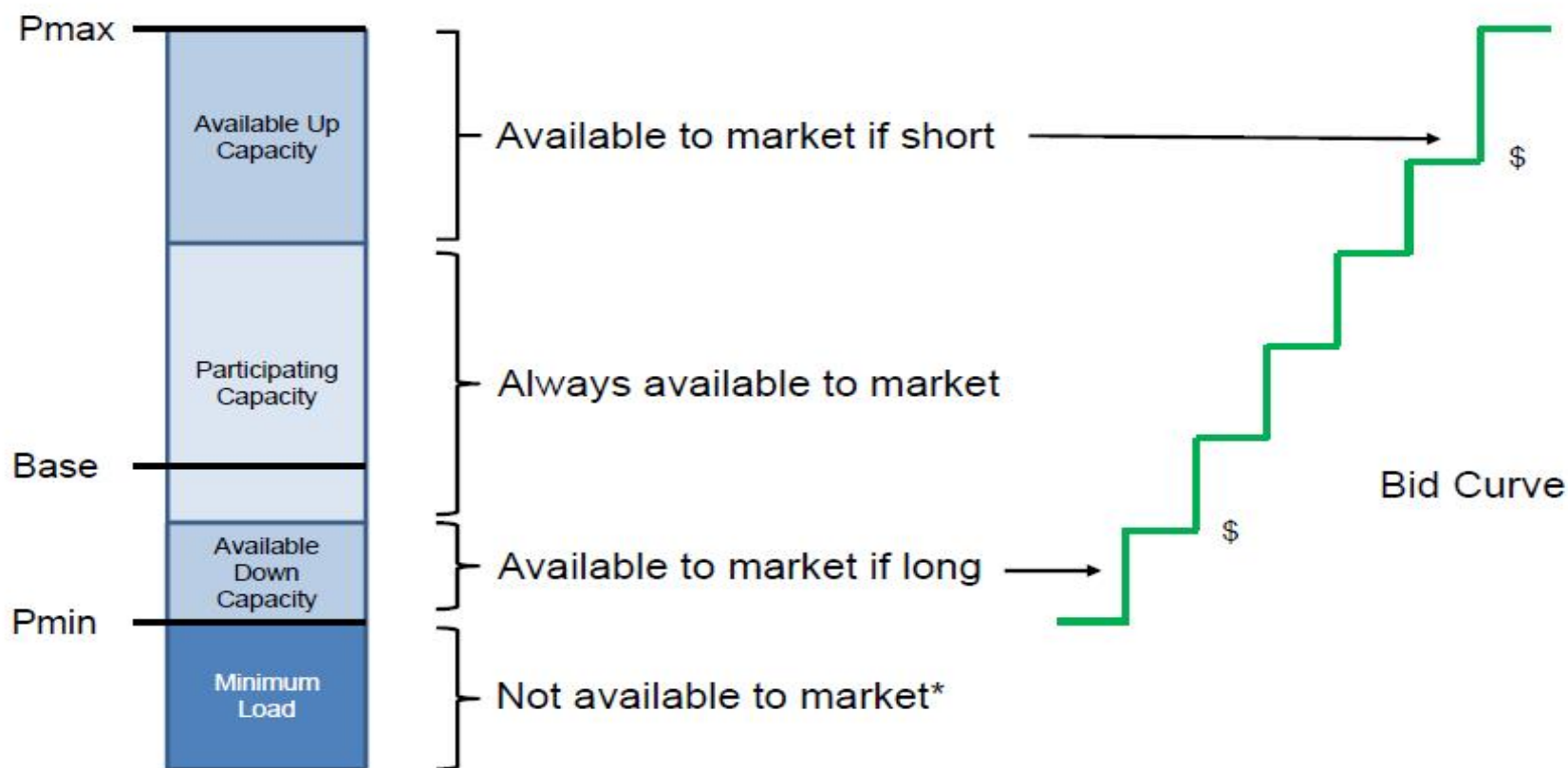
- The EIM is made up of the following types of entities:
 - Market Operator (CAISO)
 - EIM Entities (PSE, PAC, etc.)
 - Resource Scheduling Coordinators
 - Participating Resources
 - Non-Participating Resources

Participating vs. Non Participating



Energy Bids

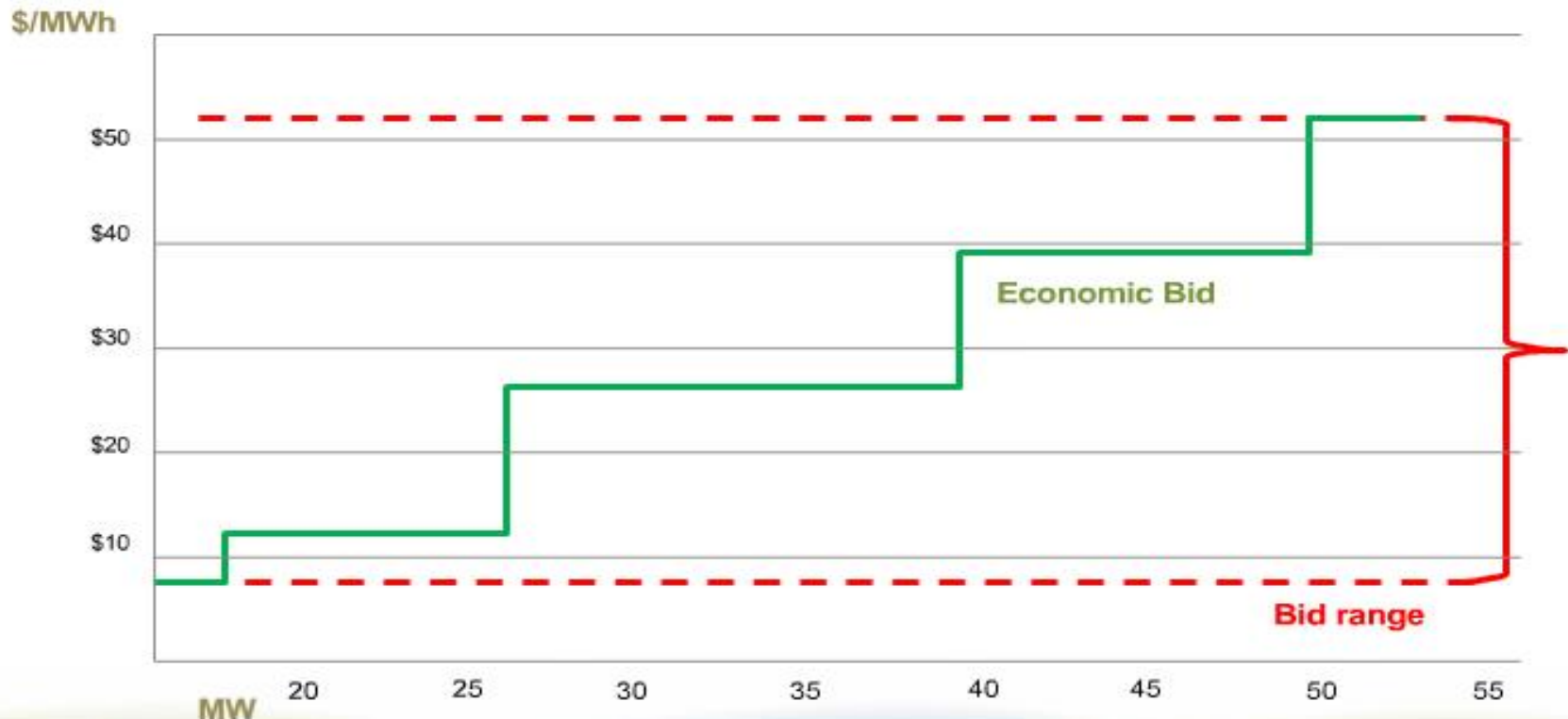
Available capacity is priced based upon resource's bid curve



* Can't de-commit since the resource is providing regulation down

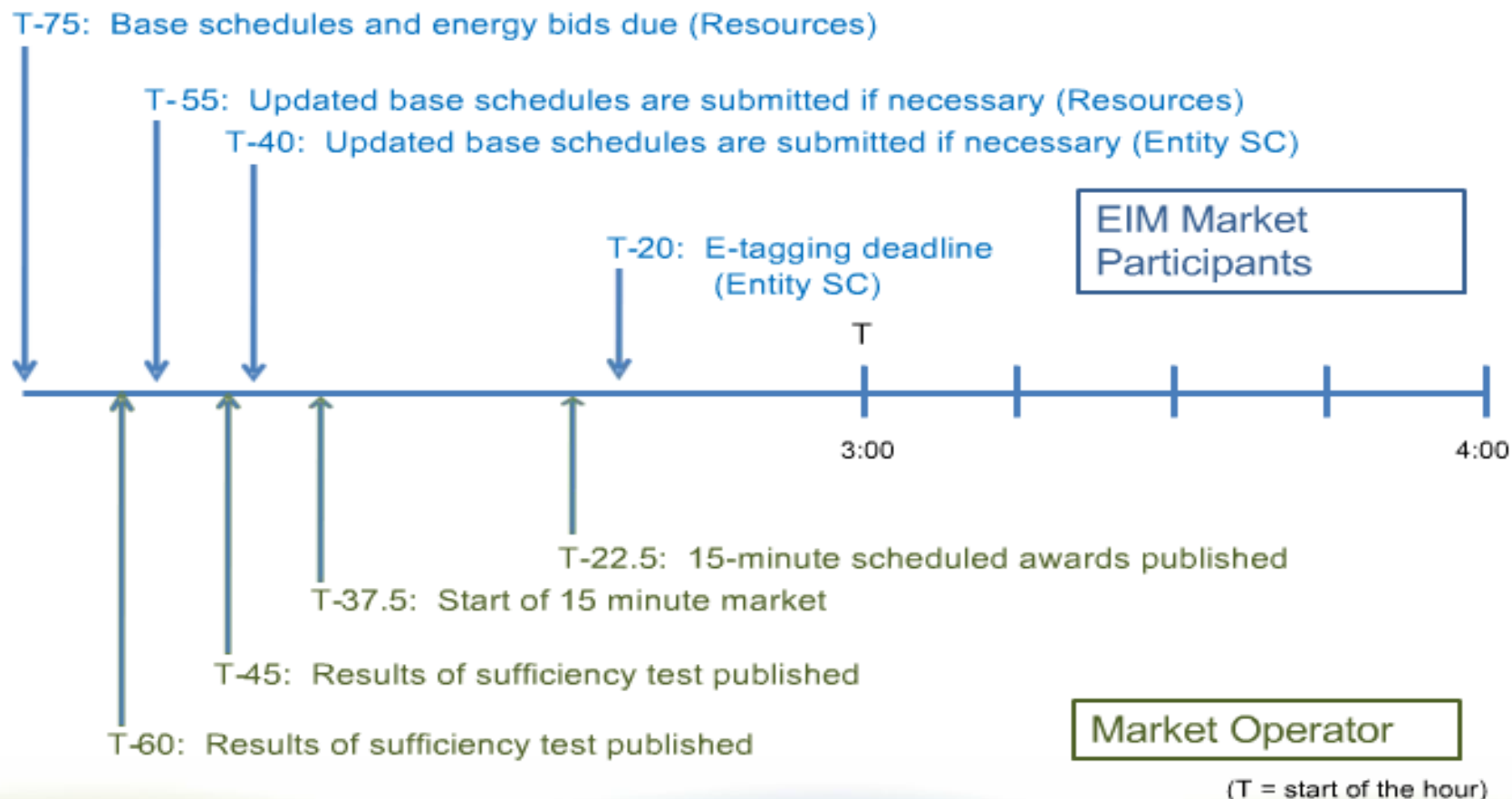
Energy Bids

Energy bids provide the ability to cover fluctuations in load.



Base Schedule Timeline

Steps leading up to the operating hour



EIM Benefits through 2017

Financial Benefits

Nov. 2014- YE 2017 \$288.44 Million Total

Oct. 2016- YE 2017 \$11.42 Million PSE

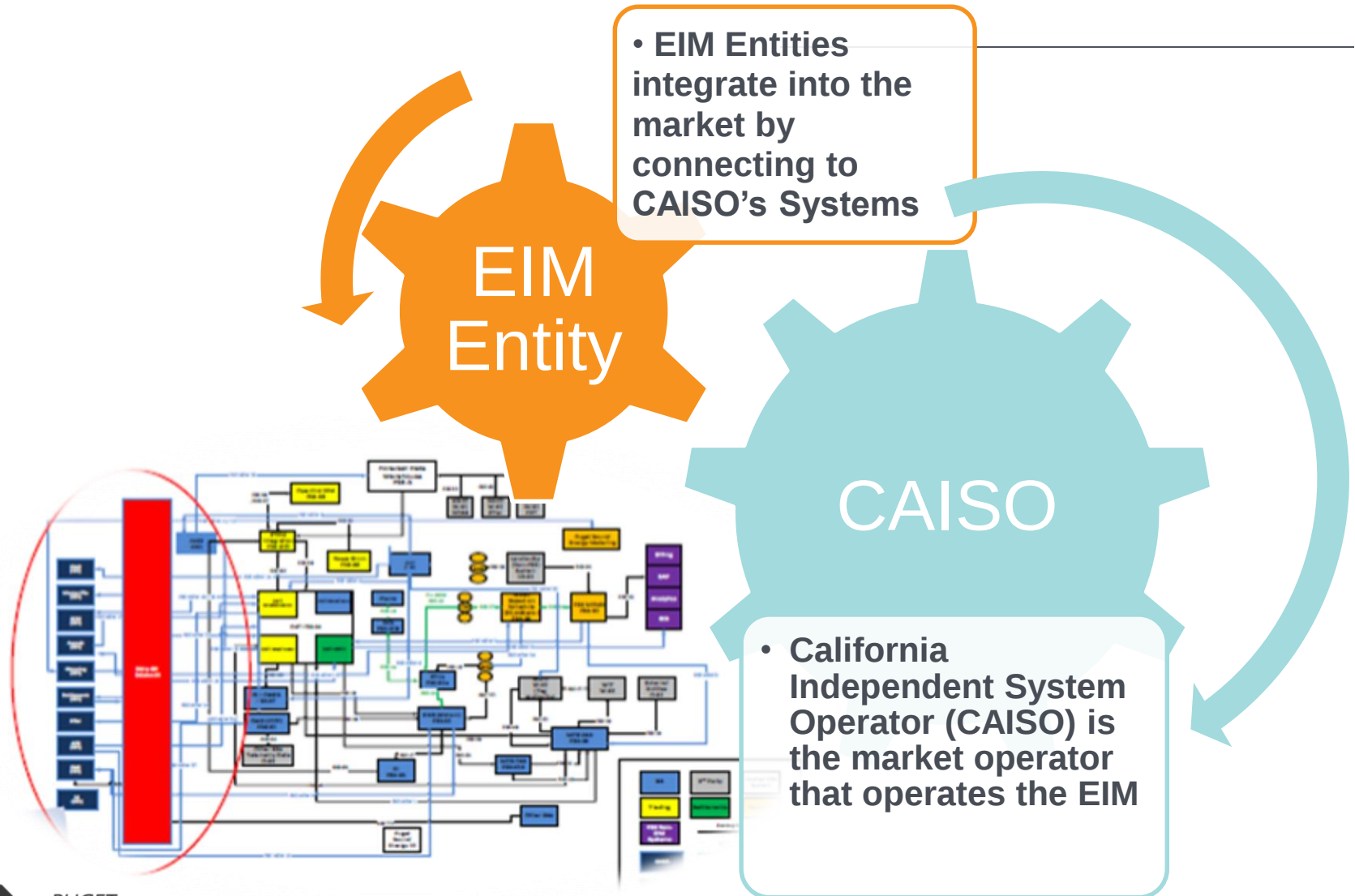
Renewables Integration

2015-17 – 520,417 MWh renewables curtailment avoided

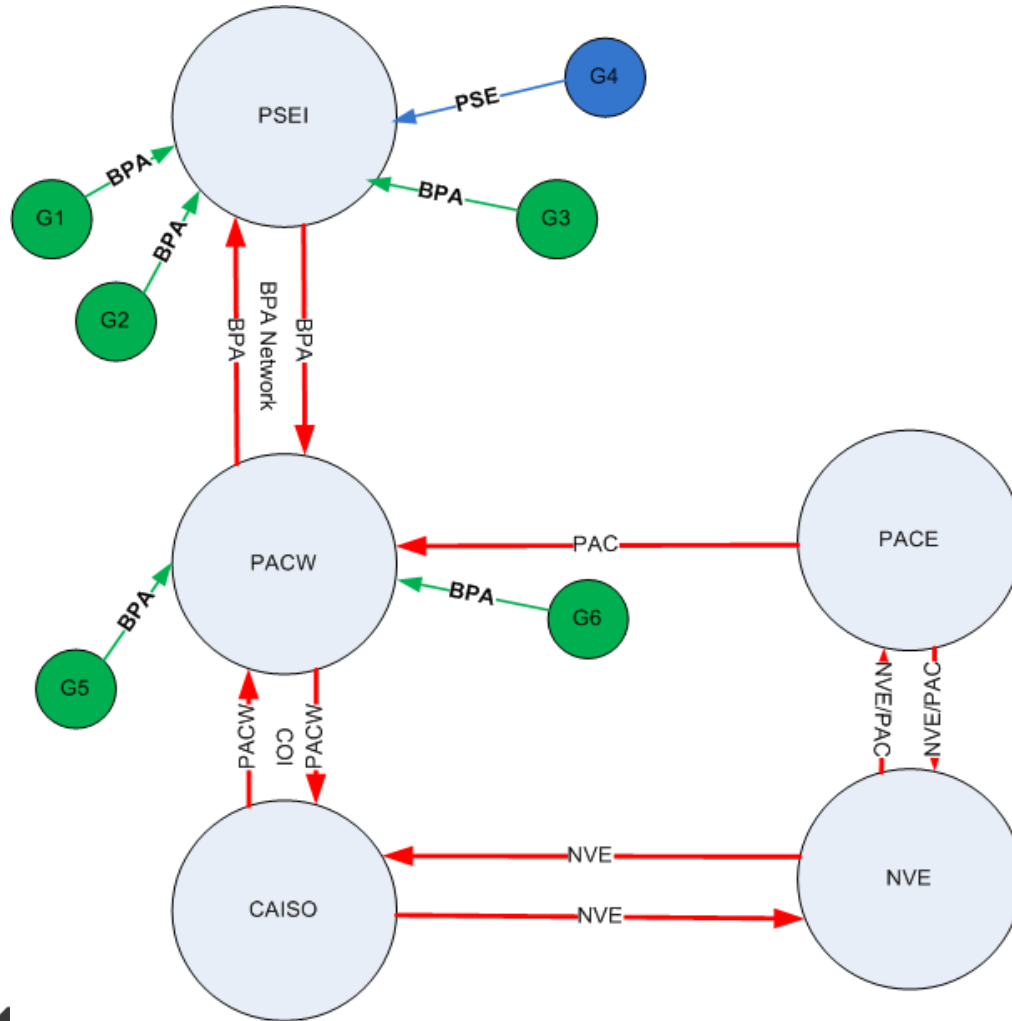
2015-17 – 222,657 MTCO₂e carbon reductions

222,657 MTCO₂e is about 46,813 cars for 1 yr

How do you connect to the market?



Transmission in the EIM



PSE Transmission System

- ~ 831 miles of transmission lines
 - ~358 miles operated at 230 KV
 - 495 miles operated at 500KV (all between Colstrip & Townsend, MT)
- Interconnects with five other electric utilities that operate their own BAAs and with other entities that purchase power needs from BPA/others.
- In addition, the PSE transmission system tends to operate in parallel with transmission controlled by BPA.

PSE Trade Floor: EIM Tasks

PSE Trade Floor performs the following tasks:

- **Day-ahead Bidding**
- **Real-time Bidding**
- **Settlement Support**
- **Resource Modelling**
- **PRSC for PSE resources**
- **Sufficiency Tests**



PSE Load Office: EIM Tasks

PSE Load Office performs the following EIM tasks:

- EIM Entity
- Scheduling Coordinator for all NPRs in PSEI BA
- Sufficiency Tests
- Network Model
- All outage submissions
- Meter data submission (ED)
- Transmission Billing (TP&C)



PSE Settlements Group: EIM Tasks

PSE Settlement Groups perform the following tasks:

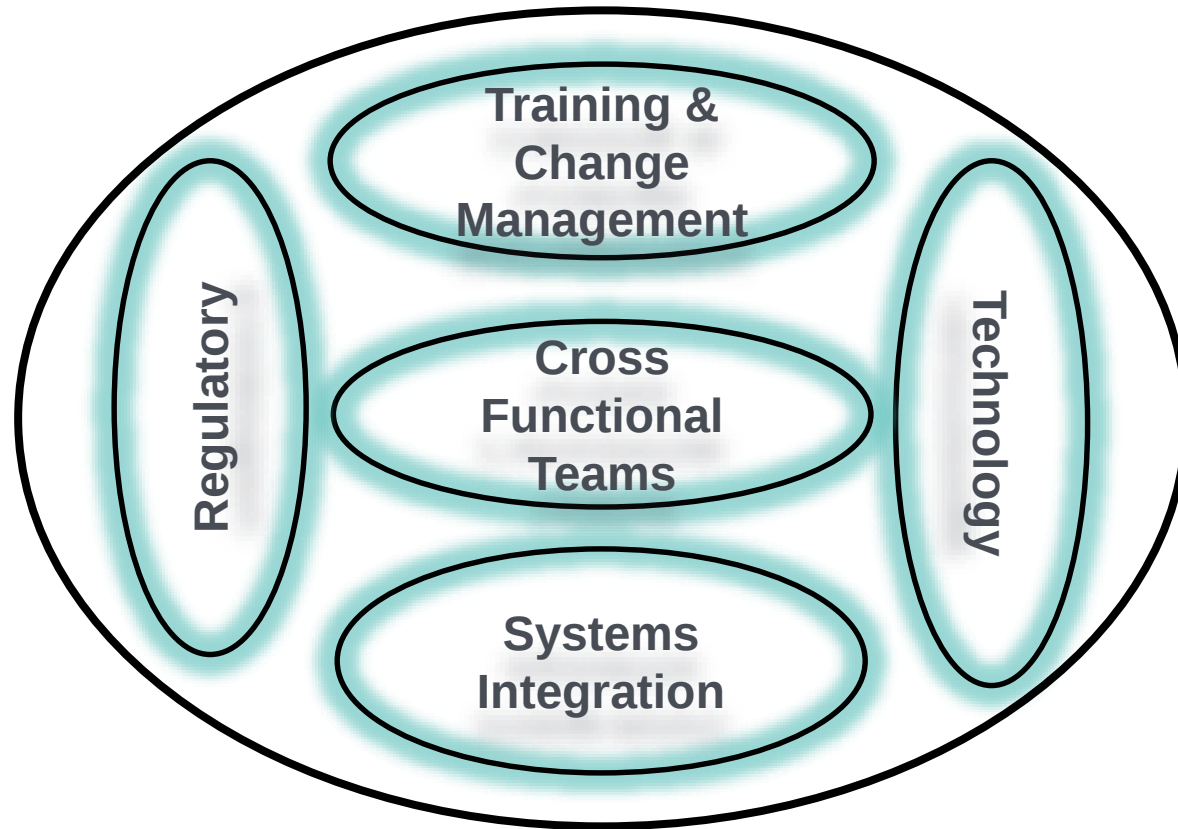
- **Validate CAISO settlement statements and invoices for:**
 - **PRSC Settlements**
 - **EIM Entity Settlements**
- **Submit settlement disputes**
- **Pay CAISO Invoices**
- **Perform Month-End Closing**



EIM related changes to operations

- The focus is now on feeding CAISO systems accurate data in order to receive the correct dispatch instructions
- Ancillary services are now scheduled to individual units
- Outage coordination including derates has become very important
- Testing must be well coordinated to avoid uninstructed imbalance
- Some hydro units may not be able to participate
 - Complicated license requirements that are not easily modeled with current CAISO tools
 - Ramping restrictions that take units out of the Market timeframes

What ~~were~~ are the challenges?



What ~~were~~ are the challenges?

Regulatory

- Cross jurisdictional activity
- Compliance

Training & Change Management

- Learning new tricks
- Unlearning old habits
- Being nimble, adaptable

Cross Functional Teams

- Existing silos
- Competing for limited resources
- Learning to talk using new terminologies

Systems Integration

- Not everybody plays well together
- New expectations
- Discovering limitations and quirks

Technology

- Automation
- Analysis
- Recommendation (optimization)
- Validation
- Settlements

Conclusion

- It ain't over until....it just ain't over
- The only constant is change
- The day after go-live is not maintenance mode
- Old dogs aren't necessarily the problem
- Trivial things can trip you up just as easily as the complex
- Develop in-house expertise and coaches
- It will work every time until you really need it
- EIM Entities need to share experiences



Questions?

