

Western U.S. Regional Market & the Emergence of EIM



25 July 2017

Agenda

Regional Market Efforts

- The Western Interconnection
- Challenges to Regional Market Formation

Emergence of the EIM

- Differences from Previous Regionalization Efforts
- Necessary Conditions
- Formation Dynamics
- Performance to Date
- Next Steps

REGIONAL MARKET EFFORTS



The Western Interconnection

- Boundaries
 - *Colorado to the West Coast*
 - *Western Canada to Baja California (Mexico)*
- Make up
 - *37 Balancing Authorities (in 2000)*
 - *1 synchronous machine*
- Regional and National Oversight
 - *North American Electric Reliability Corporation sets standards*
 - *Federal Energy Regulatory Commission has oversight*

37 Balancing Areas with 37 Separate Responsibilities

- Each Balancing Area responsible for adequacy
 - *Each Balancing Area must demonstrate it has adequate resources to meet need in every hour*
- Each Balancing Area responsible for balancing
 - *Each Balancing Area must have adequate resources to ensure that real time (within hour) imbalances can be resolved*
- Bilateral exchanges between balancing areas possible but limited

Consequences of Individual Operation

- Balancing Areas (B.A.) invest separately
 - *Each plans and invests to meet adequacy and balancing needs*
- Consequences (relative to consolidation)
 - *Each invests more than necessary*
 - *Costs are higher than necessary*
 - *Curtailment of variable generation is higher than necessary*
 - *Reliability could be more robust*

Opportunities for Mutually Beneficial Exchange

- Investment costs could be shared
- Regional and B.A. reliability could be enhanced
- Resource utilization could be increased
- Costs to customers could be decreased
- Balancing challenges could be reduced
- Curtailments could be reduced

Regionalization Failures

- Many attempts at consolidating B.A.s have been attempted
- The economic analysis always showed positive benefits
- Regionalization through the formation of an RTO has failed several times over the last 20 years

Why Has RTO Formation Failed So Far

- RTO formation requires transfer of operational control of transmission and generation assets to a common authority
- Utilities have different objectives
 - *Public Power Utilities*
 - *Investor Owned Power*
- Utilities have different resources and different planning practices
 - *Hydro dependent utilities*
 - *Fossil dependent utilities*
 - *Hybrids* *The economic analysis always showed positive benefits*
- Efforts to date have sought to reach agreement among all participating B.A.s simultaneously

EMERGENCE OF THE EIM



What is an Energy Imbalance Market (EIM)?

- Balancing Areas create a common market platform for resolving intra-hour imbalances
- An anchor Balancing Area operates the market (CAISO)
- Participating Balancing Areas contribute transmission for common use
- EIM entities (Balancing Areas that join the EIM) offer resources into the market to resolve imbalances
- The market platform ensures least-cost dispatch of resources to meet imbalances

WESTERN ENERGY IMBALANCE MARKET

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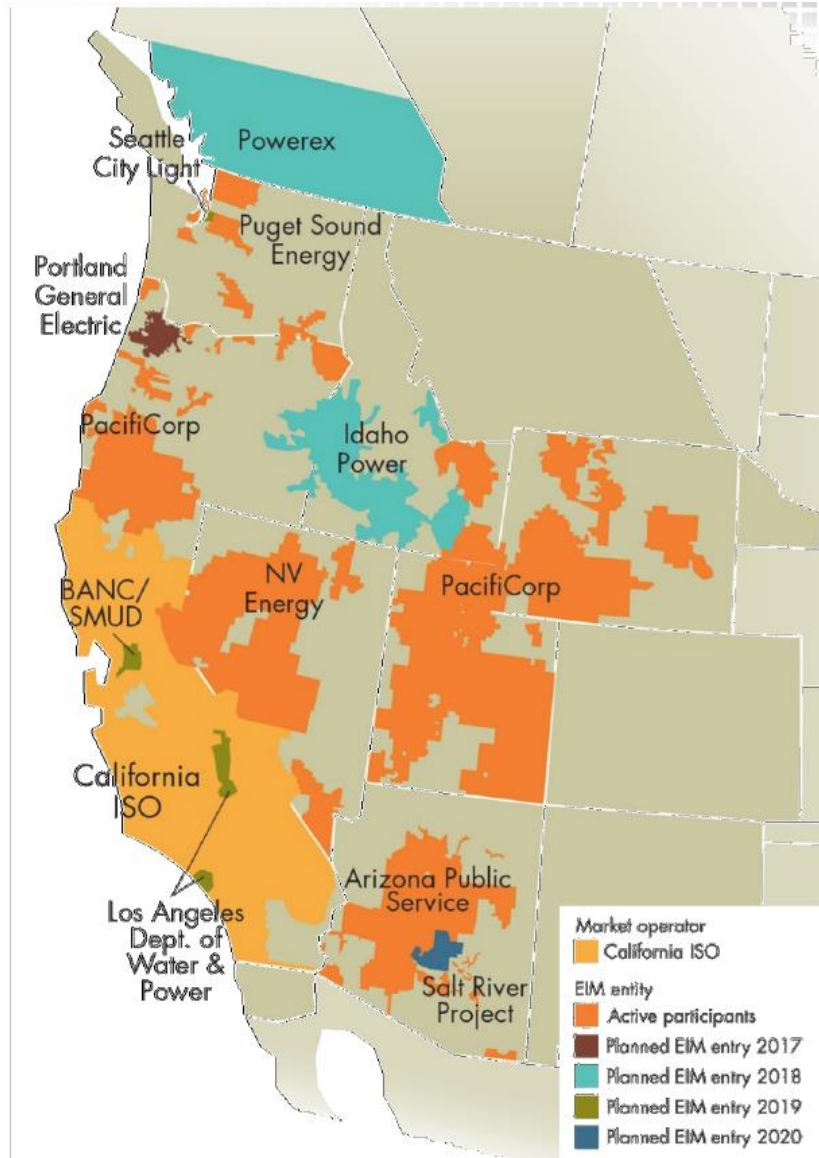


The western Energy Imbalance Market is a real-time wholesale energy trading market that enables participants anywhere in the West to buy and sell energy when needed. EIM has generated nearly \$175 million in gross benefits.

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How western EIM works



Formation Dynamics

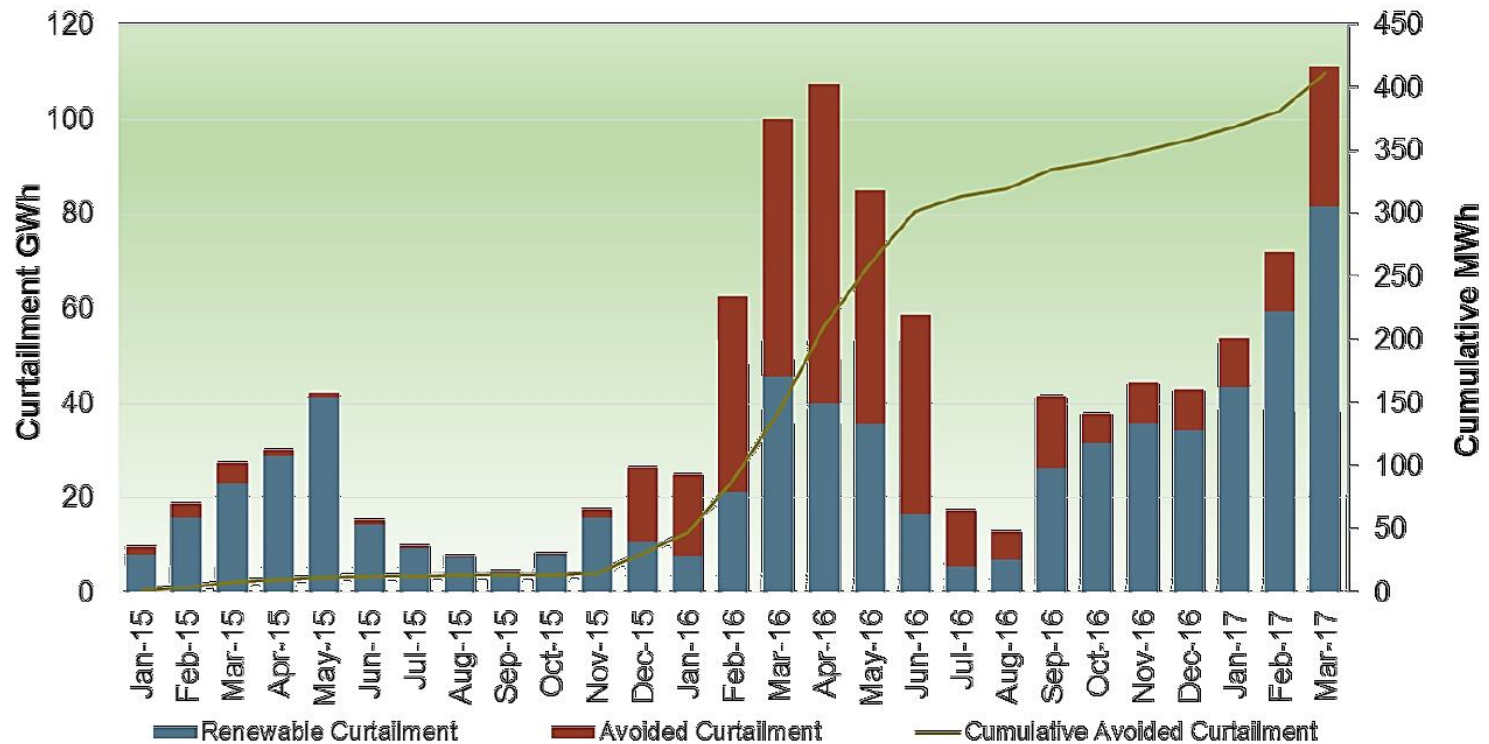
- The EIM operator invested in the platform
- EIM entities cost of joining is low
- EIM entities cost of exit is very low
- EIM entities do not give up operational control of their assets unless they are bid in as resources
- EIM entities can join one at a time
 - *No grand bargain*
 - *No making everyone happy at once*

Financial Benefits to Date

| BAA | 4 th Qtr 2014 | 1 st Qtr 2015 | 2 nd Qtr 2015 | 3 rd Qtr 2015 | 4 th Qtr 2015 | 1 st Qtr 2016 | 2 nd Qtr 2016 | 3 rd Qtr 2016 | 4 th Qtr 2016 | 1 st Qtr 2017 | Total |
|--------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---------------|
| APS | | | | | | | | | 5.98 | 5.23 | 11.21 |
| CAISO | 1.23 | 1.44 | 2.46 | 3.48 | 5.28 | 6.35 | 7.89 | 5.44 | 8.67 | 9.50 | 51.74 |
| NVE | - | - | - | - | 0.84 | 1.70 | 5.20 | 5.60 | 3.07 | 3.50 | 19.91 |
| PAC | 4.73 | 3.82 | 7.72 | 8.52 | 6.17 | 10.85 | 10.51 | 15.12 | 8.99 | 11.47 | 87.90 |
| PSE | | | | | | | | | 1.56 | 1.40 | 2.96 |
| Total | 5.96 | 5.26 | 10.18 | 12.00 | 12.29 | 18.90 | 23.60 | 26.16 | 28.27 | 31.10 | 173.72 |

| BAA | January | February | March | Q1 – 2017 Total |
|--------------|---------|----------|-------|-----------------|
| APS | 1.71 | 1.71 | 1.81 | 5.23 |
| CAISO | 2.15 | 3.17 | 4.18 | 9.5 |
| NVE | 1.07 | 1.31 | 1.12 | 3.5 |
| PAC | 2.74 | 3.84 | 4.89 | 11.47 |
| PSE | 0.41 | 0.41 | 0.58 | 1.4 |
| Total | 8.08 | 10.44 | 12.58 | 31.1 |

Curtailment Avoided to Date



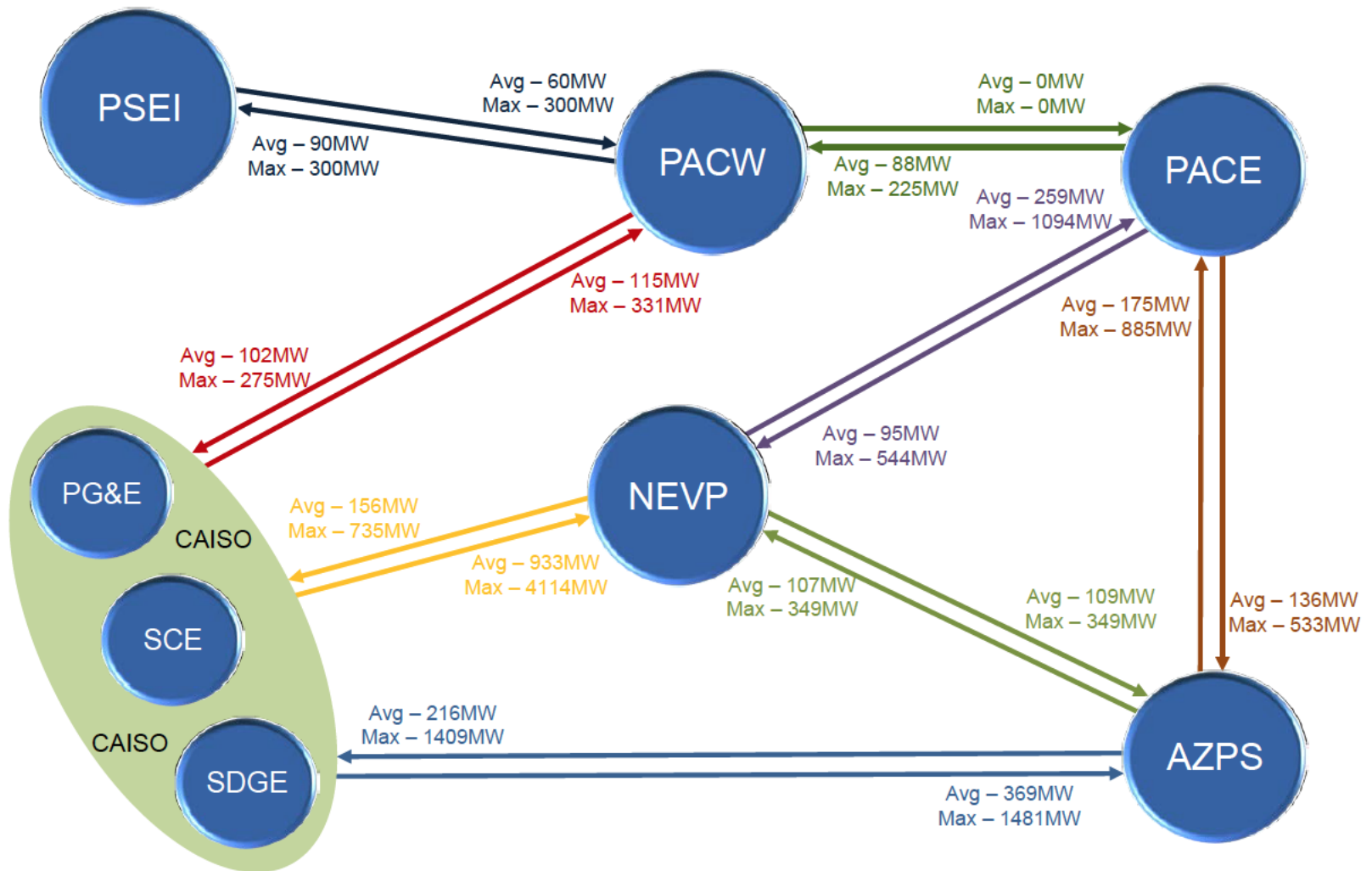
Year-to-date estimated metric tons of CO2 displaced = 176,241

Flexibility Ramping Procurement Savings Q1 2017

| | January | | February | | March | |
|--------------------------|------------|------------|------------|------------|------------|------------|
| Direction | Up | Down | Up | Down | Up | Down |
| Average MW saving | 377 | 474 | 379 | 486 | 399 | 488 |
| Sum of BAA requirements | 1,205 | 1,165 | 1,191 | 1,192 | 1,181 | 1,245 |
| Diversity Benefit | 31% | 41% | 32% | 41% | 34% | 39% |

The percentage of savings is the average MW savings divided by the sum of the four individual BAA requirements.

Transfer Statistics Q2 2017



Non-quantified Benefits

- Improved commitment and dispatch within EIM Entities
- Improved regional data
- Improved visibility
- Reliability benefits
- Benefit trajectory
 - *Very low and negative priced energy increasing (opportunity for importers, further reduced curtailment)*
 - *Scheduling and settlement timeframes shrinking (more opportunity to exchange)*

Next Steps

- Adding more balancing areas
 - *Upcoming additions of Public Power (LADWP, SCL, Salt River Project, SMUD)*
 - *Upcoming additions international (PowerEx, Cenace Baja)*
- Adding more services
 - *Ancillary services*
 - *Intra-day products?*