Energy imbalance market pricing

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Department of Market Monitoring
California Independent System Operator

EIM Body of State Regulators, Monthly update
July 9, 2021
Mission of independent market monitors

“Each independent system operator … must include a mission statement … that identifies the Market Monitoring Unit’s goals, including the protection of consumers and market participants by the identification and reporting of market design flaws and market power abuses.”

FERC Order 719

To provide independent oversight and analysis of the CAISO Markets for the protection of consumers and Market Participants by the identification and reporting of market design flaws, potential market rule violations, and market power abuses.

Department of Market Monitoring Mission Statement
CAISO Tariff, Appendix P
Core functions of independent market monitors (FERC Order 719)

1. Review and report on the performance of wholesale markets, including quarterly and annual reports.

2. Evaluate existing and proposed market rules, and provide recommendations.

3. Notify FERC Office of Enforcement when a market participant or the ISO has engaged in conduct that may require investigation.

4. Market monitors may also perform functions related to inputs for market power mitigation.
   - Bids used in mitigation, cost review, etc.
DMM reports include coverage of prices in EIM

Average 15-minute market prices

- Arizona Public Service
- NV Energy
- PacifiCorp East and Idaho Power
- PacifiCorp West, Puget Sound Energy, Portland General Electric, and Seattle City Light
- Powerex
- Salt River Project
- Balancing Authority of Northern California
- Pacific Gas and Electric (ISO)
Prices and transfers reflect differences in regional supply conditions and transfer limitations

- EIM optimization dispatches resources and schedules transfers between areas in real-time

- Northwest prices regularly lower than the rest of the system due to limited transfer capability

- Peak California area prices exceed other areas due to GHG and congestion

- Prices in the Southwestern areas averaged over $60/MWh in February, due to gas supply limitations
The ability to transfer energy between areas is one of the key benefits of the EIM

Average 15-minute market limits between January 1 and March 24, 2021

<table>
<thead>
<tr>
<th>From Balancing Authority Area</th>
<th>To Balancing Authority Area</th>
<th>Total export limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>California ISO</td>
<td>CISO 1,580</td>
<td>8,270</td>
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<tr>
<td>BANC</td>
<td>3,470</td>
<td>1,590</td>
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<tr>
<td>NV Energy</td>
<td>1,080</td>
<td>5,400</td>
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<tr>
<td>Arizona Public Service</td>
<td>1,860</td>
<td>11,240</td>
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<tr>
<td>Salt River Project</td>
<td>50</td>
<td>7,500</td>
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<tr>
<td>PacifiCorp East</td>
<td>100</td>
<td>2,590</td>
</tr>
<tr>
<td>Idaho Power</td>
<td>130</td>
<td>2,900</td>
</tr>
<tr>
<td>PacifiCorp West</td>
<td>60</td>
<td>1,300</td>
</tr>
<tr>
<td>Portland GE</td>
<td>360</td>
<td>660</td>
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<tr>
<td>Puget Sound Energy</td>
<td>350</td>
<td>750</td>
</tr>
<tr>
<td>Seattle City Light</td>
<td>10</td>
<td>520</td>
</tr>
<tr>
<td>Powerex</td>
<td>450</td>
<td>300</td>
</tr>
<tr>
<td>Total import limit</td>
<td>10,240</td>
<td>3,600</td>
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</tbody>
</table>

CAISO - Public
• Transfers in EIM vary a lot by hour-of-day and season.

• General flow of transfers in net peak hours is from northwest to CAISO and southwest.
• During peak solar hours, CAISO exports excess to other EIM areas.

• Flows can change quickly due to changes in short-term conditions.
Transfers between ISO and EIM balancing areas

Average transfer (MW)

Exports from California ISO

Imports into California ISO

Hour 1 to 24 (Q1-2020)
Hour 1 to 24 (Q2-2020)
Hour 1 to 24 (Q3-2020)
Hour 1 to 24 (Q4-2020)
Hour 1 to 24 (Q1-2021)

- California ISO ↔ NV Energy
- California ISO ↔ Arizona Public Service
- California ISO ↔ PacifiCorp West
- California ISO ↔ Portland GE
- California ISO ↔ Powerex
- California ISO ↔ BANC
- California ISO ↔ Salt River Project
- California ISO net transfer
Transfers between PacifiCorp East and other balancing areas

![Graph showing transfers between PacifiCorp East and other areas](image)

- PacifiCorp East ↔ NV Energy
- PacifiCorp East ↔ Arizona Public Ser.
- PacifiCorp East ↔ PacifiCorp West
- PacifiCorp East ↔ Idaho Power
- PacifiCorp East net transfer

Average transfer (MW)

Hour 1 to 24
(Q1-2020)

Hour 1 to 24
(Q2-2020)

Hour 1 to 24
(Q3-2020)

Hour 1 to 24
(Q4-2020)

Hour 1 to 24
(Q1-2021)
Transfers between APS and other balancing areas

Average transfer (MW)

Imports into APS

Exports from APS

-800 -600 -400 -200 0 200 400 600 800 1,000 1,200

Arizona Public Service ↔ Salt River Project
Arizona Public Service ↔ NV Energy
Arizona Public Service ↔ PacifiCorp East
Arizona Public Service ↔ California ISO
Arizona Public Service net transfer

Hour 1 to 24 (Q1-2020)
Hour 1 to 24 (Q2-2020)
Hour 1 to 24 (Q3-2020)
Hour 1 to 24 (Q4-2020)
Hour 1 to 24 (Q1-2021)
EIM market prices reflect impact of transmission constraints and California’s GHG program

Average 15-minute market prices by hour (Q1 2021)

- PacifiCorp West, Puget Sound Energy, Portland General Electric, and Seattle City Light
- PacifiCorp East and Idaho Power
- NV Energy
- Arizona Public Service
- Powerex
- Salt River Project
- Balancing Authority of Northern California
- Pacific Gas and Electric (ISO)
Key drivers of price differences between EIM areas

- Congestion on EIM transfer constraints **between** EIM areas
  - Revenues from congestion on EIM transfers are returned to transmission owners in each EIM area.

- Congestion on internal constraints **within** different balancing areas.
  - Main impact is congestion within CAISO area (typically North to South).

- California greenhouse gas emissions (GHG) costs/constraints built into EIM dispatch and pricing model.
  - GHG price reflects cost for marginal EIM resources delivered to CA to comply with California’s GHG trading program.
  - GHG constraint drives down prices paid to EIM entities for transfers to CA.
  - But EIM resources delivered to CA receive GHG price back through separate GHG payment.
  - For “greener” low emission resources delivered to CA, GHG payment is more than compliance cost (or premium for green power).
Impact of congestion and greenhouse gas on prices (2020)

- Systemwide energy price
- Transmission losses
- Congestion within CAISO
- Congestion on EIM transfer limits
- GHG component
- Total LMP

Average cost of LMP component

SDGE  SCE  PG&E  NEVP  SRP  AZPS  IPCO  PACW  PGE  PSEI  SCL  PWRX
## Frequency of import and export congestion on EIM transfer constraints (Q1 2021)

<table>
<thead>
<tr>
<th></th>
<th>15-minute market</th>
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<th>5-minute market</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Congested from area</td>
<td>Congested into area</td>
<td>Congested from area</td>
<td>Congested into area</td>
</tr>
<tr>
<td>BANC*</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>NV Energy</td>
<td>2%</td>
<td>0%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Arizona Public Service</td>
<td>3%</td>
<td>1%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>PacifiCorp East</td>
<td>2%</td>
<td>2%</td>
<td>1%</td>
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</tr>
<tr>
<td>Idaho Power</td>
<td>2%</td>
<td>3%</td>
<td>1%</td>
<td>3%</td>
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<tr>
<td>Salt River Project</td>
<td>4%</td>
<td>2%</td>
<td>3%</td>
<td>2%</td>
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<tr>
<td>PacifiCorp West</td>
<td>41%</td>
<td>6%</td>
<td>28%</td>
<td>6%</td>
</tr>
<tr>
<td>Portland General Electric</td>
<td>41%</td>
<td>6%</td>
<td>28%</td>
<td>6%</td>
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<tr>
<td>Puget Sound Energy</td>
<td>44%</td>
<td>8%</td>
<td>35%</td>
<td>12%</td>
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<tr>
<td>Seattle City Light</td>
<td>44%</td>
<td>8%</td>
<td>35%</td>
<td>12%</td>
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<tr>
<td>Powerex</td>
<td>43%</td>
<td>12%</td>
<td>36%</td>
<td>20%</td>
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## Net price impact of congestion on EIM transfer constraints (Q1 2021)

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<thead>
<tr>
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<th>15-minute market</th>
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<th>5-minute market</th>
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<tr>
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<td>Congestion</td>
<td>Price Impact ($/MWh)</td>
<td>Congestion</td>
<td>Price Impact ($/MWh)</td>
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<tr>
<td></td>
<td>Frequency</td>
<td></td>
<td>Frequency</td>
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<tr>
<td>BANC*</td>
<td>1%</td>
<td>$0.04</td>
<td>1%</td>
<td>$0.16</td>
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<tr>
<td>Arizona Public Service</td>
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<td>-$2.39</td>
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<td>-$0.05</td>
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<td>4%</td>
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<tr>
<td>PacifiCorp West</td>
<td>47%</td>
<td>-$6.24</td>
<td>33%</td>
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<td>47%</td>
<td>-$5.78</td>
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<td>Seattle City Light</td>
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<td>-$6.45</td>
<td>47%</td>
<td>-$3.07</td>
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<tr>
<td>Powerex</td>
<td>55%</td>
<td>-$5.46</td>
<td>56%</td>
<td>-$2.63</td>
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Price impact of congestion on EIM transfer constraints

Impact to prices ($/MWh)

Q1  Q2  Q3  Q4  Q1

2020 2021

Impact to prices ($/MWh)

BANC* NEVP AZPS PACE IPCO PACW PGE PSEI PWRX SCL SRP

15-minute market
Overall impact of congestion on average prices (including congestion within CAISO area)
### Overall impact of congestion on prices, 2020*

<table>
<thead>
<tr>
<th>Constraint Location</th>
<th>Constraint</th>
<th>PGAE</th>
<th>SCE</th>
<th>SDGE</th>
<th>BANC</th>
<th>NEVP</th>
<th>AZPS</th>
<th>SRP</th>
<th>PACE</th>
<th>IPCO</th>
<th>PACW</th>
<th>PGE</th>
<th>PSEI</th>
<th>PWRX</th>
<th>SCL</th>
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<tr>
<td>NEVP</td>
<td>CAL-DRM_2 120</td>
<td>-$0.01</td>
<td>$0.00</td>
<td>$0.00</td>
<td>-$0.03</td>
<td>$0.09</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
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<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
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<tr>
<td>PACE</td>
<td>TOTAL_WYOMING_EXPORT</td>
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<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
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<td>$0.00</td>
<td>$0.00</td>
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<td>$-0.22</td>
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<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
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<td>CAISO</td>
<td>Internal Constraints</td>
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<td>$1.82</td>
<td>$3.31</td>
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<td>-$0.87</td>
<td>-$0.57</td>
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<td>-$2.13</td>
<td>-$2.15</td>
<td>-$2.11</td>
<td>-$2.09</td>
<td>$2.74</td>
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<tr>
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<td>Other</td>
<td>$0.11</td>
<td>$0.03</td>
<td>$0.26</td>
<td>$0.00</td>
<td>-$0.20</td>
<td>-$0.23</td>
<td>-$0.23</td>
<td>-$0.19</td>
<td>-$0.07</td>
<td>-$0.06</td>
<td>-$0.03</td>
<td>-$0.07</td>
<td>-$0.07</td>
<td>-$0.06</td>
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<tr>
<td></td>
<td>Internal Total</td>
<td>-$0.10</td>
<td>$1.85</td>
<td>$3.58</td>
<td>-$0.36</td>
<td>-$0.14</td>
<td>-$1.10</td>
<td>-$0.80</td>
<td>-$1.62</td>
<td>-$1.72</td>
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<td>-$2.18</td>
<td>-$2.17</td>
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<tr>
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<td>Transfers</td>
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<td>-$0.17</td>
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<td>-$1.61</td>
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<td>-$4.53</td>
<td>-$4.60</td>
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<td>Grand Total</td>
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<td>$1.85</td>
<td>$3.58</td>
<td>-$1.38</td>
<td>$5.41</td>
<td>-$0.76</td>
<td>-$0.97</td>
<td>-$3.14</td>
<td>-$3.33</td>
<td>-$6.73</td>
<td>-$6.71</td>
<td>-$6.77</td>
<td>-$7.93</td>
<td>-$8.74</td>
</tr>
</tbody>
</table>

- Transfer constraints have a greater impact than internal congestion in most EIM areas.
- Internal congestion in CAISO has a greater impact than internal congestion in other areas.

* Summarized version of DMM’s forthcoming annual report
California greenhouse gas emissions (GHG) costs/constraints in the EIM

• GHG constraint used to determine which EIM resources are “deemed” to be imported into CA and are therefore required to obtain GHG emissions credits.

• Based on GHG bid adders submitted by EIM resources willing to be delivered to California.
  – GHG bid adder based on cost of emissions credits for each resource.
  – GHG price reflects GHG emission cost for marginal EIM resource delivered to CA.

• GHG constraint drives down prices paid to EIM entities for transfers to CA.
  – Payments fully offset costs of any GHG emission required.
  – For “greener” lower emission resources delivered to CA, GHG payment can exceed compliance costs as an extra profit margin.
EIM transfers into CA by fuel type based on GHG modeling
Annual greenhouse gas payments for generation deemed delivered to California

![Chart showing annual greenhouse gas payments for different energy sources from 2016 to 2020, with a significant increase in 2019 and 2020.](chart.png)
EIM transfers into CA by EIM area

Note: From DMM’s forthcoming 2020 Annual Report
Resources:

• Online training and references:
  – https://www.westerneim.com/Pages/About/HowItWorks.aspx
  – http://www.caiso.com/participate/Pages/LearningCenter/WesternEnergyImbalanceMarket.aspx
  – https://www.westerneim.com/Pages/Resources.aspx

• Track prices in real-time on the phone app or website:
  – OASIS: http://oasis.caiso.com/mrioasis/logon.do
  – Price map: http://www.caiso.com/TodaysOutlook/Pages/prices.html

• DMM reports:
  – Annual, Quarterly and new EIM participant reports: http://www.caiso.com/market/Pages/MarketMonitoring/AnnualQuarterlyReports/Default.aspx
  – Special reports cover competitiveness and other EIM issues:
For more information on DMM:

- **Department of Market Monitoring webpage**
  - **CAISO Tariff, Appendix P**

- **Contact DMM directly:**
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  - Amelia Blanke, Manager Monitoring & Reporting: [ablanke@caiso.com](mailto:ablanke@caiso.com)
  - Direct DMM contact: (916) 608-1220