Bi-Weekly Market Performance Report Metric Key

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Prepared by: Jennie Sage
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California Independent System Operator

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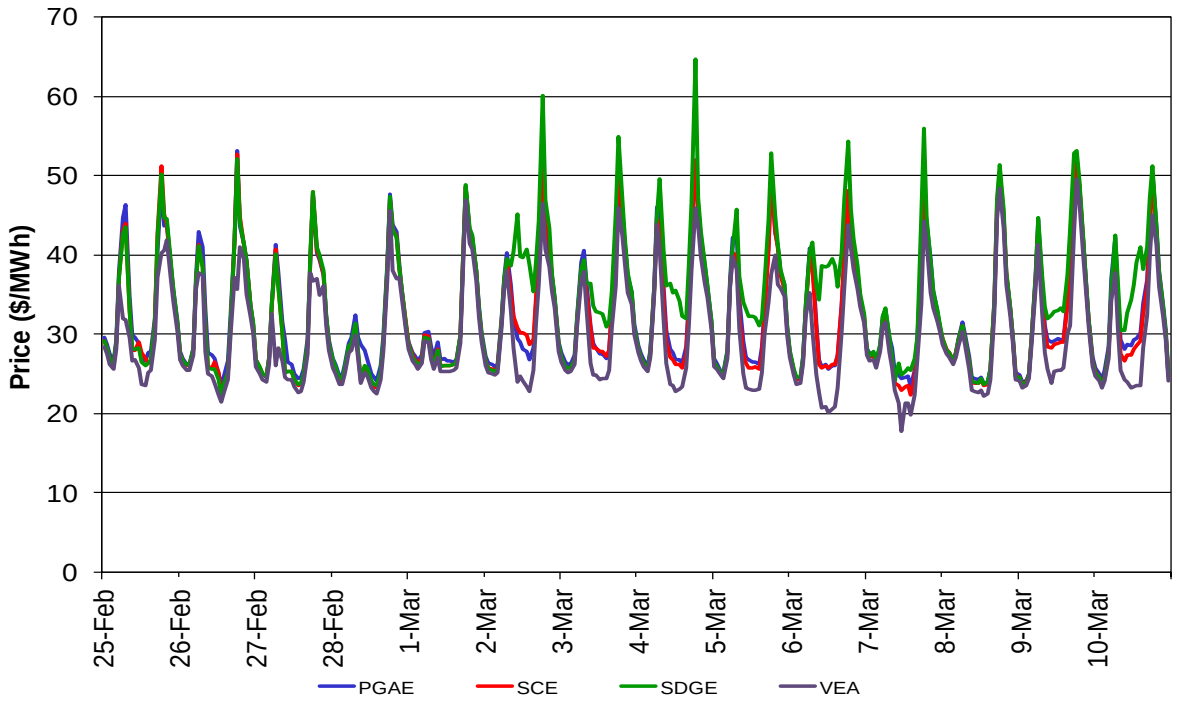
VERSION HISTORY

Date	Version	Description	Author
9/02/2009	1.0	Creation of document	Market Performance Group
09/10/2013	1.1	Updated with VEA DLAP, regulation mileage A/S service and ISO logo	Market Quality and Validation Analysis
06/18/2015	1.2	Updated with EIM metrics and ISO logo	Market Quality and Validation Analysis
7/7/2017	1.3	Updated with additional EIM BAAs	Market Quality and Validation Analysis

Day-Ahead (IFM) Prices

Figure 1 shows the hourly DLAP prices for each of the four major DLAPs –PGE, SCE, VEA and SDGE. The values are plotted for a timeframe of two weeks, which makes a total of 14*24=336 entries for each DLAP price. There is no further aggregation or averaging in the values shown in this plot.

Figure 1: Day-Ahead LAP Prices



The statistics described in the highlights of the report are the simple maximum, minimum and average from the set of all four DLAP IFM prices.

Day-Ahead (IFM) Congestion

Congestion occurs when available, least-cost energy cannot be delivered to some loads because transmission facilities do not have sufficient capacity to deliver the energy. When the least-cost, available energy cannot be delivered to load in a transmission-constrained area, higher cost units in the constrained area must be dispatched to meet that load. The result is the price of energy in the constrained area will be higher than in the unconstrained area because of the combination of transmission limitations and the costs of local generation. Congestion rents are a measured of the extent of congestion and can be estimated by transmission element.

Figure 2 below illustrates the total IFM congestion rents. Congestion rents for each transmission element is calculated as its shadow price ($/MWh) multiplied by its power flow (MW). Then the values are summed up through all hours of a day to obtain the daily cumulative. Congestion rents from branch groups, lines, transformers and nomograms are aggregated into one single group labeled as *Flow-gates*, while congestion rents from inter-ties are individually represented.

Figure 2: IFM (Day-Ahead) Daily Congestion Rents

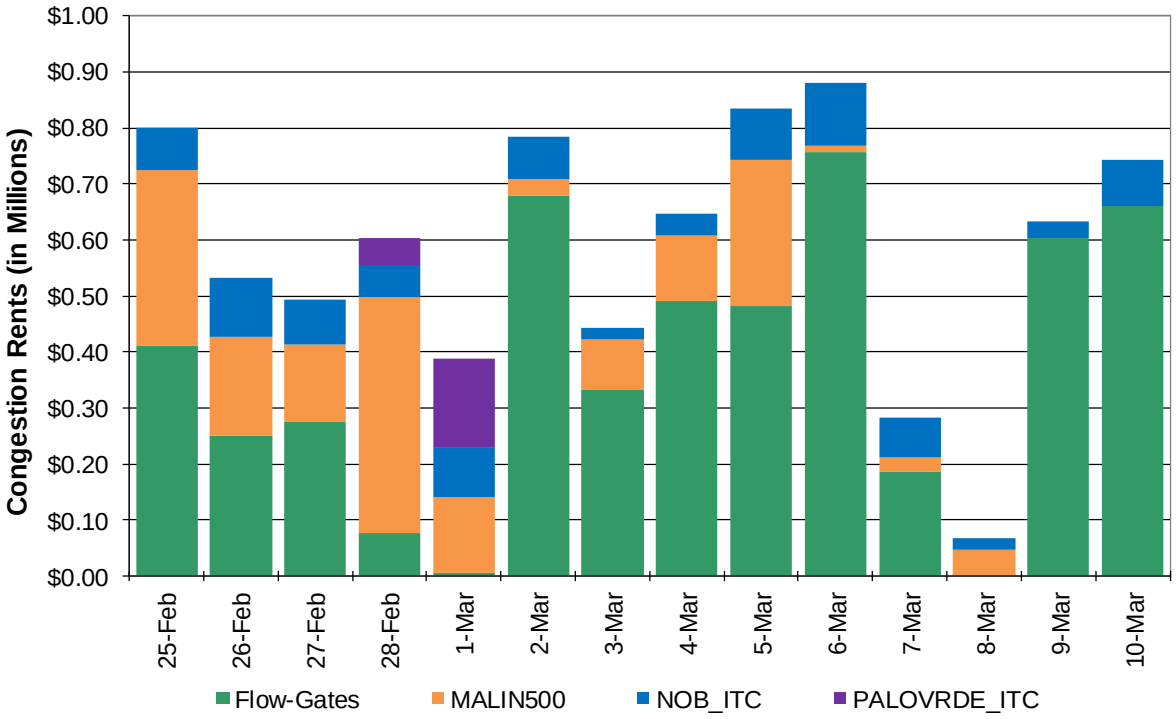


Figure 3 lists the transmission constraints binding in the IFM for flow-based constraints and the bi-weekly total congestion rent in a table format.

Figure 3: Day-Ahead Congestion Rents for Flow-Based Constraints

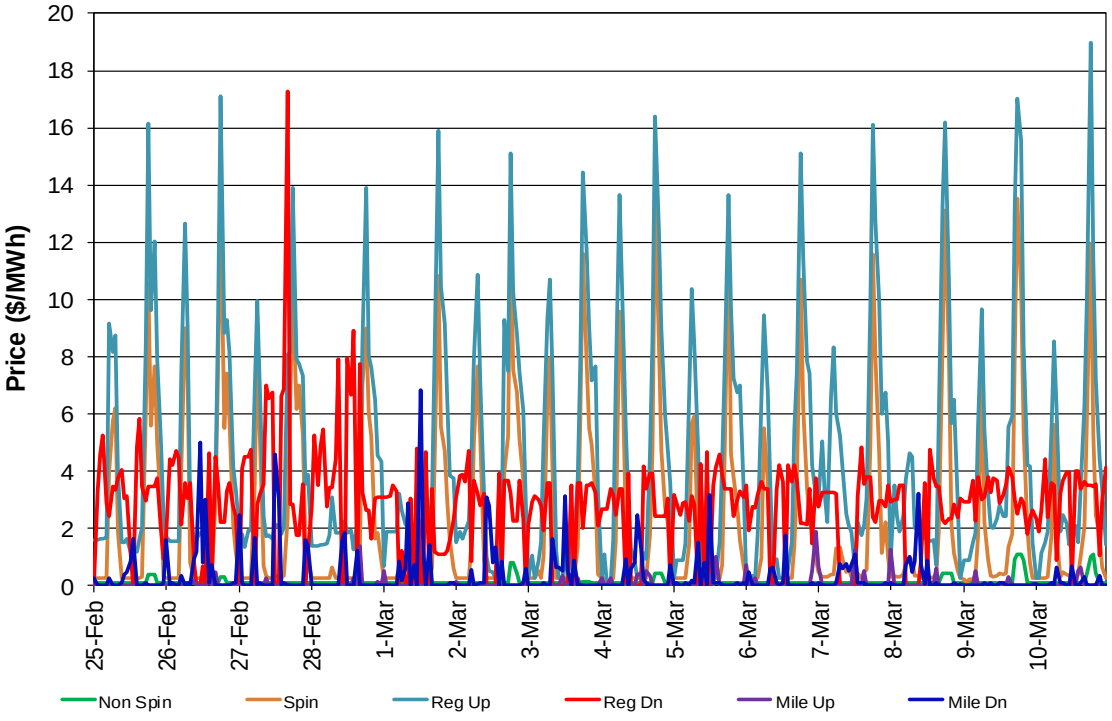
Transmission Constraint	Congestion Rent
22835_SXTAP2 _230_22504_MISSION _230_BR_1 _1	$ 3,242,373.76
24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	$ 885,032.01
24016_BARRE _230_24154_VILLA PK_230_BR_1 _1	$ 561,863.84
24016_BARRE _230_25201_LEWIS _230_BR_1 _1	$ 176,781.37
32950_PITSBURG_115_30527_PITSBRG _230_XF_13	$ 125,890.80
HUMBOLDT_IMP_NG	$ 86,373.21
33200_LARKIN _115_33204_POTRERO _115_BR_1 _1	$ 46,207.03
25406_J.HINDS _230_24806_MIRAGE _230_BR_1 _1	$ 44,572.90
PATH15_BG	$ 36,508.20
SLIC 2586107 PANOCHE SOL1	$ 5,198.09
31461_JESSTAP _115_31464_COTWDPGE_115_BR_1 _1	$ 3,678.37
IVALLY-ELCNTO_230_BR_1_1	$ 1,371.61
31090_HMBLT BY_60.0_31100_EEL RIVR_60.0_BR_1 _1	$ 1,287.79
31336_HPLND JT_60.0_31370_CLVRDLJT_60.0_BR_1 _1	$ 332.02
Total	**$ 5,217,471.00**

Day-Ahead (IFM) Ancillary Service Prices

Figure 4 illustrates the IFM weighted hourly price for Regulation Up, Regulation Down, Mileage Up, Mileage Down, Spin and Non-Spin Ancillary Services. The weighted average price for each type of Ancillary Services (A/S) is calculated for each hour as:

$$A/S\_Price_{i} = \frac{\sum (ASMP_{ij} \times Non\text{-}Self\_Scheduled\_A/S\_Award_{ij})}{\sum_{i} Non\text{-}Self\_Scheduled\_A/S\_Award_{ij}}$$

Figure 4: IFM (Day-Ahead) Ancillary Service Average Price



From these hourly averaged prices, the simple maximum and minimum are used in the statistics of A/S described in the market highlights of the bi-weekly report.

Residual Unit Commitment

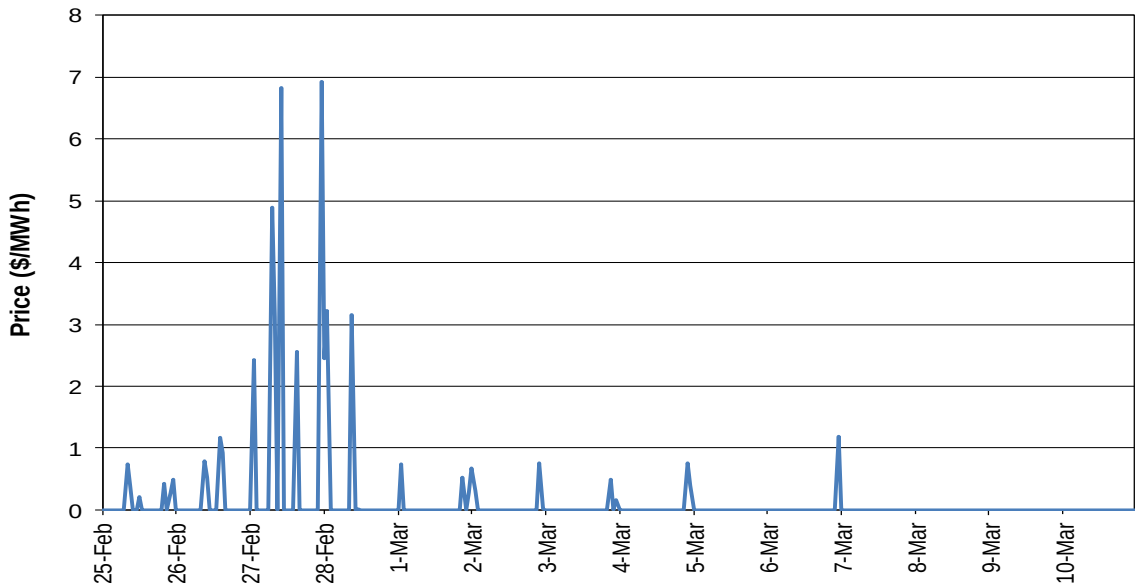
Residual Unit Commitment (RUC) is a reliability function for committing resources and procuring RUC capacity not scheduled in the IFM as Energy or Ancillary Service (AS) capacity. RUC capacity is procured in order to meet the difference between the CAISO Forecast of CAISO Demand (CFCD) – including locational differences and adjustments – and the demand scheduled in the IFM for each trading hour of the trading day.

The hourly RUC price shown in Figure 5 is computed as a weighted average of RUC prices as follows:

$$\text{RUC\_Price}_j = \frac{\sum_i (\text{RUC\_LMP}_{ij} \times \text{RUC\_Award}_{ij})}{\sum_i \text{RUC\_Capacity}_{ij}}$$

where *i* indicates individual resource and *j* indicates trading hour (from 1 to 24). This price gives a reference of the extent of the cost per MW to provide the RUC capacity, given the fact that RUC capacity may be met from both RA-units and Non-RA units. When requirements are met from RA units, it is done at a zero price.

Figure 5: Day-Ahead Average RUC Price



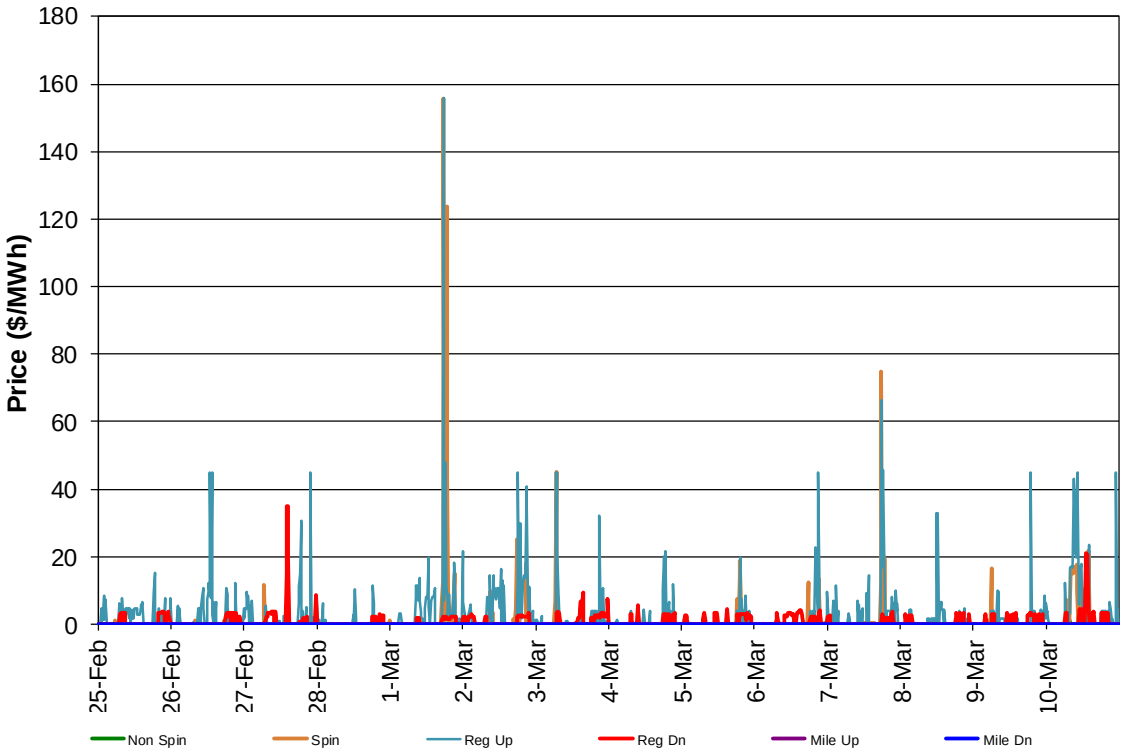
Real-Time Average A/S Price

The prices shown in Figure 6 are computed based on the same logic as defined for IFM A/S prices above, with the only difference that prices are from the fifteen-minute market. The weighted average price for each type of A/S is calculated for each 15-minute interval as:

$$A/S\_Price_{\ j} = \frac{\sum_i (ASMP_{ij} \times Non\text{-}Self\_Scheduled\_A/S\_Award_{ij})}{\sum_i Non\text{-}Self\_Scheduled\_A/S\_Award_{ij}}$$

Where $ASMP_{ij}$ is the Ancillary Service Marginal Price; the index *i* stands for the *i- th* resource, and the index *j* stands for the *j-th* 15-minute interval of each hour.

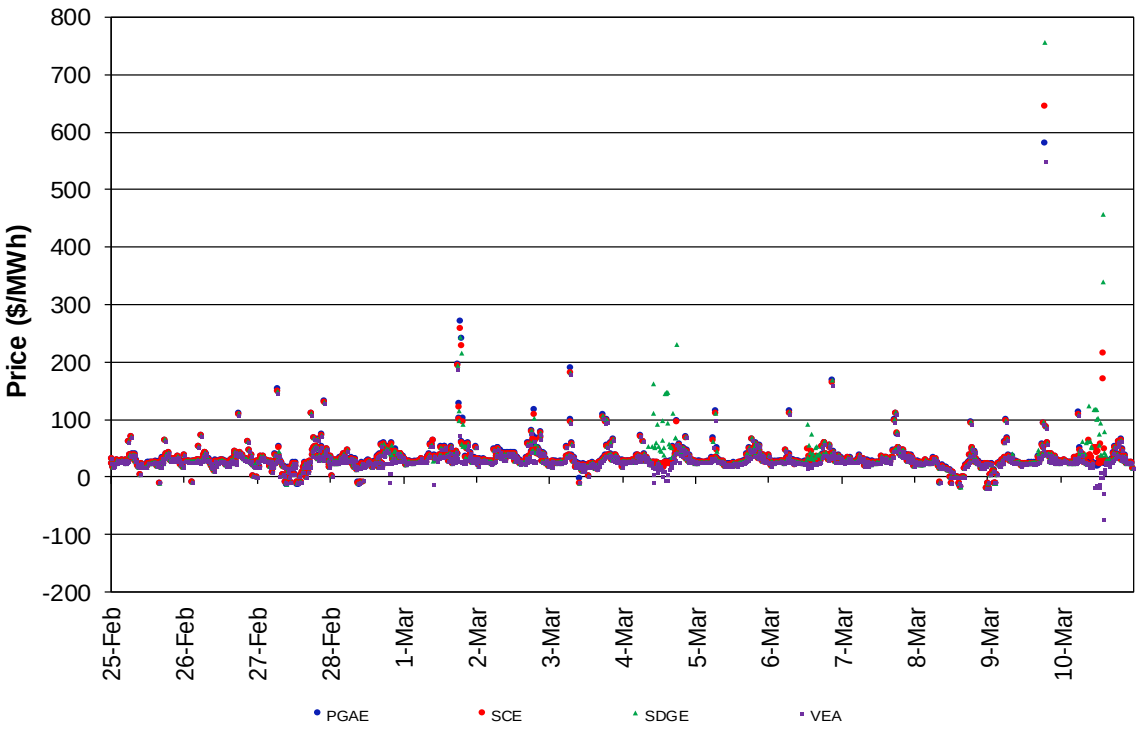
Figure 6: Real-Time (FMM) Average A/S Price



Fifteen-Minute Real-Time DLAP Prices

Figure 7 shows the real-time 15-minute interval LMP prices for each of the four DLAPs over a timeframe of two weeks, which makes a total of 4*24*14=1344 fifteen-minute intervals. The prices shown in this figure do not have any further averaging.

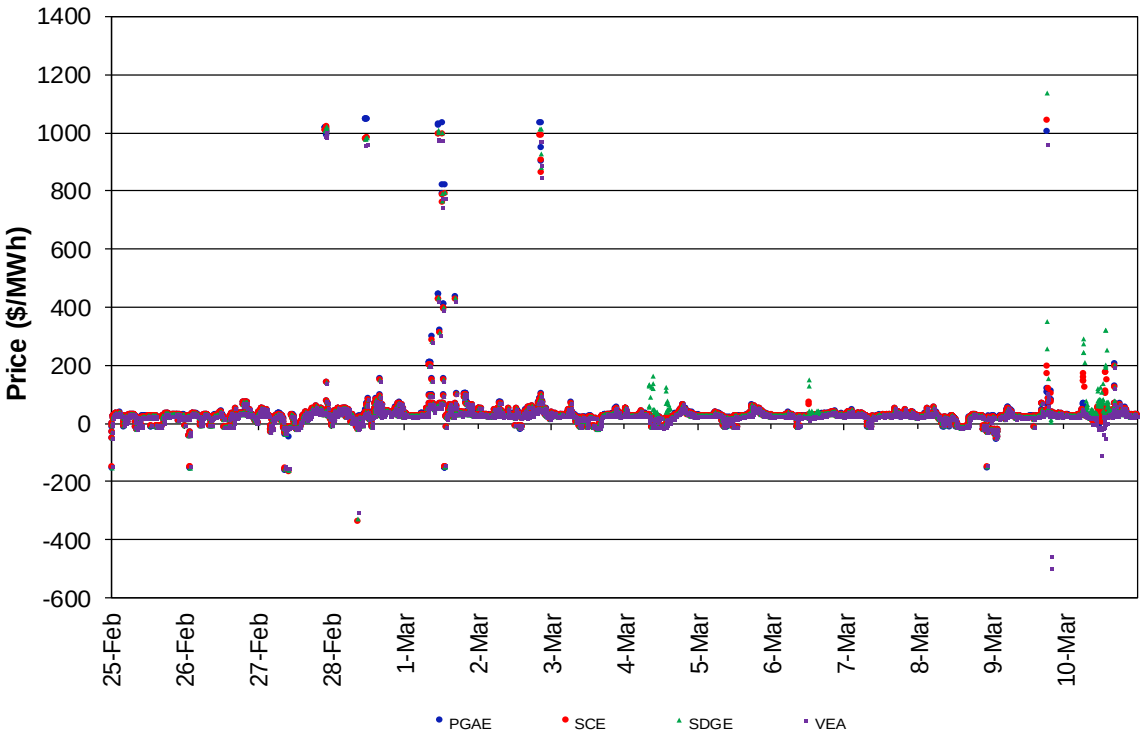
Figure 7: Real-Time (FMM) DLAP LMP



Five-Minute Real-Time DLAP Prices

Figure 8 shows the real-time 5-minute interval LMP prices for each of the four DLAPs over a timeframe of a week, which makes a total of 12*24*14=4032 five-minute intervals. The prices shown in this figure do not have any further averaging.

Figure 8: Real-Time (RTD) DLAP LMP

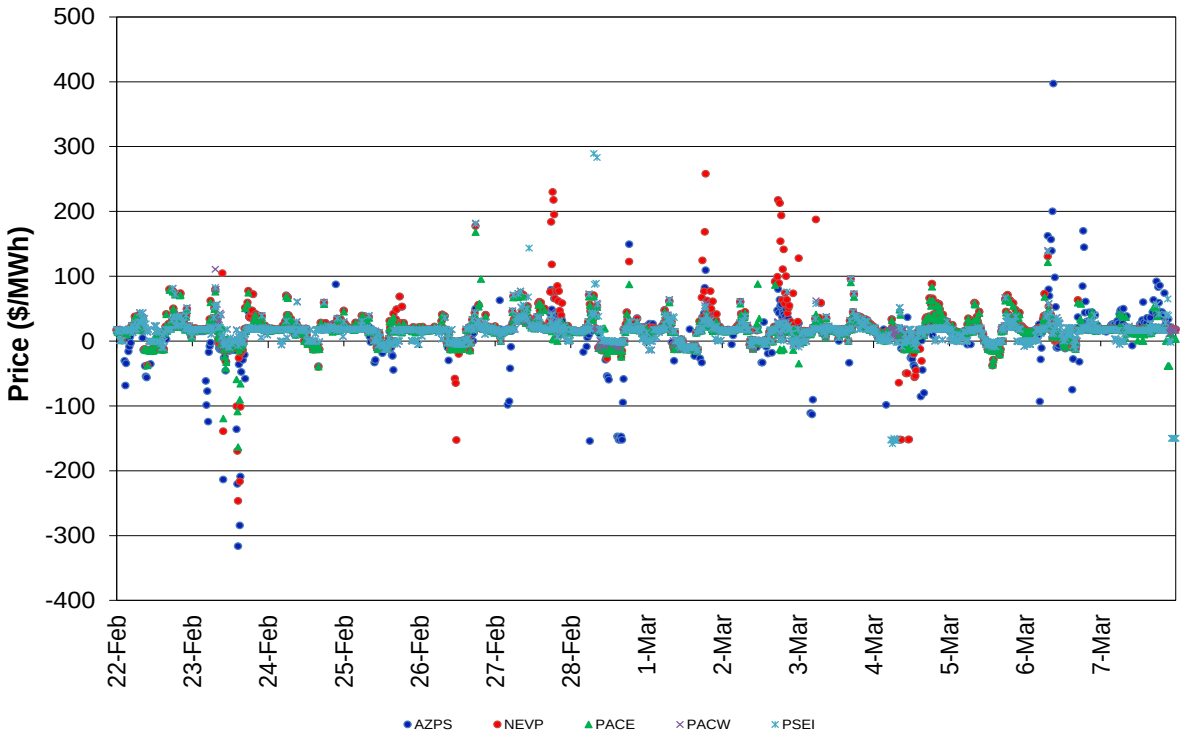


The statistics described in the highlights of the report are computed as the simple maximum, minimum and average from the set of all four DLAP Real-Time prices.

Fifteen-Minute Real-Time ELAP Prices

Figure 9 shows the real-time 15-minute interval LMP prices for each of the active ELAPs over a timeframe of two weeks, which makes a total of 4*24*14=1344 fifteen-minute intervals. The prices shown in this figure do not have any further averaging.

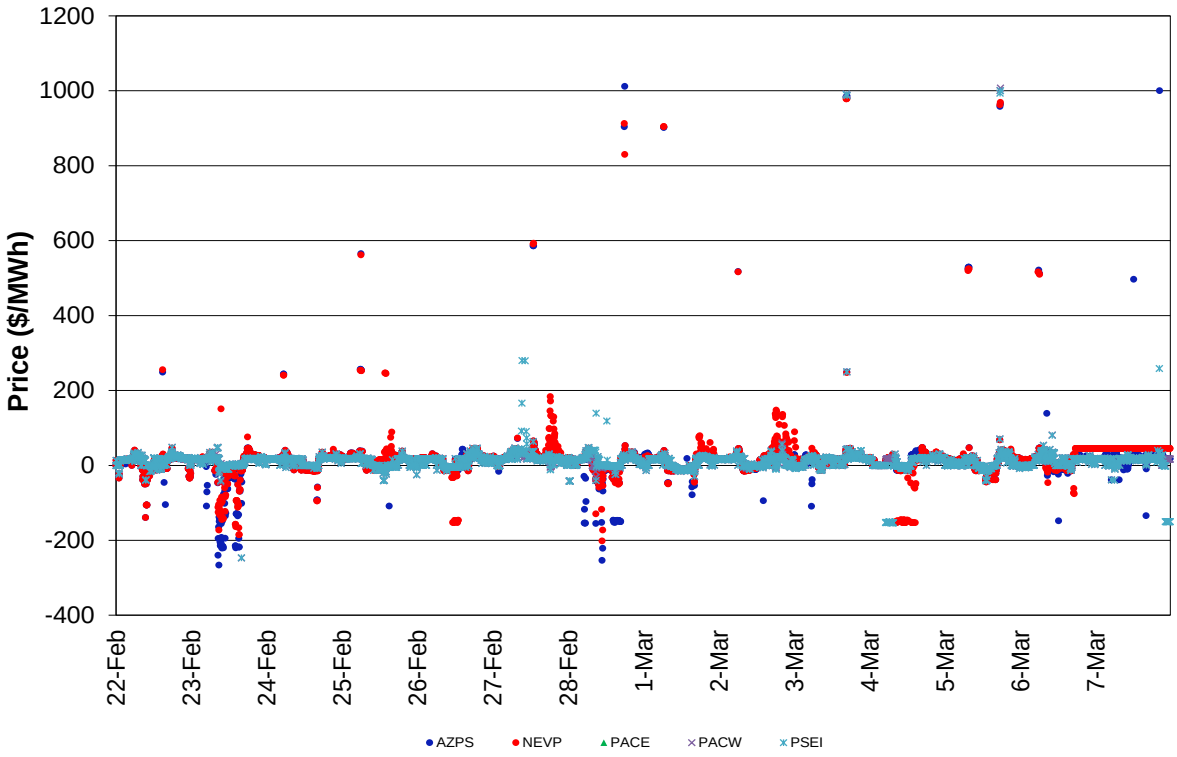
Figure 9: Real-Time (FMM) ELAP LMP



Five-Minute Real-Time ELAP Prices

Figure 10 shows the real-time 5-minute interval LMP prices for each of the active ELAPs over a timeframe of two weeks, which makes a total of 12*24*14=4032 five-minute intervals. The prices shown in this figure do not have any further averaging.

Figure 10: Real-Time (RTD) ELAP LMP



In addition, the market highlights includes the count of intervals with DLAP and ELAP prices above $250 and below -$150 in both the fifteen-minute and five-minute market. Any interval that has a price above $250 (or below -$150) in any of the four DLAPs or ELAPs is included in the corresponding count. If more than one DLAP/ELAP has a price above $250 (or below -$150) in the same interval, it is only considered as one occurrence because the counting is per interval and not by price occurrence.