Market Performance Report
May 2018

July 26, 2018

ISO Market Quality and Renewable Integration

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Executive Summary[1]

The market performance in May 2018 is summarized below.

CAISO area performance,

- Peak loads for ISO exceeded 30,000 MW for four days in May due to warm weather.
- Across all market, such as the integrated forward market (IFM), the fifteen-minute market (FMM) and real-time market (RTD), SDG&E prices were elevated in a couple of days due to transmission congestion.
- Congestion rents for interties rose to $8.88 million from $5.13 million in April. Majority of the congestion rents in May accrued on MALIN (31 percent) intertie and NOB (66 percent) intertie.
- In the congestion revenue rights (CRR) market, revenue adequacy was 86.15 percent, improving from the 64.99 percent in April. The line 22192_DOUBLTTP_138_22300_FRIARS contributed largely to the revenue shortfall.
- The monthly average ancillary service cost to load inched down to $1.01/MWh in May from $1.16/MWh in April. There were 39 scarcity events this month.
- The cleared virtual supply was well above the cleared demand in most days of May. The profits from convergence bidding edged up to $2.89 million from $2.50 million in April.
- The bid cost recovery decreased to $5.13 million from $6.34 million in April.
- The real-time energy offset dropped to -$1.60 million from $5.99 million in April. The real-time congestion offset cost rose to $9.95 million from $0.98 million in April.
- The volume of exceptional dispatch increased to 71,364 MWh from 47,340 MWh in April. The main contributor to this volume was planned transmission outage and unit testing. The monthly average of total exceptional dispatch volume as a percentage of load percentage was 0.39 percent in May, increasing from 0.28 in April.

[1] This report contains the highlights of the reporting period. For a more detailed explanation of the technical characteristics of the metrics included in this report please download the Market Performance Metric Catalog, which is available on the CAISO web site at **http://www.caiso.com/market/Pages/ReportsBulletins/Default.aspx**.

Energy Imbalance market (EIM) performance,

- In April, Idaho Power and Powerex joined the energy imbalance market. They both had a smooth transition into the market.
- In the FMM and RTD, the prices EIM areas were relatively quiet.
- The monthly average prices in FMM for EIM entities (AZPS, BCHA, IPCO, NEVP, PACE, PACW, PGE and PSEI) were $18.75, $14.94, $16.82, $18.56, $17.68, $14.31, $13.79 and $12.37 respectively.
- The monthly average prices in RTD for EIM entities (AZPS, BCHA, IPCO, NEVP, PACE, PACW, PGE and PSEI) was $21.28, $12.04, $17.95, $20.11, $18.90, $14.70, $12.68 and $11.64 respectively.
- Bid cost recovery, real-time imbalance energy offset, and real-rime congestion offset costs for EIM entities (AZPS, BCHA, IPCO, NEVP, PACE, PACW, PGE and PSEI) were $0.96 million, -$2.28 million and -$2.63 million respectively.

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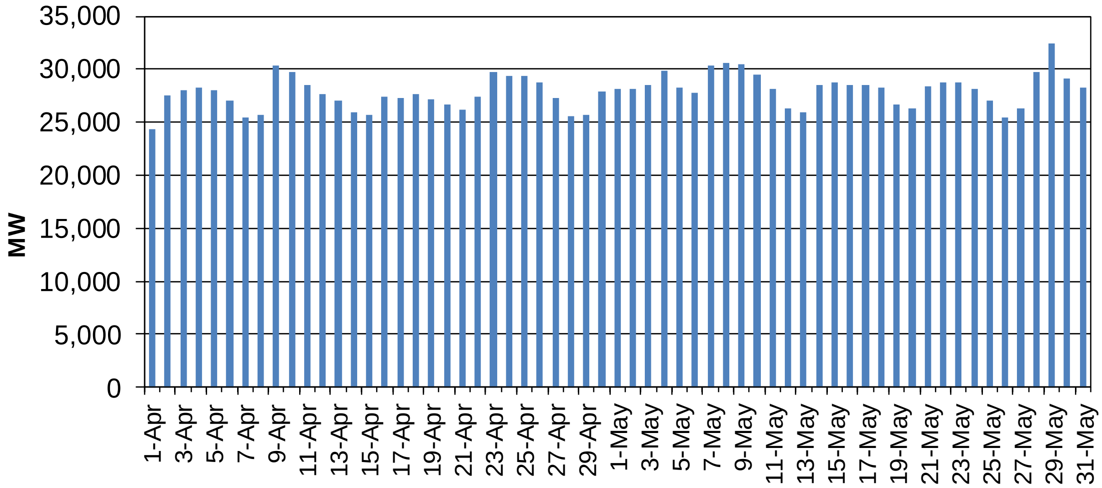
Market Characteristics

Loads

Peak loads for ISO exceeded 30,000 MW for four days in May due to warm weather.

Figure 1: System Peak Load



Resource Adequacy Available Incentive Mechanism

Resource Adequacy Availability Incentive Mechanism (RAAIM) was activated on November 1, 2016 to track the performance of Resource Adequacy (RA) Resources. RAAIM is used to determine the availability of resources providing local and/or system Resource Adequacy Capacity and Flexible RA Capacity each month and then assess the resultant Availability Incentive Payments and Non-Availability Charges through the CAISO's settlements process. Table 1 below shows the monthly average actual availability, total non-availability charge, and total availability incentive payment.[2] Starting from May 2018, the ISO reports the system RA average actual availability and flexible RA average actual availability separately.

Table 1: Resource Adequacy Availability and Payment

	Total Non-availability Charge	Total Availability Incentive Payment	Average Actual Availability	Flexible Average Actual Availability	System Average Actual Availability
Jan-17	$49,188,214	-$5,670	26.30%		
Feb-17	$3,157,590	-$1,867,721	92.31%		
Mar-17	$2,975,585	-$1,550,365	91.92%		
Apr-17	$3,641,392	-$1,483,548	89.46%		
May-17	$1,017,191	-$1,017,191	96.44%		
Jun-17	$4,058,330	-$1,502,850	94.24%		
Jul-17	$3,277,858	-$1,940,268	95.20%		
Aug-17	$3,691,798	-$1,544,674	95.27%		
Sep-17	$934,468	-$934,468	96.82%		
Oct-17	$690,037	-$690,037	97.42%		
Nov-17	$1,483,755	-$1,483,755	96.15%		
Dec-17	$1,517,252	-$1,517,252	96.87%		
Jan-18	$1,169,857	-$893,352	97.59%		
Feb-18	$2,480,894	-$1,759,093	95.46%		
Mar-18	$3,552,921	-$1,541,456	93.06%		
Apr-18	$4,069,059	-$1,546,330	92.40%		
May-18	$6,585,339	-$2,203,632		92.43%	90.15%

[2] On June 21, 2017, the ISO indicated in the market notice that it intended to file a petition with the FERC for a limited tariff waiver on section 40.9.6 to forego assessing any Resource Adequacy Availability Incentive Mechanism (RAAIM) charges for the period April 1, 2017 through December 31, 2017 due to identified implementation issues. This waiver includes April, 2017 and May 2017. The ISO is currently estimating the penalties reflected in the charge code 8830 to be zero pursuant to tariff section 11.29.10.5.

Direct Market Performance Metrics

Energy

Day-Ahead Prices

Figure 2 shows daily prices of four default load aggregate points (DLAPs). Table 2 below lists the binding constraints along with the associated DLAP locations and the occurrence dates when the binding constraints resulted in relatively high or low DLAP prices.

Figure 2: Day-Ahead Simple Average LAP Prices (All Hours)

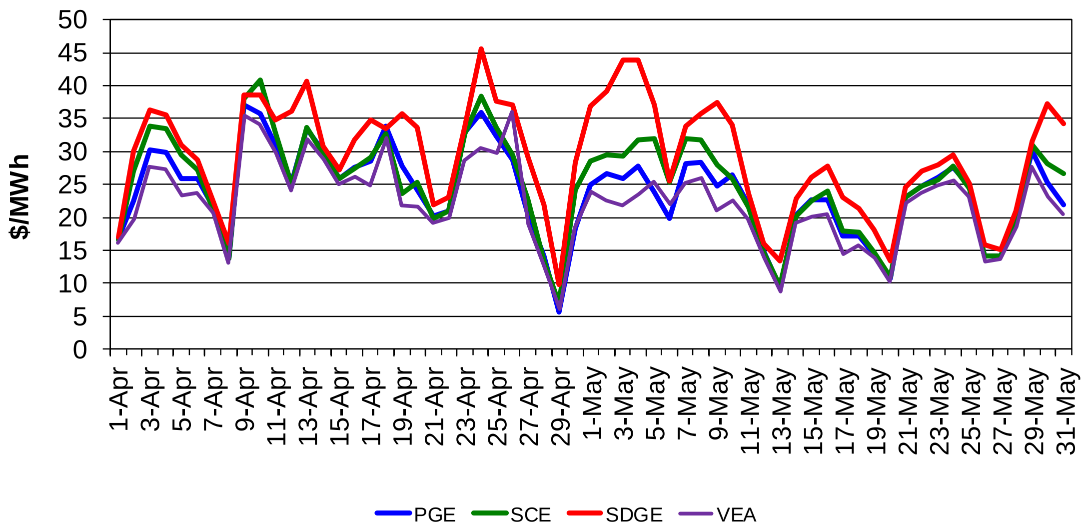


Table 2: Day-Ahead Transmission Constraints

DLAP	Date	Transmission Constraint
SDG&E	May 1, 5, 8-10, 30-31	DOUBLTTP-FRIARS -138kV line
SDG&E	May 2-4	OMS 5717006_50001_OOS_NG,

Real-Time Prices

FMM daily prices of the four DLAPs are shown in Figure 3. Table 3 lists the binding constraints along with the associated DLAP locations and the occurrence dates when the binding constraints resulted in relatively high or low DLAP prices.

Figure 3: FMM Simple Average LAP Prices (All Hours)

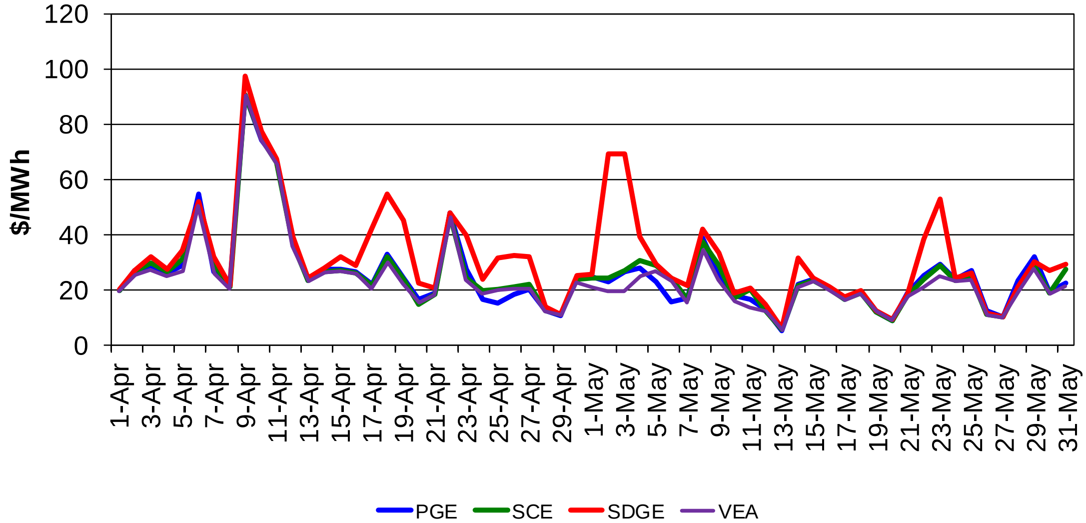
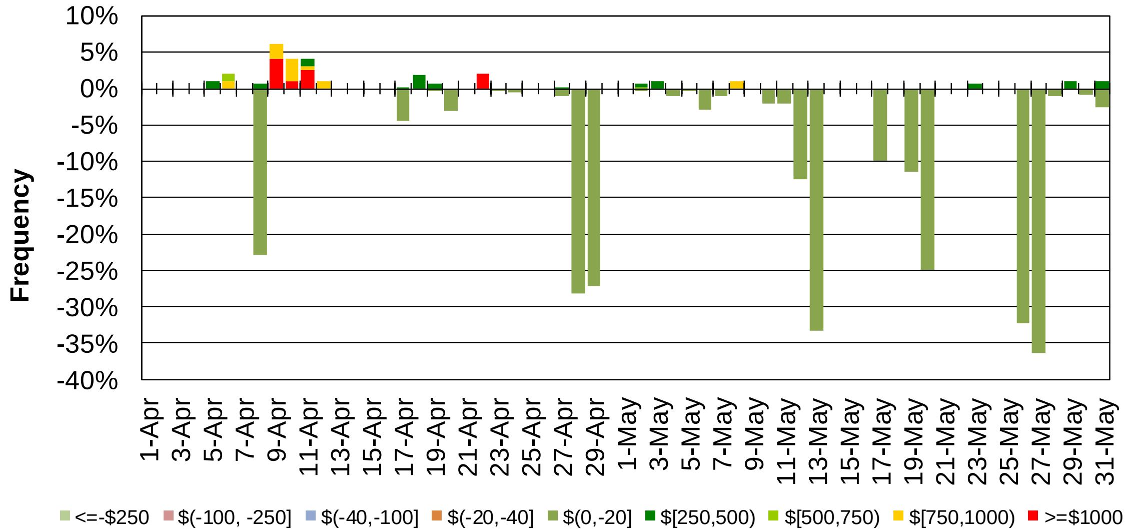


Table 3: FMM Transmission Constraints

DLAP	Date	Transmission Constraint
SDG&E	May 2-3	OMS 5717006_50001_OOS_NG, SUNCREST-SUNC TP1-230kV line
SDG&E	May 4	SUNCREST-SUNC TP1-230kV line
SDG&E	May 23	OMS 5820664 MG_BK80_NG

Figure 4 below shows the daily frequency of positive price spikes and negative prices by price range for the default LAPs in the FMM. The cumulative frequency of prices above $250/MWh decreased to 0.19 percent in May from 0.82 percent in April. The cumulative frequency of negative prices increased to 5.59 percent in May from 2.93 percent in April.

Figure 4: Daily Frequency of FMM LAP Positive Price Spikes and Negative Prices



RTD daily prices of the four DLAPs are shown in Figure 5. Table 4 lists the binding constraints along with the associated DLAP locations and the occurrence dates when the binding constraints resulted in relatively high or low DLAP prices.

Figure 5: RTD Simple Average LAP Prices (All Hours)

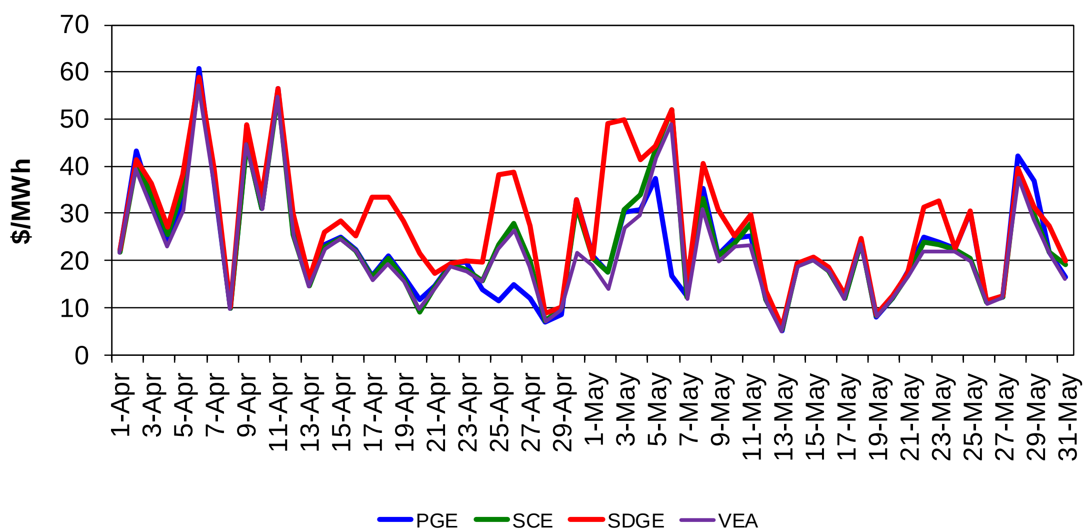
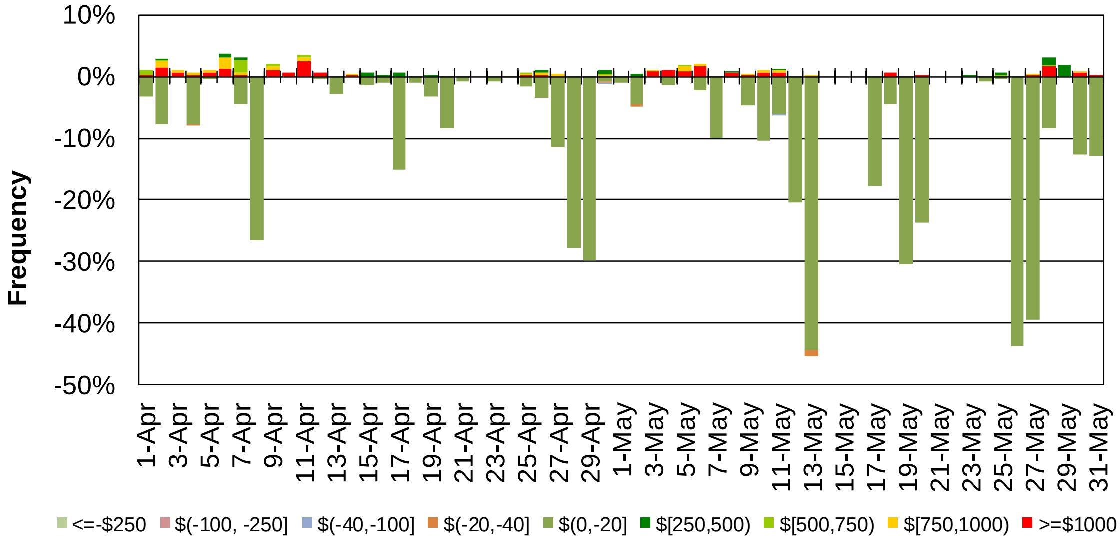


Table 4: RTD Transmission Constraints

DLAP	Date	Transmission Constraint
SDG&E	May 2-3	OMS 5717006_50001_OOS_NG, SUNCREST-SUNC TP1-230kV line
SDG&E	May 4	SUNCREST-SUNC TP1-230kV line
SDG&E	May 22-23	OMS 5820664 MG_BK80_NG

Figure 6 below shows the daily frequency of positive price spikes and negative prices by price range for the default LAPs in RTD. The cumulative frequency of prices above $250/MWh decreased to 0.61 percent in May from 0.88 percent in April. The cumulative frequency of negative prices rose to 9.61 percent in May from 5.32 percent in April.

Figure 6: Daily Frequency of RTD LAP Positive Price Spikes and Negative Price



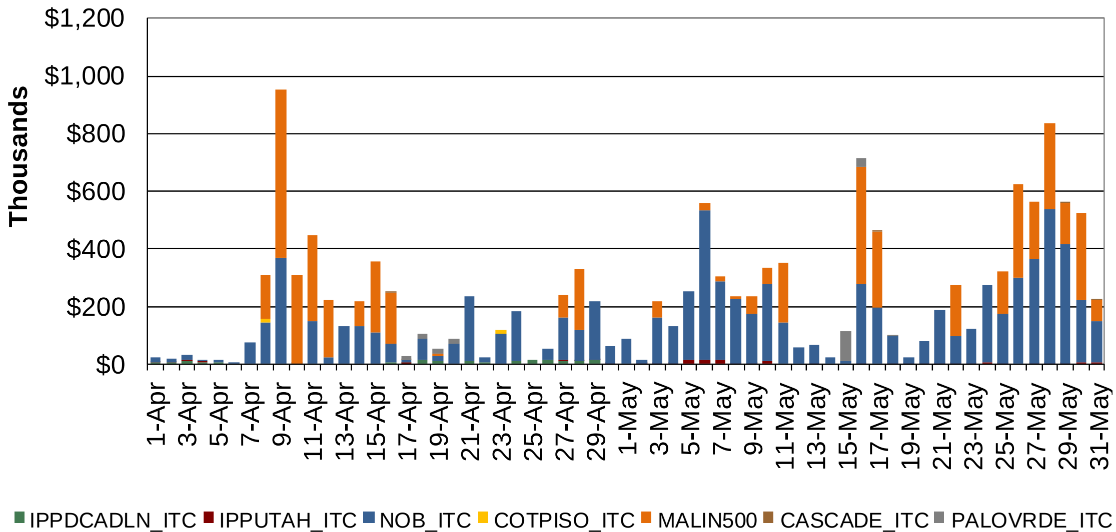
Congestion

Congestion Rents on Interties

Figure 7 below illustrates the daily integrated forward market congestion rents by interties. The cumulative total congestion rent for interties in May rose to $8.88 million from $5.13 million in April. Majority of the congestion rents in May accrued on MALIN (31 percent) intertie and NOB (66 percent) intertie.

The congestion rent on NOB increased to $5.87 million in May from $2.50 million in April. The congestion rent on MALIN inched up to $2.77 million in May from $2.36 million in April.

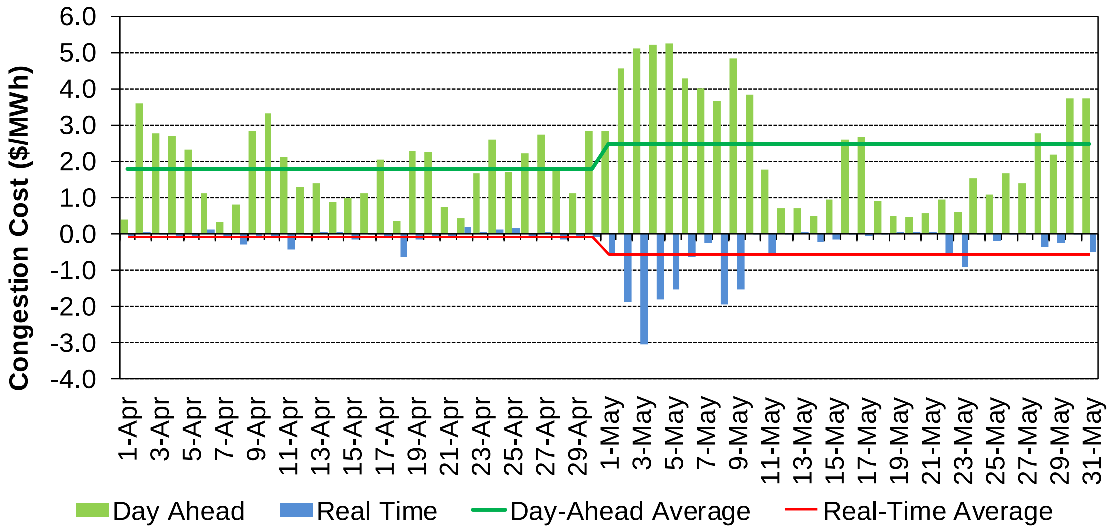
Figure 7: IFM Congestion Rents by Interties (Import)



Average Congestion Cost per Load Served

This metric quantifies the average congestion cost for serving one megawatt of load in the ISO system. Figure 8 shows the daily and monthly averages for the day-ahead and real-time markets respectively.

Figure 8: Average Congestion Cost per Megawatt of Served Load

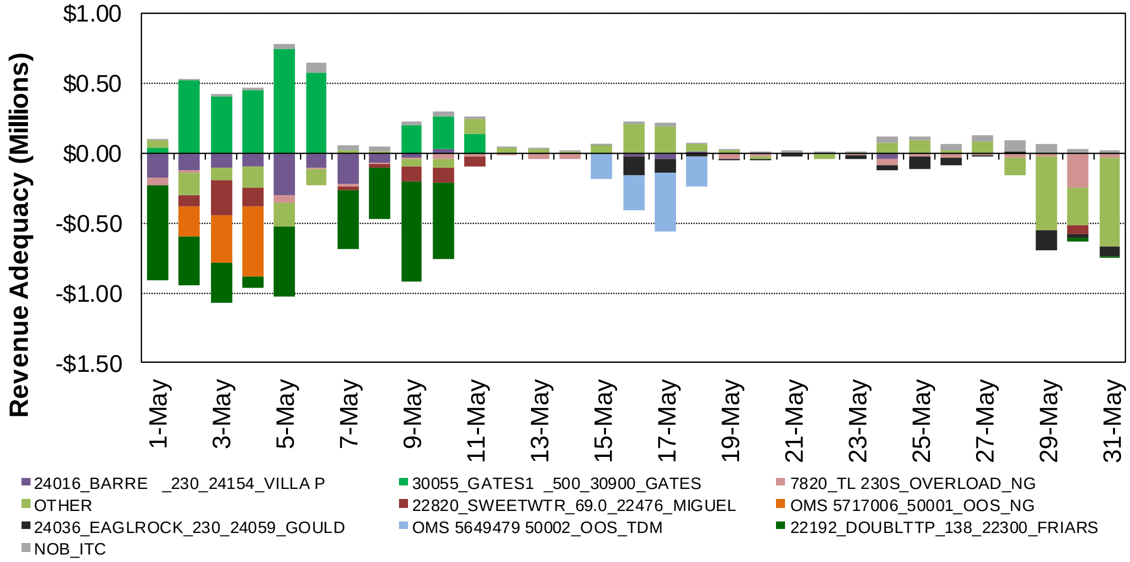


The average congestion cost per MWh of load served in the integrated forward market increased to $2.48/MWh in May from $1.80/MWh in April. The average congestion cost per load served in the real-time market fell to -$0.57/MWh in May from -$0.08/MWh in May.

Congestion Revenue Rights

Figure 9 illustrates the daily revenue adequacy for congestion revenue rights (CRRs) broken out by transmission element. The average CRR revenue deficit in May dropped to $224,877from the average revenue deficit of $520,470 in April.

Figure 9: Daily Revenue Adequacy of Congestion Revenue Rights

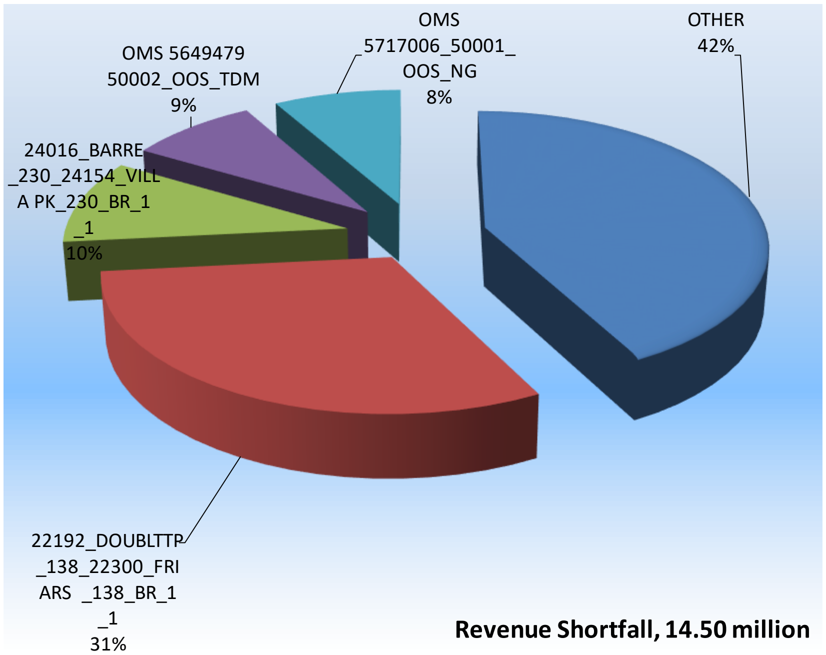


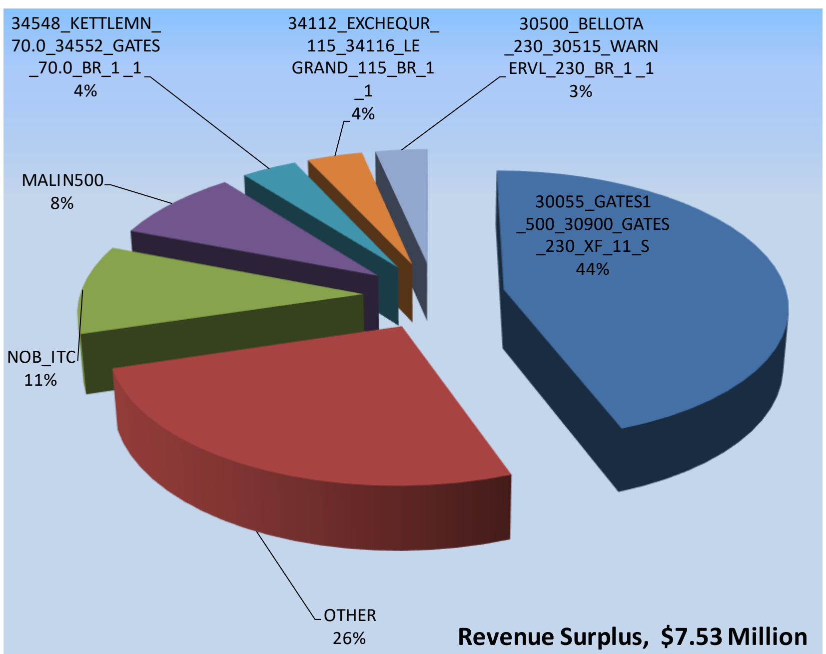
Overall, May experienced a CRR revenue deficit. Revenue shortfalls were observed in most days of May. The main reasons are

- The line 22192_DOUBLTTP_138_22300_FRIARS was binding in 12 days of this month, resulting in revenue shortfall of $3.98 million.
- The transformer 24016_BARRE _230_24154_VILLA P was binding in 16 days of this month, resulting in revenue shortfall of $1.29 million.

The shares of the revenue surplus and deficit accruing on various congested transmission elements for the reporting period are shown in Figure 10 and the monthly summary for CRR revenue adequacy is provided in Table 5.

Figure 10: CRR Revenue Adequacy by Transmission Element





Overall, the total amount collected from the IFM was not sufficient to cover the net payments to congestion revenue right holders and the cost of the exemption for existing rights. The revenue adequacy level was 86.15 percent in May. Out of the total congestion rents, 0.78 percent was used to cover the cost of existing right exemptions. Net total congestion revenues in May were in deficit by $6.97 million, compared to the deficit of $15.61 million in April. The auction revenues credited to the balancing account for May were $8.18 million. As a result, the balancing account for May had a deficit of approximately $1.27 million, which will be allocated to measured demand.

Table 5: CRR Revenue Adequacy Statistics

IFM Congestion Rents	$43,697,650.84
Existing Right Exemptions	-$340,486.03
Available Congestion Revenues	$43,357,164.81
CRR Payments	$50,328,352.30
CRR Revenue Adequacy	-$6,971,187.49
Revenue Adequacy Ratio	86.15%
Annual Auction Revenues	$3,152,070.59
Monthly Auction Revenues	$5,029,782.18
CRR Settlement Rule	$63,949.28
Allocation to Measured Demand	$1,274,614.55

Ancillary Services

IFM (Day-Ahead) Average Price

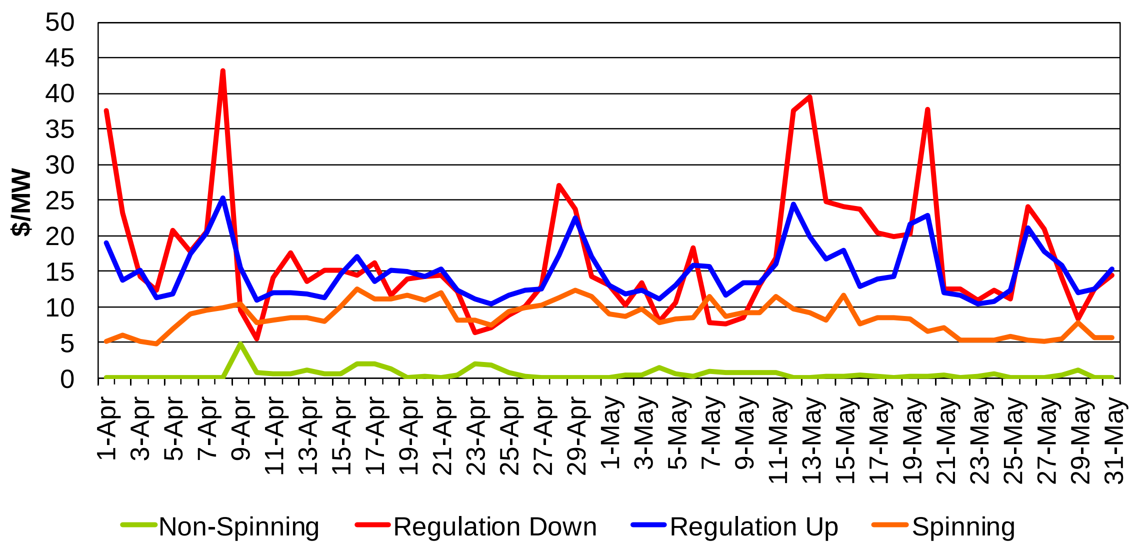
Table 6 shows the monthly IFM average ancillary service procurements and the monthly average prices. In May the monthly average procurement increased for regulation down, spinning and non-spinning reserves and decreased for regulation up.

Table 6: IFM (Day-Ahead) Monthly Average Ancillary Service Procurement

	Average Procured				Average Price			
	Reg Up	Reg Dn	Spinning	Non-Spinning	Reg Up	Reg Dn	Spinning	Non-Spinning
May-18	326	444	1054	1055	$14.97	$17.08	$7.90	$0.41
Apr-18	329	441	933	936	$14.68	$16.26	$9.18	$0.71
Percent Change	-1.02%	0.61%	12.97%	12.64%	1.97%	5.09%	-13.93%	-42.63%

The monthly average prices increased for regulation up and regulation down in May. Figure 11 shows the daily IFM average ancillary service prices. The average prices for regulation up and regulation down were elevated on May 12-13 and 20 due to high opportunity cost of energy.

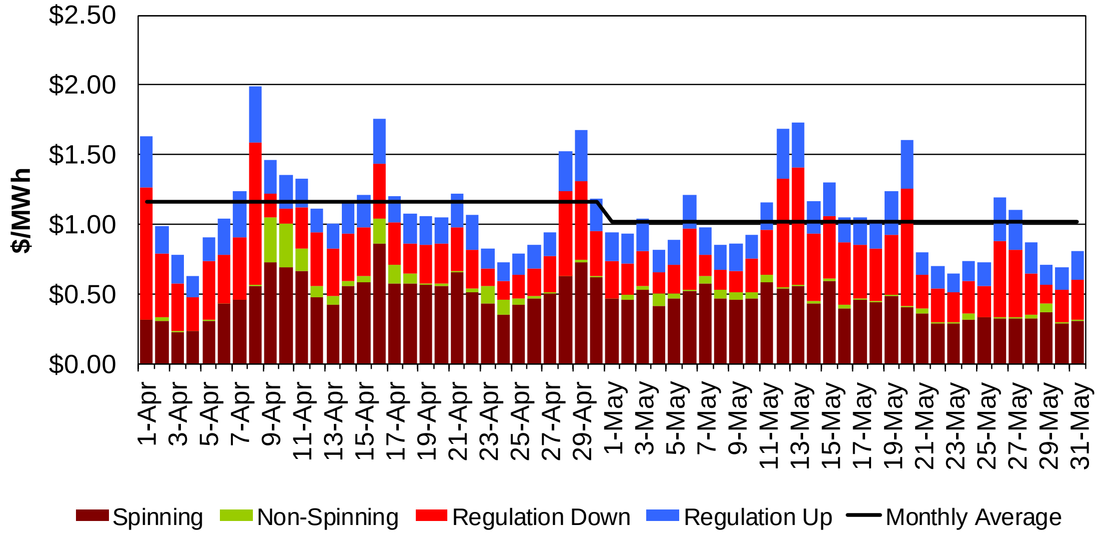
Figure 11: IFM (Day-Ahead) Ancillary Service Average Price



Ancillary Service Cost to Load

The monthly average cost to load inched down to $1.01/MWh in May from $1.16/MWh in April.

Figure 12: System (Day-Ahead and Real-Time) Average Cost to Load



Scarcity Events

The ancillary services scarcity pricing mechanism is triggered when the ISO is not able to procure the target quantity of one or more ancillary services in the IFM and real-time market runs. The scarcity events in May are shown in the table below.

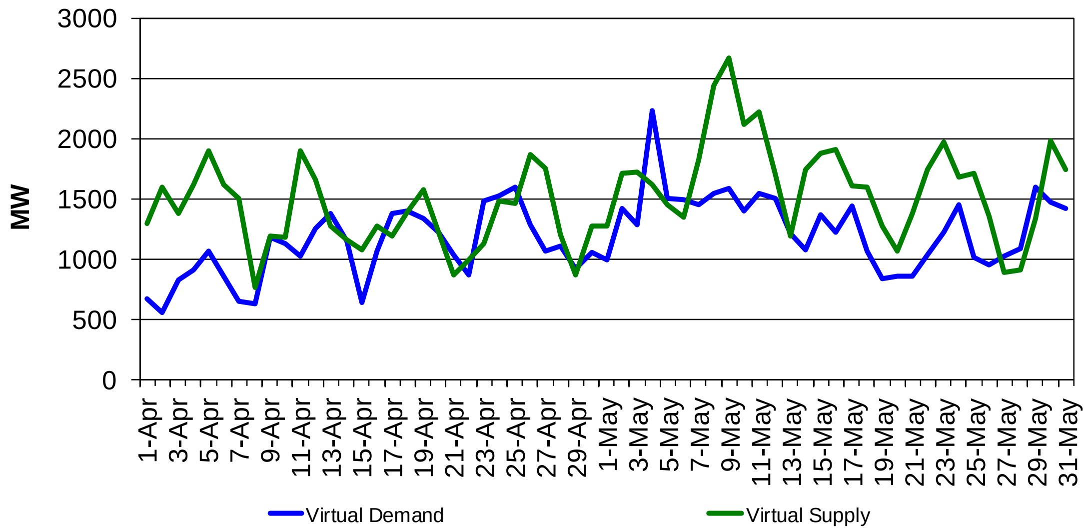
Date	Hour Ending	Interval	Ancillary Service	Region	Shortfall (MW)	Percentage of Requirement
May 3	3	1	Regulation Up	NP26_EXP	0.3	0.3%
May 6	4	1	Regulation Down	NP26_EXP	25.8	24.6%
May 6	9	4	Regulation Up	SP26_EXP	1.6	1.5%
May 6	10	2	Regulation Up	SP26_EXP	1.6	1.5%
May 6	11	2	Regulation Up	SP26_EXP	0.6	0.6%
May 6	11	3	Regulation Up	SP26_EXP	2.8	2.6%
May 6	11	4	Regulation Up	SP26_EXP	0.5	0.5%
May 6	12	2	Regulation Up	SP26_EXP	0.5	0.5%
May 6	12	4	Regulation Up	SP26_EXP	0.5	0.5%
May 15	15	1	Regulation Up	SP26_EXP	12.45	13.5%
May 15	15	2	Regulation Up	SP26_EXP	12.51	13.5%
May 15	15	3	Regulation Up	SP26_EXP	12.51	13.5%
May 15	15	4	Regulation Up	SP26_EXP	12.51	13.5%
May 23	12	2-4	Regulation Up	SP26_EXP	0.02	0.02%
May 23	13	2	Regulation Up	SP26_EXP	0.02	0.02%
May 23	13	3-4	Regulation Up	SP26_EXP	0.06	0.06%

May 26	3	2-4	Regulation Up	SP26_EXP	0.04	0.04%
May 26	5, 6	2-4	Regulation Up	SP26_EXP	0.03	0.03%
May 26	7	2-3	Regulation Up	SP26_EXP	0.03	0.03%
May 27	3, 4	2-4	Regulation Up	SP26_EXP	0.02	0.02%
May 27	5	2	Regulation Up	SP26_EXP	0.06	0.06%
May 27	5	3-4	Regulation Up	SP26_EXP	0.02	0.02%
May 27	7	2-3	Regulation Up	SP26_EXP	0.02	0.02%
May 27	7	4	Regulation Up	SP26_EXP	0.07	0.07%
May 28	7	2-4	Regulation Up	SP26_EXP	0.02	0.02%

Convergence Bidding

Figure 13 below shows the daily average volume of cleared virtual bids in IFM for virtual supply and virtual demand. The cleared virtual supply was well above the cleared demand moved in most days of May.

Figure 13: Cleared Virtual Bids



Convergence bidding tends to cause the day-ahead market and real-time market prices to move closer together, or "converge". Figure 14 shows the energy prices (namely the energy component of the LMP) in IFM, hour ahead scheduling process (HASP), FMM, and RTD.

Figure 14: IFM, HASP, FMM, and RTD Prices

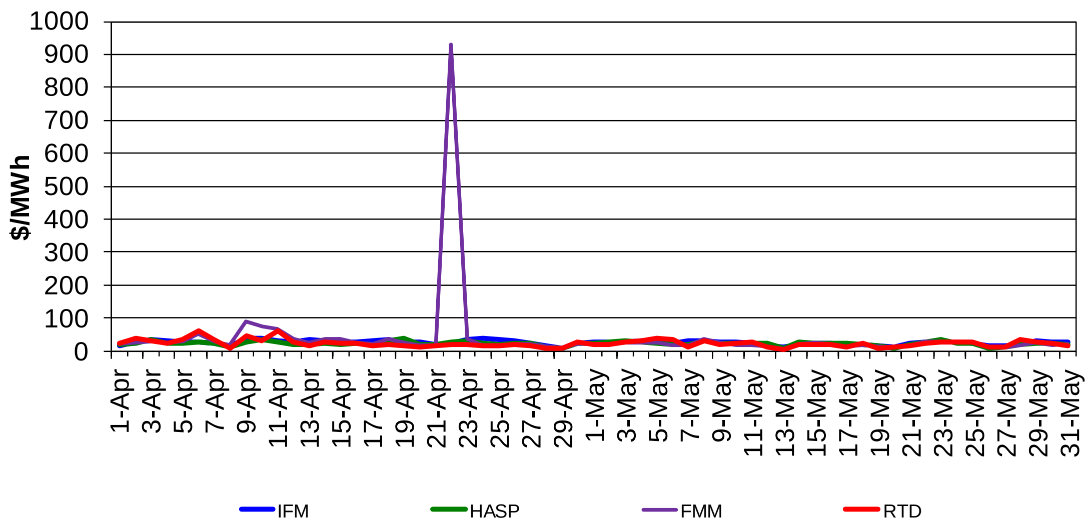
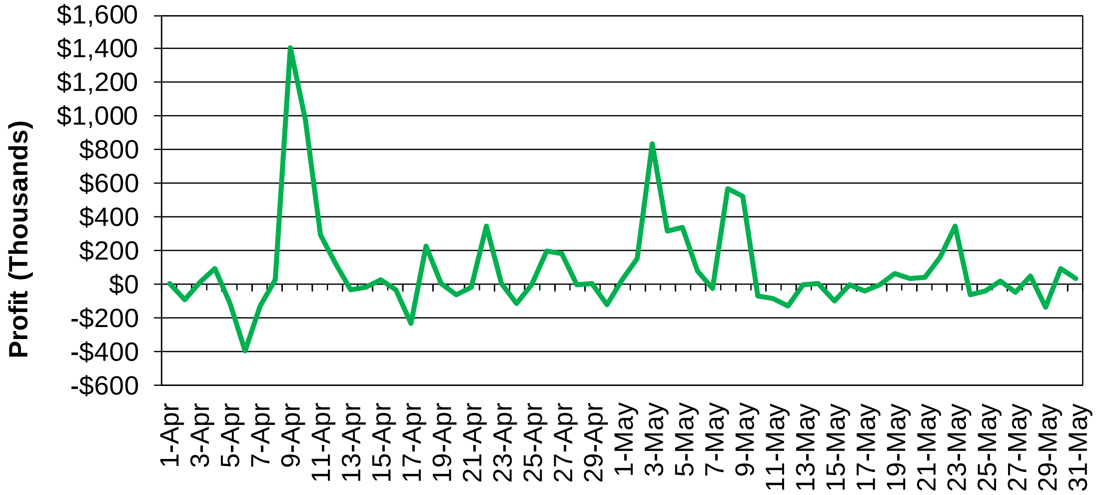


Figure 15 shows the profits that convergence bidders receive from convergence bidding. The total profits from convergence bidding edged up to $2.89 million in May from $2.50 million in April.

Figure 15: Convergence Bidding Profits



Renewable Generation Curtailment

Figure 16 below shows the monthly wind and solar VERs (variable energy resource) curtailment due to system wide condition or local congestion in RTD. Figure 17 shows the monthly wind and solar VERs (variable energy resource) curtailment by resource type in RTD. Economic curtailment is defined as the resource's dispatch upper limit minus its RTD schedule when the resource has an economic bid. Dispatch upper limit is the maximum level the resource can be dispatched to when various factors are take into account such as forecast, maximum economic bid, generation outage, and ramping capacity. Self-schedule curtailment is defined as the resource's self-schedule minus its RTD schedule when RTD schedule is lower than self-schedule. When a VER resource is exceptionally dispatched, then exceptional dispatch curtailment is defined as the dispatch upper limit minus the exceptional dispatch value.

As Figure 16 and Figure 17 below indicate, the renewable curtailment declined in May. The majority of the curtailments was economic.

Figure 16: Renewable Curtailment by Reason

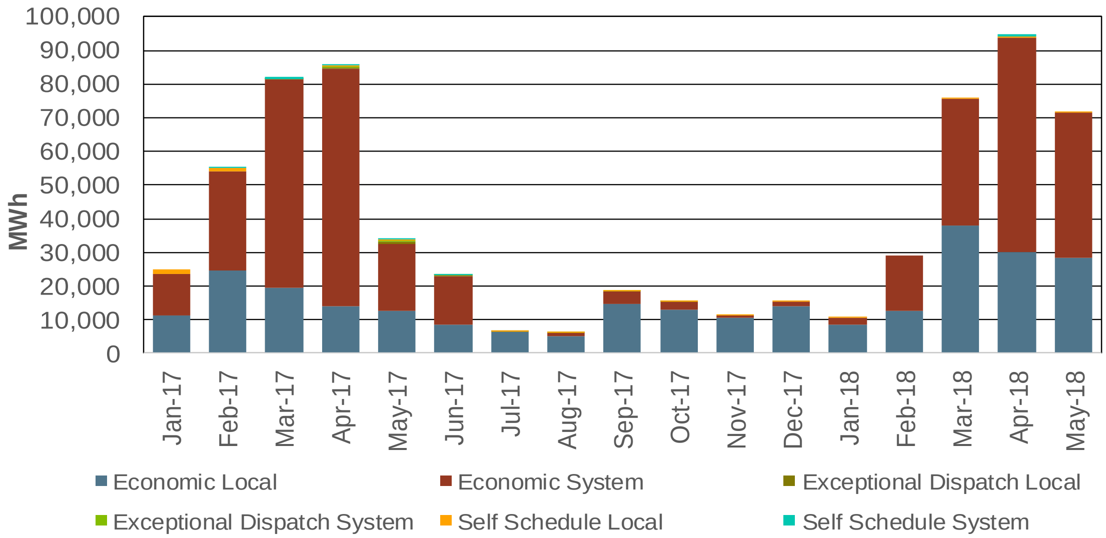
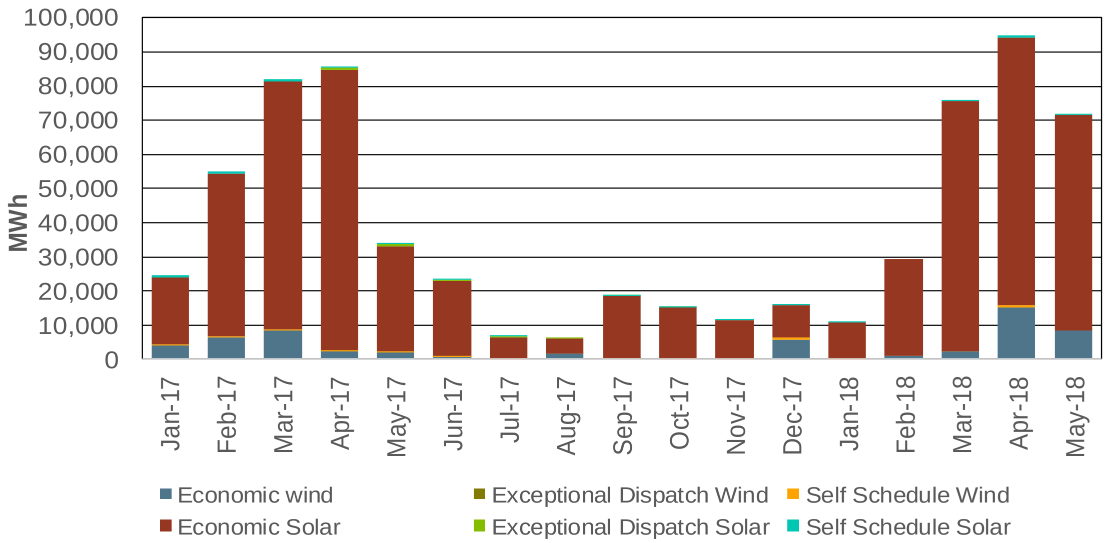


Figure 17: Renewable Curtailment by Resource Type



Flexible Ramping Product

On November 1, 2016 the ISO implemented two market products in the 15-minute and 5-minute markets: Flexible Ramping Up and Flexible Ramping Down uncertainty awards. These products provide additional upward and downward flexible ramping capability to account for uncertainty due to demand and renewable forecasting errors. In addition, the existing flexible ramping sufficiency test was extended to ensure feasible ramping capacity for real-time interchange schedules.

Flexible Ramping Product Payment

Figure 18 shows the flexible ramping up and down uncertainty payments. Flexible ramping up uncertainty payment fell to $0.12 million in May from $0.61 million in April. Flexible ramping down uncertainty payment increased to $0.14 million in May from $83,141 in April.

Figure 18: Flexible Ramping Up/down Uncertainty Payment

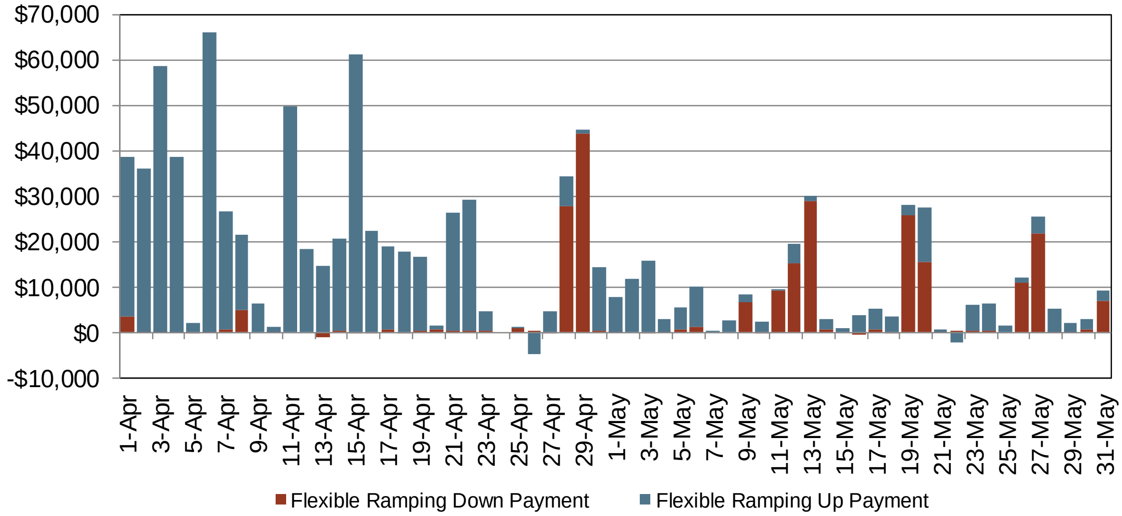
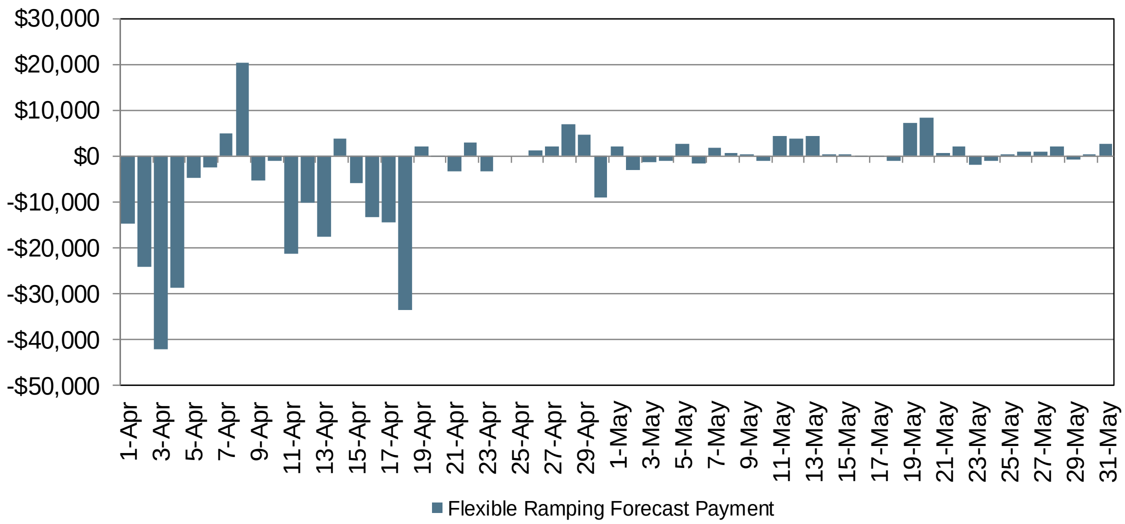


Figure 19 shows the flexible ramping forecast payment. Flexible ramping forecast payment increased to $30,911 this month from -$208,125 observed in April.

Figure 19: Flexible Ramping Forecast Payment



Indirect Market Performance Metrics

Bid Cost Recovery

Figure 20 shows the daily uplift costs due to exceptional dispatch payments. The monthly uplift costs in May decreased to $0.24 million from $0. 31 million in April.

Figure 20: Exceptional Dispatch Uplift Costs

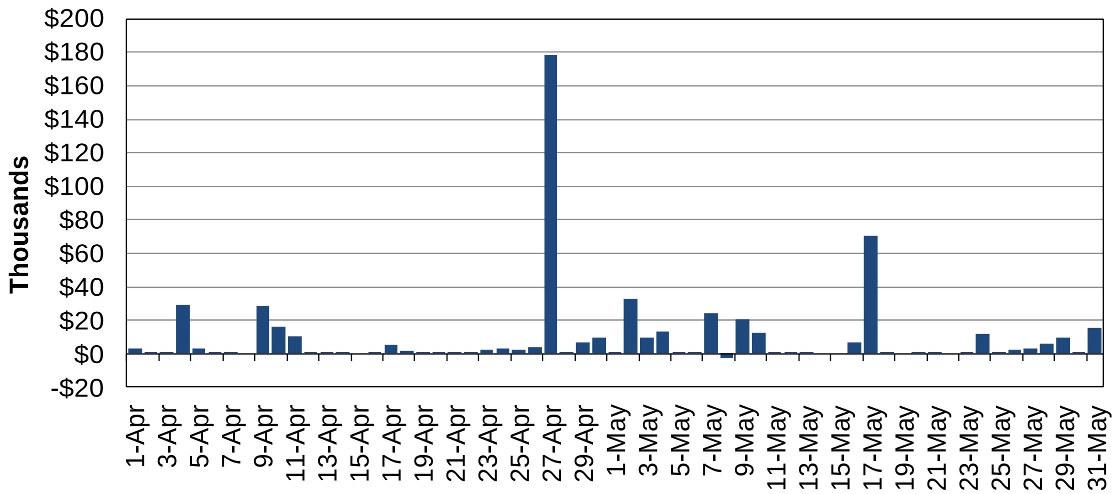


Figure 21 shows the allocation of bid cost recovery payment in the IFM, residual unit commitment (RUC) and RTM markets. The total bid cost recovery for May decreased to $5.13 million from $6.34 million in April. Out of the total monthly bid cost recovery payment for the three markets in May, the IFM market contributed 14 percent, RTM contributed 76 percent, and RUC contributed 10 percent of the total bid cost recovery payment.

Figure 21: Bid Cost Recovery Allocation

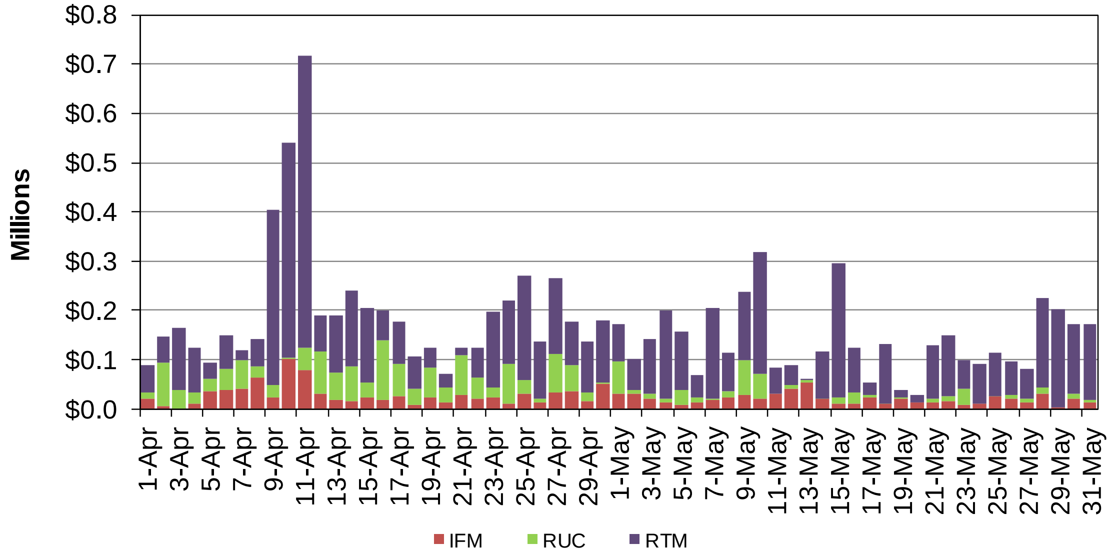


Figure 22 and Figure 23 show the daily and monthly BCR cost by local capacity requirement area (LCR) respectively.

Figure 22: Bid Cost Recovery Allocation by LCR

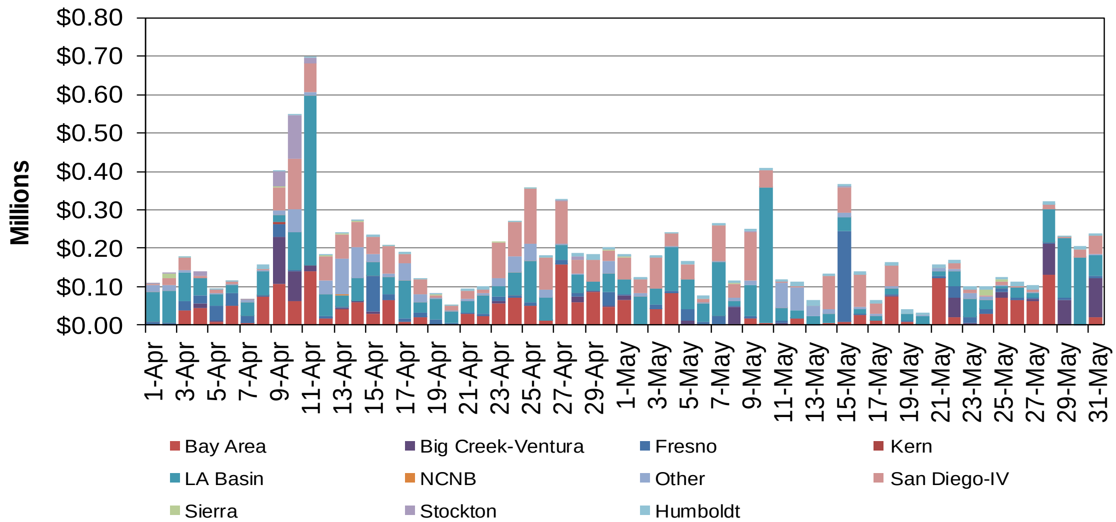


Figure 23: Monthly Bid Cost Recovery Allocation by LCR

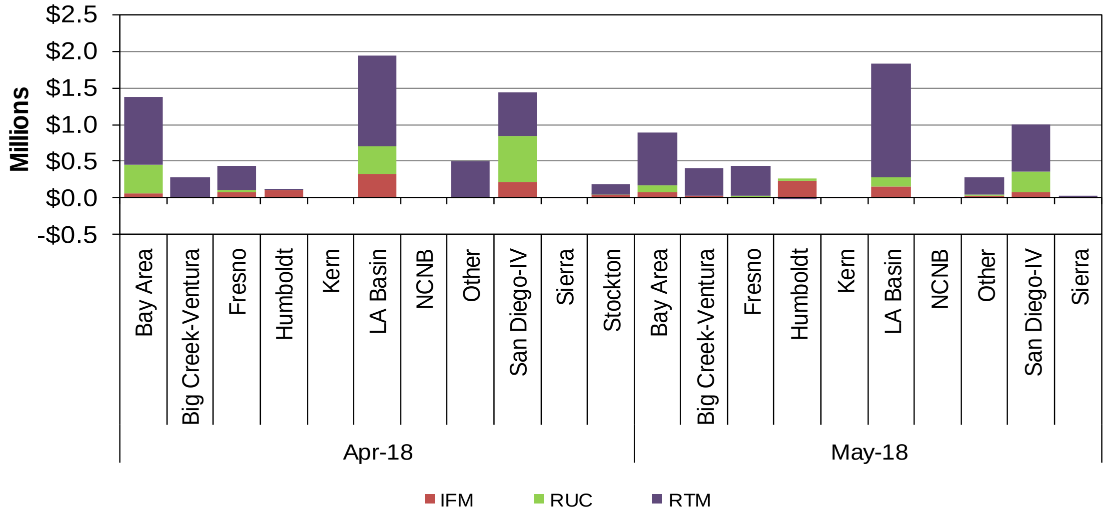


Figure 24 and Figure 25 show the daily and monthly BCR cost by utility distribution company (UDC) respectively.

Figure 24: Bid Cost Recovery Allocation by UDC

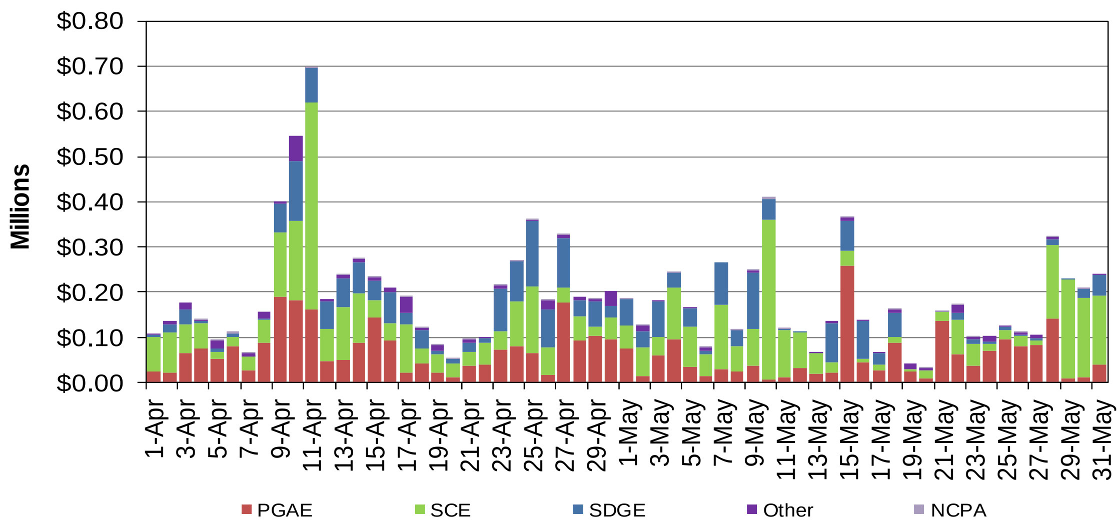


Figure 25: Monthly Bid Cost Recovery Allocation by UDC

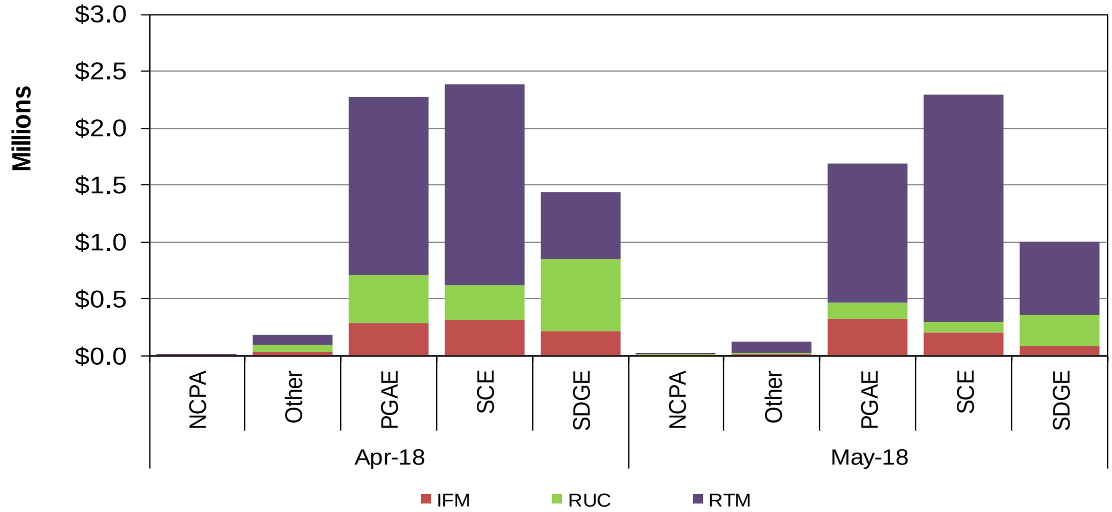


Figure 26 shows the cost related to BCR by cost type in RUC.

Figure 26: Cost in RUC

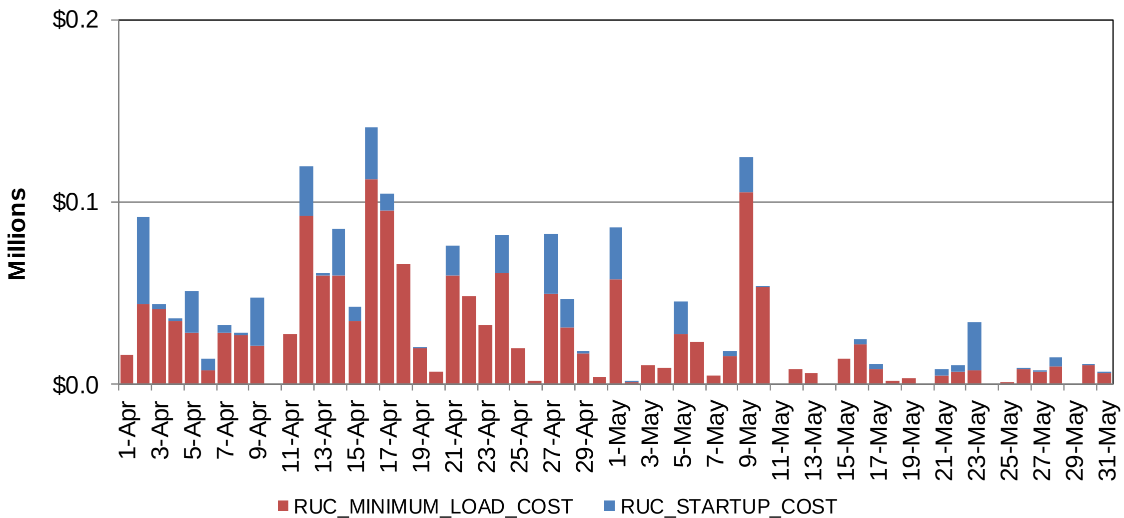


Figure 27 and Figure 28 show the daily and monthly cost related to BCR by type and LCR in RUC respectively.

Figure 27: Cost in RUC by LCR

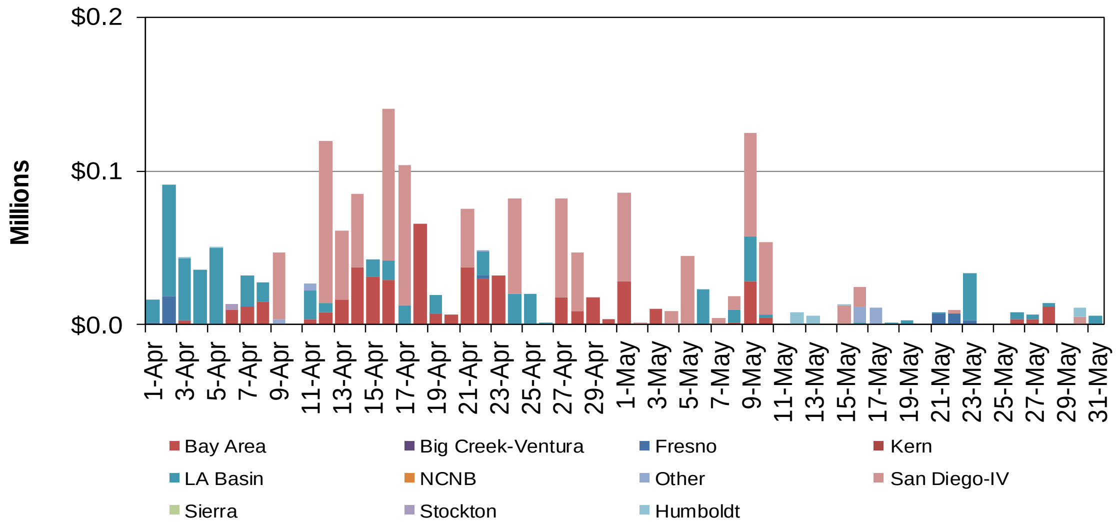


Figure 28: Monthly Cost in RUC by LCR

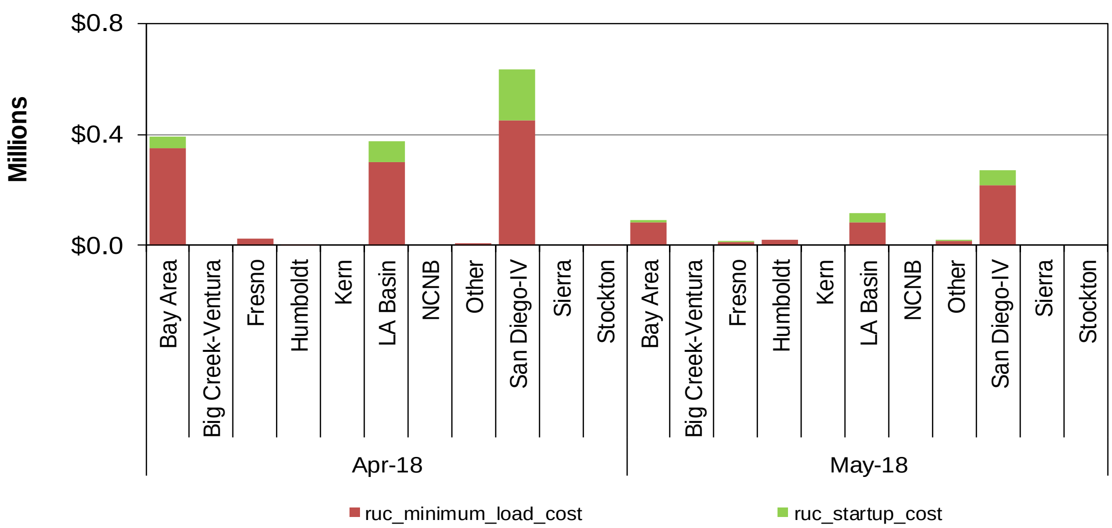


Figure 29 and Figure 30 show the daily and monthly cost related to BCR by type and UDC in RUC respectively.

Figure 29: Cost in RUC by UDC

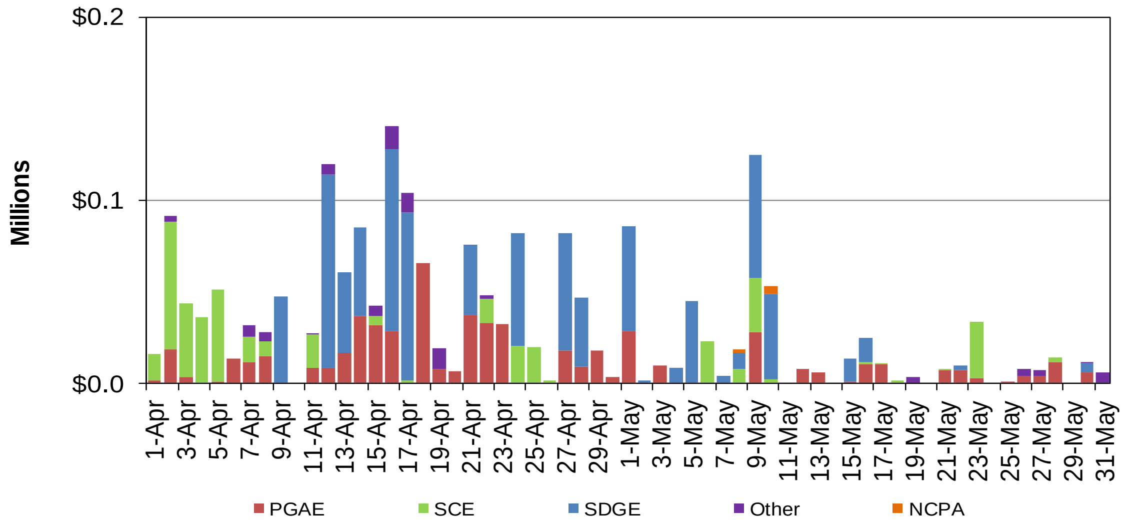


Figure 30: Monthly Cost in RUC by UDC

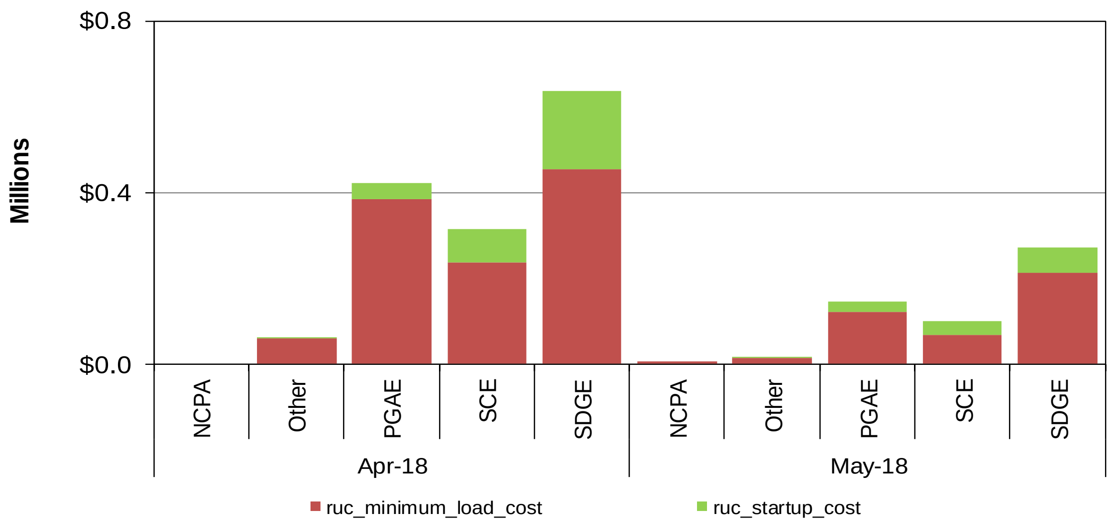


Figure 31 shows the cost related to BCR in real time by cost type. Minimum load cost contributed largely to the real time cost this month.

Figure 31: Cost in Real Time

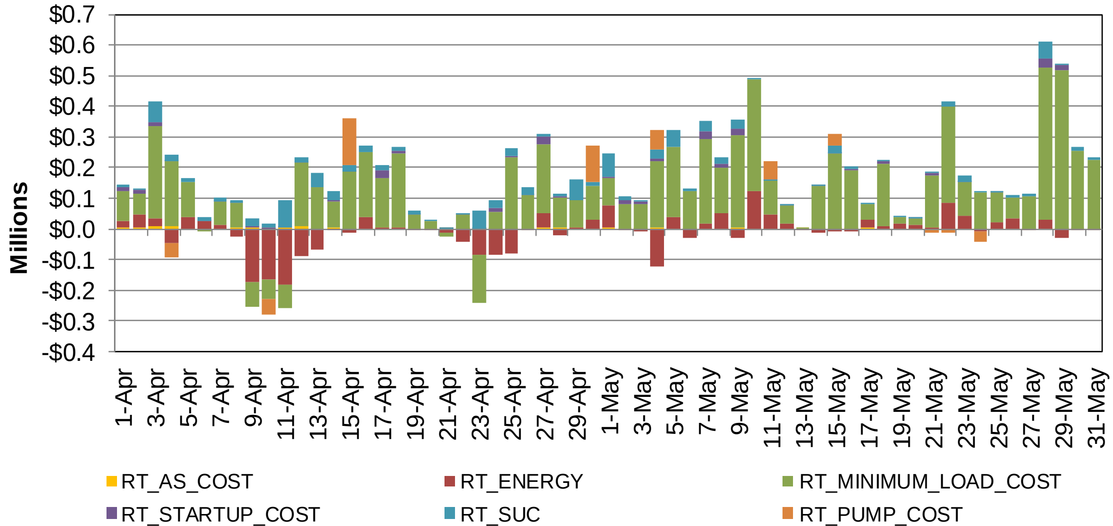


Figure 32 and Figure 33 show the daily and monthly cost related to BCR by type and LCR in real time respectively.

Figure 32: Cost in Real Time by LCR

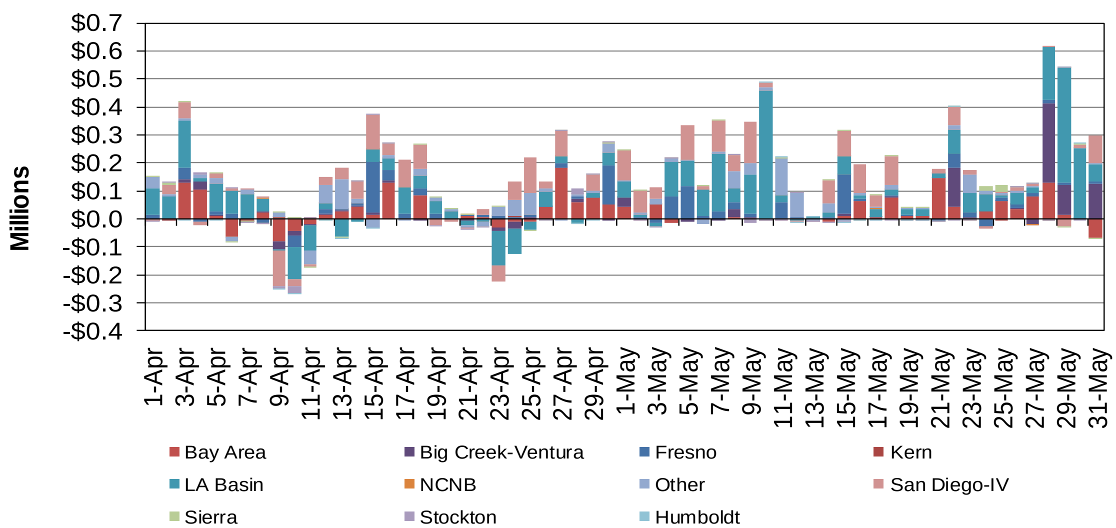


Figure 33: Monthly Cost in Real Time by LCR

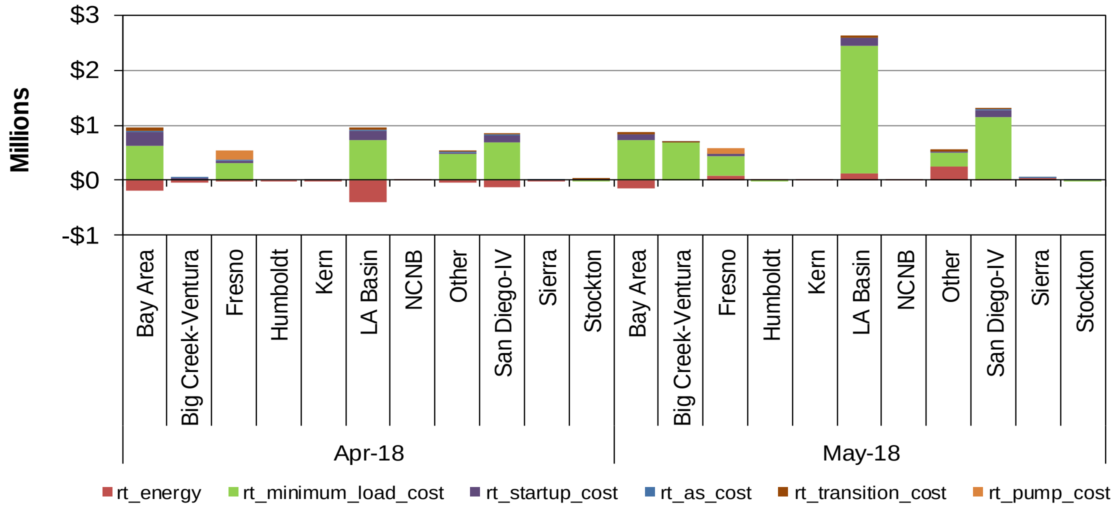


Figure 34 and Figure 35 show the daily and monthly cost related to BCR by type and UDC in Real Time respectively.

Figure 34: Cost in Real Time by UDC

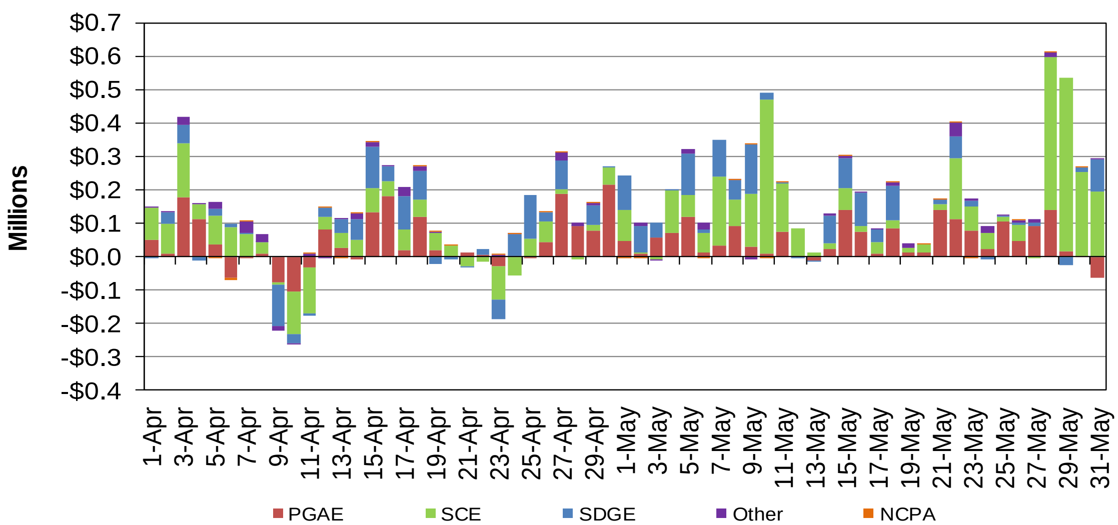


Figure 35: Monthly Cost in Real Time by UDC

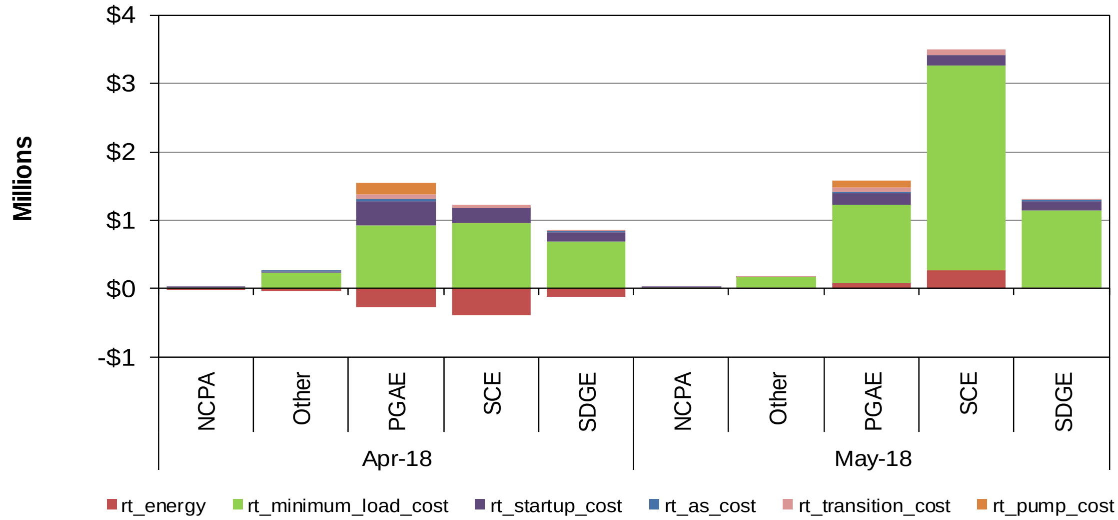


Figure 36 shows the cost related to BCR in IFM by cost type. Minimum Load cost and energy cost contributed largely to the cost in IFM this month.

Figure 36: Cost in IFM

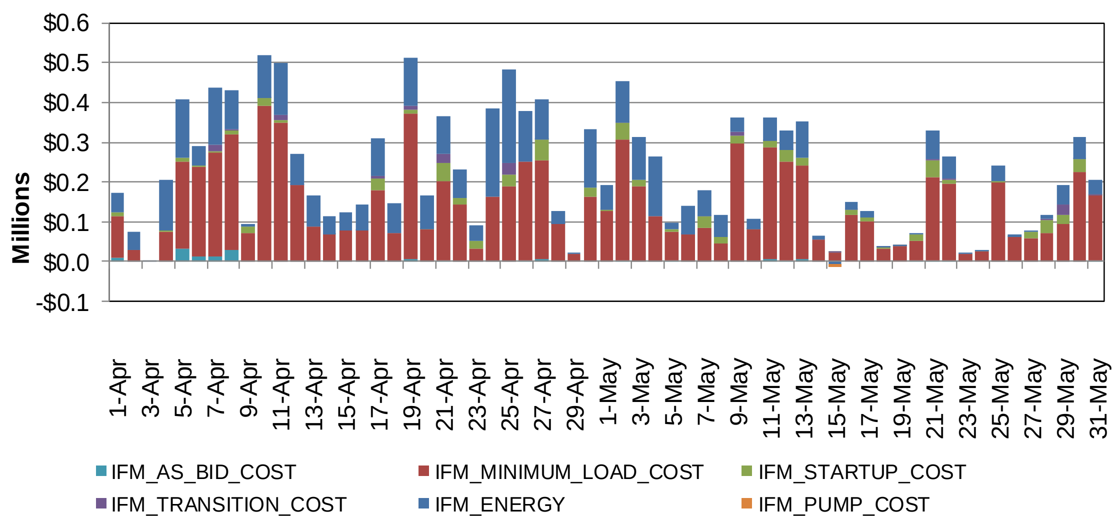


Figure 37 and Figure 38 show the daily and monthly cost related to BCR by type and location in IFM respectively.

Figure 37: Cost in IFM by LCR

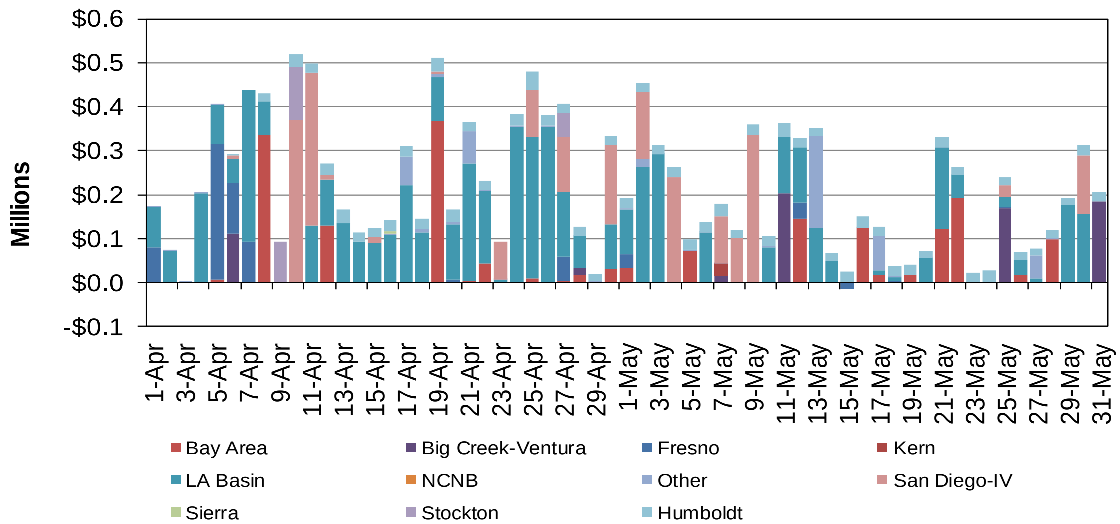


Figure 38: Monthly Cost in IFM by LCR

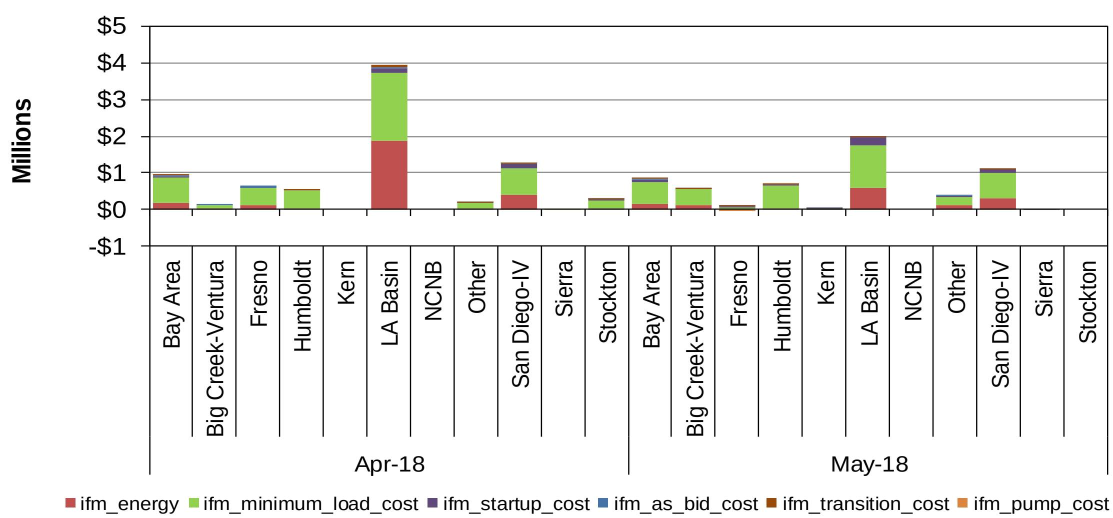


Figure 39 and Figure 40 show the daily and monthly cost related to BCR by type and UDC in IFM respectively.

Figure 39: Cost in IFM by UDC

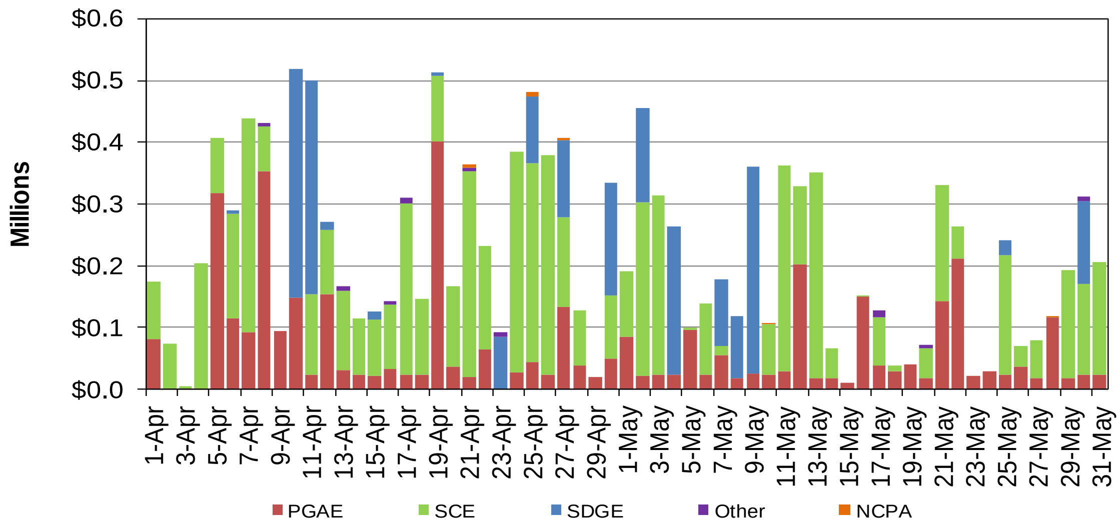
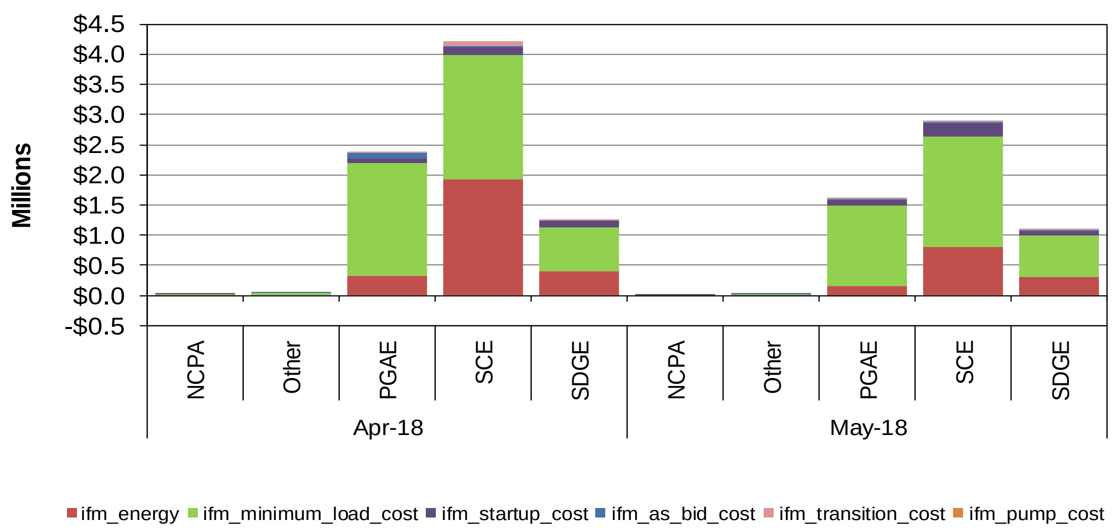


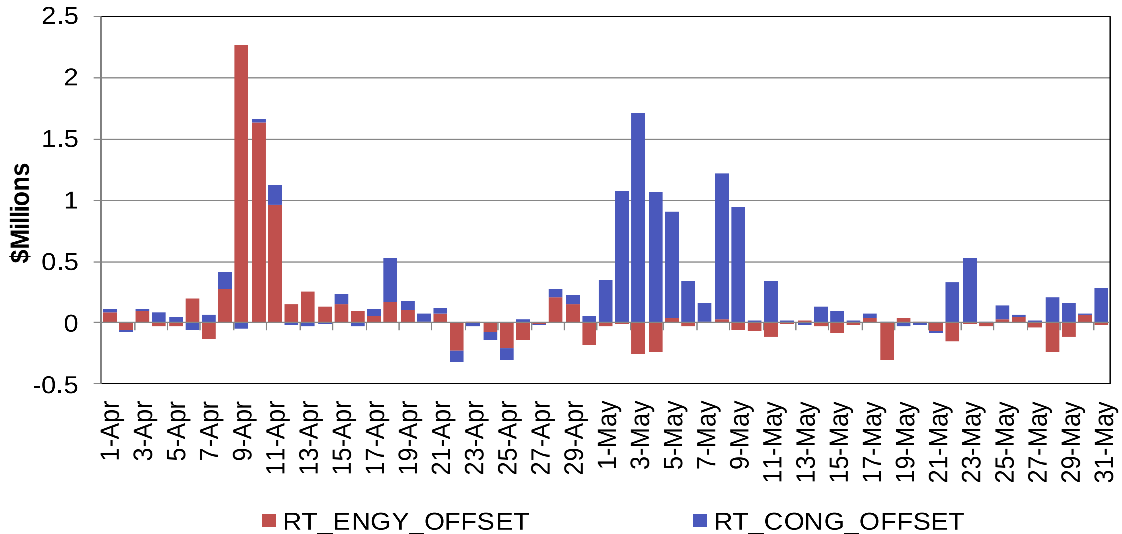
Figure 40: Monthly Cost in IFM by UDC



Real-time Imbalance Offset Costs

Figure 41 shows the daily real-time energy and congestion imbalance offset costs. Real-time energy offset cost dropped to -$1.60 million in May from $5.99 million in April. Real-time congestion offset cost rose to $9.95 million in May from $0.98 million in April.

Figure 41: Real-Time Energy and Congestion Imbalance Offset



Market Software Metrics

Market performance can be confounded by software issues, which vary in severity levels with the failure of a market run being the most severe.

Market Disruption

A market disruption is an action or event that causes a failure of an ISO market, related to system operation issues or system emergencies.[3] Pursuant to section 7.7.15 of the ISO tariff, the ISO can take one or more of a number of specified actions to prevent a market disruption, or to minimize the extent of a market disruption.

There were a total of 118 market disruptions this month. Table 7 lists the number of market disruptions and the number of times that the ISO removed bids (including self-schedules) in any of the following markets in this month. The ISO markets include IFM, RUC, FMM and RTD processes.

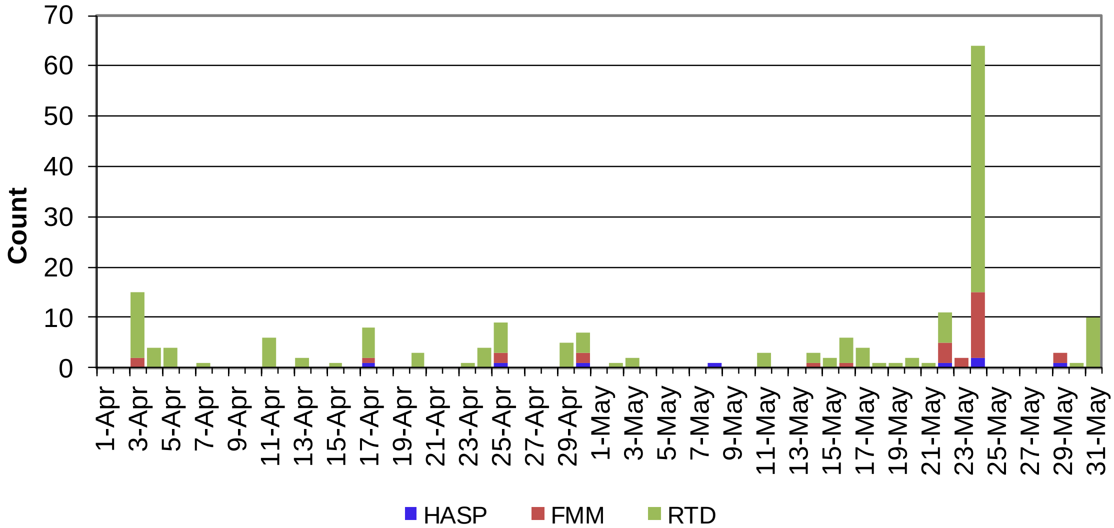
Table 7: Summary of Market Disruption

Type of CAISO Market	Market Disruption or Reportable	Removal of Bids (including Self-Schedules)
Day-Ahead		
IFM	0	0
RUC	0	0
Real-Time		
FMM Interval 1	7	0
FMM Interval 2	5	0
FMM Interval 3	8	0
FMM Interval 4	8	0
Real-Time Dispatch	90	0

Figure 42 shows the frequency of IFM, HASP (FMM interval 2), FMM (intervals 1, 3 and 4), and RTD failures. On May 24, 13 FMM, two HASP and 45 RTD disruptions occurred due to application problem. There were four other RTD disruptions due to broadcast not being successful.

[3] These system operation issues or system emergencies are referred to in Sections 7.6 and 7.7, respectively, of the ISO tariff.

Figure 42: Frequency of Market Disruption



Manual Market Adjustment

Exceptional Dispatch

Figure 43 shows the daily volume of exceptional dispatches, broken out by market type: real-time incremental dispatch and real-time decremental dispatch. The real-time exceptional dispatches are among one of the following types: a unit commitment at physical minimum; an incremental dispatch above the day-ahead schedule and a decremental dispatch below the day-ahead schedule.

The total volume of exceptional dispatch in May increased to 71,364 MWh from 47,340 MWh in April.

Figure 43: Total Exceptional Dispatch Volume (MWh) by Market Type

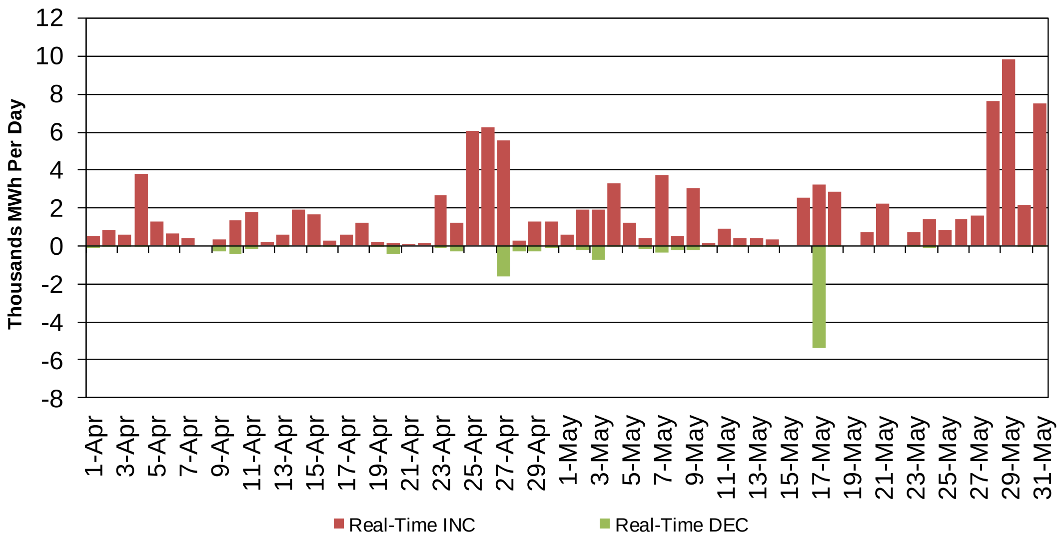


Figure 44 shows the volume of the exceptional dispatch broken out by reason.[4] The majority of the exceptional dispatch volumes in May were driven by planned transmission outage (49 percent), and unit testing (41 percent).

[4] For details regarding the reasons for exceptional dispatch please read the white paper at this link: **http://www.caiso.com/1c89/1c89d76950e00.html**.

Figure 44: Total Exceptional Dispatch Volume (MWh) by Reason

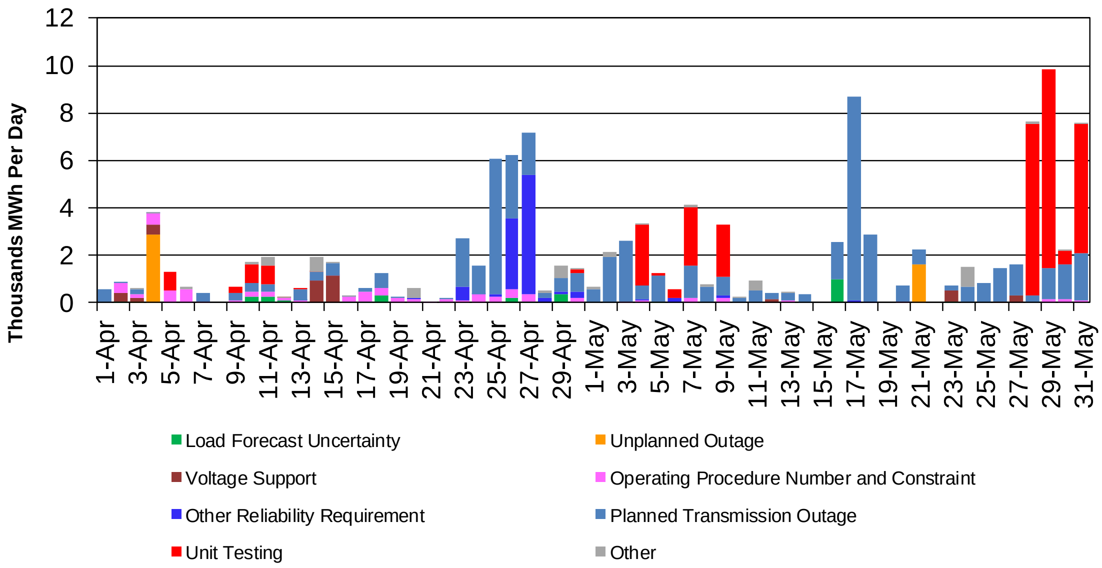
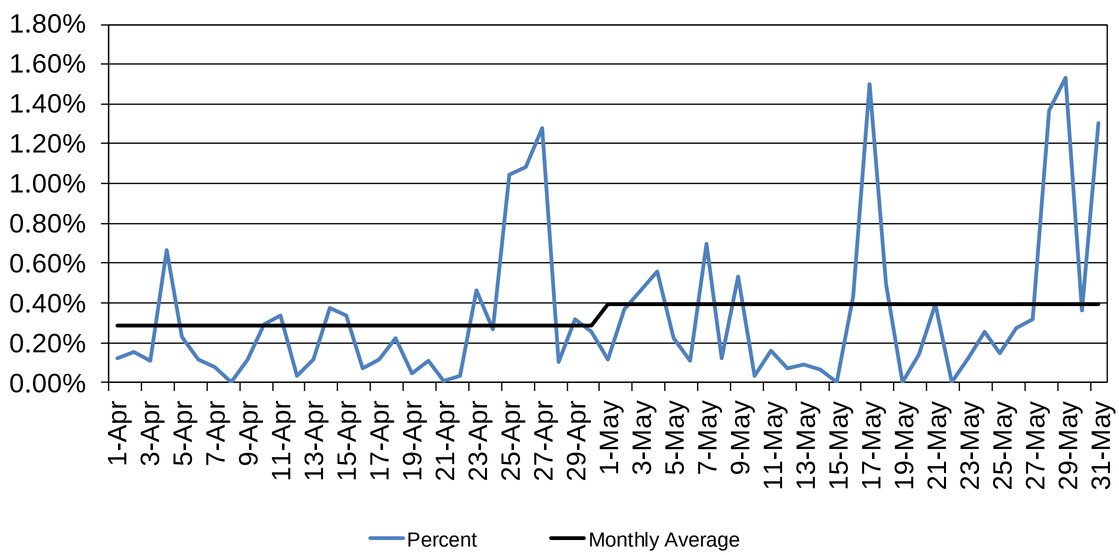


Figure 45 shows the total exceptional dispatch volume as a percent of load, along with the monthly average. The monthly average percentage was 0.39 percent in May, increasing from 0.28 in April.

Figure 45: Total Exceptional Dispatch as Percent of Load



Energy Imbalance Market

On November 1, 2014, the California Independent System Operator Corporation (ISO) and Portland-based PacifiCorp fully activated the Energy Imbalance Market (EIM). This real-time market is the first of its kind in the West. EIM covers six western states: California, Oregon, Washington, Utah, Idaho and Wyoming.

On December 1, 2015, NV Energy, the Nevada-based utility successfully began participating in the western Energy Imbalance Market (EIM). On October 1, 2016, Phoenix-based Arizona Public Service (AZPS) and Puget Sound Energy (PSEI) of Washington State successfully began full participation in the western Energy Imbalance Market.

On October 1, 2017, Portland General Electric Company (PGE) became the fifth western utility to successfully begin full participation in the western Energy Imbalance Market (EIM). PGE joins Arizona Public Service, Puget Sound Energy, NV Energy, PacifiCorp and the ISO, together serving over 38 million consumers in eight states: California, Arizona, Oregon, Washington, Utah, Idaho, Wyoming and Nevada.

On April 4, 2018, Boise-based Idaho Power and Powerex of Vancouver, British Columbia successfully entered the western Energy Imbalance Market (EIM) today, allowing the ISO's real-time power market to serve energy imbalances occurring within about 55 percent of the electric load in the Western Interconnection. The eight western EIM participants serve more than 42 million consumers in the power grid stretching from the border with Canada south to Arizona, and eastward to Wyoming.

Figure 46 shows daily simple average ELAP prices for PacifiCorp east (PACE), PacifiCorp West (PACW), NV Energy (NEVP), Arizona Public Service (AZPS), Puget Sound Energy (PSEI), Portland General Electric Company (PGE), Idaho Power (IPCO), and Powerex (BCHA) for all hours in FMM.

Figure 46: EIM Simple Average LAP Prices (All Hours) in FMM

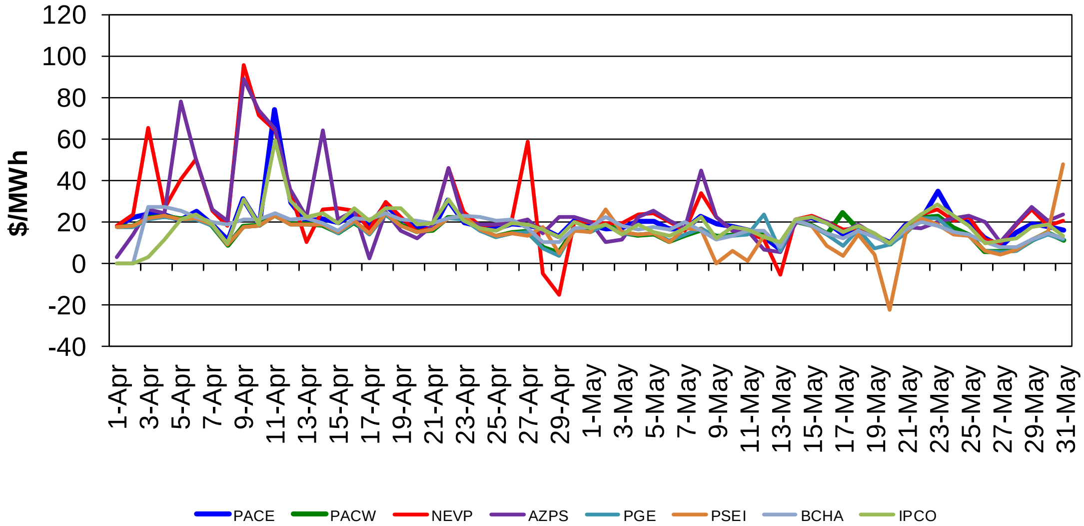


Figure 47 shows daily simple average ELAP prices for PACE, PACW, NEVP, AZPS, PSEI, PGE, IPCO, and BCHA for all hours in RTD.

Figure 47: EIM Simple Average LAP Prices (All Hours) in RTD

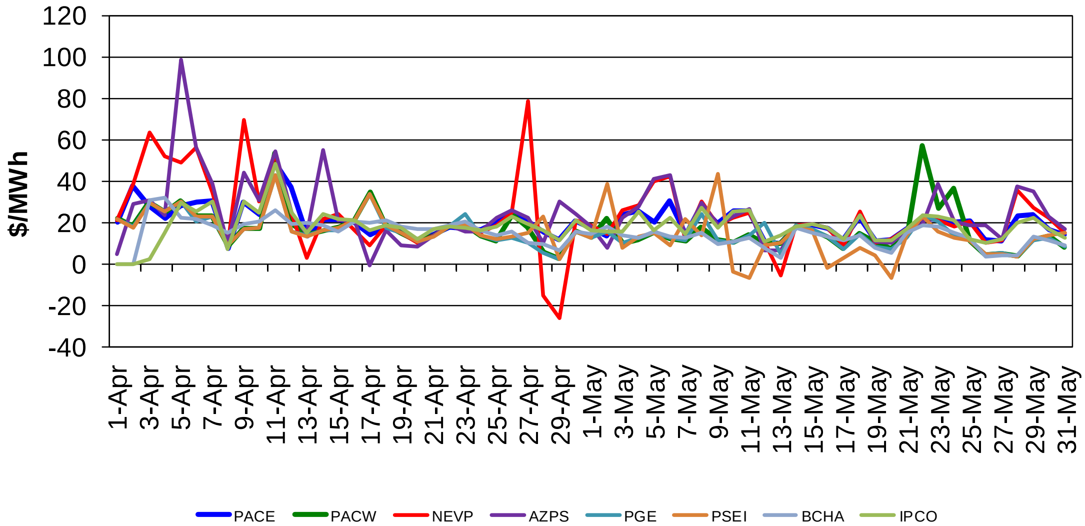


Figure 48 shows the daily price frequency for prices above $250/MWh and negative prices in FMM for PACE, PACW, NEVP, AZPS, PSEI, PGE, IPCO, and BCHA. The cumulative frequency of prices above $250/MWh decreased to 0.08 percent in May from 0.38 percent in April. The cumulative frequency of negative prices rose to 5.81 percent in May from 2.87 percent in April.

Figure 48: Daily Frequency of EIM LAP Positive Price Spikes and Negative Prices in FMM

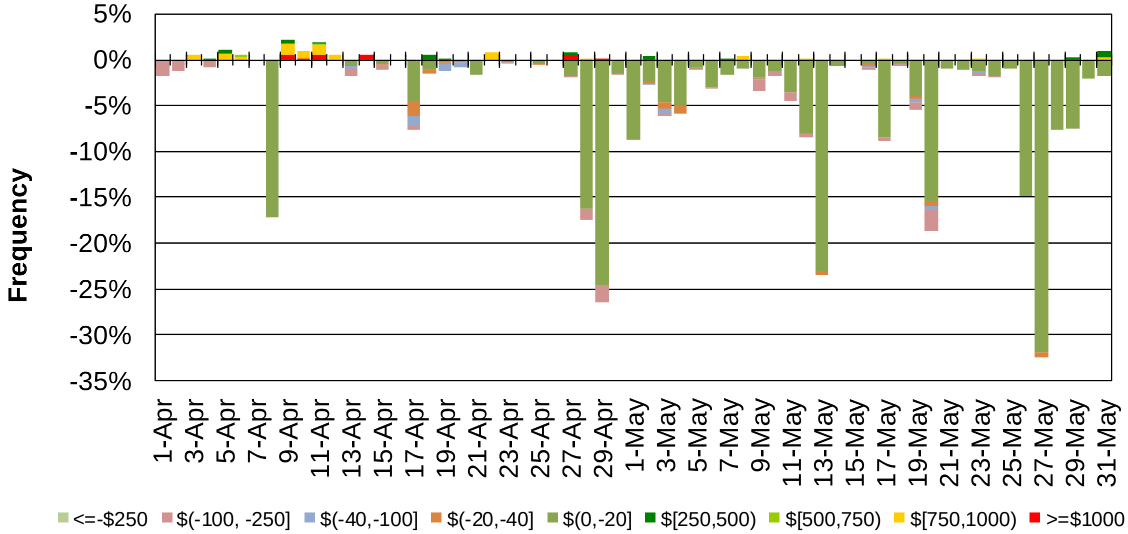


Figure 49 shows the daily price frequency for prices above $250/MWh and negative prices in RTD for PACE, PACW, NEVP, AZPS, PSEI, PGE, IPCO, and BCHA. The cumulative frequency of prices above $250/MWh decreased to 0.34 percent in May from 0.70 percent in April. The cumulative frequency of negative prices increased to 9.57 percent in May from 4.20 percent in April.

Figure 49: Daily Frequency of EIM LAP Positive Price Spikes and Negative Prices in RTD

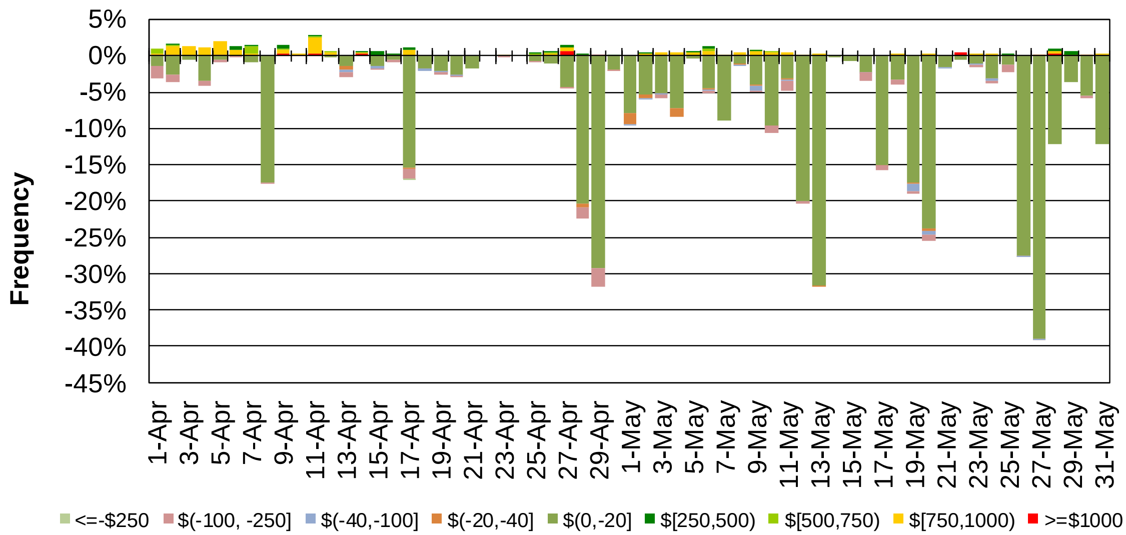


Figure 50 shows the daily volume of EIM transfer for CAISO in FMM. “Import” represents the total EIM transfer from other balancing areas (BAs) into CAISO. “Export” represents the total EIM transfer out of CAISO to other BAs in FMM.

Figure 50: EIM Transfer for CAISO in FMM

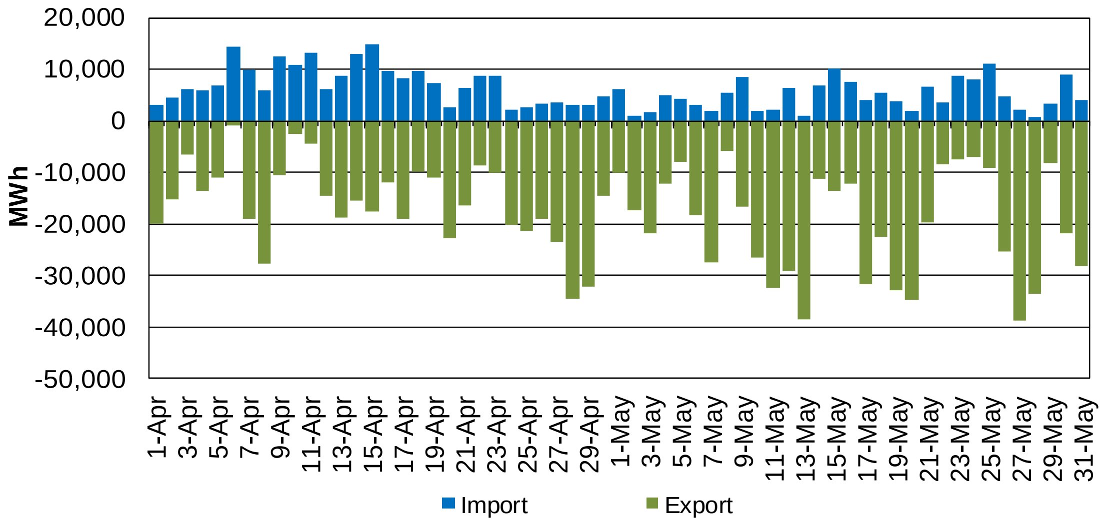


Figure 51 shows the daily volume of EIM transfer for PACE in FMM. Figure 52 shows the daily volume of EIM transfer for PACW in FMM.

Figure 51: EIM Transfer for PACE in FMM

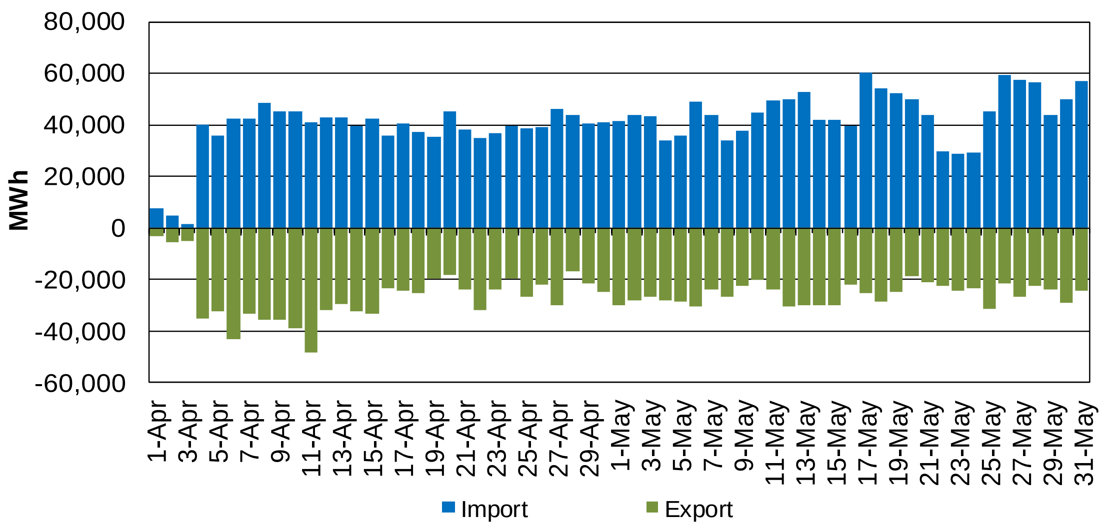


Figure 52: EIM Transfer for PACW in FMM

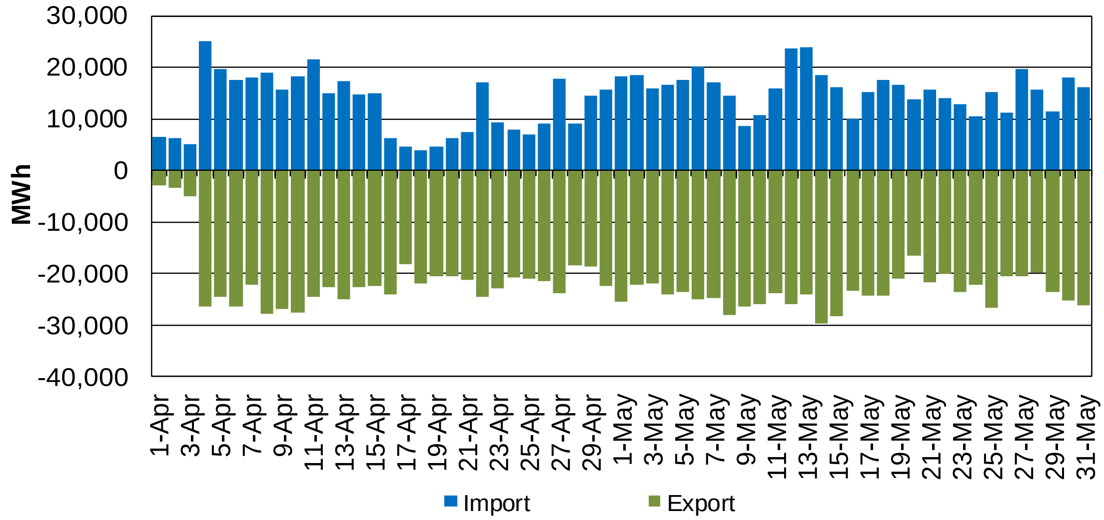


Figure 53 shows the daily volume of EIM transfer for NEVP in FMM.

Figure 53: EIM Transfer for NEVP in FMM

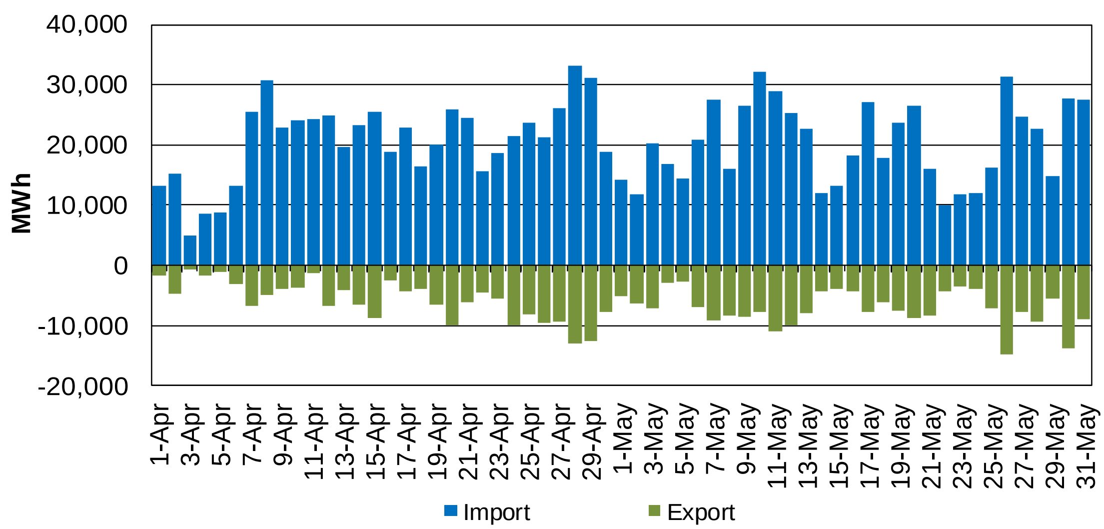


Figure 54 shows the daily volume of EIM transfer for AZPS in FMM.

Figure 54: EIM Transfer for AZPS in FMM

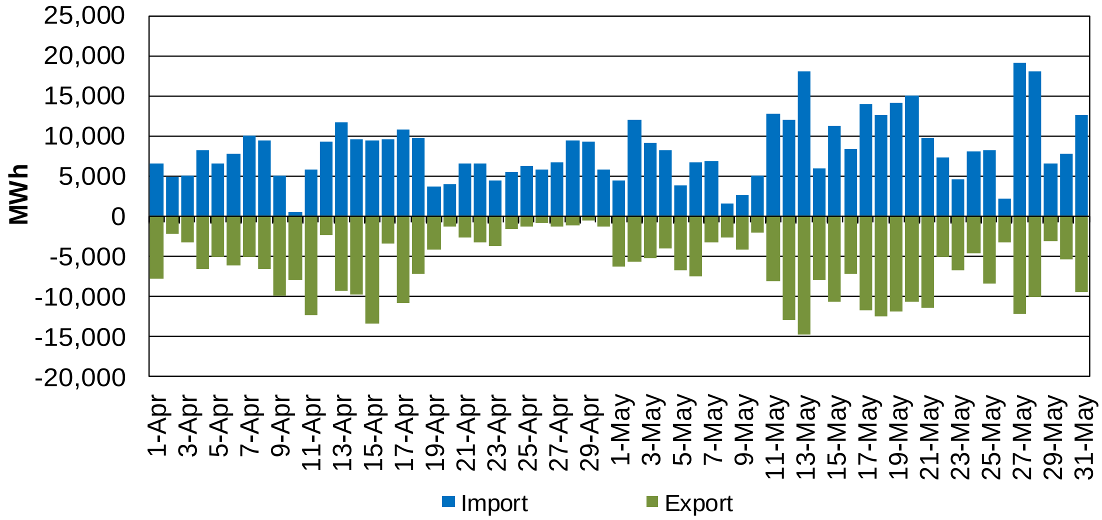


Figure 55 shows the daily volume of EIM transfer for PSEI in FMM.

Figure 55: EIM Transfer for PSEI in FMM

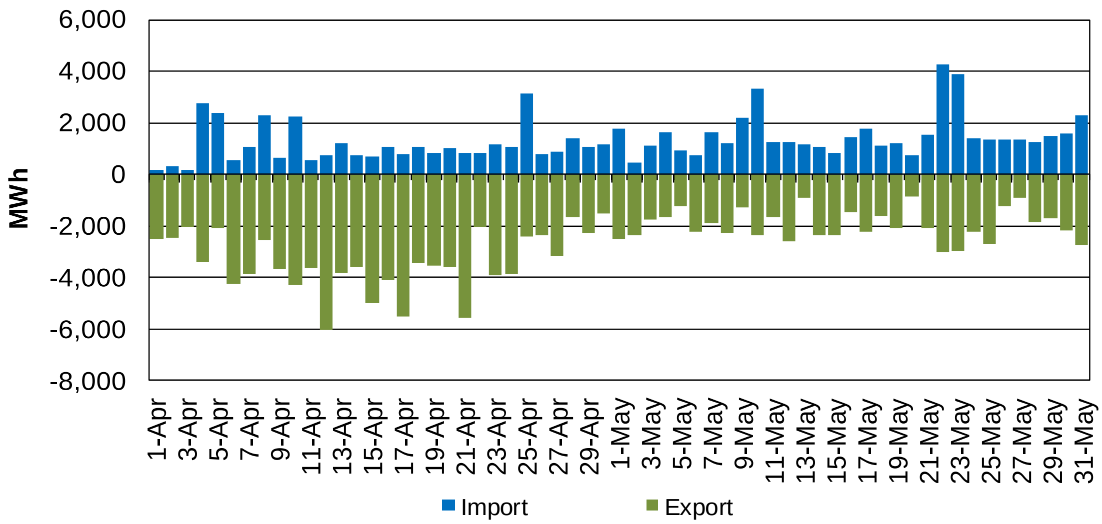


Figure 56 shows the daily volume of EIM transfer for PGE in FMM.

Figure 56: EIM Transfer for PGE in FMM

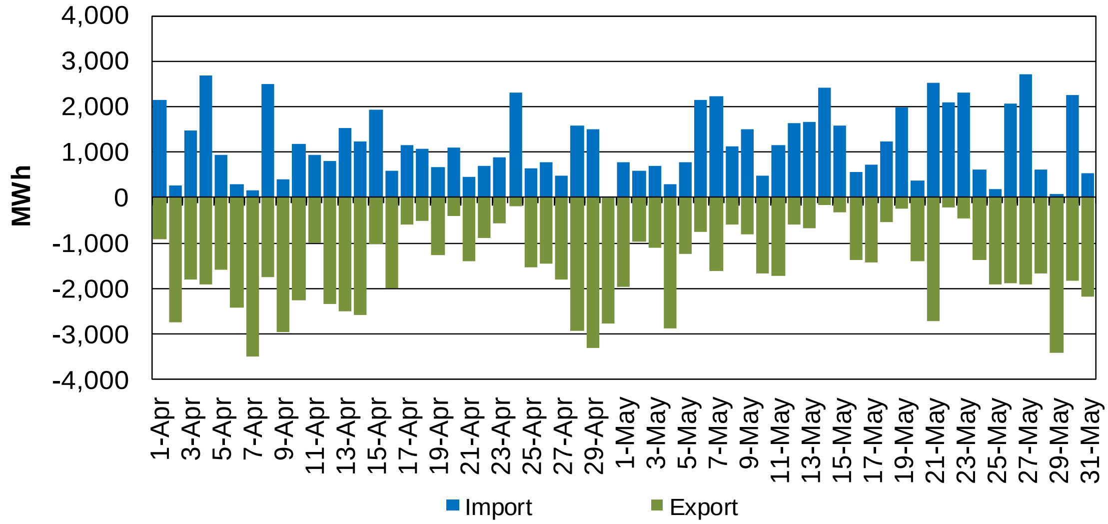


Figure 57 shows the daily volume of EIM transfer for BCHA in FMM.

Figure 57: EIM Transfer for BCHA in FMM

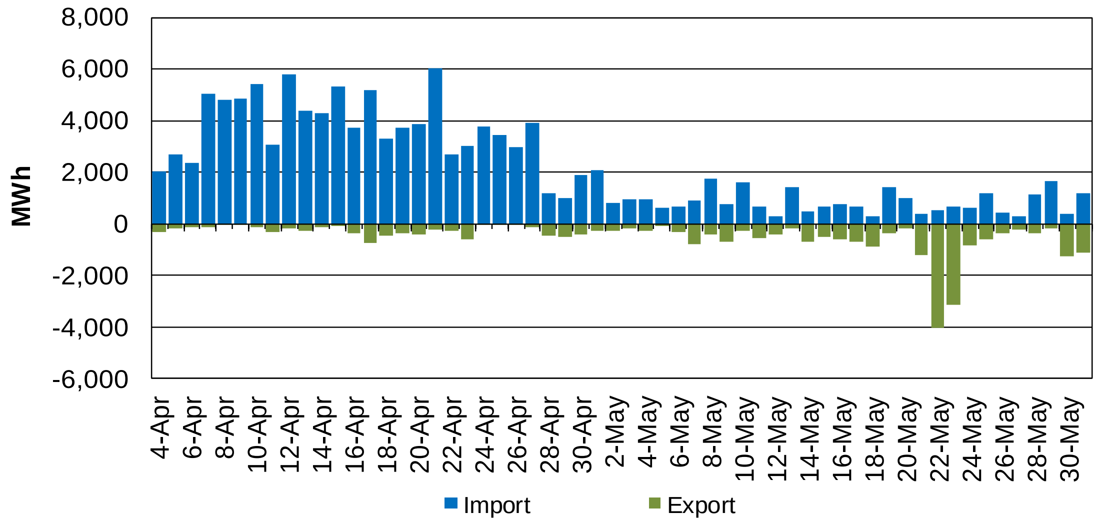


Figure 58 shows the daily volume of EIM transfer for IPCO in FMM.

Figure 58: EIM Transfer for IPCO in FMM

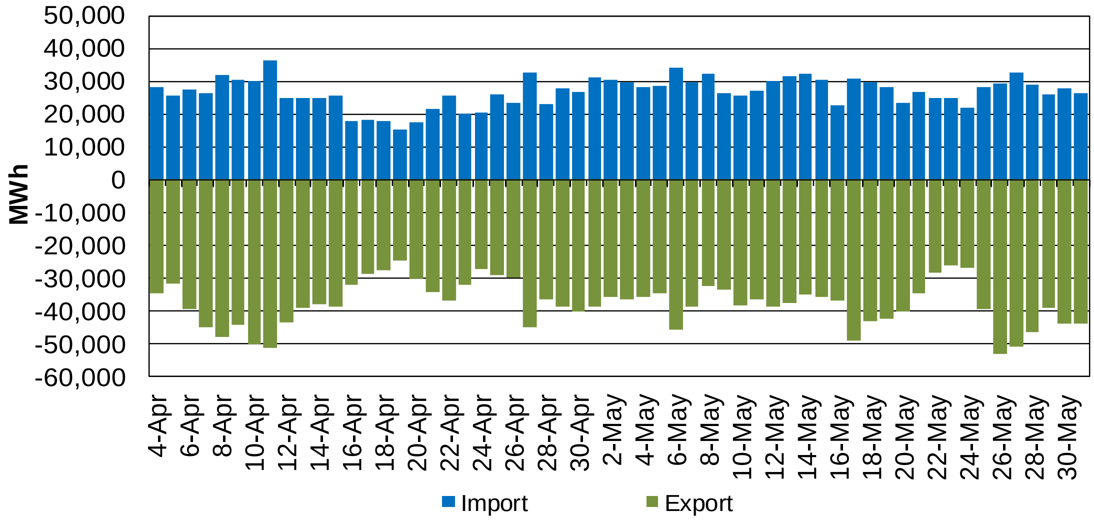


Figure 59 shows the daily volume of EIM for ISO in RTD.

Figure 59: EIM Transfer for CAISO in RTD

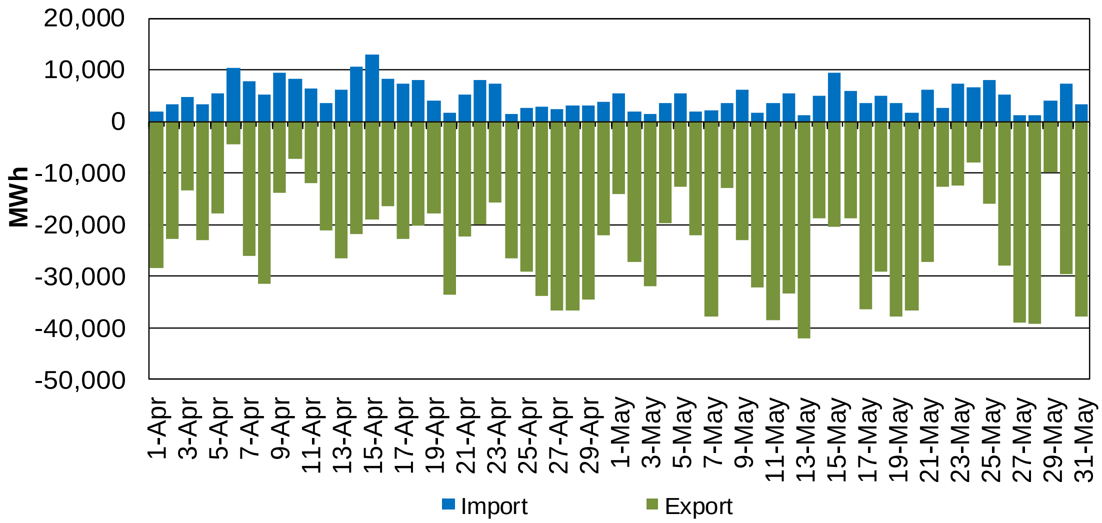


Figure 60 shows the daily volume of EIM transfer for PACE in RTD. Figure 61 shows the daily EIM transfer volume for PACW in RTD.

Figure 60: EIM Transfer for PACE in RTD

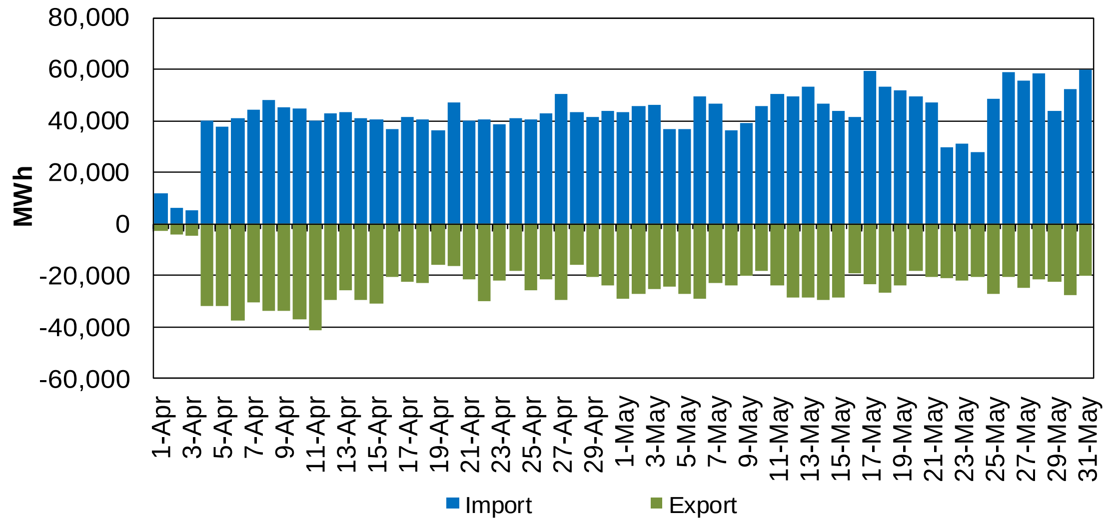


Figure 61: EIM Transfer for PACW in RTD

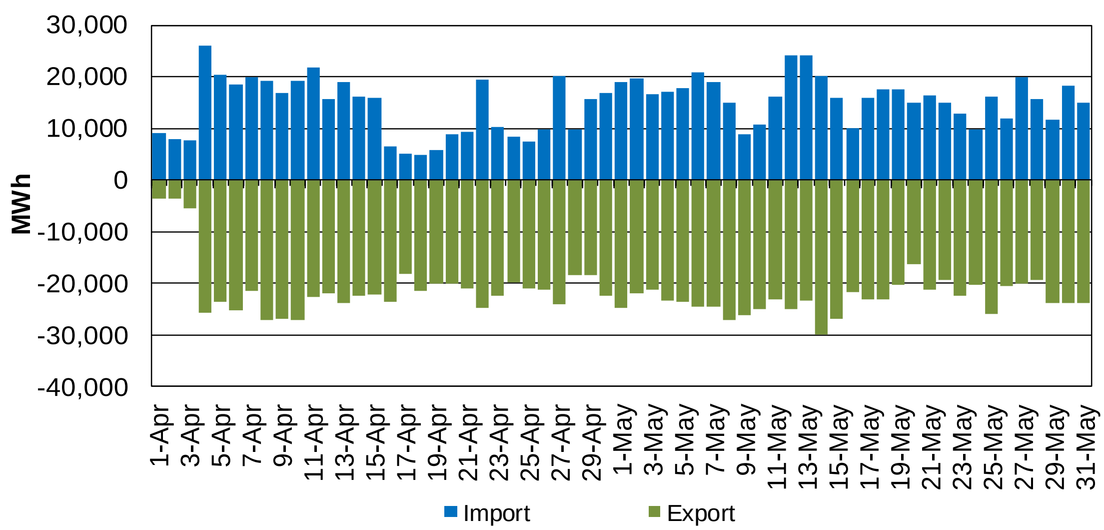


Figure 62 shows the daily EIM transfer volume for NEVP in RTD.

Figure 62: EIM Transfer for NEVP in RTD

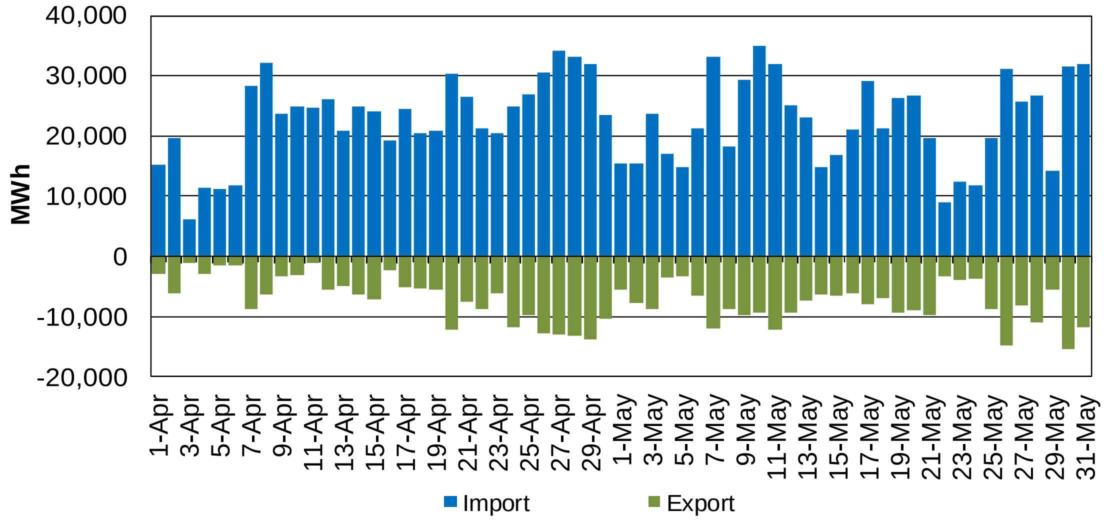


Figure 63 shows the daily volume EIM transfer for AZPS in RTD.

Figure 63: EIM Transfer for AZPS in RTD

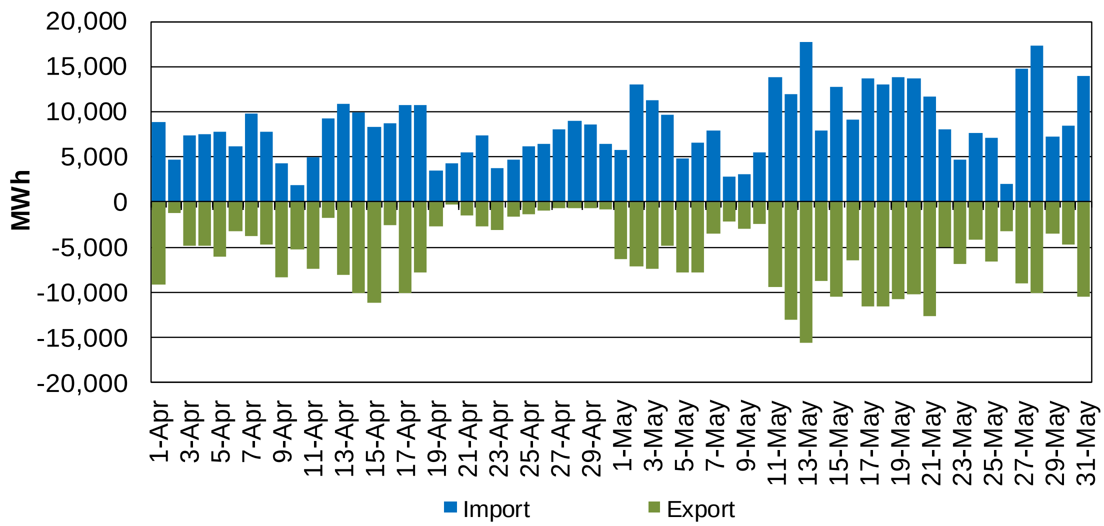


Figure 64 shows the daily volume EIM transfer for PSEI in RTD.

Figure 64: EIM Transfer for PSEI in RTD

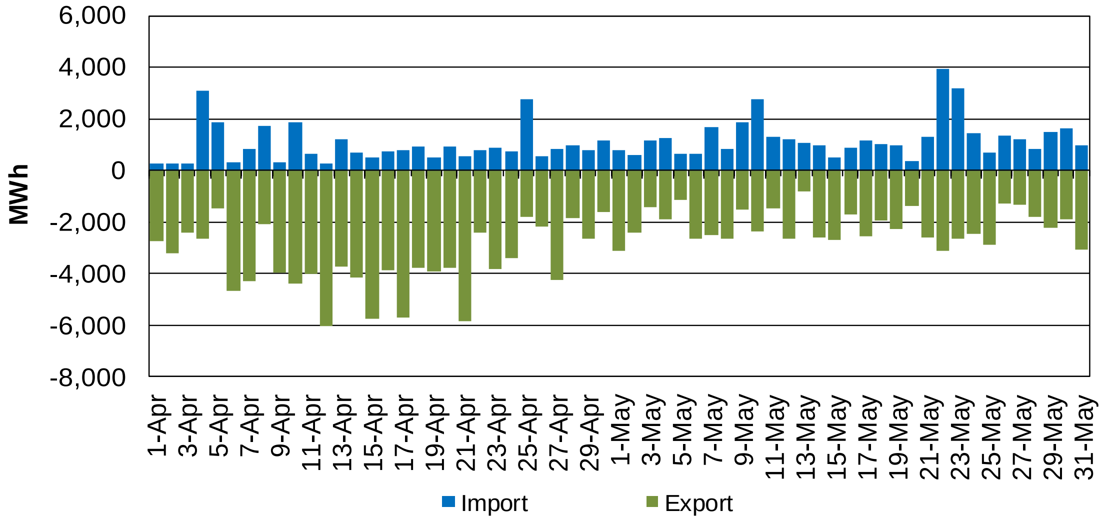


Figure 65 shows the daily volume EIM transfer for PGE in RTD.

Figure 65: EIM Transfer for PGE in RTD

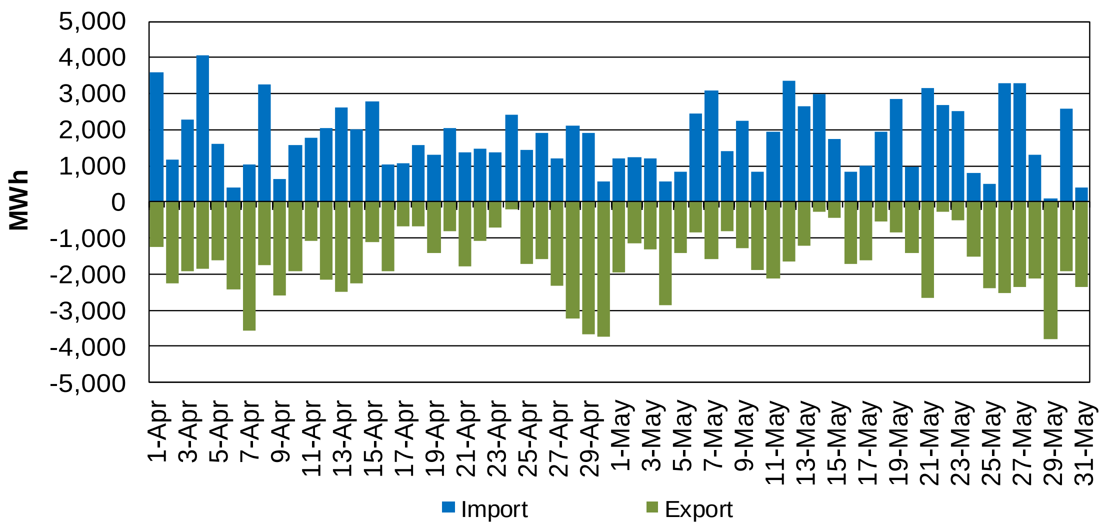


Figure 66 shows the daily volume EIM transfer for BCHA in RTD.

Figure 66: EIM Transfer for BCHA in RTD

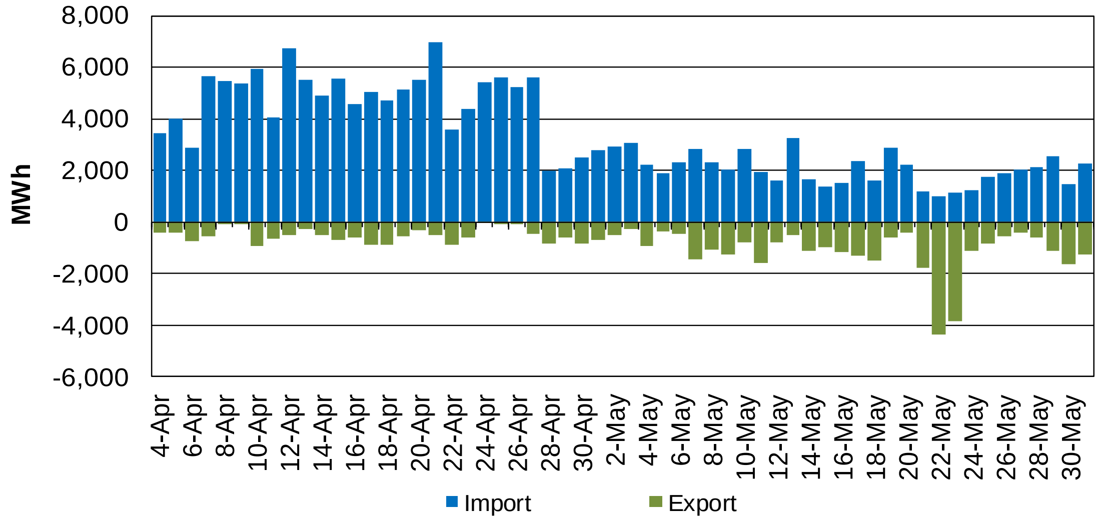


Figure 67 shows the daily volume EIM transfer for IPCO in RTD.

Figure 67: EIM Transfer for IPCO in RTD

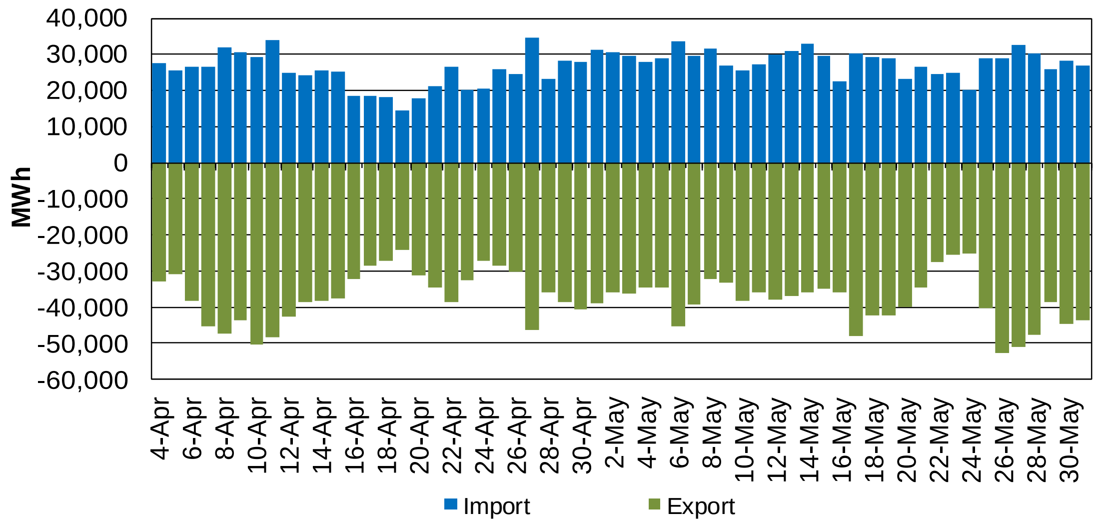


Figure 68 shows daily real-time imbalance energy offset cost (RTIEO) for PACE, PACW, NEVP, AZPS, PSEI, PGE, IPCO, and BCHA respectively. Total RTIEO edged up to -$2.28 million in May from -$2.30 million in April.

Figure 68: EIM Real-Time Imbalance Energy Offset by Area

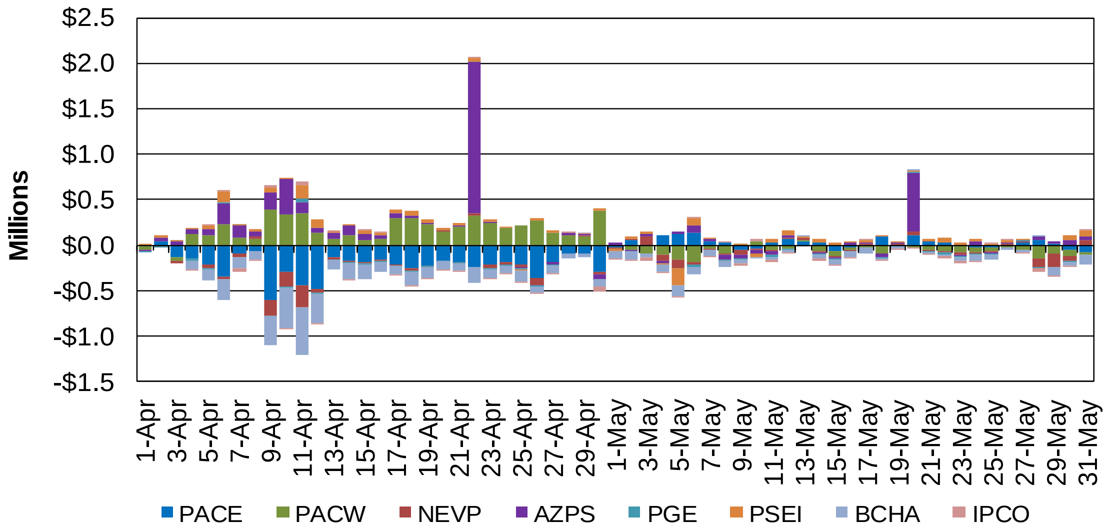


Figure 69 shows daily real-time congestion offset cost (RTCO) for PACE, PACW, NEVP, AZPS, PSEI, PGE, IPCO, and BCHA respectively. Total RTCO increased to -$2.63 million in May from -$3.43 million in April.

Figure 69: EIM Real-Time Congestion Imbalance Offset by Area

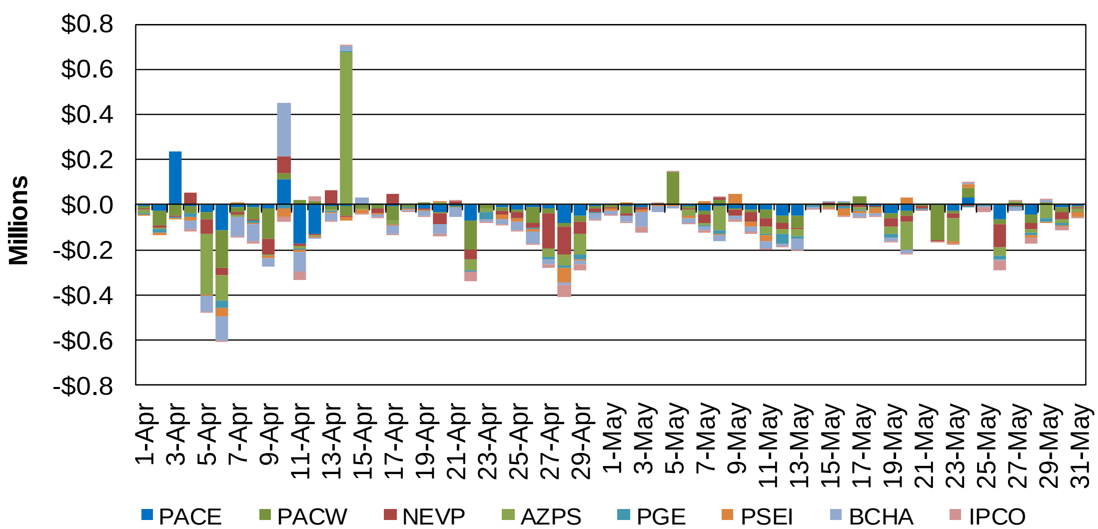


Figure 70 shows daily bid cost recovery for PACE, PACW, NEVP, AZPS, PSEI, PGE, IPCO, and BCHA respectively. Total BCR decreased to $0.96 million in May from $1.34 million in April.

Figure 70: EIM Bid Cost Recovery by Area

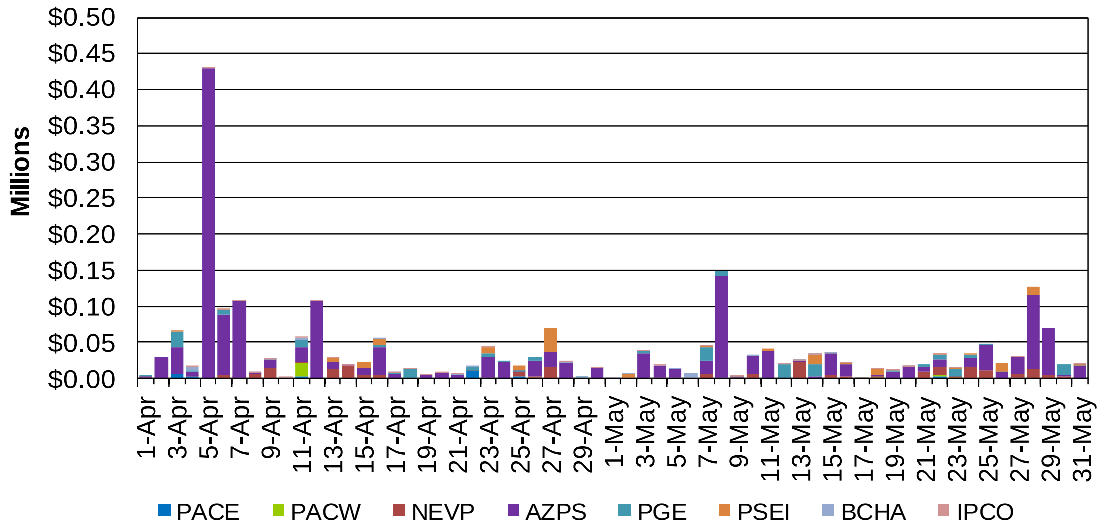


Figure 71 shows the flexible ramping up uncertainty payment for PACE, PACW, NEVP, AZPS, PSEI, PGE, IPCO, and BCHA respectively. Total flexible ramping up uncertainty payment in May decreased to $0.15 million from $0.66 million in April.

Figure 71: Flexible Ramping Up Uncertainty Payment

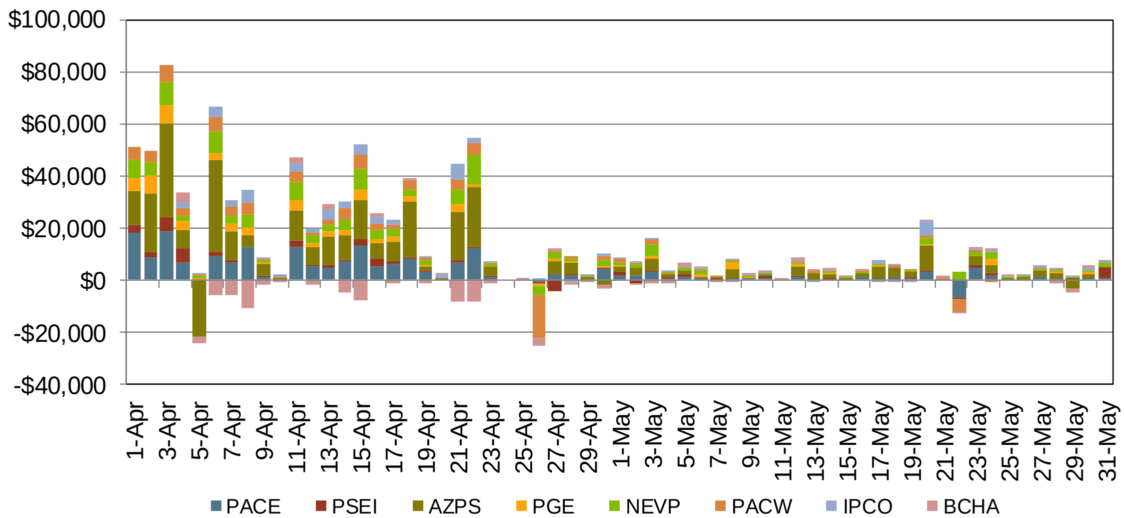


Figure 72 shows the flexible ramping down uncertainty payment for PACE, PACW, NEVP, AZPS, PSEI, PGE, IPCO, and BCHA respectively. Total flexible ramping down uncertainty payment in May decreased to $103,969 from $84,571 million in April.

Figure 72: Flexible Ramping Down Uncertainty Payment

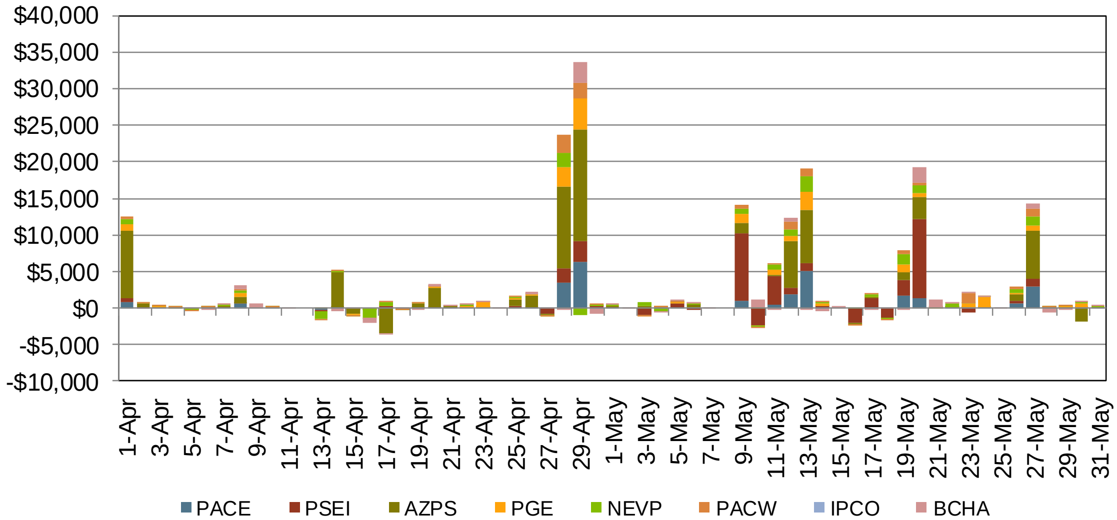
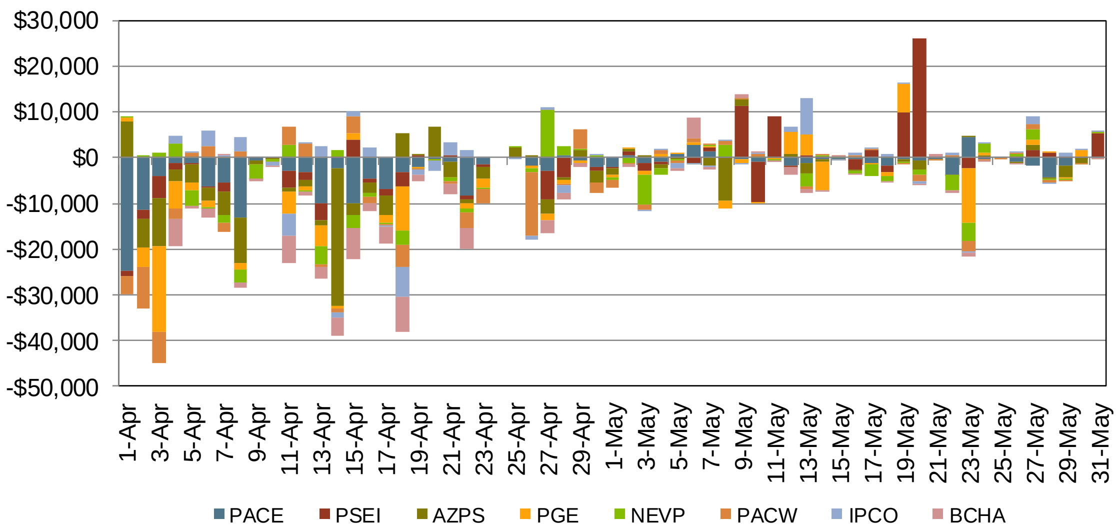


Figure 73 shows the flexible ramping forecast payment for PACE, PACW, NEVP, AZPS, PSEI, PGE, IPCO, and BCHA respectively. Total forecast payment in May rose to $1,737 from -$0.39 million in April.

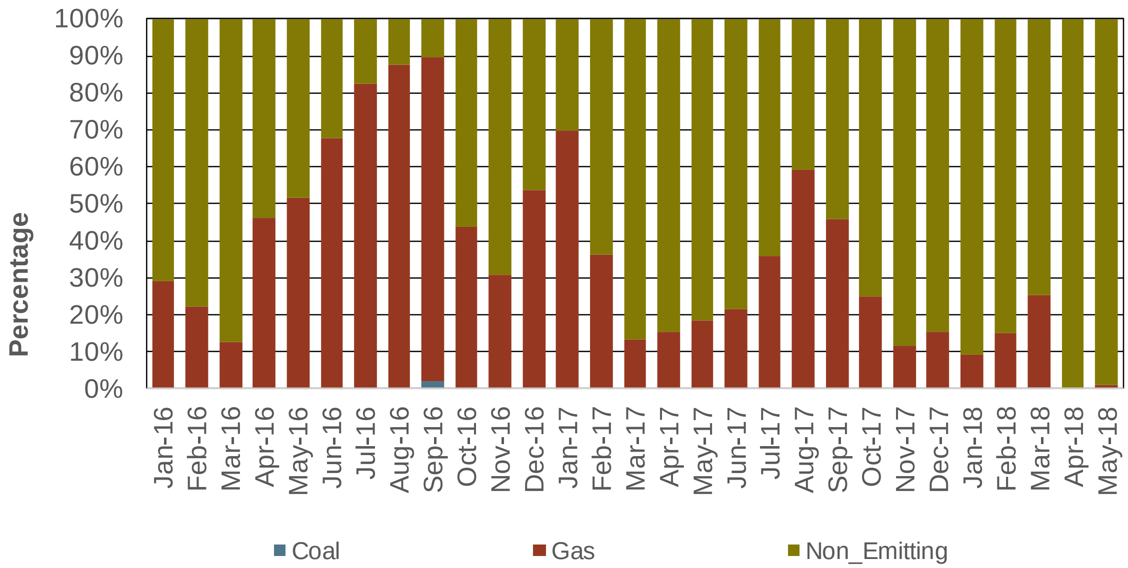
Figure 73: Flexible Ramping Forecast Payment



The ISO's Energy Imbalance Market Business Practice Manual[5] describes the methodology for determining whether an EIM participating resource is dispatched to support transfers to serve California load. The methodology ensures that the dispatch considers the combined energy and associated marginal greenhouse gas (GHG) compliance cost based on submitted bids[6].

The EIM dispatches to support transfers into the ISO were documented in Figure 74 and Table 8 below.

Figure 74: Percentage of EIM Transfer into ISO by Fuel Type



[5] See the Energy Imbalance Market Business Practice Manual for a description of the methodology for making this determination, which begins on page 42 -- http://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Energy Imbalance Market.
[6] A submitted bid may reflect that a resource is not available to support EIM transfers to California.

Table 8: EIM Transfer into ISO by Fuel Type

Month	Coal (%)	Gas (%)	Non-Emitting (%)	Total
Jan-16	0.00%	28.96%	71.04%	100%
Feb-16	0.00%	22.21%	77.79%	100%
Mar-16	0.00%	12.72%	87.28%	100%
Apr-16	0.00%	46.26%	53.74%	100%
May-16	0.00%	51.63%	48.37%	100%
Jun-16	0.00%	67.89%	32.11%	100%
Jul-16	0.00%	82.42%	17.58%	100%
Aug-16	0.00%	87.59%	12.41%	100%
Sep-16	1.98%	87.68%	10.34%	100%
Oct-16	0.00%	43.82%	56.18%	100%
Nov-16	0.00%	30.74%	69.26%	100%
Dec-16	0.00%	53.77%	46.23%	100%
Jan-17	0.00%	69.88%	30.12%	100%
Feb-17	0.00%	36.42%	63.58%	100%
Mar-17	0.00%	13.37%	86.63%	100%
Apr-17	0.00%	15.47%	84.53%	100%
May-17	0.00%	18.47%	81.53%	100%
Jun-17	0.00%	21.42%	78.58%	100%
Jul-17	0.00%	36.08%	63.92%	100%
Aug-17	0.00%	59.20%	40.80%	100%
Sep-17	0.00%	45.94%	54.06%	100%
Oct-17	0.00%	24.85%	75.15%	100%
Nov-17	0.00%	11.57%	88.43%	100%
Dec-17	0.00%	15.36%	84.64%	100%
Jan-18	0.00%	9.12%	90.88%	100%
Feb-18	0.00%	15.20%	84.80%	100%
Mar-18	0.16%	25.00%	74.84%	100%
Apr-18	0.00%	0.14%	99.86%	100%
May-18	0.00%	1.09%	98.91%	100%