Benefits for Participating in EIM

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Revision History

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Executive Summary

This is the "Quantifying EIM Benefits" report for the fourth quarter of 2015. In addition to quantifying benefits from PacifiCorp's participation in the western Energy Imbalance Market (EIM), this report also reports on the added benefits from NV Energy's (NVE) participation, which began December 1, 2015. The estimated gross benefits for October, November and December 2015 are $12.29 million. This brings the EIM total benefits to $45.69 million since it expanded the real-time market to balancing areas outside the California ISO.

The total gross benefits for December increased significantly from November with the addition of NVE. This growth reflects the economic value associated with the increase in inter-regional transfer capability.

The benefit calculation method is described in a separate document, which can be found here. This analysis demonstrates the EIM's ability to select the most economic resources across the PacifiCorp, NVE and ISO balancing authority areas (BAAs) that comprise the EIM footprint. The benefits quantified in this report fall into three categories and were described in earlier studies [1].

- ***More efficient dispatch, both inter- and intra-regional, in the Fifteen-Minute Market (FMM) and Real-Time Dispatch (RTD),*** by automating dispatch every fifteen minutes and every five minutes within and across the EIM footprint, including California ISO, PacifiCorp, and NV Energy.
- ***Reduced renewable energy curtailment,*** by allowing balancing authority areas to export or reduce imports of renewable generation when they would otherwise need to be economically curtailed, and
- ***Reduced flexibility reserves needed in all balancing authority areas,*** which saves cost by aggregating the load, wind, and solar variability and forecast errors of the combined EIM footprint. This report quantifies the diversity benefits of flexibility reserves for the entire EIM footprint.

The benefits of PAC-E and PAC-W have been combined to the EIM entity level to reflect the overall system and customer benefits. Table 1 shows the estimated gross benefits summary for the fourth quarter of 2015 in millions of dollars per EIM entity.

Region	October	November	December	Total
CAISO	1.27	1.30	2.70	**5.28**
NV Energy	n/a	n/a	0.84	**0.84**
PacifiCorp	1.24	2.19	2.75	**6.17**
Total	**2.51**	**3.49**	**6.29**	**12.29**

[1] PacifiCorp-ISO, Energy Imbalance Markets Benefits, http://www.caiso.com/Documents/PacifiCorp-ISOEnergyImbalanceMarketBenefits.pdf; NV Energy-ISO Energy Imbalance Market Economic Assessment, http://www.caiso.com/Documents/NV_Energy-ISO-EnergyImbalanceMarketEconomicAssessment.pdf.

Table 1: Estimated gross benefits shown are in millions and accrued in the fourth quarter of 2015

One of the significant contributions to the EIM benefits are transfers across the balancing areas which provides lower supply cost, even while factoring in the cost of compliance with greenhouse gas (GHG) emissions cost when it is transferring into the ISO. As such, the transfer volumes are a good indicator of a portion of the benefits attributed to the EIM. Transfers can take place in both the Fifteen Minute Market (FMM) and Real-Time Dispatch (RTD). Generally, the transfer limits are based on transmission rights and interchange rights that participating balancing authority areas make available to EIM, with the exception of the PACW-ISO transfer limit in RTD. The RTD transfer capacities between PACW and the ISO are dynamically determined based on the allocated dynamic transfer capability driven by system operating conditions. This report does not quantify a BAA's opportunity cost that the utility considered when using its transfer rights for the EIM.

Balancing authority areas may submit base scheduled transfers. These transactions occurred between NVE and PACE beginning December 2015. The EIM inter-regional benefits are calculated based on the transfer difference between the EIM and the base schedule. This is because the benefits associated with base scheduled transfers, to the extent that they exist, should be attributed to decisions made prior to the EIM, not to the economic efficiencies gained through the EIM. The majority of the benefit is due to increased inter-regional transfers in December. This is discussed later.

While market conditions will vary, the EIM continues to provide benefits to participating entities and their customers as demonstrated in this report.

Background

The EIM began financially-binding operation on November 1, 2014 by optimizing resources across ISO and PacifiCorp, which includes portions of California, Oregon, Washington, Utah, Idaho and Wyoming. NV Energy, operating in Nevada, began participating in December 2015. The EIM facilitates renewable resource integration and increases reliability by sharing information between balancing authorities on electricity delivery conditions across the EIM region. The ISO started publishing quarterly EIM benefit reports in January 2015. Results from NV Energy's participation beginning December 1, 2015 are included in this benefits report. As other BAAs join the EIM, this report will expand to include the benefits associated with their participation.

EIM Benefits in Q4 2015

Table 1 breaks out the estimated EIM gross benefits by each BAA per month. The savings presented in the table show $2.51 million for October, $3.49 million for November, and $6.29 million for December.

The lower benefit in October was driven primarily by the transfer capacity derate from PACE to PACW. A transmission line outage starting on September 15, 2015 caused the transfer capacity from PACE to PACW to be derated from 200 MW to 0 MW. The outage ended on October 30, 2015. The EIM benefit

for September 2015 reported in the Q3 report was $2.99 million with the outage impacting half of the month. The EIM benefit for October was reduced to $2.51 million with the outage impacting almost the entire month. The line's return to service in late October contributed to the higher $3.49 million EIM benefit in November.

The EIM gross benefits increased from $3.49 million in November to $6.29 million in December with the integration of NV Energy as an EIM participant. Of the $6.29 million in total gross benefits, $0.84 million was attributed to NV Energy. The expansion of the EIM facilitated greater benefits for all EIM participants.

NV Energy's EIM benefit mainly reflects inter regional transfer benefit that occurs intra hour. This is because NV Energy has optimized base schedules before submitting them to EIM.

Inter-regional Transfers

One of the significant contributions to the EIM benefits are transfers across the balancing areas which provides lower supply cost. Table 2 provides the 15-minute EIM transfer volume and the 5-minute EIM transfer volume, both with base schedule transfer excluded. NVE and PACE had submitted base schedule transfers in December 2015. The EIM benefit is only attributable the transfers that occurred after EIM, but not the base schedules submitted prior to the EIM.

The transfer from BAA_x to BAA_y and the transfer from BAA_y to BAA_x are separately reported. For example, in an interval, if there is 100 MWh transfer from CISO to NEVP, it will be reported as 100 MW with from_BAA=CISO and to_BAA=NEVP, and it will be reported as 0 MW with from_BAA=NEVP and to_BAA=CISO in the opposite direction. The 15-minute transfer volume results from EIM optimization in the 15-minute market with all bids and base schedules submitted into EIM. The 5-minute transfer volume results from EIM optimization in the 5-minute market with all bids and base schedules submitted into EIM, and unit commitments determined in the 15-minute market optimization. The total transfer volume, either the 15-minute or the 5-minute, could be higher or lower than the base schedule transfers depending on the net load imbalance from the base schedule level, and supply bids. The EIM transfer volume is positive if the total transfer is higher than the base schedule transfer, and is negative otherwise.

Year	Month	from_BAA	to_BAA	15m EIM transfer (total 15m - base)	5m EIM transfer (total 5m - base)
2015	Oct	CISO	PACW	15,580	10,654
2015	Oct	PACE	PACW	1,454	1,778
2015	Oct	PACW	CISO	35,252	43,178
2015	Nov	CISO	PACW	12,749	18,348
2015	Nov	PACE	PACW	37,752	48,104
2015	Nov	PACW	CISO	71,358	87,149

2015	Dec	CISO	NEVP	76,461	56,155
2015	Dec	CISO	PACW	19,175	24,469
2015	Dec	NEVP	CISO	56,607	94,035
2015	Dec	NEVP	PACE	17,902	13,926
2015	Dec	PACE	NEVP	-11,252	2,498
2015	Dec	PACE	PACW	37,958	54,740
2015	Dec	PACW	CISO	67,897	79,859

Table 2: Energy transfers (MWh) in the FMM and RTD for the fourth quarter of 2015

Reduced Renewable Curtailment

The EIM helps avoid renewable curtailments within the ISO, which has both economic and environmental benefits. The EIM benefit calculation includes the economic benefits that can be attributed to avoided renewable curtailment within the ISO. If not for energy transfers facilitated by the EIM, some renewable generation located within the ISO would have been curtailed via either economic or exceptional dispatch. The total avoided renewable curtailment volume in MWh for Q4 2015 was calculated to be 192 MWh (October) + 1,909 MWh (November) + 15,664 MWh (December) = 17,765 MWh total. The increase in avoided curtailment in November is reflective of an increase of renewable output relative to lower seasonal load. The further increase of avoided curtailment in December appears to reflect both seasonal changes as well as the start of NVE's EIM participation and resulting in increased EIM transfer opportunity from ISO southern system to NVE.

The environmental benefits of avoided renewable curtailment are significant. Under the assumption that avoided renewable curtailments displace production from other resources at a default emission rate of 0.428 metric tons CO2/MWh, avoided curtailments displaced an estimated 7,521 metric tons of CO2 for Q4 2015. Avoided renewable curtailments may also have reduced the volume of renewable credits that would have been retracted. However, this report does not quantify the additional value in dollars associated with this benefit.

Flexible ramping procurement diversity savings

The EIM facilitates procurement of flexible ramping capacity in the FMM to address variability that may occur in the RTD. Because variability across different BAAs may happen in opposite directions, the flexible ramping requirement for the entire EIM footprint can be less than the sum of individual BAA's requirement. This difference is known as the flexible ramping procurement diversity savings. Starting in March 2015, the ISO implemented an automated tool to analyze historical uncertainties and calculate the flexible ramping requirement for each BAA in the EIM. In Q4 2015, the flexible ramping requirement for the ISO varied from 300 MW to 500 MW, the requirement for PACE varied from 80 MW to 150 MW, the requirement for PACW varied from 62 MW to 100 MW, and the requirement for NVE varied from 80 MW to 100 MW. Due to the reduction in flexible ramping requirement associated with the larger EIM footprint, the total requirement across the four BAAs varied from 400 MW to 530 MW.

The flexible ramping procurement diversity savings for all the intervals averaged over a month are listed in Table 3.[2] The percentage saving is the average MW savings divided by the sum of the three individual BAA requirements. The flexible ramping procurement diversity savings was lower in October because PACE was unable to share flexible ramping with other EIM regions when PACE to PACW transfer capability was reduced to zero.

	October	November	December
Average MW	83	179	261
Percentage savings	12%	26%	34%

Table 3: Flexible ramping procurement diversity saving for the fourth quarter of 2015

Under the current flexible ramping constraint design, the procured flexible ramping capacity can be fully accessed in RTD. If the flexible ramping procurement in the FMM is beneficial, it will reduce the RTD dispatch cost. With the EIM benefits being quantified on a 5-minute level, the benefit of flexible ramping is fully captured in the RTD dispatch. The EIM benefits calculated at a 5-minute level includes the savings from procuring and deploying flexible ramping. However, this analysis does not breakout the dollar savings separately because the savings are tightly integrated with the RTD dispatch.

Conclusion

The EIM continued to show significant benefits during the fourth quarter of 2015. The total benefits for the quarter of $12.29 million are consistent with pre-launch studies, and incorporate the added benefits to all EIM participants brought about by NV Energy's participation beginning December 1, 2015.

[2] From September 15, 2015, until October 30, 2015, the total EIM footprint flexible ramping requirement was not enforced in production due to planned outage work between PACE to PACW. In this case, the flexible ramping procurement diversity savings were calculated for the ISO and PACW, which is the difference in the requirement for the ISO and PACW together and the sum of individual ISO and PACW requirements.