DOCKETED

Docket Number:	17-IEPR-07
Project Title:	Integrated Resource Planning
TN #:	222399
Document Title:	Western EIM Benefits Report Fourth Quarter 2017
Description:	Western EIM Benefits Report Fourth Quarter 2017
Filer:	Raquel Kravitz
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	1/30/2018 12:57:27 PM
Docketed Date:	1/30/2018

Western EIM Benefits Report

Fourth Quarter 2017

January 30, 2018

Contents

Executive Summary

This report presents the benefits associated with participation in the western Energy Imbalance Market (EIM) for the fourth quarter of 2017. The benefits include cost savings and the use of surplus renewable energy to displace conventional generating resources.

The estimated gross benefits for October, November and December 2017 are $33.46 million, bringing the total benefits of EIM to $288.44 million since the California Independent System Operator (ISO) expanded its real-time market to balancing authority areas outside the ISO in November 2014.

The report also shows that EIM is helping to displace less-clean energy supplies with surplus renewable energy that otherwise may have been curtailed.[1] In Q4, the EIM used 18,060 MWh of surplus renewable energy to displace 7,730 metric tons of CO_2 emissions.

The benefit calculation methodology is described in a separate document.[2] This analysis demonstrates the real-time market's ability to select the most economic resources across the ISO, PacifiCorp, NVE, APS, PSE and PGE balancing authority areas (BAAs), which comprise the EIM footprint. The benefits quantified in this report fall into three categories and were described in earlier studies:[3]

- ***More efficient dispatch, both inter-and intra-regional, in the Fifteen-Minute Market (FMM) and Real-Time Dispatch (RTD). Q4 estimated savings = $33.46 million.***
- ***Reduced renewable energy curtailment. Q4 estimated reduction = 18,060 MWh displacing approximately 7,730 metric tons of CO_2.***
- ***Reduced flexibility ramping reserves needed in all balancing authority areas. Q4 reduction = 418 MW – 432 MW in the upward direction and 504 MW – 543 MW in the downward direction.***

[1] The GHG emission reduction reported is associated with the avoided curtailment only. The current market process and counterfactual methodology cannot differentiate the GHG emissions resulting from serving ISO load via the EIM versus dispatch that would have occurred external to the ISO without the EIM. For more details, see http://www.caiso.com/Documents/GreenhouseGasEmissionsTrackingReport-FrequentlyAskedQuestions.pdf

[2] EIM Quarterly Benefit Report Methodology, https://www.caiso.com/Documents/EIM_BenefitMethodology.pdf

[3] PacifiCorp-ISO, Energy Imbalance Markets Benefits, http://www.caiso.com/Documents/PacifiCorp-ISOEnergyImbalanceMarketBenefits.pdf

Background

The EIM began financially-binding operation on November 1, 2014 by optimizing resources across the ISO and PacifiCorp BAAs. NV Energy, operating in Nevada, began participating in December 2015. Arizona Public Service and Puget Sound Energy began operations October 1, 2016. Portland General Electric began participation on October 1, 2017 and is included in this benefit analysis for Q4. The EIM footprint now includes portions of Arizona, California, Idaho, Nevada, Oregon, Utah, Washington, and Wyoming. 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 began publishing quarterly EIM benefit reports in January 2015. Prior reports can be accessed at https://www.westerneim.com/Pages/About/QuarterlyBenefits.aspx

EIM Benefits in Q4 2017

Table 1 shows the estimated EIM gross benefits by each region per month. The monthly savings presented in the table show $12.39 million for October, $12.35 million for November, and $8.72 million for December with a total estimated benefit of $33.46 million.

The EIM benefits reported here are calculated based on available data. Intervals without complete data are excluded in the calculation. The intervals excluded due to unavailable data are normally within a few percent of the total intervals.

Region	October	November	December	Total
APS	$3.72	$3.60	$2.68	$10.00
ISO	$2.35	$1.56	$0.61	$4.52
NV Energy	$2.63	$2.96	$0.86	$6.45
PacifiCorp	$1.71	$2.43	$2.69	$6.83
PGE	$0.99	$0.85	$0.99	$2.83
PSE	$0.99	$0.95	$0.89	$2.83
Total	$12.39	$12.35	$8.72	$33.46

Table 1: Fourth quarter 2017 benefits in millions USD

Inter-Regional Transfers

A significant contributor to EIM benefits is transfers across balancing areas, providing access to lower cost supply, while factoring in the cost of compliance with greenhouse gas (GHG) emissions regulations when energy is transferred 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 and Real-Time Dispatch (RTD).

Generally, transfer limits are based on transmission and interchange rights that participating balancing authority areas make available to the EIM, with the exception of the PacifiCorp West (PACW)-ISO transfer limit and Portland General Electric (PGE)-ISO transfer limit in RTD. These RTD transfer capacities between PACW/PGE and the ISO are 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.

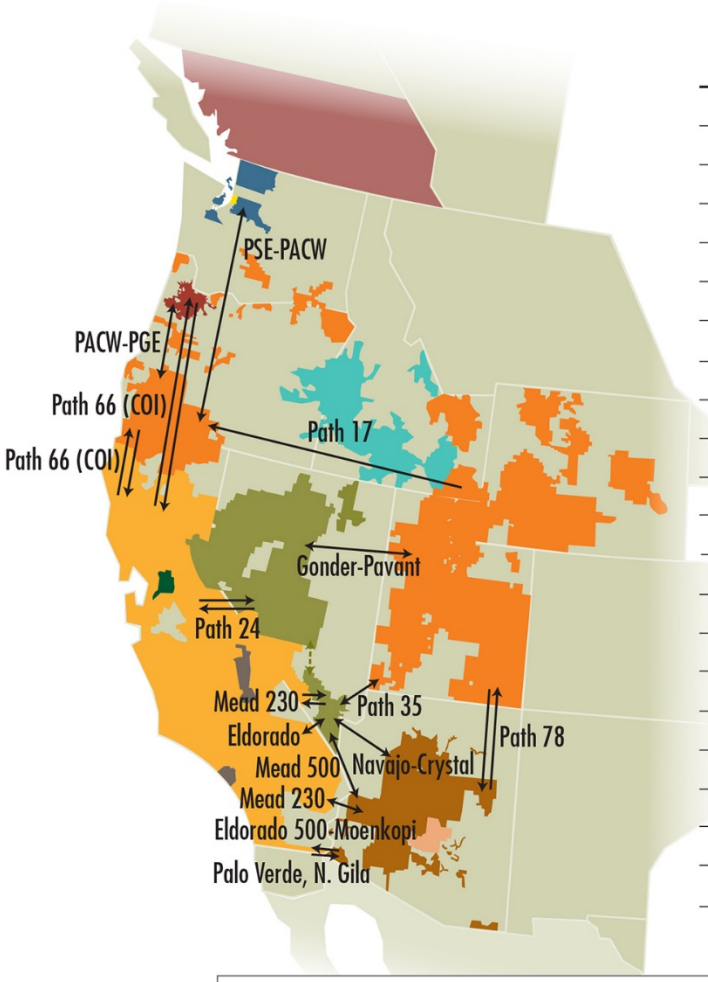
Table 2 provides the 15-minute and 5-minute EIM transfer volumes with base schedule transfers excluded. The EIM entities submit inter-BAA transfers in their base schedules. The benefits quantified in this report are only attributable to the transfers that occurred through the EIM. The benefits do not include any transfers attributed to transfers submitted in the base schedules that are scheduled prior to the start of the EIM.

The transfer from BAA_x to BAA_y and the transfer from BAA_y to BAA_x are separately reported. For example, if there is a 100 MWh transfer during a 5-minute interval, in addition to a base transfer from ISO to NVE, it will be reported as 100 MWh from_BAA ISO to_BAA NEVP, and 0 MWh from_BAA NEVP to_BAA ISO in the opposite direction. The 15-minute transfer volume is the result of optimization in the 15-minute market using all bids and base schedules submitted into the EIM. The 5-minute transfer volume is the result of optimization using all bids and base schedules submitted into EIM, based on unit commitments determined in the 15-minute market optimization. The maximum transfer capacities between EIM entities are shown in Graph 1 below.

Year	Month	from_BAA	to_BAA	15m EIM transfer (15m - base)	5m EIM transfer (5m - base)
2017	October	AZPS	CISO	129,251	105,562
		AZPS	NEVP	17,807	15,600
		AZPS	PACE	13,445	16,654
		CISO	AZPS	70,607	83,018
		CISO	NEVP	51,277	77,199
		CISO	PACW	16,283	17,727
		CISO	PGE	15,151	22,139
		NEVP	AZPS	9,240	9,878
		NEVP	CISO	38,013	33,045
		NEVP	PACE	114,986	140,689
		PACE	AZPS	95,443	81,511
		PACE	NEVP	11,074	8,102
		PACE	PACW	8,619	22,680
		PACW	CISO	38,391	42,021
		PACW	PGE	36,713	38,289
		PACW	PSEI	56,678	59,778
		PGE	CISO	4,022	6,496
		PGE	PACW	32,926	31,420
		PSEI	PACW	24,522	23,907
		AZPS	CISO	135,869	117,407
		AZPS	NEVP	6,926	5,947
		AZPS	PACE	22,675	28,169
		CISO	AZPS	56,783	58,022
		CISO	NEVP	33,812	48,617
		CISO	PACW	22,452	22,752
		CISO	PGE	16,739	21,525
		NEVP	AZPS	1,955	1,440

2017	**November**	NEVP	CISO	63,979	60,242
		NEVP	PACE	57,814	72,404
		PACE	AZPS	126,077	109,762
		PACE	NEVP	19,618	17,718
		PACE	PACW	9,332	18,361
		PACW	CISO	38,946	44,192
		PACW	PGE	36,952	40,642
		PACW	PSEI	38,098	37,393
		PGE	CISO	5,960	8,088
		PGE	PACW	27,963	27,436
		PSEI	PACW	40,110	42,819
2017	**December**	AZPS	CISO	125,118	106,937
		AZPS	NEVP	9,733	8,982
		AZPS	PACE	9,319	15,103
		CISO	AZPS	37,032	45,090
		CISO	NEVP	30,408	39,163
		CISO	PACW	8,290	7,790
		CISO	PGE	7,432	11,350
		NEVP	AZPS	9,706	9,591
		NEVP	CISO	64,392	58,211
		NEVP	PACE	28,615	42,492
		PACE	AZPS	77,248	65,177
		PACE	NEVP	39,361	33,496
		PACE	PACW	33,339	46,906
		PACW	CISO	121,159	125,697
		PACW	PGE	65,117	67,027
		PACW	PSEI	39,930	39,856
		PGE	CISO	11,945	13,845
		PGE	PACW	24,974	23,603
		PSEI	PACW	38,121	39,571

Table 2: Energy transfers (MWh) in the FMM and RTD for the fourth quarter 2017



Path	Estimated Max Capacity (MW)*
Path 24 *(west to east)*	100
Path 24 *(east to west)*	35-90
Eldorado	797
Path 35 *(west to east)*	580
Path 35 *(east to west)*	538
Gonder-Pavant	130
PACW to PGE	320
Path 66 *(ISO to PGE)*	627
Path 66 *(PGE to ISO)*	296
Path 66 *(ISO to PACW)*	331
Path 66 *(PACW to ISO)*	432
Path 17	400
PSE to PACW	300
Eldorado 500-Moenkopi	732
Palo Verde, N. Gila	3,151
Path 78 *(PACE to APS)*	625
Path 78 *(APS to PACE)*	660
Navajo-Crystal	522
Mead 500	349
Mead 230 *(APS <–> ISO)*	236
Mead 230 *(ISO to NVE)*	3,443
Mead 230 *(NVE to ISO)*	3,476

*Current as of December 2017

Graph 1: Estimated maximum transfer capacity (EIM entities operating in Q4 2017)

Wheel through transfers

As the footprint of the EIM grows and continues to change, wheel through transfers may become more common. Currently, an EIM entity facilitating a wheel through receives no direct financial benefit for facilitating the wheel; only the sink and source directly benefit. As part of the EIM Consolidated Initiatives stakeholder process, the ISO committed to monitoring the wheel through volumes to assess whether, after the addition of new EIM entities, there is a potential future need to pursue a market solution to address the equitable sharing of wheeling benefits. The ISO committed to tracking the volume of wheels through in the EIM market in this quarterly report. In order to derive the wheels through for each EIM BAA, the ISO uses the following calculation for every real-time interval dispatch:

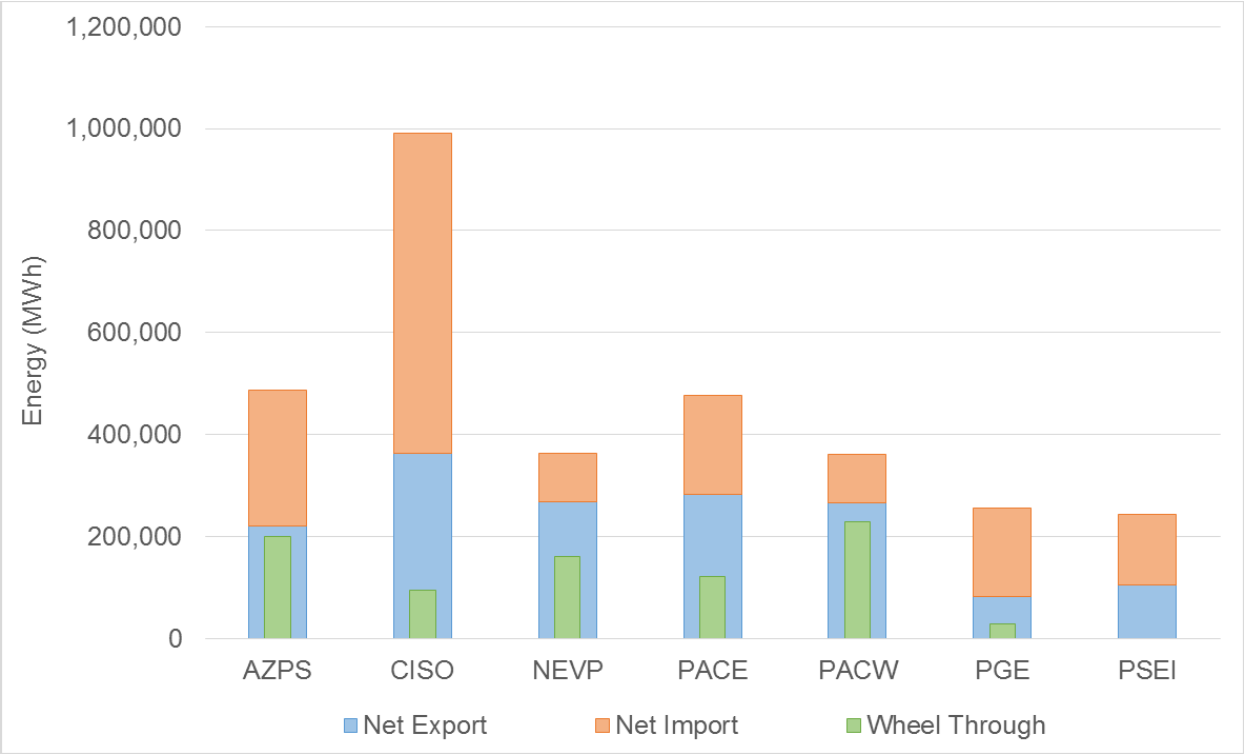
- Total import: summation of transfers above base transfers coming into the EIM BAA under analysis
- Total export: summation of all transfers above base transfers leaving the EIM BAA under analysis
- Net import: the maximum of zero or the difference between total imports and total exports
- Net export: the maximum of zero or the difference between total exports and total imports
- Wheel through: the minimum of the EIM transfers into (total import) or EIM transfer out (total export) of a BAA for a given interval

All wheels through are summed over the month or quarter. This volume reflects the total wheels through for each EIM BAA, regardless of the potential paths used to wheel through. The net imports and exports estimated in this section reflect the overall volume of net imports and exports; in contrast, the imports and exports provided in Table 2 reflect the gross transfers between two EIM BAAs.

The metric is measured as energy in MWh for each month and the corresponding calendar quarter, as shown in Tables 3 through 6 and Figures 2 through 5.

BAA	Net Export	Net Import	Wheel Through
AZPS	221,464	265,351	199,274
CISO	362,774	628,625	94,295
NEVP	268,287	94,685	161,090
PACE	281,967	194,972	121,536
PACW	266,488	95,744	229,828
PGE	82,276	172,658	29,349
PSEI	105,977	137,197	

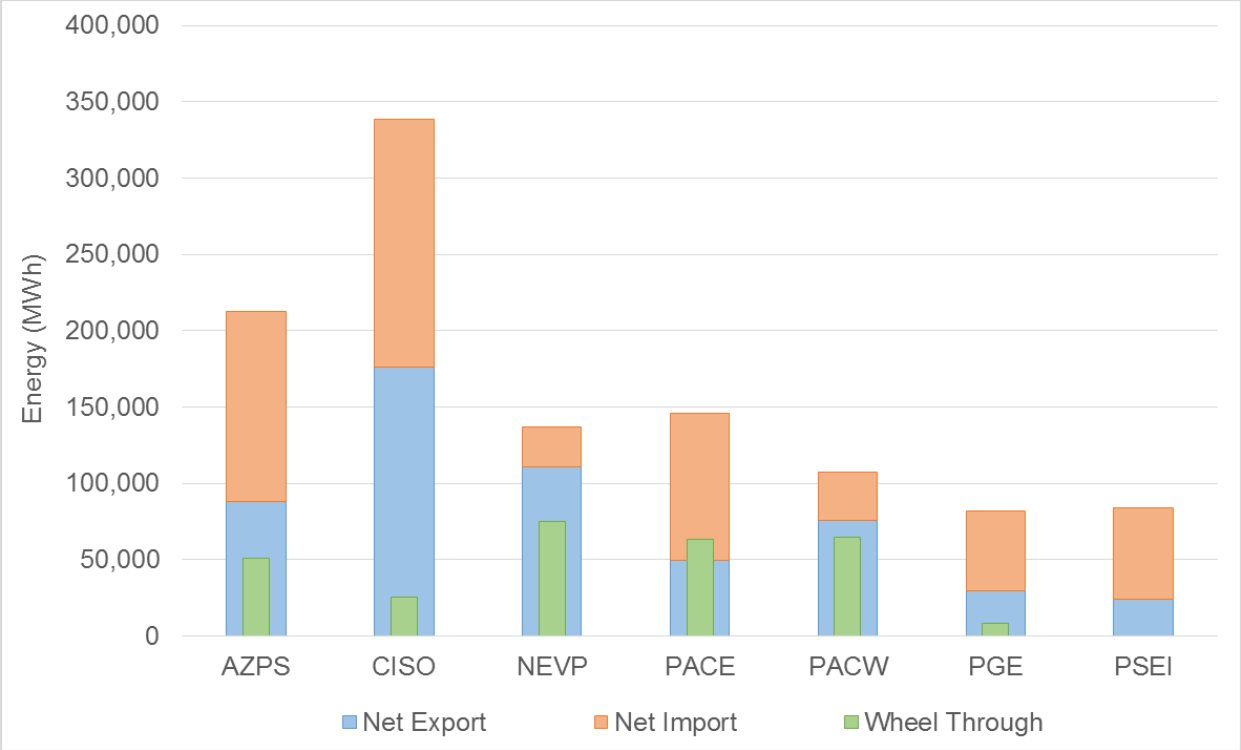
Table 3: Estimated wheel through transfers in Q4 2017



Graph 2: Estimated wheel through transfers in Q4 2017

BAA	Net Export	Net Import	Wheel Through
AZPS	87,695	124,717	50,621
CISO	176,066	162,477	25,247
NEVP	110,524	26,396	75,124
PACE	49,669	96,336	62,882
PACW	75,791	31,784	64,682
PGE	29,749	52,210	8,433
PSEI	24,303	59,875	

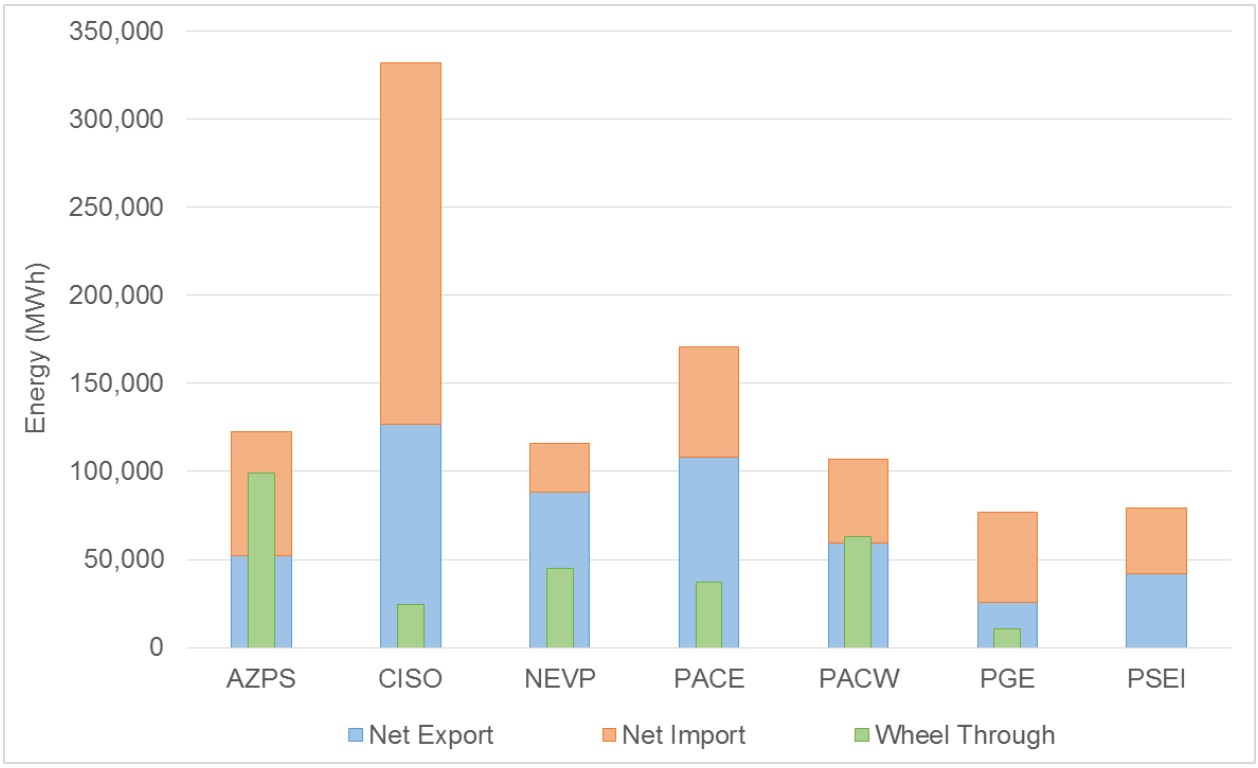
Table 4: Estimated wheel through transfers in October 2017



Graph 3: Estimated wheel through transfers in October 2017

BAA	Net Export	Net Import	Wheel Through
AZPS	52,406	70,173	98,901
CISO	127,020	205,244	24,407
NEVP	88,220	27,595	44,667
PACE	108,313	62,621	36,798
PACW	59,223	47,590	62,874
PGE	25,322	51,727	10,497
PSEI	41,842	37,395	

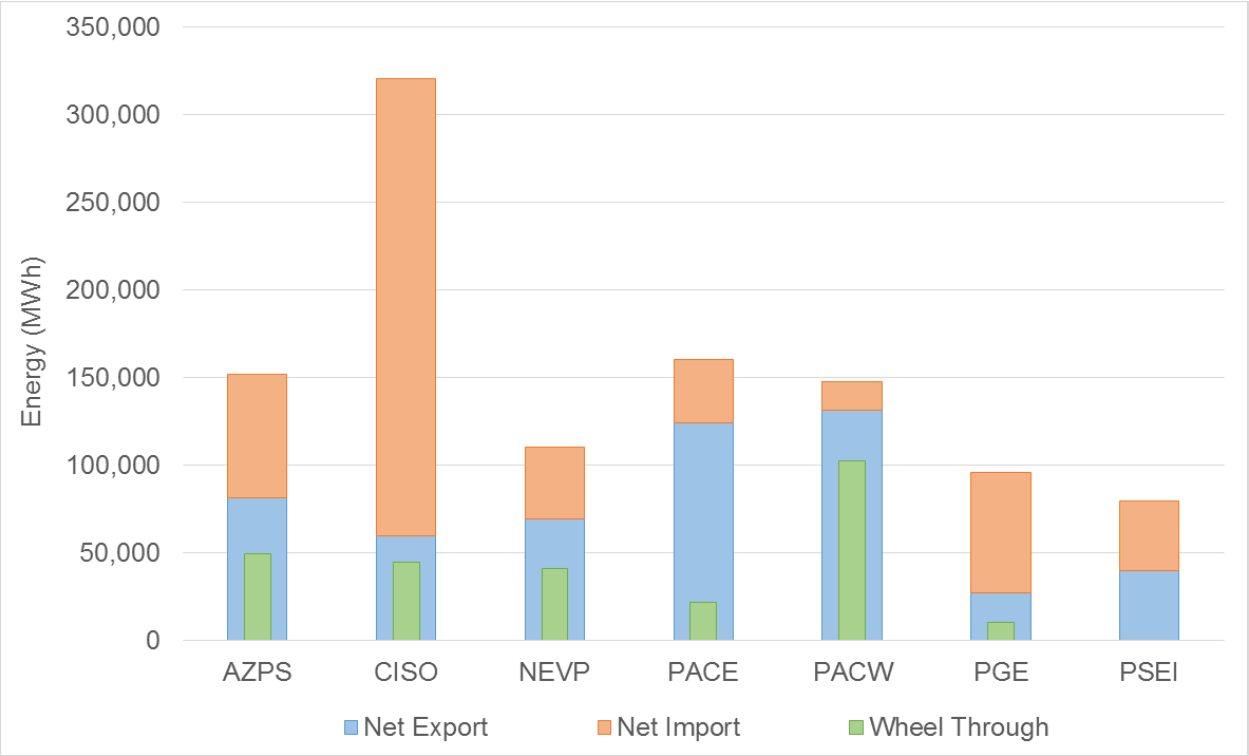
Table 5: Estimated wheel through transfers in November 2017



Graph 4: Estimated wheel through transfers in November 2017

BAA	Net Export	Net Import	Wheel Through
AZPS	81,363	70,461	49,751
CISO	59,689	260,904	44,641
NEVP	69,543	40,694	41,299
PACE	123,986	36,015	21,856
PACW	131,474	16,370	102,272
PGE	27,205	68,721	10,419
PSEI	39,832	39,926	

Table 6: Estimated wheel through transfers in December 2017



Graph 5: Estimated wheel through transfers in December 2017

Reduced Renewable Curtailment and GHG Reductions

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 2017 was calculated to be 9,444 MWh (October) + 5,974 MWh (November) + 2,642 MWh (December) = 18,060 MWh total.

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 CO_2/MWh, avoided curtailments displaced an estimated 7,730 metric tons of CO_2 for Q4 2017. Avoided renewable curtailments also may have contributed to an increased volume of renewable credits that would otherwise have been unavailable. This report does not quantify the additional value in dollars associated with this benefit. Total estimated reductions in the curtailment of renewable energy along with the associated reductions in CO_2 are shown in Table 7.

Year	Quarter	MWh	Eq. Tons CO2
2015	1	8,860	3,792
	2	3,629	1,553
	3	828	354
	4	17,765	7,521
2016	1	112,948	48,342
	2	158,806	67,969
	3	33,094	14,164
	4	23,390	10,011
2017	1	52,651	22,535
	2	67,055	28,700
	3	23,331	9,986
	4	18,060	7,730
	Total	520,417	222,657

Table 7: Total reduction in curtailment of renewable energy along with the associated reductions in CO_2

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 requirements. This difference is known as flexible ramping procurement diversity savings. Starting in November 2016, the ISO replaced the flexible ramping constraint with flexible ramping products that provide both upward and downward ramping. The minimum and maximum flexible ramping requirements for each BAA and for each direction are listed in Table 8.

Year	Month	BAA	Direction	Minimum requirement	Maximum requirement
2017	October	AZPS	up	0	249
		CISO	up	0	1,000
		NEVP	up	0	234
		PACE	up	0	300
		PACW	up	0	150
		PGE	up	0	132
		PSEI	up	0	135
		ALL EIM	up	0	1,800
		AZPS	down	0	350
		CISO	down	0	1,000
		NEVP	down	0	250
		PACE	down	0	300
		PACW	down	0	175

		PGE	down	0	131
		PSEI	down	0	135
		ALL EIM	down	0	1,200
2017	**November**	AZPS	up	0	249
		CISO	up	0	1,000
		NEVP	up	3	228
		PACE	up	25	300
		PACW	up	17	150
		PGE	up	0	113
		PSEI	up	20	135
		ALL EIM	up	0	1,800
		AZPS	down	17	214
		CISO	down	0	1,000
		NEVP	down	0	250
		PACE	down	58	300
		PACW	down	0	175
		PGE	down	0	148
		PSEI	down	13	135
		ALL EIM	down	0	1,200
2017	**December**	AZPS	up	0	241
		CISO	up	0	1,000
		NEVP	up	0	204
		PACE	up	0	300
		PACW	up	0	150
		PGE	up	0	150
		PSEI	up	0	135
		ALL EIM	up	0	1,800
		AZPS	down	0	236
		CISO	down	0	1,000
		NEVP	down	0	250
		PACE	down	0	300
		PACW	down	0	175
		PGE	down	0	148
		PSEI	down	0	135
		ALL EIM	down	0	1,200

Table 8: Flexible ramping requirements

The flexible ramping procurement diversity savings for all the intervals averaged over a month are shown in Table 9. The percentage savings is the average MW savings divided by the sum of the four individual BAA requirements.

	October		November		December	
Direction	Up	Down	Up	Down	Up	Down
Average MW saving	418	543	426	504	432	512
Sum of BAA requirements	1,247	1,323	1,169	1,232	1,151	1,196
Percentage savings	33%	41%	36%	41%	38%	43%

Table 9: Flexible ramping procurement diversity savings for fourth quarter 2017

Flexible ramping capacity may be used in RTD to handle uncertainties in the future interval. The RTD flexible ramping capacity is prorated to each BAA. Flexible ramping surplus MW is defined as the awarded flexible ramping capacity in RTD minus its share, and the flexible ramping surplus cost is defined as the flexible ramping surplus MW multiplied by the flexible ramping EIM-wide marginal price. A positive flexible ramping surplus MW is the capacity that a BAA provided to help other BAAs, and a negative flexible ramping surplus MW is the capacity that a BAA received from other BAAs. The EIM dispatch cost for a BAA with positive flexible ramping surplus MW is increased because some capacities are used to help other BAAs. The flexible ramping surplus cost is subtracted from the BAA's EIM dispatch cost to reflect the true dispatch cost of a BAA. Please see the Benefit Report Methodology in the Appendix for more details.

Conclusion

Participation in the western EIM continues to show that utilities can realize cost benefits and reduced carbon emissions. With $288.44 million in gross benefits to date, the realized savings are in line with analysis conducted by each EIM entity before they joined EIM. The EIM resource sharing also continues to have a positive effect on reducing greenhouse gas emissions by using renewable generation that otherwise would have been turned off. Use of this energy to meet demand across the EIM footprint is likely replacing less clean energy sources. The GHG quantified benefits due to avoided curtailments[4] of 222,657 metric tons from 2015 to date is roughly equivalent to avoiding the emissions from 46,813 passenger cars driven for one year.

[4] See footnote 1 on page 3.