

WESTERN EIM BENEFITS REPORT

Second Quarter 2021 ■ ■ ■

Prepared by: Market Analysis and Forecasting

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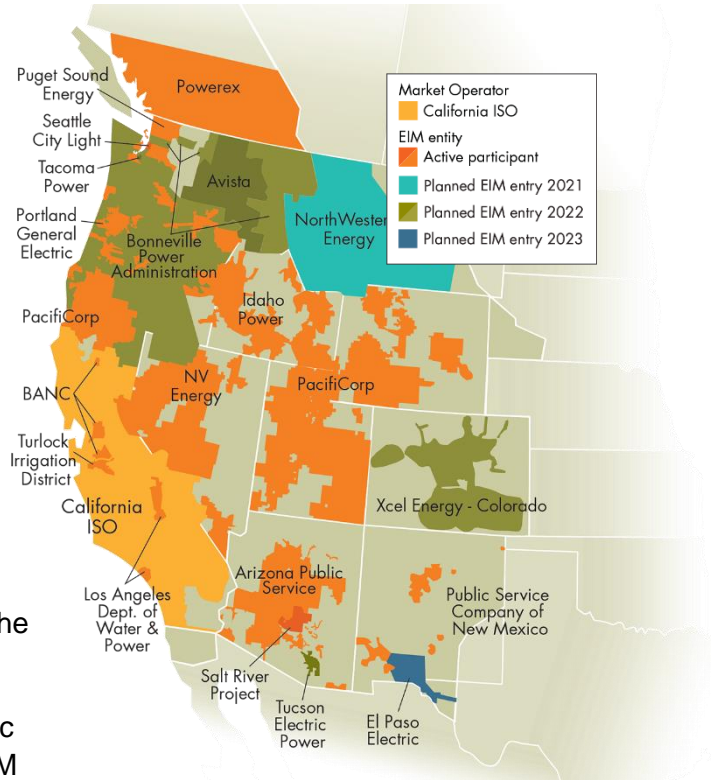
EXECUTIVE SUMMARY

Gross benefits from EIM since November 2014
\$1.42 billion

This report presents the benefits associated with participation in the Western Energy Imbalance Market (EIM).

The measured benefits of participation in the Western EIM include cost savings, increased integration of renewable energy, and improved operational efficiencies including the reduction of the need for real-time flexible reserves.

This analysis demonstrates the benefit of economic dispatch in the real time market across a larger EIM footprint with more diverse resources and geography.



2021 Q2 BENEFITS

Q2 2021 Gross Benefits by Participant

	(millions \$)
Arizona Public Service	\$9.25
BANC	\$18.12
California ISO	\$27.58
Idaho Power	\$15.23
LADWP	\$8.54
NV Energy	\$6.20
NorthWestern Energy	\$1.06
PacifiCorp	\$15.05
Portland General Electric	\$7.45
PNM	\$2.32
Puget Sound Energy	\$4.16
Powerex	\$1.01
Seattle City Light	\$2.75
Salt River Project	\$12.61
TID	\$1.37
Total	\$132.70

ECONOMICAL

\$132.70 M

Gross benefits realized due to more efficient inter-and intra-regional dispatch in the Fifteen-Minute Market (FMM) and Real-Time Dispatch (RTD)*

ENVIRONMENTAL

46,677

Metric tons of CO₂** avoided curtailments

OPERATIONAL

52%

Average reduction in flexibility reserves across the footprint

*EIM Quarterly Benefit Report Methodology:
<https://www.westerneim.com/Documents/EIM-BenefitMethodology.pdf>

**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.aiso.com/Documents/GreenhouseGasEmissionsTrackingReport-FrequentlyAskedQuestions.pdf>

BACKGROUND

The Western EIM began financially binding operation on November 1, 2014 by optimizing resources across the ISO and PacifiCorp Balancing Authority Areas (BAAs). NV Energy began participating in December 2015, Arizona Public Service and Puget Sound Energy began participating in October 2016, and Portland General Electric began participating in October 2017. Idaho Power and Powerex began participating in April 2018, and the Balancing Authority of Northern California (BANC)¹ began participating in April 2019. Seattle City Light and Salt River Project began participating in April 2020.

Most recently, three new balancing authorities began participating in the Western EIM, with the Turlock Irrigation District (TID) in March 2021², the second phase of BANC in March 2021, and the Los Angeles Department of Water and Power (LADWP) and Public Service Company of New Mexico (PNM) in April 2021, followed by NorthWestern Energy (NWMET) starting in June 2021.

The Western EIM footprint now includes portions of Arizona, California, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming, Montana, and extends to the border with Canada.

WESTERN EIM ECONOMIC BENEFITS IN Q2 2021

Table 1 shows the estimated EIM gross benefits by each region per month³. The monthly savings presented show \$31.11 million for April, \$30.43 million for May, and \$71.16 million for June with a total estimated benefit of \$132.70 million for this quarter.

The increased benefits observed on June 2021 were largely driven by the heat wave in mid-June that resulted in high electric energy prices.

¹ Modesto Irrigation District, the City of Redding, the City of Roseville, and the Western Area Power Administration – Sierra Nevada Region became part of the overall BANC EIM on March 25. Benefits for BANC for March 25 through March 31 are incorporated in April 2021 benefits for BANC.

² Benefits for TID for March 25 through March 31 are incorporated in April 2021 benefits for TID.

³ 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.

<i>Region</i>	April	May	June	Total
<i>APS</i>	\$2.46	\$2.61	\$4.18	\$9.25
<i>BANC</i>	\$5.21	\$3.45	\$9.46	\$18.12
<i>CISO</i>	\$3.77	\$4.50	\$19.31	\$27.58
<i>IPCO</i>	\$3.33	\$3.11	\$8.79	\$15.23
<i>LADWP</i>	\$2.17	\$2.58	\$3.79	\$8.54
<i>NVE</i>	\$1.52	\$1.88	\$2.80	\$6.20
<i>NWMT</i>			\$1.06	\$1.06
<i>PAC</i>	\$3.51	\$3.19	\$8.35	\$15.05
<i>PGE</i>	\$2.69	\$1.82	\$2.94	\$7.45
<i>PNM</i>	\$0.33	\$0.68	\$1.31	\$2.32
<i>PSE</i>	\$1.29	\$1.17	\$1.70	\$4.16
<i>PWRX</i>	\$0.50	\$0.23	\$0.28	\$1.01
<i>SCL</i>	\$0.71	\$0.66	\$1.38	\$2.75
<i>SRP</i>	\$3.20	\$4.09	\$5.32	\$12.61
<i>TID</i>	\$0.42	\$0.46	\$0.49	\$1.37
Total	\$31.11	\$30.43	\$71.16	\$132.70

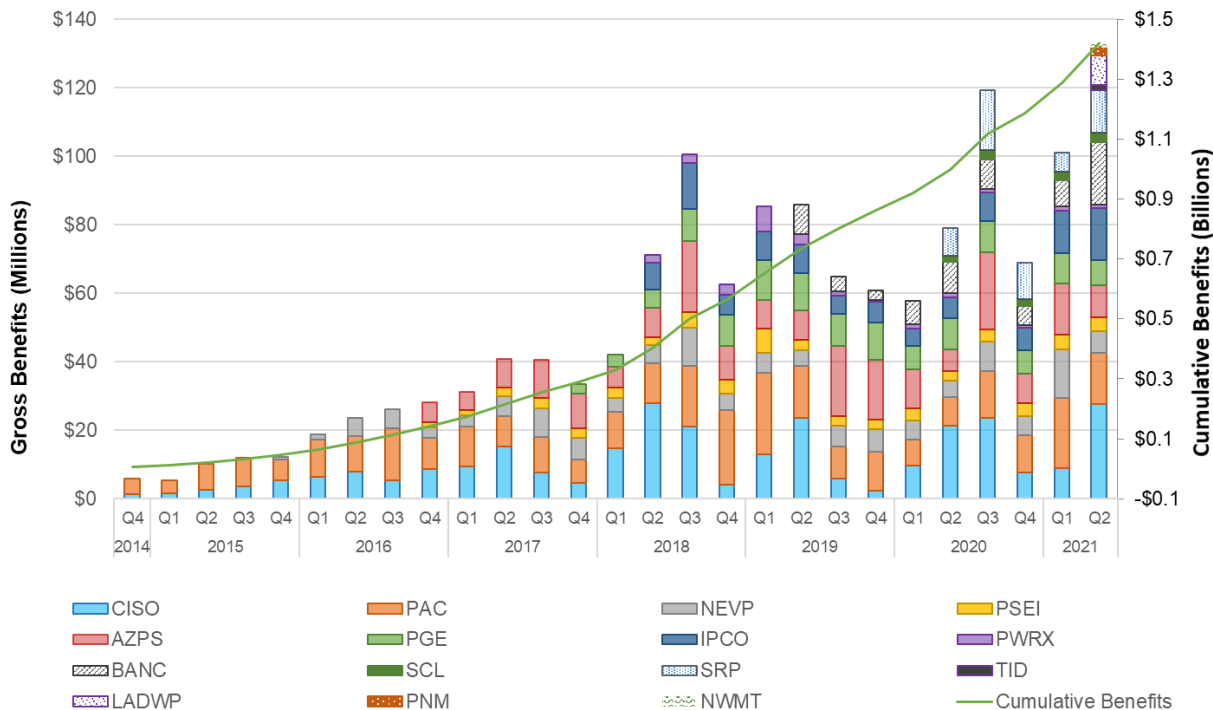
TABLE 1: Q2 2021 benefits in millions USD

■ CUMULATIVE ECONOMIC BENEFITS SINCE INCEPTION

Since the start of the EIM in November 2014, the cumulative economic benefits of the market have totaled \$1.42 billion. The quarterly benefits have grown over time as a result of the participation of new BAAs, which results in benefits for both the individual BAA but also compounds the benefits to adjacent BAAs through additional transfers. The ISO began publishing quarterly EIM benefit reports in April 2015.⁴

Graph 1 illustrates the gross economic benefits of the EIM by quarter for each participating BAA.

⁴ Prior reports are available at <https://www.westerneim.com/Pages/About/QuarterlyBenefits.aspx>



GRAPH 1: Cumulative economic benefits for each quarter by BAA

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 15-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 the 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 Megawatt-Hour (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 2 below.

Month	From BAA	To BAA	15min EIM transfer (15m – base)	5min EIM transfer (5m – base)
<i>April</i>	AZPS	CISO	108,819	82,649
	AZPS	LADWP	19,700	21,650
	AZPS	NEVP	6,129	8,467
	AZPS	PACE	24,536	35,027
	AZPS	PNM	11,340	14,805
	AZPS	SRP	22,461	14,092
	BANC	CISO	2,770	1,381
	BANC	TIDC	0	0
	CISO	AZPS	57,488	83,244
	CISO	BANC	163,792	181,035
	CISO	LADWP	73,970	87,289
	CISO	NEVP	91,696	109,257
	CISO	PACW	2,974	40,512
	CISO	PGE	11,271	29,855
	CISO	PWRX	10,604	13,383
	CISO	SRP	139,681	156,429
	CISO	TIDC	9,995	13,605
	IPCO	NEVP	24,537	11,946
	IPCO	PACE	3,767	4,814
	IPCO	PACW	26,101	24,934
IPCO	PSEI	0	0	
IPCO	SCL	6,040	6,387	

	LADWP	AZPS	681	1,449
	LADWP	CISO	46,638	33,441
	LADWP	NEVP	10,829	12,280
	LADWP	PACE	16,409	15,336
	NEVP	AZPS	924	1,189
	NEVP	CISO	89,801	49,410
	NEVP	IPCO	46,136	47,925
	NEVP	LADWP	28,449	22,483
	NEVP	PACE	31,339	35,024
	PACE	AZPS	80,698	56,765
	PACE	IPCO	92,865	91,028
	PACE	LADWP	14,847	11,901
	PACE	NEVP	64,915	38,033
	PACE	PACW	21,351	18,423
	PACE	SRP	0	0
	PACW	CISO	8,819	31,044
	PACW	IPCO	47,968	39,768
	PACW	PGE	37,825	32,749
	PACW	PSEI	17,772	23,213
	PACW	SCL	731	813
<i>April</i>	PGE	CISO	16,473	2
	PGE	PACW	37,523	43,599
	PGE	PSEI	9,670	13,458
	PGE	SCL	2,988	3,229
	PNM	AZPS	22,400	20,279
	PNM	SRP	22,383	16,383
	PSEI	IPCO	0	0
	PSEI	PACW	34,206	35,707

	PSEI	PGE	13,831	14,152
	PSEI	PWRX	17,091	18,504
	PSEI	SCL	24,117	23,349
	PWRX	CISO	11,263	6
	PWRX	PSEI	42,304	42,430
	SCL	IPCO	6,791	6,016
	SCL	PACW	4,175	4,206
	SCL	PGE	4,770	5,242
	SCL	PSEI	8,652	10,059
	SRP	AZPS	8,195	18,801
	SRP	CISO	129,543	120,922
	SRP	PACE	0	0
	SRP	PNM	2,487	3,785
	TIDC	BANC	29	84
	TIDC	CISO	14,316	12,159
<i>May</i>	AZPS	CISO	70,135	45,856
	AZPS	LADWP	25,283	30,715
	AZPS	NEVP	5,061	5,387
	AZPS	PACE	23,386	22,483
	AZPS	PNM	44,520	43,914
	AZPS	SRP	25,637	23,056
	BANC	CISO	9,669	5,658
	BANC	TIDC	0	0
	CISO	AZPS	117,836	125,411
	CISO	BANC	127,005	154,165
	CISO	LADWP	128,015	132,731
	CISO	NEVP	101,242	110,488
	CISO	PACW	2,153	45,620

May	CISO	PGE	11,285	32,191
	CISO	PWRX	11,947	15,175
	CISO	SRP	191,781	203,853
	CISO	TIDC	17,724	19,962
	IPCO	NEVP	27,378	18,196
	IPCO	PACE	8,340	9,435
	IPCO	PACW	15,378	13,673
	IPCO	PSEI	15,528	13,553
	IPCO	SCL	8,109	7,795
	LADWP	AZPS	3,137	4,838
	LADWP	CISO	30,785	20,130
	LADWP	NEVP	12,667	12,311
	LADWP	PACE	68,066	63,798
	NEVP	AZPS	6,336	7,032
	NEVP	CISO	62,718	34,254
	NEVP	IPCO	40,437	41,627
	NEVP	LADWP	66,933	57,781
	NEVP	PACE	39,510	38,006
	PACE	AZPS	111,346	101,199
	PACE	IPCO	103,964	94,656
	PACE	LADWP	34,462	31,803
	PACE	NEVP	105,934	80,539
	PACE	PACW	24,974	25,105
	PACE	SRP	0	0
	PACW	CISO	15,301	25,496
	PACW	IPCO	29,356	22,645
	PACW	PGE	28,124	29,430
	PACW	PSEI	20,373	24,909

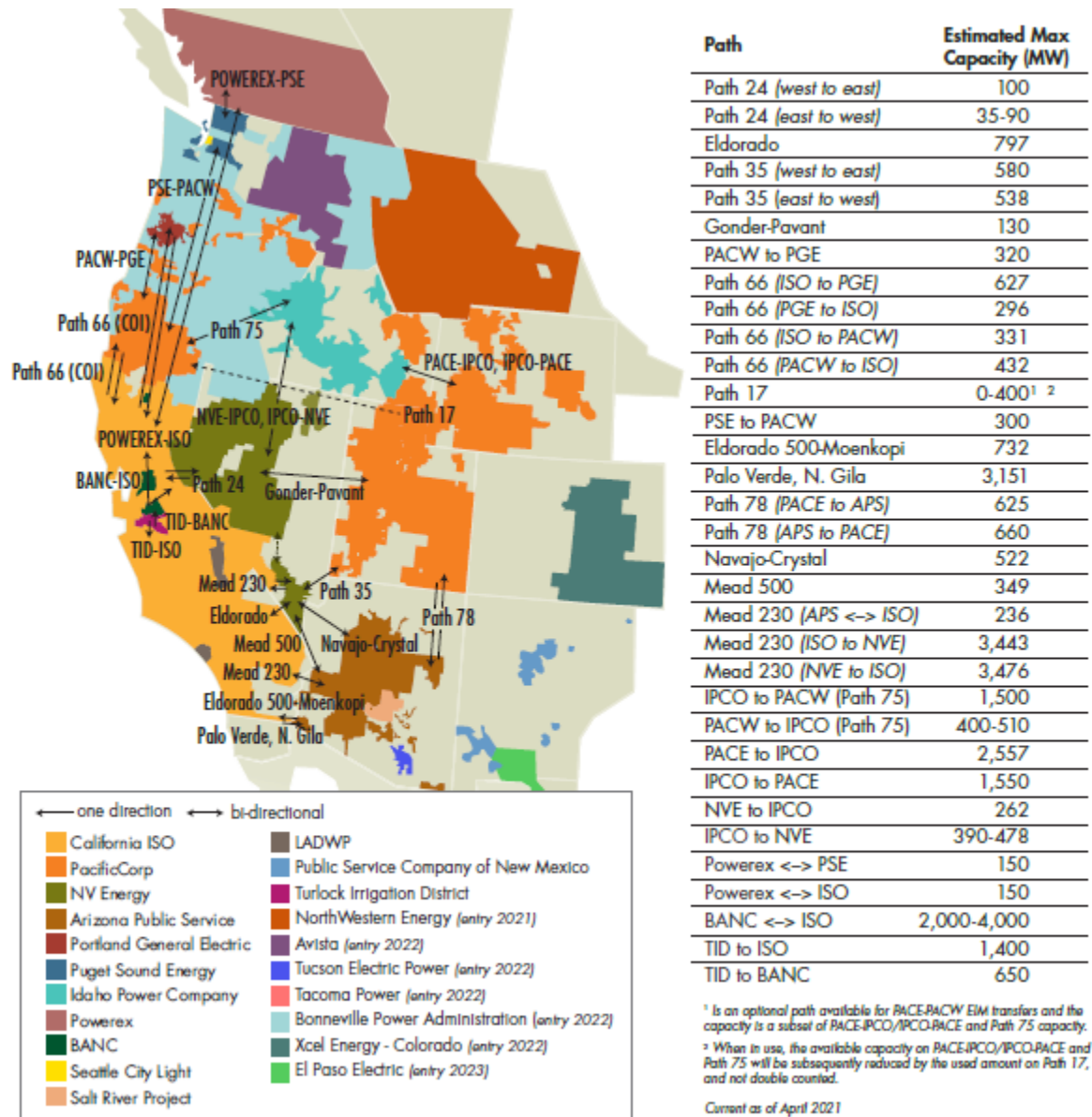
<i>May</i>	PACW	SCL	790	784	
	PGE	CISO	18,572	13	
	PGE	PACW	32,039	32,146	
	PGE	PSEI	8,568	12,307	
	PGE	SCL	3,514	3,485	
	PNM	AZPS	36,402	32,241	
	PNM	SRP	6,387	5,628	
	PSEI	IPCO	0	0	
	PSEI	PACW	23,168	21,538	
	PSEI	PGE	7,882	7,719	
	PSEI	PWRX	16,755	16,123	
	PSEI	SCL	20,075	22,423	
	PWRX	CISO	19,938	44	
	PWRX	PSEI	15,920	15,816	
	SCL	IPCO	5,890	5,388	
	SCL	PACW	3,989	3,846	
	SCL	PGE	4,658	5,110	
	SCL	PSEI	5,263	8,777	
	SRP	AZPS	17,225	22,900	
	SRP	CISO	87,397	80,693	
	SRP	PACE	0	0	
	SRP	PNM	1,509	2,429	
	TIDC	BANC	0	0	
	TIDC	CISO	15,007	13,005	
	<i>June</i>	AZPS	CISO	165,939	128,119
		AZPS	LADWP	29,081	24,591
		AZPS	NEVP	18,514	20,144
AZPS		PACE	27,141	37,186	

AZPS	PNM	22,266	26,363
AZPS	SRP	28,094	27,971
BANC	CISO	15,741	13,772
BANC	TIDC	55	18
CISO	AZPS	36,113	40,836
CISO	BANC	118,199	131,930
CISO	LADWP	45,431	56,064
CISO	NEVP	58,823	71,104
CISO	PACW	6,195	8,783
CISO	PGE	5,773	12,552
CISO	PWRX	8,877	12,269
CISO	SRP	63,452	70,907
CISO	TIDC	15,155	17,413
IPCO	NEVP	27,855	18,049
IPCO	NWMT	1,328	1,635
IPCO	PACE	1,396	1,940
IPCO	PACW	10,642	12,254
IPCO	PSEI	2,629	2,578
IPCO	SCL	2,785	2,780
LADWP	AZPS	5,538	8,986
LADWP	CISO	95,140	76,104
LADWP	NEVP	9,561	13,235
LADWP	PACE	17,854	15,652
NEVP	AZPS	2,546	4,592
NEVP	CISO	124,249	77,570
NEVP	IPCO	49,372	58,382
NEVP	LADWP	20,771	24,159
NEVP	PACE	23,256	25,824

<i>June</i>	NWMT	IPCO	3,168	3,096
	NWMT	PACE	325	137
	PACE	AZPS	91,242	73,212
	PACE	IPCO	117,342	121,126
	PACE	LADWP	82,694	78,048
	PACE	NEVP	102,997	84,127
	PACE	NWMT	12,982	14,388
	PACE	PACW	28,708	31,612
	PACE	SRP	0	0
	PACW	CISO	13,929	53,649
	PACW	IPCO	66,159	52,691
	PACW	PGE	36,093	32,552
	PACW	PSEI	16,009	14,581
	PACW	SCL	704	424
<i>June</i>	PGE	CISO	11,849	0
	PGE	PACW	36,936	48,387
	PGE	PSEI	6,445	6,464
	PGE	SCL	2,824	2,385
	PNM	AZPS	44,575	40,237
	PNM	SRP	9,617	8,069
	PSEI	IPCO	0	0
	PSEI	PACW	33,010	42,722
	PSEI	PGE	13,126	14,794
	PSEI	PWRX	18,707	15,462
	PSEI	SCL	24,940	21,561
	PWRX	CISO	15,829	2
	PWRX	PSEI	6,423	9,584
	SCL	IPCO	11,094	10,432

SCL	PACW	4,629	7,326
SCL	PGE	4,544	5,793
SCL	PSEI	4,999	8,810
SRP	AZPS	29,316	37,432
SRP	CISO	204,531	191,172
SRP	PACE	0	0
SRP	PNM	800	1,343
TIDC	BANC	0	119
TIDC	CISO	16,965	15,428

TABLE 2: Energy transfers (MWh) in the FMM and RTD markets for Q2 2021



GRAPH 2: Estimated maximum transfer capacity (EIM entities operating in Q1 2021)

WHEEL THROUGH TRANSFERS

As the footprint of the Western EIM grows, 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 Western 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 will continue to track the volume of wheel-through transfers in the EIM market in the quarterly reports. In order to derive the wheel-through transfers 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 going out of 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

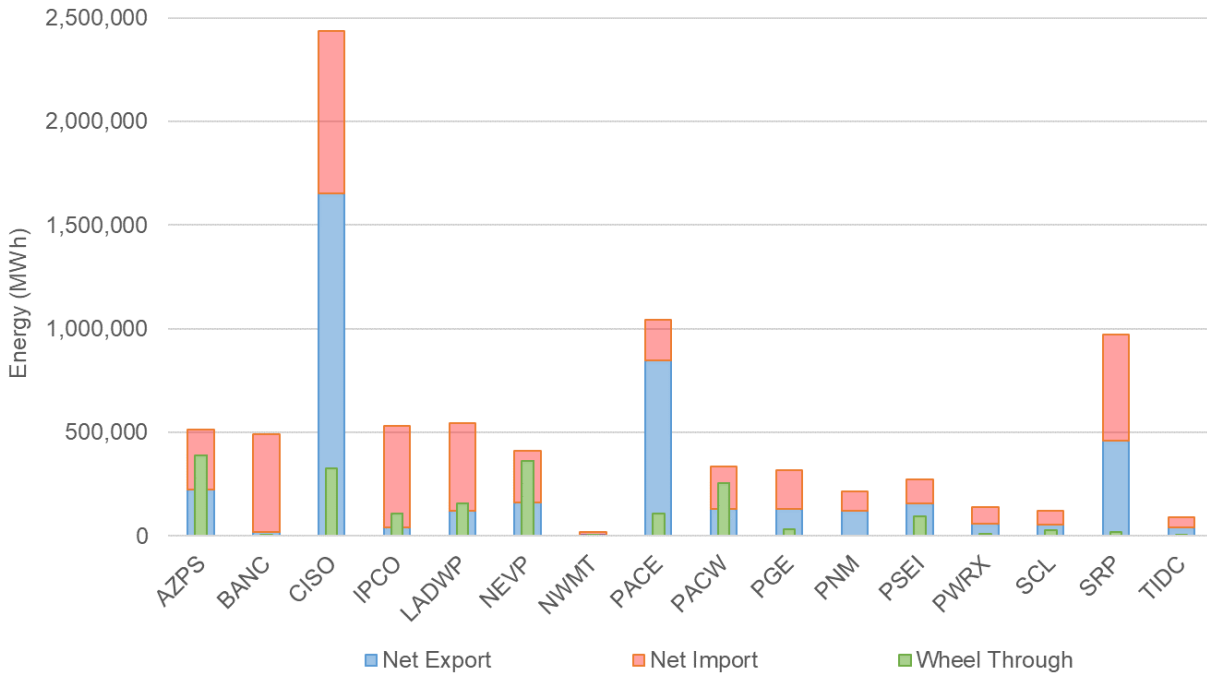
All wheel-through transfers are summed over both the month and the quarter. This volume reflects the total wheel-through transfers for each EIM BAA, regardless of the potential paths used to wheel through. The net imports and exports estimated in this section reflect the overall volume of net imports 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 Graphs 3 through 6.

<i>BAA</i>	<i>Net Export</i>	<i>Net Import</i>	<i>Wheel Through</i>
<i>AZPS</i>	222,849	291,466	391,014
<i>BANC</i>	20,819	468,521	17
<i>CISO</i>	1,653,347	785,004	328,082
<i>IPCO</i>	43,479	489,356	106,908
<i>LADWP</i>	120,981	423,902	157,023
<i>NEVP</i>	162,231	250,100	364,199
<i>NWMT</i>	2,496	15,344	738
<i>PACE</i>	845,232	197,109	108,627
<i>PACW</i>	130,917	206,141	255,248
<i>PGE</i>	131,225	188,589	34,419
<i>PNM</i>	123,035	92,852	-
<i>PSEI</i>	159,334	111,874	95,190
<i>PWRX</i>	57,999	81,019	10,049

<i>SCL</i>	53,373	67,837	27,788
<i>SRP</i>	461,302	509,306	18,757
<i>TIDC</i>	40,752	50,949	117

TABLE 3: Estimated wheel-through transfers in Q2 2021

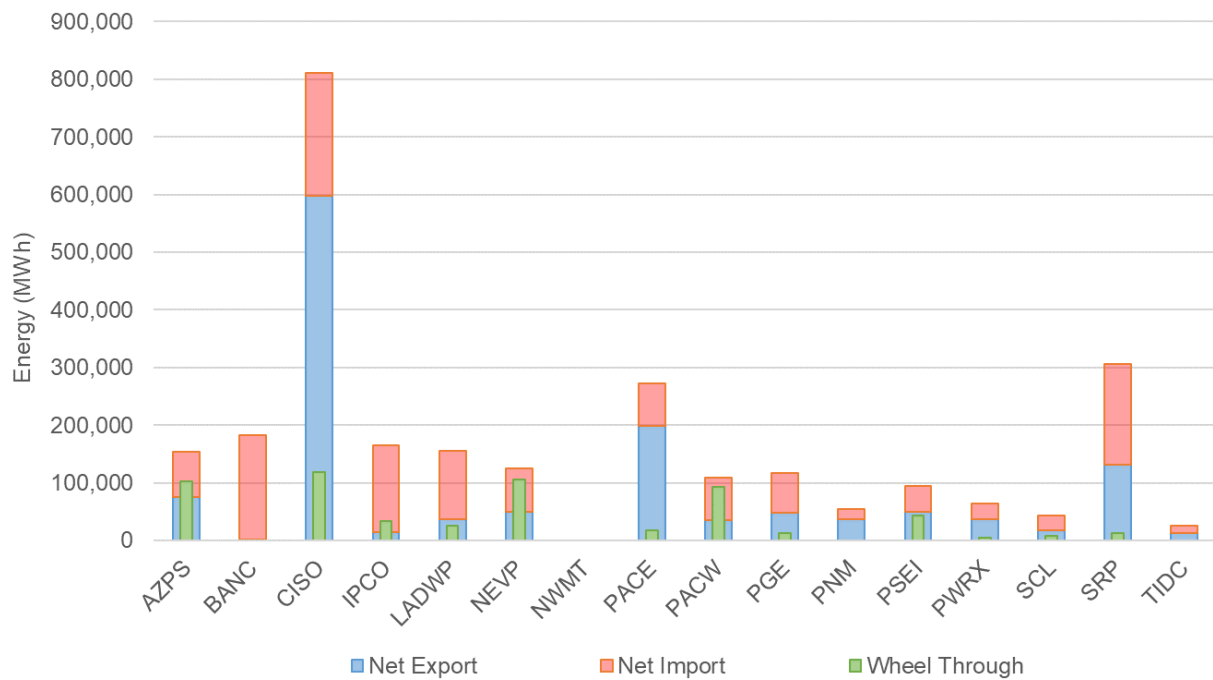


GRAPH 3: Estimated wheel-through transfers in Q2 2021

BAA	Net Export	Net Import	Wheel-Through
<i>AZPS</i>	74,633	79,982	102,292
<i>BANC</i>	1,388	181,310	-
<i>CISO</i>	597,823	213,064	118,415
<i>IPCO</i>	14,024	150,828	34,194
<i>LADWP</i>	37,687	118,563	24,994
<i>NEVP</i>	50,536	74,530	105,713
<i>NWMT</i>	-	-	-
<i>PACE</i>	199,366	73,529	16,949

<i>PACW</i>	34,706	74,522	93,090
<i>PGE</i>	47,741	69,533	12,590
<i>PNM</i>	36,713	18,611	-
<i>PSEI</i>	49,001	46,416	42,879
<i>PWRX</i>	37,111	26,480	5,428
<i>SCL</i>	17,338	25,598	8,243
<i>SRP</i>	131,186	174,927	12,563
<i>TIDC</i>	12,252	13,614	-

TABLE 4: Estimated wheel-through transfers in April 2021

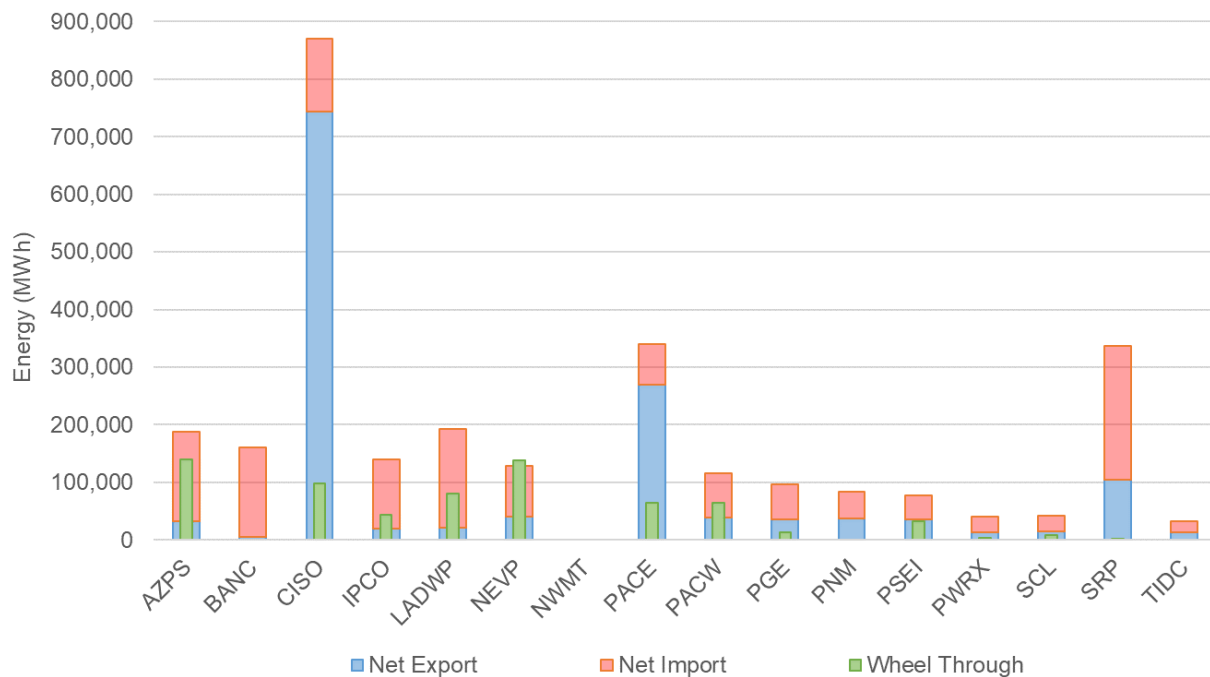


GRAPH 4: Estimated wheel-through transfers in April 2021

<i>BAA</i>	Net Export	Net Import	Wheel- Through
<i>AZPS</i>	32,204	154,930	139,474
<i>BANC</i>	5,658	154,424	-
<i>CISO</i>	743,797	127,282	98,075

<i>IPCO</i>	19,397	121,086	43,327
<i>LADWP</i>	20,388	172,772	80,815
<i>NEVP</i>	40,133	88,338	138,716
<i>NWMT</i>	-	-	-
<i>PACE</i>	269,730	70,642	63,693
<i>PACW</i>	39,013	77,186	64,969
<i>PGE</i>	34,830	61,566	13,177
<i>PNM</i>	37,877	46,452	-
<i>PSEI</i>	34,866	42,462	33,042
<i>PWRX</i>	12,679	28,135	3,213
<i>SCL</i>	14,866	26,318	8,269
<i>SRP</i>	104,791	231,693	1,491
<i>TIDC</i>	13,031	19,975	-

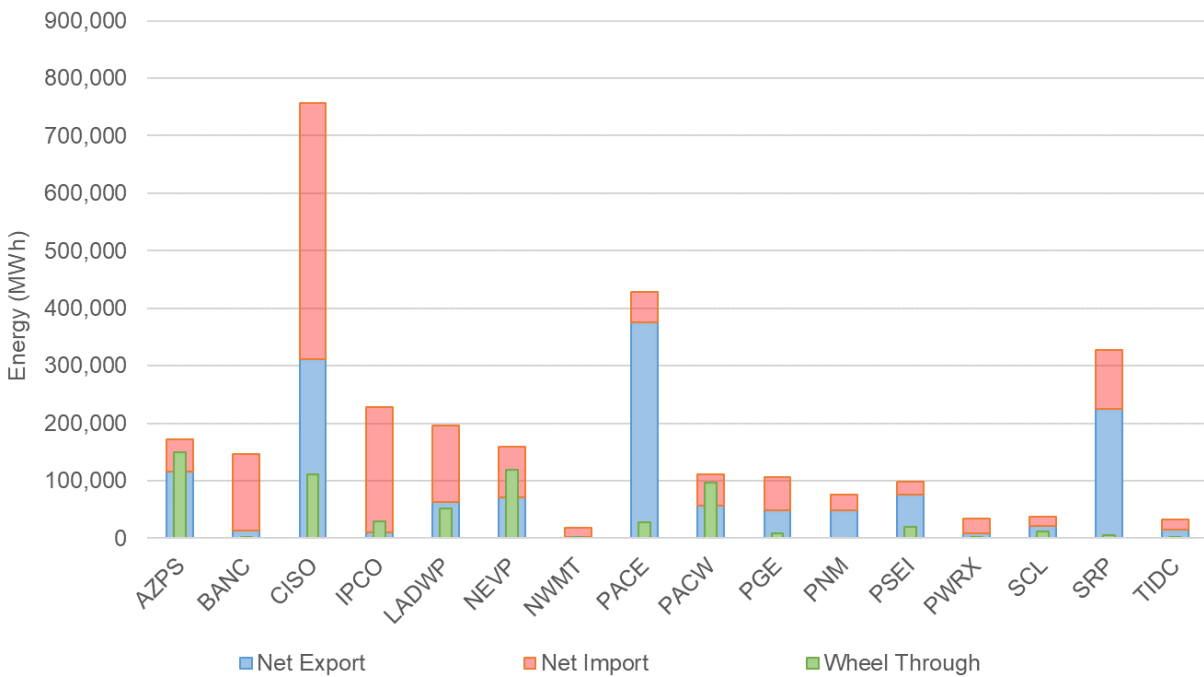
TABLE 5: Estimated wheel-through transfers in May 2021



GRAPH 5: Estimated wheel-through transfers in May 2021

<i>BAA</i>	Net Export	Net Import	Wheel Through
<i>AZPS</i>	116,013	56,554	149,247
<i>BANC</i>	13,773	132,787	17
<i>CISO</i>	311,727	444,659	111,592
<i>IPCO</i>	10,058	217,442	29,387
<i>LADWP</i>	62,906	132,567	51,215
<i>NEVP</i>	71,561	87,232	119,770
<i>NWMT</i>	2,496	15,344	738
<i>PACE</i>	376,136	52,938	27,985
<i>PACW</i>	57,198	54,434	97,189
<i>PGE</i>	48,654	57,490	8,652
<i>PNM</i>	48,445	27,788	-
<i>PSEI</i>	75,467	22,996	19,268
<i>PWRX</i>	8,209	26,404	1,408
<i>SCL</i>	21,168	15,920	11,276
<i>SRP</i>	225,325	102,687	4,703
<i>TIDC</i>	15,469	17,361	117

TABLE 6: Estimated wheel-through transfers in June 2021



GRAPH 6: Estimated wheel-through transfers in June 2021

REDUCED RENEWABLE CURTAILMENT AND GHG REDUCTIONS

The Western EIM benefit calculation includes the economic benefits that can be attributed to avoided renewable curtailment within the ISO footprint. 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 Q2 2021 was calculated to be 49,173 MWh (April) + 43,119 MWh (May) + 16,767 MWh (June) = 109,059 MWh total.

There are environmental benefits of avoided renewable curtailment as well. 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 46,677 metric tons of CO₂ for Q2 2021. 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 in the ISO footprint, along with the associated reductions in CO₂, are shown in Table 7.

Year	Quarter	MWh	Eq. Tons CO ₂
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
2018	1	65,860	28,188
	2	129,128	55,267
	3	19,032	8,146
	4	23,425	10,026
2019	1	52,254	22,365
	2	132,937	56,897
	3	33,843	14,485
	4	35,254	15,089
2020	1	86,740	37,125
	2	147,514	63,136
	3	37,548	16,071
	4	39,956	17,101
2021	1	76,147	32,591
	2	109,059	46,677
Total		1,509,114	645,821

TABLE 7: Total reduction in curtailment of renewable energy and associated reductions in CO₂

■ FLEXIBLE RAMPING PROCUREMENT DIVERSITY SAVINGS

The Western 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 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.

Month	BAA	Direction	Minimum requirement	Maximum requirement
April	AZPS	up	0	292
	BANC	up	0	113
	CISO	up	0	1955
	IPCO	up	0	212
	LADWP	up	0	241
	NEVP	up	0	275
	PACE	up	0	328
	PACW	up	0	181
	PGE	up	0	310
	PNM	up	0	162
	PSEI	up	0	177
	PWRX	up	0	282
	SCL	up	0	52
	SRP	up	0	136
	TIDC	up	0	15
	ALL EIM	up	0	2,734
April	AZPS	down	0	292
	BANC	down	0	119
	CISO	down	0	1,361
	IPCO	down	0	224
	LADWP	down	0	171
	NEVP	down	0	272
	PACE	down	0	407
	PACW	down	0	157
	PGE	down	0	234
	PNM	down	0	164
	PSEI	down	0	144

	<i>PWRX</i>	down	0	268
	<i>SCL</i>	down	0	43
	<i>SRP</i>	down	0	161
	<i>TIDC</i>	down	0	18
	ALL EIM	down	0	1,807
<i>May</i>	<i>AZPS</i>	up	34	292
	<i>BANC</i>	up	7	80
	<i>CISO</i>	up	113	1,824
	<i>IPCO</i>	up	26	229
	<i>LADWP</i>	up	31	241
	<i>NEVP</i>	up	27	275
	<i>PACE</i>	up	104	328
	<i>PACW</i>	up	60	181
	<i>PGE</i>	up	72	310
	<i>PNM</i>	up	35	158
	<i>PSEI</i>	up	36	177
	<i>PWRX</i>	up	69	278
	<i>SCL</i>	up	5	52
	<i>SRP</i>	up	37	148
	<i>TIDC</i>	up	1	15
	ALL EIM	up	101	2,563
<i>May</i>	<i>AZPS</i>	down	34	292
	<i>BANC</i>	down	0	119
	<i>CISO</i>	down	226	1,361
	<i>IPCO</i>	down	54	224
	<i>LADWP</i>	down	23	171
	<i>NEVP</i>	down	22	277
	<i>PACE</i>	down	121	407
	<i>PACW</i>	down	29	157
	<i>PGE</i>	down	45	234
	<i>PNM</i>	down	32	164

	<i>PSEI</i>	down	27	154	
	<i>PWRX</i>	down	69	268	
	<i>SCL</i>	down	0	38	
	<i>SRP</i>	down	16	159	
	<i>TIDC</i>	down	1	18	
	ALL EIM	down	272	1,807	
<i>June</i>	<i>AZPS</i>	up	32	294	
	<i>BANC</i>	up	6	73	
	<i>CISO</i>	up	321	2,059	
	<i>IPCO</i>	up	31	229	
	<i>LADWP</i>	up	34	359	
	<i>NEVP</i>	up	37	303	
	<i>NWMT</i>	up	36	83	
	<i>PACE</i>	up	66	541	
	<i>PACW</i>	up	54	181	
	<i>PGE</i>	up	67	310	
	<i>PNM</i>	up	34	227	
	<i>PSEI</i>	up	30	150	
	<i>PWRX</i>	up	69	219	
	<i>SCL</i>	up	4	32	
	<i>SRP</i>	up	23	160	
	<i>TIDC</i>	up	2	15	
		ALL EIM	up	323	2,260
		<i>AZPS</i>	down	30	288
		<i>BANC</i>	down	2	96
		<i>CISO</i>	down	98	1,631
		<i>IPCO</i>	down	38	246
		<i>LADWP</i>	down	29	191
		<i>NEVP</i>	down	34	282
		<i>NWMT</i>	down	24	100
	<i>PACE</i>	down	121	581	

<i>PACW</i>	down	14	159
<i>PGE</i>	down	39	244
<i>PNM</i>	down	48	196
<i>PSEI</i>	down	37	154
<i>PWRX</i>	down	69	229
<i>SCL</i>	down	1	29
<i>SRP</i>	down	18	178
<i>TIDC</i>	down	2	12
ALL EIM	down	196	1,807

Table 8: Flexible ramping requirements

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

	April		May		June	
<i>Direction</i>	Up	Down	Up	Down	Up	Down
<i>Average MW saving</i>	1,168	1,179	1,110	1,145	1,206	1,305
<i>Sum of BAA requirements</i>	2,437	2,187	2,278	2,142	2,399	2,172
<i>Percentage savings</i>	48%	54%	49%	53%	50%	60%

Table 9: Flexible ramping procurement diversity savings in Q2 2021

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 for more details.

■ CONCLUSION

Using state-of-the-art technology to find and deliver low-cost energy to meet real-time demand, the Western EIM demonstrates that utilities can realize financial and operational benefits through increased coordination and optimization. In addition to these benefits, the Western EIM provides significant environmental benefits through the reduction of renewable curtailments during periods of oversupply.

Sharing resources across a larger geographic area reduces greenhouse gas emissions by using renewable generation that otherwise would have been turned off. The quantified environmental benefits from avoided curtailments of renewable generation from 2015 to-date reached 645,821 metric tons of CO₂, roughly the equivalent of avoiding the emissions from 135,781 passenger cars driven for one year.

APPENDIX 1: GLOSSARY OF ABBREVIATIONS

Abbreviation	Description
APS	Arizona Public Service
BAA	Balancing Authority Area
BANC	Balancing Authority of Northern California
CISO, ISO	California ISO
EIM	Energy Imbalance Market
FMM	Fifteen Minute Market
GHG	Greenhouse Gas
IPCO	Idaho Power
MW	Megawatt
MWh	Megawatt-Hour
NVE	NV Energy
PAC	PacifiCorp
PACE	PacifiCorp East
PACW	PacifiCorp West
PGE	Portland General Electric
PSE	Puget Sound Energy
PWRX	Powerex
RTD	Real Time Dispatch
SCL	Seattle City Light
SRP	Salt River Project
TID	Turlock Irrigation District