



To Our Partners in the WEIM,

The opportunity to work with many of you through the Western Energy Imbalance Market has been one of the most rewarding elements of my role here at the California Independent System Operator. It has been truly impressive to watch the growth of the market and how it has produced such significant economic and environmental savings while deepening relationships and collaboration across the West.

We are extremely honored and proud to reach this important milestone with you for the WEIM's financial benefits and look forward to continue leveraging our collective success into an extended day-ahead market and beyond. Thank you again for your partnership.

Sincerely,

Elliot Mainzer



WESTERN ENERGY IMBALANCE MARKET

BENEFITS REPORT First Quarter 2022

Prepared by:
Market Analysis and Forecasting

April 21, 2022

www.westerneim.com

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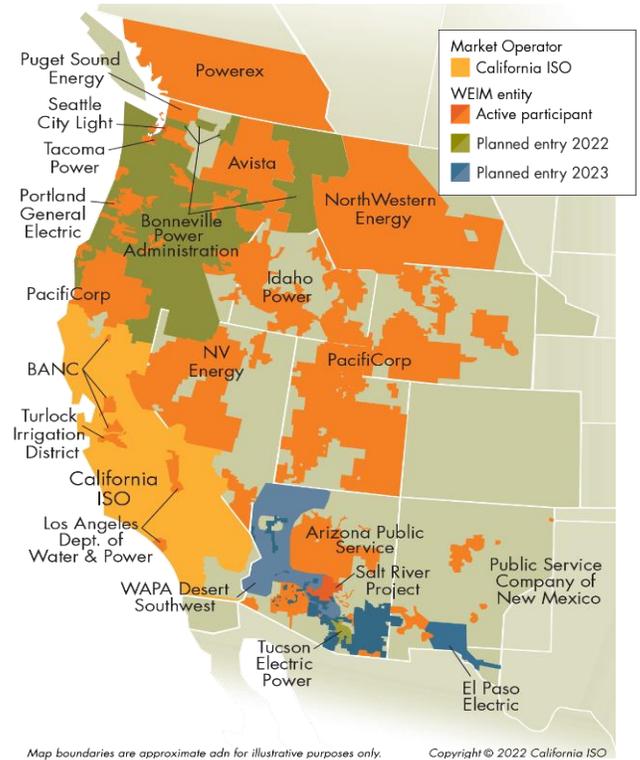
EXECUTIVE SUMMARY

Gross benefits from WEIM since November 2014
\$2.10 billion

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

The measured benefits of participation in the WEIM 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 WEIM footprint with diverse resources and geography.



Q1 2022 Gross Benefits by Participant

	(millions \$)
Arizona Public Service	\$7.41
Avista	\$1.95
BANC	\$18.58
California ISO	\$63.56
Idaho Power	\$6.29
LADWP	\$10.35
NV Energy	\$4.41
NorthWestern Energy	\$5.53
PacifiCorp	\$26.40
Portland General Electric	\$8.59
PNM	\$3.31
Puget Sound Energy	\$3.85
Powerex	\$1.54
Seattle City Light	\$3.60
Salt River Project	\$5.50
Tacoma Power	\$0.15
TID	\$1.29
Total	\$172.31

2022
 Q1 BENEFITS

ECONOMICAL

\$172.31 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

40,304

Metric tons of CO₂** avoided curtailments

OPERATIONAL

54%

Average reduction in flexibility reserves across the footprint

*WEIM 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 WEIM. For more details, see <http://www.caiso.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) began participating in April 2019. Seattle City Light and Salt River Project began participating in April 2020.

In 2021, new balancing authorities began participating in the Western EIM, with the Turlock Irrigation District (TID) in March 2021, 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 (NWMT) starting in June 2021.

Avista Utilities (AVA) and Tacoma Power (TPWR), two utilities serving a combined 600,000 electric customers in the Pacific Northwest, became the newest members of the WEIM, with both beginning their participation on March 2, 2022.

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

■ WEIM ECONOMIC BENEFITS IN Q1 2022

Table 1 shows the estimated WEIM gross benefits by each region per month¹. The monthly savings presented show \$51.55 million for January, \$54.31 million for February, and \$66.45 million for March with a total estimated benefit of \$172.31 million for this quarter². This level of WEIM benefits accrued from having additional WEIM areas participating in the market and economical transfers displacing more expensive generation.

¹ The WEIM 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 points of the total intervals.

² For several quarterly estimates, CAISO benefits were calculated on a variation of the counterfactual methodology. For CAISO only the logic had considered offline resources as part of the bid stack in the counterfactual. In Q4 2021, CAISO identified some questionable results that drove persistent negative benefits for CAISO when considering offline resources. Since Q4 2021, the benefit calculation for CAISO area follows the same methodology applicable to all WEIM entities in which only online resources are used.

<i>Region</i>	January	February	March	Total
<i>APS</i>	\$2.85	\$2.04	\$2.52	\$7.41
<i>AVA</i>			\$1.95	\$1.95
<i>BANC</i>	\$5.04	\$3.83	\$9.71	\$18.58
<i>CISO</i>	\$15.03	\$19.66	\$28.87	\$63.56
<i>IPCO</i>	\$2.66	\$2.34	\$1.29	\$6.29
<i>LADWP</i>	\$2.81	\$4.25	\$3.29	\$10.35
<i>NVE</i>	\$1.36	\$1.61	\$1.44	\$4.41
<i>NWMT</i>	\$1.91	\$1.73	\$1.89	\$5.53
<i>PAC</i>	\$10.36	\$9.82	\$6.22	\$26.40
<i>PGE</i>	\$2.67	\$3.23	\$2.69	\$8.59
<i>PNM</i>	\$1.51	\$0.97	\$0.83	\$3.31
<i>PSE</i>	\$1.68	\$0.97	\$1.20	\$3.85
<i>PWRX</i>	\$0.15	\$0.56	\$0.83	\$1.54
<i>SCL</i>	\$1.55	\$1.06	\$0.99	\$3.60
<i>SRP</i>	\$1.63	\$1.88	\$1.99	\$5.50
<i>TID</i>	\$0.34	\$0.36	\$0.59	\$1.29
<i>TPWR</i>			\$0.15	\$0.15
Total	\$51.55	\$54.31	\$66.45	\$172.31

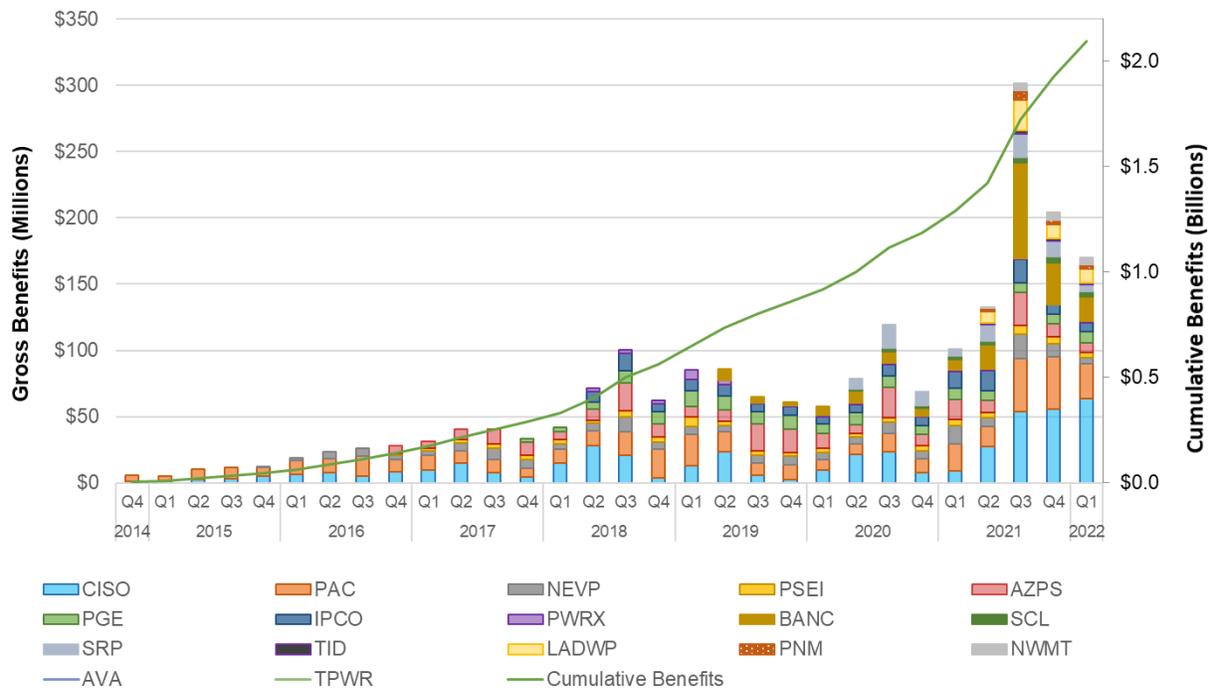
TABLE 1: Q1 2022 benefits in millions USD

■ CUMULATIVE ECONOMIC BENEFITS SINCE INCEPTION

Since the start of the WEIM in November 2014, the cumulative economic benefits of the market have totaled \$2.10 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 WEIM benefit reports in April 2015.³

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

³ 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 WEIM. 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 WEIM, 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 WEIM transfer volumes with base schedule transfers excluded. The WEIM 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 WEIM. 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 WEIM. The 5-minute transfer volume is the result of optimization using all bids and base schedules submitted into WEIM, based on unit commitments determined in the 15-minute market optimization. The maximum transfer capacities between WEIM entities are shown in Graph 2 below.

Month	From BAA	To BAA	15min WEIM transfer (15m – base)	5min WEIM transfer (5m – base)
January	AZPS	CISO	118,743	72,202
	AZPS	LADWP	17,593	19,952
	AZPS	NEVP	5,240	5,947
	AZPS	PACE	18,980	38,259
	AZPS	PNM	39,390	38,395
	AZPS	SRP	26,147	24,154
	BANC	CISO	6,501	2,743
	BANC	TIDC	22	88
	CISO	AZPS	35,068	51,172
	CISO	BANC	87,894	123,607
	CISO	LADWP	32,845	41,818
	CISO	NEVP	57,698	75,616
	CISO	PACW	11,572	38,255
	CISO	PGE	15,777	32,445
	CISO	PWRX	32,316	45,374
	CISO	SRP	38,033	52,578
	CISO	TIDC	9,917	13,188
	IPCO	NEVP	35,809	14,639
	IPCO	NWMT	2,198	2,108
	IPCO	PACE	6,504	2,754
IPCO	PACW	24,319	20,997	
IPCO	PSEI	0	0	
IPCO	SCL	2,955	3,196	

<i>January</i>	LADWP	AZPS	2,499	2,983
	LADWP	CISO	110,255	66,932
	LADWP	NEVP	7,764	13,365
	LADWP	PACE	9,819	13,274
	NEVP	AZPS	603	697
	NEVP	CISO	82,891	34,904
	NEVP	IPCO	88,744	109,290
	NEVP	LADWP	11,639	11,550
	NEVP	PACE	14,381	17,254
	NWMT	IPCO	10,483	10,886
	NWMT	PACE	6,560	3,857
	NWMT	PACW	39	49
	NWMT	PGE	2	48
	NWMT	PSEI	4	44
	PACE	AZPS	66,803	54,583
	PACE	IPCO	84,861	99,770
	PACE	LADWP	101,746	79,610
	PACE	NEVP	85,711	73,798
	PACE	NWMT	16,441	22,356
	PACE	PACW	12,168	17,532
	PACE	SRP	0	0
	PACW	CISO	43,940	68,282
	PACW	IPCO	39,803	36,397
	PACW	NWMT	0	2
	PACW	PGE	31,998	26,535
	PACW	PSEI	16,214	20,511
	PACW	SCL	843	808
	PGE	CISO	32,750	27,570

	PGE	NWMT	126	70
	PGE	PACW	34,210	37,935
	PGE	PSEI	0	0
	PGE	SCL	1,151	1,090
	PNM	AZPS	19,222	18,520
	PNM	SRP	312	360
	PSEI	IPCO	0	0
	PSEI	NWMT	5	42
	PSEI	PACW	47,747	50,679
	PSEI	PGE	0	0
	PSEI	PWRX	13,773	15,743
	PSEI	SCL	21,217	24,309
	PWRX	CISO	0	0
	PWRX	PSEI	12,946	11,866
	SCL	IPCO	11,803	11,429
	SCL	PACW	1,294	1,499
	SCL	PGE	1,580	1,780
	SCL	PSEI	18,800	13,864
	SRP	AZPS	33,808	27,442
	SRP	CISO	48,933	41,814
	SRP	PACE	0	0
	SRP	PNM	1,661	2,127
	TIDC	BANC	15	88
	TIDC	CISO	10,199	5,785
<i>February</i>	AZPS	CISO	64,740	33,432
	AZPS	LADWP	12,726	11,670
	AZPS	NEVP	2,979	6,546
	AZPS	PACE	36,868	37,003

	AZPS	PNM	33,789	36,984
	AZPS	SRP	20,211	13,646
	BANC	CISO	5,393	2,879
	BANC	TIDC	75	153
	CISO	AZPS	91,629	90,842
	CISO	BANC	90,169	114,869
	CISO	LADWP	93,651	111,393
	CISO	NEVP	98,608	114,495
	CISO	PACW	8,025	25,307
	CISO	PGE	19,898	30,506
	CISO	PWRX	50,574	63,110
	CISO	SRP	55,299	66,382
	CISO	TIDC	6,634	8,786
	IPCO	NEVP	33,090	17,165
	IPCO	NWMT	3,549	3,519
	IPCO	PACE	8,691	4,326
	IPCO	PACW	13,523	15,421
	IPCO	PSEI	0	0
	IPCO	SCL	3,639	4,237
	LADWP	AZPS	1,401	1,956
	LADWP	CISO	44,004	27,577
	LADWP	NEVP	10,989	12,432
	LADWP	PACE	20,430	21,959
<i>February</i>	NEVP	AZPS	1,999	2,058
	NEVP	CISO	64,069	28,650
	NEVP	IPCO	73,018	86,247
	NEVP	LADWP	24,884	23,174
	NEVP	PACE	36,121	34,598

<i>February</i>	NWMT	IPCO	8,047	7,862
	NWMT	PACE	4,896	3,244
	NWMT	PACW	54	13
	NWMT	PGE	6	50
	NWMT	PSEI	8	30
	PACE	AZPS	64,346	55,733
	PACE	IPCO	66,977	71,276
	PACE	LADWP	69,256	59,490
	PACE	NEVP	50,173	32,607
	PACE	NWMT	15,196	17,340
	PACE	PACW	12,210	13,675
	PACE	SRP	0	0
	PACW	CISO	44,430	91,933
	PACW	IPCO	34,274	32,700
	PACW	NWMT	0	6
	PACW	PGE	25,339	21,244
	PACW	PSEI	27,220	27,962
	PACW	SCL	1,347	1,199
	PGE	CISO	46,152	35,837
	PGE	NWMT	1	49
	PGE	PACW	32,444	45,060
	PGE	PSEI	0	0
	PGE	SCL	1,542	1,557
	PNM	AZPS	24,075	20,191
	PNM	SRP	5,260	4,259
	PSEI	IPCO	0	0
	PSEI	NWMT	1	29
	PSEI	PACW	29,025	32,855

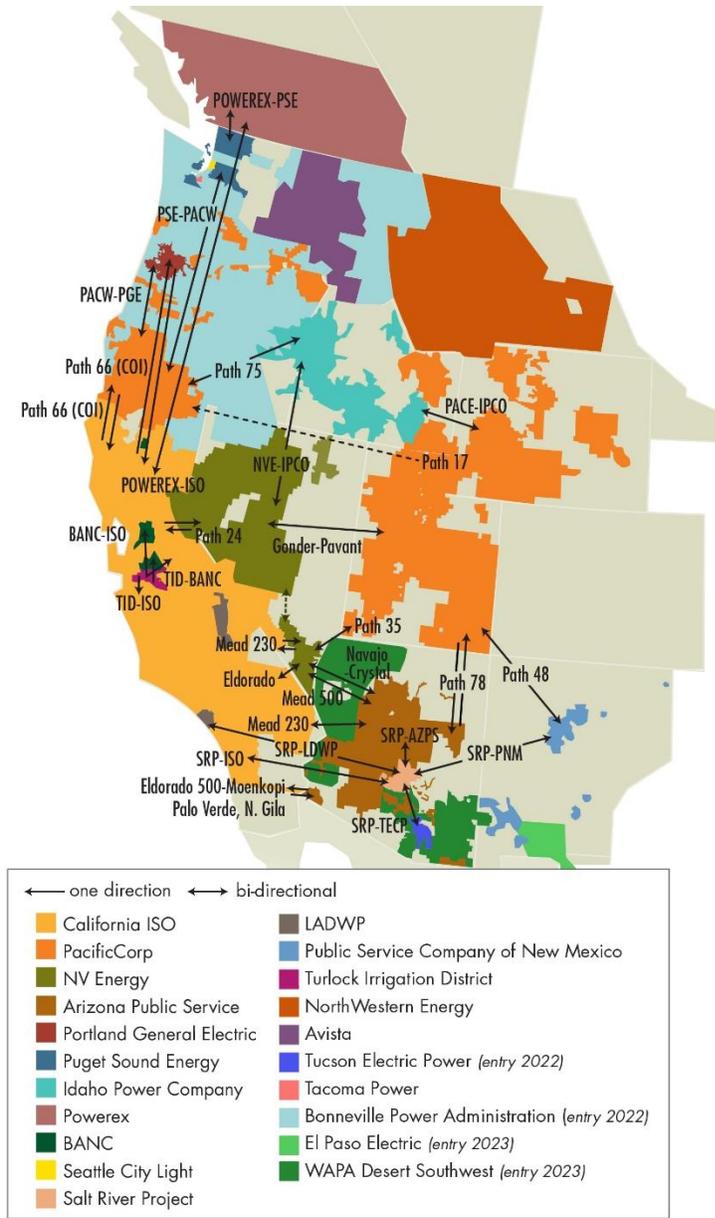
	PSEI	PGE	0	0
	PSEI	PWRX	14,595	15,700
	PSEI	SCL	30,478	30,119
	PWRX	CISO	0	0
	PWRX	PSEI	11,200	11,315
	SCL	IPCO	12,239	11,581
	SCL	PACW	685	907
	SCL	PGE	940	1,033
	SCL	PSEI	6,165	6,049
	SRP	AZPS	13,542	19,966
	SRP	CISO	54,897	40,795
	SRP	PACE	0	0
	SRP	PNM	1,072	2,058
	TIDC	BANC	3,513	2,603
	TIDC	CISO	8,730	5,714
<i>March</i>	AVA	CISO	36	35
	AVA	IPCO	41,079	30,694
	AVA	NWMT	20,262	13,976
	AVA	PACW	492	934
	AVA	PGE	0	62
	AVA	PSEI	2	42
	AVA	SCL	4	2
	AZPS	CISO	118,636	60,827
	AZPS	LADWP	13,543	12,957
	AZPS	NEVP	3,359	4,346
	AZPS	PACE	70,436	94,386
	AZPS	PNM	36,302	40,678
	AZPS	SRP	31,055	26,305

	BANC	CISO	9,468	4,768
	BANC	TIDC	145	157
	CISO	AVA	0	0
	CISO	AZPS	128,838	147,868
	CISO	BANC	135,926	151,421
	CISO	LADWP	91,221	113,805
	CISO	NEVP	155,740	190,858
	CISO	PACW	10,484	44,930
	CISO	PGE	23,431	49,823
	CISO	PWRX	70,105	87,960
	CISO	SRP	71,743	82,831
	CISO	TIDC	8,870	11,526
	IPCO	AVA	6,766	11,113
	IPCO	NEVP	40,989	22,055
	IPCO	NWMT	3,196	4,284
	IPCO	PACE	43,574	20,184
	IPCO	PACW	14,394	22,587
	IPCO	PSEI	0	0
	IPCO	SCL	3,515	5,295
	LADWP	AZPS	1,597	2,993
	LADWP	CISO	35,241	24,140
	LADWP	NEVP	3,317	4,833
	LADWP	PACE	7,525	8,585
	NEVP	AZPS	800	1,131
<i>March</i>	NEVP	CISO	127,997	56,105
	NEVP	IPCO	38,306	59,337
	NEVP	LADWP	51,570	45,547
	NEVP	PACE	84,835	110,488

<i>March</i>	NWMT	AVA	18,172	27,943
	NWMT	IPCO	6,996	7,745
	NWMT	PACE	17,012	10,016
	NWMT	PACW	32	16
	NWMT	PGE	62	85
	NWMT	PSEI	4	37
	PACE	AZPS	117,183	84,121
	PACE	IPCO	75,351	90,801
	PACE	LADWP	26,324	22,494
	PACE	NEVP	102,187	55,974
	PACE	NWMT	22,459	33,316
	PACE	PACW	28,363	37,696
	PACE	SRP	0	0
	PACW	AVA	10,199	10,169
	PACW	CISO	37,888	79,115
	PACW	IPCO	43,457	35,531
	PACW	NWMT	0	3
	PACW	PGE	37,555	31,476
	PACW	PSEI	27,452	41,994
	PACW	SCL	1,013	1,029
	PGE	AVA	0	63
	PGE	CISO	24,281	19,273
	PGE	NWMT	48	48
	PGE	PACW	28,165	32,661
	PGE	PSEI	0	0
	PGE	SCL	1,172	1,322
	PGE	TPWR	32	60
	PNM	AZPS	22,036	21,389

PNM	SRP	4,832	2,788
PSEI	AVA	0	41
PSEI	IPCO	0	0
PSEI	NWMT	5	37
PSEI	PACW	32,839	33,619
PSEI	PGE	0	0
PSEI	PWRX	18,220	20,675
PSEI	SCL	20,542	18,715
PSEI	TPWR	4,539	5,345
PWRX	CISO	0	0
PWRX	PSEI	9,950	8,828
SCL	AVA	13	10
SCL	IPCO	12,814	10,554
SCL	PACW	885	1,101
SCL	PGE	1,480	1,364
SCL	PSEI	11,788	15,118
SRP	AZPS	4,890	8,533
SRP	CISO	36,340	23,202
SRP	PACE	0	0
SRP	PNM	282	447
TIDC	BANC	4,112	2,716
TIDC	CISO	8,868	4,532
TPWR	PGE	1	31
TPWR	PSEI	6,687	6,442

TABLE 2: Energy transfers (MWh) in the FMM and RTD markets for Q1 2022



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	0-400 ¹ ²
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
IPCO to PACW (Path 75)	1,500
PACW to IPCO (Path 75)	400-510
PACE to IPCO	2,557
IPCO to PACE	1,550
NVE to IPCO	262
IPCO to NVE	390-478
Powerex <-> PSE	150
Powerex <-> ISO	150
BANC <-> ISO	2,000-4,000
TID to ISO	1,400
TID to BANC	650
Path 48	2,100
SRP <-> TEPC	9,988
SRP <-> PNM	400
SRP <-> AZPS	10,021
SRP <-> ISO	14,488
SRP <-> LDWP	349

¹ Is an optional path available for PACE-PACW EIM transfers and the capacity is a subset of PACE-IPCO/IPCO-PACE and Path 75 capacity.
² When in use, the available capacity on PACE-IPCO/IPCO-PACE and Path 75 will be subsequently reduced by the used amount on Path 17, and not double counted.

Note: Avista & Tacoma paths will be added soon. Current as of April 2022

GRAPH 2: Estimated maximum transfer capacity

WHEEL-THROUGH TRANSFERS

As the footprint of the WEIM grows, wheel-through transfers may become more common. In order to derive the wheel-through transfers for each WEIM BAA, the ISO uses the following calculation for every real-time interval dispatch:

- **Total import:** summation of transfers above base transfers coming into the WEIM BAA under analysis
- **Total export:** summation of all transfers above base transfers going out of the WEIM 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 WEIM transfers into (total import) or WEIM transfer out (total export) of a BAA for a given interval

All wheel-through transfers are summed over both the month and the quarter.

Currently, a WEIM 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 WEIM Consolidated Initiatives stakeholder process, the ISO committed to monitoring the wheel through volumes to assess whether, after the addition of new WEIM 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 WEIM market in the quarterly reports.

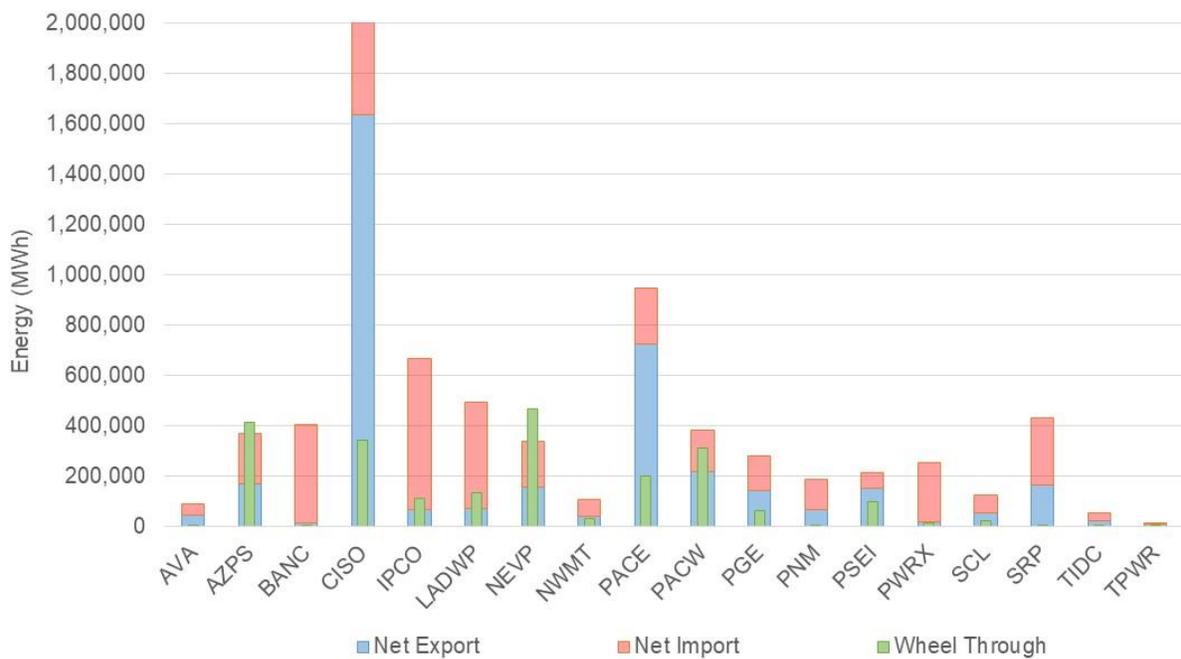
This volume reflects the total wheel-through transfers for each WEIM BAA, regardless of the potential paths used to wheel through. The net imports and exports estimated in this section reflect the overall volume of net imports and exports; in contrast, the imports and exports provided in Table 2 reflect the gross transfers between two WEIM 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>AVA</i>	43,306	46,901	2,440
<i>AZPS</i>	166,484	200,973	411,205
<i>BANC</i>	10,493	395,010	295
<i>CISO</i>	1,638,892	517,173	341,873
<i>IPCO</i>	63,929	602,149	109,952
<i>LADWP</i>	70,422	422,855	130,606
<i>NEVP</i>	156,110	179,757	464,919
<i>NWMT</i>	40,301	65,558	31,625
<i>PACE</i>	723,253	224,613	198,918
<i>PACW</i>	219,342	162,824	310,904

<i>PGE</i>	143,166	137,055	59,428
<i>PNM</i>	67,062	120,243	446
<i>PSEI</i>	149,085	65,281	98,823
<i>PWRX</i>	17,740	234,291	14,270
<i>SCL</i>	54,694	71,285	21,596
<i>SRP</i>	161,794	268,713	4,590
<i>TIDC</i>	21,091	33,551	347
<i>TPWR</i>	6,412	5,343	62

TABLE 3: Estimated wheel-through transfers in Q1 2022

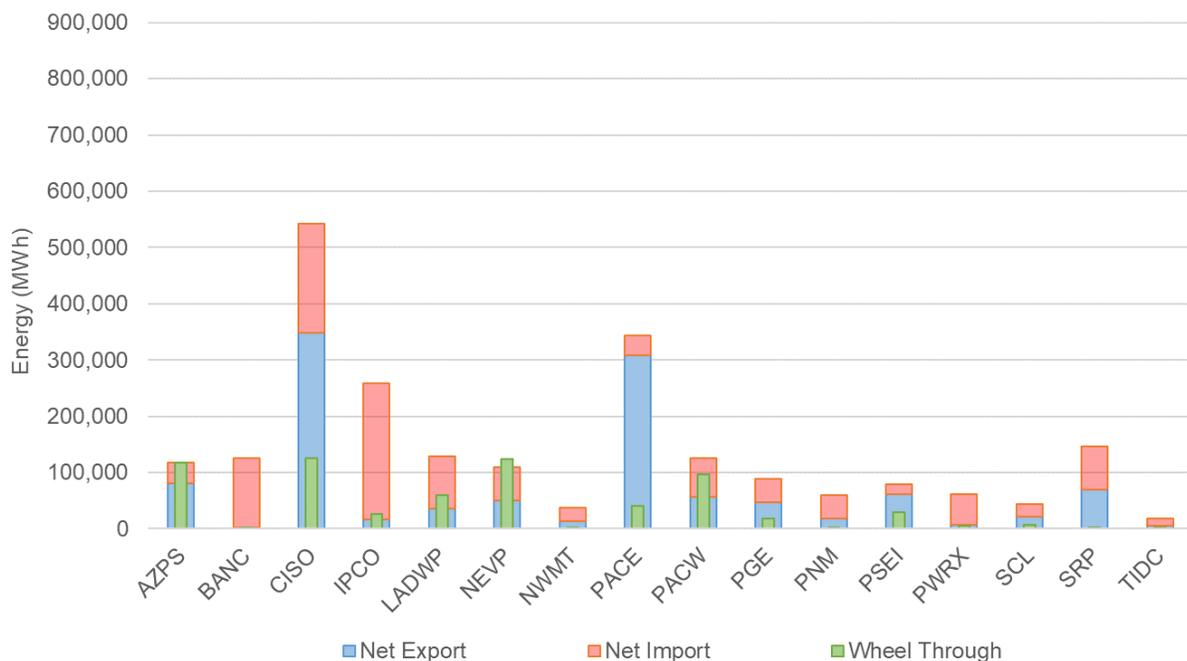


GRAPH 3: Estimated wheel-through transfers in Q1 2022

<i>BAA</i>	Net Export	Net Import	Wheel-Through
<i>AZPS</i>	80,872	37,360	118,037
<i>BANC</i>	2,744	123,608	87
<i>CISO</i>	347,913	194,094	126,139

<i>IPCO</i>	17,171	241,249	26,523
<i>LADWP</i>	36,061	92,437	60,493
<i>NEVP</i>	50,033	59,702	123,661
<i>NWMT</i>	14,045	23,739	838
<i>PACE</i>	307,611	36,519	40,037
<i>PACW</i>	56,453	69,703	97,242
<i>PGE</i>	47,549	41,692	19,117
<i>PNM</i>	18,774	40,416	106
<i>PSEI</i>	61,849	17,362	28,924
<i>PWRX</i>	6,539	55,790	5,327
<i>SCL</i>	21,816	22,648	6,757
<i>SRP</i>	70,183	75,893	1,199
<i>TIDC</i>	5,788	13,190	86

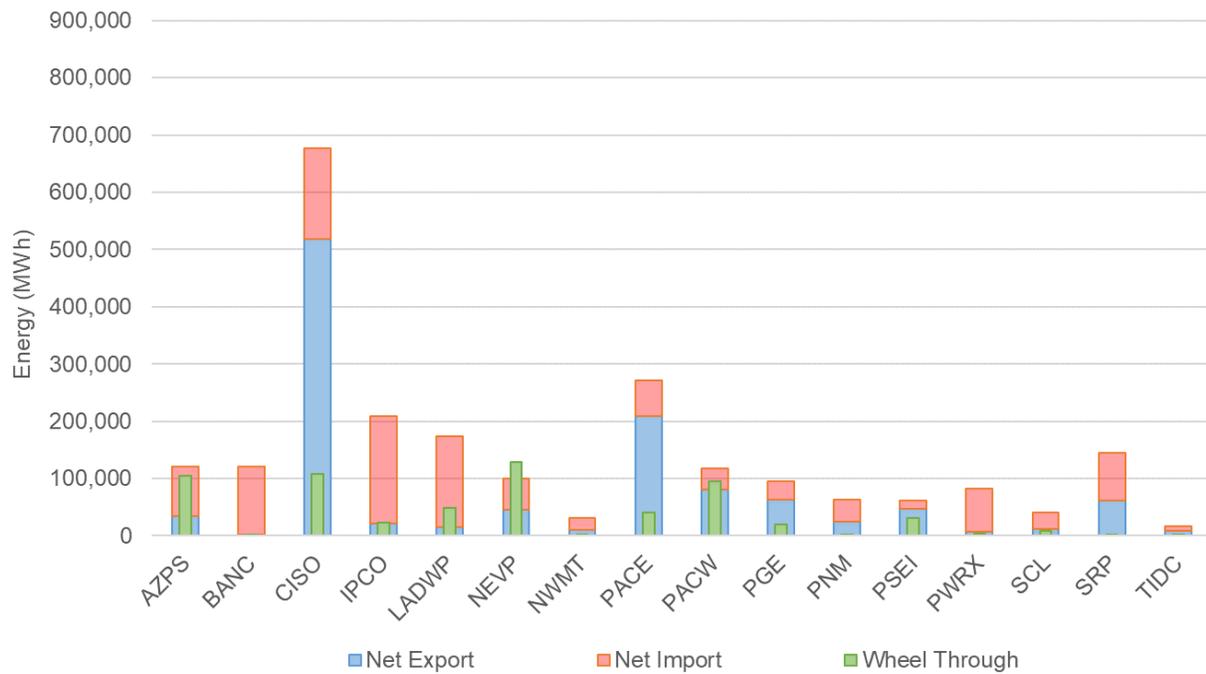
TABLE 4: Estimated wheel-through transfers in January 2022



GRAPH 4: Estimated wheel-through transfers in January 2022

<i>BAA</i>	Net Export	Net Import	Wheel-Through
<i>AZPS</i>	34,347	85,813	104,934
<i>BANC</i>	2,935	117,374	98
<i>CISO</i>	517,910	159,037	107,781
<i>IPCO</i>	22,128	187,127	22,540
<i>LADWP</i>	15,884	157,688	48,040
<i>NEVP</i>	45,735	54,254	128,992
<i>NWMT</i>	10,313	20,056	886
<i>PACE</i>	209,609	61,687	40,513
<i>PACW</i>	80,557	37,680	95,559
<i>PGE</i>	62,800	33,131	19,702
<i>PNM</i>	24,331	38,924	119
<i>PSEI</i>	47,616	14,270	31,087
<i>PWRX</i>	7,092	74,587	4,223
<i>SCL</i>	11,669	29,212	7,901
<i>SRP</i>	61,596	83,064	1,223
<i>TIDC</i>	8,218	8,840	99

TABLE 5: Estimated wheel-through transfers in February 2022

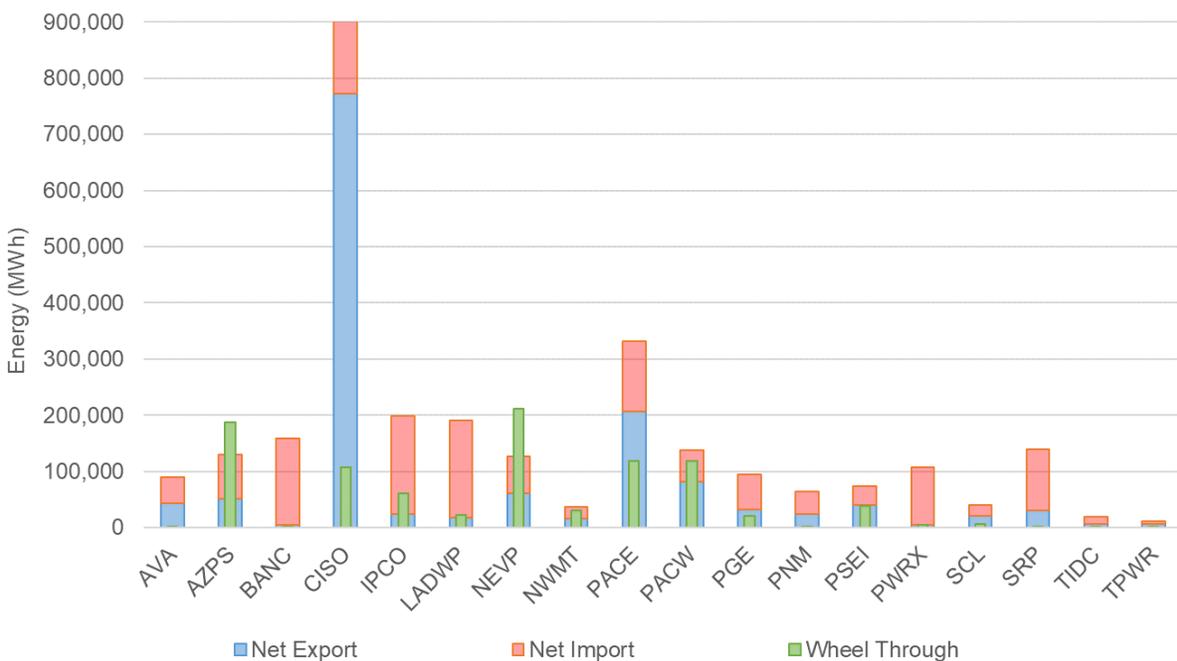


GRAPH 5: Estimated wheel-through transfers in February 2022

BAA	Net Export	Net Import	Wheel-Through
<i>AVA</i>	43,306	46,901	2,440
<i>AZPS</i>	51,264	77,801	188,234
<i>BANC</i>	4,815	154,027	110
<i>CISO</i>	773,070	164,043	107,953
<i>IPCO</i>	24,629	173,774	60,889
<i>LADWP</i>	18,477	172,730	22,074
<i>NEVP</i>	60,343	65,802	212,265
<i>NWMT</i>	15,942	21,763	29,901
<i>PACE</i>	206,033	126,407	118,369
<i>PACW</i>	82,333	55,441	118,102
<i>PGE</i>	32,816	62,233	20,610
<i>PNM</i>	23,957	40,904	221
<i>PSEI</i>	39,620	33,649	38,812

PWRX	4,108	103,915	4,720
SCL	21,209	19,426	6,938
SRP	30,015	109,757	2,167
TIDC	7,085	11,521	163
TPWR	6,412	5,343	62

TABLE 6: Estimated wheel-through transfers in March 2022



GRAPH 6: Estimated wheel-through transfers in March 2022

■ REDUCED RENEWABLE CURTAILMENT AND GHG REDUCTIONS

The WEIM 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 WEIM, 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 Q1 2022 was calculated to be 18,160 MWh (January) + 29,740 MWh (February) + 46,268 MWh (March) = 94,168 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 40,304 metric tons of CO₂ for Q1 2022. 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 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
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
	3	23,042	9,862

	4	38,044	16,283
2022	1	94,168	40,304
Total		1,664,368	712,270

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

■ FLEXIBLE RAMPING PROCUREMENT DIVERSITY SAVINGS

The WEIM 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 WEIM 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
<i>January</i>	<i>AZPS</i>	up	21	251
	<i>BANC</i>	up	8	120
	<i>CISO</i>	up	209	2,437
	<i>IPCO</i>	up	30	140
	<i>LADWP</i>	up	38	295
	<i>NEVP</i>	up	17	328
	<i>NWMT</i>	up	26	156
	<i>PACE</i>	up	146	612
	<i>PACW</i>	up	57	222
	<i>PGE</i>	up	64	212
	<i>PNM</i>	up	31	148
	<i>PSEI</i>	up	51	192
	<i>PWRX</i>	up	82	366
	<i>SCL</i>	up	7	45
	<i>SRP</i>	up	14	151
<i>TIDC</i>	up	2	14	
	ALL EIM	up	390	2,917

<i>January</i>	AZPS	down	6	278
	BANC	down	5	85
	CISO	down	57	1,577
	IPCO	down	43	184
	LADWP	down	28	272
	NEVP	down	14	328
	NWMT	down	39	159
	PACE	down	120	484
	PACW	down	43	232
	PGE	down	23	217
	PNM	down	41	161
	PSEI	down	35	200
	PWRX	down	72	339
	SCL	down	4	49
	SRP	down	16	207
	TIDC	down	0	16
ALL EIM	down	221	2,021	
<i>February</i>	AZPS	up	19	261
	BANC	up	9	120
	CISO	up	257	2,226
	IPCO	up	39	150
	LADWP	up	44	295
	NEVP	up	23	337
	NWMT	up	43	129
	PACE	up	112	463
	PACW	up	48	222
	PGE	up	43	212
	PNM	up	43	143
	PSEI	up	38	187
	PWRX	up	68	259
SCL	up	8	44	

<i>February</i>	<i>SRP</i>	up	24	151
	<i>TIDC</i>	up	2	14
	ALL WEIM	up	464	2,661
	<i>AZPS</i>	down	22	254
	<i>BANC</i>	down	5	81
	<i>CISO</i>	down	54	1,577
	<i>IPCO</i>	down	49	203
	<i>LADWP</i>	down	51	272
	<i>NEVP</i>	down	12	355
	<i>NWMT</i>	down	35	159
	<i>PACE</i>	down	124	484
	<i>PACW</i>	down	38	232
	<i>PGE</i>	down	34	230
	<i>PNM</i>	down	36	150
	<i>PSEI</i>	down	26	156
	<i>PWRX</i>	down	93	339
	<i>SCL</i>	down	5	49
	<i>SRP</i>	down	22	170
	<i>TIDC</i>	down	1	17
	ALL EIM	down	284	2,021
<i>March</i>	<i>AVA</i>	up	17	91
	<i>AZPS</i>	up	32	286
	<i>BANC</i>	up	7	113
	<i>CISO</i>	up	281	2,120
	<i>IPCO</i>	up	34	159
	<i>LADWP</i>	up	37	315
	<i>NEVP</i>	up	26	337
	<i>NWMT</i>	up	26	115
	<i>PACE</i>	up	111	495
	<i>PACW</i>	up	47	222
	<i>PGE</i>	up	33	177

March	<i>PNM</i>	up	28	177
	<i>PSEI</i>	up	43	162
	<i>PWRX</i>	up	67	319
	<i>SCL</i>	up	5	45
	<i>SRP</i>	up	24	169
	<i>TIDC</i>	up	2	14
	<i>TPWR</i>	up	3	29
	ALL WEIM	up	459	2,710
	<i>AVA</i>	down	19	87
	<i>AZPS</i>	down	22	229
	<i>BANC</i>	down	5	88
	<i>CISO</i>	down	110	1,623
	<i>IPCO</i>	down	35	223
	<i>LADWP</i>	down	50	279
	<i>NEVP</i>	down	15	395
	<i>NWMT</i>	down	33	161
	<i>PACE</i>	down	142	470
	<i>PACW</i>	down	53	179
	<i>PGE</i>	down	40	219
	<i>PNM</i>	down	36	150
	<i>PSEI</i>	down	27	174
	<i>PWRX</i>	down	93	314
	<i>SCL</i>	down	4	49
	<i>SRP</i>	down	20	175
	<i>TIDC</i>	down	0	19
	<i>TPWR</i>	down	4	34
	ALL WEIM	down	283	2,122

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 individual BAA requirements.

<i>Direction</i>	January		February		March	
	Up	Down	Up	Down	Up	Down
<i>Average MW saving</i>	1,247	1,229	1,236	1,246	1,317	1,350
<i>Sum of BAA requirements</i>	2,487	2,148	2,364	2,217	2,488	2,370
<i>Percentage savings</i>	50%	57%	52%	56%	53%	57%

Table 9: Flexible ramping procurement diversity savings in Q1 2022

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 WEIM-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 WEIM 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 WEIM demonstrates that utilities can realize financial and operational benefits through increased coordination and optimization. In addition to these benefits, the WEIM 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 712,270 metric tons of CO₂, roughly the equivalent of avoiding the emissions from 149,752 passenger cars driven for one year.

APPENDIX 1: GLOSSARY OF ABBREVIATIONS

Abbreviation	Description
APS	Arizona Public Service
AVA	Avista Utilities
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
LADWP	Los Angeles Department of Water and 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
TPWR	Tacoma Power
WEIM	Western Energy Imbalance Market