WESTERN ENERGY IMBALANCE MARKET BENEFITS

Second Quarter 2022

Prepared by: Market Analysis and Forecasting

July 29, 2022

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EXECUTIVE SUMMARY

Gross benefits from WEIM since November 2014

$2.39 billion

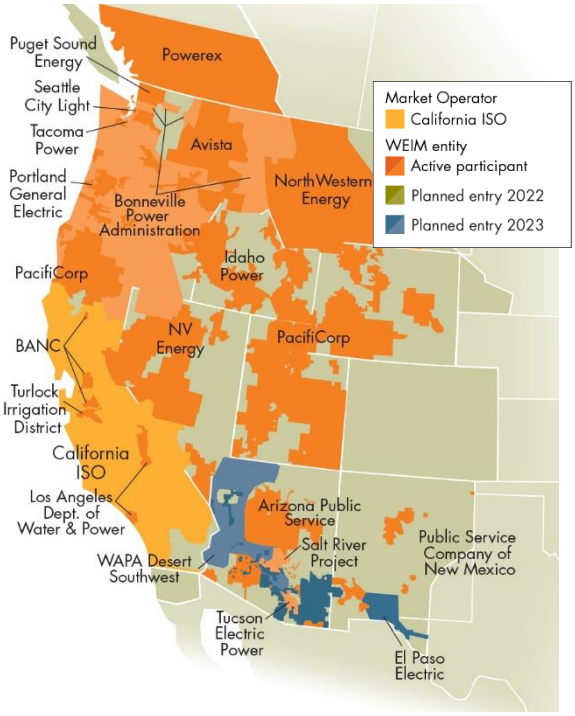
This report presents the benefits associated with participation in the Western Energy Imbalance Market (WEIM).

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.

Q2 2022 Gross Benefits by Participant

	(millions $)
Arizona Public Service	$10.14
Avista	$5.16
BANC	$68.09
BPA	$4.36
California ISO	$71.75
Idaho Power	$8.44
LADWP	$13.78
NV Energy	$8.63
NorthWestern Energy	$5.90
PacifiCorp	$35.21
Portland General Electric	$11.92
PNM	$3.10
Puget Sound Energy	$4.90
Powerex	$4.66
Seattle City Light	$2.90
Salt River Project	$21.26
Tacoma Power	$1.55
TEP	$2.84
TID	$2.85
Total	$287.44



2022 Q2 BENEFITS

ECONOMICAL

$287.44 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

50,655

Metric tons of CO_2** 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. On May 3, 2022, the Bonneville Power Administration (BPA) and Tucson Electric Power (TEP) both Joined the WEIM.

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 Q2 2022

Table 1 shows the estimated WEIM gross benefits by each region per month[1]. The monthly savings presented show $93.66 million for April, $83.84 million for May, and $109.94 million for June with a total estimated benefit of $287.44 million for this quarter[2]. 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.

Region	April	May	June	Total
APS	$3.69	$3.83	$2.62	$10.14
AVA	$1.98	$1.72	$1.46	$5.16
BANC	$4.71	$13.78	$49.60	$68.09
BPA		$2.26	$2.10	$4.36
CISO	$42.10	$14.56	$15.09	$71.75
IPCO	$3.89	$2.78	$1.77	$8.44
LADWP	$4.42	$5.30	$4.06	$13.78
NVE	$2.49	$2.40	$3.74	$8.63
NWMT	$2.50	$2.44	$0.96	$5.90
PAC	$13.35	$15.43	$6.43	$35.21
PGE	$3.60	$3.43	$4.89	$11.92
PNM	$0.07	$1.26	$1.77	$3.10
PSE	$1.79	$1.94	$1.17	$4.90
PWRX	$0.64	$2.05	$1.97	$4.66
SCL	$1.10	$1.00	$0.80	$2.90
SRP	$5.95	$7.04	$8.27	$21.26
TPWR	$0.40	$0.43	$0.72	$1.55
TEP		$1.29	$1.55	$2.84
TID	$0.98	$0.90	$0.97	$2.85
Total	$93.66	$83.84	$109.94	$287.44

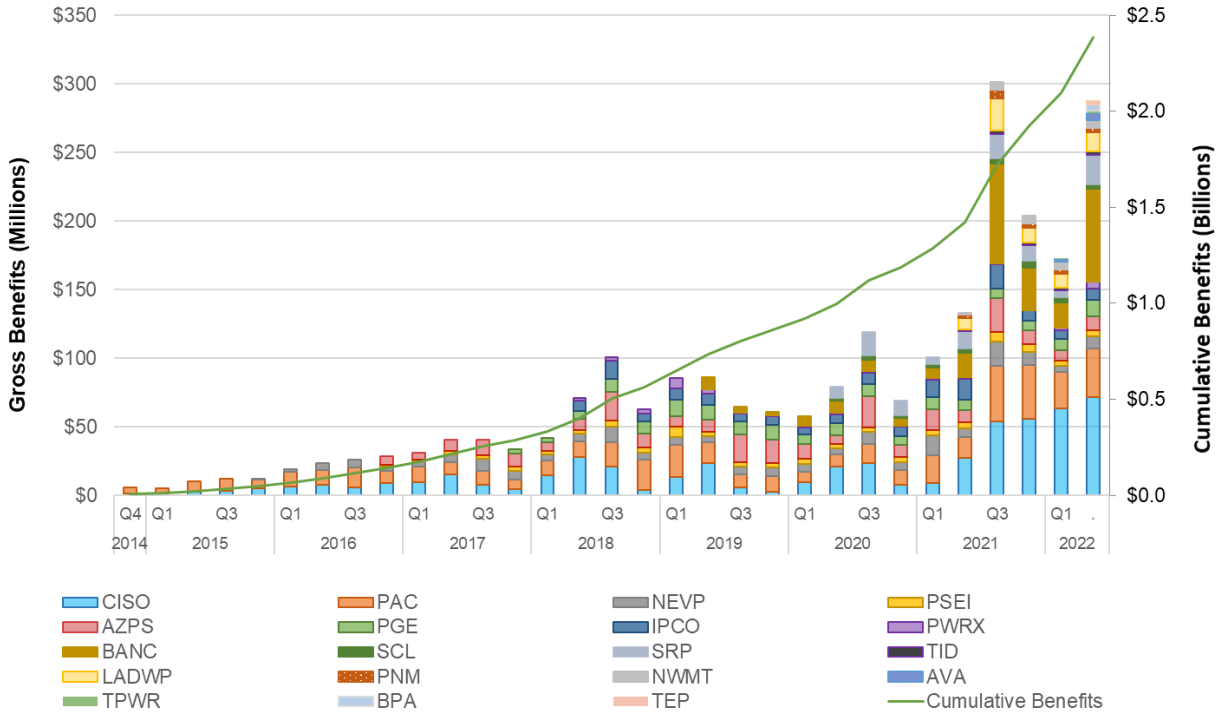
TABLE 1: Q2 2022 benefits in millions USD

CUMULATIVE ECONOMIC BENEFITS SINCE INCEPTION

Since the start of the WEIM in November 2014, the cumulative economic benefits of the market have totaled $2.39 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)
April	AVA	CISO	0	0
	AVA	IPCO	20,394	16,524
	AVA	NWMT	6,205	5,541
	AVA	PACW	10,480	12,791
	AVA	PGE	48	62
	AVA	PSEI	0	1
	AVA	SCL	2	1
	AVA	TPWR	2,909	3,389
	AZPS	CISO	106,535	70,984
	AZPS	LADWP	6,478	7,404
	AZPS	NEVP	8,905	16,269
	AZPS	PACE	31,007	36,001
	AZPS	PNM	18,144	15,167
	AZPS	SRP	44,298	47,638
	BANC	CISO	7,941	3,264
	BANC	TIDC	30	145
	CISO	AVA	87	20
	CISO	AZPS	69,708	73,122
	CISO	BANC	85,021	100,826
	CISO	LADWP	76,743	80,241
	CISO	NEVP	73,631	78,704
	CISO	PACW	0	8,331

CISO	PGE	11,468	15,791
CISO	PWRX	41,738	50,391
CISO	SRP	173,251	176,313
CISO	TIDC	11,060	12,811
IPCO	AVA	27,722	33,028
IPCO	NEVP	45,717	33,915
IPCO	NWMT	2,648	3,081
IPCO	PACE	19,505	14,309
IPCO	PACW	30,365	40,626
IPCO	PSEI	0	0
IPCO	SCL	9,280	10,695
LADWP	AZPS	2,428	3,116
LADWP	CISO	92,685	66,908
LADWP	NEVP	11,999	16,419
LADWP	PACE	34,565	37,081
NEVP	AZPS	3,021	3,101
NEVP	CISO	75,594	53,435
NEVP	IPCO	34,940	45,747
NEVP	LADWP	19,953	23,871
NEVP	PACE	10,672	12,977
NWMT	AVA	21,314	26,256
NWMT	IPCO	3,773	4,108
NWMT	PACE	8,283	5,869
NWMT	PACW	0	4
NWMT	PGE	10	29
NWMT	PSEI	20	33
NWMT	TPWR	3,119	3,684
PACE	AZPS	163,693	150,630

	PACE	IPCO	51,491	64,637
	PACE	LADWP	84,511	69,606
	PACE	NEVP	23,563	20,808
	PACE	NWMT	24,092	27,565
	PACE	PACW	32,675	41,067
	PACE	SRP	0	0
	PACW	AVA	8,656	9,452
	PACW	CISO	60,528	80,218
	PACW	IPCO	21,181	14,035
	PACW	NWMT	5	5
	PACW	PGE	39,297	45,740
	PACW	PSEI	30,125	32,468
	PACW	SCL	998	972
	PGE	AVA	0	61
April	PGE	CISO	30,727	29,991
	PGE	NWMT	34	29
	PGE	PACW	21,307	24,282
	PGE	PSEI	0	0
	PGE	SCL	1,067	996
	PGE	TPWR	2,843	2,905
	PNM	AZPS	28,441	36,596
	PNM	SRP	15,061	16,969
	PSEI	AVA	0	1
	PSEI	IPCO	0	0
	PSEI	NWMT	8	33
	PSEI	PACW	34,478	37,186
	PSEI	PGE	0	0
	PSEI	PWRX	5,578	6,972

	PSEI	SCL	12,480	11,398
	PSEI	TPWR	5,344	5,461
	PWRX	CISO	0	0
	PWRX	PSEI	21,825	21,249
	SCL	AVA	1	1
	SCL	IPCO	1,474	1,341
	SCL	PACW	920	1,112
	SCL	PGE	1,374	1,607
	SCL	PSEI	12,048	16,353
	SRP	AZPS	4,575	6,585
	SRP	CISO	49,283	40,892
	SRP	PACE	0	0
	SRP	PNM	1,580	1,225
	TIDC	BANC	74	148
	TIDC	CISO	14,826	12,010
	TPWR	AVA	2,038	1,631
	TPWR	NWMT	1,796	1,493
	TPWR	PGE	3,053	3,061
	TPWR	PSEI	10,632	10,722
May	AVA	BPAT	4,997	3,193
	AVA	CISO	321	320
	AVA	IPCO	12,634	12,924
	AVA	NWMT	20,196	14,720
	AVA	PACW	7,459	9,702
	AVA	PGE	0	27
	AVA	PSEI	0	0
	AVA	SCL	8	3
	AVA	TPWR	1,915	1,951

May	AZPS	CISO	56,237	34,273
	AZPS	LADWP	526	1,364
	AZPS	NEVP	1,175	2,596
	AZPS	PACE	29,605	38,059
	AZPS	PNM	42,248	34,449
	AZPS	SRP	94,492	90,578
	AZPS	TEPC	11,098	11,526
	BANC	BPAT	1,112	1,264
	BANC	CISO	7,397	6,010
	BANC	TIDC	33	76
	BPAT	AVA	3,264	2,655
	BPAT	BANC	45	171
	BPAT	CISO	9,105	13,408
	BPAT	IPCO	1,277	1,325
	BPAT	LADWP	1,928	818
	BPAT	NEVP	389	220
	BPAT	NWMT	8,458	4,973
	BPAT	PACW	3,747	1,938
	BPAT	PGE	15,217	10,544
	BPAT	PSEI	13,355	15,088
	BPAT	PWRX	13,404	2,790
	BPAT	SCL	964	1,242
	BPAT	TPWR	4,105	4,675
	CISO	AVA	0	0
	CISO	AZPS	108,931	119,324
	CISO	BANC	140,055	144,032
	CISO	BPAT	5,329	9,780
	CISO	LADWP	65,629	76,466

May	CISO	NEVP	114,631	142,138
	CISO	PACW	898	13,245
	CISO	PGE	13,869	35,171
	CISO	PWRX	103,222	116,329
	CISO	SRP	233,061	251,791
	CISO	TEPC	3,935	3,799
	CISO	TIDC	16,133	16,403
	IPCO	AVA	22,176	25,776
	IPCO	BPAT	4,252	1,603
	IPCO	NEVP	4,572	2,682
	IPCO	NWMT	4,814	5,912
	IPCO	PACE	62,009	39,574
	IPCO	PACW	27,098	32,785
	IPCO	PSEI	0	0
	IPCO	SCL	8,334	9,465
	LADWP	AZPS	2,322	3,093
	LADWP	BPAT	1,735	800
	LADWP	CISO	71,092	50,524
	LADWP	NEVP	15,764	21,057
	LADWP	PACE	28,235	32,900
	LADWP	TEPC	0	83
	NEVP	AZPS	9,672	8,583
	NEVP	BPAT	743	502
	NEVP	CISO	100,199	65,338
	NEVP	IPCO	18,269	20,665
	NEVP	LADWP	24,255	27,189
	NEVP	PACE	62,305	75,527
	NWMT	AVA	13,111	16,444

	NWMT	BPAT	8,236	5,871
May	NWMT	IPCO	2,319	3,858
	NWMT	PACE	18,733	13,988
	NWMT	PACW	0	1
	NWMT	PGE	31	16
	NWMT	PSEI	43	7
	NWMT	TPWR	1,679	2,136
	PACE	AZPS	188,726	166,512
	PACE	IPCO	59,360	86,462
	PACE	LADWP	107,420	95,825
	PACE	NEVP	95,324	73,337
	PACE	NWMT	24,644	28,147
	PACE	PACW	17,234	21,078
	PACE	SRP	0	0
	PACE	TEPC	2,868	1,649
	PACW	AVA	10,429	11,849
	PACW	BPAT	6,114	8,427
	PACW	CISO	40,522	74,582
	PACW	IPCO	41,422	36,860
	PACW	NWMT	1	1
	PACW	PGE	61,168	52,085
	PACW	PSEI	23,739	24,918
May	PACW	SCL	1,476	1,513
	PGE	AVA	24	28
	PGE	BPAT	10,097	9,760
	PGE	CISO	25,689	23,700
	PGE	NWMT	38	12
	PGE	PACW	18,473	26,855

	PGE	PSEI	0	2
	PGE	SCL	1,396	1,621
	PGE	TPWR	5,783	7,298
	PNM	AZPS	7,443	9,283
	PNM	SRP	3,717	3,799
	PNM	TEPC	19,551	19,898
	PSEI	AVA	0	0
	PSEI	BPAT	23,116	24,524
	PSEI	IPCO	0	0
	PSEI	NWMT	14	3
	PSEI	PACW	13,399	14,445
	PSEI	PGE	0	2
May	PSEI	PWRX	19,784	20,398
	PSEI	SCL	7,287	7,266
	PSEI	TPWR	5,988	6,051
	PWRX	BPAT	3,143	2,461
	PWRX	CISO	0	0
	PWRX	PSEI	9,627	9,607
	SCL	AVA	4	2
	SCL	BPAT	1,583	1,514
	SCL	IPCO	6,414	6,157
	SCL	PACW	502	652
	SCL	PGE	1,001	1,031
	SCL	PSEI	10,783	13,798
	SRP	AZPS	8,960	13,548
	SRP	CISO	35,923	32,898
	SRP	PACE	0	0
	SRP	PNM	777	1,096

	SRP	TEPC	80,131	91,726
May	TEPC	AZPS	250	72
	TEPC	CISO	13,630	2,924
	TEPC	LADWP	0	0
	TEPC	PACE	158	225
	TEPC	PNM	8,882	6,798
	TEPC	SRP	8,763	17,041
	TIDC	BANC	148	226
	TIDC	CISO	7,454	6,662
	TPWR	AVA	991	1,194
	TPWR	BPAT	5,938	5,746
	TPWR	NWMT	594	371
	TPWR	PGE	3,586	2,963
	TPWR	PSEI	6,116	7,682
June	AVA	BPAT	5,697	406
	AVA	CISO	0	0
	AVA	IPCO	19,387	9,691
	AVA	NWMT	8,671	8,888
	AVA	PACW	4,100	2,252
	AVA	PGE	0	0
	AVA	PSEI	0	0
	AVA	SCL	7	0
	AVA	TPWR	0	0
	AZPS	CISO	62,964	27,082
	AZPS	LADWP	20,883	18,279
	AZPS	NEVP	8,203	9,826
	AZPS	PACE	78,792	95,501
	AZPS	PNM	28,526	29,050

June	AZPS	SRP	30,063	17,897
	AZPS	TEPC	26,059	23,874
	BANC	BPAT	2,035	0
	BANC	CISO	6,626	9,577
	BANC	TIDC	161	309
	BPAT	AVA	5,927	3,735
	BPAT	BANC	136	0
	BPAT	CISO	970	2,042
	BPAT	IPCO	1,597	31
	BPAT	LADWP	2,748	0
	BPAT	NEVP	267	0
	BPAT	NWMT	25,521	3,725
	BPAT	PACW	9,990	3,840
	BPAT	PGE	26,200	16,429
	BPAT	PSEI	28,247	28,987
	BPAT	PWRX	13,371	0
	BPAT	SCL	5,389	4,838
	BPAT	TPWR	11,342	9,848
	CISO	AVA	0	0
	CISO	AZPS	95,766	117,824
	CISO	BANC	189,226	186,320
	CISO	BPAT	862	1,968
	CISO	LADWP	92,507	120,240
	CISO	NEVP	114,963	134,766
	CISO	PACW	5,909	48,873
	CISO	PGE	22,744	62,760
	CISO	PWRX	63,709	83,326
	CISO	SRP	205,170	240,137

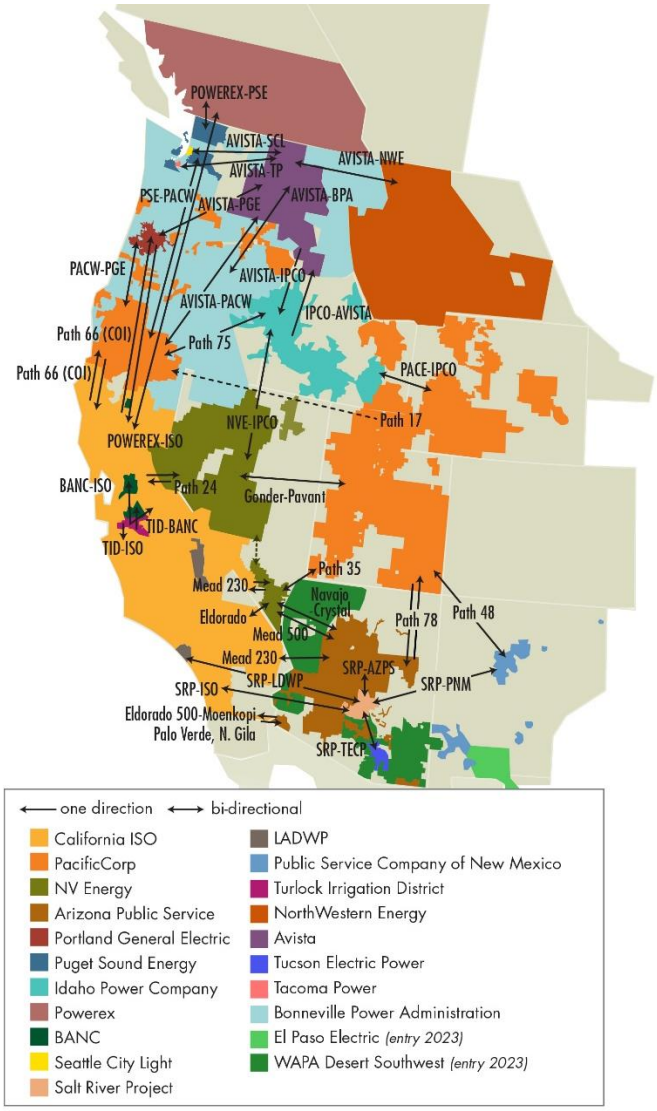
	CISO	TEPC	2,011	2,538
June	CISO	TIDC	9,640	9,452
	IPCO	AVA	21,875	23,515
	IPCO	BPAT	1,411	0
	IPCO	NEVP	23,059	11,967
	IPCO	NWMT	4,394	7,790
	IPCO	PACE	25,922	15,769
	IPCO	PACW	37,118	19,512
	IPCO	PSEI	0	0
	IPCO	SCL	7,773	10,522
	LADWP	AZPS	3,850	5,604
	LADWP	BPAT	5,096	0
	LADWP	CISO	14,438	6,421
	LADWP	NEVP	13,680	17,035
	LADWP	PACE	13,217	12,022
	LADWP	TEPC	0	0
	NEVP	AZPS	6,668	7,636
	NEVP	BPAT	1,347	0
	NEVP	CISO	43,430	10,628
	NEVP	IPCO	70,804	77,974
	NEVP	LADWP	39,289	34,228
	NEVP	PACE	43,582	47,042
	NWMT	AVA	21,277	19,088
	NWMT	BPAT	6,028	625
	NWMT	IPCO	3,571	2,858
	NWMT	PACE	5,959	2,625
	NWMT	PACW	282	0
	NWMT	PGE	174	0

	NWMT	PSEI	77	0
	NWMT	TPWR	1,229	2,492
June	PACE	AZPS	74,780	55,992
	PACE	IPCO	57,496	62,736
	PACE	LADWP	49,749	51,623
	PACE	NEVP	39,964	22,428
	PACE	NWMT	30,729	27,130
	PACE	PACW	51,580	40,357
	PACE	SRP	0	0
	PACE	TEPC	1,536	1,103
	PACW	AVA	15,528	16,880
	PACW	BPAT	4,176	656
	PACW	CISO	7,124	21,286
	PACW	IPCO	14,579	13,248
	PACW	NWMT	0	0
	PACW	PGE	54,893	47,383
	PACW	PSEI	22,296	29,307
	PACW	SCL	1,680	2,024
	PGE	AVA	0	0
June	PGE	BPAT	9,824	14,726
	PGE	CISO	9,436	5,703
	PGE	NWMT	108	0
	PGE	PACW	19,654	18,578
	PGE	PSEI	3	0
	PGE	SCL	1,469	1,868
	PGE	TPWR	1,339	2,453
	PNM	AZPS	24,924	25,722
	PNM	SRP	4,149	2,826

	PNM	TEPC	25,169	24,931
June	PSEI	AVA	0	0
	PSEI	BPAT	9,819	13,642
	PSEI	IPCO	0	0
	PSEI	NWMT	17	0
	PSEI	PACW	11	0
	PSEI	PGE	1	0
	PSEI	PWRX	15,518	16,414
	PSEI	SCL	20,565	17,180
	PSEI	TPWR	6,136	6,662
	PWRX	BPAT	4,255	34
	PWRX	CISO	0	0
	PWRX	PSEI	12,295	12,347
	SCL	AVA	17	0
	SCL	BPAT	118	46
	SCL	IPCO	9,305	6,415
	SCL	PACW	1,098	798
	SCL	PGE	1,170	867
	SCL	PSEI	3,912	6,684
	SRP	AZPS	15,979	19,695
	SRP	CISO	50,824	38,195
	SRP	PACE	0	0
	SRP	PNM	947	1,651
	SRP	TEPC	65,964	77,789
	TEPC	AZPS	399	0
	TEPC	CISO	16,959	10,582
	TEPC	LADWP	0	0
	TEPC	PACE	864	1,578

June	TEPC	PNM	17,131	13,585
	TEPC	SRP	12,777	10,796
	TIDC	BANC	203	0
	TIDC	CISO	12,951	14,046
	TPWR	AVA	0	0
	TPWR	BPAT	1,275	2,462
	TPWR	NWMT	2,957	1,689
	TPWR	PGE	2,372	1,449
	TPWR	PSEI	7,000	9,278

TABLE 2: Energy transfers (MWh) in the FMM and RTD markets for Q2 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
Avista <–> BPA	3,600
Avista <–> NorthWestern	764
Avista <–> PACW	500
Avista <–> SCL	500
Avista <–> TP	500
Avista <–> PGE	500
Avista to IPCO	1,420
IPCO to Avista	1,300

[1] *Is an optional path available for PACE-PACW WEIM 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: Does not include paths for Tacoma Power, Bonneville Power Administration and Tucson Electric Power. *07/2022*

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.

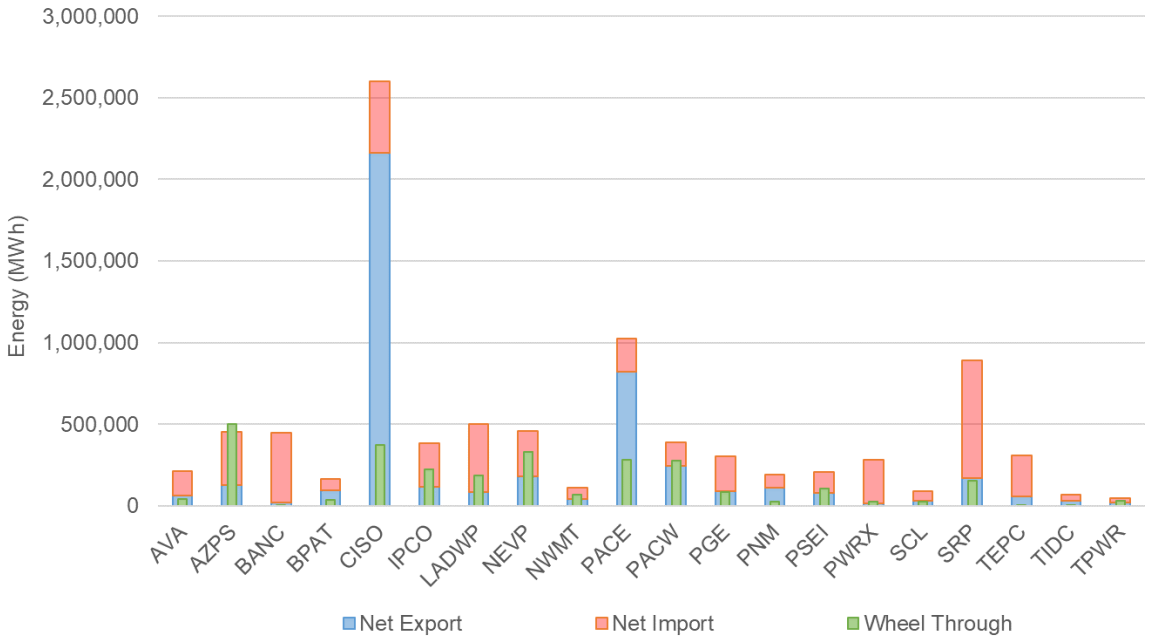
This volume reflects the total wheel-through transfers for each WEIM BAA, regardless of the potential paths used to wheel through. The net imports and exports estimated in this section reflect the overall volume of net imports and exports; in contrast, the imports and exports provided in Table 2 reflect 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.

BAA	Net Export	Net Import	Wheel Through
AVA	62,566	151,797	39,821
AZPS	127,260	325,482	500,557
BANC	19,328	430,405	1,317
BPAT	93,752	70,440	39,571
CISO	2,160,868	441,541	372,362
IPCO	118,497	263,568	224,029
LADWP	84,341	418,433	188,721
NEVP	183,385	273,110	331,057
NWMT	40,364	71,478	69,628

PACE	824,667	198,626	284,023
PACW	248,054	142,851	277,458
PGE	88,154	214,303	82,713
PNM	113,932	76,929	26,093
PSEI	79,693	130,587	107,944
PWRX	16,732	267,654	28,967
SCL	32,420	55,646	25,956
SRP	169,868	720,349	155,433
TEPC	58,079	253,395	5,521
TIDC	32,509	38,613	583
TPWR	19,923	29,186	29,818

TABLE 3: Estimated wheel-through transfers in Q2 2022

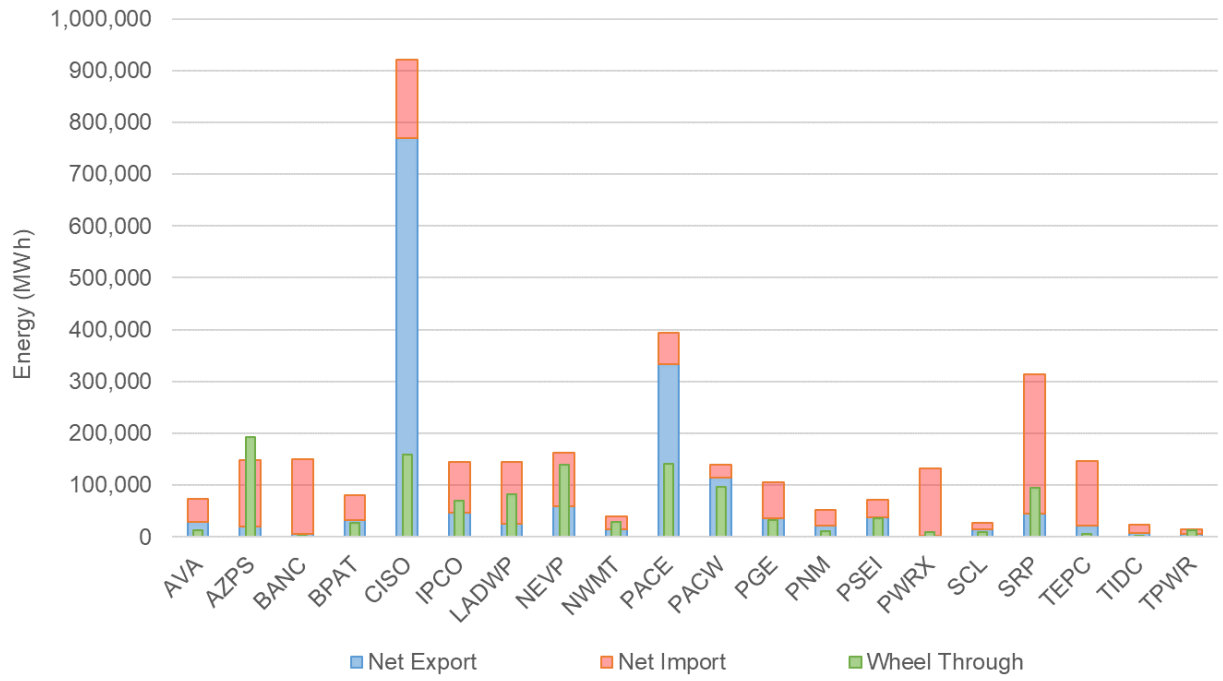


GRAPH 3: Estimated wheel-through transfers in Q1 2022

BAA	Net Export	Net Import	Wheel Through

AVA	22,848	54,990	15,462
AZPS	30,459	110,147	163,004
BANC	3,272	100,837	137
CISO	494,339	255,490	102,212
IPCO	46,954	57,693	88,700
LADWP	41,281	98,879	82,243
NEVP	55,128	82,111	84,004
NWMT	17,552	15,316	22,431
PACE	294,558	27,639	79,755
PACW	72,220	53,570	111,828
PGE	41,277	49,303	16,987
PNM	52,128	14,956	1,436
PSEI	29,559	49,335	31,492
PWRX	10,937	47,051	10,312
SCL	13,337	16,984	7,077
SRP	45,994	238,211	2,708
TIDC	12,011	12,809	147
TPWR	8,702	7,234	8,205

TABLE 4: Estimated wheel-through transfers in April 2022

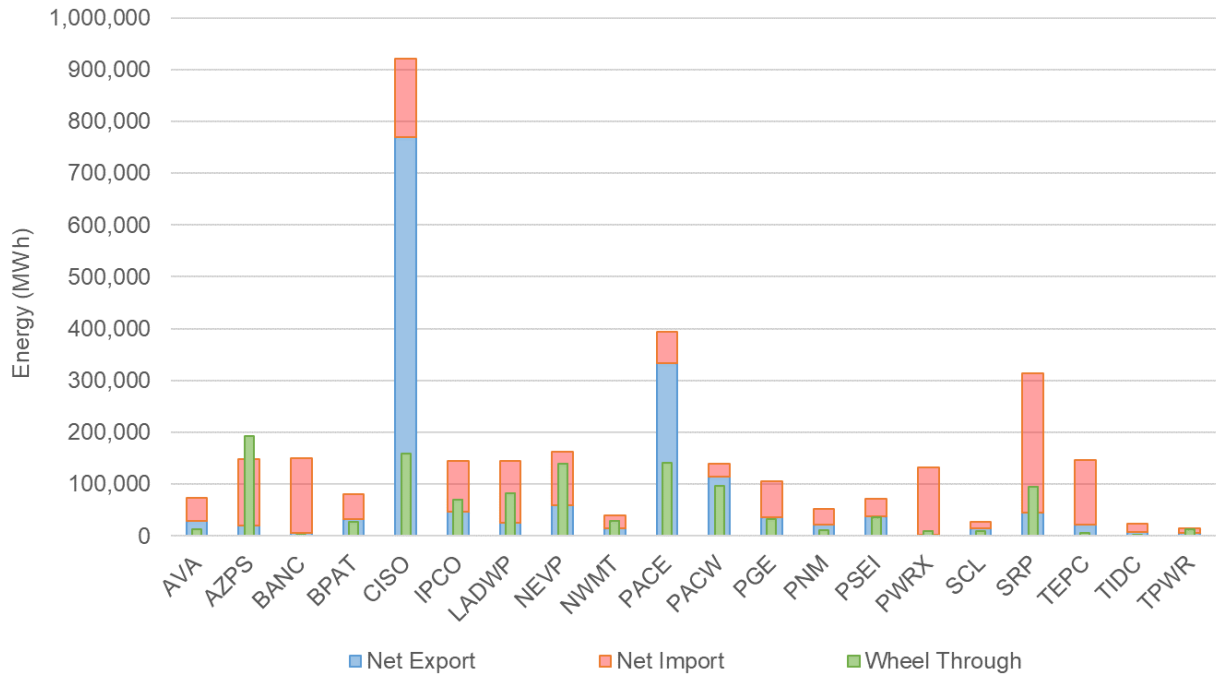


GRAPH 4: Estimated wheel-through transfers in April 2022

BAA	Net Export	Net Import	Wheel Through
AVA	29,449	44,558	13,391
AZPS	20,765	128,333	192,081
BANC	6,170	143,248	1,180
BPAT	32,468	48,067	27,379
CISO	769,360	151,522	159,118
IPCO	47,285	97,739	70,512
LADWP	25,667	118,873	82,789
NEVP	59,358	103,585	138,445
NWMT	13,868	25,684	28,454
PACE	332,732	60,441	140,277
PACW	114,734	24,756	95,945
PGE	36,218	68,781	33,058

PNM	21,064	30,427	11,916
PSEI	37,049	35,461	35,640
PWRX	2,802	130,251	9,266
SCL	14,237	12,194	8,916
SRP	45,112	269,052	94,156
TEPC	22,104	123,726	4,955
TIDC	6,752	16,343	135
TPWR	5,415	9,570	12,541

TABLE 5: Estimated wheel-through transfers in May 2022

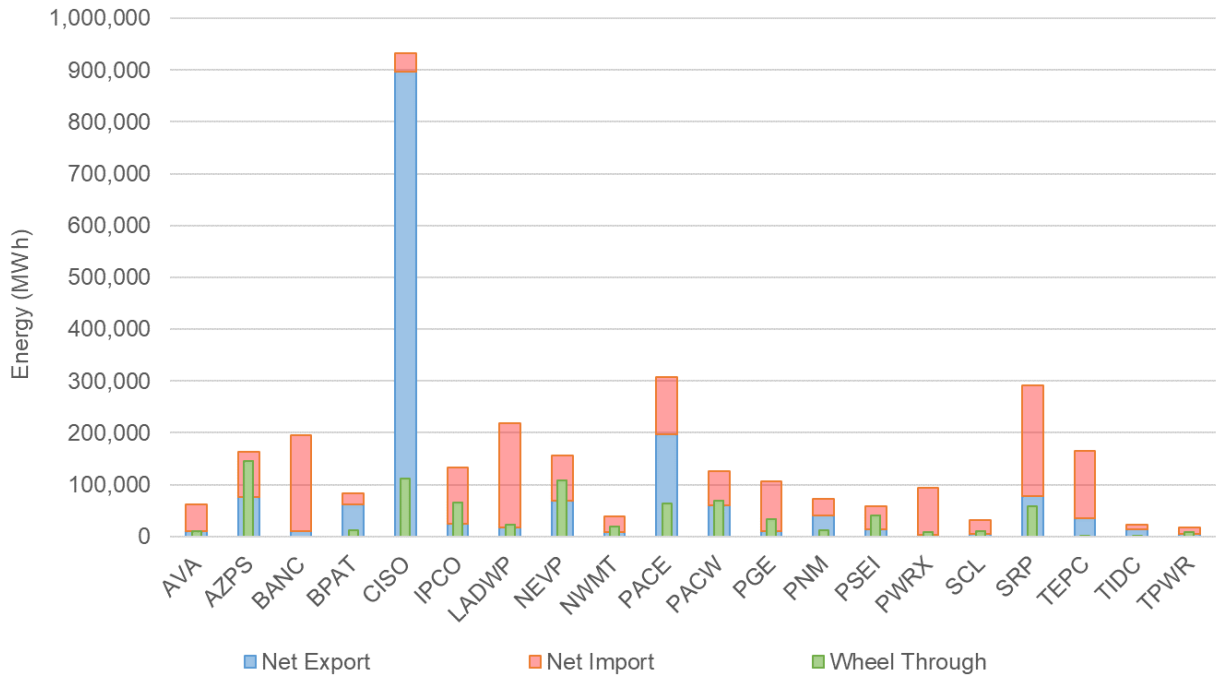


GRAPH 5: Estimated wheel-through transfers in May 2022

BAA	Net Export	Net Import	Wheel Through
AVA	10,269	52,249	10,968

AZPS	76,036	87,001	145,473
BANC	9,886	186,320	-
BPAT	61,283	22,373	12,192
CISO	897,170	34,529	111,033
IPCO	24,257	108,136	64,817
LADWP	17,394	200,681	23,689
NEVP	68,899	87,414	108,608
NWMT	8,944	30,478	18,743
PACE	197,378	110,546	63,991
PACW	61,100	64,525	69,685
PGE	10,660	96,220	32,669
PNM	40,739	31,545	12,741
PSEI	13,085	45,791	40,812
PWRX	2,992	90,351	9,389
SCL	4,846	26,468	9,964
SRP	78,761	213,086	58,569
TEPC	35,975	129,669	567
TIDC	13,745	9,460	300
TPWR	5,806	12,383	9,072

TABLE 6: Estimated wheel-through transfers in June 2022



GRAPH 6: Estimated wheel-through transfers in June 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 Q2 2022 was calculated to be 31,330 MWh (April) + 41,764 MWh (May) + 45,259 MWh (June) = 118,352 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 CO_2/MWh, avoided curtailments displaced an estimated 50,655 metric tons of CO_2 for Q2 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 CO_2, 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
	3	23,042	9,862
	4	38,044	16,283
2022	1	94,168	40,304
	2	118,352	50,655
Total		1,782,720	762,925

TABLE 7: Total reduction in curtailment of renewable energy and associated reductions in CO_2

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
	AVA	up	21	91
April	*AZPS*	up	30	286
	BANC	up	7	113
	CISO	up	367	2,072
	IPCO	up	34	159
	LADWP	up	59	315
	NEVP	up	26	332
	NWMT	up	36	118
	PACE	up	116	516
	PACW	up	45	190
	PGE	up	33	177
	PNM	up	40	177
	PSEI	up	39	203
	PWRX	up	77	319
	SCL	up	5	45
	SRP	up	32	152
April	*TIDC*	up	2	14
	TPWR	up	3	29
	ALL EIM	**up**	**471**	**2,759**
	AVA	down	22	87
	AZPS	down	38	229
	BANC	down	5	88
	CISO	down	148	1,682
	IPCO	down	36	223

	LADWP	down	45	279
	NEVP	down	16	395
	NWMT	down	31	135
	PACE	down	116	470
	PACW	down	60	186
	PGE	down	62	219
	PNM	down	49	163
	PSEI	down	27	174
	PWRX	down	76	314
	SCL	down	3	38
	SRP	down	17	160
	TIDC	down	1	19
	TPWR	down	4	34
	ALL EIM	**down**	**326**	**2,122**
	AVA	up	21	84
May	*AZPS*	up	33	286
	BANC	up	7	113
	BPAT	up	85	236
	CISO	up	363	2,072
	IPCO	up	38	159
	LADWP	up	66	315
	NEVP	up	0	332
	NWMT	up	36	129
May	*PACE*	up	118	516
	PACW	up	49	190
	PGE	up	51	277
	PNM	up	40	149
	PSEI	up	41	203
	PWRX	up	71	319
	SCL	up	5	45
	SRP	up	25	169

May	*TEPC*	up	37	135
	TIDC	up	0	14
	TPWR	up	4	25
	ALL WEIM	**up**	**359**	**2,759**
	AVA	down	33	84
	AZPS	down	38	229
	BANC	down	3	88
	BPAT	down	139	385
	CISO	down	142	1,682
	IPCO	down	61	223
	LADWP	down	51	279
	NEVP	down	0	395
	NWMT	down	38	135
	PACE	down	116	470
	PACW	down	55	221
	PGE	down	55	219
	PNM	down	40	163
	PSEI	down	36	174
	PWRX	down	59	314
	SCL	down	2	37
	SRP	down	15	143
	TEPC	down	33	149
	TIDC	down	1	19
	TPWR	down	3	19
	ALL EIM	**down**	**337**	**2,122**
June	*AVA*	up	17	84
	AZPS	up	40	286
	BANC	up	7	113
	BPAT	up	64	407
	CISO	up	363	1,967
	IPCO	up	41	159

	LADWP	up	66	315
	NEVP	up	0	332
	NWMT	up	24	128
	PACE	up	135	516
	PACW	up	47	200
	PGE	up	48	177
	PNM	up	34	179
	PSEI	up	40	203
	PWRX	up	71	225
	SCL	up	5	45
	SRP	up	30	169
	TEPC	up	42	135
	TIDC	up	0	15
	TPWR	up	4	26
	ALL WEIM	**up**	**358**	**2,560**
	AVA	down	23	84
June	*AZPS*	down	39	229
	BANC	down	3	88
	BPAT	down	139	402
	CISO	down	149	1,682
	IPCO	down	63	223
	LADWP	down	56	279
	NEVP	down	0	327
June	*NWMT*	down	30	156
	PACE	down	129	470
	PACW	down	57	221
	PGE	down	65	219
	PNM	down	45	163
	PSEI	down	33	174
	PWRX	down	67	239
	SCL	down	2	34

SRP	down	22	159
TEPC	down	26	134
TIDC	down	1	19
TPWR	down	2	24
ALL WEIM	**down**	**342**	**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.

	April		**May**		**June**	
Direction	Up	Down	Up	Down	Up	Down
Average MW saving	1,387	1,397	1,676	1,428	1,747	1,504
Sum of BAA requirements	2,708	2,472	3,010	2,945	3,056	2,880
Percentage savings	51%	57%	56%	48%	57%	52%

Table 9: Flexible ramping procurement diversity savings in Q2 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 762,925 metric tons of CO_2, roughly the equivalent of avoiding the emissions from 160,402 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
BPA	Bonneville Power Administration
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
TEP	Tucson Electric Power
TID	Turlock Irrigation District
TPWR	Tacoma Power
WEIM	Western Energy Imbalance Market