



WESTERN ENERGY IMBALANCE MARKET BENEFITS REPORT

First Quarter 2023 ■ ■ ■

Prepared by: Market Analysis and Forecasting

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CONTENTS

EXECUTIVE SUMMARY 3

BACKGROUND 4

WEIM ECONOMIC BENEFITS IN Q1 2023 4

 CUMULATIVE ECONOMIC BENEFITS SINCE INCEPTION..... 5

 INTER-REGIONAL TRANSFERS 6

 WHEEL-THROUGH TRANSFERS..... 23

REDUCED RENEWABLE CURTAILMENT AND GHG REDUCTIONS..... 30

FLEXIBLE RAMPING PROCUREMENT DIVERSITY SAVINGS 31

CONCLUSION..... 36

APPENDIX 1: GLOSSARY OF ABBREVIATIONS 37

EXECUTIVE SUMMARY

Gross benefits from WEIM since November 2014

\$3.82 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.



2023 Q1 BENEFITS

Q1 2023 Gross Benefits by Participant

	(millions \$)
Arizona Public Service	\$26.43
Avista	\$6.38
BANC	\$44.63
BPA	\$11.83
California ISO	\$67.86
Idaho Power	\$13.31
LADWP	\$27.99
NV Energy	\$47.19
NorthWestern Energy	\$12.60
PacifiCorp	\$28.94
Portland General Electric	\$21.67
PNM	\$22.40
Puget Sound Energy	\$15.28
Powerex	\$16.80
Seattle City Light	\$4.20
Salt River Project	\$31.38
Tacoma Power	\$6.55
TEP	\$10.37
TID	\$3.01
Total	\$418.82

ECONOMICAL

\$418.82 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

22,685

Metric tons of CO₂** avoided curtailments

OPERATIONAL

50%

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 WEIM 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 WEIM, 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 Q1 2023

Table 1 shows the estimated WEIM gross benefits by each region per month¹. The monthly savings presented show \$173.57 million for January, \$115.44 million for February, and \$129.81 million for March with a total estimated benefit of \$418.82 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>	\$11.52	\$7.21	\$7.70	\$26.43
<i>AVA</i>	\$2.84	\$1.65	\$1.89	\$6.38
<i>BANC</i>	\$18.37	\$20.87	\$5.39	\$44.63
<i>BPA</i>	\$4.57	\$4.20	\$3.06	\$11.83
<i>CISO</i>	\$22.41	\$17.64	\$27.81	\$67.86
<i>IPCO</i>	\$6.31	\$3.33	\$3.67	\$13.31
<i>LADWP</i>	\$10.65	\$9.48	\$7.86	\$27.99
<i>NVE</i>	\$17.93	\$8.34	\$20.92	\$47.19
<i>NWMT</i>	\$8.07	\$2.60	\$1.93	\$12.60
<i>PAC</i>	\$19.32	\$3.80	\$5.82	\$28.94
<i>PGE</i>	\$9.27	\$6.46	\$5.94	\$21.67
<i>PNM</i>	\$10.25	\$5.05	\$7.10	\$22.40
<i>PSE</i>	\$7.33	\$3.39	\$4.56	\$15.28
<i>PWRX</i>	\$2.15	\$7.73	\$6.92	\$16.80
<i>SCL</i>	\$1.74	\$1.04	\$1.42	\$4.20
<i>SRP</i>	\$12.39	\$9.00	\$9.99	\$31.38
<i>TPWR</i>	\$3.25	\$1.23	\$2.07	\$6.55
<i>TEP</i>	\$4.17	\$1.67	\$4.53	\$10.37
<i>TID</i>	\$1.03	\$0.75	\$1.23	\$3.01
Total	\$173.57	\$115.44	\$129.81	\$418.82

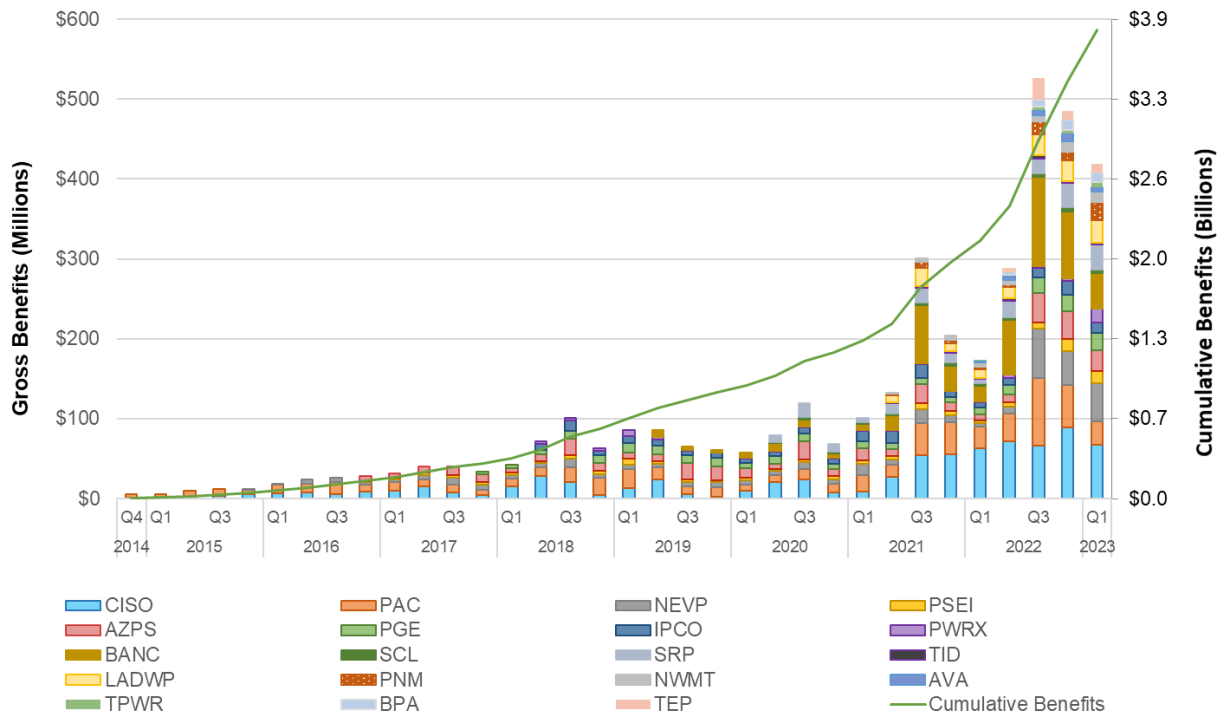
TABLE 1: Q1 2023 benefits in millions USD

■ CUMULATIVE ECONOMIC BENEFITS SINCE INCEPTION

Since the start of the WEIM in November 2014, the cumulative economic benefits of the market have totaled \$3.82 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	AVA	BPAT	14,447	12,743
	AVA	CISO	0	0
	AVA	IPCO	25,928	22,418
	AVA	NWMT	3,527	2,075
	AVA	PACW	8,338	9,885
	AVA	PGE	0	0
	AVA	PSEI	0	0
	AVA	SCL	0	0
	AVA	TPWR	0	0
	AZPS	CISO	239,844	188,035
	AZPS	LADWP	54,635	54,691
	AZPS	NEVP	14,963	15,504
	AZPS	PACE	35,647	38,963
	AZPS	PNM	5,920	2,973
	AZPS	SRP	2,800	2,312
	AZPS	TEPC	5,524	1,721
	BANC	BPAT	0	0
	BANC	CISO	5,730	5,948
	BANC	TIDC	29	0
	BPAT	AVA	9,832	9,473
BPAT	BANC	0	0	
BPAT	CISO	26,238	33,920	

<i>January</i>	BPAT	IPCO	9,644	271
	BPAT	LADWP	0	0
	BPAT	NEVP	0	0
	BPAT	NWMT	16,374	2,157
	BPAT	PACW	5,710	5,451
	BPAT	PGE	27,517	29,698
	BPAT	PSEI	14,731	14,954
	BPAT	PWRX	3,413	0
	BPAT	SCL	3,419	3,355
	BPAT	TPWR	7,335	8,831
	CISO	AVA	0	0
	CISO	AZPS	13,475	17,544
	CISO	BANC	101,677	105,617
	CISO	BPAT	23,062	26,574
	CISO	LADWP	49,505	56,542
	CISO	NEVP	18,639	20,381
	CISO	PACW	15,177	34,803
	CISO	PGE	35,840	53,953
	CISO	PWRX	154,650	171,000
	CISO	SRP	2,381	4,371
	CISO	TEPC	0	0
	CISO	TIDC	4,468	4,804
	IPCO	AVA	18,399	19,962
	IPCO	BPAT	426	166
	IPCO	NEVP	50,872	42,378
	IPCO	NWMT	218	565
	IPCO	PACE	39,298	18,343
	IPCO	PACW	30,297	31,398

<i>January</i>	IPCO	PSEI	0	0
	IPCO	SCL	9,620	8,790
<i>January</i>	LADWP	AZPS	169	289
	LADWP	BPAT	0	0
	LADWP	CISO	36,044	30,065
	LADWP	NEVP	10,247	11,522
	LADWP	PACE	18,160	19,136
	LADWP	TEPC	0	0
	NEVP	AZPS	250	844
	NEVP	BPAT	0	0
	NEVP	CISO	175,550	131,046
	NEVP	IPCO	49,907	49,266
	NEVP	LADWP	36,279	37,424
	NEVP	PACE	14,755	12,031
	NWMT	AVA	30,886	31,569
	NWMT	BPAT	9,417	8,840
	NWMT	IPCO	22,211	22,310
	NWMT	PACE	22,893	13,364
	NWMT	PACW	0	0
	NWMT	PGE	71	0
	NWMT	PSEI	285	0
	NWMT	TPWR	0	0
PACE	AZPS	57,485	51,918	
PACE	IPCO	61,980	64,413	
PACE	LADWP	20,362	23,037	
PACE	NEVP	64,559	58,882	
PACE	NWMT	10,358	13,373	
PACE	PACW	40,489	39,802	

<i>January</i>	PACE	SRP	0	0
	PACE	TEPC	55	302
<i>January</i>	PACW	AVA	6,464	5,835
	PACW	BPAT	5,869	5,212
	PACW	CISO	57,547	89,428
	PACW	IPCO	19,341	18,889
	PACW	NWMT	2	0
	PACW	PGE	64,408	64,217
	PACW	PSEI	20,751	19,480
	PACW	SCL	1,402	1,248
	PGE	AVA	0	0
	PGE	BPAT	28,931	31,304
	PGE	CISO	29,499	28,293
	PGE	NWMT	165	0
	PGE	PACW	14,299	18,163
	PGE	PSEI	0	0
	PGE	SCL	1,241	1,141
	PGE	TPWR	0	0
	PNM	AZPS	113,667	119,571
	PNM	SRP	498	465
	PNM	TEPC	15,512	17,130
	PSEI	AVA	0	0
	PSEI	BPAT	25,093	31,195
	PSEI	IPCO	0	0
	PSEI	NWMT	136	0
	PSEI	PACW	11,026	13,840
	PSEI	PGE	0	0
	PSEI	PWRX	13,662	15,620

<i>January</i>	PSEI	SCL	13,531	11,598
	PSEI	TPWR	407	570
<i>January</i>	PWRX	BPAT	18,442	0
	PWRX	CISO	0	0
	PWRX	PSEI	14,029	14,617
	SCL	AVA	0	0
	SCL	BPAT	1,139	1,906
	SCL	IPCO	3,741	4,651
	SCL	PACW	516	774
	SCL	PGE	789	1,094
	SCL	PSEI	5,235	8,650
	SRP	AZPS	49,716	50,770
	SRP	CISO	117,888	110,109
	SRP	PACE	0	0
	SRP	PNM	0	0
	SRP	TEPC	5,623	7,555
	TEPC	AZPS	812	40
	TEPC	CISO	62,756	61,758
	TEPC	LADWP	137	162
	TEPC	PACE	840	876
	TEPC	PNM	14,631	15,096
	TEPC	SRP	10,235	9,133
	TIDC	BANC	184	190
	TIDC	CISO	17,941	17,086
	TPWR	AVA	0	0
	TPWR	BPAT	11,559	12,150
	TPWR	NWMT	0	0
	TPWR	PGE	0	0

	TPWR	PSEI	23,512	23,880
<i>February</i>	AVA	BPAT	5,279	3,457
	AVA	CISO	0	0
	AVA	IPCO	30,101	26,908
	AVA	NWMT	8,116	7,304
	AVA	PACW	5,404	5,719
	AVA	PGE	0	0
	AVA	PSEI	0	0
	AVA	SCL	0	0
	AVA	TPWR	0	0
	AZPS	CISO	121,604	89,140
	AZPS	LADWP	29,838	26,510
	AZPS	NEVP	27,657	25,294
	AZPS	PACE	128,447	130,889
	AZPS	PNM	9,649	9,443
	AZPS	SRP	1,545	1,483
	AZPS	TEPC	2,310	2,350
	BANC	BPAT	0	0
	BANC	CISO	1,189	682
	BANC	TIDC	77	0
	BPAT	AVA	10,013	8,934
	BPAT	BANC	0	0
	BPAT	CISO	16,204	24,965
	BPAT	IPCO	13,746	7,826
	BPAT	LADWP	0	0
	BPAT	NEVP	0	0
	BPAT	NWMT	18,506	8,124
	BPAT	PACW	8,771	6,464

<i>February</i>	BPAT	PGE	29,445	29,808
	BPAT	PSEI	22,973	24,062
<i>February</i>	BPAT	PWRX	4,877	0
	BPAT	SCL	5,075	4,840
	BPAT	TPWR	11,241	13,604
	CISO	AVA	0	0
	CISO	AZPS	42,390	39,061
	CISO	BANC	169,164	175,480
	CISO	BPAT	26,038	28,530
	CISO	LADWP	45,705	50,036
	CISO	NEVP	68,821	56,244
	CISO	PACW	22,574	55,675
	CISO	PGE	62,842	89,377
	CISO	PWRX	304,096	326,115
	CISO	SRP	31,532	30,711
	CISO	TEPC	0	0
	CISO	TIDC	6,530	7,114
	IPCO	AVA	22,331	26,192
	IPCO	BPAT	1,540	779
	IPCO	NEVP	23,409	14,186
	IPCO	NWMT	191	738
	IPCO	PACE	15,762	8,421
	IPCO	PACW	28,915	21,610
	IPCO	PSEI	0	0
	IPCO	SCL	7,578	7,099
	LADWP	AZPS	1,083	1,949
	LADWP	BPAT	0	0
	LADWP	CISO	18,190	14,640

<i>February</i>	LADWP	NEVP	10,565	10,472
	LADWP	PACE	19,162	16,736
<i>February</i>	LADWP	TEPC	0	0
	NEVP	AZPS	829	2,108
	NEVP	BPAT	0	0
	NEVP	CISO	70,252	44,499
	NEVP	IPCO	77,369	67,803
	NEVP	LADWP	30,651	34,471
	NEVP	PACE	100,091	87,196
	NWMT	AVA	12,646	12,559
	NWMT	BPAT	2,857	775
	NWMT	IPCO	19,350	18,526
	NWMT	PACE	29,657	25,144
	NWMT	PACW	0	0
	NWMT	PGE	0	0
	NWMT	PSEI	195	0
	NWMT	TPWR	0	0
	PACE	AZPS	32,910	27,943
	PACE	IPCO	39,841	33,920
	PACE	LADWP	10,562	10,073
	PACE	NEVP	16,583	14,061
	PACE	NWMT	7,867	6,093
	PACE	PACW	26,877	17,452
	PACE	SRP	0	0
	PACE	TEPC	0	0
	PACW	AVA	7,496	8,647
	PACW	BPAT	2,345	1,680
	PACW	CISO	33,658	46,692

<i>February</i>	PACW	IPCO	22,740	28,416
	PACW	NWMT	0	0
<i>February</i>	PACW	PGE	45,848	42,930
	PACW	PSEI	20,930	20,019
	PACW	SCL	1,425	1,319
	PGE	AVA	0	0
	PGE	BPAT	22,706	23,755
	PGE	CISO	25,404	23,302
	PGE	NWMT	0	0
	PGE	PACW	25,456	28,718
	PGE	PSEI	0	0
	PGE	SCL	1,341	1,289
	PGE	TPWR	0	0
	PNM	AZPS	90,489	91,889
	PNM	SRP	1,128	1,556
	PNM	TEPC	14,685	16,367
	PSEI	AVA	0	0
	PSEI	BPAT	24,244	26,069
	PSEI	IPCO	0	0
	PSEI	NWMT	314	0
	PSEI	PACW	19	0
	PSEI	PGE	0	0
	PSEI	PWRX	22,045	22,782
	PSEI	SCL	19,703	17,653
	PSEI	TPWR	4,953	5,785
	PWRX	BPAT	16,060	0
	PWRX	CISO	0	0
	PWRX	PSEI	7,676	7,094

<i>February</i>	SCL	AVA	0	0
	SCL	BPAT	504	601
<i>February</i>	SCL	IPCO	6,078	6,984
	SCL	PACW	821	1,002
	SCL	PGE	831	1,059
	SCL	PSEI	4,878	6,181
	SRP	AZPS	38,548	45,286
	SRP	CISO	174,867	161,834
	SRP	PACE	0	0
	SRP	PNM	23	5
	SRP	TEPC	24,646	24,850
	TEPC	AZPS	1,800	683
	TEPC	CISO	29,966	26,352
	TEPC	LADWP	152	272
	TEPC	PACE	371	121
	TEPC	PNM	10,702	7,802
	TEPC	SRP	31,790	30,468
	TIDC	BANC	12	0
	TIDC	CISO	17,975	16,672
	TPWR	AVA	0	0
	TPWR	BPAT	5,585	6,249
	TPWR	NWMT	0	0
TPWR	PGE	0	0	
TPWR	PSEI	12,520	13,643	
<i>March</i>	AVA	BPAT	9,088	5,439
	AVA	CISO	0	0
	AVA	IPCO	15,021	10,702
	AVA	NWMT	19,795	18,901

<i>March</i>	AVA	PACW	5,058	5,192
	AVA	PGE	0	0
	AVA	PSEI	0	0
	AVA	SCL	18	0
	AVA	TPWR	0	0
	AZPS	CISO	94,839	72,171
	AZPS	LADWP	23,695	31,347
	AZPS	NEVP	47,626	41,500
	AZPS	PACE	157,262	161,848
	AZPS	PNM	15,947	17,827
	AZPS	SRP	4,154	3,967
	AZPS	TEPC	3,646	4,856
	BANC	BPAT	0	0
	BANC	CISO	44,574	36,068
	BANC	TIDC	3,432	2,735
	BPAT	AVA	11,325	10,021
	BPAT	BANC	0	0
	BPAT	CISO	17,197	22,876
	BPAT	IPCO	14,535	4,749
	BPAT	LADWP	0	0
	BPAT	NEVP	0	0
	BPAT	NWMT	17,054	12,962
	BPAT	PACW	4,837	3,257
	BPAT	PGE	24,718	22,672
	BPAT	PSEI	15,618	20,547
	BPAT	PWRX	4,923	0
	BPAT	SCL	4,745	4,992
	BPAT	TPWR	10,188	13,112

<i>March</i>	CISO	AVA	0	0
	CISO	AZPS	41,759	30,917
<i>March</i>	CISO	BANC	43,639	57,361
	CISO	BPAT	31,944	35,760
	CISO	LADWP	50,554	51,085
	CISO	NEVP	83,463	66,098
	CISO	PACW	12,786	41,442
	CISO	PGE	49,531	71,815
	CISO	PWRX	320,642	338,692
	CISO	SRP	57,800	54,009
	CISO	TEPC	0	0
	CISO	TIDC	13,747	14,714
	IPCO	AVA	30,978	32,600
	IPCO	BPAT	6,070	6,616
	IPCO	NEVP	27,095	16,084
	IPCO	NWMT	1,024	1,548
	IPCO	PACE	56,934	50,980
	IPCO	PACW	40,885	30,879
	IPCO	PSEI	5,331	4,233
	IPCO	SCL	9,549	8,271
	LADWP	AZPS	2,818	4,747
	LADWP	BPAT	0	0
LADWP	CISO	37,042	26,249	
LADWP	NEVP	23,056	22,861	
LADWP	PACE	29,943	34,177	
LADWP	TEPC	0	0	
NEVP	AZPS	3,215	5,454	
NEVP	BPAT	0	0	

<i>March</i>	NEVP	CISO	62,375	46,255
	NEVP	IPCO	57,556	49,906
<i>March</i>	NEVP	LADWP	19,634	19,823
	NEVP	PACE	212,357	186,860
	NWMT	AVA	10,554	9,244
	NWMT	BPAT	5,717	3,668
	NWMT	IPCO	6,618	5,441
	NWMT	PACE	43,856	41,416
	NWMT	PACW	0	0
	NWMT	PGE	1	0
	NWMT	PSEI	110	0
	NWMT	TPWR	0	0
	PACE	AZPS	18,149	12,804
	PACE	IPCO	31,322	32,991
	PACE	LADWP	7,604	4,718
	PACE	NEVP	5,031	3,178
	PACE	NWMT	6,576	4,985
	PACE	PACW	31,300	24,028
	PACE	SRP	0	0
	PACE	TEPC	0	0
	PACW	AVA	6,192	6,250
	PACW	BPAT	6,379	4,744
PACW	CISO	17,710	37,856	
PACW	IPCO	16,380	15,076	
PACW	NWMT	0	0	
PACW	PGE	65,927	56,243	
PACW	PSEI	40,077	37,812	
PACW	SCL	1,724	1,375	

<i>March</i>	PGE	AVA	0	0
	PGE	BPAT	41,815	29,998
<i>March</i>	PGE	CISO	17,578	15,852
	PGE	NWMT	1	0
	PGE	PACW	10,172	16,529
	PGE	PSEI	2,480	2,995
	PGE	SCL	1,306	1,242
	PGE	TPWR	0	0
	PNM	AZPS	114,933	125,827
	PNM	SRP	803	852
	PNM	TEPC	13,343	12,707
	PSEI	AVA	0	0
	PSEI	BPAT	33,095	26,767
	PSEI	IPCO	2,931	2,478
	PSEI	NWMT	97	0
	PSEI	PACW	5,289	6,876
	PSEI	PGE	1,040	1,124
	PSEI	PWRX	23,355	26,297
	PSEI	SCL	23,516	21,716
	PSEI	TPWR	7,682	7,104
	PWRX	BPAT	16,390	0
	PWRX	CISO	0	0
PWRX	PSEI	7,650	6,979	
SCL	AVA	7	0	
SCL	BPAT	856	846	
SCL	IPCO	5,394	5,905	
SCL	PACW	359	522	
SCL	PGE	721	814	

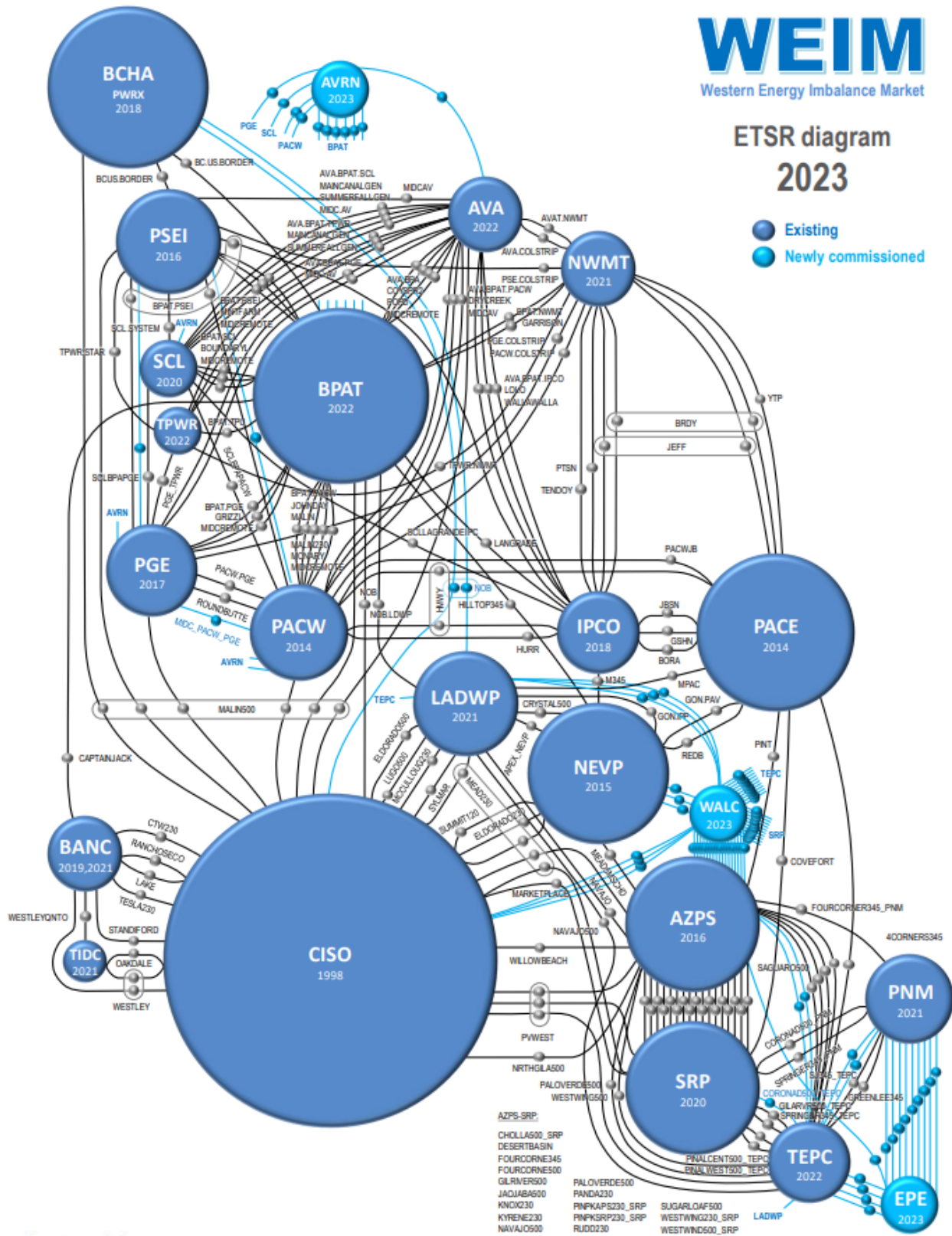
<i>March</i>	SCL	PSEI	3,440	4,061
	SRP	AZPS	53,332	52,849
<i>March</i>	SRP	CISO	136,422	125,198
	SRP	PACE	0	0
	SRP	PNM	58	91
	SRP	TEPC	25,779	23,480
	TEPC	AZPS	2,770	2,511
	TEPC	CISO	65,489	67,012
	TEPC	LADWP	0	0
	TEPC	PACE	5,869	4,703
	TEPC	PNM	21,855	16,460
	TEPC	SRP	24,516	21,236
	TIDC	BANC	4,589	5,538
	TIDC	CISO	19,037	15,510
	TPWR	AVA	0	0
	TPWR	BPAT	6,029	4,742
	TPWR	NWMT	0	0
TPWR	PGE	0	0	
TPWR	PSEI	6,198	7,767	

TABLE 2: Energy transfers (MWh) in the FMM and RTD markets for Q1 2023



ETSR diagram 2023

- Existing
- Newly commissioned



GRAPH 2: WEIM transfer

■ 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.

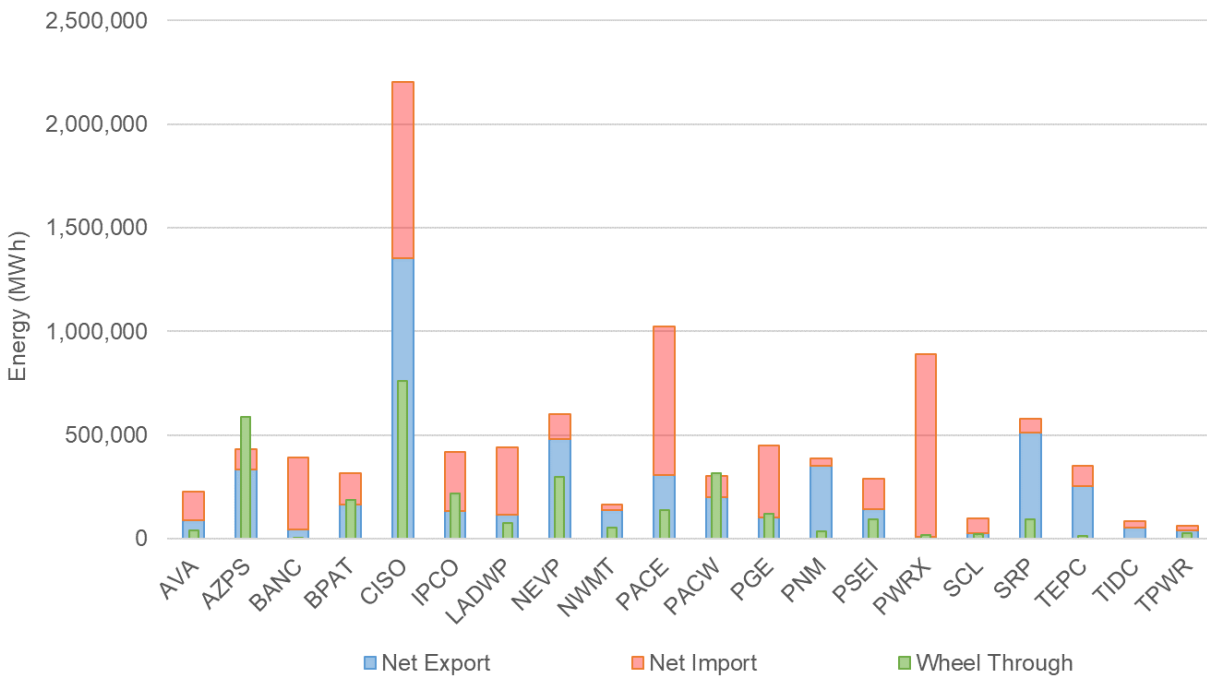
This volume reflects the total wheel-through transfers for each WEIM BAA, regardless of the potential paths used to wheel through. The net imports and exports estimated in this section reflect the overall volume of net imports and exports; in contrast, the imports and exports provided in Table 2 reflect 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	89,033	139,575	41,711
AZPS	335,627	97,806	587,198
BANC	45,406	344,159	27
BPAT	163,219	151,860	188,705

CISO	1,354,826	848,513	760,999
IPCO	134,840	282,849	217,001
LADWP	116,399	323,748	76,443
NEVP	478,330	121,989	296,657
NWMT	138,434	24,401	54,423
PACE	307,605	714,838	136,367
PACW	198,530	104,643	314,838
PGE	103,768	345,990	118,814
PNM	350,796	34,129	35,569
PSEI	143,862	143,365	93,611
PWRX	9,974	881,791	18,715
SCL	24,259	75,138	20,791
SRP	510,350	68,884	91,678
TEPC	253,452	100,086	11,232
TIDC	54,996	29,366	-

TABLE 3: Estimated wheel-through transfers in Q1 2023



GRAPH 3: Estimated wheel-through transfers in Q1 2023

BAA	Net Export	Net Import	Wheel Through
AVA	31,563	51,280	15,559
AZPS	104,474	41,250	199,725
BANC	5,948	105,806	-
BPAT	44,031	66,013	64,078
CISO	250,023	450,123	245,565
IPCO	54,962	115,578	66,641
LADWP	28,738	139,583	32,273
NEVP	136,668	54,724	93,943
NWMT	63,081	5,166	13,003
PACE	208,253	59,238	43,474
PACW	81,578	31,385	122,731

PGE	37,956	108,018	40,945
PNM	125,036	5,939	12,130
PSEI	44,148	52,906	28,675
PWRX	5,951	177,954	8,665
SCL	9,611	18,669	7,464
SRP	160,003	7,850	8,432
TEPC	82,788	22,430	4,278
TIDC	17,276	4,804	-
TPWR	27,342	714	8,688

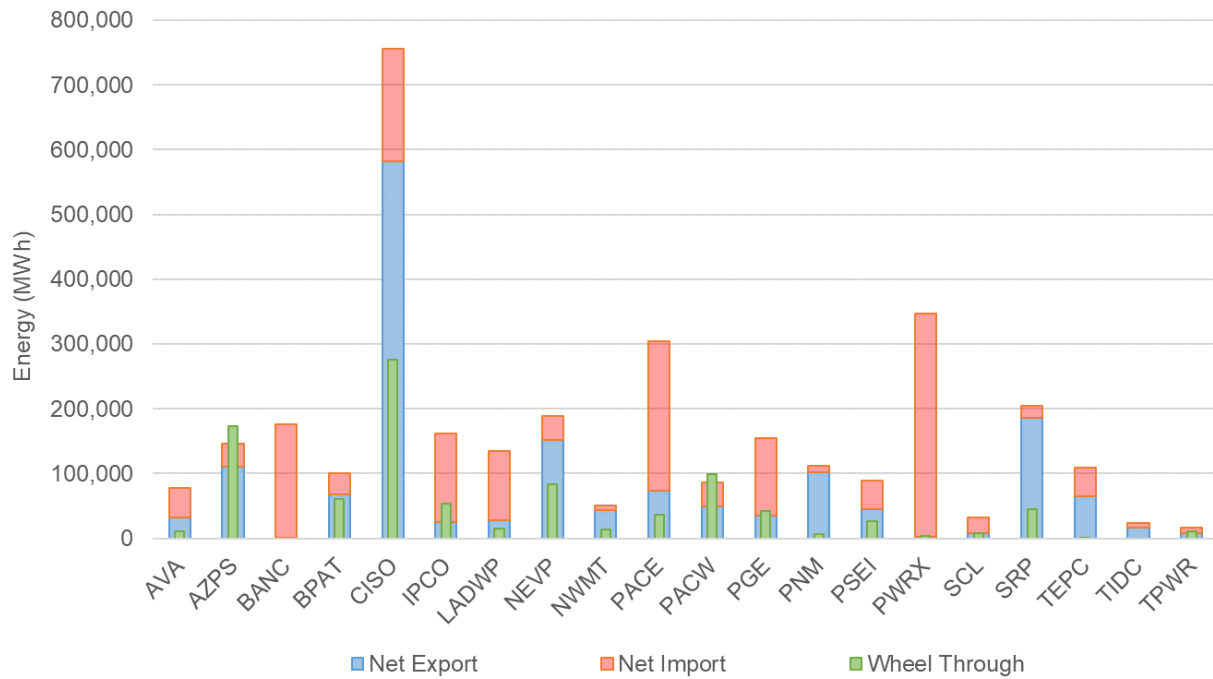
TABLE 4: Estimated wheel-through transfers in January 2023



GRAPH 4: Estimated wheel-through transfers in January 2023

BAA	Net Export	Net Import	Wheel Through
AVA	32,236	45,181	11,152
AZPS	111,287	35,097	173,822
BANC	682	175,480	-
BPAT	68,437	31,704	60,190
CISO	582,404	172,838	275,940
IPCO	25,221	136,577	53,806
LADWP	28,307	105,874	15,489
NEVP	152,045	36,225	84,033
NWMT	43,070	8,325	13,934
PACE	72,930	231,896	36,612
PACW	49,803	36,741	99,900
PGE	34,474	120,584	42,590
PNM	102,484	9,921	7,329
PSEI	45,624	44,335	26,665
PWRX	2,650	344,454	4,444
SCL	7,714	24,087	8,114
SRP	186,532	18,775	45,443
TEPC	65,427	43,296	271
TIDC	16,672	7,114	-
TPWR	8,439	7,936	11,453

TABLE 5: Estimated wheel-through transfers in February 2023

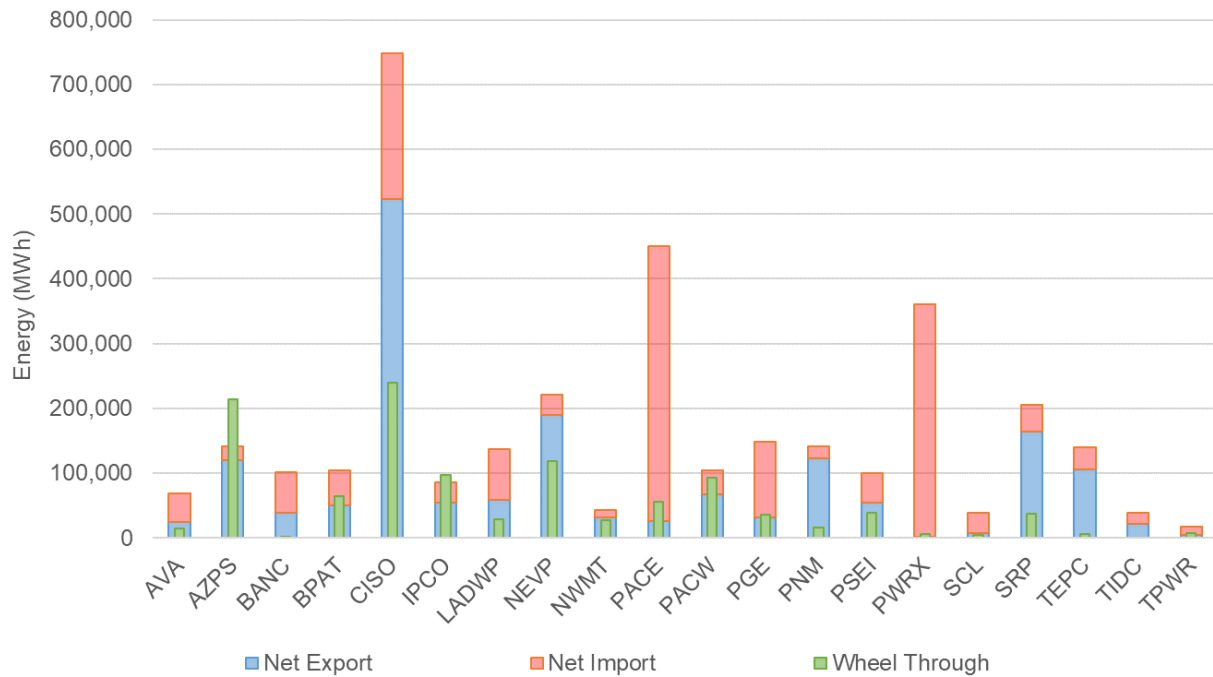


GRAPH 5: Estimated wheel-through transfers in February 2023

BAA	Net Export	Net Import	Wheel Through
AVA	25,234	43,115	15,000
AZPS	119,866	21,459	213,651
BANC	38,775	62,872	27
BPAT	50,751	54,143	64,437
CISO	522,398	225,552	239,494
IPCO	54,657	30,694	96,554
LADWP	59,353	78,291	28,681
NEVP	189,617	31,040	118,681
NWMT	32,284	10,909	27,486
PACE	26,422	423,704	56,281
PACW	67,148	36,517	92,207
PGE	31,338	117,388	35,279

PNM	123,276	18,268	16,109
PSEI	54,090	46,125	38,271
PWRX	1,373	359,383	5,606
SCL	6,934	32,383	5,214
SRP	163,815	42,260	37,803
TEPC	105,237	34,359	6,684
TIDC	21,048	17,449	-
TPWR	4,982	12,689	7,526

TABLE 6: Estimated wheel-through transfers in March 2023



GRAPH 6: Estimated wheel-through transfers in March 2023

■ 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 2023 was calculated to be 8,283 MWh (January) + 21,976 MWh (February) + 22,743 MWh (March) = 53,002 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 22,685 metric tons of CO₂ for Q1 2023. 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
	2	118,352	50,655
	3	42,468	18,176
	4	25,609	10,960
2023	1	53,002	22,685
Total		1,903,799	814,746

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>AVA</i>	up	22	81
	<i>AZPS</i>	up	49	284
	<i>BANC</i>	up	10	96
	<i>BPAT</i>	up	82	371

	<i>CISO</i>	up	248	2,337
	<i>IPCO</i>	up	36	189
	<i>LADWP</i>	up	30	393
	<i>NEVP</i>	up	20	446
	<i>NWMT</i>	up	22	127
	<i>PACE</i>	up	90	460
	<i>PACW</i>	up	49	174
	<i>PGE</i>	up	51	200
	<i>PNM</i>	up	39	155
	<i>PSEI</i>	up	74	167
	<i>PWRX</i>	up	78	294
	<i>SCL</i>	up	7	31
	<i>SRP</i>	up	17	201
	<i>TEPC</i>	up	66	193
	<i>TIDC</i>	up	2	17
	<i>TPWR</i>	up	3	19
	ALL EIM	up	315	2,771
	<i>AVA</i>	down	11	92
	<i>AZPS</i>	down	23	231
<i>January</i>	<i>BANC</i>	down	6	152
	<i>BPAT</i>	down	141	639
	<i>CISO</i>	down	187	1,332
	<i>IPCO</i>	down	36	194
	<i>LADWP</i>	down	38	297
	<i>NEVP</i>	down	24	414
	<i>NWMT</i>	down	41	124
	<i>PACE</i>	down	176	461
	<i>PACW</i>	down	34	163
	<i>PGE</i>	down	28	204
	<i>PNM</i>	down	41	141
	<i>PSEI</i>	down	52	153

	<i>PWRX</i>	down	69	356
	<i>SCL</i>	down	4	28
	<i>SRP</i>	down	20	181
	<i>TEPC</i>	down	0	165
	<i>TIDC</i>	down	1	17
	<i>TPWR</i>	down	2	24
	ALL EIM	down	279	2,175
<i>February</i>	<i>AVA</i>	up	20	81
	<i>AZPS</i>	up	39	284
	<i>BANC</i>	up	8	102
	<i>BPAT</i>	up	87	435
	<i>CISO</i>	up	259	2,303
	<i>IPCO</i>	up	44	175
	<i>LADWP</i>	up	49	393
	<i>NEVP</i>	up	26	463
	<i>NWMT</i>	up	32	124
	<i>PACE</i>	up	103	525
<i>February</i>	<i>PACW</i>	up	51	174
	<i>PGE</i>	up	35	200
	<i>PNM</i>	up	39	155
	<i>PSEI</i>	up	67	167
	<i>PWRX</i>	up	79	369
	<i>SCL</i>	up	6	31
	<i>SRP</i>	up	27	267
	<i>TEPC</i>	up	64	200
	<i>TIDC</i>	up	2	20
	<i>TPWR</i>	up	23	19
	ALL WEIM	up	395	2,771
	<i>AVA</i>	down	14	103
	<i>AZPS</i>	down	31	383
	<i>BANC</i>	down	9	152

	<i>BPAT</i>	down	163	639
	<i>CISO</i>	down	220	1,332
	<i>IPCO</i>	down	52	194
	<i>LADWP</i>	down	68	307
	<i>NEVP</i>	down	32	414
	<i>NWMT</i>	down	36	132
	<i>PACE</i>	down	139	451
	<i>PACW</i>	down	50	163
	<i>PGE</i>	down	45	204
	<i>PNM</i>	down	59	146
	<i>PSEI</i>	down	74	153
	<i>PWRX</i>	down	66	356
	<i>SCL</i>	down	7	28
	<i>SRP</i>	down	23	400
	<i>TEPC</i>	down	39	134
	<i>TIDC</i>	down	1	17
	<i>TPWR</i>	down	2	25
	ALL EIM	down	438	2,175
<i>March</i>	<i>AVA</i>	up	23	81
	<i>AZPS</i>	up	44	300
	<i>BANC</i>	up	7	102
	<i>BPAT</i>	up	76	435
	<i>CISO</i>	up	266	2,323
	<i>IPCO</i>	up	45	189
	<i>LADWP</i>	up	51	393
	<i>NEVP</i>	up	24	463
	<i>NWMT</i>	up	46	127
	<i>PACE</i>	up	103	525
	<i>PACW</i>	up	49	174
	<i>PGE</i>	up	59	200
	<i>PNM</i>	up	50	155

March	<i>PSEI</i>	up	67	167
	<i>PWRX</i>	up	79	377
	<i>SCL</i>	up	6	31
	<i>SRP</i>	up	35	280
	<i>TEPC</i>	up	62	263
	<i>TIDC</i>	up	2	20
	<i>TPWR</i>	up	2	19
	ALL WEIM	up	385	2,771
	<i>AVA</i>	down	15	94
	<i>AZPS</i>	down	18	383
	<i>BANC</i>	down	5	152
	<i>BPAT</i>	down	109	639
	<i>CISO</i>	down	220	1,332
	<i>IPCO</i>	down	52	194
	<i>LADWP</i>	down	41	307
	<i>NEVP</i>	down	12	414
	<i>NWMT</i>	down	9	132
	<i>PACE</i>	down	96	451
	<i>PACW</i>	down	22	163
	<i>PGE</i>	down	24	204
	<i>PNM</i>	down	36	155
	<i>PSEI</i>	down	10	153
	<i>PWRX</i>	down	46	356
	<i>SCL</i>	down	5	28
	<i>SRP</i>	down	28	400
	<i>TEPC</i>	down	19	129
	<i>TIDC</i>	down	0	19
	<i>TPWR</i>	down	2	25
	ALL WEIM	down	1,718	2,175

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>	1,655	1,657	1,698	1,484	2,470	951
<i>Sum of BAA requirements</i>	2,983	2,714	2,982	3,013	4,985	3,113
<i>Percentage savings</i>	55%	61%	57%	49%	50%	31%

Table 9: Flexible ramping procurement diversity savings in Q1 2023

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 814,746 metric tons of CO₂, roughly the equivalent of avoiding the emissions from 171,297 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