



Variability in Loads and
Resources Study
Report to PCDS

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Variability in Loads and Resources

- Purpose of the assessment
 - The purpose of this study is to determine the impact of variability in loads and resources on the Western Interconnection.
- Reliability Questions
 - Study reliability impacts of a heat wave weather event.
 - Can BESS be used effectively to respond to variability in loads and resources?
- Leadership team
 - Radha Soorya—Chair
 - David Le—Vice-Chair

Process Flow

Using CEC forecast develop 1-in-10 and 1-in-20 load shapes, simulating a heat wave

Observed unserved load in the PCM

Added BESS to mitigate unserved load

Analyze a single hour in PF

Study Assumptions

- Accelerated coal generation retirements: 9 units; 3,436 MW capacity
 - Rest of coal is still modeled consistent with the 2030 ADS PCM
- Used the CEC 2030 IEPR for peak load assumptions
- Other data is the same as the 2030 ADS PCM

Load Development (1-in-10 and 1-in-20)

- ADS PCM loads are typically the 1-in-2, or average loads
- 2030 CEC forecast includes 1-in-2, 1-in-5, 1-in-10, and 1-in-20 peak projected values for the year
 - For the study, we used 1-in-10 and 1-in-20
- Calculated a multiplier to increase load from 1-in-2 to 1-in-10 and 1-in-20
- For areas outside of California, used California weighted average
- Ran simulation for two weeks around the system peak on August 29, 2030: August 22 to September 5

Load Multipliers

Area	2030 CEC Peak			2030 Multiplier	
	1 in 2	1 in 10	1 in 20	1 in 10	1 in 20
CIPB	9,698	10,322	10,487	6.44%	8.13%
CIPV	14,120	15,014	15,249	6.33%	7.99%
CISC	26,676	28,369	28,839	6.35%	8.11%
CISD	4,871	5,310	5,358	9.00%	10.00%
LDWP	7,045	7,731	7,909	9.74%	12.26%
IID	1,202	1,258	1,264	4.63%	5.09%
TIDC	708	772	800	8.97%	12.92%
BANC	4,936	5,379	5,574	8.97%	12.92%
VEA	176	192	194	9.00%	10.00%
CA Weighted Avg. Applied to all Other Areas:				7.08%	8.99%

Peak Load by Area (MW)

Area	2030 ADS	1in10	1in20	Area	2030 ADS	1in10	1in20
AESO	12,289	13,159	13,393	NEVP	6,392	6,844	6,966
AVA	2,141	2,293	2,333	NWMT	1,934	2,071	2,108
AZPS	8,439	9,036	9,197	PACW	3,592	3,846	3,915
BANC	4,684	5,104	5,289	PAID	1,143	1,224	1,246
BCHA	9,048	9,688	9,861	PAUT	7,863	8,419	8,570
BPAT	9,607	10,287	10,470	PAWY	1,336	1,431	1,456
CFE	4,232	4,531	4,612	PGE	3,529	3,779	3,846
CHPD	266	285	290	PNM	2,740	2,934	2,986
CIPB	8,390	8,930	9,073	PSCO	9,322	9,982	10,160
CIPV	13,284	14,125	14,346	PSEI	3,747	4,012	4,084
CISC	25,868	27,509	27,964	SCL	1,187	1,271	1,294
CISD	5,021	5,473	5,523	SPPC	2,097	2,245	2,285
DOPD	312	334	340	SRP	8,870	9,498	9,667
EPE	2,233	2,391	2,434	TEPC	3,384	3,623	3,688
GCPD	1,481	1,586	1,614	TIDC	636	693	718
IID	1,248	1,306	1,312	TPWR	583	624	635
IPFE	601	644	655	VEA	170	185	187
IPMV	1,154	1,236	1,258	WACM	4,117	4,408	4,487
IPTV	2,425	2,597	2,643	WALC	1,791	1,918	1,952
LDWP	7,801	8,560	8,758	WAUW	152	163	166

Unserved Load (MWh)

Area	Hours		Unserved Load		Area	Hours		Unserved Load	
	1in10	1in20	1in10	1in20		1in10	1in20	1in10	1in20
AVA	6	9	87	119	NWMT	4	6	168	338
AZPS	6	13	433	917	PAUT	1	4	193	705
BANC	6	8	1,105	1,772	PAWY	2	5	8	28
BPAT	6	8	2,130	5,850	PGE	6	8	2,539	4,902
CFE	14	14	6,644	7,770	PNM	5	7	921	1,953
CIPB	6	10	5,229	7,682	PSCO	5	8	119	755
CIPV	6	12	5,179	7,866	PSEI	4	7	14	537
CISC	6	9	2,050	3,072	SCL	0	4	0	276
CISD	6	10	1,563	2,215	SPPC	5	7	672	1,333
EPE	0	1	0	55	SRP	2	5	572	2,663
GCPD	6	7	293	1,485	TEPC	6	15	2,072	4,522
IID	6	9	485	668	TIDC	6	8	678	839
IPFE	2	3	91	146	TPWR	0	3	0	257
IPMV	3	5	27	48	WACM	4	9	69	1,039
IPTV	3	5	298	466	WALC	0	1	0	22
NEVP	4	6	96	267					

Battery Sizing

- All Batteries have 4-hour storage except CFE, 6-hour for 1in10 and 8-hour for 1in20.
- Path 45 SDG&E to CFE rating was increased from 408 MW to 600 MW.

Area	1 in 10 Peak Unserved Load	1 in 20 Peak Unserved Load	BESS Pmax	# of Buses	Area	1 in 10 Peak Unserved Load	1 in 20 Peak Unserved Load	BESS Pmax	# of Buses
AVA	14.5	14.5	15	1	NWMT	63.8	83.2	84	1
AZPS	73.2	88.8	89	1	PAUT	192.8	245.0	245	1
BANC	251.6	261.8	262	1	PAWY	4.0	12.5	13	1
BPAT	668.9	1,348.9	1,349	5	PGE	768.6	769.2	770	3
CFE	1,109.8	1,188.5	1,189	4	PNM	393.8	421.8	422	2
CIPB	982.4	1,215.1	1,216	4	PSCO	46.7	304.8	305	2
CIPV	1,147.6	1,263.2	1,264	5	PSEI	3.5	172.2	173	3
CISC	343.6	343.6	344	2	SCL	0.0	69.1	70	1
CISD	305.5	305.5	306	2	SPPC	302.2	385.5	386	3
EPE	0.0	55.3	56	1	SRP	486.4	563.6	564	3
GCPD	198.4	384.8	385	2	TEPC	366.7	730.7	731	4
IID	89.0	91.5	92	2	TIDC	125.9	125.9	126	3
IPFE	50.5	52.4	53	1	TPWR	0.0	130.4	131	3
IPMV	9.5	9.5	10	1	WACM	25.3	307.5	308	2
IPTV	99.4	99.4	100	1	WALC	0.0	22.0	22	1
NEVP	46.0	54.6	55	1					

Battery Placement Methodology

- Limit size to 300 MW or less for each bus
- Determine number of buses
- Go to highest load buses for each area (load centers)
- Place battery on nearby well-connected high voltage bus (100 kV and above)

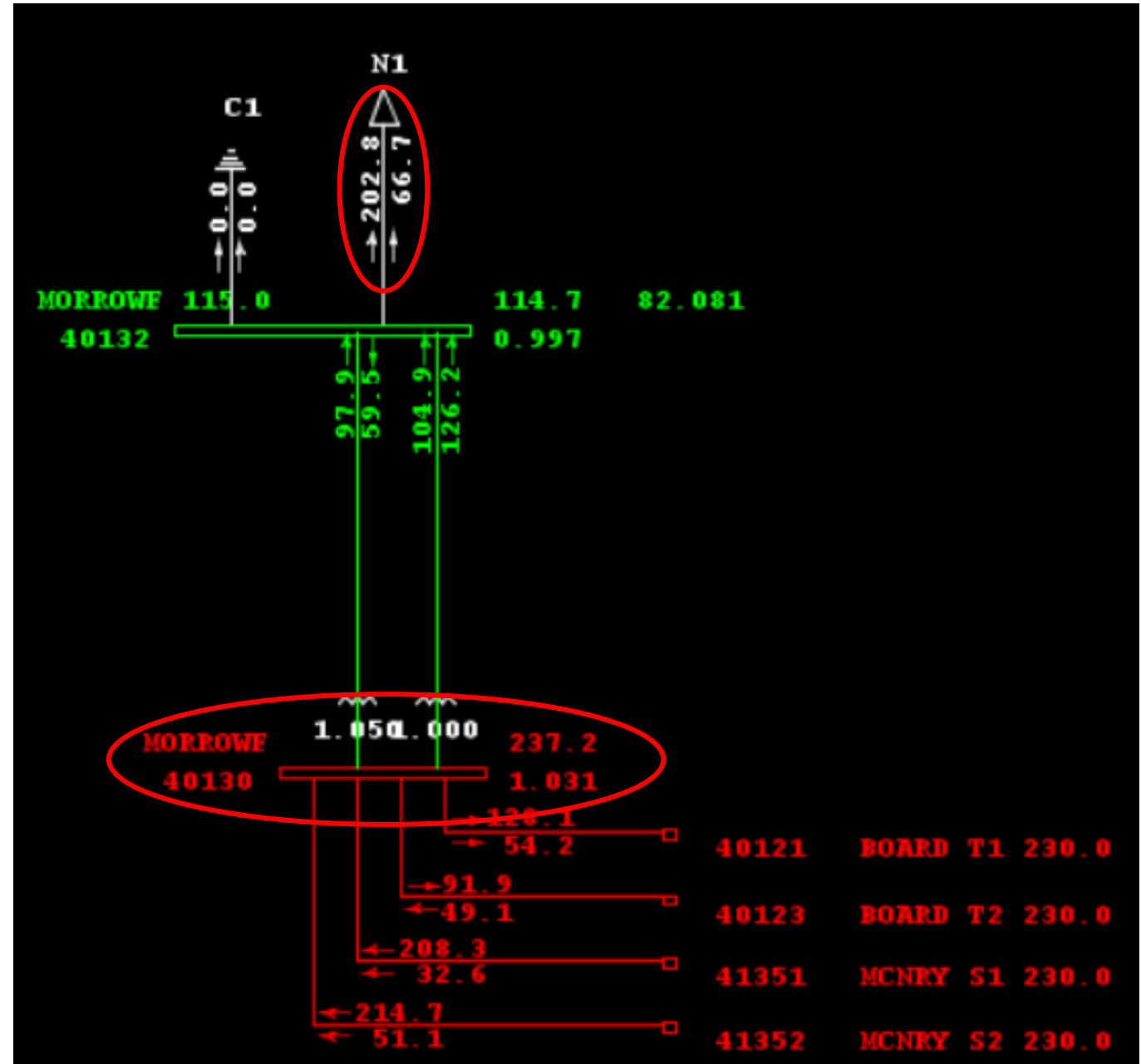
Example: BPAT

	2030 ADS	1-in-10	1-in-20
Load Multiplier	N/A	7.08%	8.99%
Peak Load (MW)	9,607	10,287	10,470
Total Unserved Load (MWh)	0	2,130	5,850
Peak Unserved Load (MW)	0	668.9	1,348.9
Added BESS (MW)	N/A	1,349	1,349

Example:

BPAT Battery Placement – 1,349 MW

BPAT Bus ID	Load (MW)	BESS Bus	BESS size (20% of total need each) (MW)
40132	202.8	40130	269.8
40127	174.1	41141	269.8
40717	161.9	40422	269.8
41047	158.7	41353	269.8
402170	128.2	42100	269.8

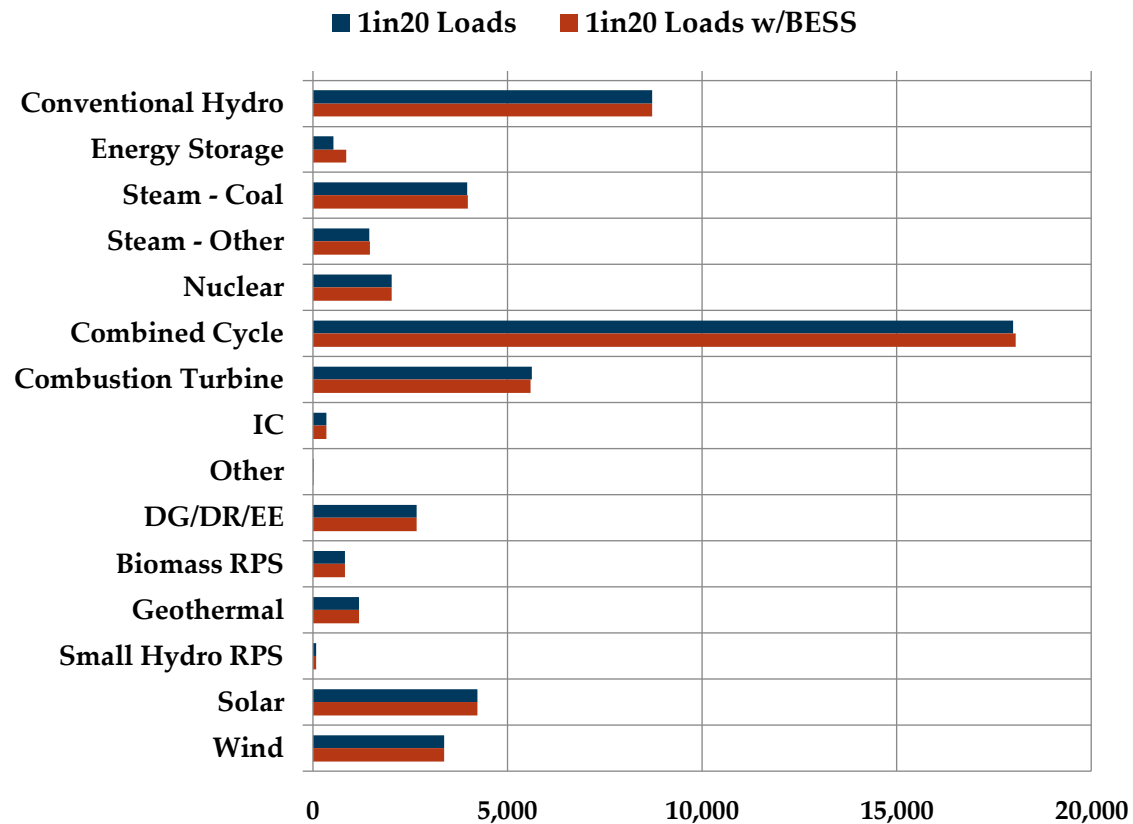


Results

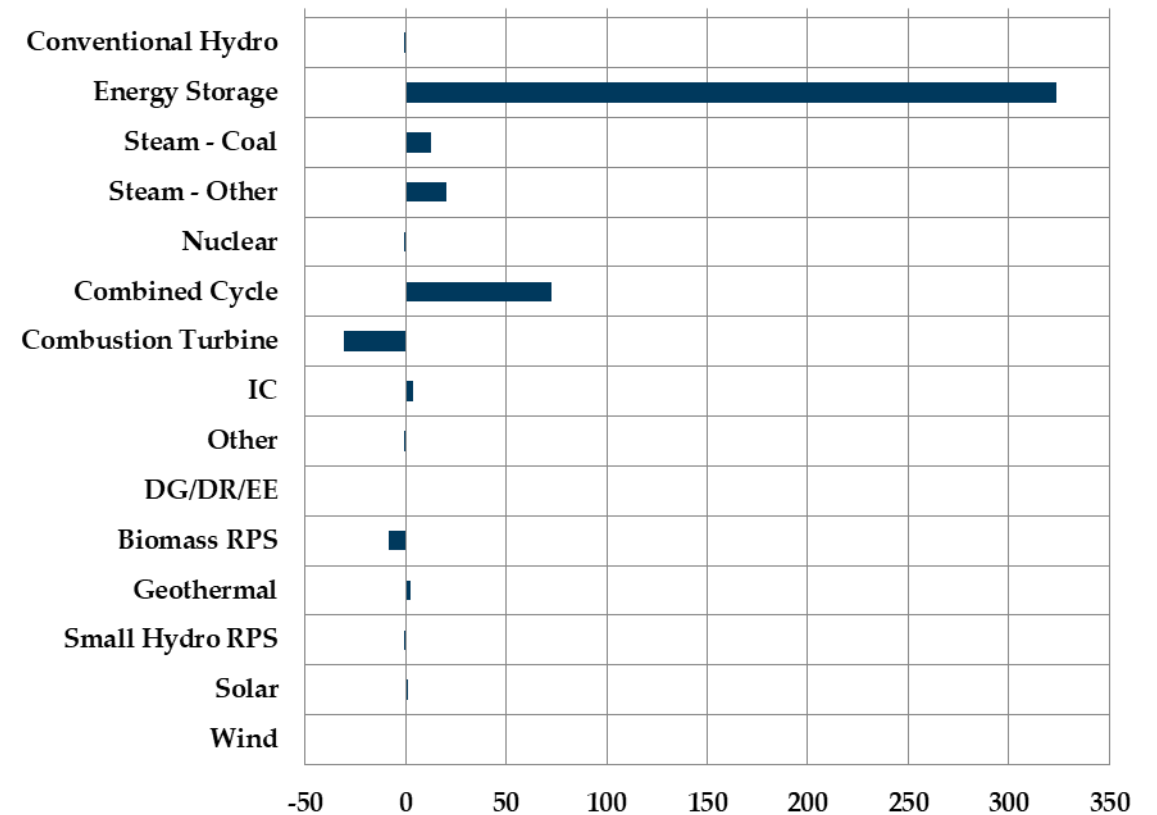
1-in-20 Loads

Generation Dispatch Before and After Adding BESS

Annual Generation by Category (GWh)



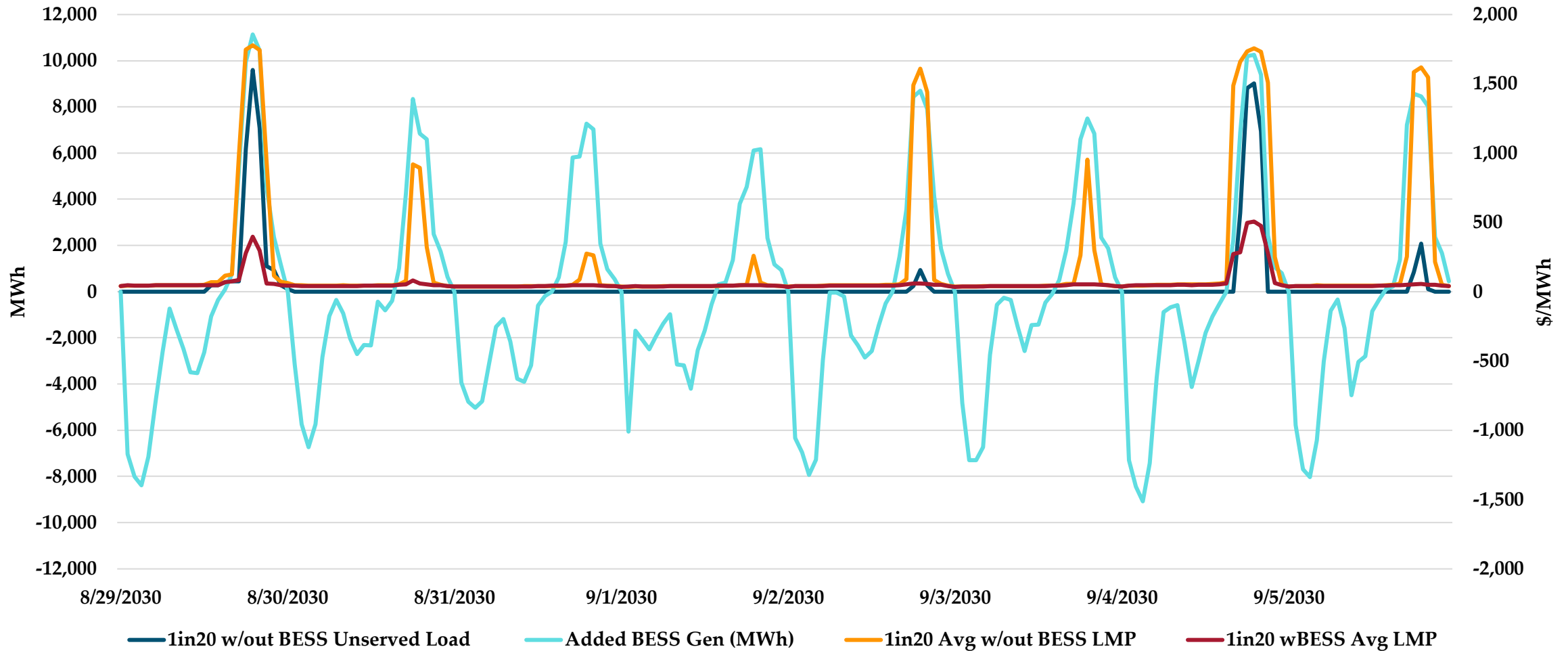
Annual Energy Difference (GWh): 1in20 Loads vs 1in20 Loads w/BESS



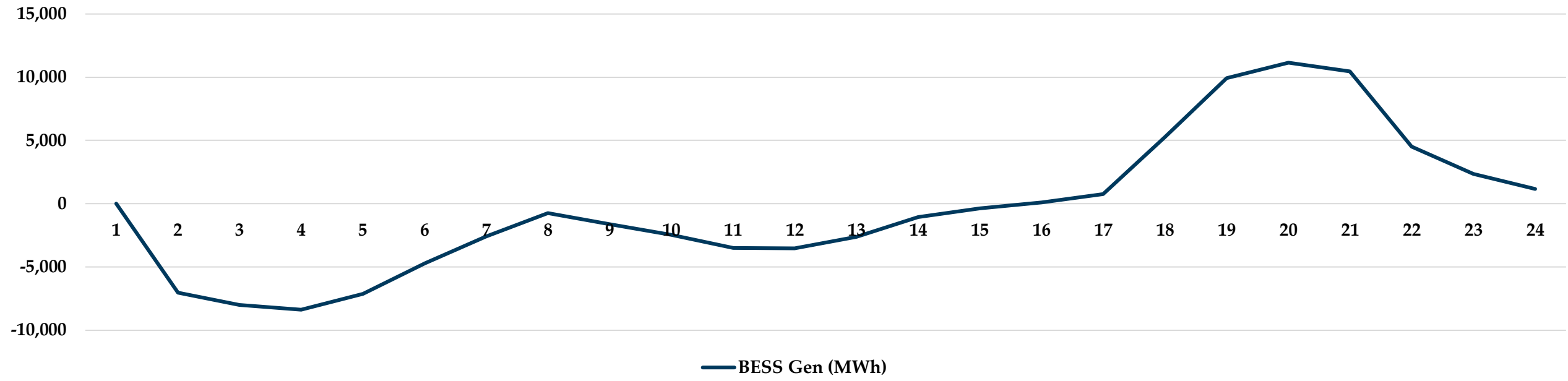
Transmission Congestion

BranchName	Branch	From Area	To Area	1in20 Loads			1in20 Loads w/BESS		
				U75	U90	U99	U75	U90	U99
SHERIDAN_YELLOWTLP_1	66335_66750_1	PAWY	PAWY	5%	1%	0%	46%	28%	18%
J.HINDS_MIRAGE_1	25406_24806_1	CISC	CISC	59%	22%	0%	55%	20%	0%
SUNDANC4_1045L TAP_45	54135_57783_45	AESO	AESO	37%	18%	14%	37%	19%	13%
MARKETPL_ADELANTO_1	26044_26003_1	LDWP	LDWP	40%	21%	0%	37%	18%	0%
MCCULLGH_VICTORVL_1	26048_26105_1	LDWP	LDWP	40%	21%	0%	38%	18%	0%
SILVERGT_BAY BLVD_1	22430_22771_1	CISD	CISD	53%	6%	0%	51%	17%	0%
MCCULLGH_VICTORVL_2	26048_26105_2	LDWP	LDWP	39%	20%	0%	36%	17%	0%
OTAYMESA_TJI-230_1	22609_20149_1	CISD	CFE	34%	17%	0%	29%	14%	0%
CROSSOVER_PHSFT XOVER_PS	630040_630041_PS	WAUW	WAUW	14%	3%	0%	37%	13%	0%
MEADOWBK_SUNYSLOP_1	14218_14227_1	AZPS	AZPS	36%	11%	0%	47%	12%	0%
N.GILA_IMPRLVLY_1	22536_22360_1	CISD	CISD	30%	13%	0%	27%	11%	0%

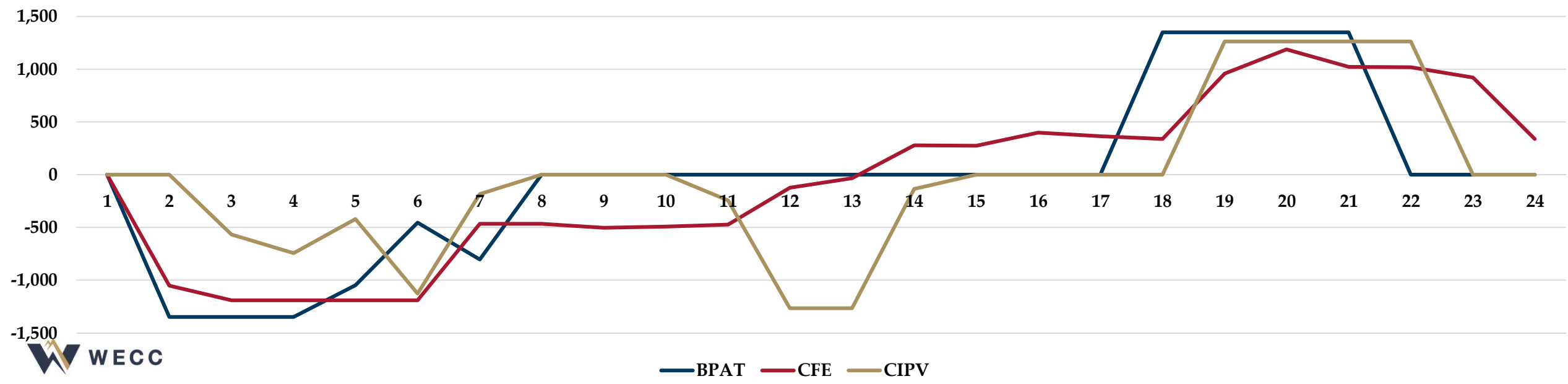
Average Aggregated LMP vs Unserved Load and BESS for WECC-wide Area



August 29 System Added BESS Gen (MWh)



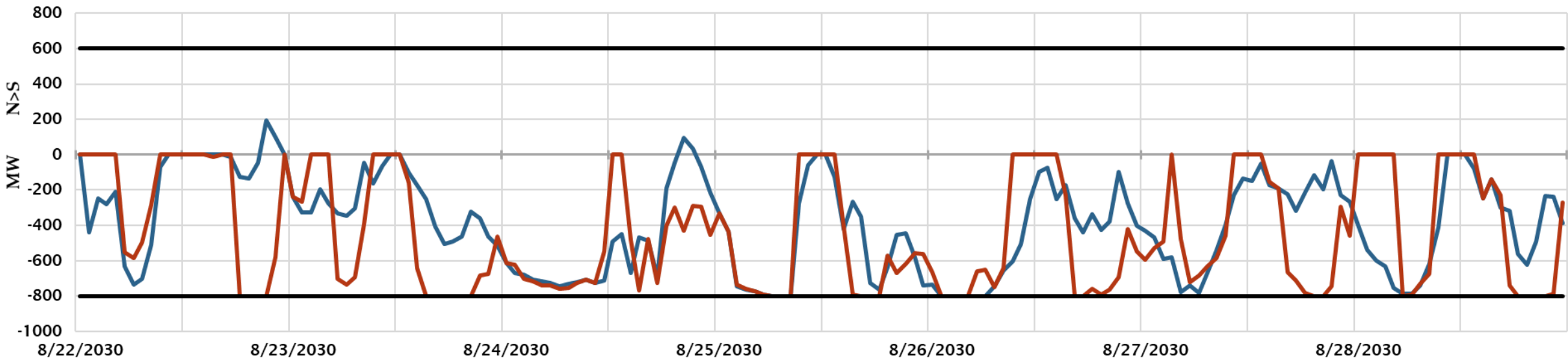
BESS by Use by Area August 29 (MW)



BPAT CFE CIPV

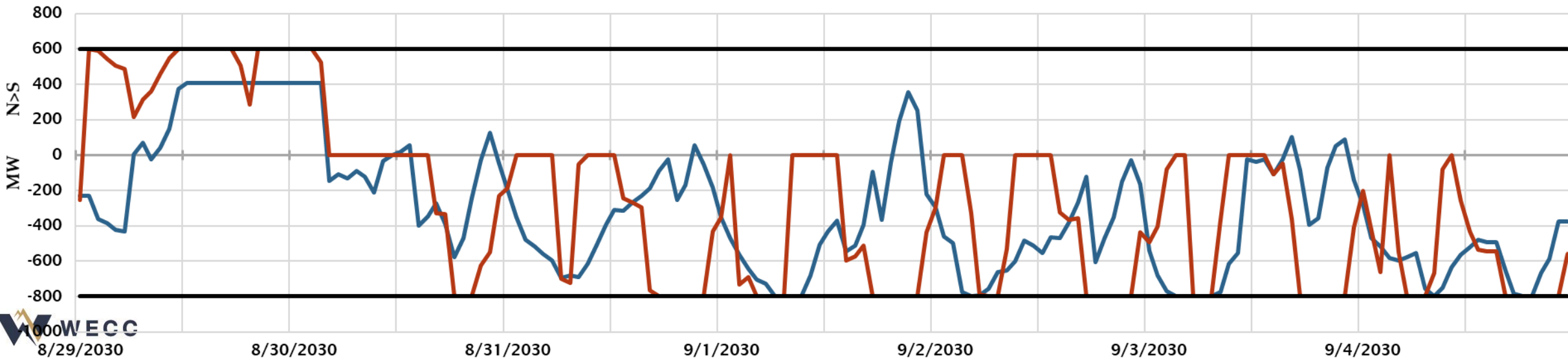
Week 1 Hourly Extract P45 SDG&E-CFE

— 2030 VLRAG 1 in20 — 2030 VLRAG 1 in20 w/BESS — Min — Max Day of week synchronized

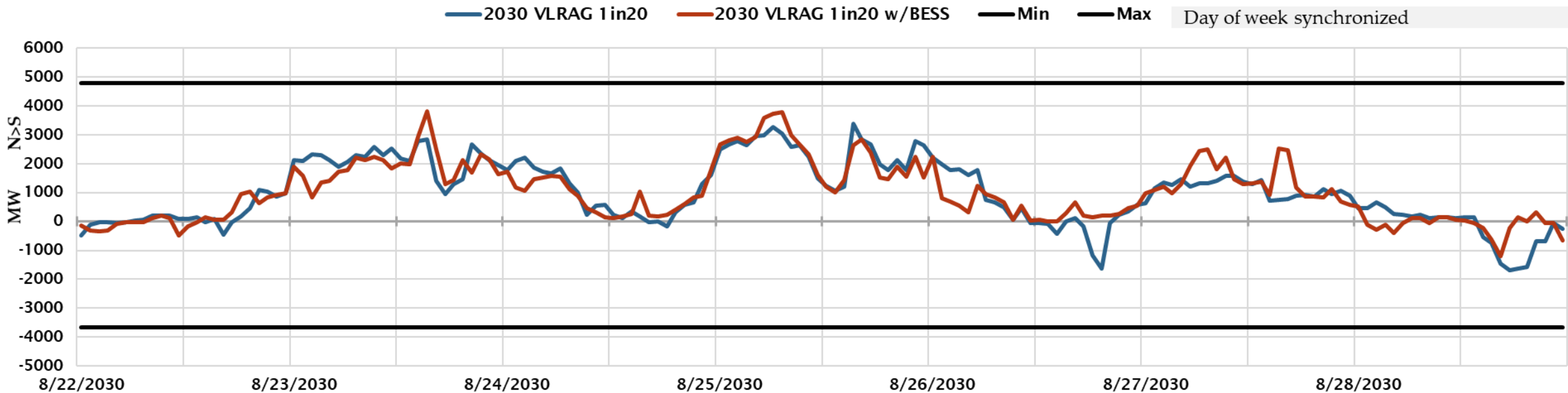


Week 2 Hourly Extract P45 SDG&E-CFE

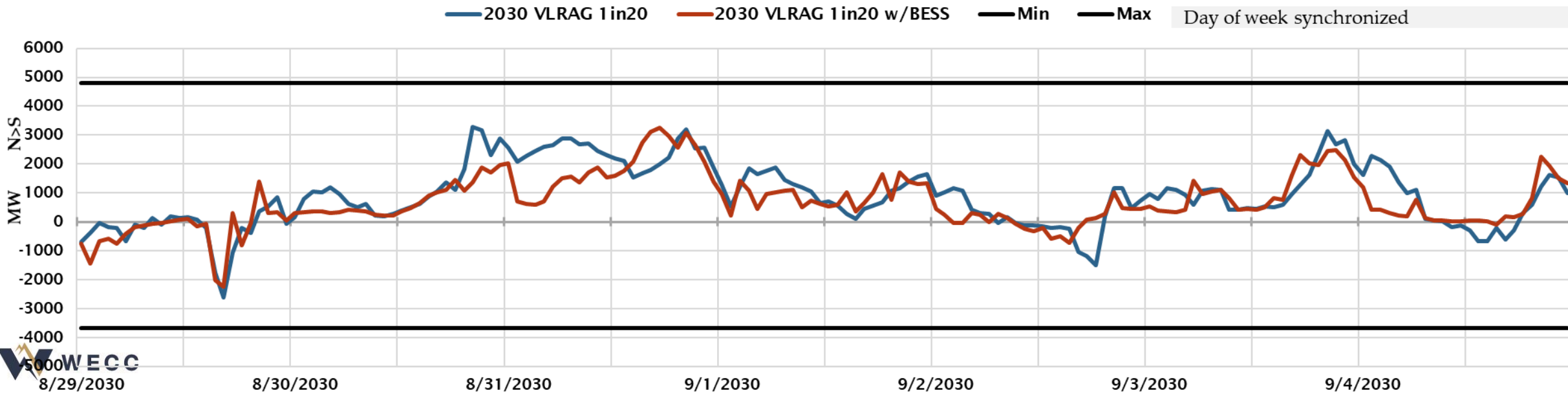
— 2030 VLRAG 1 in20 — 2030 VLRAG 1 in20 w/BESS — Min — Max Day of week synchronized



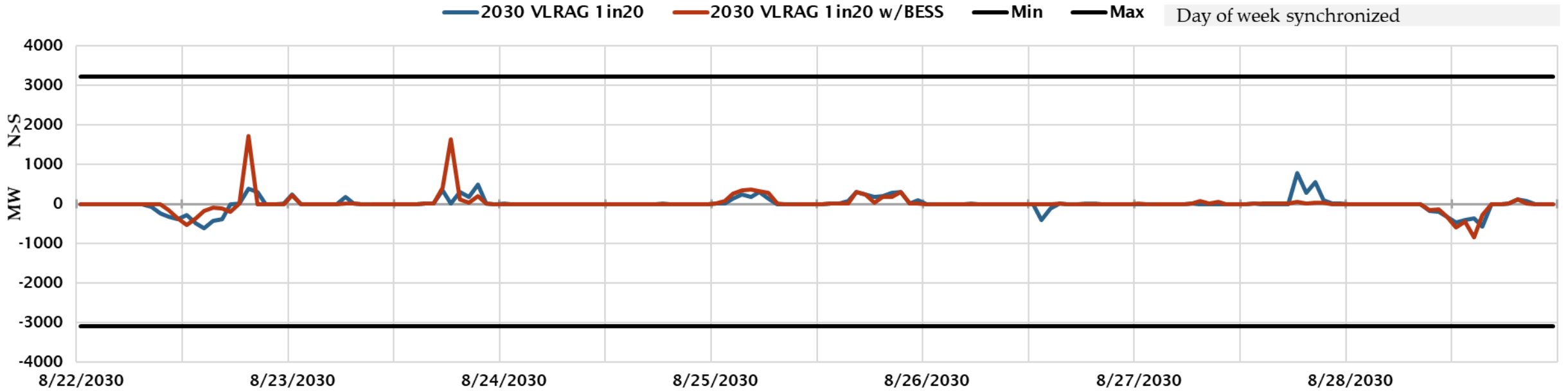
Week 1 Hourly Extract P66 COI



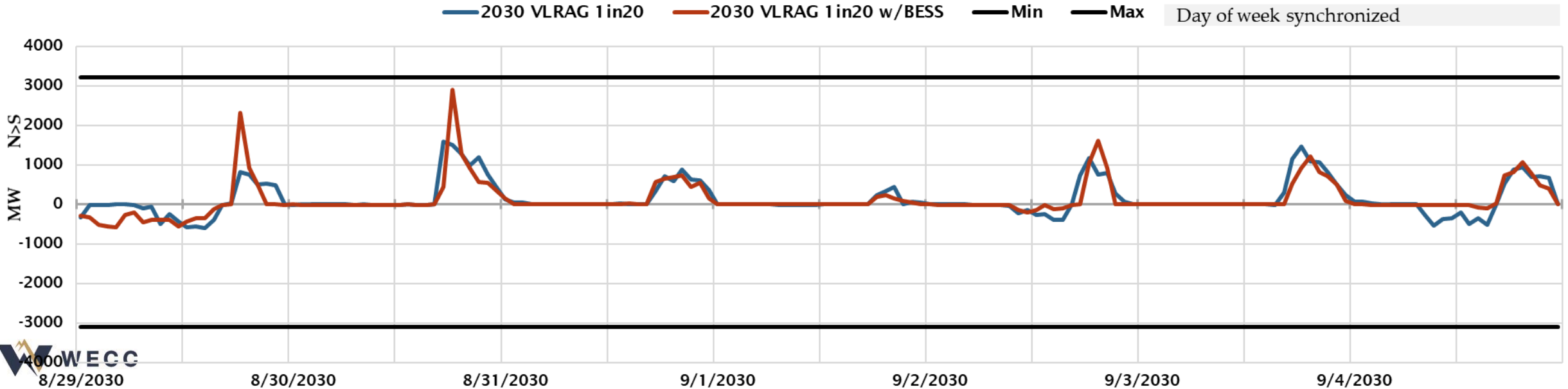
Week 2 Hourly Extract P66 COI



Week 1 Hourly Extract P65 Pacific DC Intertie (PDCI)

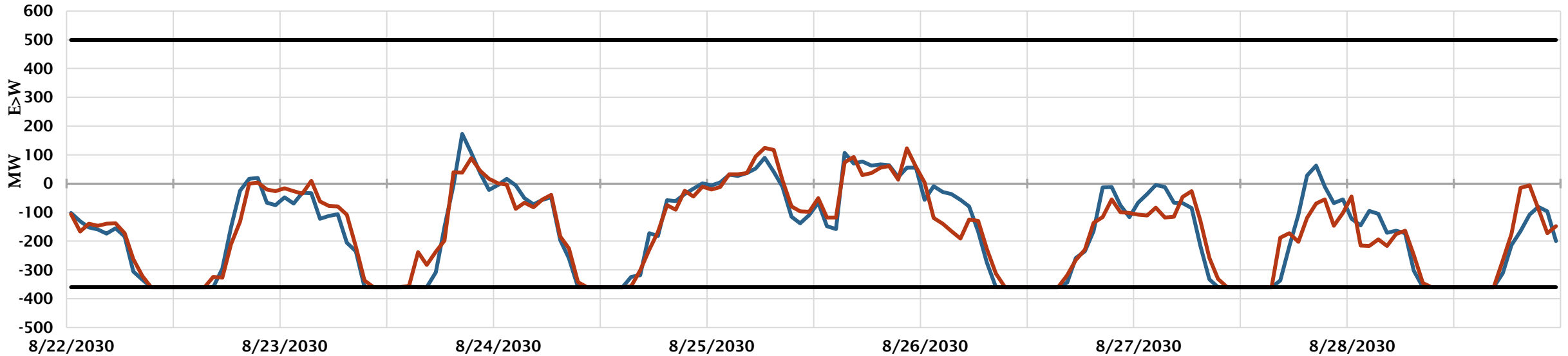


Week 2 Hourly Extract P65 Pacific DC Intertie (PDCI)



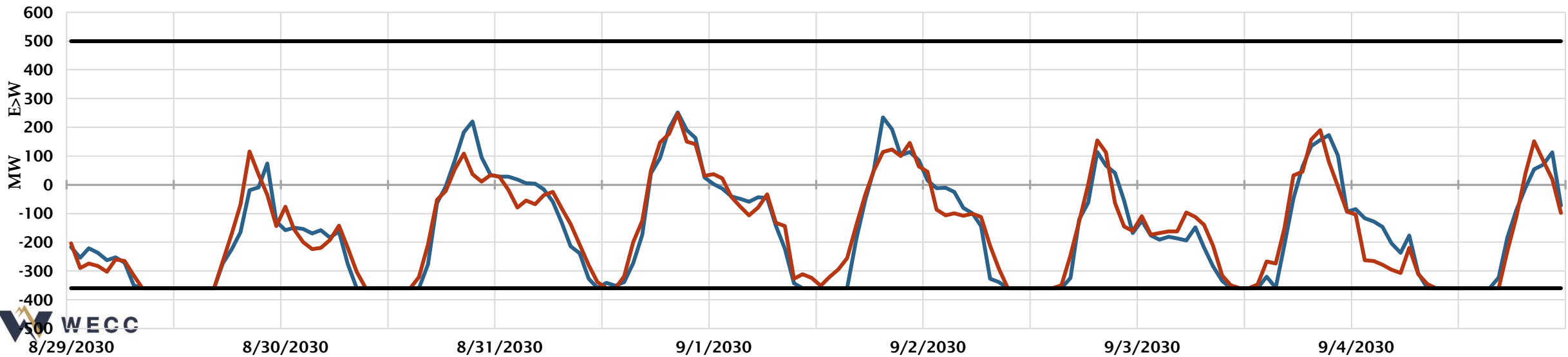
Week 1 Hourly Extract P16 Idaho-Sierra

— 2030 VLRAG 1in20 — 2030 VLRAG 1in20 w/BESS — Min — Max Day of week synchronized



Week 2 Hourly Extract P16 Idaho-Sierra

— 2030 VLRAG 1in20 — 2030 VLRAG 1in20 w/BESS — Min — Max Day of week synchronized





WECC

Electric Reliability and Security for the West

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