Planning for the October 14, 2023 Solar Eclipse

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September 5, 2023

Housekeeping reminders

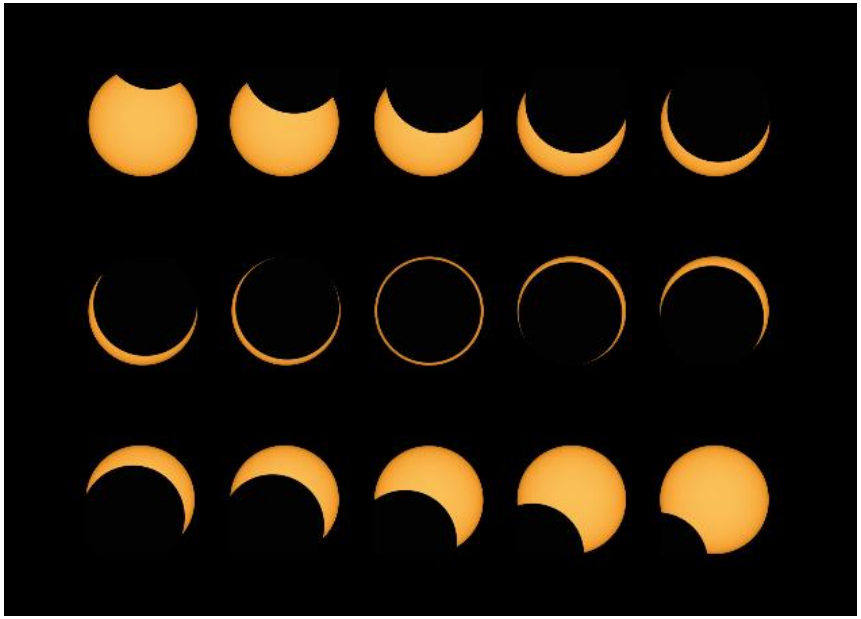
- This call is being recorded for informational and convenience purposes only. Any related transcriptions should not be reprinted without ISO's permission.
- These collaborative working groups are intended to stimulate open dialogue and engage different perspectives.
- Please keep comments professional and respectful.
- Please try and be brief and refrain from repeating what has already been said so that we can manage the time efficiently.

Instructions for raising your hand to ask a question

- If you are connected to audio through your computer or used the “call me” option, select the raise hand icon  located on the top right above the chat window. **Note**: #2 only works if you dialed into the meeting.
  - Please remember to state your name and affiliation before making your comment.
- If you need technical assistance during the meeting, please send a chat to the event producer.
- You may also send your question via chat to all panelists.

Agenda

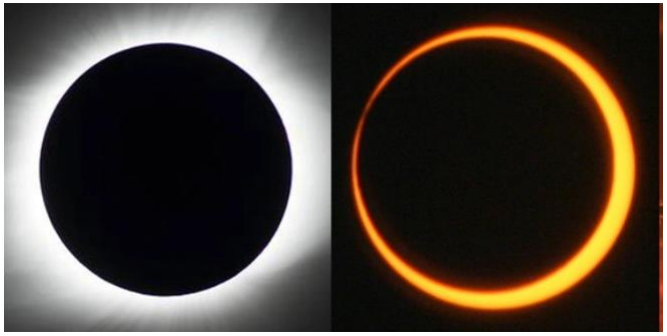
- Eclipse overview
- CAISO impacts:
  - Grid-scale solar
  - Temperature, wind
  - BTM solar
  - Load
- WEIM impacts:
  - BTM and grid-scale solar
  - Load
- Grid Protections
- Timeline

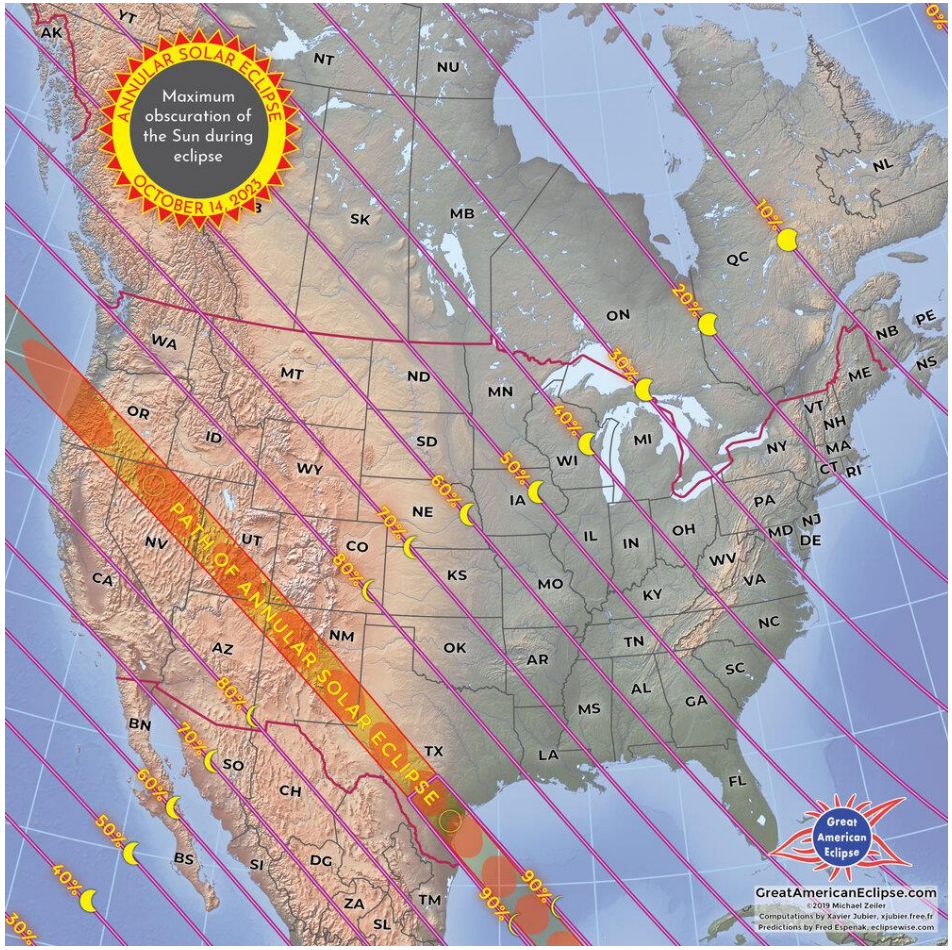


Eclipse Overview

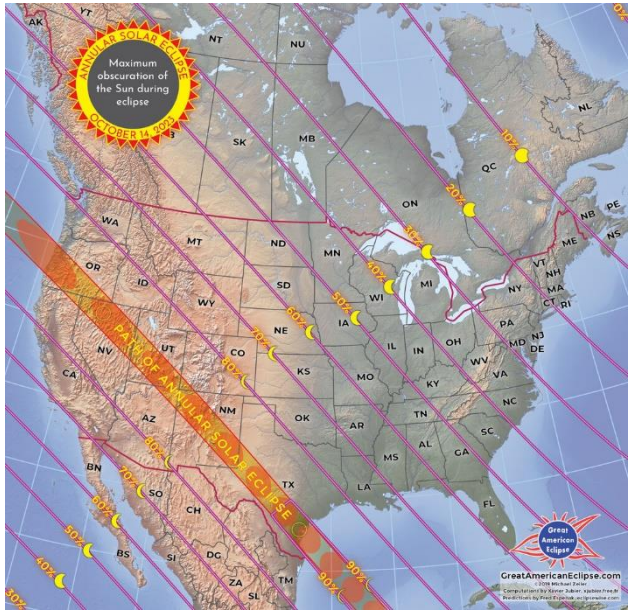
- Saturday, October 14
- Impacts California 8-11 a.m.
- Annular eclipse
  - Sun isn't fully covered by the moon

Total Annular





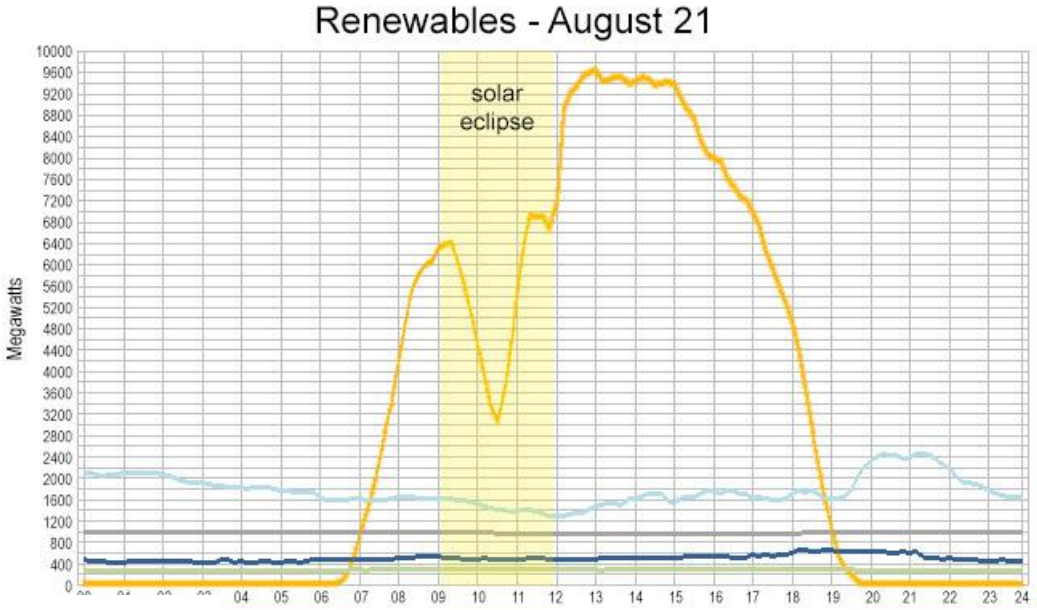
2017 vs. 2023 Eclipse

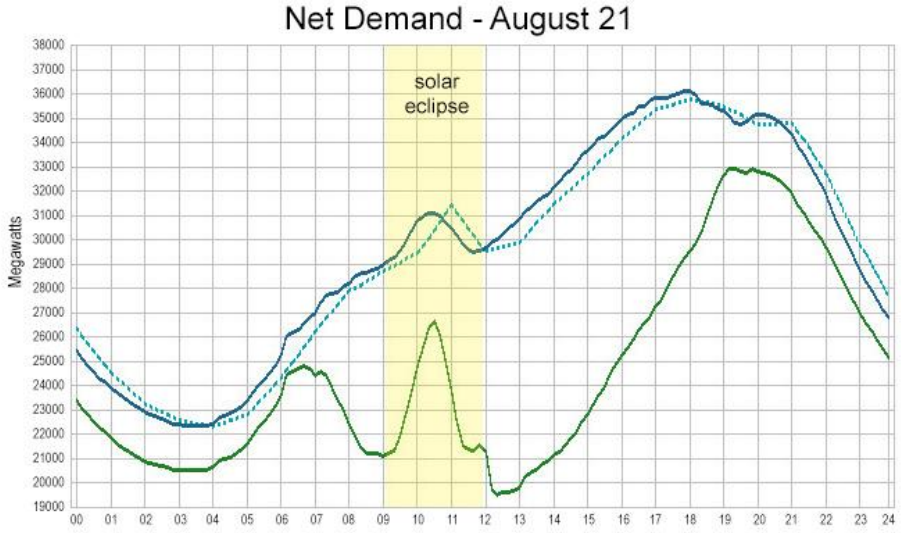


	CAISO		WEIM	
	Grid-scale solar (MW)	**BTM solar (MW)**	**Grid-scale solar (MW)**	**BTM solar (MW)**
2017	10,000	5,700	866	739
2023	16,500	14,350	10,280	6,458
Change	+6,500	+8,650	+9,414	+5,719

2017 Eclipse Impacts

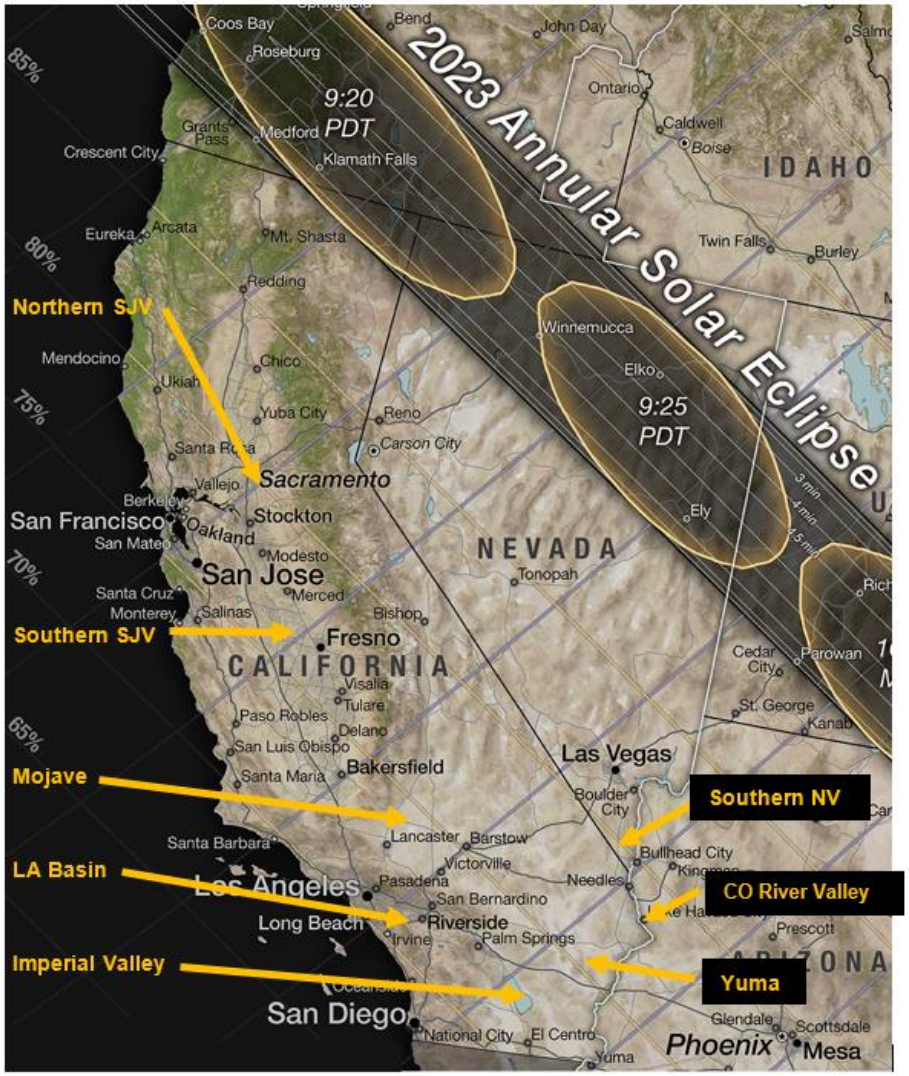
- 6,000 MW solar reduction compared to a clear day
- -48.4 MW/min ramp down
- +77.3 MW/min ramp up
- Solar min of 2,845 MW





- 1,914 MW increase in load
- 1,659 MW load drop after
- Net load increase of ~5,500 MW

2023 Eclipse over California

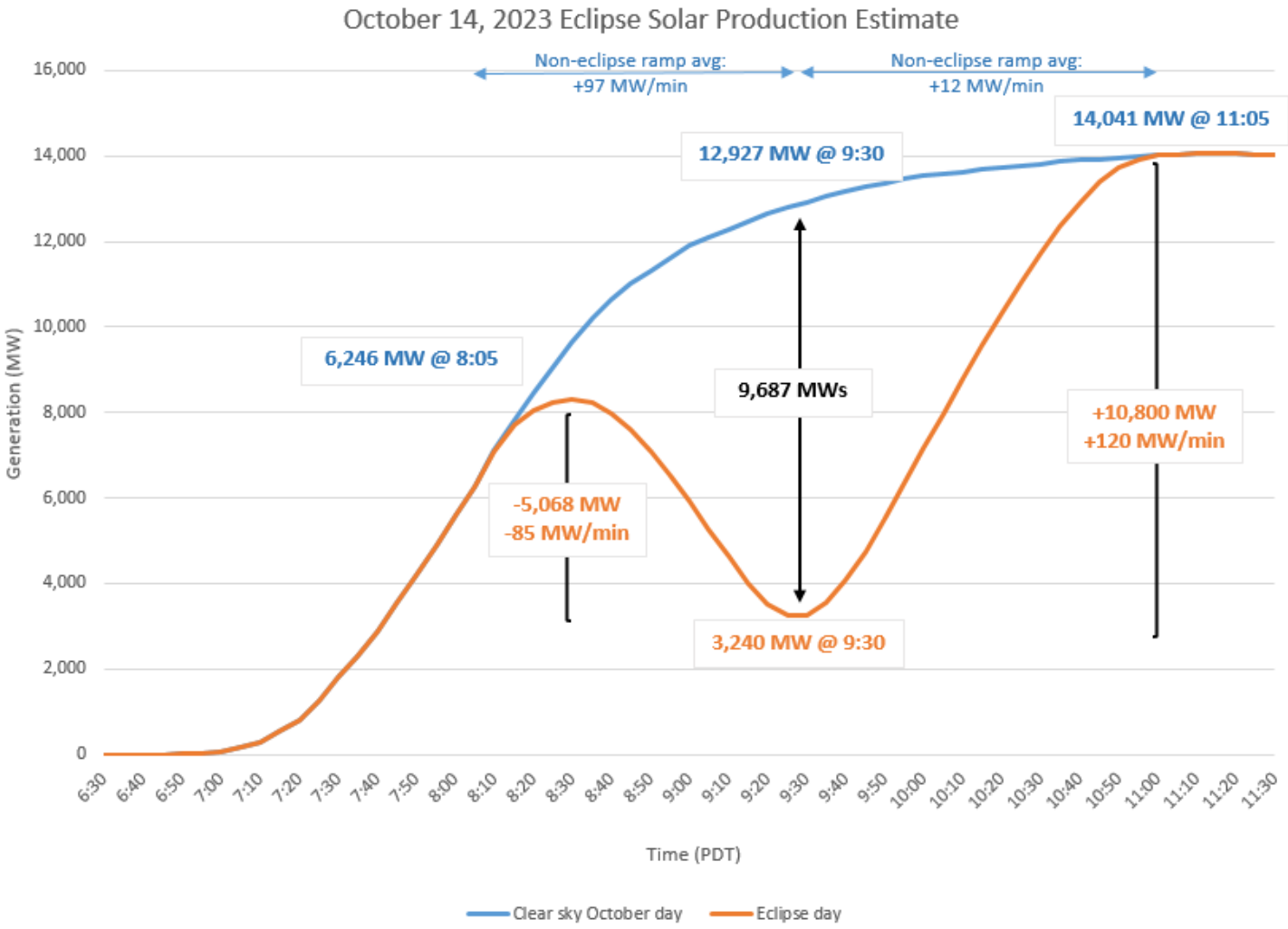


Grid-Scale impact by region

Forecast Area	Eclipse Start Time (a.m.)	**Eclipse Max Time (a.m.)**	Eclipse End Time (a.m.)	**Eclipse Max Obscuration**	Oct 2023 Regional Capacity	Approx. Area Production at Eclipse Start		Approx. Area Production at Eclipse Max		Approx. Area Production at Eclipse End	
					MW	Cap %	MW	CAP %	MWs	Cap %	MW
N. San Joaquin	8:05	**9:20**	10:43	**80%**	305	24%	74	12%	38	65%	198
S. San Joaquin	8:06	**9:22**	10:46	**75%**	4,355	27%	1,167	16%	693	70%	3,059
Mojave	8:07	**9:24**	10:50	**73%**	4,141	38%	1,582	20%	812	78%	3,228
LA Basin	8:08	**9:25**	10:51	**72%**	266	38%	102	13%	34	79%	209
Coachella/Imperial Valley	8:09	**9:27**	10:55	**72%**	2,635	54%	1,412	23%	608	84%	2,201
S. Nevada	8:08	**9:27**	10:54	**81%**	1,407	40%	558	15%	218	87%	1,225
Colorado River Valley	8:09	**9:27**	10:55	**75%**	2,241	37%	834	19%	420	82%	1,831
Yuma	8:09	**9:29**	10:57	**78%**	1,115	53%	590	18%	202	89%	996
						SUM:	**6,318**		**3,023**		**12,946**

- Start: 8:05-8:10 a.m.
- Peak: 9:20-9:30 a.m. generation at 12-23% of capacity
- Ends: 10:43-11 a.m.

System-wide solar impact



*Since assumption is clear sky results should be viewed as high impact scenario

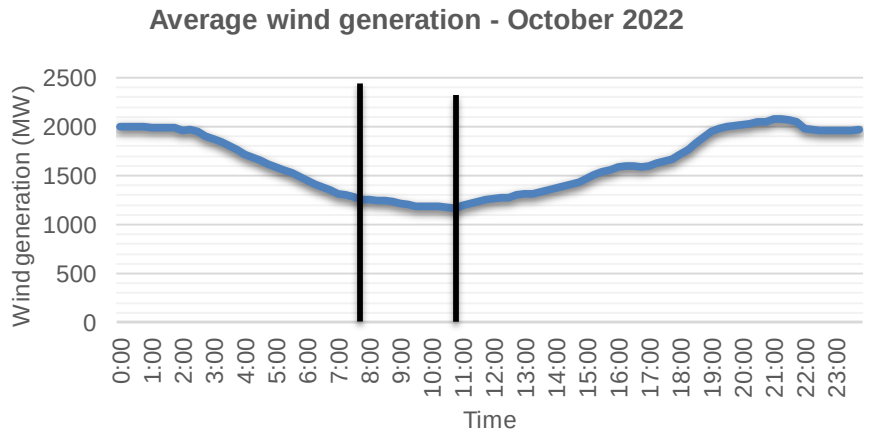
Solar eclipse impacts to temperature and wind forecasting

Temperature

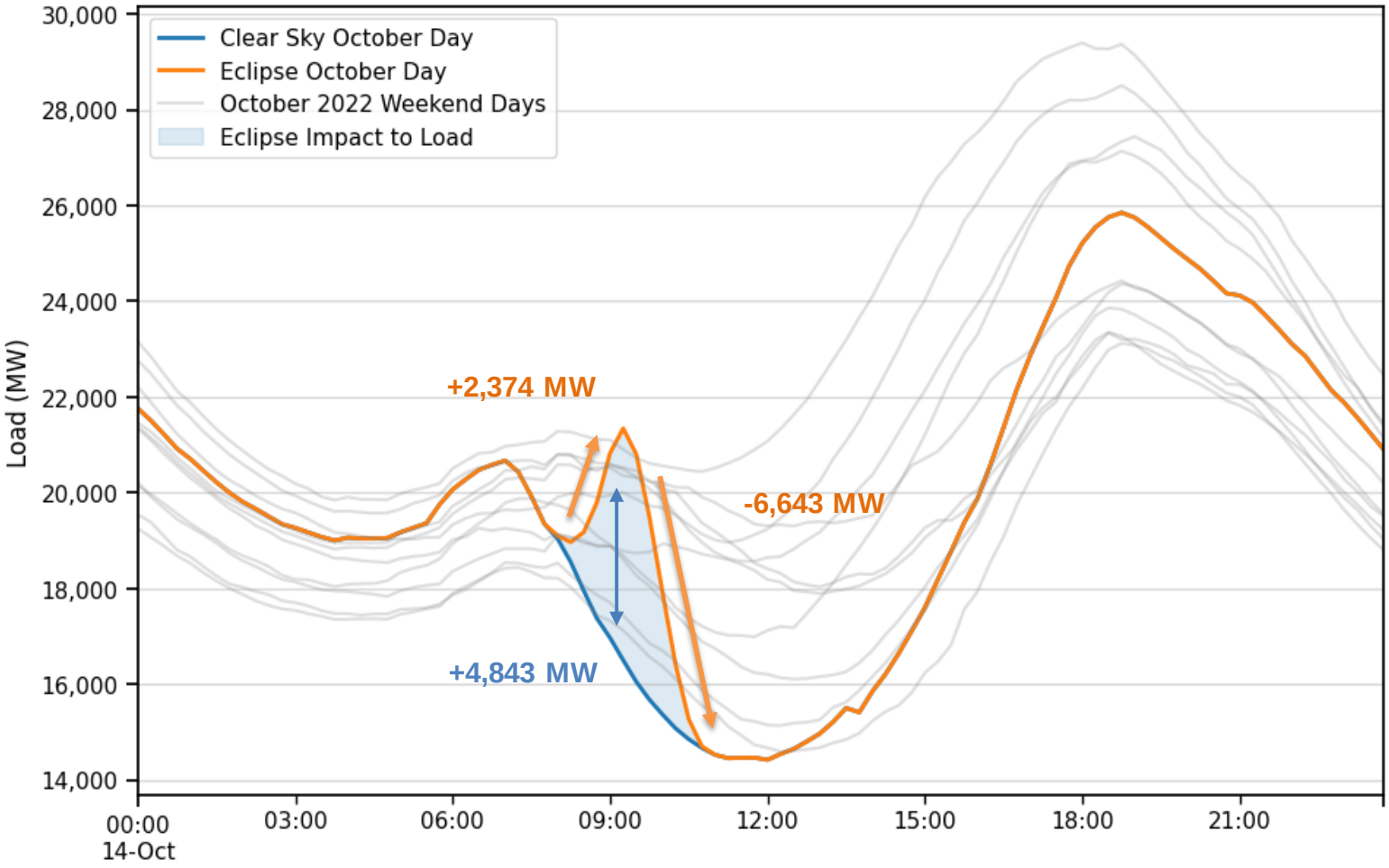
Obscuration level	Potential temp reduction
60%	2 degrees
60-80%	2-4 degrees
80-100%	6-8 degrees

Wind

Obscuration level	Potential wind speed reduction	Potential wind generation reduction
65-75%	~2mph	
85-95%	2-6 mph	10%



System-wide load impact (SCE, PG&E and SDG&E)



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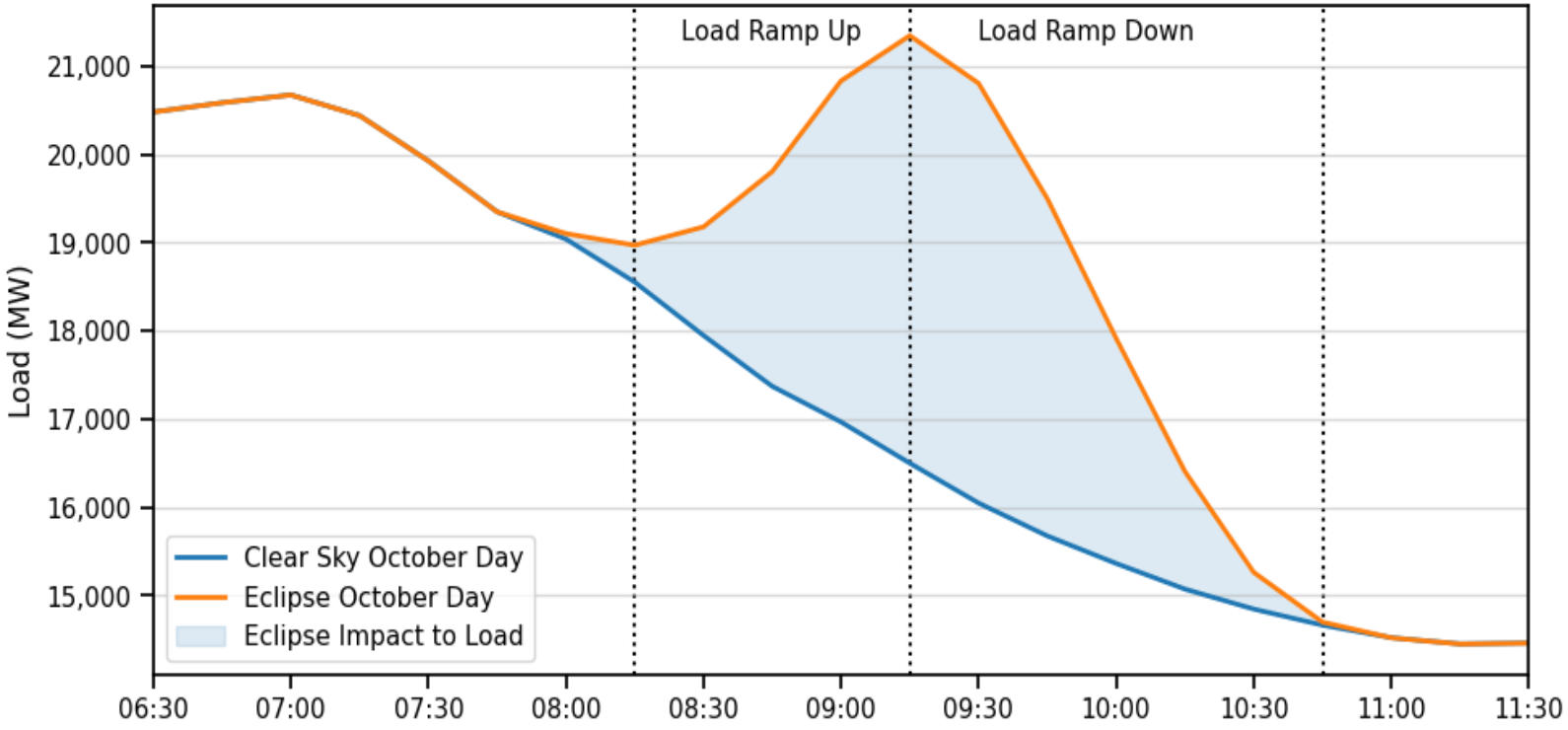
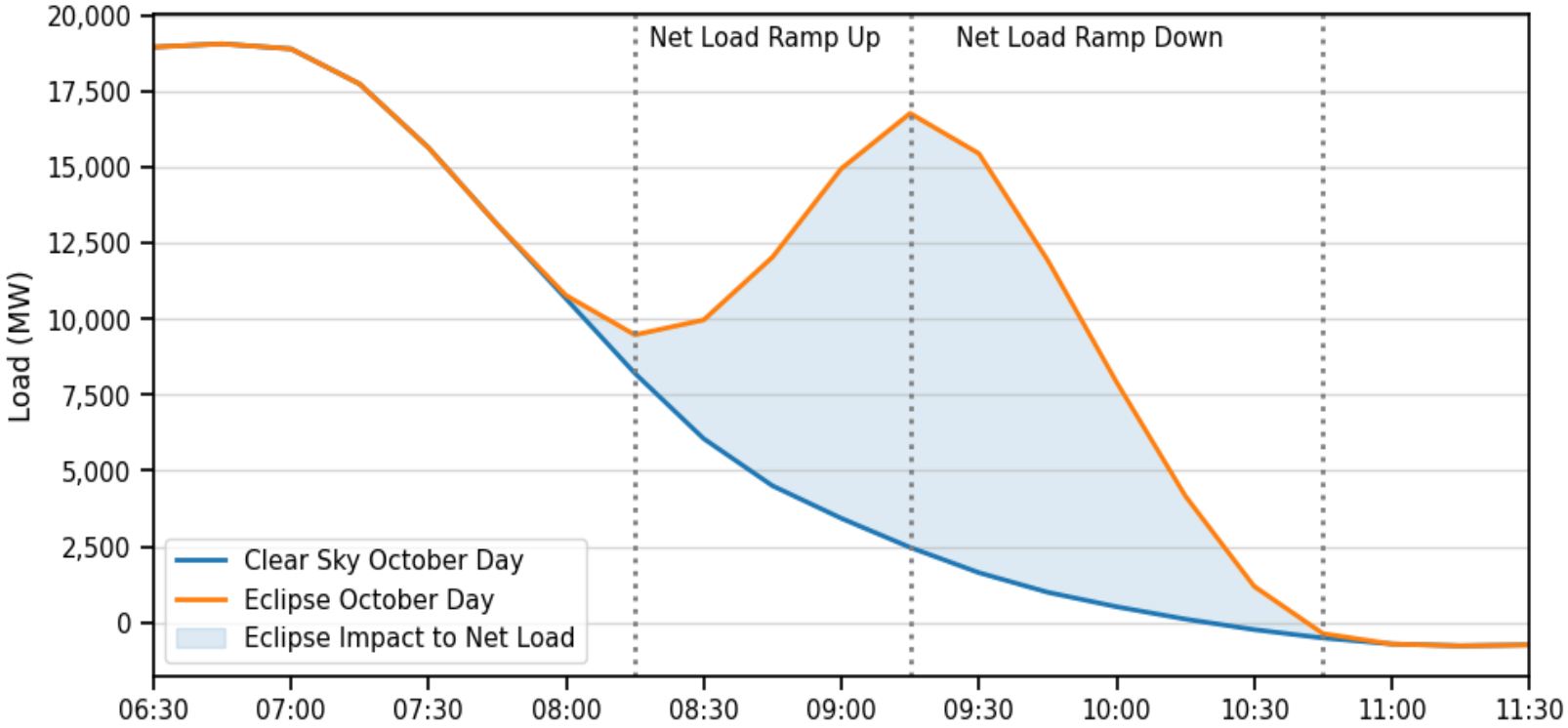
System-wide load impact



	Start	End	Load Start	Load End	Total Ramp (MW)	Average Ramp (MW/min)	Max Ramp (MW/min)	Typical Ramp (MW/min)
Ramp Up	8:15	9:15	18,969	21,343	2,374	40	68	-34
Ramp Down	9:15	10:45	21,343	14,701	-6,643	-74	-105	-20

	Start	End	Load Start	Load End	Total Ramp (%)	Average 15 Min Ramp (%)	Max 15 Min Ramp (%)	Typical 15 Min Ramp (%)
Ramp Up	8:15	9:15	18,969	21,343	12.5%	3.0%	5.1%	-2.5%
Ramp Down	9:15	10:45	21,343	14,701	-31.1%	-6.2%	-8.7%	-1.7%

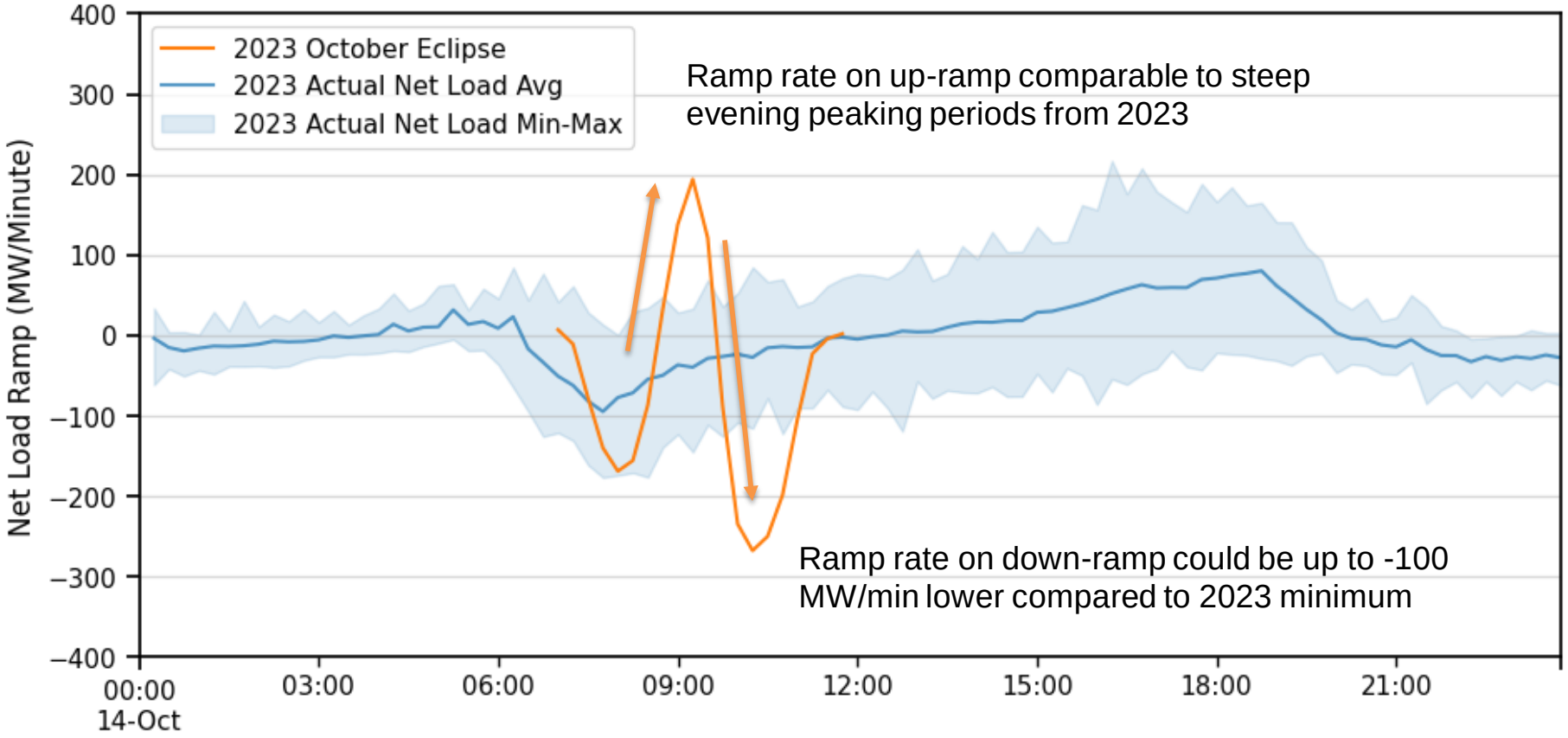
System-wide net load impact



	Start	End	Load Start	Load End	Total Ramp (MW)	Average Ramp (MW/min)	Max Ramp (MW/min)	Typical Ramp (MW/min)
Ramp Up	8:15	9:15	9,474	16,767	7,294	122	194	-96
Ramp Down	9:15	10:45	16,767	-366	-17,134	-190	-267	-33

	Start	End	Load Start	Load End	Total Ramp (%)	Average 15 Min Ramp (%)	Max 15 Mn Ramp (%)	Typical 15 Min Ramp (%)
Ramp Up	8:15	9:15	9,474	16,767	77.0%	13.9%	22.2%	-11.0%
Ramp Down	9:15	10:45	16,767	-366	-102.2%	-34.8%	-48.8%	-6.0%

System-wide eclipse net load ramping comparison



Solar eclipse summary - CAISO

- Large scale solar ramps:
  - Loss of 5,068 MW from eclipse start to max (-85 MW/min)
  - Increase of 10,800 MW from eclipse max to end (+120 MW/min)

- Gross load ramps:
  - Increase of 2,374 MW from eclipse start to max (+40 MW/min)
  - Decrease of 6,643 MW from eclipse max to end (-74 MW/min)

- Net load ramps:
  - Increase of 7,294 MW from eclipse start to max (+122 MW/min)
  - Decrease of 17,134 MW from eclipse max to end (-190 MW/min)

WEIM IMPACTS

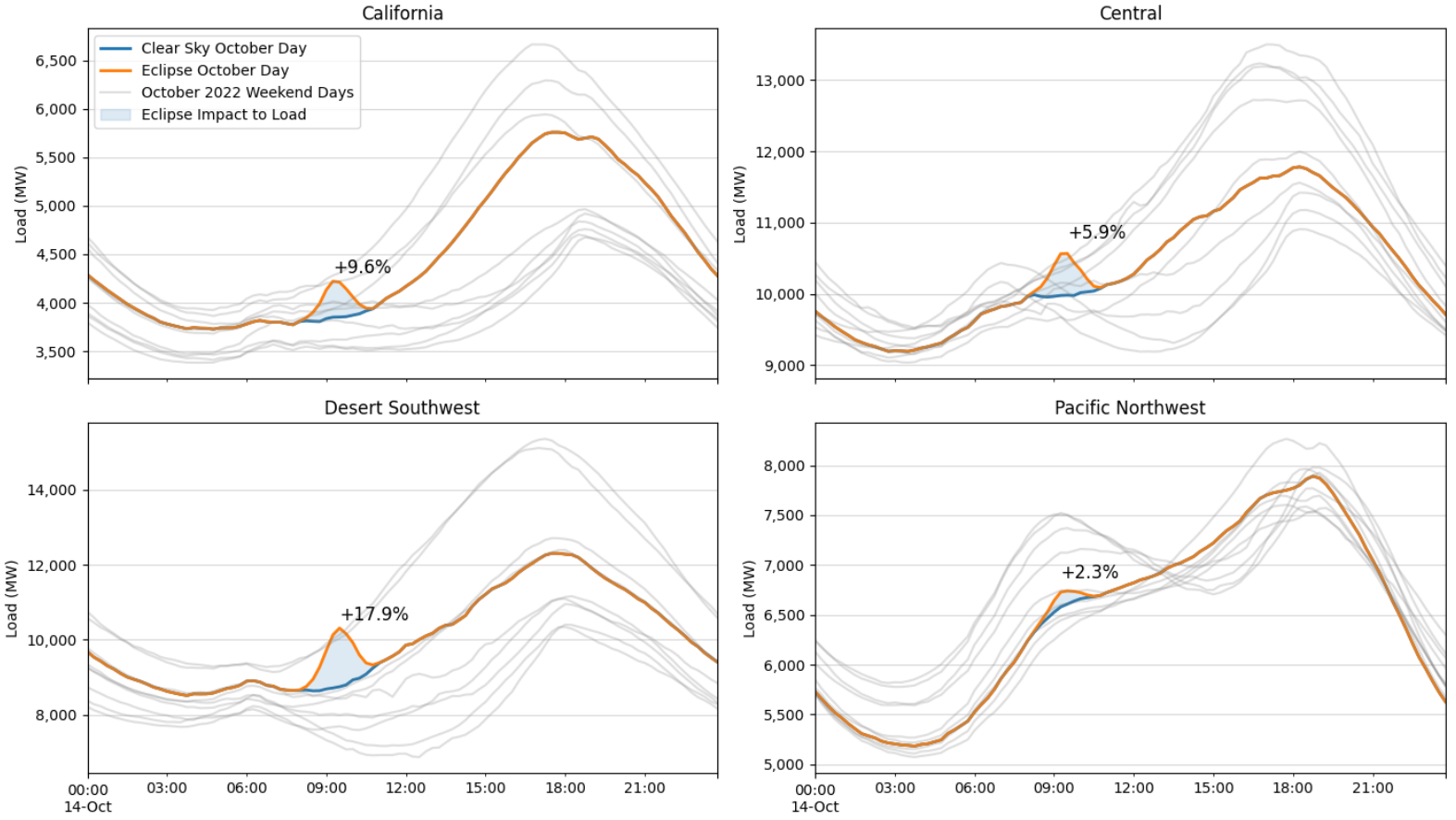
WEIM BTM and grid-scale and BTM solar capacities

WEIM Region	Approx. Grid Connected Solar (MW)	Approx. Rooftop BTM Solar (MW)
California	**1,561**	**953**
Balancing Area of Northern CA (BANC)	407	335
Los Angeles Department of Water and Power (LADWP)	1,154	564
Turlock Irrigation District (TID)		55
Central	**4,807**	**1,453**
Idaho Power Company (IPCO)	473	116
Northwestern Energy (NWMT)	178	38
NV Energy (NVEP)	2,471	835
PacifiCorp East (PACE)	1,685	464
Desert Southwest	**2,851**	**3,402**
Arizona Public Service (AZPS)	794	1,761
El Paso Electric Company (EPE)	285	170
Public Service Company of New Mexico (PNM)	841	340
Salt River Project (SRP)	436	497
Tucson Electric Power (TEPC)	428	503
WAPA Desert Southwest Region (WALC)	67	130
Pacifc Northwest	**1,061**	**650**
Avangrid (AVRN)*	522	
Avista (AVA)	20	21
Bonneville Power Authority (BPA)	138	88
PacifiCorp West (PACW)	381	173
Portland General Electric (PGE)		161
Puget Sound Energy (PSE)		149
Seattle City Light (SCL)		44
Tacoma Power (TPWR)		15
WEIM Totals	**10,280**	**6,458**

*Avangrid is a generation only WEIM and does not serve load

It is critical for WEIMs to account for the eclipse in their grid-scale solar forecasts sent to the CAISO

WEIM Regional Eclipse Load Impacts



WEIM Region	Approx Rooftop BTM Solar (MW)	Approx Rooftop BTM MW % Peak
California	953	8%
Central	1,453	6%
Desert Southwest	3,402	14%
Pacific Northwest	650	2%
WEIM Total	6,458	7%

Market mechanisms and processes to be utilized during the solar eclipse

Grid protection options ahead of and during the eclipse	
Internal market simulation	WECC/RC West coordination
IOU coordination	Adjacent BA coordination
Scheduling Coordinator (SC) interaction	Gas supply coordination
Outage coordination	Assistance Energy Transfer (AET) opt-in
Consider declaring restricted maintenance operations (RMO)	Execution of 48-hour Reliability Unit Commitments (RUC)
Day +2 conference bridge	Importance of DA solar forecasting
Reserves procurement	RUC net short
Resource Optimization of renewable, battery and hydro generation	Minimum state-of-charge
Post-DA Conference bridge	Potential use of Flex Alert or Demand Response
Tighten Automated Generation Control (AGC) bands	Exceptional Dispatch
Use of WEIM transfer capability	Flexible Ramp product usage

Our renewable forecast service providers will be **producing a forecast accounting for the solar eclipse** that will automatically feed through the ISOs daily processes. The aggregate forecast for large scale solar will be available to the market participants, as well as public, through the OASIS applications.

October 14, 2023 Solar Eclipse Planning - Real Time Operations

Brian Murray: Manager, Market Operations Coordination
Michael Martin: Sr. Advisor, System Operations
Dave Delparte: Director, Real Time Operations
John Phipps: Executive Director, Grid Operations

CAISO System Operations & Preparation

Pre Day Ahead	Day Ahead Activities	Real Time
Internal Market Simulation	Importance of Day-Ahead Solar Forecasting	Tighten AGC Bands
WECC/RC Coordination	Reserves & A/S Procurement	Exceptional Dispatch
IOU Coordination	RUC Net Short	Use of WEIM Transfer Capability
Adjacent BA Coordination	Resource Optimization	FRP Usage
Scheduling Coordinator Interaction	Minimum State-of-charge	Prohibit Test Energy
Gas Supply Coordination	Post DA Conference Bridge	OI Solar Resources - Not Exceed DOT
Outage Coordination	Issue Flex Alert if RUC Infeasible	Additional CAISO Operators & Support
Assistance Energy Transfer Opt-In		
Consider RMO Declaration		
48 Hour RUC		
Day +2 Conference Bridge		
CAISO Crew Training		
MNS Messaging	MNS Messaging	ADS, MNS & Everbridge Messaging

** The CAISO Day Ahead Market normally uses hourly averages for load and resource values. This will dampen the impact of the eclipse.*

Coordination in preparation for the solar eclipse

Entity	Items
RC West	• Share Operational Plan • Discuss eclipse impact on BES & rooftop resources • Share market simulation results • Peak RC solar eclipse readiness call
Adjacent BA's	• Review anticipated eclipse impact & Operational Plans
WEIM Participants	• Discuss consistent policy for ETSR's during eclipse • No planned ETSR locks or significant limitations • Account for eclipse in energy schedule submittals
Gas companies	• Share gas burn calculations from market simulations • Discuss any planned gas line work
IOU's	• Anticipate eclipse impact & Operational plan • Send "Peak Day" messaging before and during the eclipse
Market Participants	• Share anticipated eclipse impact & Operational Plan • Verify resources have adequate fuel • Request bids to keep resources flexible • Request they follow their DOT

MNS Messaging

Operations and Customer Services will develop pre-written MNS messaging that will be used during the event to externally communicate to SC's and Market Participants.

Timing	Topic	Message
Daily from 10/11 – 10/14	Pre Eclipse Message	This message is to serve as a reminder that the Solar Eclipse will take place October 14, 2023 from 08:05 – 11:05 PDT. This is a unique event for the ISO BA, during which approximately 9,700 MW of solar generation will rapidly go away and then return within the span of less than 3 hours. Your cooperation and support throughout the event will help to ensure grid reliability. Please monitor MNS and ADS messaging to stay current with real time operations. Forecast loads Monday from 08:05 – 11:05 PDT XX,XXX MW Monday Peak XX,XXX MW
10/14 06:45	Eclipse readiness - timing of eclipse	This message is to serve as a reminder that the Solar Eclipse will take place today from 08:05 – 11:05 PDT. This is a unique event for the ISO BA, during which approximately 9,700 MW of solar generation will rapidly go away and then return within the span of less than 3 hours. Your cooperation and support throughout the event will help to ensure grid reliability. Please monitor MNS and ADS messaging to stay current with real time operations.
10/14 07:45	Ensure units are following DOTs	The Solar Eclipse will be starting shortly. From 08:05 through maximum obscuration at 09:30, the ISO anticipates the ramp down of solar generation in the BA to occur at roughly 85 MW/min. Participants are requested to follow all dispatch instructions and Dispatch Operating Targets (DOTs) and adhere to unit ramping capabilities as stated in the Master File. Your cooperation will help to ensure grid reliability for the duration of the event. Thank you.
10/14 09:30	Reminder to follow DOTs as solar units RAMP back up	The Solar Eclipse has reached maximum obscuration. The ISO anticipates solar generation to ramp up at 120 MW/min through the end of the Eclipse at 11:05. Participants are reminded to continue following all dispatch instructions and adhere to unit ramping capabilities as stated in the Master File. Thank you.
10/14 11:05	Eclipse event has ended	The Solar Eclipse Event has ended and system operations have returned to normal. Thank you for your cooperation and support during this unique event.

Timeline

Item	Date
WEIM Bi-weekly Ops Meeting	September 13
IOU coordination discussions	September 13
RC West, adjacent RC coordination discussion	September 18
RC West Real-Time Working Group (RTWG) - Review of BA/TOP plans	September 19
Follow-up eclipse stakeholder call	October 2
RC West webinar with RTWG members to verify system posture plans	October 13
TOP/BA – RC West and RC-RC Coordination day-of early morning conference calls confirming readiness	October 14 (03:00 PNW, 04:00 PSW, 06:00 RC/RC)

- Following Event: review solar eclipse and identify lessons learned

Additional information

- Visit initiative webpage for more information: http://www.caiso.com/informed/Pages/MeetingsEvents/MiscellaneousStakeholderMeetings/Default.aspx

- If you have any questions, please contact isostakeholderaffairs@caiso.com