

Solar Eclipse

On Monday, August 21, 2017, the moon will hurtle between the earth and the sun, creating a solar eclipse visible for about three hours that morning across the United States. The eclipse will cast a 70-mile wide shadow in a path through 14 states from Oregon to South Carolina, the first coast-to-coast total eclipse in 99 years. It is believed it will be the most viewed total solar eclipse in human history.

While the “Great American Eclipse” is exciting to thousands of astronomers and everyday viewers, when the moon creeps over the sun in the Pacific Northwest, the California ISO will be busy managing a drop in solar production and a fast restart of generators.

The ISO started planning for the event in 2016, to mitigate the effects of the loss of solar generation, and keep the system operating reliably.

Here are some frequently asked questions about the upcoming eclipse:

Why is this event any different than past solar eclipses?

The last total solar eclipse visible in North America was in 1979 when no solar generation was interconnected to the California grid. In the last four years alone, about 2,000 MW of solar generation has been added to our system each year. Today, the ISO has almost 10,000 MW of installed solar capacity on the system, and at the demand peak, solar can serve as much as 30 to 40 percent of the ISO load.

So while solar eclipses are not new, solar power has become a major source of electricity for California, and has become a keystone of the state’s climate goals of reducing carbon in the grid.

How does the solar eclipse impact California?

Although California will not see a total solar eclipse, we will see a 76% eclipse in Northern California, and a 58% eclipse in Southern California. This obscuration will impact the California ISO Balancing Area (BA) by reducing the amount of solar energy produced, between 9:02 a.m. and 11:54 a.m., with the maximum obscuration of the sun at 10:22 a.m.

The eclipse is expected to cause a loss of 4,194 megawatts (MW) of large-scale solar electricity production. There will also be a projected loss of about 1,365 MW of rooftop solar generation, which will push the net load, or demand, to about 6,008 MW during the eclipse, a gap that will need to be filled using resources other than solar generation.

Has the ISO planned for the solar eclipse?

The ISO has been preparing for the effects of the solar eclipse for over a year, including close coordination with utilities and generators in its market. ISO staff also studied a total solar eclipse that affected Europe’s solar generation in 2015, and conferred with grid operators from that event.

What specific challenges is the ISO planning for?

In addition to the loss of solar production, the ISO is preparing for a rapid decrease and then increase in solar generation, known as ramp rates, during the eclipse, which can stress the system. When solar plants come back online quickly, the ISO needs to plan for solar generators coming back online in a fast ramp, which can cause oversupply conditions and frequency management issues.

What steps are being taken to mitigate generation shortages during the eclipse?

The ISO is coordinating with the gas companies, utilities, and generators within its footprint in advance to procure additional regulation and reserve capacity to help manage rapid loss and return of solar generation during the eclipse. The ISO also plans to use flexible ramping energy, including hydropower and natural gas plants. California has access to about 6,000 MW of hydroelectric energy, which is easily turned up and down, and because of the high water season, will still be available in August.

The transfer capability between Energy Imbalance Market (EIM) participants, which will be affected by the eclipse at slightly different times than the ISO, should provide additional flexibility.

The ISO used Aug. 22, 2016, a typical Monday morning with theoretically similar weather conditions, to model demand, plan for supply, and map ramp rates on the day of the eclipse. The forecasting models suppose full sun, no extraordinary consumer conservation, and higher obscuration rates in the northern part of the state, along with a corresponding loss of rooftop solar generation.

Here are the activities the ISO has undertaken to prepare for the eclipse:

- Completed a market simulation to predict developing conditions;
- Conducted grid operations modeling for a typical Monday morning, with no clouds, and reduced solar output. [Click here to view an ISO impact analysis.](#) The findings were shared with the board and posted to the ISO's website.
- Conducting table-top exercises and training for real-time ISO operators;
- Refining ISO's renewable resource forecasts, including comparisons with third-party forecasting entities;
- Coordinating with natural gas companies to plan an increase in gas-fired power plant production to replace solar generation lost during the eclipse. Accordingly, when solar production returns, gas usage will be reduced;
- Coordinating with EIM entities to incorporate eclipse impacts in their power schedules, maintain full operational energy transfers, and collaborate on forecasting.

Here are the activities planned just prior to the August 21 event:

- One week prior - Refine resources and load forecasts and communicate needed reserves to market.
- Two days prior - Conduct a conference call with market participants to facilitate coordination and transparency.
- On the morning of the event - Verify real-time forecasts are transferred into the ISO system to prepare all generation and optimize transmission pathways.

How will the ISO maintain grid reliability and stability?

While the eclipse will present some challenges, the advantage is that it is a known and predictable event. Losses of solar generation are not uncommon, so the ISO grid operators will balance demand and supply much as they do on days with cloud cover or rain. Partially cloudy sky is the hardest weather to prepare for, due to the rapid increase and decrease in solar generation. In the case of the eclipse, however, operators know when it will occur and have an identified path and obscuration rates.

Will there be electric service outages because of the eclipse?

The ISO doesn't anticipate any eclipse-related service outages. We will ramp up generation to compensate for lost solar production, and there is plenty of capacity to meet need. It is not unusual for the ISO grid operators to manage ramps this large on certain days.

How will the Energy Imbalance Market (EIM) be impacted?

By the time of the eclipse on August 21, 2017, there will be about 1,700 to 2,000 MW of solar generation within the utilities participating in the EIM that will be directly affected by the eclipse. Due to the slightly different times that EIM participants will be affected by the eclipse, EIM may provide some additional flexibility in managing it for all affected. [Click here to see a report on the impacts on the EIM.](#)

How much solar energy is connected to the ISO grid?

The ISO continues to add solar to its system, so modeling was based on about 10,000 MW of solar interconnection, which is the projected amount for the date of the eclipse.

Will alternative sources be turned on during the eclipse, and then turned off once it has waned?

The ISO will have resources committed to offset solar production, and then reduce generation when the solar plants come online immediately after the eclipse. The ISO power grid, along with its partner Balancing Authorities in other western states and parts of Mexico and Canada, is required by federal authority to carry enough reserves to regulate the system. The expected loss of solar energy will be optimized in the market dispatch, and the market will commit and dispatch the amount needed to stabilize the system.

What will the ramp rates be as the sun is obscured and then starts to emerge again?

As the eclipse begins its path across the sun, the decrease in production will be about 70 MW a minute, and the ramp up is expected to be about 90 to 100 MW per minute as the sun begins to reappear. A typical average ramp-up rate is around 29 MW per minute during the 9 a.m. to noon time period.

How will the Energy Management System (EMS) play a role in planning for the eclipse?

The EMS and Market software give the grid operators tools they need to monitor and control the system. One of these tools includes automatic generation control (AGC), which monitors Area Control Error (ACE). During the eclipse, the objective is to reach an error of 0, which means resources meet demand. The automatic generation control updates every four seconds, however, there will be additional operational reserve energy on the system during the hours of the eclipse in case it's needed.

Did the ISO learn from the total solar eclipse in Europe in 2015, specifically its effects on the German electric grid?

The ISO has consulted with the team that provided forecasting for the 2015 European total solar eclipse, which was a concern especially to Germany since it had nearly 40,000 MW of Europe's 90,000 MW of solar on their system. That has helped guide our forecasting and preparation. But each eclipse has unique qualities, such as the geographical path and totality of coverage, the proximity to generation, and the weather. Even conservation measures will affect demand and supply.

How can consumers help?

The ISO predicts the typical consumer will not notice the grid management challenges and balancing strategies. However, energy efficiency is always helpful to curb spikes in need for power, and to lower consumer electricity bills during times of high demand.

The ISO predicts the market will work efficiently the day of the eclipse, but if there are unforeseen circumstances, such as generation or transmission outages, or high heat, the ISO can call a Flex Alert, which is voluntary call to consumers for conservation. Visit FlexAlert.org to learn more about Flex Alerts, and to sign up for notifications.

How will my solar photovoltaic system be affected?

Homeowners and businesses will see production on their solar PV systems lowered, and solar thermal systems will not heat as much water. As with any time that solar generation is reduced, the electrical grid will make up for the drop-off.

How do I view the eclipse safely?

For safe viewing tips, go to <https://eclipse2017.nasa.gov/safety>