

## Solar Eclipse

On Monday, August 21, 2017, a total solar eclipse will pass over the Pacific Northwest affecting the California ISO solar resources supplying power to the grid.

The eclipse is expected to occur from 9:02 a.m. to 11:54 a.m., with the moon obscuring 58 to 76 percent of solar rays, depending on the resource location, and causing a loss of 4,194 megawatts (MW) of large scale solar electricity.

When adding in the load joining the grid from the loss of rooftop solar, the net load is anticipated to increase to about 6,008 MW during the eclipse, a gap that will need to be filled using resources other than solar generation.

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

Here are some frequently asked questions about the upcoming eclipse:

### How is the ISO planning for the solar eclipse?

The ISO has been planning for 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.

### Why is this event any different than past solar eclipses?

The last total solar eclipse visible in North America was in 1979 and no solar 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 set an all-time instantaneous solar generation peak of 9,914 MW on June 17, 2017. 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.

### What challenge is the ISO planning for?

The ISO is preparing for a rapid decrease and then increase in solar generation, also known as ramp rates, during the eclipse, which will stress the system.

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

The ISO will procure additional regulation and reserve capacity to assist with the rapid loss and return of solar generation during the eclipse. The ISO also plans to use abundant hydropower and flexible ramping energy. The transfer capability between Energy Imbalance Market (EIM) participants, who will be affected by the eclipse at slightly different times than the ISO, should provide additional flexibility.

Why does the solar eclipse impact us?

Although California will not see a total solar eclipse, we will see a 76% eclipse in Northern California, and a 62% eclipse in Southern California. This obscuration will impact the California ISO Balancing Area (BA) between 9:02 a.m. and 11:54 a.m., with the obscuration peak at 10:22 a.m., by reducing the amount of solar energy produced by the ISO BA.

How will the ISO maintain grid reliability and stability?

A loss of solar generation is 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 increase and decrease in ramp rates. The advantage in this case is that the parameters of the eclipse are known and which we are preparing for, including consideration for all of the above variables.

How is the Energy Imbalance Market (EIM) impacted?

By the time of the eclipse on August 21, 2017, there will be approximately 866 MW of solar 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.

Has the ISO's preparation for the eclipse changed based on how much solar energy is in the system?

The ISO continues to add solar to its system, therefore it was expected there would be a higher amount of solar in the system by the date of the eclipse, so we planned accordingly.

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

The expected loss of the solar energy will be optimized in the market dispatch taking into consideration the changes to load due to loss of roof top solar as well as large scale solar facilities. The market optimization will be able to commit and dispatch the facilities needed to assist with changes on the system, such as hydro, gas, EIM transfers, etc.

What will the ramp rate be as the sun starts to emerge from the eclipse?

The ramp up is expected to be about 6,008 MW, about 90 MW per minute. A typical average ramp rate is around 29 MW per minute during the 9 a.m. to noon time period.

How do I view the eclipse safely?

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

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

The EMS and Market software are responsible for providing the grid operators with the tools they need to monitor and control the grid. 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.

How much of the load does solar generation make up on an average summer day?

At the demand peak, solar serves as much as 30 to 40 percent of the load.

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 does the ISO plan to fill the gap in energy production during the eclipse?

Because of the strong hydro season this year, we are expecting hydro power will still be available and flexible in August to assist with the eclipse. The ISO has been coordinating with the gas companies, utilities, and generators within its footprint in advance to assist with the ramp rates that are expected to be seen on the day of the eclipse. These resources will be key to supplying the replacement generation as we go into the eclipse, and continuing to help us maintain grid reliability and stability when reducing that generation as we come out of it.