

**UNITED STATES OF AMERICA  
BEFORE THE  
FEDERAL ENERGY REGULATORY COMMISSION**

Technical Conference on Environmental )  
Regulations and Electric Reliability, ) Docket No. AD15-4-000  
Wholesale Electricity Markets, and )  
Energy Infrastructure )

**Prepared Statement of Mark Rothleder on behalf of the California  
Independent System Operator Corporation**

On behalf of the California Independent System Operator Corporation (CAISO), I offer these comments in response to the Commission’s inquiry regarding the potential implications of compliance approaches to the Clean Power Plan proposed rule issued by the United States Environmental Protection Agency.

I serve as Vice President, Market Quality and Renewable Integration at the California Independent System Operator Corporation. In this role, I lead the CAISO’s renewable integration work. Prior to this role, I served as Executive Director of Market Analysis and Development and oversaw the design and implementation of market rules and software modifications related to the launch and implementation of the CAISO’s nodal markets.

My comments address potential implications to wholesale markets associated with using more variable energy sources, including solar and wind, which is one approach that states may explore to comply with the EPA’s Clean Power Plan proposed rule. Specifically, my comments address mitigation strategies to address concerns that may arise with this effort, including use of a broader regional dispatch.

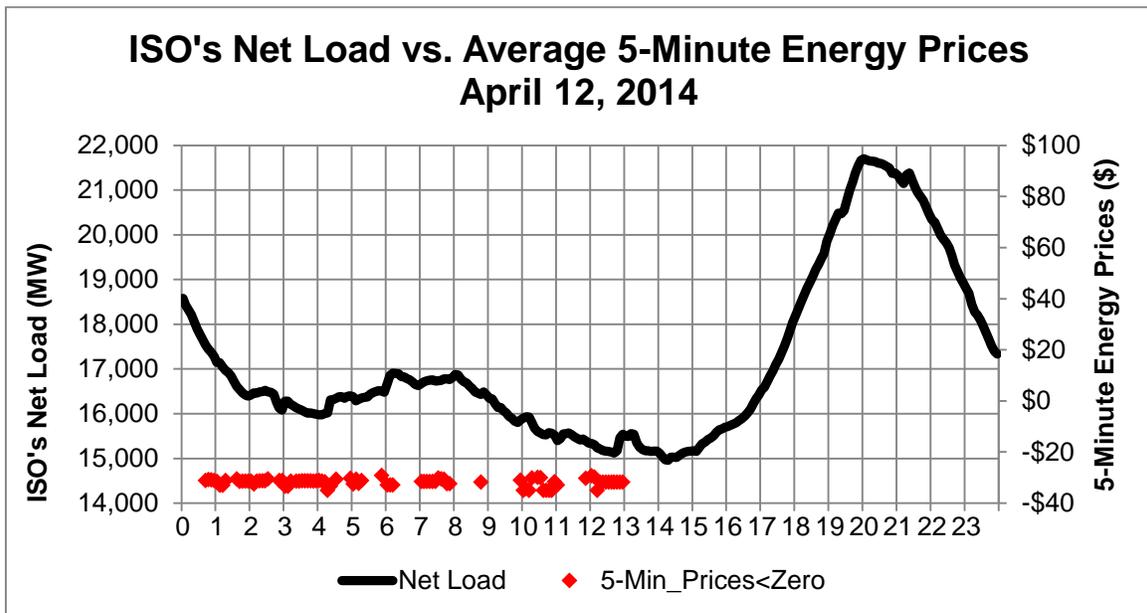
Over the last decade, the CAISO balancing authority has successfully integrated a tremendous increase in variable energy resources. We have worked in close coordination with our stakeholders as well as the California Public Utilities Commission, the California Energy Commission, and the California Air Resources Board to ensure our market rules and practices will help integrate greater amounts of variable energy resources. The Federal Energy Regulatory Commission has also been a catalyst in this area. The adoption of Order 764 concerning variable energy resource integration provided the foundation for the CAISO to enhance its real-time markets to improve solar and wind production forecasts and permit 15 minute scheduling on the CAISO's interties. In addition on November 1, 2014, the CAISO implemented the Energy Imbalance Market with PacifiCorp. The Energy Imbalance Market provides 1) an efficient way to dispatch resources to meet the imbalances across multiple balancing authority areas in real-time and 2) an opportunity to better manage over-generation conditions. Both 15 minute scheduling and the Energy Imbalance Market increase operating flexibility.

As we integrate greater volumes of variable energy resources in the West, however, the CAISO and other balancing authority areas will need to manage the potential for increasing over-generation conditions. Although demand is gradually increasing in the CAISO balancing authority area, the net load is decreasing. Net load is load minus variable resources and is effectively the load that the CAISO must balance using other dispatchable resources. The CAISO expects minimum net load levels to continue to decrease as increasing amounts

of variable energy resources such as wind and solar produce energy when their source of fuel is available.

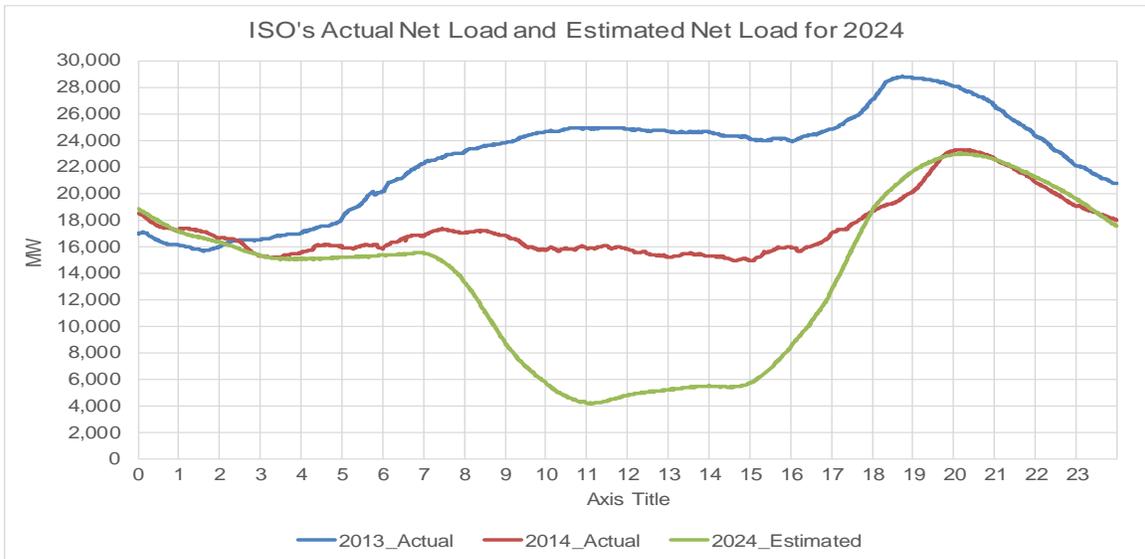
During these minimum load hours when renewable production is high, the CAISO anticipates variable energy resources will displace output from conventional resources. By way of example, on April 12, 2014, coincident wind and solar production exceeded 8,300 MW (35 percent of total demand) during mid-day when the total system load was about 23,450 MW. Figure 1 reflects the actual net load curve (load less solar and wind production) for April 12, 2014 when the net load dropped below 15,000 MW due to high wind and solar production levels. We expect other balancing authorities in the West will face similar issues at perhaps different or similar time periods depending on the diversity of load and variable resource patterns in these areas.

**Figure 1 - Actual Net Load Curve for April 12, 2014**



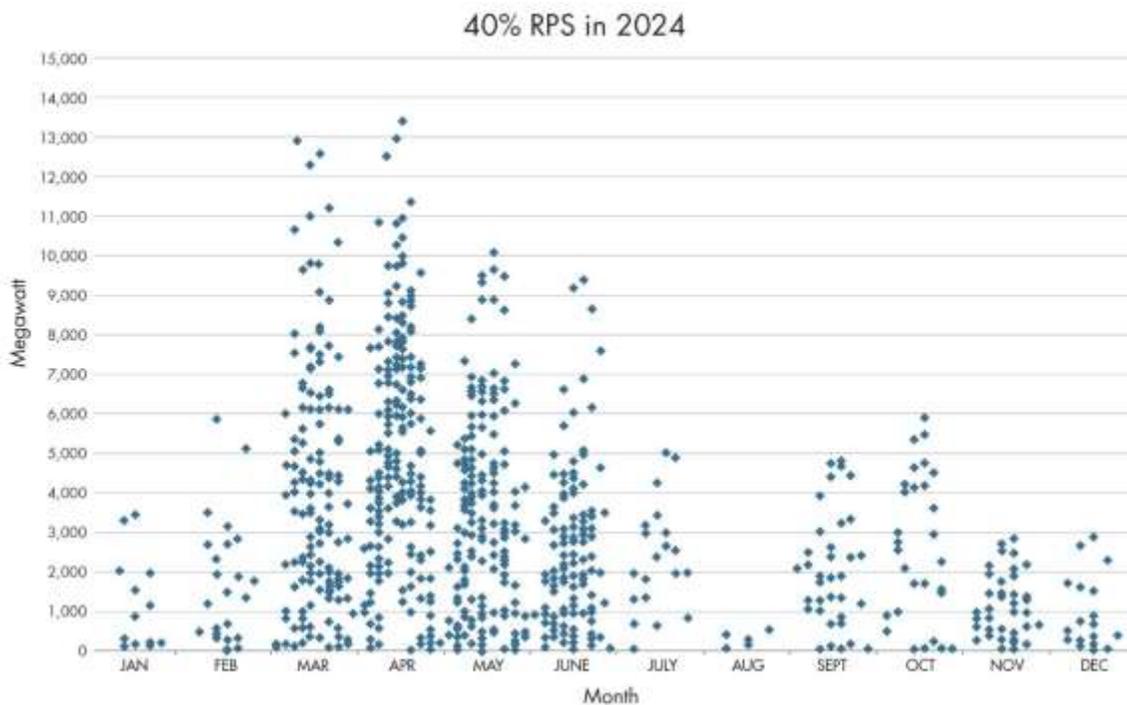
The red dots in Figure 1 reflect that the real-time 5-minute energy prices were zero or negative for 43 percent of the total 5-minute intervals for the entire operating day. Negative prices reflect or are precursor to over-generation conditions. The data from April 12, 2014 demonstrates that on some days, especially on weekends and holidays, the CAISO's supply portfolio consists largely of variable energy resources. As greater amounts of variable energy resources interconnecting with the CAISO by 2020 and in future years, the CAISO anticipates that during some operating hours wind and solar coincident production could exceed 60 percent of the total supply mix. Figure 2 illustrates how the net load has changed and how the CAISO expects it to change by 2024 based on the current trajectory of variable energy resource development.

**Figure 2: Net Load Curves (2013, 2014 and 2024 Estimated)**



The frequency of these over-supply conditions will further increase with the addition of more distributed energy resources because the transmission system will need to serve less load. Recently, the CAISO developed an analysis for purposes of proceedings before the California Public Utilities Commission that identified potential over-generation conditions that could occur under a 40 percent renewable portfolio standard in 2024. Figure 3 is a scatter graph that estimates the frequency and magnitude of potential renewable curtailment under these over-supply conditions.

**Figure 3: Estimated Renewable Curtailment Frequency and Magnitude in 2024 at 40% RPS**



The CAISO is actively working to identify and implement strategies to mitigate over-generation conditions in order to integrate even greater amounts of variable energy resources. Among other strategies, the CAISO is exploring the following efforts.

- **Day-ahead scheduling of variable energy resources.** The CAISO is examining how to more accurately forecast variable energy resource production in the day ahead timeframe, including encouraging scheduling coordinators to schedule the output of their variable energy resources in the day-ahead timeframe. More accurate production forecasts will help the CAISO position remaining resources in the fleet to serve net load.
- **Increasing flexibility of the whole fleet and inerties.** The CAISO is working with stakeholders to develop a flexible ramping product to obtain both upward and downward ramping capabilities. The CAISO is also examining mechanisms to incentivize resources to operate at lower minimum load and adjust market rules to encourage exports.
- **Reducing self-schedules.** The CAISO has already lowered its bid floor to encourage more economic bidding by all resources to reduce their output during over-generation conditions. The CAISO plans to revise its resource adequacy rules to incentivize more economic bidding as well.
- **Increased energy storage and demand response.** The CAISO will continue to look for means to foster the participation of energy storage and demand response resource in its markets including incentivizing shifting loads to periods when there is excess supply from periods of peak net demand.
- **Electrification of transportation and load growth.** The CAISO will explore how to ensure increases in demand from electrification of

transportation or water conveyance and desalination complement increased output from variable energy resources.

- **Increased regional collaboration.** The Energy Imbalance Market already is demonstrating that optimizing across a broader footprint in real-time can help address over-generation conditions. But increased regional collaboration, including optimizing resource portfolios in the day-ahead timeframe, may be the most efficient means to integrate increasing volumes of variable energy resources both in the CAISO and across other balancing authorities because it does not involve significant capital investments and will in fact result in more efficient electric system operations while reducing carbon emissions.

## CERTIFICATE OF SERVICE

I hereby certify that I have served the foregoing document upon the parties listed on the official service list in the captioned proceeding, in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.2010).

Dated at Folsom this 19<sup>th</sup> day of February, 2015.

*S/ Sarah Garcia*  
Sarah Garcia