

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

Reliability Technical Conference

Docket No. AD14-9-000

Prepared Statement of Brad Bouillon on behalf of the California Independent System Operator Corporation

I. Introduction

My name is Brad Bouillon. I am the Director, Day-Ahead Operations and Real-Time Operations Support for the California Independent System Operator Corporation (California ISO). In this position, I oversee operation of the California ISO's day-ahead market and provide support to real-time market operations on scheduling and outage coordination issues.

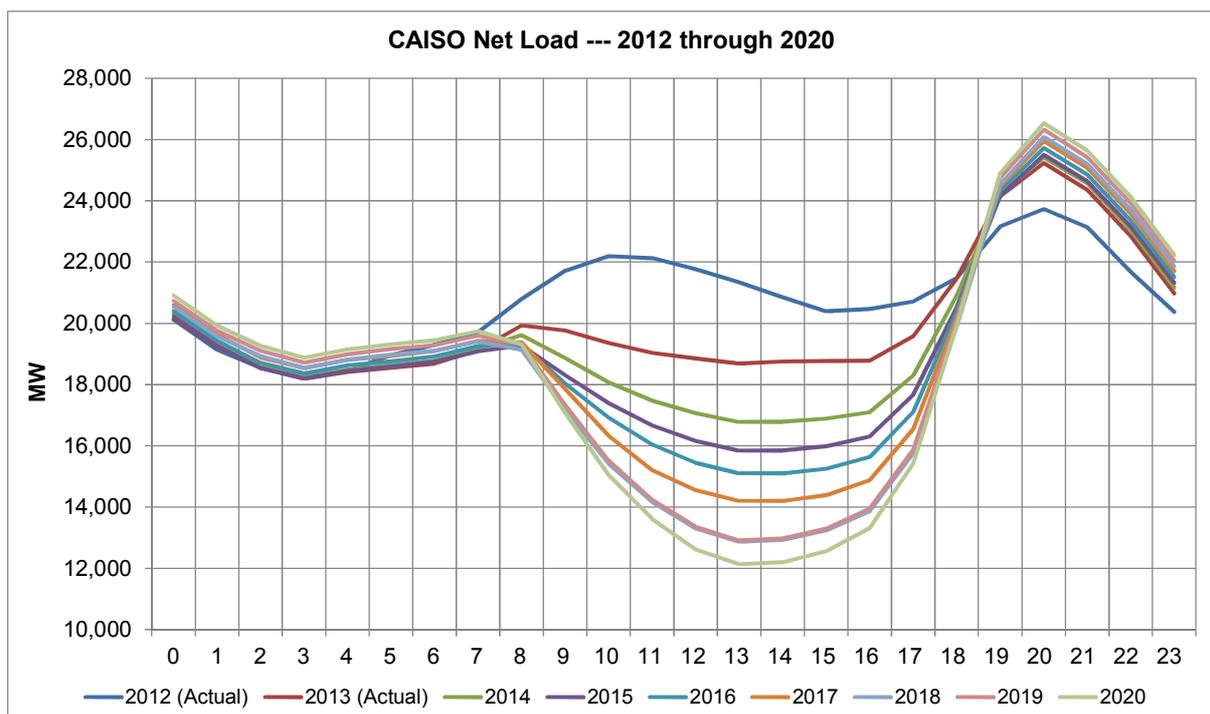
Among the emerging policy issues related to the reliability of the bulk-power system in the West is the integration of variable energy resources. California's renewable portfolio standard requires load serving entities to supply 33 percent of their electricity from renewable resources by 2020. As a result, there is a proliferation of variable energy resources interconnected to both the high-voltage transmission and utility distribution systems within the California ISO's balancing authority area. My remarks highlight three aspects of this issue:

- Operational challenges to integrate variable energy resources are already occurring;
- The capability of variable energy resources to help address these challenges; and
- The importance of resources with flexible operating capabilities to balance load and supply.

II. The transformation of the electricity grid is already creating operational challenges

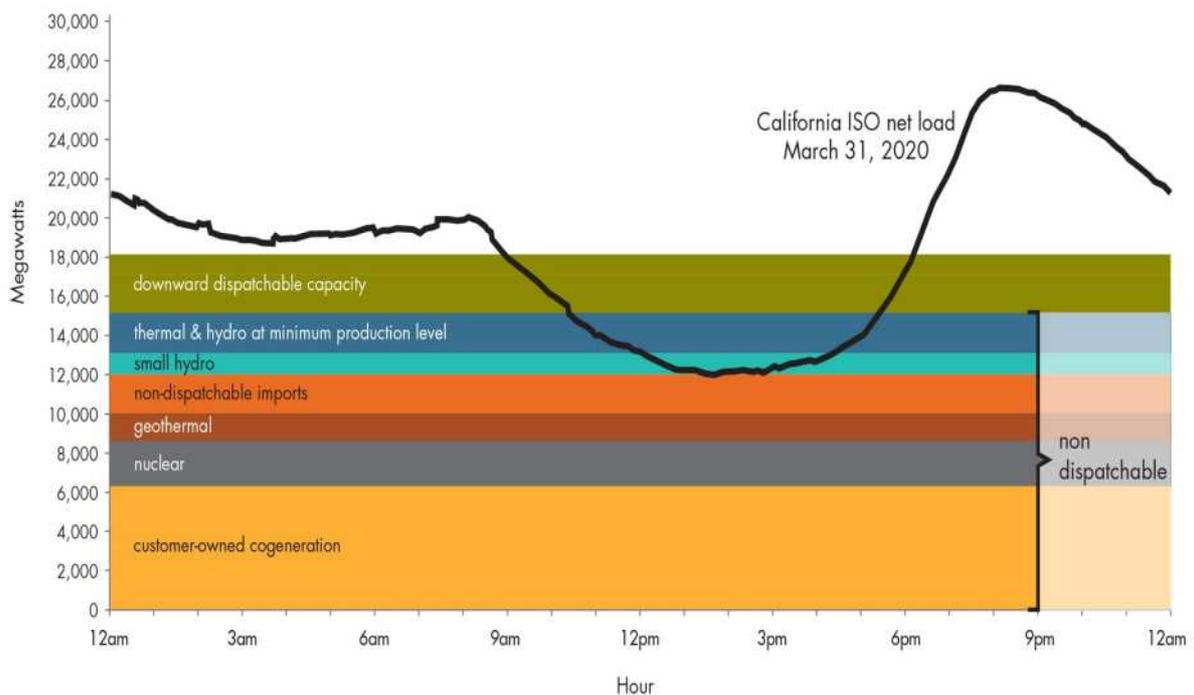
With a changing resource mix that includes an increasing amount of variable energy resources, the California ISO will face steep ramps and will need to meet increasing or decreasing electricity demand quickly. We will need resources with fast ramping and fast start capabilities as well as the ability to start multiple times during an operating day. The California ISO also expects an increased risk of over-generation, when resources are supplying more electricity than is needed to satisfy real-time electricity requirements. This condition creates negative market prices that may create shortfalls in expected market revenues for certain resources. In addition, there is a risk of decreased frequency response capability when fewer resources are operating and available to automatically adjust electricity production to maintain grid reliability. The California ISO developed the “duck chart” depicted in Figure 1 to illustrate the difference between forecasted load and expected electricity production from variable generation resources (i.e. net load) during a typical March day.

Figure 1 – The Duck Chart



The duck chart reflects that in certain times of the year, a “belly” appears in the mid-afternoon that quickly ramps up for the evening load pull when solar output ceases. The duck chart shows that over-generation may occur during the middle of the day and not just during low load conditions. This condition may be exacerbated by high levels of non-dispatchable generation. Figure 2 reflects an estimated net load curve in 2020 with estimated levels of non-dispatchable generation, which identifies a shortage of downward dispatchable capacity to balance supply and demand.

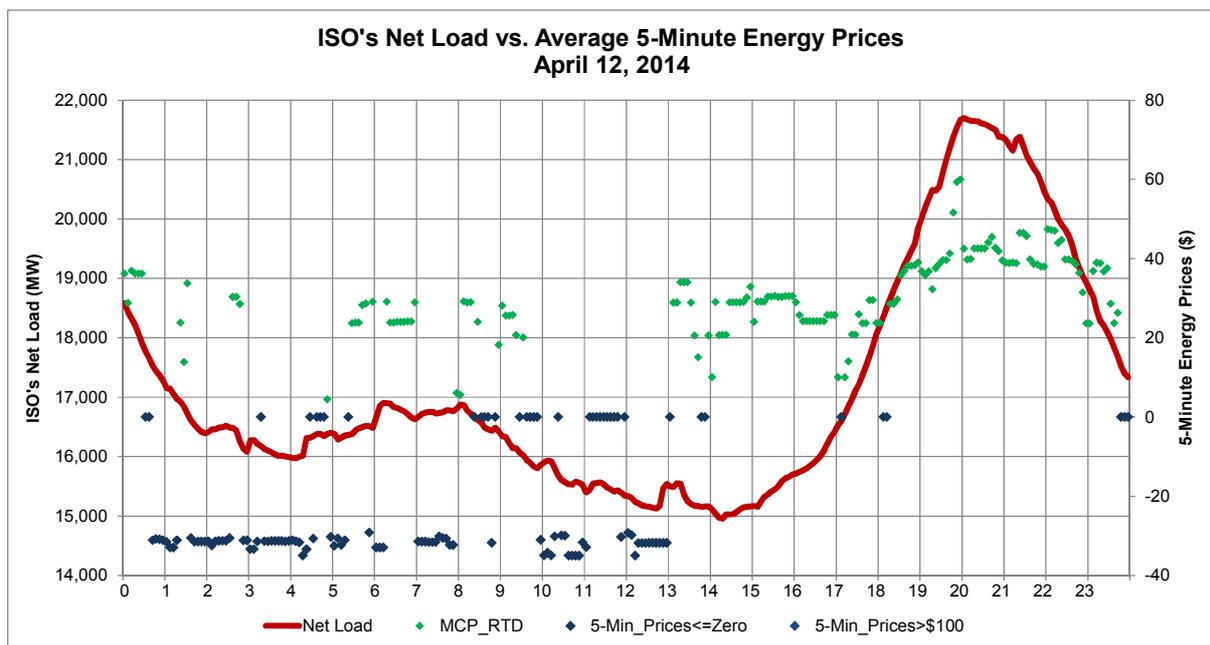
Figure 2 – The Duck Chart and Estimated Non-dispatchable Generation



Initially, the California ISO estimated that its minimum net-load (the belly of the duck) would approach 15,000 MW in the 2016 timeframe during hours of low demand and high renewable production. So far in 2014, net-load has dropped below 15,000 MW twice, resulting in periods of over-generation and negative prices. In

short, the belly of the duck has already arrived. By way of example, Figure 3 depicts the California ISO's net-load when compared to actual real time dispatch energy prices for April 12, 2014. The California ISO market experienced sustained zero or negative real-time 5-minute prices during the middle of the operating day as shown by the blue dots. The green dots show the real-time 5-minute energy prices greater than zero.

Figure 3 - April 12, 2014 Net Load and Real Time Prices



Beyond negative prices created by over-generation conditions, the reduction in generation capacity that can adjust its production of energy in response to under- or over-frequency occurrences raises grid reliability concerns. The California ISO must maintain resources with sufficient capabilities on its system at all times to effect real-time control performance. In order for ISO to comply with FERC's recently approved Frequency Response and Frequency Bias Setting standard (BAL-003-1), the ISO will have to operate in a manner such that resources on governor control must forego operating at their maximum capability and reserve available headroom

at all times in order to provide frequency response following a disturbance. Low net load conditions create more challenges to meet this requirement because it requires the commitment of additional resources at a time when too much generation is already on the system.

III. Variable energy resources can help address the operational changes reflected by the duck curve

The California ISO has adopted market reforms to help address the challenges of renewable integration. These reforms include, among others, procurement of flexible capacity, lowering the bid floor to incentivize economic curtailment, and implementing a 15 minute market that will permit greater opportunities for intra-hour scheduling.

To help address grid reliability needs, over-generation conditions and maintaining system frequency, the California ISO believes variable energy resources must also contribute to the reliability of the bulk power system. As reflected in a 2013 special reliability assessment developed by the North American Electric Reliability Corporation and the California ISO, variable energy resources should contribute to the stable and reliable operation of the bulk power system.¹ Among other capabilities, these resources should have the ability to limit power production as needed for the promotion of reliability as well as some frequency response capability.

Variable energy resources should have the capability to receive and respond to automated dispatch instructions as well as maintain an ability to limit active power

¹ Maintaining Bulk Power System Reliability While Integrating Variable Energy Resources – CAISO Approach dated November 13, 2013
http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC-CAISO_VG_Assessment_Final.pdf

output, should there be a reliability need. These resources should have flexible ramping capabilities. While variable energy resources cannot necessarily maintain output when wind speed or solar irradiation declines, they can regulate decreases in power output by implementing shut-down sequences or responding to market conditions. In addition, when fuel source returns, variable energy resources should have the capability to ramp up in controlled increments. Variable energy resources should also have capability to adjust energy output automatically in response to over-frequency conditions.

IV. Resources with flexible operating capabilities will become increasingly important for the reliable operation of the bulk power system.

As variable energy resources continue to proliferate on the electricity grid, fast ramping resources with the ability to start more than once in an operating day will become increasingly important. Higher penetration of distributed generation may also make load more unpredictable and therefore require resources that can ramp in both directions.

The California ISO is developing market products for the upward and downward flexible ramping.² The purpose of these products is to address the operational challenges of maintaining power balance in the real-time dispatch. All resources, including variable energy resources, may provide this product. Under the California ISO's recent fifteen minute market design changes associated with Commission Order 764, variable energy resources may submit economic bids. With the implementation of flexible ramping products, variable energy resources may

² See Straw Proposal - Flexible Ramping Products Incorporating Fifteen Minute Market and Energy Imbalance Market dated June 2, 2014
http://www.caiso.com/Documents/Strawproposal_FlexibleRampingProduct_FMM-EIM.pdf

submit upward bids based on their production forecasts and downward bids to reduce their output. This capability may help reduce the ramping requirements faced by the system as depicted in the duck curve.

The California ISO is also finalizing must offer rules for flexible resource adequacy capacity.³ These rules will allow all resource types, including variable energy resources, to contribute to reliable operation of the bulk power system. The California ISO is working with the California Public Utilities Commission (CPUC) to examine expanding the CPUC's resource adequacy program to include procurement of flexible capacity for multiple years forward.⁴ The California ISO plans to undertake similar efforts with other local regulatory authorities within its balancing authority area.

While all resources may provide flexible capacity to the grid, the California ISO expects natural gas fired generators to continue to serve as a critical resource to help balance supply and demand. For example, the development of simple cycle peakers or other resources that have fast start and ramping capability will advance reliable grid operations while increasing the participation of variable energy resources. This underscores the need to ensure sufficient gas pipeline infrastructure and gas scheduling rules are available to support operation of these facilities when and where needed. The California ISO has developed strong relationships with gas pipeline operators serving electric generators in its balancing authority area and will

³ See Memorandum dated March 14, 2014 to California ISO Board of Governors Re: Decision on flexible resource adequacy criteria and must-offer obligation <http://www.caiso.com/Documents/Decision-FlexibleResourceAdequacyCriteriaMustOfferObligation-Memo-Mar2014.pdf>

⁴ See Memorandum dated December 11, 2013 to California ISO Board of Governors Re: Decision on the Joint Reliability Plan <http://www.caiso.com/Documents/DecisionJointReliabilityPlan-Memo-Dec2013.pdf>

continue to discuss its operational challenges with these pipelines to ensure gas-fired generators have access to adequate fuel supply.

Dated June 10, 2014