White Paper

CAISO Reliability is Feeling the Heat

By Judah L.Rose and Chris McCracken, ICF

Shareables:

- In a recent heat wave, CAISO's demand was 7.5% above forecast annual peak and prices reached $750/MWh.
- In July, the California PUC concluded California overstates solar's reliability contribution by nearly 100%. This has caused CAISO to understate the potential for shortages and the need for thermal and storage.[1]
- California is attempting to integrate record levels of renewables and additional effort is required to secure adequate storage and thermal supply.

Executive Summary

Hot weather is only part of the story of California's recent power market behavior. The overstatement of solar's contribution may also account for the understatement of demand because demand is net of behind-the-meter solar. Also, incremental solar capacity may not fully solve the peak demand problem, even if it contributes energy supply and achieves environmental goals, because the peak is occurring when solar output is falling. A 2015 ICF whitepaper anticipated that this overestimate of solar would be recognized and accompanied by shortages at the peak before 2020. As a result of the change to solar's contribution to reserve, thermal and storage plants may face a more favorable if still challenging environment than expected and should position themselves for opportunities especially in load pockets.

[1] Decision 17-06-027, June 29, 2017. Before the PUC, Rulemaking 14-10-010, Order effective July 10.

CAISO Prices 8/29-9/1/17

The highest prices were in the hours ending 6 and 7 pm. This is also a sign of system stress in hours well past the solar output peak. In late August 2017, CAISO solar output in HE 6 pm is approximately 50% of the diurnal peak (occurring in HE 1 pm) and HE 7 pm is 15% of peak. HE 8 pm is zero.

Source: SNL

CAISO Misses Forecasts on Shortage Potential

CAISO attributed no quantitative chance to shortages this summer in its summer reliability assessment published May 11, 2017.[2] As forecasted, its lowest possible operating reserve margin was 13%, which should be more than enough given that most systems require 3-5%. However, even that margin could not prepare CAISO for the recent levels of peak demand.

CAISO[3] recently experienced shortages of generation supply, as indicated by CAISO conservation alerts calling for conservation until 10 PM in the evening.[4] That timing indicates that the grid stress extends past the typical historic peak demand period of Hour Ending (HE) 5 PM, and into hours in which solar cannot provide significant output. Electricity prices during the time period have been extremely high throughout CAISO and the surrounding states. On September 1, 2017, Day Ahead wholesale electricity prices reached $750/MWh. In comparison, average annual prices are in the $25 to $35/MWh range.

Peak and Solar Miscalculations

CAISO's forecast expected 2017 peak demand to be 46.5 GW. However, demand on September 1, 2017 peaked at 50 GW, 7.5% higher than expected, and the day ahead forecast was 51 GW, or ten percent higher.[5] While it is the case that record temperatures were reached in this period, demand forecasting should account for 1-in-10 demand levels in the stochastic analysis.[6] As warming occurs, 1-in-10 peaks will occur more frequently. Put another way, while temperature records have been set, the weather is not likely to have been so extreme to create no chance of there being no future event capable of creating shortages in CAISO's Monte Carlo probability studies. As a result of the inconsistency between its forecast and actual system performance, California will have to revisit its forecast methodology, including the extent to which it updates weather forecasts for the warming trend and accounts for behind-the-meter solar.[7]

A sample of recent temperature records shows a once-in-ten year trend:

[2] CAISO, Summer 2017 Assessment of Loads and Resources, May 11, 2017, page 27. Reflects resource adequacy contribution set by PUC, and CEC load forecasts.

[3] CAISO is FERC Regulated.

[4] http://www.caiso.com/Documents/CaliforniaISOIssuesStatewideFlexAlertDuetoHeatWave083117.pdf

[5] Forecast for September 1, 2017. 51 GW for both HE 5 pm and HE 6 pm. Source: CAISO OASIS. Another reason to revisit the peak demand forecasts is that the peak of 50 GW is only 1% higher than the pre-recession average peak in 2006 and 2007. This adds to the expectation that such a level could happen and should be anticipated more fully in stochastic planning.

[6] Forecasts have an expected value, and variation around the expected value. The variation would have been expected to include weather and demand that would be expected 10% of the time.

[7] If the solar behind the meter output at peak was also 40% overstated, it would alone account for 69% of peak underestimate.

"Woodland Hills reached 112 degrees Tuesday, tying a record for the date set in 1996. Temperatures broke records in Lancaster and Sandberg, where highs reached 109 and 103, respectively. Lancaster's previous record for the date was in 1998, when the temperature reached 107. In Sandberg, an earlier record of 97 degrees was set in 2007." [8]

Updating Solar's Reliability Contribution

Peaks in CAISO have been occurring during the hour ending 5 PM in recent years, but may be occurring even later in the day on a net basis (after removing intermittent renewables).[9] This was an anticipated trend due to greater solar usage – referred to as the "duck curve." In fact, in a 2015 ICF whitepaper titled[10], "California, the Coming Retirement Wave and the Return of Capacity Pricing", ICF stated:

Much of the existing dispatchable capacity is being paid too little for reliable performance… We note the symptoms of these problems could first emerge around load pockets….any decrease to the solar reserve margin contribution or additional energy efficiency targets would result in lower reserve margins that could easily accelerate supply demand equilibrium before 2020. Going forward, we flag the decreasing share of thermal generation in California's supply mix as a potential reliability concern.

However, this solar issue is not mentioned in the 2017 Summer Assessment and did not lead to a change in reliability planning until July 2017 effective only in 2018.

In 2017, California over-estimates the reliability contribution of solar by nearly 100%. During the summer, the Public Utilities Commission (PUC) decided to greatly lower solar's contribution to reserve margin targets,[11] with adjustments to August alone from 80% to 41%, starting 2018. [12]

With the highest solar power concentration in the nation, the reliability treatment of solar is critical in California.[13]

[8] http://www.latimes.com/local/lanow/la-me-ln-heat-warnings-socal-20170829-story.html

[9] On June 21, 2017, net peak (demand less solar and wind) occurred in hour ending 8pm when solar output is zero. Also, solar output is more variable later in the day; between August 25 and 30, 2017, HE 6 pm solar output was 3.25 x more variable than at 1 pm possibly due to greater haze and aerosols.

[10] Adil Sener is the ICF author. He is now with Jeffries.

[11] California has 52 transmission security sub zones with additional requirements further compounding planning errors." as a second sentence in footnote

[12] May 25, 2017, State of California, Public Utilities Commission, "To Parties of record in Rulemaking 14-10-01". On July 10, 2017, the Public Utilities Commission of California adopted this down-rate for next year. See Decision 17-06-027, June 29, 2017, Before the Public Utilities Commission of the State California, Rulemaking 14-10-010, Order Docket opened in 2014.

[13] http://www.energy.ca.gov/renewables/tracking_progress/documents/renewable.pdf. At the end of 2016, California had a total installed solar capacity of nearly 15 GW (making it the highest solar power generating state in the nation. 5.8 GW of BTM solar, 8.9 GW MW of Grid Solar. Thus, the reliability treatment of solar is critical. For example, if on average, the reliability contribution is decreased 40%, all else equal, need increases nearly 6 GW.

In summer months, CAISO uses 75-80% solar contribution to reserve margin.[14] In other words, 75 to 80 MW of a 100 MW solar plant contributes to meeting monthly reserve margin targets, as compared to a new thermal plant that would be close to 100% in all summer months. That derate reflects lower output levels when output is most needed. The California PUC's change to the solar reserve margin contribution will therefore have a significant impact on reserve margin. The change noted above from 80% in August 2017 to around 41% in August 2018 could impact reserves on the order of 6 GW. However, this change starts only in 2018. Further, more changes may be required.[15]

Thermal Generation, Storage and Gas Assurance

The change in solar's contribution to reserve could leave a gap to be filled by other sources of generation, including thermal and storage. Before Aliso Canyon, California's Long Term Planning Process (LTPP) has been forecasting very high planning reserve margins of 40% for 2017[16] and has forecasted California would not need additional new thermal dispatchable capacity in any period because the minimum target is 15%. In 2017, the forecast indicated that even if California peak demand reached 51 GW, it should still have 10 GW in reserve. However, the recent experience means that CAISO must reconsider its forecasts – CAISO should not have required alerts if the state's critical planning parameters were correct.[17]

Aliso Canyon is identified in the recent CAISO press release[18] as a limiting factor, as well in its May 11, 2017 study. However, this would have been known in May 11, 2017 and could have been factored in more in the May study than it was. Put another way, while the Summer CAISO assessment explicitly says it does not take it into account quantitatively, one would have expected more treatment of this issue given the apparent importance of fuel supply while rapidly increasing reliance on intermittent renewables. Furthermore, ALISO Canyon is identified as a local problem but the problems are CAISO wide.

Looking Ahead

California's on-going review of reliability should be accelerated, and additional forensic review conducted. This is especially the case as it is attempting to accommodate record levels of intermittent renewables, as well as problems in load pockets (e.g. Aliso Canyon). Thermal units and storage, especially in load pockets should anticipate commercial opportunities earlier than indicated in planning documents.

[14] June 79%, July 75%, August 80%, and September 75%. Non-Dispatchable Solar See Net Qualifying Capacity Report Compliance Year 2017. Also, see Qualifying Capacity Methodology Manual, Adopted 2015.

[15] As noted, in late August 2017, CAISO solar output in HE 6 pm is approximately 50% of the diurnal peak (occurring in HE 1 pm) and HE 7 pm is 15% of peak. HE 8 pm is zero. HE 6 demand can be virtually the same as HE 5 pm, and HE 7 pm is still within 3% of peak.

[16] Minimum planning reserve targets (15% of peak) are set to ensure adequate operating reserves (typically in US 3-5% of peak). https://apps.cpuc.ca.gov/apex/f?p=401:56:0::NO:RP,57,RIR:P5_PROCEEDING_SELECT:R1602007.

[17] The 2014 LTPP is the last approved LTPP. 2016 LTPP is still pending. Using the 2016 released on August 5, 2016.

[18] See August 31, 2017, http://www.caiso.com/Documents/CaliforniaISOIssuesStatewideFlexAlertDuetoHeatWave083117.pdf.

About ICF

ICF (NASDAQ:ICFI) is a global consulting and technology services provider with more than 5,000 professionals focused on making big things possible for our clients. We are business analysts, policy specialists, technologists, researchers, digital strategists, social scientists, and creatives. Since 1969, government and commercial clients have worked with ICF to overcome their toughest challenges on issues that matter profoundly to their success. Come engage with us at **icf.com**.

About the Authors

Judah L. Rose joined ICF in 1982 and currently serves as a Managing Director of ICF International. He co-chairs its Energy Advisory and Solution line of business. Mr. Rose has approximately 35 years of experience in the energy industry including in electricity generation, fuels, environmental compliance, planning, finance, forecasting, and transmission. His clients include electric utilities, financial institutions, law firms, government agencies, fuel companies, and Independent Power Producers. Mr. Rose is one of ICF's Distinguished Consultants, an honorary title given to three of ICF's 5,000 employees, and has served on the Board of Directors of ICF International as the Management Shareholder Representative.

Chris MacCracken is a Principal with ICF. He assists clients in assessing the impacts of environmental regulation on their portfolios to support the development of compliance, regulatory, and operational strategies. Chris' clients include electric utilities, IPPs, and NGOs. He has directed ICF's support in a number of regulatory analysis engagements, including for RGGI Inc. in support of the 2016 RGGI Program Review and several related to state plan design strategy under the Clean Power Plan.

For more information, contact:

Judah L. Rose
judah.rose@icf.com +1.703.934.3342

Chris MacCracken
chris.maccracken@icf.com +1.703.934.3277

facebook.com/ThisIsICF/
twitter.com/ICF
youtube.com/icfinternational
plus.google.com/+icfinternational
linkedin.com/company/icf-international
instagram.com/thisisicf/