Effective load carrying capacity ("ELCC") of solar photovoltaic ("PV") resources in a KSA context

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Overview

For power system planning purposes, resources have historically been assigned capacity credit consistent with the extent to which their output could be relied upon to offset peak load. For intermittent resources, historical or expected daily and seasonal output profiles have been correlated with load shapes to assess their contribution to serving peak load. In North America, the concept of effective load carrying capacity ("ELCC") has been developed as a means to frame the discussion about the role of intermittent resources and the extent to which additional back up capacity is required.

At increasing levels of penetration by solar photovoltaic ("PV") resources, there is a risk that subsequent additions may provide little or no augmentation to the system's capability to meet peak load. This situation is exacerbated if there is a significant amount of behind the meter ("BTM") solar installed, as the system peak (net load) may consequently peak as production from both utility scale and BTM solar abates in the evening.

In North America, this challenge may become more acute as a result of electrification of heating, as winter peak demand is likely to occur after dark, rendering PV of little reliability value during several months of the year. While the interconnected nature of continental electricity systems may allow for some sharing between time zones, the transmission system is not adequate to allow for balancing across four time zones, nor would time differences alone be sufficient to address the issue.

The situation in Kingdom of Saudi Arabia (KSA) is different; load profiles are different from North America, the potential solar PV resource is more extensive, electric heating load is low, and BTM penetration less significant. Nonetheless, the role of solar PV needs to be carefully considered in a KSA context.

Methods

In this paper, the authors shall take the following approach:

- Review the approach to calculating ELCC in the PJM Interconnection and other US independent system operators ("ISOs");
- Based on publicly available information regarding KSA load profiles and PV production curves, assess PV ELCC today in KSA, being mindful of potential regional differences;
- Review solar PV targets for KSA and assess corresponding PV ELCCs in target years given expected load growth but assuming no change in load profile; and
- Assess PV ELCCs based on scenarios regarding BTM solar penetration and the impact on load profiles.

Results

The following outcomes shall be presented based on the undertaken analysis:

- Determine whether targets for dispatchable resources (batteries, fossil fuel, demand response) in target years reflect system needs given PV ELCC, with and without solar BTM penetration; and
- Recommend adjustments to targets if appropriate.

Conclusions

The results from this study will help us to understand the resource portfolio needs for KSA in the near future when integrating increasing levels of solar PV into the grid, and recommend adjustments to the current targets if appropriate.