Capacity Value of Renewable Energy

Net qualifying capacity (NQC) is used by CAISO to determine the value of renewable energy in satisfying the capacity obligations of load-serving entities in California. Current NQC methodology for wind and solar define monthly NQC values using average performance during hours of peak demand (noon – 6PM). The current methodology is simple in its application but needs improvements over time so that its accuracy continues to match the needs of load-serving entities.

California's 2020 renewable portfolio standard (RPS) goal requires that 33% of electricity sold in the state comes from renewable energy. However, renewable energy facilities that exhibit identical diurnal and seasonal patterns in performance show diminishing capacity values with increasing penetration. Diminishing marginal capacity value is best illustrated by the example of solar PV. Given enough solar PV, additional insulations have no capacity value because peak demand is effectively shifted to the early evening hours after the sun has set. I demonstrated this phenomenon while researching the value of solar PV to Georgia Power and will be presenting that data (Fig. 1) at the National Solar Conference this spring. The solid blue line shows the capacity value for each new MW of PV. As one would expect, the capacity credit of each new MW of solar PV slowly declines as the total amount of simulated solar PV increases.

The declining marginal capacity value of renewable energy has clear implications for NQC. This summer, I propose investigating this phenomenon using electricity load and renewable performance data from CAISO. The project will have two parts: 1) Diminishing capacity values will first be investigated by simulating a build-out of renewable energy at current installation sites. This analysis can be completed in Matlab using historical data. My goal in part one is to quantify the diminishing capacity value effect and set a foundation for additional exploration. 2) Part two will look specifically at how CAISO calculates NQC and how the methodology might be made more accurate when renewable energy penetration increases.

Given my previous experience looking at capacity values for renewable energy in Georgia's electric utility market, I expect the analysis to show several things. First, the capacity value of Solar PV will likely show a clearer decline than wind under high penetrations. However, today's solar PV capacity in California will likely be much too small to make current changes to NQC methodology worthwhile. I hope to help define when the penetration of solar PV will no longer be trivial. Second, improving NQC will involve a tradeoff between accuracy and simplicity. The simplicity of the current methodology has meant, for instance, that wind energy has failed to perform at its calculated NQC during extreme temperature events, exactly when the electricity is most in demand. It is possible that more general improvements to NQC calculations might produce better results than specifically correcting for diminishing capacity values. Finally, I expect a synergy to emerge between wind and solar that helps justify the co-development of these resources.

I am excited by the opportunity to explore these topics in greater detail this summer.

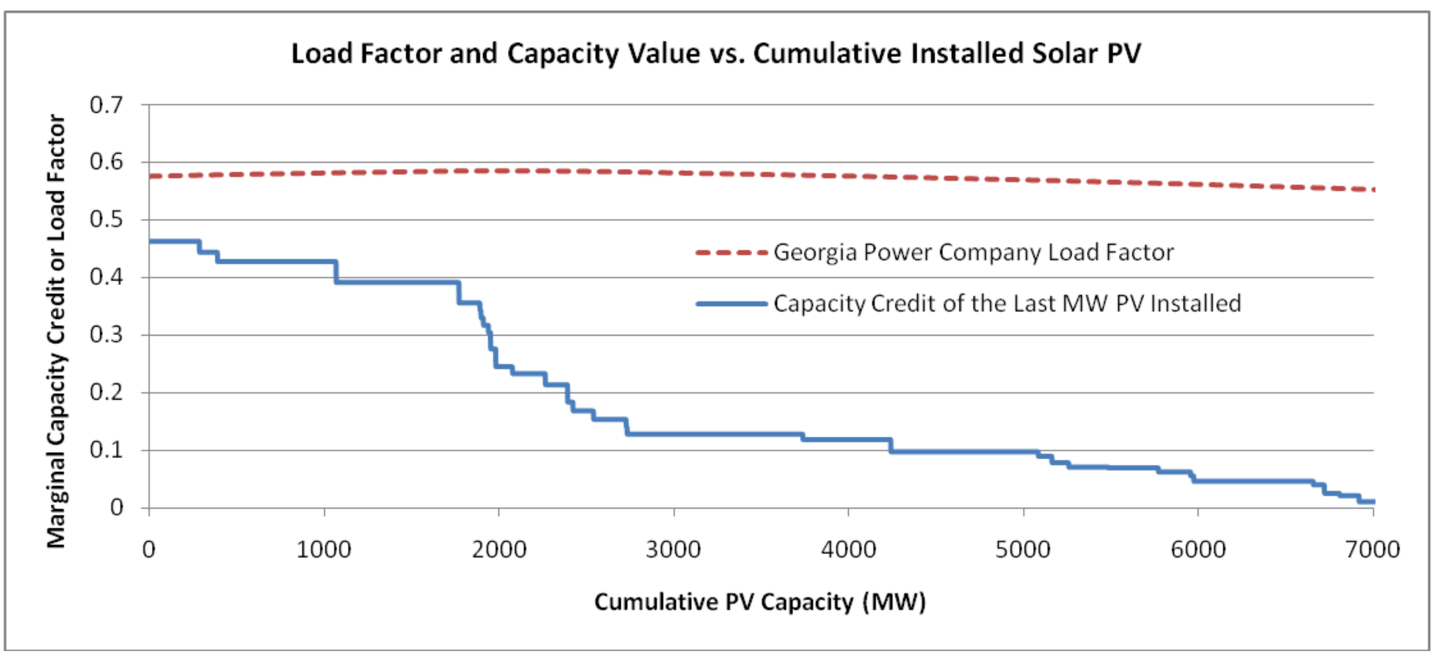

Fig 1: The impact of each additional megawatt of PV installed in Georgia using PV output and electricity demand from 2000-2006. The marginal capacity value for solar PV declines as the total amount of PV on the system rises and the hours of maximum load are shifted into the evening.