

ESIG August Webinar - Solar to Grid - Market Value and Bulk Power Impacts of US Solar Through 2019	
Question	Answer
what are the retail/tou prices when solar generation is high?	We didn't use retail electricity prices for our solar value estimate but only used wholesale energy and capacity prices, including for residential and non-residential DPV. Retail electricity prices would be much higher as they capture additional transmission and distribution infrastructure charges along with a variety of program charges. The additional revenue streams that we briefly touched upon for PV+S projects in ISO-NE include transmission and capacity demand charge offsets or Feed-in tariff payments in the MA Smart program.
Much of the solar in the ISOs is BTM that cannot be curtailed. Did you attempt to quantify the negative mkt impact due to the requirement for additional storage	No, we did not model BTM-sited storage and it's impact on electricity markets. If the dispatch of those storage systems is aligned with frequently updated TOU-periods I would assume that they would increase the apparent value of distributed solar by moving solar energy from mid-day to the shoulder hours.
what are the utilities paying for solar IN CA?	PPAs for solar in CAISO (by load-serving utilities or other large energy consumers) averaged \$16/MWh for projects that came online 2019 and \$19/MWh for projects that have come online in 2021 so far. Level 10 estimates \$24/MWh for corporate solar PPAs which are usually shorter in duration (10/15 years instead of 20+). Legacy contracts signed in prior years will have a higher cost.
Have you looked at what would happen to the price curve if every EV in CAISO bought charging energy during the high solar production hours?	We have only used empirical nodal wholesale electricity prices and do not estimate alternative price curves for different demand or supply-side flexibility options
re slide 9, CAISO, what do the confidence ranges represent? Across utility scale sites? So covering locational market differences?	The error bars represent the generation-weighted average of the 10th and 90th percentile of estimated value points of both DPV and UPV sector, encompassing differences in generation profiles and nodal LMPs
Hawaii has large solar penetration, why aren't you studying Hawaii?	Good point. We exclude it because our focus is primarily on the market value and bulk system impacts, which requires wholesale markets that are not prevalent in Hawaii.

<p>Could you please walk through the formulas for energy value and capacity value introduced in the first few slides</p>	<p>Energy value: It is the simple product of modeled solar hourly generation (after subtracting curtailment) and coincident electricity prices at the nearest node, summed over a year (annual revenue in \$), divided by the annual solar generation (before subtracting curtailment). If a project has a lot of curtailment it earns less revenue and the effective value per pre-curtailment MWh goes down. Capacity value: time period T varies by capacity zone - it can be month season or year. We use the capacity credit (slide 6) and multiply it with the project's nameplate capacity to get the "firm capacity" that is then compensated at prevailing capacity prices. This capacity revenue is again divided by all pre-curtailment solar generation in that time period.</p>
<p>Could you comment on the grid services provided by BPS-connected solar resource?</p>	<p>The primary grid services provided by BPS-connected solar are energy and capacity. A few are compensated for providing reactive power, and at least one plant in CAISO is certified to provide Spinning Reserves. Grid-services of PV+Storage hybrids varied by plants, but in addition to energy and capacity, we found many examples of PV+Storage providing regulating reserves. Some of the BPS-connected PV+Storage in our sample were sited within a utility territory and were being used to reduce the utilities billing determinants for energy, capacity, and transmission from the ISO/RTO.</p>