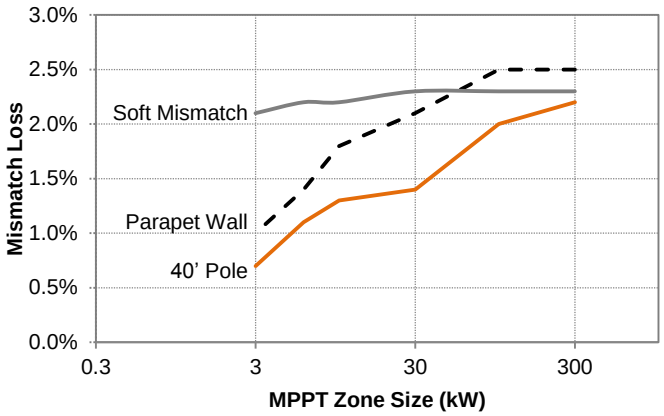
Summary

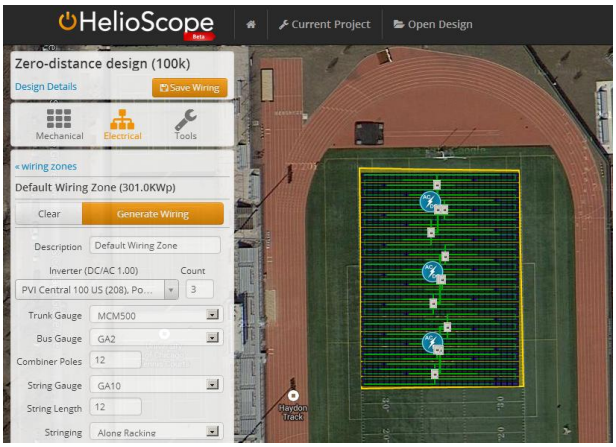
While three-phase string inverters have many benefits in design simplicity and installation speed, they also provide meaningful improvement in mitigating shade-based mismatch. Compared to a large central inverter, the smaller MPPT zones of string inverters localize and minimize the losses from parallel mismatch. These string inverters can often regain 30 to 60% of the mismatch losses from nearby obstructions.

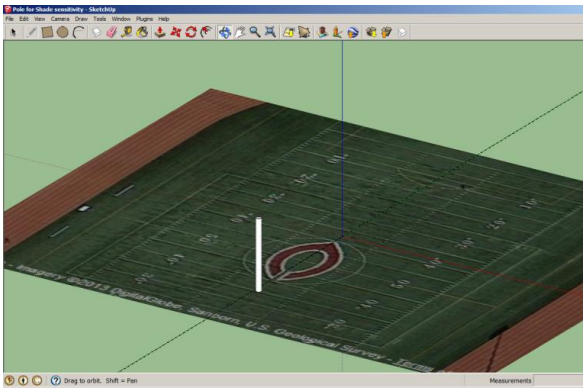


Analysis

In order to assess the full impact of the smaller MPPT zones, a number of mismatch scenarios were modeled in HelioScope, a solar PV modeling tool. HelioScope simulates the IV curves of each module, incorporating all stringing effects in each MPPT zone.

Two obstructions (a 40' pole and parapet wall) were modeled to create near-shade effects on a 300kWdc system. "Soft" mismatch was also modeled to simulate variable soiling across modules. For each type of mismatch, a range of inverter MPPT zones were simulated: 300kW, 100kW, 30kW, 10kW, 6kW, and 3kW.





Results

With shade obstructions, the size of the MPPT zone appears to have a material impact on mismatch losses. While a central inverter can limit mismatch losses to 2.2-2.5%, string inverters are able to further mitigate these losses. The new inverters reduce the impact of mismatch to just 1.1-1.4%, roughly half that of a central inverter.

On the other hand, soft mismatch from soiling is largely unchanged with different MPPT sizes. This is to be expected, since soiling leads to series mismatch, which cannot be addressed by string-level MPPT.

Implications

System engineers look for every way to optimize their array designs. In commercial installations with obstructions, the smaller MPPT zones of string inverters can reduce mismatch losses, improving a system's energy yield by 1% or more.