A Designer's Perspective on Complex 3D Shading Scenes in Solar PV Performance

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INTRODUCTION

Shading scenes in PV performance models are often considered straightforward and easily assembled However, they are often over simplified and overlook important aspects of the site and its design. This can lead to underprediction of shading related losses and resulting overprediction of generation. Often overlooked in early design are aspects like trees, transmission lines, existing and planned structures, and terrain, all of which are highly site and layout specific, and which can have major influence on annual energy yield.

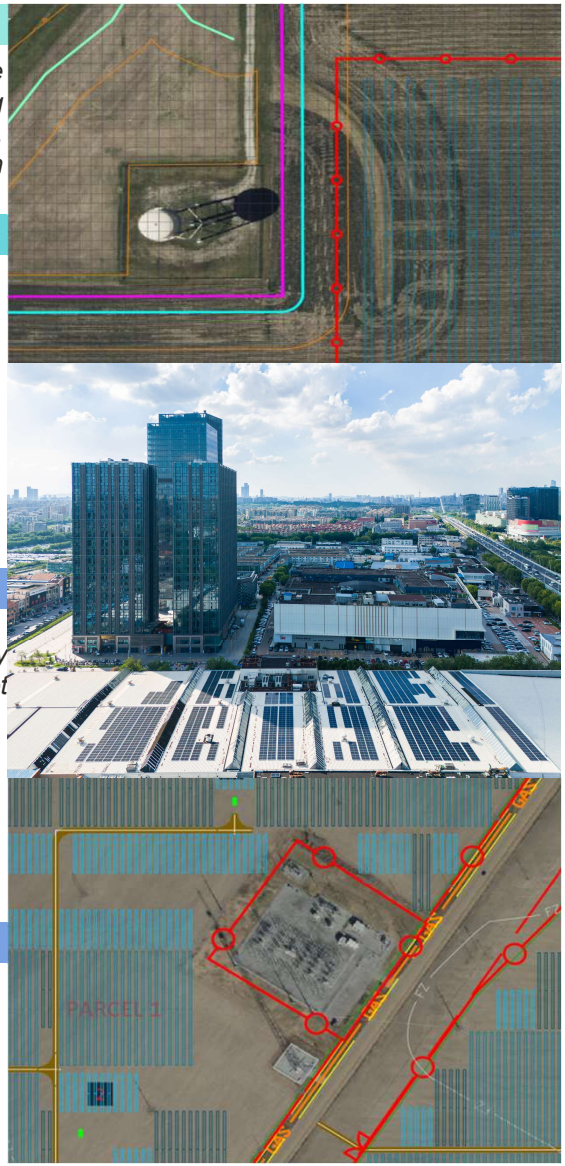
PROCESS

- *Begin by identifying what is known versus assumed, regardless of request origin (proposal, owner's engineer, or EPC).*
- *Obtain the CAD layout to confirm system configuration and site location; recreate PVcase objects as needed before modeling shading.*
- *Build the model from the ground up using the best available grading data (finished grade, survey, or PVcase spot grading). Flat terrain should never be assumed.*
- *Verify rack height, especially for bifacial systems, as unrealistic elevations impact albedo. Typical assumption: 5–5.5 ft above grade.*
- *Model vegetation based on regional conditions, using realistic tree types and heights informed by local research.*
- *Assess adjacent features—such as transmission lines, silos, towers, or billboards—that may cast sweeping shadows across the array.*

CONCLUSIONS

Regardless of system configuration—fixed tilt or tracker, conventional modules or thin film—accurate shade scene development requires a comprehensive evaluation of all objects on and near the array. While a 3:1 rule of thumb is commonly applied for shading objects, reliance on simplified assumptions can overlook meaningful loss drivers. Shading impacts are not limited to on-site features or objects located to the south; and structure or vegetation capable of casting sweeping shadows across the array must be considered.

Special attention should be given to objects east and west of the site, where low sun angles during morning and evening hours can disproportionately influence production. Every object casts a shadow, and omission of these interactions introduces uncertainty and potential over-prediction of energy yield. Terrain effects must also be explicitly modeled, as even modest elevation changes can materially alter shading behavior and system performance.



ACKNOWLEDGMENTS

Black & Veatch: Steven Block for encouraging the topic submission. Todd Harris for allowing myself and the team to attend this conference. And all the solar techs at B&V, when one of us make it! we all make it!

Images: Top is a B&V services layout of a 130MW solar farm in Indiana; Water tower is servicing the town North of the tower and site. Middle is from a stock picture from Getty's, but it is a great example of not taking into account of the surroundings adjacent to the array. Bottom is a B&V proposals layout of a 150MW solar farm in Illinois, existing cell tower and transmission line shown as shading objects that will shade the PV site.