Calculating Model Shading Inputs from Design Data

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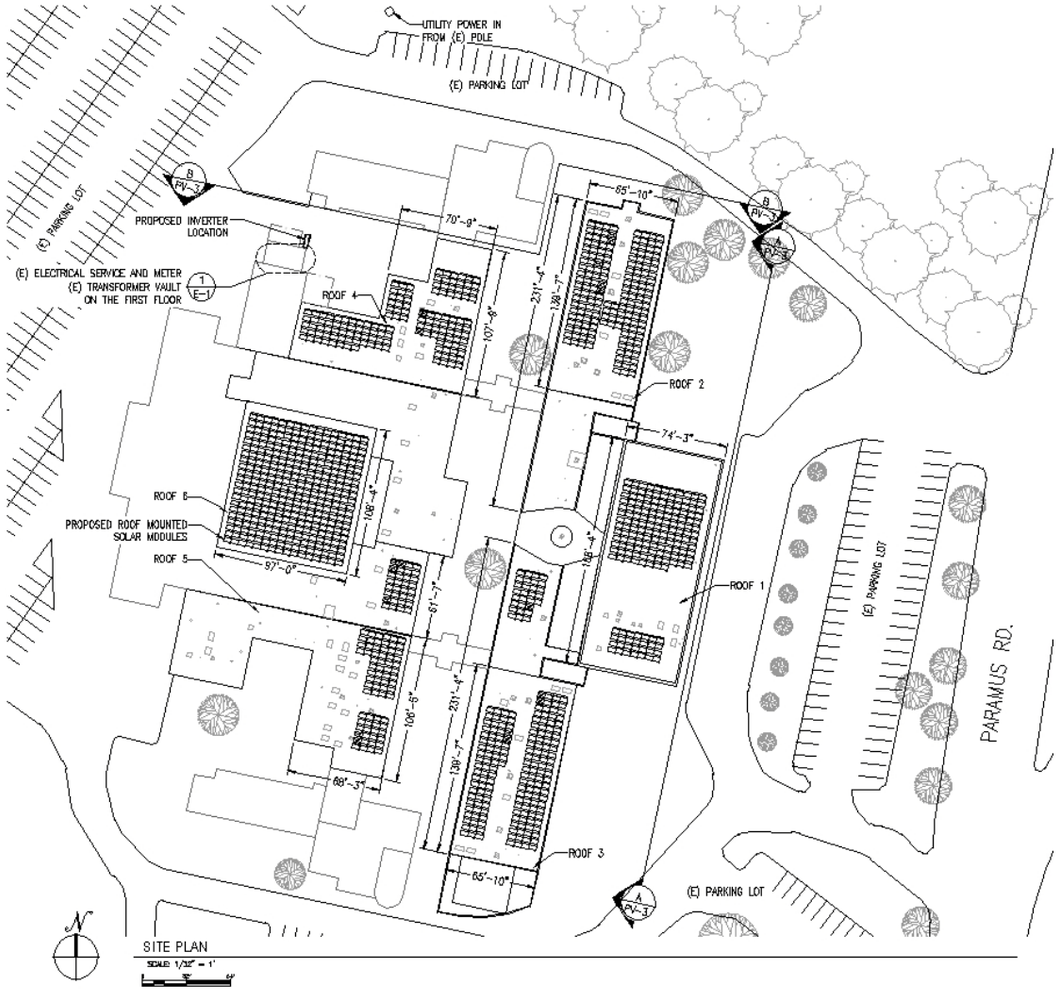
Topics

- The need to integrate shade calculations into Design Tools
- Borrego AutoSHADE Tool
- Helios 3D
- Next Steps

Commercial & Utility Project Development

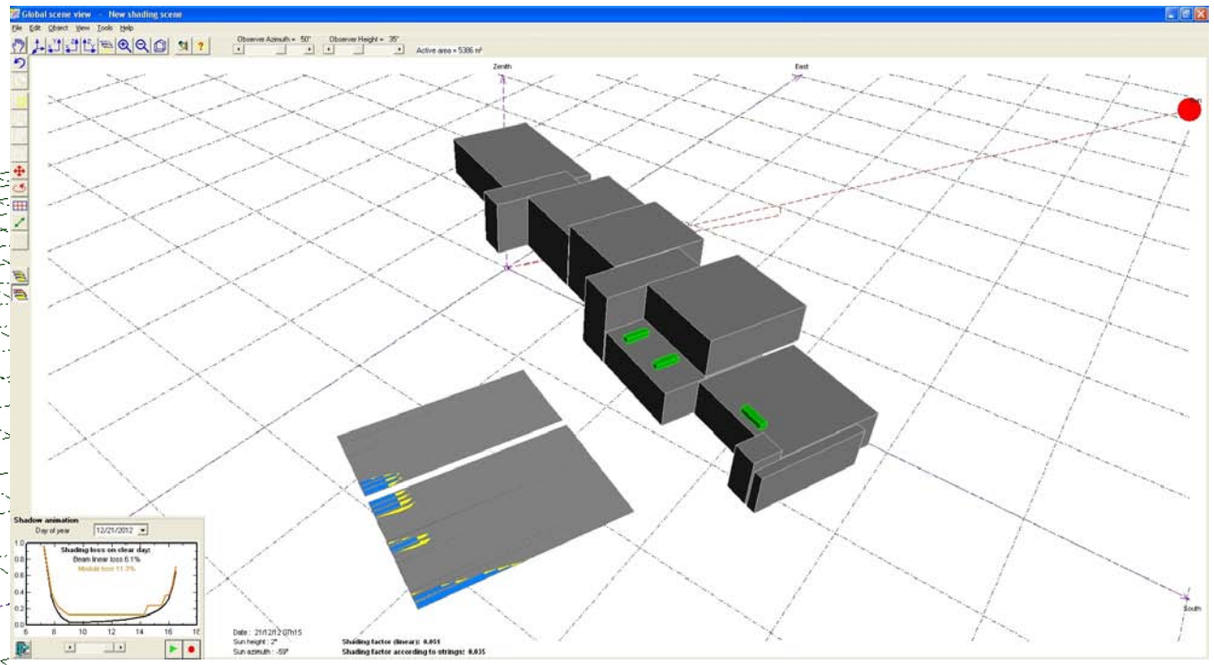
Borrego Solar created over 650 proposal designs in 2012!

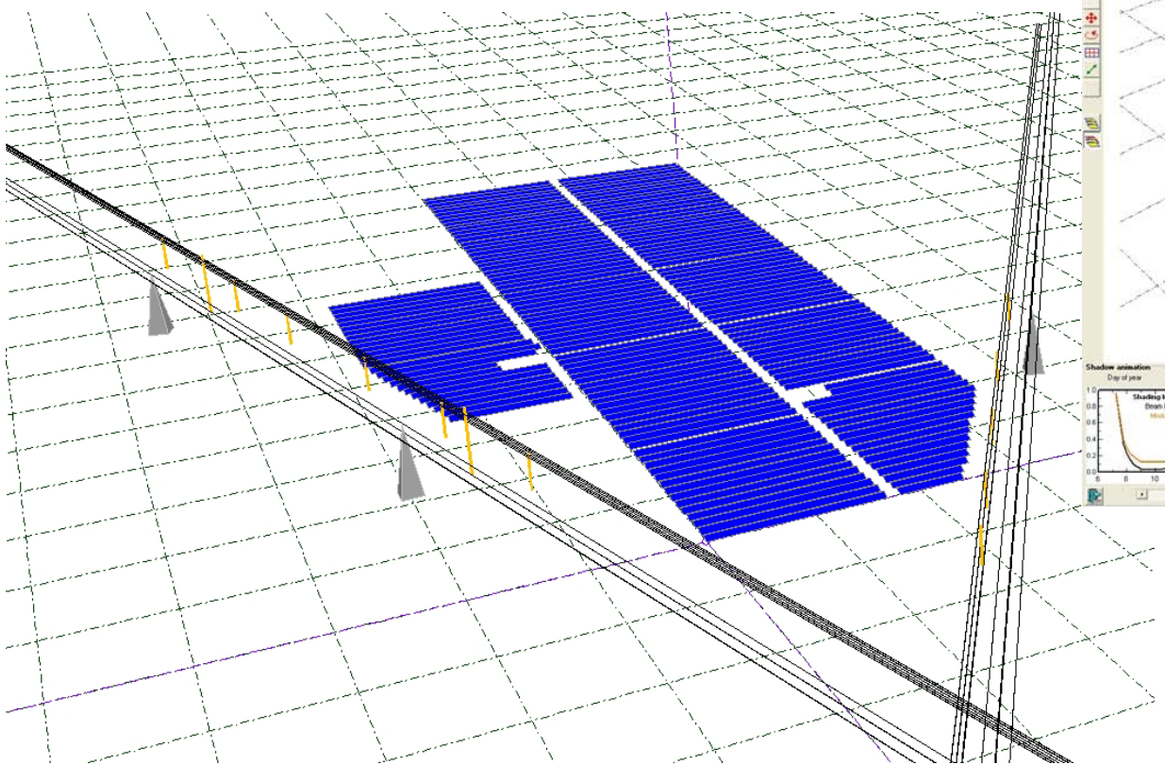
- There is typically a short time period to complete proposal design / value engineering
- Important design decisions are locked in during the sales process



Shade Models

- PVsyst “Near Shadings” tool is incredibly valuable, but also time consuming and cumbersome to use
- Models can take half a day or more to build

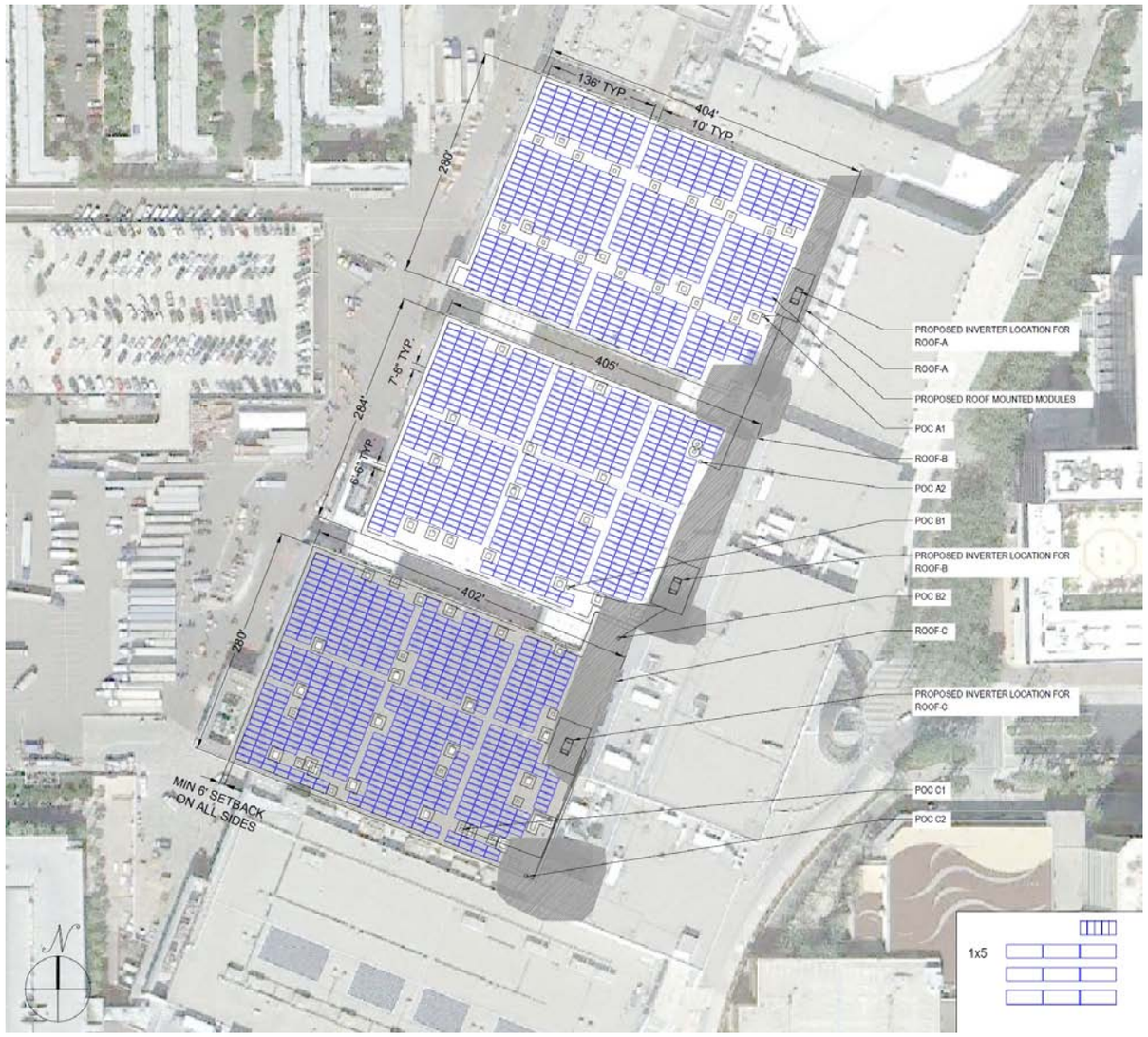




AutoSHADE Tool

Exiting 2D Models

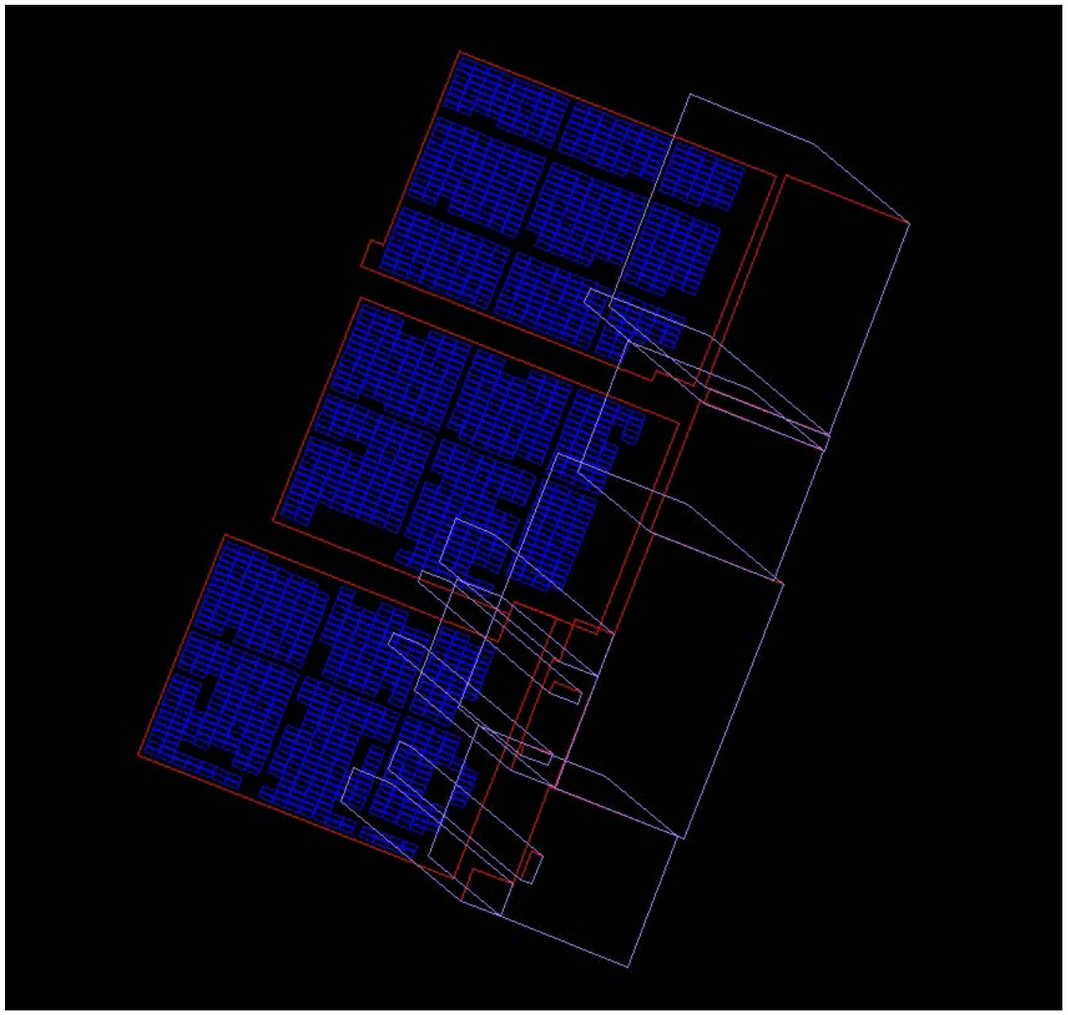
- A proposal design is created in AutoCAD for every project
- This design can be used as a shade model
- Location of shade obstructions is facilitated by background image
- Eliminates duplicate effort of recreating a shade model in PVsyst



AutoSHADE Tool

VBA Program for AutoCAD

- Basic Inputs
  - Site Latitude
  - Module tilt and azimuth
  - Obstruction Heights
- Direct Shading
  - Draws shade outlines on an hourly and monthly basis
  - Checks if a module/string is intersected by or inside one or more shade outlines
  - Calculates a direct irradiance derate factor based on the percentage of modules/strings that are shaded
- Diffuse Shading
  - Calculates obstruction width and height angles from each module/string location



AutoSHADE Tool

Excel Interface

12 X 24 Shade Table

Paste in Hourly Derate Factors from AutoShade Tool

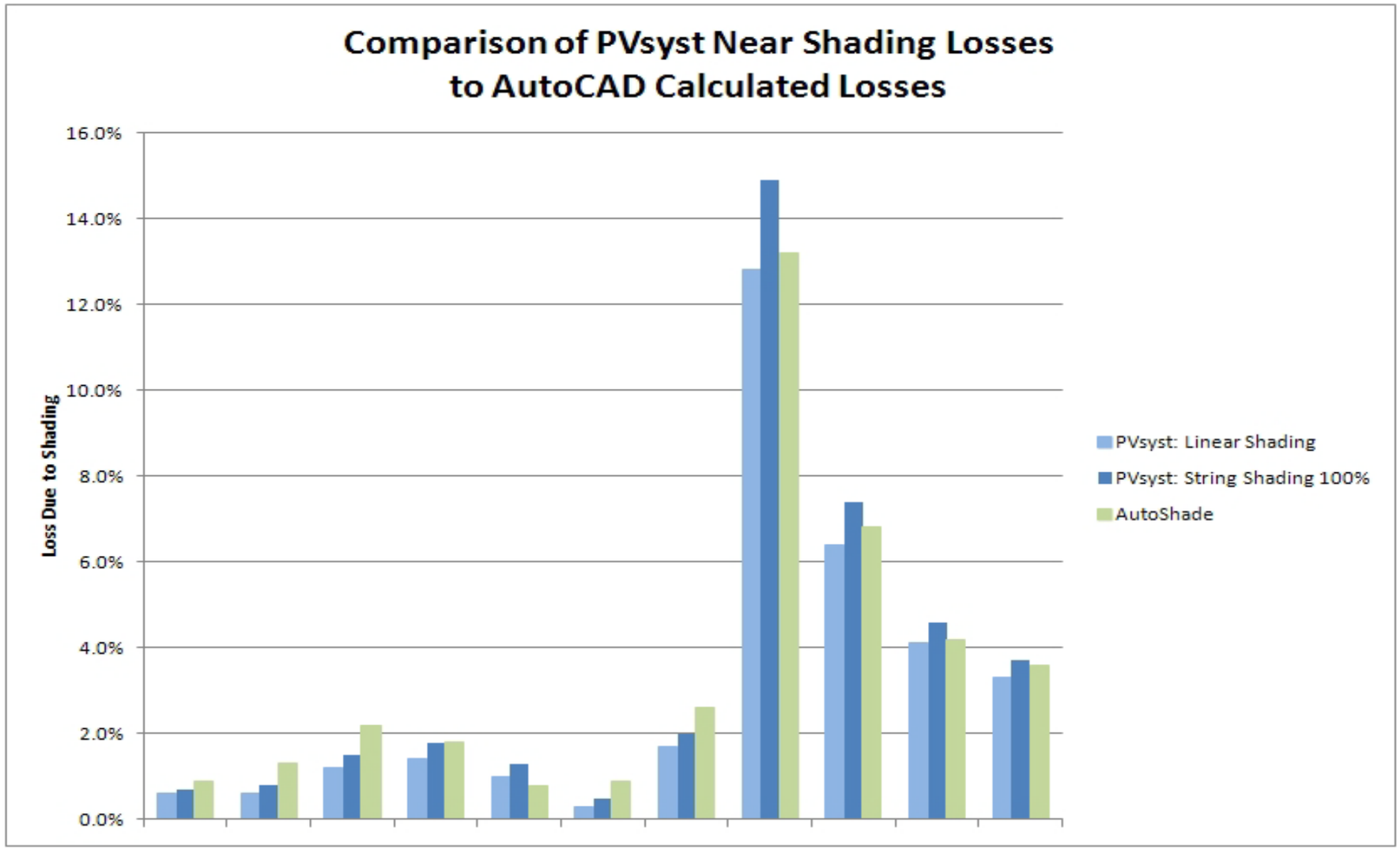
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan	1.00	1.00	1.00	1.00	1	1	1	0.48	0.55	1	1	1	1	1	1	0.7	0.48	1	1	1	1.00	1.00	1.00	1.00
Feb	1.00	1.00	1.00	1.00	1	1	1	0.5	0.9	1	1	1	1	1	1	0.9	0.5	1	1	1	1.00	1.00	1.00	1.00
Mar	1.00	1.00	1.00	1.00	1	1	0.5	0.8	1	1	1	1	1	1	1	1	0.8	0.5	1	1	1.00	1.00	1.00	1.00
Apr	1.00	1.00	1.00	1.00	1	0.73	0.5	1	1	1	1	1	1	1	1	1	1	0.5	0.73	1	1.00	1.00	1.00	1.00
May	1.00	1.00	1.00	1.00	1	0.9	0.83	1	1	1	1	1	1	1	1	1	1	0.83	0.9	1	1.00	1.00	1.00	1.00
Jun	1.00	1.00	1.00	1.00	1	0.98	0.93	1	1	1	1	1	1	1	1	1	1	0.93	0.98	1	1.00	1.00	1.00	1.00
Jul	1.00	1.00	1.00	1.00	1	0.93	0.93	1	1	1	1	1	1	1	1	1	1	0.93	0.93	1	1.00	1.00	1.00	1.00
Aug	1.00	1.00	1.00	1.00	1	0.78	0.6	1	1	1	1	1	1	1	1	1	1	0.6	0.78	1	1.00	1.00	1.00	1.00
Sep	1.00	1.00	1.00	1.00	1	1	0.5	0.9	1	1	1	1	1	1	1	1	0.9	0.5	1	1	1.00	1.00	1.00	1.00
Oct	1.00	1.00	1.00	1.00	1	1	1	0.5	1	1	1	1	1	1	1	1	0.5	1	1	1	1.00	1.00	1.00	1.00
Nov	1.00	1.00	1.00	1.00	1	1	1	0.5	0.73	1	1	1	1	1	1	0.8	0.5	1	1	1	1.00	1.00	1.00	1.00
Dec	1.00	1.00	1.00	1.00	1	1	1	0.43	0.4	0.88	1	1	1	1	0.95	0.5	0.43	1	1	1	1.00	1.00	1.00	1.00

Enter Shading Factor for Difuse:	0.96

Results	
Pre-Shade kWh	10637
Post-Shade kWh	10367
Near Shading Losss	2.5%

- Excel tool combines: hourly direct derate factors, an annual diffuse derate factor, and an 8760 report with kWh and Incident Beam to Global Ratio
- Takes minutes rather than hours

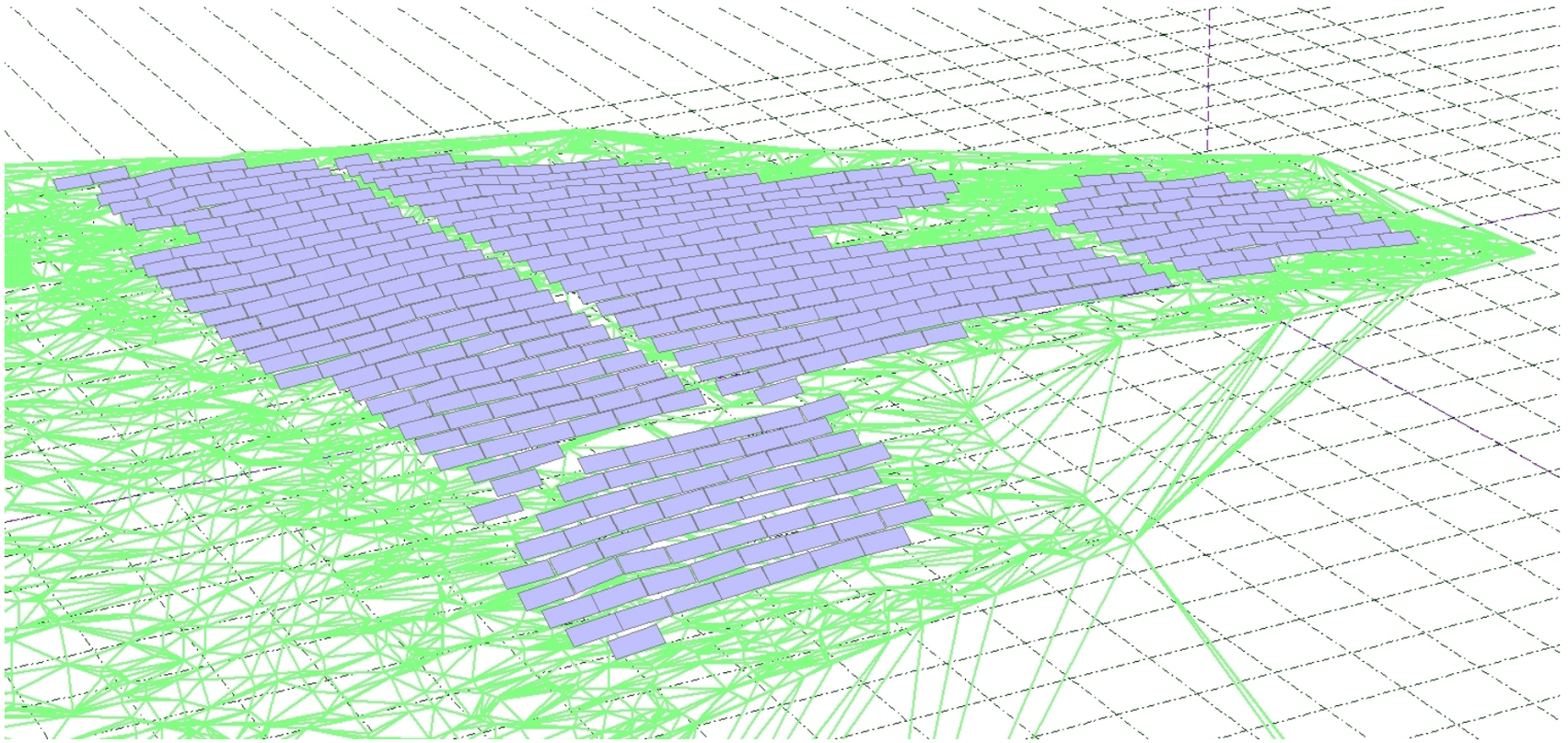
AutoSHADE Tool



- Shows reasonable agreement with PVsyst Near Shading calculations

Helios 3D

- Powerful tool for site layout on uneven terrain
- Shade models that account for slopes
  - Variable row spacing based on time specific shade windows
- Can not currently import shade objects (buildings, trees, power lines, etc.) into PVsyst



Next Steps

- Shade calculations should be AutoCAD based
  - Or production modeling tools need the ability to import AutoCAD models
- Develop a “universal” AutoCAD layout tool
  - Model building blocks need to be controlled to produce reliable shade models
- Modify production modeling tools to accept external shade factors
  - SAM has this functionality
  - Should there be a standard?

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