Comparing HelioScope and PVWatts

Introduction

HelioScope and PVWatts are both tools used to estimate energy production of solar arrays. The two programs are similar in many ways, including most of the major elements of sun angle and system behavior calculations. Both models can be lined up to within a few percent of each other, assuming the user has selected the same weather files, system design parameters, and loss factors. However, there are some assumptions that are unique to each model, so they will likely not line up perfectly by default.

Differences between HelioScope and PV Watts

HelioScope:

- Based on bottoms-up simulation of system performance (including module-level calculations of sunlight and module physics)
- Based on specific modules and inverters (unique efficiency and thermal behavior)
- Calculations include adjustments for low-light performance ("Output at Irradiance"), row-to-row spacing, and obstruction shading (plus any associated mismatch), which are not included in PVWatts

PV Watts:

- Top-down estimate of system production based on multiplying system nameplate
- Does not include specific module or inverter components
- Most loss factors are based on "derates" defined by the user
- Calculations include additional loss parameters for light induced degradation (default 1.5% loss) and system availability (default 3% loss)

How to Align HelioScope & PV Watts

1. **Make sure the weather files are the same**. The default Condition Set in HelioScope uses the closest weather station, which is often Solar Prospector, as opposed to TMY2/TMY3 (which is what PVWatts uses). If so, create a new Condition Set with the same weather file.
2. **Check components**, particularly:
    a. Module temperature coefficient: PV Watts assumes 0.47%/ºC losses for all standard modules, whereas HelioScope uses the specific temperature coefficients of each module
    b. Inverter efficiency: PV watts assumes a standard 96% efficient inverter, HelioScope calculates inverter efficiency based on the specific efficiency of the device (typically based on specific power & voltage levels)
3. **System Design**: Make sure the design assumptions (including racking type, module tilt & azimuth, DC/AC ratio) are the same
4. **Adjust HelioScope losses** to account for additional loss parameter defaults in PV Watts: light induced degradation (1.5%) can be added to soiling losses, and availability (default 3% in PVWatts) can be added to AC losses

Mapping the Loss Table to PV Watts

When looking at the HelioScope loss table in comparison to the PV Watts assumptions, keep the following in mind:

- Irradiance calculations, reflection losses, and temperature losses are calculated, but not shown, in PV Watts
- About half of the lines on the HelioScope loss table line are mapped to the PV Watts Loss Breakdown. See Figure 1 below for more detail.

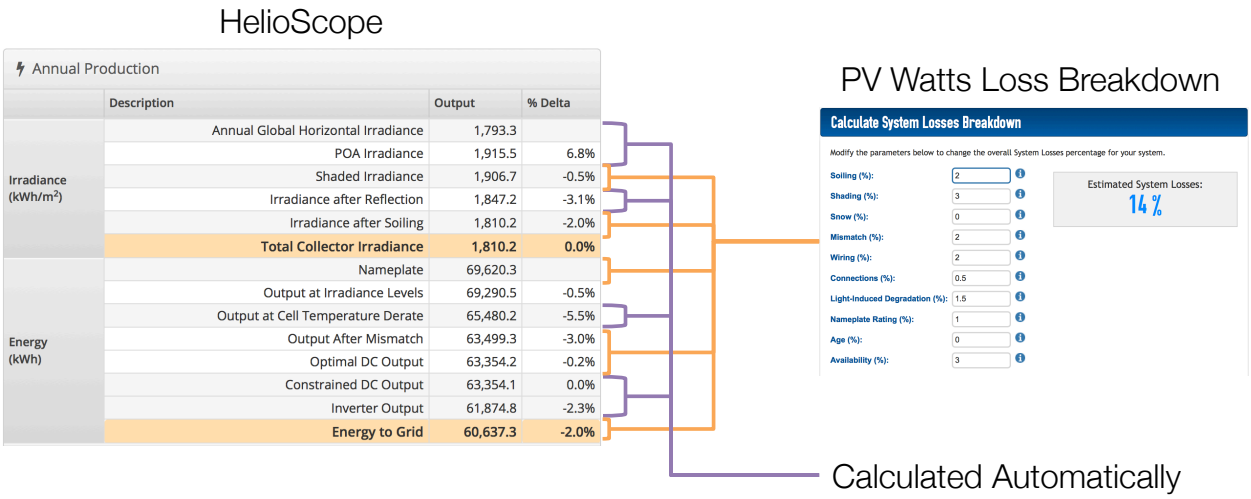

Figure 1: Mapping from HelioScope Loss Table to PV Watts Loss Breakdown

Calculation Summary Table

Calculation	PV Watts	HelioScope
Sunlight (global horizontal, plane-of-array)	Similar	
Shading	Assumption (default 3%)	Calculated, based on geometry of obstructions and module spacing
Reflection	Similar	
Soiling	Same (2% default in both)	
Module nameplate	Similar (0% default in HelioScope, 1% loss default in PV Watts)	
Output at irradiance	Not included	Calculated
Temperature losses	Calculated, assumed 0.47%/ºC for all standard modules	Calculated, different %/ºC for each module based on spec sheet
Light induced degradation	Assumption (default 1.5%)	Not included
Connectors	Assumption (default 0.5%)	Not included
Mismatch	Assumption (default 2%)	Calculated based on shading effects and mismatch assumptions
DC wiring losses	Assumption (default 2%)	Calculated based on wire size and lengths
Clipping losses	Power clipping calculated Voltage clipping not included	Both power and voltage calculated based on specific array design
Inverter efficiency	Assumption (default 4%)	Calculated based on actual power & voltage, and CEC efficiency
AC losses	Assumption (grouped with DC losses)	Calculated based on conductors and transformers in design
System availability	Assumption (default 3%)	Not included