

## Loss Factors in HelioScope

This table provides typical values for the loss factors in HelioScope energy simulations, and the high-level drivers of the various losses.

Parameter	“Normal” Range	Notes
POA Irradiance	+1% to +20%	Depends on tilt of array; one of the rare numbers that will be positive, i.e. an increase. If negative, means the modules are pointed away from the equator.
Shaded Irradiance	0 to -10%	Depends on shading in Design. Will come from three sources: row-to-row, obstructions (either Keepouts or SketchUp) and horizon files.
Reflection	-1% to -5%	Based on reflection of light from shallow angles. Will be larger for lower-tilt arrays, and locations farther from the equator.
Soiling	-1% to -5%	Defined in the Condition Set. Can be negative (i.e. to add in gains). Also used to account for snow losses. Default is 2% loss.
Output at Irradiance	-1% to -5%	Accounts for non-linear behavior of module I/V curve under low light (i.e. at 500W/m <sup>2</sup> , a module is not producing exactly half of rated power)
Output at Temperature	-3 to -7% for fixed tilt -6 to -15% for flush mount	All arrays will have temperature-related losses. Flush-mounted arrays (i.e. residential) don't get as much ventilation as fixed-tilt array, and therefore run hotter.
Output at Mismatch	0 to -7%	Default mismatch assumptions in Condition Set should lead to ~2% mismatch loss. If shading losses, then there will be additional mismatch caused by the shading, approximately equal to the shading losses. If module-level optimization (i.e. microinverters or optimizers), should be zero by default.
Optimizer Output	0 to -2%	Accounts for efficiency of DC optimizers, if included in Design. Otherwise will be zero.
Optimal DC Output	0 to -2%	Accounts for DC wiring losses between modules and inverter
Constrained DC Output	0 to -3%	Accounts for clipping losses. Typically over-power clipping can be 1-2% in a healthy design, and up to 4-5% in an aggressive design. Under-voltage can also cause more significant losses (10-30%), but should be able to be addressed by improved design (i.e. string size)
Inverter Output	-2% to -7%	Accounts for efficiency of inverter.
Energy to Grid	-0.5% to -3%	Accounts for AC losses between inverter and grid connection.
Total Performance Ratio	68% to 88%	Composite of all of the factors above (excluding POA irradiance). Biggest drivers of differences are temperature losses and shading – hotter locations will be on the lower end of the range, cooler locations on the higher end.