

UHelioScope

User Manual

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1.0 Glossary and Requirements

Term	Definition
Project	 A Project represents a specific location where an array (or arrays) will be designed and installed. The Project is the highest-level structure in HelioScope; all Designs and Condition Sets are created under a Project.
Design	 A Design describes the physical layout of a solar array. A Design includes the modules used, the quantity and location of the modules, and how the modules are oriented. It also includes the electrical stringing design, the conductors used, the inverters used, and the location of the inverters.
Field Segment	 A Field Segment is an area of the design, used to define module layouts. A user defines a shape, which is populated with modules based on a set of layout rules. A Design can consist of multiple Field Segments.
Wiring Zone	 A Wiring Zone defines the electrical rules for the modules that have been laid out in the Field Segment. A Wiring zone consists of one or more Field Segments, an inverter SKU and quantity, and a set of rules for how to connect the modules electrically (including the string size, conductor size, and combiner box size). A Design can consist of multiple Wiring Zones, but a single Field Segment may not be split across multiple Wiring Zones.
Condition Set	 A Condition Set describes the environment around the solar array. A Condition Set includes a weather file, shading assumptions, soiling assumptions, and temperature assumptions.
Shade Profile	 A Shade Profile describes the shading patterns that result from nearby obstructions around an array over the course of the year. A Shade Profile consists of a series of 2D images that are spatially located around the array. Each shade image will dictate if a module is shaded during that hour. The Shade Profile is generated from SketchUp, using a plugin available from Folsom Labs. Shade Profile are calculated every hour, every month, so they are able to represent a full year worth of shading behavior.
Simulation	 A Simulation is an estimate for how much energy a Design will produce over a full year, based on the environment defined in the Condition Set. Most simulations are based on hourly time intervals (8,760 per year).
Report	 The results of each Simulation can be viewed as a report, which summarizes the production of the corresponding Design under the given Conditions. Reports will also show the calculation of system losses at each step in the process.

Glossary of Terms

System Requirements

HelioScope is a web-based product that can be accessed from any standard modern browser. Recommended browsers include Chrome, Firefox, Safari, and Internet Explorer 10. Internet Explorer 8 (or earlier) is not supported.



2.0 Quick-Start Guide

Five steps to using HelioScope:

- 1) Create Project
- 2a) Create Design (Mechanical)
- 2b) Create Design (Electrical)
- 3) Create Condition Set
- 4) Run Simulation and View Report

Scop	C	1: Create Project	ot	
) ojects	🗷 New Project		×	njin etts
	Project Name	A THE AND AND	Map Satellite	
S com	SF Post Office			
ngle plannec	Address		Marter all and a	they can see
any reports y	1300 Evans St, SF	Select location using street	and the second second	
Project	Description	address of latitude-longitude		
-nojour	Description			
es weather a es always ap screen. Con- ures that it c it home scre it does not d	Drag the map on the right to the precise location of your project Center Map on Address	Coogle	Hint: Can adjust map position to center on specific location	
,	Costco Demo	450 TUTN SC SF	Close Create New Project	tation
			3 4 5 6 7 *	Contact us!



FULSOM LABS











Description	Condition Set 4			
Weather	Weather used t	o calculate the hourly perfo	rmance of th	ne array for a given year
Shading	Name		Distance	Map shows the
California (Satellite TMY	prospector)	1.8	exact location of
Soling	C SAN FRANCIS	CO INTL AP (tmy3)	8.6	each weather file
Cell Temperature	C OAKLAND ME	TROPOLITAN ARPT (tmy3)	9.1	Mill Valley Walnut
Mismatch	C HAYWARD AIR	R TERM (tmy3)	15.3	Berkeley
	C Climate Zone	4 (epw)	23.5	Danville Sa Sa San San San San San San San San Sa
Advanced	C CONCORD C (tmy3)	Choose	25.5	illones Francis Co Alar Oa Sanctuary Daly City Havward
	C MOUNTAIN (tmy3)	weather file from the list of	29.7	Pacifica
	C LIVERMORE	nearby weather	31.0	, San Carlos
	C NAPA CO. All	stations	33.4	Coople
	C LIVERMORE	nearby weather stations	31.0 33.4	Google Map Data 10km Terms of Use Reportan



Home SF Pc	Projects Current Project	4: Run Simulation	nents Documentation
0 Project	Overview 🔂 🛓	Designs Users Conditions Shading Reports	
Project	SF Post Office	For each Condition Set and Design HelioScope can run a simulation to see exactly how that design	gn will perform.
Address	1300 Evans St, SF	Condition Sets	New
Description		Condition Set 1 Condition Set 2 (SF0 TMY3) Prospector, Shade
Owner	John Doe		
Last Modified	7/20/13 8:52 PM	Initiate simulation and generate report	1,549.3
Location	(37.7399079291662, -122.38116602737) (GMT -8)	Design 2 (Sovraciv) event (covraciv) 1,565.4 1,495.3	1,535.9
Project I	Location	Select to view completed annual report	C Initializing
		<i>Hint:</i> Can compare all reports using these summary metrics	© KWh/KWp C Performance Ratio C Energy





3.0 Project

A Project represents a specific location where an array (or arrays) will be designed and installed. The Project is the highest-level structure in HelioScope; all Designs and Condition Sets are created under a Project.

3.1 Project List

The HelioScope home page shows a Project list and link to create a new project.

- A. Project list, in order of last modified
- B. Starred projects are at the top of the list
- C. The number of Designs, Reports, and users for each Project
- D. Archive a Project
- E. Create a New Project

Home	Projects						Components	D ocumenta
Ø R	ecent Projects			Full Projec	t List	Ν	lew Proiect	E
	Project	Designs	Reports	Users			-	
*	McQuaid Jesuit HS 1800 Clinton Ave S, Roc	14	16	2	*		0	\searrow
*	Elk Grove Honda Elk Grove, CA	1	0	1		Training	FAQ	Support
в	Victorville Jail 13777 Air Base Rd, Victorville, CA 92394	24	14	11	÷	G Come and See		
*	SF Post Office 1300 Evans St, SF	23 C	26	15	*	We've got a full sch season. Drop us a	hedule this upcoming line to schedule a me	conference eting.
*	Southwest Warehouse Test array 450 10th St, SF	15	9	3	*	NABCEP Continu Conference Denver CO	iing Education	13-15 March 2014
☆	cape town 14 mimosa st, cape town	0	0	1	*	Greentech Media	a Solar Summit	14-16
☆	Brisbane Brisbane	1	1	1	±	Phoenix, AZ	a solar samme	April 2014
☆	Toronto Toronto, Canada	0	0	1	ź	Sandia PV Perfor Conference	mance Modeling	May
☆	Starbucks Santa Rosa Starbucks Santa Rosa CA	1	1	1	*	Santa Clara, CA		2014
~	Los Gatos Cafe	Δ	G	2		Intersolar Europ Munich, Germany	e y	2-4 Jun



3.2 Create Project

Create a project using a name and address. Center the map on the area where the system will be designed, and select "Create New Project".



A Project consists of several components that are created in the software:

- A. **Designs** and **Condition Sets** are the core aspects of modeling, and the resulting **Simulation Reports** are stored within the Project
- B. Shade Profiles are created based on obstructions around the array
- C. A Project has an owner, who can share the Project and control user access

Components	D ocumentation
\frown	
A	
Reports	
of a field: the modules, inverter, wiring, optimizers, ar	nd layout.
	<i>▶</i> New
Actions	
	teports of a field: the modules, inverter, wiring, optimizers, an Actions



3.3 Project Sharing

HelioScope enables sharing at the Project level. Users have full access to the Project, including read/write access to Designs and Reports.

Sharing is controlled under the "Users" tab:

A. Button to generate a share link

- B. Users list
- C. Delete users
- D. The share link appears in a separate window. Copy and send the link to collaborators (they must have a HelioScope account to view the Project).

UHelioScope Johnson & Johnson - New Brunswick 1 Johnson And Johnson Plaza New Brunswick, NJ 08933 🟫 🛓 🕼 Edit Designs Conditions Shading Sharing Reports Project Overview Project Johnson & Johnson - New Brunswick Each user on the project has full access to all the properties. Only administrators can manage users, or update А metadata. 1 Johnson And Johnson Plaza New Brunswick, NJ 08933 Address 🖀 Current Users Description User Role Actions Paul Grana Owner Paul Gibbs B <mark>⊘</mark>(C) User Last Modified 7/21/14 11:30 AM Paul Grana Admin (40.4982699, -74.4427771) (GMT -5) Location • Project Location 🖻 Share Your Project × D To share your project simply copy and paste this link and send it to any other user of HelioScope: http://helioscope.folsomlabs.com/projects/share/c@f8d22b107d8b122224bc555c4bcd8b Warning! Anyone with this URL (and a HelioScope account) will be able to see all resources associated with this project. Only the project administrator can add or remove users. This URL will expire once it has been used. Close



3.4 **Project Management**

The Project page shows all available projects:

- A. Projects sorted by name
- B. Click the orange star to make a Project a "favorite"

C. Click to archive projects (will not show up on the Home page)

- D. Search projects based on name, address, or description
- E. Toggle check-box to show archived Projects

Home Projects				Components	
Projects complete lis	stin	g			
Projects represent a single planned installation (l working on as well as any reports you generate.	ocatio	n). They effectively form the hub	for all the work, you can share a project with other people o	n your team so they can see t	he designs you'ı
New Project		Project Listing		D Search	
Ticking the star toggles weather a project is a	*	Project	Address	Description	Archive
avorite or not. Favorites always appear first	☆	JCC Revised	3921 Fabian Way		📩 Archive
on the Projects home screen. Conversely,	☆	JESSOLAR	via LA BASSA NUOVA - IESOLO (VE)	2MWp JESSOLAR	📩 Archive
show up on the Project home screen. Note	☆	Kakegawa	Obuchi, Kakegawa-shi, Shizuoka Prefecture, Japan	Kobe Bussan Project	📥 Archive
hat archiving a project does not delete it, or	☆	Kevin demo	Fukuoka, KAMA		📩 Arch
any of your data.	☆	Landfill	42°35'2.47"N, 71°14'51.32"W		📥 Arch
	☆	LCX	London	Example	📩 Archive
	☆	Linear Shading Test	1269 South Van Ness, 94110		📥 Archive
	☆	Masa A	fukuoka, japan	Sales project	📩 Archive
	☆	Maxim Integrated Products	160 Rio Robles, san jose, ca	Carport System	🕹 Archive
-	1	McOunid Insuit US	1800 Clinton Ave 5 Perhester NV		A Arabica





4.0 Design

A Design describes the physical layout of a solar array, including the module layout and orientation. It also includes the wiring and conductor design and inverter topology.

A Project can have multiple Designs. Often, these multiple designs are used to compare design alternatives, or to model sub-sections of an array.

Designs	Users	Conditions	Shading	Reports		
ach design	encompas	ses all the elect	rical compon	ents of a field: the	modules, inverter, wiring,	, optimizers, and layou
🕸 Desi	gns					
Design					Nameplate	Actions
Design 10a	(60-cell)				995.5 kW	۵
Design 10a	(60-cell, hi	gher GCR)			1.20 MW	۵
Design 10a	(60-cell, pu	ılled in)			1.14 MW	~ 🖻
Design 10a	(72-cell)				1.04 MW	~ 🗎
Design 10a	(thin-film)				918.0 kW	۵
Design 10b	(#12 AWG)			870.8 kW	۵

Each design includes a bill of materials including the module quantity, wire quantity, combiner boxes, and inverters

• Design Design	1									e ×
🖋 System De	esigner	🖨 Components								
		Component	Na	me				Count		
Design	C Edit	Inverter	AE	250NX (Advanced Energy)				4 (1,000.0	kW)	
	Attack of the best	Combiners	No	ne				28		
oject Name	victorville Jali	Busses	0 A)	WG (Aluminum)				24 (1,583.9))	
oject Description		Strings	10/	AWG (Copper)				275 (17,58	1.6m)	
roject Address	Victorville, CA	Module	TSN	M-300 P14A (Trina Solar)				3,575		
esign	Design 1	III Field Segme	nts							
ameplate Power	1.07 MW	Description	Racking	Orientation	Tilt	Azimuth	Spacing	Bank Depth	Modules	Power
C Nameplate Power (Load	1,000.0 kW	Field Segment 1	Fixed Tilt	Horizontal (Landscape)	15°	180°	3m	3	3,155	946.5 kW
atio)	(107.3%)	Field Segment 2	Fixed Tilt	Horizontal (Landscape)	10°	190°	1m	1	420	126.0 kW
Field Segments		🏦 Wiring Zone	s							
the last	and the second	Description		Combiner Poles		String	Size	Stringing String	Strategy	
STATISTICS STATISTICS		Default Wiring Zone		12		13		Along Rack	king	

A Design requires both a Mechanical layout and an Electrical layout, selected at the top of the Design tool.

Important: Each Design must be saved (with the "Save Design" button) once it is finished.



4.1 Mechanical Layout

A Mechanical Layout is based on Field Segments that define the areas to be filled with modules, and Keepout Zones which define the areas to be excluded.

Generating a Field Segment:

- 1) Click points to create a Field Segment shape
- 2) Define module layout & racking assumptions
- Click "Update Field Segment" to populate the Field Segment
- 4) If desired, set the maximum system size
- 5) Every line segment has a grey circle that can create a new point when dragged

	• Funent Project • Open Design
Design 1	
Design Details	
Mechanical Electrical Overlays	
« back to list	
Field Segment Details	
Potential Modules: 3,786 (1,154.7kW) (Set Max	2 minimum
Size)	
→ つUndo Update Field Segmen 3	and the second se
Description Field Segment 1	
Suniva, MVX305-72-5-801 (305	the second se
Azimuth 180 ° 2	
Tilt 15 °	
Orientation Horizontal (Landscape) 🗘	ter and a state of the second se
Racking Fixed Tilt Racking \$	
Frame Size 3 up 1 wide	angenin fungitus in an Angenerig ut aristi pungitus
Row Spacing 9 ft Span / rise: 3,5	
Module Spacing 0.0328 ft GCR: 0.53	A the second sec
Setback 10 ft Time of Day	
1 1 21 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Powertho Rd
1 · · · · · · · · · · · · · · · · · · ·	PersetingRo
	PowetineRd

Span / rise: 3.5

GCR: 0.53

Time of Day

Row Spacing Metrics:

There are four ways to define the spacing between modules:

- A) **Row Spacing** is the back-tofront spacing between rows
- B) **Span / Rise** defines the ratio of the distance between rows over the height at the back of the module bank

C) Ground Coverage Ratio (GCR) is the ratio of module area divided by the surface area covered by the modules

D) **Time of Day** specifies a day and time range without shade, based on sun angles at the Project location

A Row Spacing

Module Spacing 0.0328

Setback 10

9

ft

ft

ft

All of the metrics are linked: any can be specified, and the others will be adjusted automatically.

2014-	12-21		Ű	1
Start Tin	ne			
^	^			
10	00	AM		
~	~			
End Tim	e			
^	^			
02	00	PM		
~	~			
Row Sp	acing: 4.8	3 ft		
Span / F	Rise: 1.87			
GCR: 0.6	59			
່ວ Un	do	8 Save	D	
				2



Generating a Keepout Zone:

- 1) Toggle "Show Modules" to hide modules
- 2) Draw Keepout shapes on map
- Switch to Edit mode to modify or copy the Keepout objects
- (optional) Define setback distance for buffer around the perimeter of Keepout object
- 5) (optional) Define height of the object for shade calculations
- 6) Define time range for generating shade patterns
- 7) Save to re-draw modules



Field Segment Editing

Right-click on a Field Segment for a menu of advanced controls:

- Select Move to drag the entire Field Segment
- Select Align Modules to Click, and the modules align to the point that was just clicked (with the top left corner of a frame at the exact point)
- Hide Modules to see the imagery underneath the modules



Mechanical Layout Assumptions



Glossary: Mechanical Layout

Term	Description
Azimuth Angle	The orientation angle of the modules, following a compass: 90 degrees is East, 180 degrees
	is South
Tilt Angle	The angle of inclination of the modules. Zero is flat.
Orientation	The direction that the modules are mounted in the racking, either vertical (portrait) or
	horizontal (landscape).
Racking Type	Indicates whether modules are mounted in fixed-tilt racking on a flat plane, or are mounted
	flush to a roof in the same plane.
	This effects the row-to-row shading (zero for flush-mount), and the thermal coefficients
	(thermal losses will be higher in flush-mount).
Frame Size	The number of modules in each frame, including the vertical ("up") and horizontal ("wide")
	size
Row Spacing	The distance (in meters) from the back of one bank of modules to the front of the next bank.
Module Spacing	The distance between adjacent modules in the same frame.
Setback	The area around the perimeter of the Field Segment that is off-limits to modules



4.2 Electrical Design

Select the "Electrical" icon for the electrical layout:

- Choose inverter and quantity
- 2) Confirm electrical design assumptions
- Click "Generate Wiring" to generate electrical layout, including wires, combiner boxes, and inverters
- Inverters and combiner boxes can be moved, and the wires will be rerouted
- Percentage values next to the conductors show their total voltage drop at STC. These numbers are based on the wire distances shown in the Des
- 6) When finished, click "Save Design"
- 7) The drop-down menu of conductors shows the corresponding voltage drop for each conductor.

U HelioSco	Oe 🌴 🖋 Current Project 🛸 Open Design
Design 1	
Design Details	
Mechanical Electrical Overlay	
« wiring zones	
Default Wiring Zone (1,129.1KWp)	3
Clear Generate Wiring	
Description Default Wiring Zone	and the second
Inverter (DC/AC 1.13) Advanced Energy, Solaron 500 *	
Home Runs 1/0 AWG (Aluminum), 1.2	5
Combiner Poles 12 104.8 Amps @	
Strings 10 AWG (Copper), 0.6%	
String Length 22 987.8V @ Voc	
Stringing Along Racking	
– Select an Optimizer (Optional) –	4
	PowelineRd PowelineRd
1 2	Poweiline Rd
signer.	Design 1





Electrical Layout Assumptions



Glossary: Electrical Layout

Term	Description
Trunk Gauge	The conductor size between the re-combiner box and the inverter. If no re-combiner has
Home Run	The conductor size between each combiner box and the inverter or recombiner.
Combiner Poles	The number of strings connected to each combiner box. Important : If the combiner box size is larger than the inverter, then the strings will feed directly to the inverter.
Strings	The size of the conductor for the source circuits from the modules.
String Length	The number of modules wired in series. Important : If the Wiring Zone does not divide evenly into full strings, then the remaining modules will not be included in the final Design.
Stringing Direction	The direction in which modules are connected to each other.



4.3 Managing Multiple Field Segments and Wiring Zones

If the Design has multiple Field Segments, they can either be wired in one or multiple Wiring Zones. Click the "<< Wiring Zones" link at the top of the Electrical control.



With one Wiring Zone selected, all modules in the Field Segments will be assigned to strings as one group, and connected to the inverter(s). In this case, modules will be assigned to strings in the order that the Field Segments are listed.



When Field Segments are assigned to separate Wiring Zones, each electrical design is independent.





4.4 Shade Overlays

Use overlays to compare the positioning of modules relative to shade patterns*:

- A. Select the Shade Profile and timestamp
- B. The shade pattern the date & time will be shown as an overlay on the map

Note*: requires Shade Profiles loaded via the SketchUp plugin (see "Shade Modeling", section 8).

U HelioScope	🐐 🖌 Current Project 🛛 😂 Open Design
Design 1b (2.1m spacing) Design Details	
Mechanical Electrical Overlays	
Overlays Ø Clear	
Overlays allow you to add additional imagery to help you design the array.	B
Sketchup Model	
Sketchup Render	
Opacity 65%	
rentra Bil	Reweiline Rd Reweiline Rd
	and the second





4.5 Design Summary

From the Design home, click a Design to view the details:

- A. Design name and size
- B. Location of Field Segments on map
- C. Bill of materials, including modules, wire, combiners, and inverters
- D. Module layout and wiring assumptions
- E. Full image of Layout
- F. Configurable list of Design details to be shown in image





21



4.6 Cloning

Use Design cloning to copy a design from an original.

🕼 Add a New [Design ×
Description	Design 1 (3m spacing) (copy)
Clone a design	Design 1 (3m spacing) (1.07 Select a Design to Copy Design 1 (3m spacing) (1.07 MW) Cancel Create a New Design

Use cloning to create multiple Designs for detailed engineering analysis (ground coverage ratio, tilt, conductor size, etc.):

Designs	Users	Conditions	Shading	Reports		
Each design	encompas	ses all the electr	rical compon	ents of a field: t	the modules, inverter, wiring,	optimizers, and layout.
🕫 Desi	gns					🖋 New
Design					Nameplate	Actions
Design 10a	(60-cell)				995.5 kW	~
Design 10a	(60-cell, hi	gher GCR)			1.20 MW	A
Design 10a	(60-cell, pu	illed in)			1.14 MW	e
Design 10a (72-cell)			1.04 MW	》		
Design 10a (thin-film)			918.0 kW	》		
Design 10b (#12 AWG)				870.8 kW	~	
Design 10b (#8 AWG)				870.8 kW	》	
Design 10b	(#8 AWG, s	string inverters)			870.8 kW	チ 団
Design 10b (15-tilt)			1.19 MW	チ 1		
Design 10b	(3m spacir	ng)			870.8 kW	~
Design 10b	(String inv	erters)			951.8 kW	~
Decigo 10c	(2m coocie	(m)			0	



5.0 Condition Sets

A Condition Set describes the environment around the solar array, including the weather conditions, shading patterns, and soiling losses.

Weather:

- A. Nearby weather stations are shown on map
- B. Weather stations are sorted by distance from Project. The source and class of each file is shown in parenthesis
- C. Select the desired weather file

Shading: If the Project has shading, choose the Shade profile and/or Horizon profile

Note: the Shade Profile must have first been loaded (see Section 8)

Soiling: Confirm or adjust monthly soiling losses.

A New Con	dition Set
Description	kondition Set 1
Weather	Weather used to calculate the hourly performance of the array for a given year
Shading Soling Cell Temperature Mismatch Components Advanced	Name Distance © Satellite TMY (prospector) B 1.1 mi 1.1 mi C EDWARDS AFB (tmy3, ll) 37.0 mi DAGGETT BARSTOW-DAGGETT AP (tmy3, l) 37.7 mi C PALMDALE AIRPORT (tmy3, ll) 41.3 mi C RIVERSIDE MUNI (tmy3, ll) 42.6 mi C CHINO AIRPORT (tmy3, ll) 42.6 mi C CHINO AIRPORT (tmy3, ll) 46.3 mi C LANCASTER GEN WM FOX FIELD (tmy3, ll) 50.0 mi C FULLERTON MUNICIPAL (tmy3, ll) 59.8 mi
	Cancel Create a New Condition Set
A New Con	dition Set *
Description	Condition Set 1
Weather	Shading include models of any near-shade or horizon obstructions
Shading	SketchUp Model Select shading profile HelioScope uses a shade prof Select shading profile hading on the array. This shading only impacts the
Soiling	beam component of irradiand Victor Ville Jali
Cell Temperature	Horizon Profile Select Horizon profile The horizon file (imported from a Solmetric Suneye) defines the far shading of the array, and affects all modules equaly.
Components	
Advanced	
5	
4	Cancel Create a New Condition Set
A New Cor	ndition Set *
Description	Condition Set 1
	Soiling derates to irradiance due to module soiling or other factors
it Shading	jan 2.0 % jul 2.0 %
Soiling	feb 2.0 % aug 2.0 %
Cell Temperature	mar 2.0 % sep 2.0 %
A New Cond	lition Set 🛛 🗶
Description	Condition Set 1
Weather	Femperature Model used to determine cell temperature based on environmental factors and module
Shading	rradiance
Soiling	Cell Temperature Model Sandia Model
Cell Temperature	Edit Model Coefficients (Advanced)
Mismatch	The Sandia Temperature Model is quantitatively derived from module performance in the field, the diffusion model is equivalent to that used in PVSvst
Components	
Advanced	

А

Cell temperature model: Choose temperature model (HelioScope supports both the Sandia Labs Temperature Model and the Linear Diffusion model used by PVsyst).

A) Click "Edit Model Coefficients" to view and modify the coefficients.

Mismatch: View or modify three statistical mismatch parameters:

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- A. Difference in plane-of-array irradiance (normally distributed)
- B. Module temperature differences (uniform distribution)
- C. Module manufacturing tolerance (uniform distribution). This has two inputs to account for positivetolerance module binning.

A New Condition Set × Description Condition Set 1 Mismatch statistical distributions applied module-by-module used to define module binning and other Weather match parameters Shading В А rradiation 5.0 % Temperature 4.0 °C Variance Spread Soiling Standard deviation around expected irradiance (normal Total degree spread centered around the modeled cell Cell Temperature distribution) temperature (uniform distribution) Mismatch C in Module С -2.5 Max Module 2.5 % % Components Tolerance Tolerance Minimum deviation from specified maximum power point Maximum deviation from specified maximum power Advanced (uniform distribution) point (uniform distribution) Cancel Create a New Condition Se

Components: Manage the

mathematical characterizations used for each module or inverter.

- A. List of all modules used on any Design in the Project.
- B. If multiple PAN files are available (including a custom PAN file), configure then via the drop-down menu

See Section 7 for additional information on managing component characterizations.

Advanced:

A. Choose the transposition model (the mathematics used to convert diffuse light to effective irradiance).

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A New Con	dition Set		×
Description	Condition Set 5		
Weather	Component Characteri be used during the simulation	zations define precisely which module on	characterizations (e.g. PAN files) will
Shading	Module SKU	Characterization	Description
Soiling	TSM-240 A (na Solar)	RETC Characterization, PAN	Validated by RETC 2012-02-17
Cell Temperature	TSM-285 PA14 (Trina Solar)	Default Characterization, Full-Diode RETC Characterization, PAN	
Components	TSM-245 P05A (Trina Solar)	Default Characterization, PA	Manufacturer, June 2012
Advanced	JKM-225P (Jinko Solar)	Default Characterization, Fu	
5	YL280P-35b (Yingli)	Default Characterization, Fu	
2			
		Can	Create a New Condition Set
A New Cond	dition Set		×
Description	Condition Set 5		
Weather	Advanced other settings us	ed in the simulation of your design	
Shading	Transposition Model	erez Model	
Soiling			
Cell Temperature	Solar Angle Source N The location used for calculating	feteo File Lat/Lng	
Mismatch		(A)	
Components			
Advanced		В	
		Cance	Create a New Condition Set
		cance	

B. Choose the location used for calculating solar angles (either the location of the weather file, or the project location).



6.0 Reports

The Reports page shows the full set of Designs and Condition Sets that have been created in the Project. Each combination of a Design and Condition Set can be Simulated to create a Report.

- A. Click on orange "Simulate" button to trigger a simulation
- Blue progress bar shows the status of active simulations
- C. Completed Reports are shown with a blue button. Click to view the detailed Report
- D. The metric shown on the completed Reports can be configured from the controls below

<mark>Ů</mark> Не	elioScope				🌡 Paul Grana 👻
A Home	Projects Current Project			Components	Documentation
Victo	rville Jail Victorville,	CA			
Project	Overview 🏠 📩 🕑 Edit	Designs Users Condition	ns Shading Reports		
Project	Victorville Jail	For each Condition Set and Design	HelioScope can run a simulation t	to see exactly how that design will perfor	m.
Address	Victorville, CA			Condition Sets	New
Description		Designs	Dagget	t, no shade	shade 😭
Owner	Paul Grana	5 chans	_ A		В
Last	11/4/13 11:05 AM	Design 1 (3m spacing)	(1.07 MW)	Simulate	
Location	(24 5621001400770 117 26205072621)	Design 1b (2.1m spacing)	(1.25 MW) 💼	1,860.0 C	1,825.8
Location	(GMT -8)	New Design			
Project I	ocation				KWh/KWp Performance Ratio Energy





6.1 Production Report

A detailed Report is available for each completed Simulation:

- A. Summary metrics, including energy production, performance ratio, and kWh/kWp
- B. Hourly results can be downloaded in CSV format
- C. Locations of Field Segments shown on map
- D. Download a PDF report
- E. Monthly production values
- F. Chart shows loss factors
- G. Detailed loss tree shows the total losses at each step of the irradiance and energy calculations
- H. Records of condition set assumptions

III Production Report: Design 1b (2.1m spacing) D ₿ × 🍞 Edit Production **9** Field Segments 🔑 Design В 2.321 GWh Production Project Name Victorville Jail Performance Project Description 80.7% А Ratio Project Address Victorville, CA С KWh/KWp 1 860 0 Design 1b (2.1m Design Weather DAGGETT BARSTOW-DAGGETT AP spacing) Source (tmy3, I) Nameplate Power 1.25 MW Transposition Perez Model Model AC Nameplate Power (Load 1,000.0 kW (124.8%) Ratio) Simulator 34 (2eab8c426a-ba2dc4b7b0 Version da99ed0c8e-6fddfda1d2) Monthly Production O Sources of System Loss F 300k Shading: 0.9% Reflection: 2.8% iling: 2.0% Wh nizers: 0.0% Irradiance: 0.1% Temperature: 7.5% Annual Production Condition Set Description Output % Delta Description Daggett, no shade Annual Global Horizontal Irradiance 2,089.6 Irradiance Weather Source DAGGETT BARSTOW-DAGGETT AP (tmy3, I) POA Irradiance 2,304.8 10.3% (kWh/m²) Shaded Irradiance 2,284.6 -0.9% Solar Angle Location Meteo Lat/Lng Н G Irradiance after Reflection 2,219.6 -2.8% Transposition Model Perez Mode Irradiance after Soiling 2,175.2 -2.0% Total Collector Irradiance 2,175.2 0.0% Temperature Model Sandia Mode Nameplate 2 718 834 7 Energy Rack Type Temperature Delta Temperature Model b Output at Irradiance Levels 2 714 953 1 -0.196 а (kWh) Parameters Output at Cell Temperature Derate 2.511.579.4 -7.5% -3.56 -0.075 Fixed Tilt 3°C Output After Mismatch 2,433,097.9 -3.1% -2.81 -0.0455 0°C Flush Mount Optimizer Output 0.0 0.0% Soiling (%) J F M A M J J A S O N D System DC Output 2,395,742.6 -1.5% 2 2 2 2 2 2 2 2 2 2 2 2 2 System AC Output 2,321,264.1 -3.1% Irradiation Variance 5% Temperature Metrics Avg. Operating Ambient Temp 23.5 °C Cell Temperature Spread 4º 0 Avg. Operating Cell Temp 34.4 °C Module Binning Range -2.5% to 2.5% Simulation Metrics Module Characterizations Module Characterization Operating Hours 4592 4592 TSM-300 P14A (Trina Default Characterization Solved Hours Solar) PAN Component Characterizations Device Characterization AE 250NX (Advanced Energy) Default Characterization



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HelioScope User Manual

- I. Bill of materials, including modules, wire, and inverters
- J. Electrical design assumptions
- K. Mechanical layout assumptions
- L. Image of detailed layout





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7.0 Components

HelioScope includes three different component databases: modules, Inverters/optimizers, and wires.

Modules and inverters are organized in a hierarchy. The SKU represents the product (e.g., a Trina PC14 280watt module). Each SKU can have multiple characterizations, which define the product's behavior. For a module, a PAN file is a characterization, so a single module SKU can have multiple PAN files.

- A. Access the library from the Components menu
- B. Search for specific products
- C. Click any module or inverter to view its details (see section 7.1)
- D. Click "Upload Module" to open PAN file uploader (see section 7.2)
- E. Click the orange star to 'favorite' a device. It will show up on the dropdown menu in the Designer.

HelioScope					
Norme Projects				A	ponents
Component Libr	ary Mod	ules			
Q Search B	i≣ Module	s 1	2		D Ipload Module
Manufacturer	Name	Manufacturer	Power	Technology	Vmp, Imp
Manufacturer	1 STH-215	0 I Soltech	210	Si-Poly	29V 7 35A
Madula Nama	Emerald G	reen 220 1 Soltech	C 220	Si-Poly	28.5V, 7.6A
Neme	1 STH-220	P 1 Soltech	220	Si-Poly	29.3V, 7.47A
Name	🟠 Forest Gre	en 225 1 Soltech	225	Si-Poly	29V, 7.7A
Cell Technology	1 STH-225	P 1 Soltech	225	Si-Poly	29.6V, 7.58A
All \$	1 STH-230	P 1 Soltech	230	Si-Poly	29.9V, 7.65A
Only Show Envorites	1 STH-230	1 Soltech	230	Si-Mono	28.8V, 8A
Only show Pavonces	1 STH-230	(Horizont) 1 Soltech	230	Si-Poly	29.9V, 7.65A
Favorites will always show up	🔯 Polished N	1 Soltech	230	Si-Poly	28.9V, 7.8A
down	1 STH-235	(Horizont) 1 Soltech	235	Si-Poly	30V, 7.76A
	1 STH-235	1 Soltech	235	Si-Mono	29.3V, 8.02A
(1 STH-240	(Horizont) 1 Soltech	240	Si-Poly	30.2V, 7.87A
	E 1 STH-240	1 Soltech	240	Si-Mono	29.7V, 8.07A
	1 STH-245	1 Soltech	245	Si-Mono	30.2V, 8.1A
		(Horizont) 1 Soltech	245	Si-Poly	30 AV 7 964

Wiring database details:

- A. Select preferred wires (North American wires (AWG) or metric)
- B. Select to include aluminum conductors
- C. Choose default conductors for the three conductor runs

Home Projects				mponents Documentation
omponent Library	/ Wires			
Preferences	I Wires			
	Size	Material	Units	² Resistivity (Ω/m)
nits	600 MCM	Aluminum	American Wire Gauge (AW	0.000110236
American Wire Gauge (AWG)	500 MCM	Aluminum	American Wire Gauge (AW	0.000132218
Show Aluminum	300 MCM	Aluminum	American Wire Gauge (AW	0.000220472
(В)	4/0 AWG	Aluminum	American Wire Gauge (AW	0.00026378
esginer Defaults parameters for wire choice when	250 MCM	Aluminum	American Wire Gauge (AW	0.000264436
eating new Wiring Zones	3/0 AWG	Aluminum	American Wire Gauge (AW	0.00039042
unk Gauge	2/0 AWG	Aluminum	American Wire Gauge (AW	0.000419947
500 MCM (Copper)	0 AWG	Aluminum	American Wire Gauge (AW	0.000528215
ome Run (Bus) Gauge	2 AWG	Aluminum	American Wire Gauge (AW	0.000839895
0 AWG (Aluminum)	4 AWG	Aluminum	American Wire Gauge (AW	0.00133858
	6 AWG	Aluminum	American Wire Gauge (AW	0.00212598
ring Gauge	750 MCM	Copper	American Wire Gauge (AW	0.00004681
10 AWG (Copper)	500 MCM	Copper	American Wire Gauge (AW	0.0000718504
	250 MCM	Copper	American Wire Gauge (AW	0.00013609
Constal Mandata Desfavoração	4/0 AWG	Copper	American Wire Gauge (AW	0.00016072
Cancer Opdate Preferences	2/0 4/4/5	6	American Mine Course (A)M	0.00000075



7.1 Component Detail

Detailed view of module or inverter:

- A. The key specifications are shown at the left
- B. Toggle the orange star to make the product a 'favorite'
- C. Choose the temperature and irradiance levels for viewing the I-V or P-V curves
- D. If multiple characterizations are available for the product, choose the default characterization. These can still be modified in the Condition Set of the Project.

Spec Sheet	(B) *	RETC Characterizati	on (PAN)							
Name	TSM-240PA05	Validated by RETC 2012-0	2-17							
		Modeled Performa	ance							
Manufacturer	I rina Solar	10								- 1000W/m2
Power	240.0 W	7.5								- 800W/m2 - 600W/m2
	30.4V	±			_		_			- 400W/m2 - 200W/m2
Voc N	37.2V	s								- 100W/m2
Isc	8.37A	2.5								
Imp	7.89A	0								
Technology	Si-Poly (60 cells)	5	\sim '	0	15	Vol	20 age	25	30	35
Dimensions	0.992m x 1.65m	Chart Type	Leg	end			Other Optio	ns		
Temp Coefficient P _{max}	-0.45%/°C	 Current Power 	О Т 0 н	'emperatu rradiance	re		lemperature		25 °C	
Temp Coefficient P _{max} Temp Coefficient V _{oc}	-0.45%/°C	 Current Power 	от • н	'emperatu rradiance	re		Temperature		25 °C	
Temp Coefficient P _{max} Temp Coefficient V _{oc}	-0.45%/°C	Current Power Irradiance (W/m ²)	⊖ T ⊛ II Isc	'emperatu rradiance V _{OC}	I _{MP}	V _{MP}	Femperature	dP _{mp} /dT	25 °C dV _{mp} /dT	dV _{oc} /dT
Temp Coefficient P _{max} Temp Coefficient V _{oc} Temp Coefficient I _{sc}	-0.45%/°C -0.35%/°C %/°C	Current Power Irradiance (W/m ²) 1000	0 T ● H	Voc 37.2	ге І _{МР} 7.86	V _{MP} 30.6	Power 240.5	dP _{mp} /dT -0.45%	25 °C dV _{mp} /dT -0.47%	dV _{oc} /dT -0.39%
emp Coefficient P _{max} emp Coefficient V _{oc} emp Coefficient I _{sc} iource	-0.45%/°C -0.35%/°C %/°C	Current Power Irradiance (W/m ²) 1000 800	0 T ● II Isc 8.37 6.70	Voc 37.2 36.9	ге І _{МР} 7.86 6.27	V _{MP} 30.6 30.8	Power 240.5 193.0	dPmp/dT -0.45%	25 °C dV _{mp} /dT -0.47% -0.47%	dV _{oc} /dT -0.39% -0.39%
iemp Coefficient P _{max} iemp Coefficient V _{oc} iemp Coefficient I _{sc} iource	-0.45%/°C -0.35%/°C %/°C	Current Power Irradiance (W/m ²) 1000 800 600	□ T ● H Isc 8.37 6.70 5.02 2.25	Voc 37.2 36.9 36.5	I _{MP} 7.86 6.27 4.69	V _{MP} 30.6 30.8 30.8	Power 240.5 193.0 144.5	dP _{mp} /dT -0.45% -0.45% -0.45%	25 °C dV _{mp} /dT -0.47% -0.47% -0.47%	dV _{oc} /dT -0.39% -0.39% -0.40%
Temp Coefficient P _{max} Femp Coefficient V _{oc} Femp Coefficient I _{sc} Source .ast Update	-0.45%/°C -0.35%/°C %/°C 	Current Power Irradiance (W/m²) 1000 800 600 400 200	□ T ● II Isc 8.37 6.70 5.02 3.35 1.60	emperatu rradiance Voc 37.2 36.9 36.5 36.0	I _{MP} 7.86 6.27 4.69 3.10	V _{MP} 30.6 30.8 30.8 30.7	Power 240.5 193.0 144.5 95.3	dPmp/dT -0.45% -0.45% -0.45% -0.45%	25 °C dV _{mp} /dT -0.47% -0.47% -0.47% -0.48% 0.48%	dV _{oc} /dT -0.39% -0.39% -0.40% -0.41%
Temp Coefficient P _{max} Temp Coefficient V _{oc} Femp Coefficient I _{sc} Source Last Update	-0.45%/°C -0.35%/°C %/°C 11/2/13 1:31 AM	Current Power Irradiance (W/m ²) 1000 800 600 400 200	• T • II • II • II • II • II • II • II •	Voc 37.2 36.9 36.5 36.0 35.0	I _{MP} 7.86 6.27 4.69 3.10 1.51	V _{MP} 30.6 30.8 30.8 30.7 30.2	Power 240.5 193.0 144.5 95.3 45.8	dPmp/dT -0.45% -0.45% -0.45% -0.45%	25 °C dVmp/dT -0.47% -0.47% -0.48% -0.48% -0.48%	dV _{oc} /dT -0.39% -0.39% -0.40% -0.41%
Temp Coefficient P _{max} Temp Coefficient V _{oc} Temp Coefficient J _{sc} Source Last Update	-0.45%/°C -0.35%/°C %/°C 11/2/13 1:31 AM	Current Power Irradiance (W/m ²) 1000 800 600 400 200 100	Isc 8.37 6.70 5.02 3.35 1.68 0.84	Voc 37.2 36.9 36.5 36.0 35.0 34.0	I _{MP} 7.86 6.27 4.69 3.10 1.51 0.72	V _{MP} 30.6 30.8 30.8 30.7 30.2 29.4	Power 240.5 193.0 144.5 95.3 45.8 21.3	dPmp/dT -0.45% -0.45% -0.45% -0.45% -0.45% -0.45%	25 °C dVmp/dT -0.47% -0.47% -0.47% -0.48% -0.49% -0.51%	dV _{oc} /dT -0.39% -0.39% -0.40% -0.41% -0.43% -0.44%
Temp Coefficient P _{max} Temp Coefficient V _{oc} Temp Coefficient I _M Source Last Update A Other Characterization efoult	-0.45%/°C -0.35%/°C %/°C 11/2/13.1:31 AM	Current Power Irradiance (W/m ²) 1000 800 600 400 200 100 Raw Parameters	■ T ■ I Sc 8.37 6.70 5.02 3.35 1.68 0.84	remperatu rradiance Voc 37.2 36.9 36.5 36.0 35.0 34.0	не I _{MP} 7.86 6.27 4.69 3.10 1.51 0.72	V _{MP} 30.6 30.8 30.8 30.7 30.2 29.4	Power 240.5 193.0 144.5 95.3 45.8 21.3	dPmp/dT -0.45% -0.45% -0.45% -0.45% -0.45% -0.45% -0.44%	25 °C dVmp/dT -0.47% -0.47% -0.47% -0.47% -0.48% -0.48% -0.49% -0.51%	dVoc/dT -0.39% -0.39% -0.40% -0.41% -0.43% -0.44%

E. The details of the module PAN file are shown in the "Raw Parameters" table.



7.2 PAN File Uploader

Use the PAN file uploader to import module characterizations.

- 1) Click "Add files" to browse and select PAN files
- 2) The characterizations are automatically matched to modules in the database
- View drop-down menu to choose or confirm the module used
- 4) If no match is found, a new module will be created
- 5) Click Preview to view and edit the characterization details (see section 6.3)
- 6) Upload files to add them to the database

🚯 Module Upload				×
Select any PAN files you have to add them to irradiance and temperature assumptions. T you upload are private by defau Add files Upload All Files	o HelioScope. When we upload a PAN file w he Module itself is stored independently (so It.	e store it as a Module Characterization, which defines how o one module may have many characterizations).	a given module will perform under different	4
File	Details	Module	Actions	
sample_test:PAN 0.60 KB	Manufacturer: SunGen Model: SG-NH 97-GG Source: Manufacturer 2011	Will add SunGen, SG-NH 97-GG to your database when saved.	O Upload Q Preview	
Silfab_SLA260M.pan 0.46 KB	Manufacturer: Silfab S.p.A. Model: SLA260M Source: Photon DB 2012	Silfab S.p.A., SLA260M (100.0%)	O Upload Q Preview	
Silfab_SLA265M.pan 0.46 KB	Manufacturer: Silfab S.p.A. Model: SLA265M Source: Photon DB 2012	Silfab S.p.A., SLA265M (100.0%)	O Upload Q Preview X	
Silfab_SLA265M3A.PAN 0.52 KB	Manufacturer: Silfab Model: SLA 265M3A Source: Manufacturer 2011	Silfab, SLA265M (96.5%)	O Upload Q Preview X	
SLSM-230P.PAN 0.59 KB	Manufacturer: Long Energy Model: SLSM-230P Source: Manufacturer	Long Energy, SLSM-230P (100.0%)	O Upload Q Preview X	
STN140.PAN 0.41 KB	Manufacturer: STION Model: STN140 Source: Manufacturer	Suzhou Shenglong PV-Tech CO., Ltd., SLSM-230P Create a new module Matched with an existing module	(76.7%) Q Preview X	
Trina_TSM_240_P05_RETC.PAN 0.51 KB	Manufacturer: Trina Solar Model: TSM-240 PC05 by RETC Source: RETC	Trina Solar Energy Co., Ltd, TSM-240PC0	Oupload Q Preview X	

7.3 Characterization Preview & Editing

The PAN Characterization page shows the PAN details:

- Default access rights are private (only available to the user), but can select Public
- B. The PAN details (coefficients and curves) are shown for confirmation
- C. Edit the characterization name, description, and module SKU

III PAN Characteriz	ation Upload		×
Name Silfab_SLA260/ Description Source: Photo	M.pan n DB 2012	Access Rights C Public Any user of HelioScope can use the Module Characterization from this PAN file Private Only you can use the Module Characterization based on this PAN file	
Module Silfab S.p.A., Si Matched with an	LA260M (100.0		
		O Undo Cancel O Upload Characterization	
Module		Silfab_sLA260M.pan (PAN) Source: Photon DB 2012	
Name	SLA260M	Jul Modeled Performance	
Manufacturer	Silfab S.p.A.	10	-
Power	260.0 W	- 1000/m - 800/m2 - 600W/m2	
V _{mp}	30.420V	E - 400W/m2 - 200W/m2	
Voc	37.900V		
Isc	9.070A	2.5	
I _{mp}	8.550A		
Technology	Si-Mono (60 cells)	0 5 10 15 20 25 30 35 Voltage	
Dimensions	0.99m x 1.65m	Chart Type Legend Other Options	
Temp Coefficient P _{max}	-0.46%/°C	Current C Temperature Temperature C Power C Irradiance 35 *C	



8.0 Shade Modeling

HelioScope incorporates obstruction shading using SketchUp, a widely-used and freely available 3D modeling program. SketchUp enables detailed geo-location through Google Earth. HelioScope integrates with SketchUp via a software plugin.

8.1 Installing the Plugin

- Download plugin: The SketchUp plugin for HelioScope can be found on the 'Shading' tab within any Project. The SketchUp plugin file has the standard ".RBZ" extension and is compatible with both the Windows and Mac versions of SketchUp. Download and save this file to your computer. A note on compatibility: some versions of Internet Explorer will change the file extension to .ZIP while downloading. If this happens, please rename the extension to .RBZ.
- 2. Install plugin: From within SketchUp, open the System Preferences window. On Windows this can be found under the "Windows" menu (Windows \rightarrow Preferences), while on Macs this is located under the "SketchUp" menu (SketchUp > Preferences). From here, highlight "Extensions" in the left menu, and select "Install Extension." Navigate to the RBZ file on your computer and select it. A dialog box will pop up to ask if you trust the source; confirm that you know and trust the author. The installation will

System Preferen	ces	×
Applications Compatibility Drawing Extensions Files General OpenGL Shortcuts Template Workspace	□ Ruby Script Examples ☑ HelioScope Tools □ Ocean Modeling □ SolarModel Tools □ Utilities Tools	× •
	Version: Creator: Copyright:	
,	Install Extension OK	Cancel

complete automatically, and the unpacked plugin will be added to your computer.



- 3. For SketchUp Make Grant Permissions for Plugin Folder: In the latest version of SketchUp (known as "SketchUp 2013" or "SketchUp Make"), an additional step is needed for the SketchUp program to access the plugin.
 - 3.1 Navigate to the SketchUp Plugin folder, likely at "C:\Program Files\SketchUp\SketchUp 2013\Plugins"
 - **3.2** Right-click on the HelioScope plugin folder, which will be named "helioscope_ext", and select 'Properties'.
 - **3.3** Select the "Security" tab and click the "Edit" button to modify permissions.
 - **3.4** A separate window will appear with a list of users. Go down the list of users, and select "full control" for each user in the box below for "Permissions for Users".

📕 Plugins Properties	×	
General Sharing Security Customize		
Object name: C:\Program Files\SketchU;	p\SketchUp 2013\Plugii	
Group or user names:		
CREATOR OWNER SYSTEM Administrators (red 781-PC\Administrato		
To change permissions, click Edit.	Edit	
Permissions for CREATOR OWNER	Permissions for Plugins	xI
Full control Modify Read & execute List folder contents Read Write For special permissions or advanced setting click Advanced.	Security Object name: C:\Program Files\SketchUp\SketchUp 2013\Plugi Group or user names: CREATOR OWNER SYSTEM Administrators (red781-PC\Administrators) Users (red781-PC\Users) TustedInstaller	
ОК	Add Remove Pemissions for Users Allow Deny Full control Image: Control im	
	OK Cancel Apply	

- 4. **Re-start SketchUp**: at this point, SketchUp may need to be re-started.
- 5. Activate plugin: The HelioScope Plugin should show up in the Plugin menu under "HelioScope" > "Shading Plugin". If you do not see this menu option, ensure that the plugin has been activated in the Sketchup Preferences pane described in step 1.b. The HelioScope plugin will show up as 'HelioScope Tools.'

💞 U	ntitle	d - Ske	etchUp										
<u>F</u> ile	<u>E</u> dit	<u>V</u> iew	<u>C</u> amera	D <u>r</u> aw	<u>T</u> ools	<u>W</u> indow	Plugins	<u>H</u> elp					
k		2	10	ϵ	94	IJ 🔎	Helio	Scope	Shading Plugin	172	٩	Q	2



8.2 Modeling the 3D Obstructions in HelioScope

The HelioScope SketchUp plugin requires a geo-located 3D model of the obstructions near the array.

Add Location.

- Click the "Add Location" button, which will open up an "Add Location" window
- Enter the Project address or latitude/longitude into the dialog box and select "Search"



The control box will now show the Google Earth satellinte image for the location.

Re-center the map and zoom out so the entire project area is in the box. Click "Select Region".





The control window will now show an active area, surrounded by push pins. Size the active area to match the array, including all relevant obstructions. When finished, click "Grab".



The satellite image will now be a layer in the SketchUp model.



Create shade objects. Build the obstructions, including roof objects, nearby trees, and nearby buildings, in the SketchUp model.

Pay attention to the locations and dimensions of the objects. Use the Google Earth layer to locate the exact position of each object.

Best Practices for modeling shade in SketchUp:



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- A. Only model objects (in SketchUp) that will cause shade on the modules. For example, if there is a vent pipe below the module plane (and therefore has no impact on the array's performance), then it should be omitted from the 3D model.
- B. Avoid modeling the modules themselves. Row-to-row shading is already calculated within HelioScope based on the exact geometry of the modules.
- C. In the cases where the modules will be raised from the ground (say, in a carport or canopy application), create a raised shape (at the same height of the modules) across the entire array area. This will shorten the shade patterns, based on the relative height of the modules versus the nearby obstructions.



Standard 3D model of high-voltage powerlines



3D model of high-voltage powerlines with vertical adjustment for raised modules

- D. Beware modeling shade from wires. Shade from wires will often be diffused by the time it reaches the modules, yet HelioScope treats all shade as binary. So a single pixel of shade will remove a module's entire DNI.
- E. In the Z (height) axis, it may be easier to adjust the zero point to the plane of the modules. This may require the user to shrink shade obstructions if the modules are elevated from the ground level. For example, say a 40-foot tall tree is near an array on a 10-foot roof. The tree in SketchUp would be 30 feet high, representing the top 30 feet of the tree.





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8.3 Importing Shade Profile Using the SketchUp Plugin

1. **Initiate plugin and log in**: Once the SketchUp obstructions are designed, select the HelioScope plugin from the plugin menu. Log in to your HelioScope account.

HelioScope Plugin

2. Link to a Project and begin upload: The dialog box will show the list of all Projects under your account. Select the Project where you would like the shade profile uploaded. Click "Link Model" to associate the local file with the Project in HelioScope.

3. **Run plugin**: Click "Upload Shade Profile" to begin the shadow rendering and uploading process. The SketchUp plugin will run automatically, taking several minutes. During the process, you can track the progress via the status bar.

The plugin generates a series of 2-dimensional shade patterns that characterize the shade patterns on the array throughout the year. These can be viewed from the Shade Tab in HelioScope (see Section 5.1), and also in the Overlays section of the Designer (see Section 4.4).

Once a 3D model ha	as been linked to a proied	t you can upload
near shade profiles	for use in simulations.	
Enter a name for th	his 3D Model	
Victorville Jail v1.1		
Description		
Project		
Victorville Jail		
		Link Model
elioScope Plugin	~	
HelioScope Plugin	Scope	📕 💶 🖕
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HelioScope Plugin	Scope Shadows for Jail generating shade profile tessfully generated 52 re Rendering Progress	Paul Grana ▼ •: Victorville for month 4 nders.
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8.4 Verifying Shade Patterns in HelioScope

After importing a shade profile from the SketchUp Plugin, the shade patterns can be viewed in HelioScope.

Manage the Shade Profiles from the "Shading":

- A. List of Shade Profiles
- B. Link to download the Plugin
- C. SketchUp Plugin User Manual

A Home	Projects Current Project			Con	Documentatio
Victo	rville Jail Victorville,	CA			
Project (Overview 🏫 📥 🕼 Edit	Designs Users Conditions Sha	ding Reports		
Project	Victorville Jail	Shade Profiles allow you to evaluate the imp	act of near shade on you	r array. HelioScope uses a !	5ketchUp plugin that enables
Address	Victorville, CA	SketchUp model to be tied directly to array p	erformances. To get start	ted, download the plugin b	elow.
Description		Shade Profiles			
Owner	Paul Grana	Name Des	ription	Renders	Actions
Last Modified	11/1/13 4:53 PM			107	
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		HelioScope can use SketchUp models to c HelioScope, we provide a plugin for Sketch	alculate effects shading e iUp which allows vou to t	ffects. To upload your 3d n tie any 3d model in Sketchl	nodel from SketchUp to Up to a project in HelioScope
• Project L	ocation	Install the plugin by downloading this file a plugin, you will need to restart SketchUp.	and adding installing it th	rough the SketchUp Extens	ion Menu After installing the
10		For help setting up and using the plugin, d	ownload the manual.	с	

Each Shade Profile includes a full year worth of geo-located shade images for a given 3D design.

- A. Shade patterns are calculated for every hour of each month
- B. Each shade render is a black-andwhite image of the shade pattern, based on the position of the sun and the shape of the obstructions

The shade patterns can also be viewed in the Designer by using the shade overlays functionality (see section 4.4).

Note that shading must be selected as part of the Condition Set in order to be used in a Simulation.

	🖾 Shade Profiles fro	m SketchUp	×
	Timestamp	Viewing shadow renders for Victorville Jail	
•	7:30, 15 Jan		
	8:30, 15 Jan		
	9:30, 15 Jan		
	10:30, 15 Jan		
	11:30, 15 Jan		
	12:30, 15 Jan	h h	
Δ	13:30, 15 Jan		
	14:30, 15 Jan		
7	15:30, 15 Jan	Viewing shade profile for 10:30, 15 Jan	
	<u> </u>		
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9.0 Appendix

Glossary: Report Summary Metrics

Term	Description
Production	The total energy generated during the simulation, in AC MWh or GWh
Performance Ratio	Performance Ratio (PR) shows the percentage of total potential energy for the array that is converted to AC energy. Mathematically, the PR is defined as the AC power production, divided by the product of plane-of-array (POA) irradiance times the system DC nameplate power.
kWh/kWp	The specific energy – total simulation energy generation divided by the system DC nameplate power.

Glossary: Annual Production Metrics

Term	Description
Annual Global Horizontal Irradiance	The total irradiance that will fall on a flat plane at the location of the array. This is aggregated directly from the weather file.
POA Irradiance	The total irradiance in the Plane of Array (POA), accounting for tilt and azimuth angles. This is averaged across all modules in the array.
Shaded Irradiance	The total irradiance accounting for all shading (from horizon, row-to-row, and obstruction)
Irradiance after Reflection	The total irradiance after accounting for reflection off the surface of the module (also known as the Incident Angle Modifier, or "IAM" reflection).
Irradiance after Soiling	Irradiance after module soiling is accounted for. Note that soiling assumptions are made in the Condition Set.
Total Collector Irradiance	The total annual irradiance available to the modules in the array. This is averaged across all modules.
Nameplate	The maximum potential power of the array, defined as the total collector irradiance multiplied by the system nameplate power.
Output at Irradiance Levels	The total energy output by the modules, after accounting for low-light effects and module IV curve distortions.
Output at Cell Temperature Derate	The total output of the modules, factoring in the temperature effects on the IV curves. This is the sum of the modules at their maximum power points.
Output After Mismatch	The total energy output of the modules, factoring in all system constraints (e.g. series & parallel mismatch, voltage drop, etc.).
Optimizer Output	If DC optimizers are present, this shows the total output of the optimizers, factoring in their efficiency curves and principles of operation.
System DC Output	The total energy output of the DC system, accounting for all wire resistive losses.
System AC Output	The total AC energy output from the inverters, taking into account inverter performance losses.



Questions or Comments:

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