PV Studio 2 User's Guide

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1 Introduction

Thank you for purchasing the SolarPathfinder PV Studio application. We believe you will find this to be a worthwhile investment in assisting with your solar site analysis. The PV Studio application is designed to remove the mundane calculation tasks that current users of the SolarPathfinder are forced to perform. By doing so, users can expect quicker and more accurate results in addition to having permanent reports regarding a prospective installation site.

A primary feature of PV Studio is the design editor that enables you to layout the modules on the roof plane or other solar target. The layout area has an "insolation map" to show you the part of the solar target that receives the greatest sun energy. There are also no-module zones and visible set back regions where no modules are placed during the auto-layout.

To use this application, you will need access to a computer running Microsoft Windows (XP, Vista, 7, 8, 10) and a digital camera. Administrative privileges will be required to install the application. However, normal users can run the application without having administrative privileges.

2 Preliminary Setup

Before creating your first report, make sure that you have the necessary weather data. If you haven't yet purchased a license for PV Studio, you will be running in evaluation mode. While in evaluation mode, you will not be able to produce a report or export data.

➢Installing Weather Data 45
➢License Validation 46

3 Creating a Report

To complete a report, work your way through the following steps.

3.1 Capturing Your Image

The SolarPathfinder PV Studio application works off of one or more user-supplied digital picture(s) of the SolarPathfinder dome. There are several steps that need to be followed to get the best results.

STEP 1: At the prospective site, set up your SolarPathfinder so that it

is facing magnetic south and adjust the unit for level.

STEP 2: Take a digital picture of the dome reflection. The application is relatively forgiving regarding the size and orientation of the picture.

There are several pointers that will help you take the best possible picture.

- Your body should be on the north side of the unit so that your reflection is not covering the tracing area.
- The camera should be looking straight down at the Pathfinder unit. If you are too far off, this will introduce skew into the picture and affect the calculations. One way to confirm your positioning is that the blue plastic housing should be equally wide on all sides of the dome. If it is wider on one side than the other, you are not looking straight down on the unit.
- The calibration step will take care of image normalization. When looking through your camera viewfinder, the Solar Pathfinder unit should fill as much of the viewing area as possible, yet include ALL of the blue (or green) plastic housing. Camera resolution does not matter.

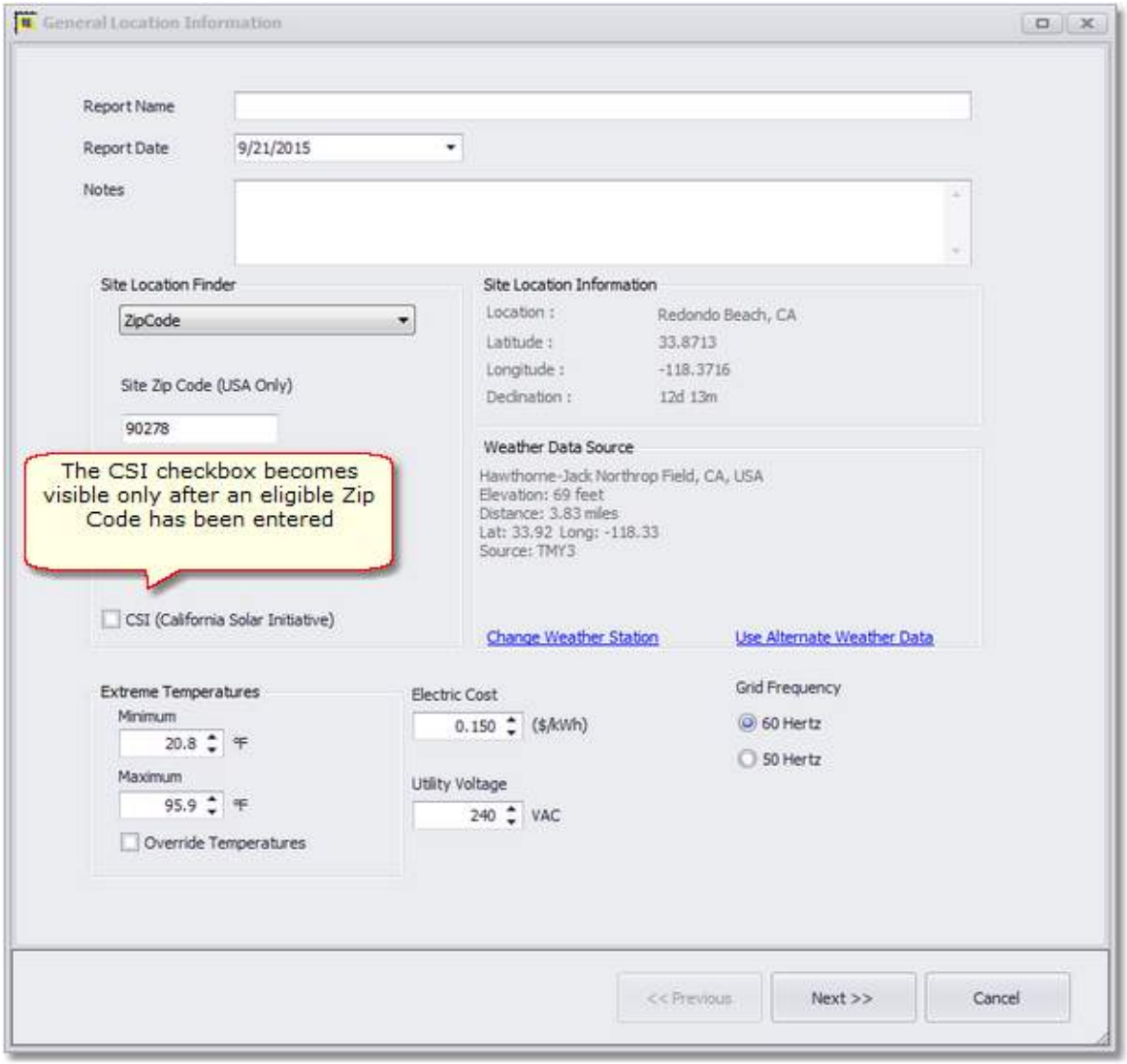
Note: If you are unsure whether you obtained a good picture, it may be worthwhile to take several.

Example of a Properly Aligned Image

STEP 3: Transfer the digital image that was just taken to your computer. There are many conventional methods for doing this, such as removing your flash memory card, transfer via USB cable, etc. Consult your digital camera user's manual for more information. At this point, we are ready to start the SolarPathfinder Assistant application.

3.2 Enter Location Information

Enter information about your site location and select a weather station.



General Location Information Form

Report Name

This text appears as the title on the cover page and is also shown again on the title page (2nd page of the report). On the Cover Page, the size of the report name is determined by the PDF Cover Page Title Font Size 78.

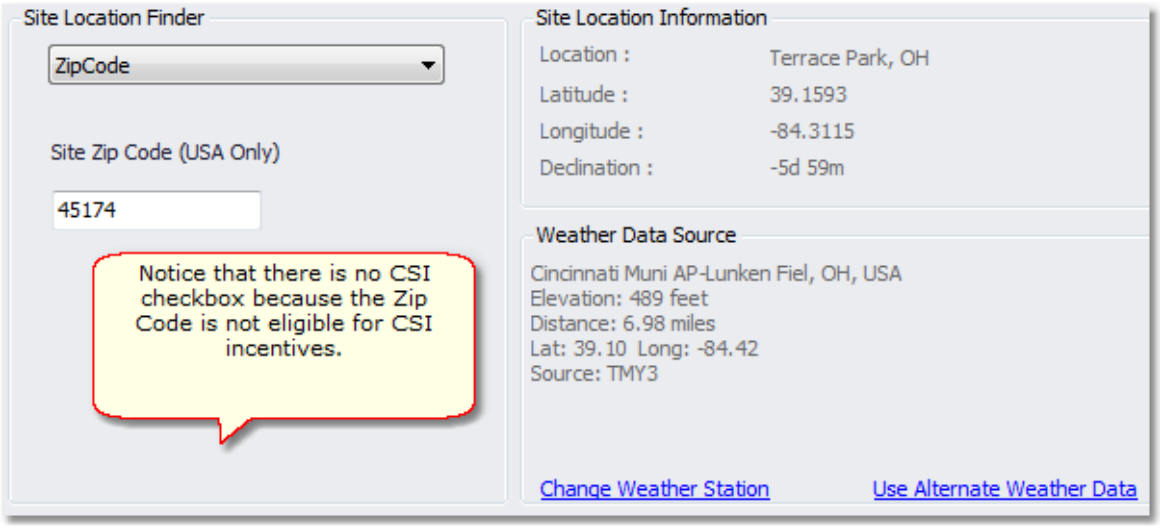
Report Date

Appears on the cover and the title page of the report.

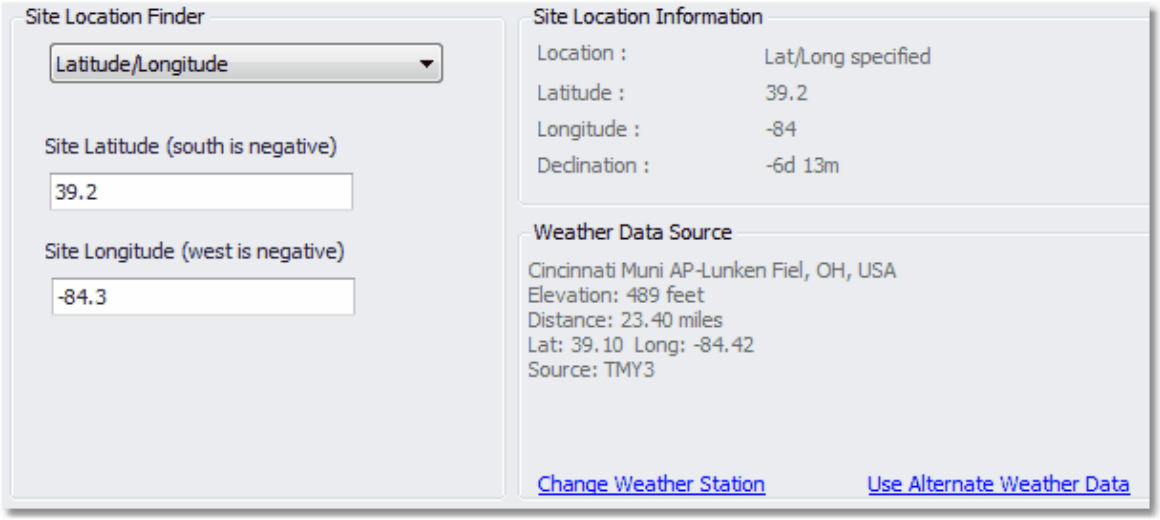
Notes

Appears on the title page.

Site Location Finder



Site/Location Information (zipcode - USA Only)



Site/Location Information (lat./long.)

When defining a report, you must enter the location information for the analysis site. You can either enter the Zip Code (United States only) or the latitude/longitude pair. To toggle between the two input modes, select an option in the location drop-down list.

The application uses the location information to determine latitude & longitude (in the case of Zip Code entry), what template to use, magnetic declination, and the weather station that is closest to the site location.

For latitude/longitude entry, negative latitudes are south of the

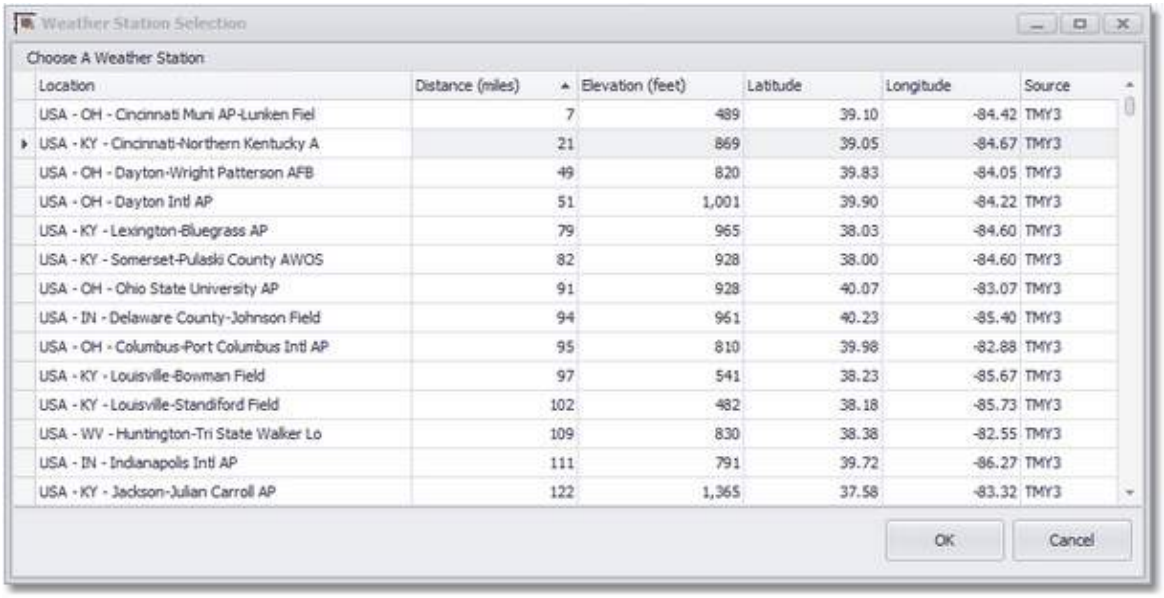
equator and negative longitudes are west of the prime meridian (i.e. USA longitudes for all 50 states are negative).

CSI Checkbox

See the California Solar Initiative 94 page for more information.

Weather Station

PV Studio uses historical weather data that was measured at various locations around the world. This data is used during the analysis phase to determine solar exposure. When you enter a Zip Code, the closest weather station is determined. In some cases, this might not be the best selection. You can override the automatic weather station selection by clicking in the "Change Weather Station" link to open the Weather Station Selection window:

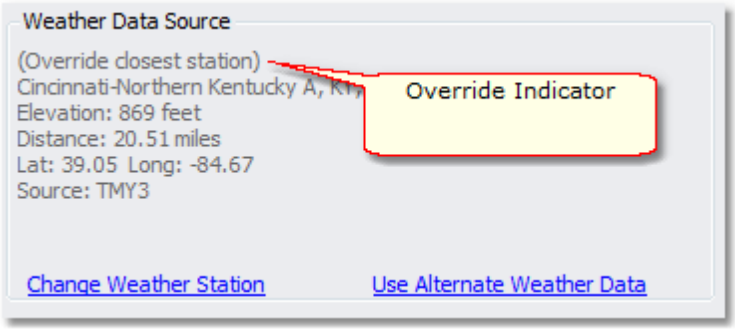


Weather Station Selection Form

Here, you can choose an alternate weather station. Each entry gives the distance from the analysis location as well as the elevation of the weather station. The weather station data can be ordered by any of the columns. For instance, to order the list by the distance from the analysis site, simply click on the "Distance (miles)" column header.

Select an alternate station using the mouse and click "OK" to accept this new station or "Cancel" to exit without selecting a new station.

If you have selected a new station, the General Location Information Form will be updated to reflect your new selection.



Overridden Weather Station

Once you have overridden your default weather station, the form is updated to reflect this information.

Extreme Temperatures

These are the extreme minimum and maximum temperatures encountered at your site. These values are obtained from the weather data and you should only change these values if you have reliable data. These temperatures are used to calculate the string sizes for the inverters since the voltage output for PV modules are sensitive to the ambient temperatures. The highest voltages are reached on the coldest days.

Electric Cost

This value is used to calculate how much the generated power will save on the electric bill. The values can be found in the cost savings column of the report.

Utility Voltage and Frequency (not visible if CSI is enabled)

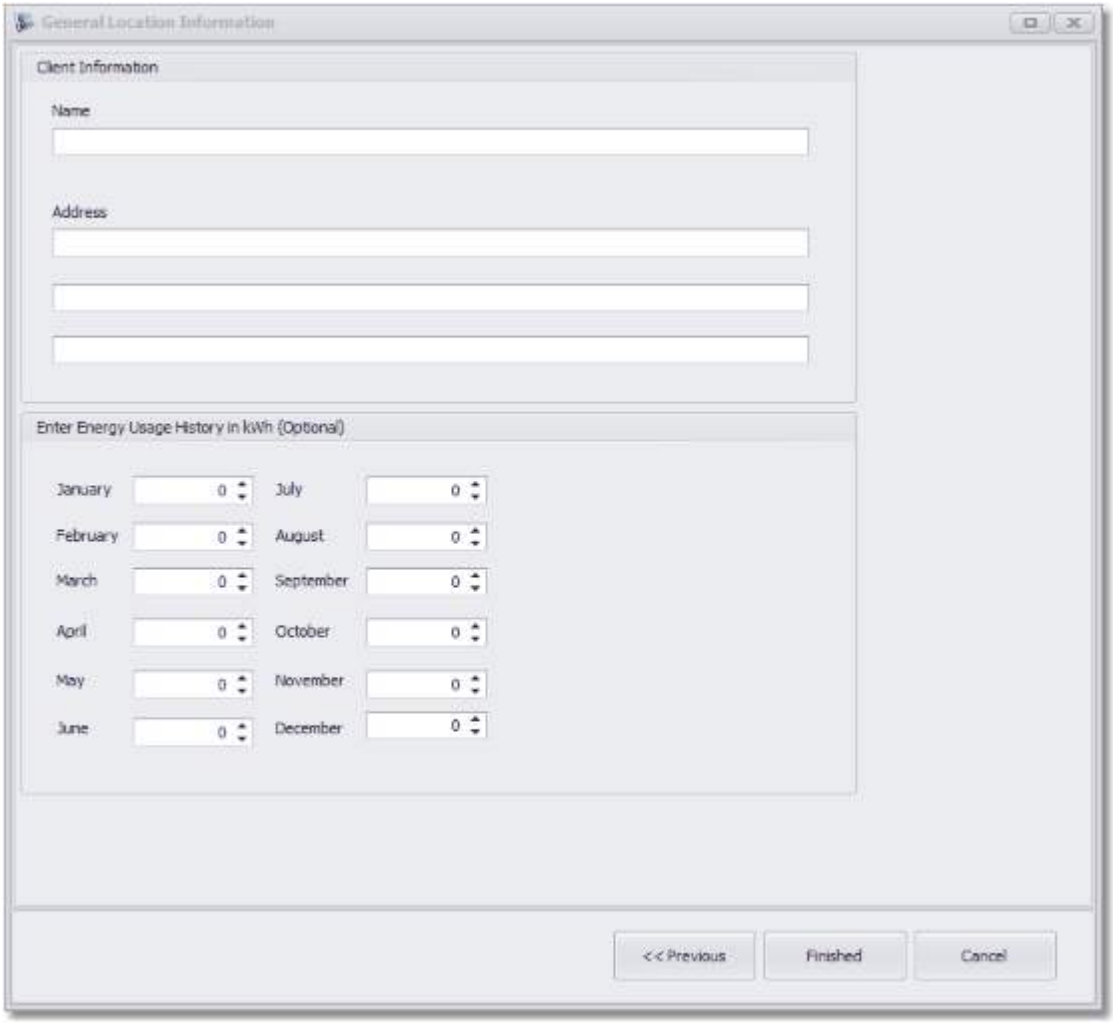
The is the electric company grid connect voltage and frequency of your inverter.

CSI Data

If the CSI checkbox has been selected, you will see a CSI page after clicking the Next Button. See the California Solar Initiative 94 page for more details.

Client Location Information

Clicking the Next Button will bring you to this page:



General Location Information Form (Client Information Part)

The client information will appear on the cover page of the PDF report preceded by the label "For:". If you leave all these fields blank, then the "For:" text will not appear on the cover page.

Energy Usage History

If you enter monthly usage history in kWh into this section, then the values will be displayed in the production graph 62. If all the values are zero then no usage history will be added to the production graph 62.

3.3 Decide Whether to Do a Module Layout

The module layout feature is enabled by default. This method requires more time to complete a report because you will have to place modules on the solar target and connect each of the modules to an inverter.

To disable the module layout feature, go to the the menu options command 51 and select Disable Module Layout command.

The stacked menu navigator commands will change depending on the options you choose.

Choose one of these options:

Module Layout Steps 13

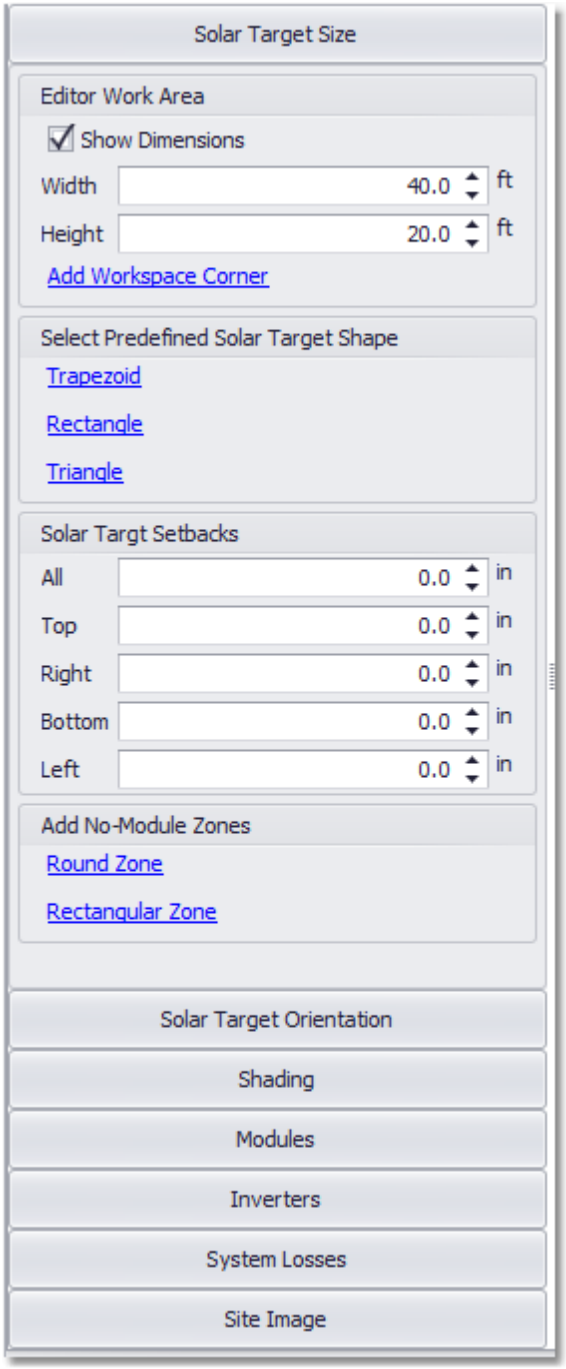
or

No Module Layout Steps 28

3.4 Module Layout Steps

To the left of the editor is the stack editor navigator. The image below is the navigator for the module layout option. The other navigator is for the no module layout option 28.

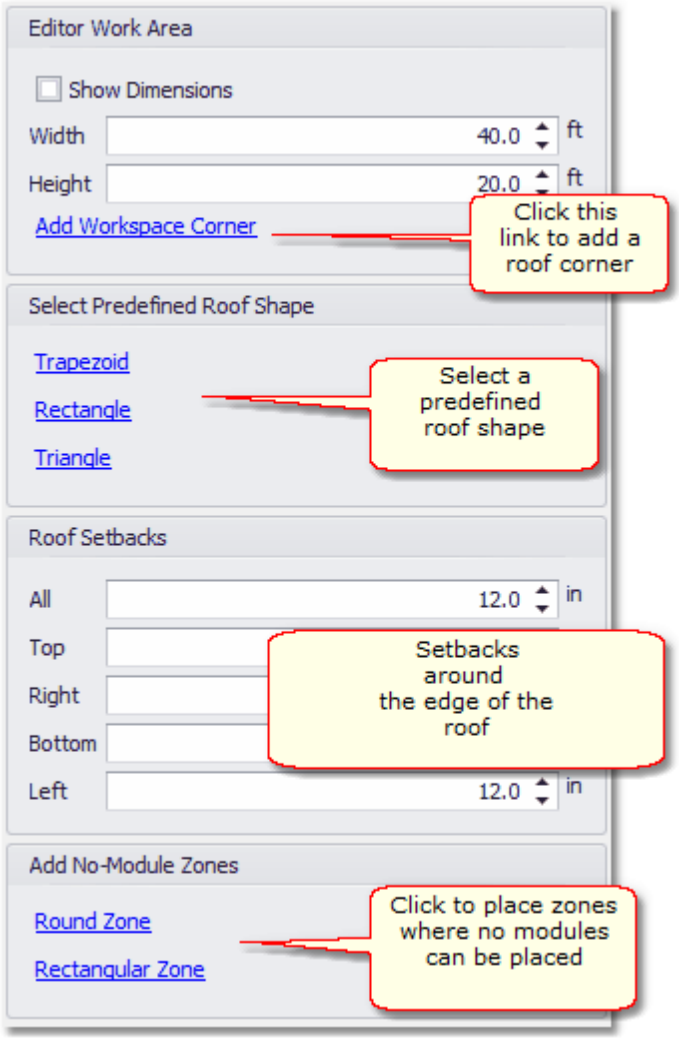
Clicking on each of the buttons below will open a separate input window where you enter information about your system.



3.4.1 Enter Solar Target Size

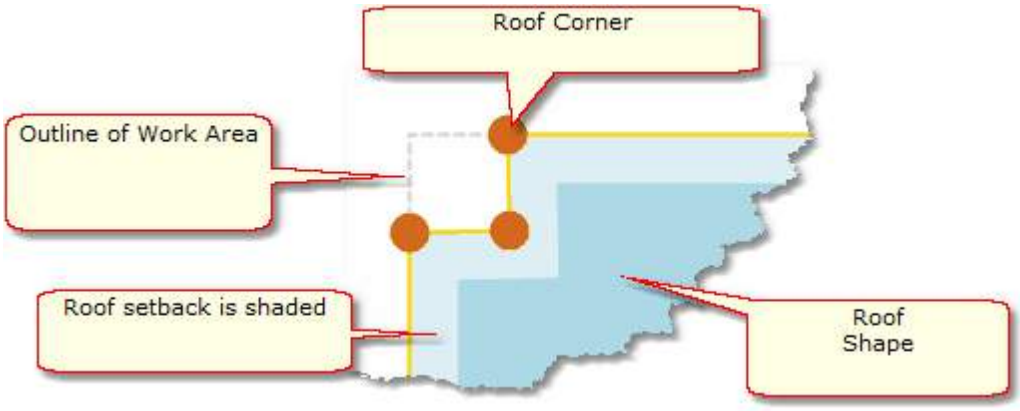
Solar Target Size Window

Define the solar target area where modules will be placed.



Roof Properties window in the Stacked Editor Navigator

Editor Work Area



Anatomy of the editor work area

The Editor work area is always rectangular and must be large enough to hold the roof shape. A light gray dashed-line rectangle marks the

outline of the work area. Roof corners cannot be moved outside of the work area.

The default roof shape has 4 corners but you can create almost any shape by adding additional corners to the edge of the roof area. To add a corner, click on the "Add Workspace Corner" link, and then move the mouse cursor to the location of the new corner. Add as many corners as you need. Corners can be moved by clicking and dragging them to create the desired cut-out area.

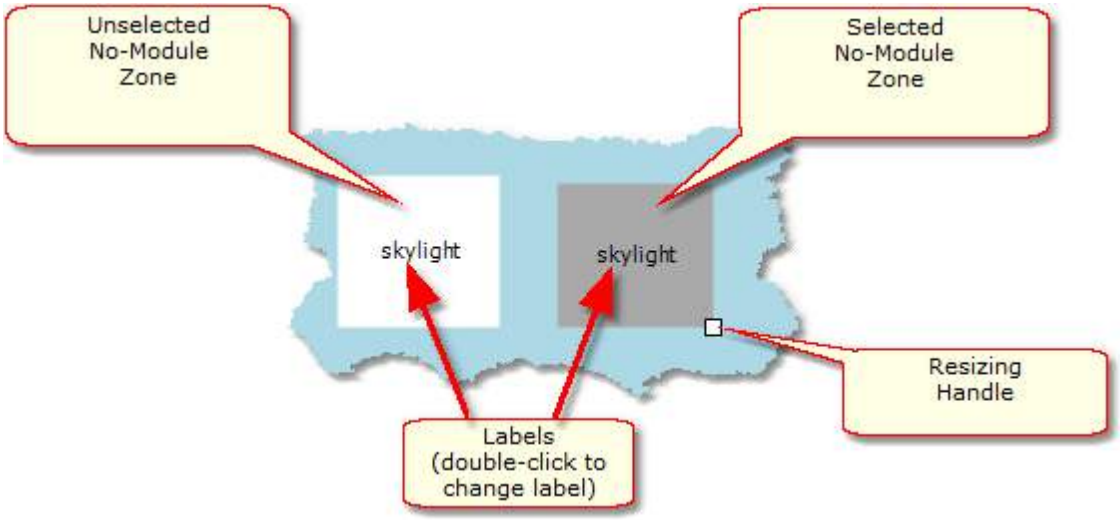
Predefined Roof Shape

Clicking on any of the predefined roof shape links will delete any custom corners you may already have placed on the roof shape.

Roof Setbacks

The setback area runs along the edge of the roof and is used to show an area where modules should not be placed. Also, the automatic module layout function will not place modules in the setback area.

No-Module Zones



No-module zones are obstructions on the roof where no modules can be placed, such as a vent, skylight, or chimney. You have the option of placing a round or rectangular shaped zone. To place a zone, click on the link and move the mouse cursor to the desired location on the roof and click once more to place the zone. Double-clicking on the zone will open a text box where you can enter a descriptive label for the zone. An unselected zone will be white and a selected zone will be gray. Selected zones can be moved or re-sized. To move a selected zone, click on the zone and drag the zone while holding down the mouse button. In a similar manner, a zone can be re-sized by clicking on the resizing handle and dragging the handle by moving

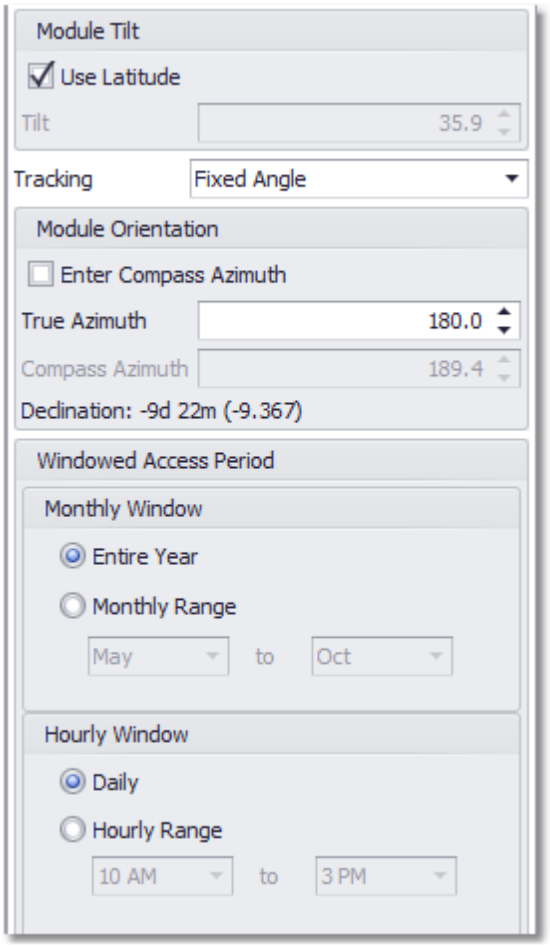
the mouse while holding down the mouse button.

As with setback area, the automatic module layout function will not place modules in these zones.

3.4.2 Enter Solar Target Orientation and Windowed Access

Solar Target Orientation Window

Enter the direction the solar target is pointing.



Plane Orientation window in the Stacked Editor Navigator

Tilt Angle

The tilt angle represents the angle of the PV array with respect to horizontal. Note that tilt angle is not applicable for two-axis PV tracking arrays. By default, the tilt angle is set to the latitude for the current location. This generally gives the most solar exposure for the site. If you need to override this value for some reason, you can click in the "Use Latitude" checkbox to remove the "check", which will

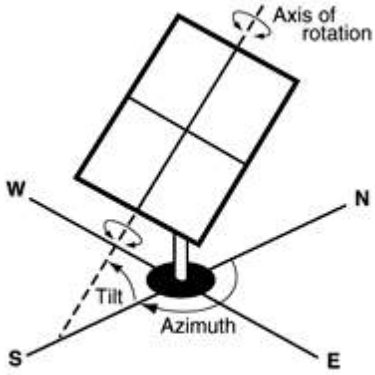
enable the text box for manual entry.

Use Latitude

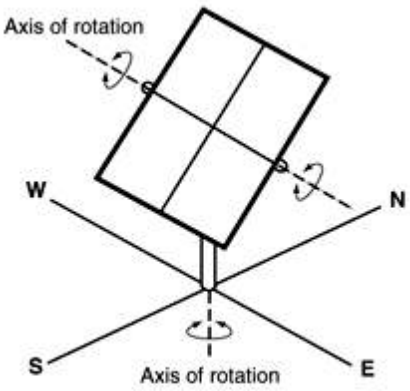
Select this checkbox to set the Tilt to the site latitude.

Tracking

This selection specifies the type of tracking used by the PV array. This can be fixed (no tracking), one axis, or two axis. One axis tracking is used to track on the azimuth, and two axis tracking affects both azimuth and tilt. Tracking arrays are not applicable for ecological studies.



One axis tracking PV array with axis oriented south.



Two-axis tracking PV array

Azimuth (True Azimuth)

For a fixed PV array, the azimuth angle is the angle clockwise from true north of the direction that the PV array faces. For a sun-tracking PV array with one axis of rotation, the azimuth angle is the angle clockwise from true north of the direction of the axis of rotation. The azimuth angle is not applicable for sun tracking PV arrays with two axes of rotation.

The default value is the south-facing azimuth angle of 180° (for southern hemisphere users, the default value is the north-facing azimuth of 0°). This normally maximizes energy production. Increasing the azimuth angle favors afternoon energy production, while decreasing the azimuth angle favors morning energy production.

The table below provides azimuth angles for various headings.

Heading	Azimuth

	Angle (°)
N	0 or 360
NE	45
E	90
SE	135
S	180
SW	225
W	270
NW	315

Compass Azimuth

This field converts a magnetic heading to the true direction. The value entered in this field should be the compass heading that your arrays are facing. When the value is entered in this field, the True Azimuth field will be automatically adjusted to account for magnetic declination.

Azimuth Information On the Internet

Information from NREL about the azimuth as it relates to PV arrays:
http://rredc.nrel.gov/solar/calculators/PVWATTS/system.html#azimuth

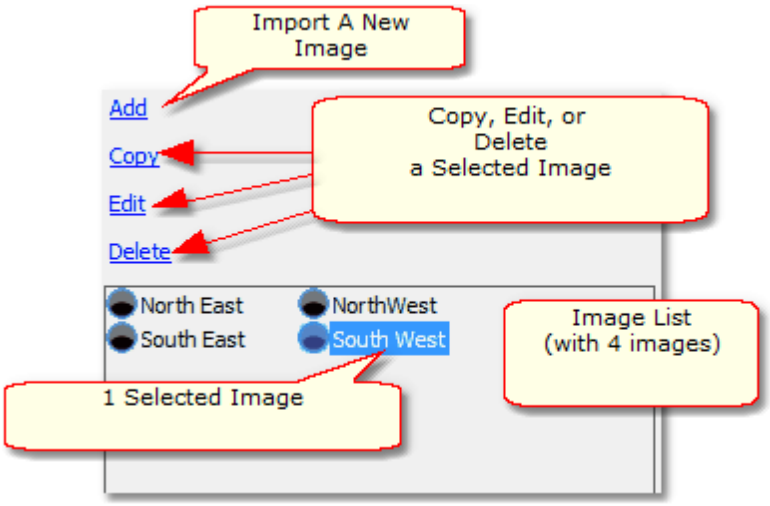
Windowed Access Period

The Windowed Access feature enables you to look at the solar data for particular months of the year and/or particular hours of the day. The default is the entire year and all hours of the day. Using a smaller solar access window enables you to focus on the most productive times of the day and/or months of the year, which might improve your efficiency ratings if the window has less shade.

3.4.3 Place Site Survey Images

Shading Window

Add the site survey images to this design.



Shading window in the Stacked Editor Navigator

This menu is used to create and manage your site images.

Add

Brings up a dialog to load, crop, orient, and trace your SolarPathfinder site image. See create one or more traces 31.

Select An Image

Once there are two or more images in the image list, you can select a single image by clicking on the name.

Copy

This function is enabled when you've selected an image from the image list, you can use it to create a duplicate image that can then be edited to make "what-if" shading changes.

Edit

When an image is selected, this function uses the same trace dialog 31 as the one you used in the Add function; step through the dialog pages to make any changes to the selected image.

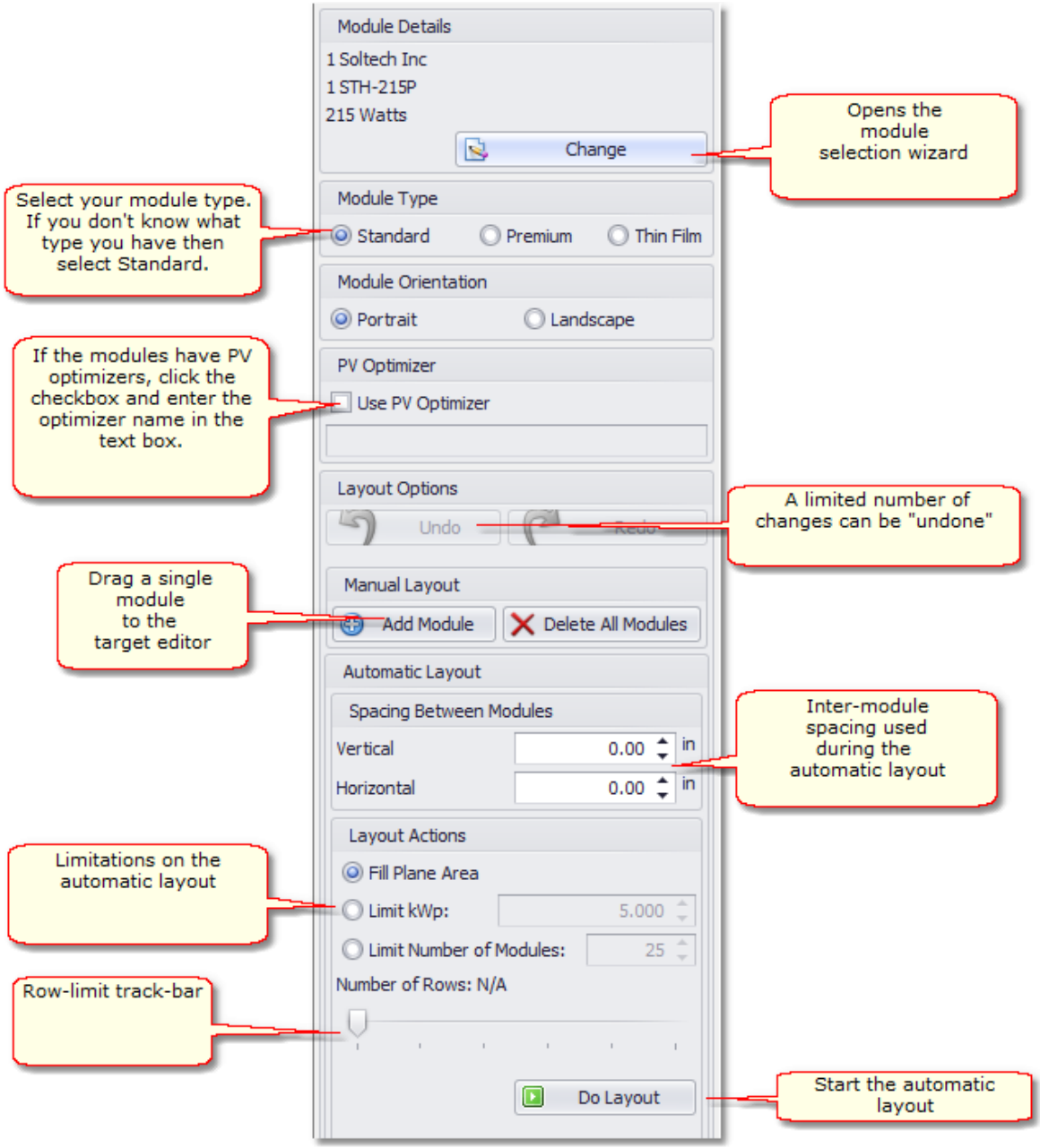
Delete

Removes the selected image from the image list.

3.4.4 Select and Place Modules

Modules Window

Place modules onto the solar target.



Modules window in the Stacked Editor Navigator

Module Details

Clicking the "Change" button opens the Module Selection Form 84.

Module Type

This allows you to select "Premium" or "Thin Film" modules, which have better performance. If you do not know what type of module you have, select "Standard."

Module Orientation

Determines the way modules are placed on the target area. This does not affect modules that have already been placed on the target area. To change the orientation of modules already on the target, you must first select the modules you want to change, and then select the desired orientation in the Module Detail Window 55.

PV Optimizer

If your modules have PV Optimizers, then select this checkbox and enter the name of the optimizer in the text box.

Undo/Redo

The Undo and Redo buttons can be used to undo and redo module delete or move actions.

Add Module

After clicking on this button, the cursor will change to a PV module; move the cursor to the target and click on the location where you want to place the module.

Manual Layout

Use this to place the modules on the target one at a time. This can be tedious and slow. Use the automatic layout to place large numbers of modules.

Automatic Layout

Use this to quickly fill a target area with modules. If an inverter has already been selected then modules will be placed into inverter strings on a minimum module per string basis with new inverters being added as necessary. All inverters and modules will be removed from the work area before doing an automatic layout.

No modules will be placed in the roof setback area and the no-module zones.

Spacing Between Modules

The automatic layout will use this spacing while placing the modules.

Layout Actions

There are three types of layout actions, the remaining options merely limit these three actions.

Layout Actions	Description
Fill Plane Area	This selection will fill the entire solar target.
Limit kWp	When this radio button is selected, the number of modules placed will not exceed the stated kWp rating.
Limit number of modules	When this radio button is selected, the number of modules placed will not exceed the stated number of modules.

Limit Number of Rows

This track-bar affects all layout actions. When the track-bar is all the way to the left, such that the row-limit is "N/A", the modules will be placed onto the plane in a row first order. However, if the row limit is enabled by moving the track-bar slider to the right, then modules will be placed onto the plane in a column-first order. The row-limit number is the maximum number of rows of modules that will be placed onto the solar target.

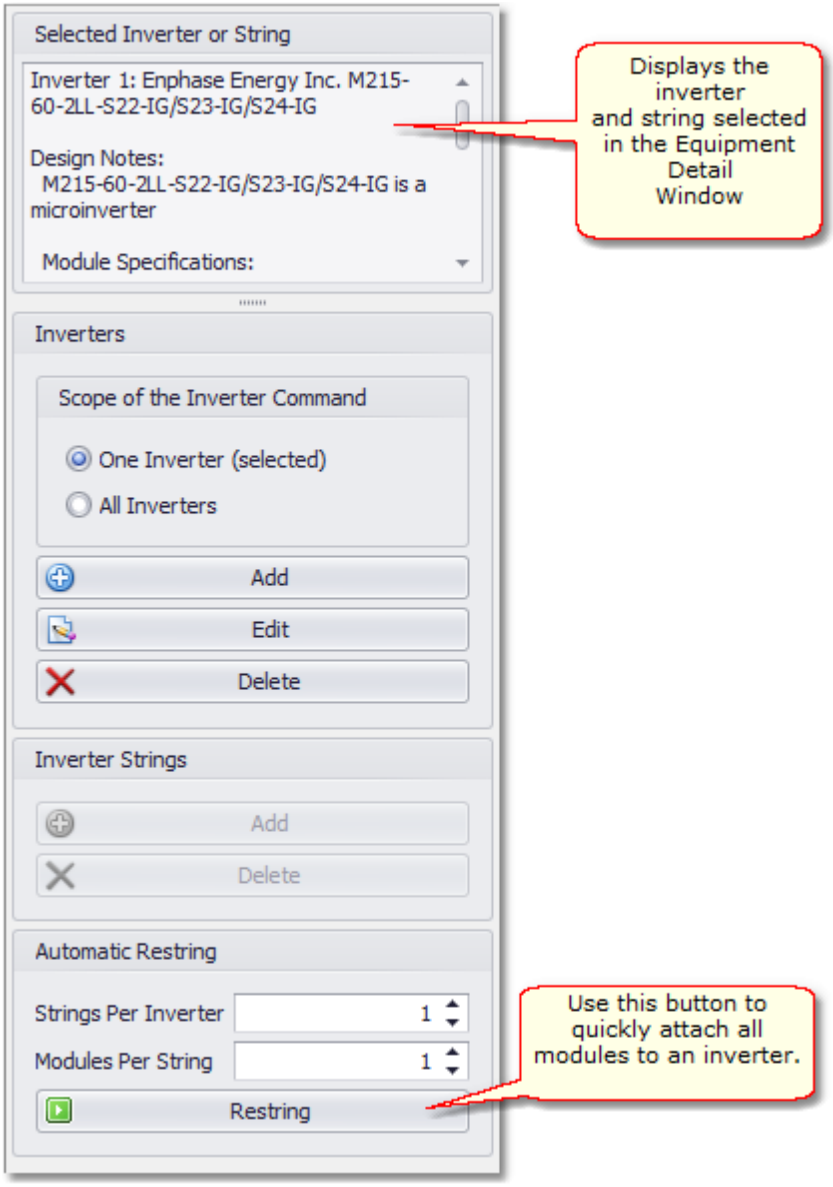
Unstated Layout Limits

No modules will be placed into a no-module zone or into the roof setback area.

3.4.5 Enter Inverter Information

Inverters Window

Select and string the inverters.



Inverters window in the Stacked Editor Navigator

Selected Inverter or String

This information is displayed after an inverter or string has been selected from the Equipment Detail Window 56.

Inverters

The Add function is used to add one inverter to the design. Clicking on Add opens the Inverter Selection Form 87. Once an inverter has been added, additional inverters will automatically be added during the Automatic Module Layout function or during the Automatic Restring function. The Add function is only available when the "One Inverter" radio button is selected. The Edit and Delete functions can

be applied to the selected inverter or to all inverters. If you edit the inverter when the "All Inverters" radio button is selected, then all inverters in the current design will be changed to the manufacturer/ model you selected in the edit dialog.

To use inverters from other designs, see Multi-Design Inverters 80.

Inverter Strings

The Add and Delete functions will only be available after you have selected a particular string in the detail window 56. (You cannot select a string by merely clicking on the inverter name, but you must click on the specific inverter string name.) When you have selected a string, the "Selected Inverter or String" window will show the string name that has been selected and these buttons will be enabled.

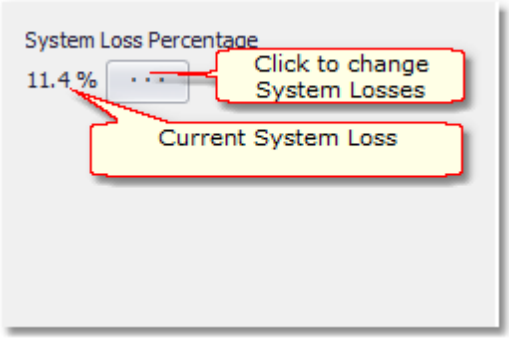
Automatic Restring

This function will reassign all modules to inverter strings using the exact values given the two boxes above the button (the first entry is "strings per inverter" number and the second entry is the "modules per string" number). For example, if you are using a Microinverter for each module, then you would enter a 1 in each numeric box. New inverters will be created, if necessary, and inverters with no modules will be removed.

3.4.6 Enter System Losses

System Losses Window

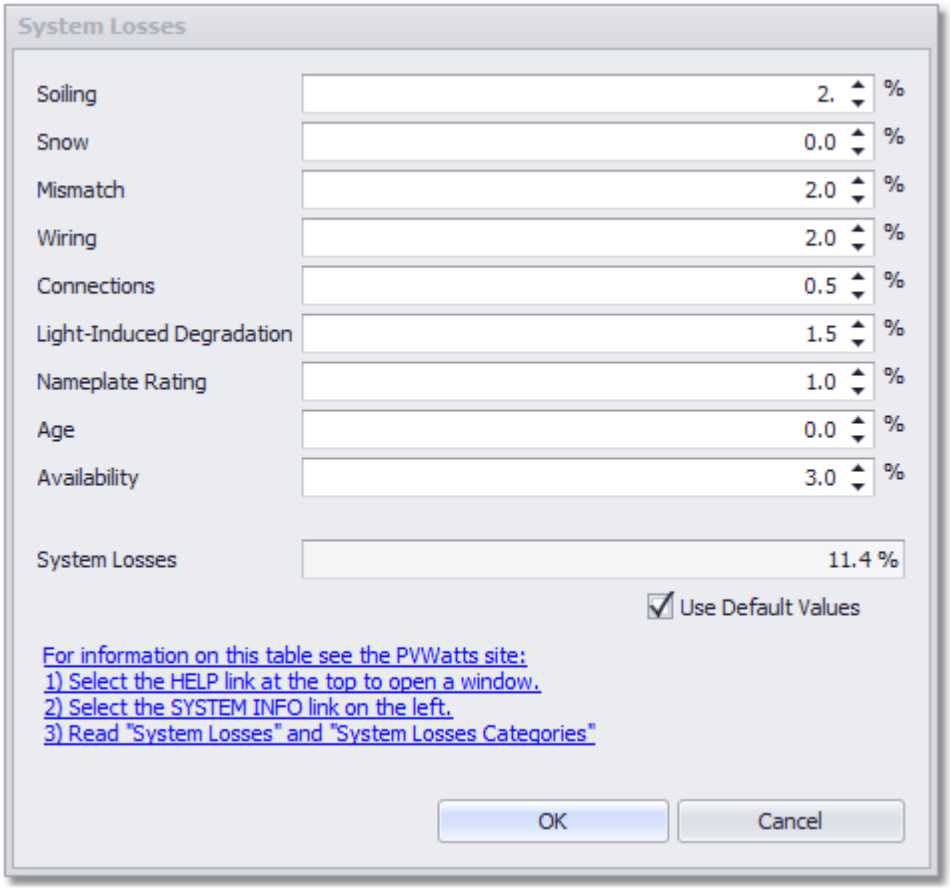
The system losses is a percentage that is applied to the total system output to arrive at a realistic energy production value for your system. This method is a standard way of accounting for the various real-world factors that can reduce the ideal energy production of the whole system.



System Losses window in the Stacked Editor Navigator

System Losses Categories

Edit the system losses categories by clicking on the button.



System Losses Categories

Default System Losses

- With a central string inverter the default system losses are 11.4%
- With Microinverters or PV Optimizers, the mismatch is set to 0% and the default system losses are 9.6%

Shading Category

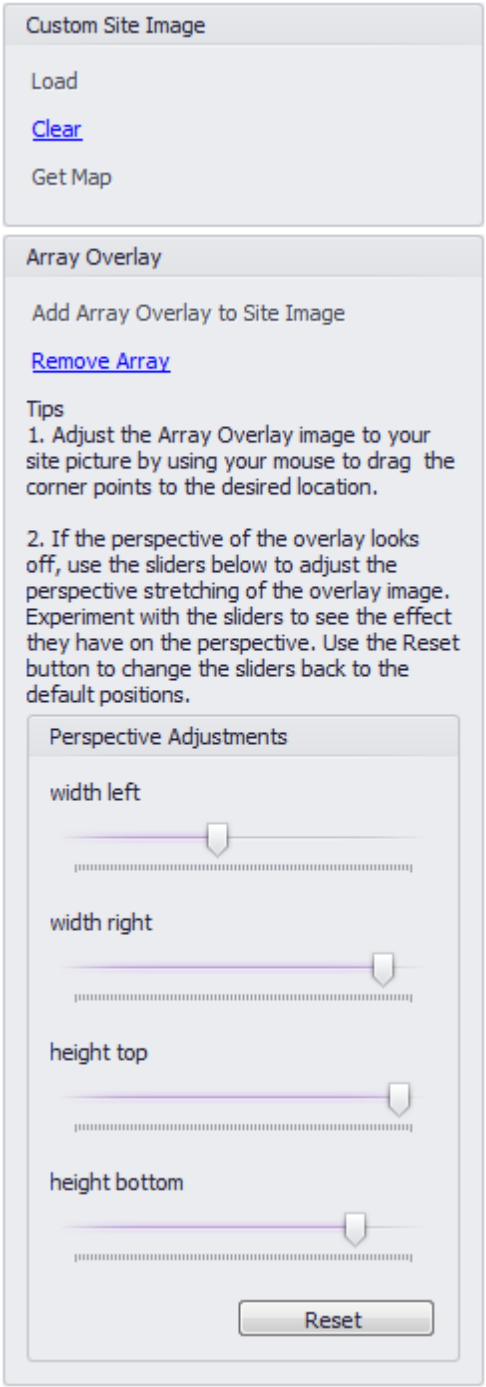
This system losses calculation differs from the NREL system loss in that it does not include the a shading loss value since that is added separately in PV Studio.

NREL System Losses Help

Link to PV Watts website(http://pvwatts.nrel.gov/index.php). To get to the system losses information: 1) select the help link at the top, 2) in the new window, select the SYSTEM INFO link on the left, and 3) read the "System Losses" and "System Losses Categories" sections.

3.4.7 Enter Site Image

This window gives you the option of adding a site photograph or a overhead satellite map.



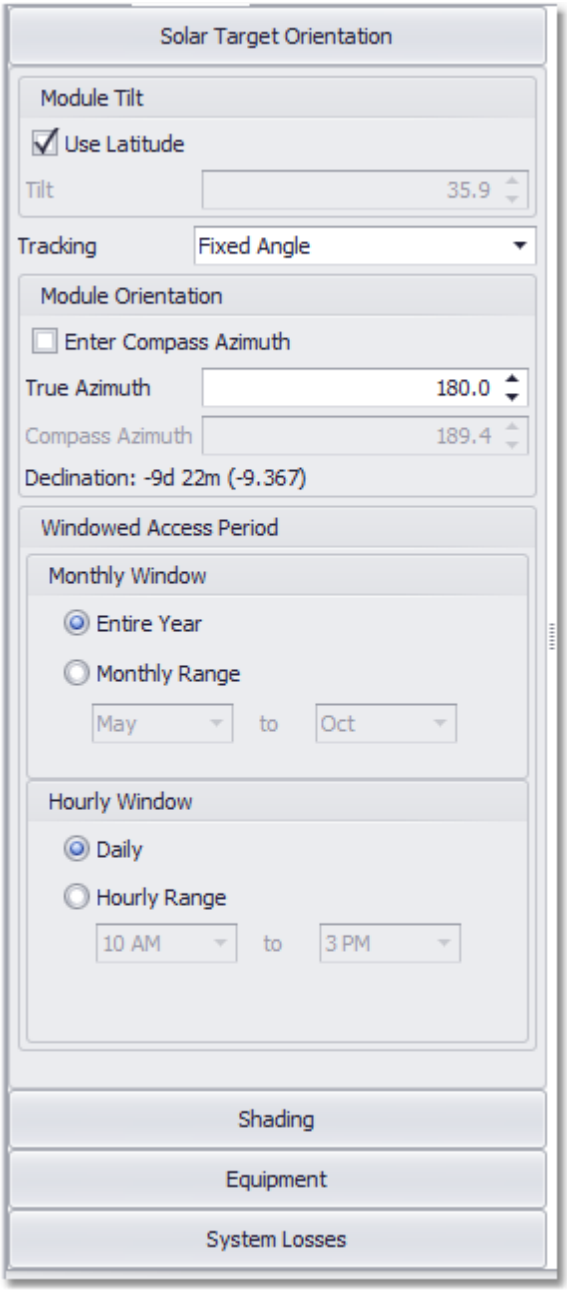
The module layout of this design can be placed over the site image.

The example below uses the perspective distortion adjustments shown above. The perspective adjustments are complex and you will need to experiment a bit to use them. You can avoid the need for the perspective adjustment by shooting a photograph that this perpendicular to the side of the house.

3.5 No Module Layout Steps

The image below is the navigator for the no module layout option. The other navigator is for the module layout option 13.

Clicking on each of the buttons below will open a separate input window where you enter information about your system.



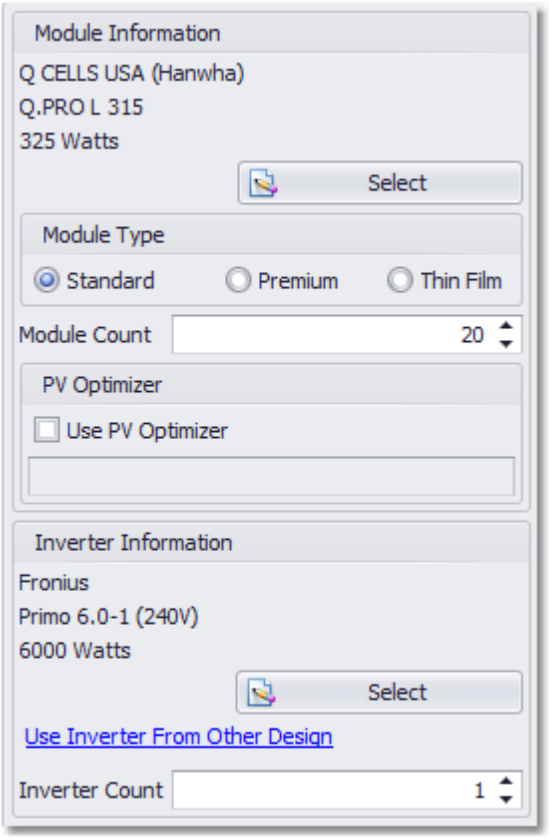
3.5.1 Enter Solar Target Orientation

There will be no solar target in this view, but the solar target orientation window 17 will be the same as the one with the layout options.

3.5.2 Place Site Survey Images

The commands to manipulate the surveys is the same as the site layout page 19, except that the surveys will either be placed on a generic background or on a custom site picture.

3.5.3 Enter Modules and Inverters



Module Information

The details for entering module and optimizer information is the same as the module layout option 20.

Inverter Information

For the no-layout option, specifying the inverters is much simpler. You have the option of using one type of inverter and the option of specifying the number of inverters. If you want to use one inverter over multiple designs then select the "Use Inverter From Other Design" to select that option.

3.5.4 Enter System Losses

See the System Losses 25 page in the Module Layout Steps.

4 Creating One or More Traces

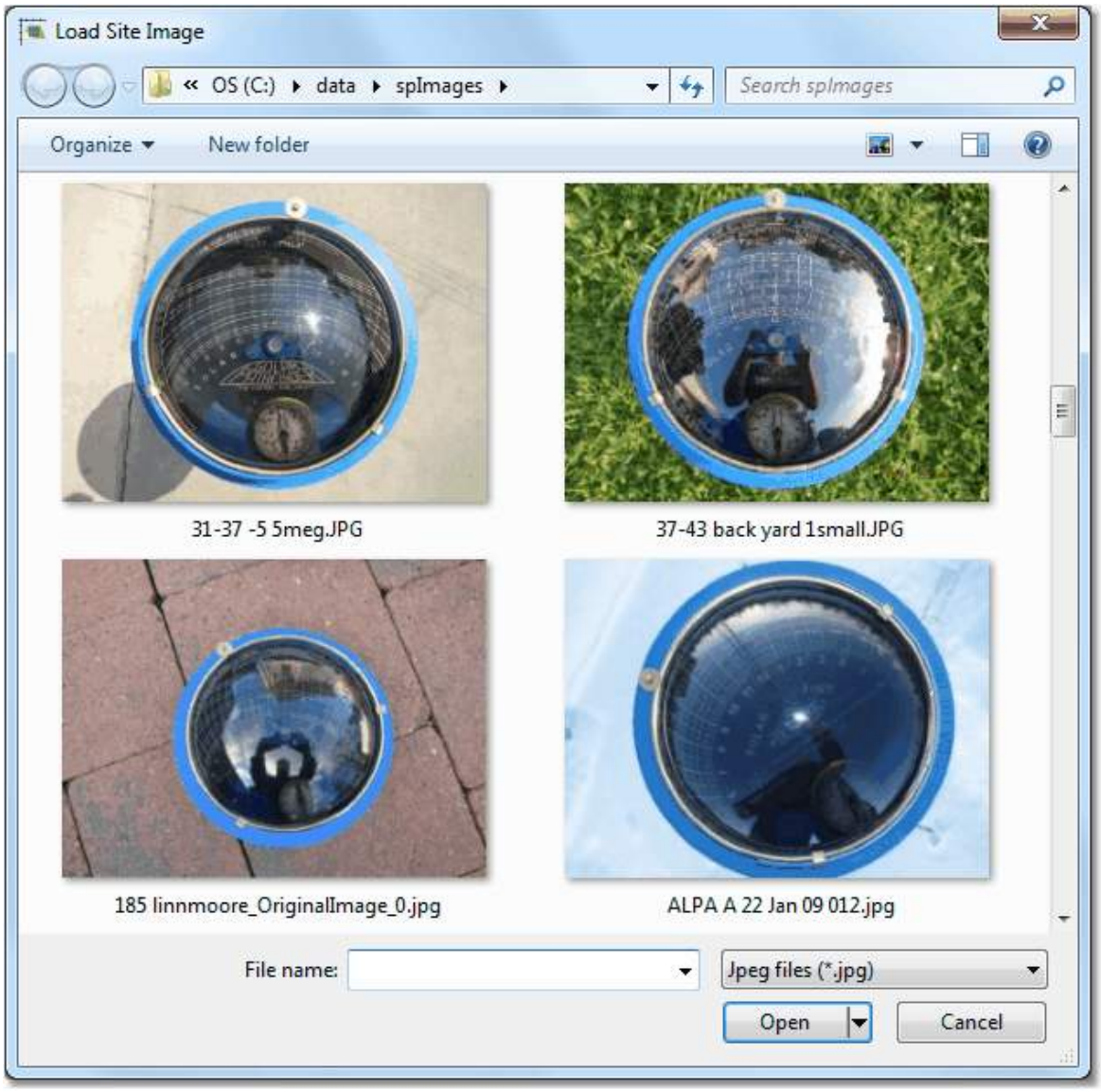
Creating a trace is the process where you take your captured image 5 and prepare it for use by the analysis software. The trace dialog will guide you through these steps. To start the dialog, click on the "Add" link in the Navigator Shading Window 19.

Trace Dialog Steps

1. Load Survey Image 31
2. Cropping the Image 33
3. Calibrating the Image 35
4. Trace the Image Obstructions 39
5. Enter Deciduous Areas 40 (Optional Step)
6. Adjust Survey Position 41 (Optional Step)

4.1 Load Your Survey Image

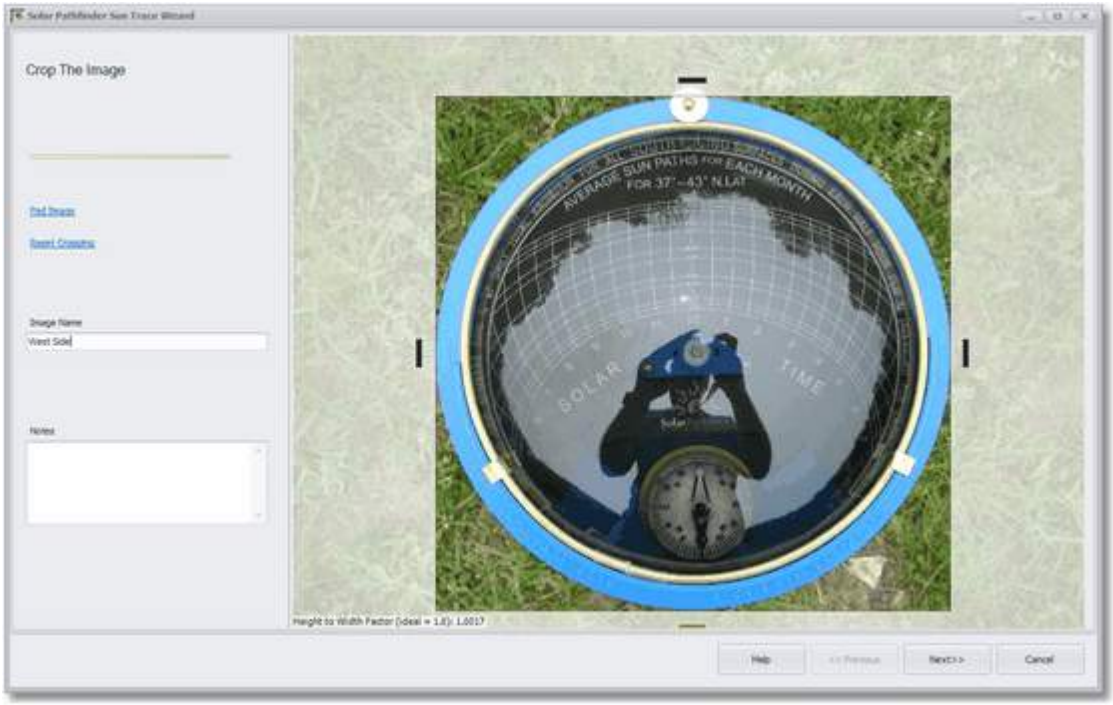
After you have clicked on the "Create Report" button in the Report Creation Dialog, you will see the "Load Site Image" dialog box.



Select your image and click on the "Open" button to continue...

You also have the option of loading Solmetric Sun Eye 90 images.

4.2 Cropping the Image



Trace Wizard at the Cropping Step

Set All Four Crop Handles

The application uses the cropping step to determine where your Pathfinder is in the image and how much skew has been introduced. It is very important to set these crop points as accurately as possible.

There are four crop handles (left, top, right, bottom). The software tries to set the cropping handles but because of the complexity of these images, they will not be completely accurate, so you must manually finish this step. These handles should be dragged so that the translucent box frames the outside of the plastic Pathfinder housing.

Bad Cropping Examples

Bad Crop #1 (leaves too much space outside the blue ring)

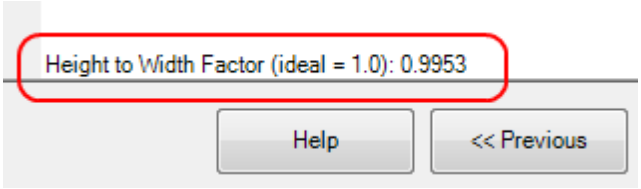
Bad Crop #2 (cuts off part of the blue ring)

Good Cropping Example

Good Crop

Image Skew

Once you have set your crop handles, you can determine your image skew by examining the "Height to Width Factor" on the bottom left of the cropping control.



Height to Width Factor

If there is no skew, the height to width factor will be 1.0, meaning

that the Pathfinder is a perfect circle. Once you are within 0.99, do not attempt to adjust the cropping handles further to fix this. The software will adjust the picture to correct for this skew.

Pad Image

Possibly you have taken a picture that is missing a portion of the pathfinder, such as the bottom of the image. Using the pad image link you can simulate cropping to the outer edge of the blue frame. Adding space will allow the image to be cropped as if the whole picture were present. However this is only an estimate for your convenience, to be used to continue the analysis. Your best course of action would be to go out to the field again and take new pictures.

Image Name

This is the label that will be attached to the survey in the survey list and on the roof layout.

Notes

Whatever text you enter into this box will be displayed with the image on the report.

Next

After the crop handles have been set to your satisfaction, click the "Next" button to continue. This will take you to image calibration.

If you try to skip cropping, you will be notified that doing so is not recommended.

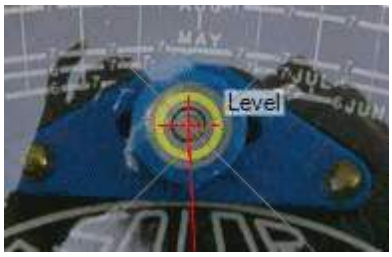
4.3 Calibrating the Image

In order to properly analyze the Pathfinder image, the application needs you to indicate the position of the level and its relationship to the North/South line.

Calibration Window

Calibration Instructions

Using your mouse, click and drag the reference point marked as "Level" to the center of the level. Click and drag the reference point marked as "Below Compass" so that the red line passes directly through the North/South points on the compass.



Level Reference Point

Below-Compass
Reference Point

The "below compass" line will always remain at a fixed distance from the level point. If you are using the keyboard to move the "below compass" marker, the up and right arrow keys will move the point counter-clockwise whereas the down and left arrow keys will move the point clockwise around the image. If you do not set either the level or compass reference points, you will be notified of the error with a dialog box.

You can bypass the setting of reference points if by some slight chance the picture was taken so perfectly that everything lines up by default, but most likely that is not the case. The reference point locations are crucial to the proper analysis of your image. It is recommended that you click "No" and set your reference points properly.

You will notice that there are gray lines drawn diagonally across the picture. The intersection of these lines gives a visual indication as to where the level should be. If the center of the level is offset from this, this indicates that parallax was introduced into the picture. If this difference is significant, it can have adverse effects on the outcome. The software will make a reasonable effort to try to correct this discrepancy. If the error is too great, you will be notified of this with a dialog box.

Should you need to reset the reference points to their default location, click the "Reset Reference Points" link on the bottom left of the form.

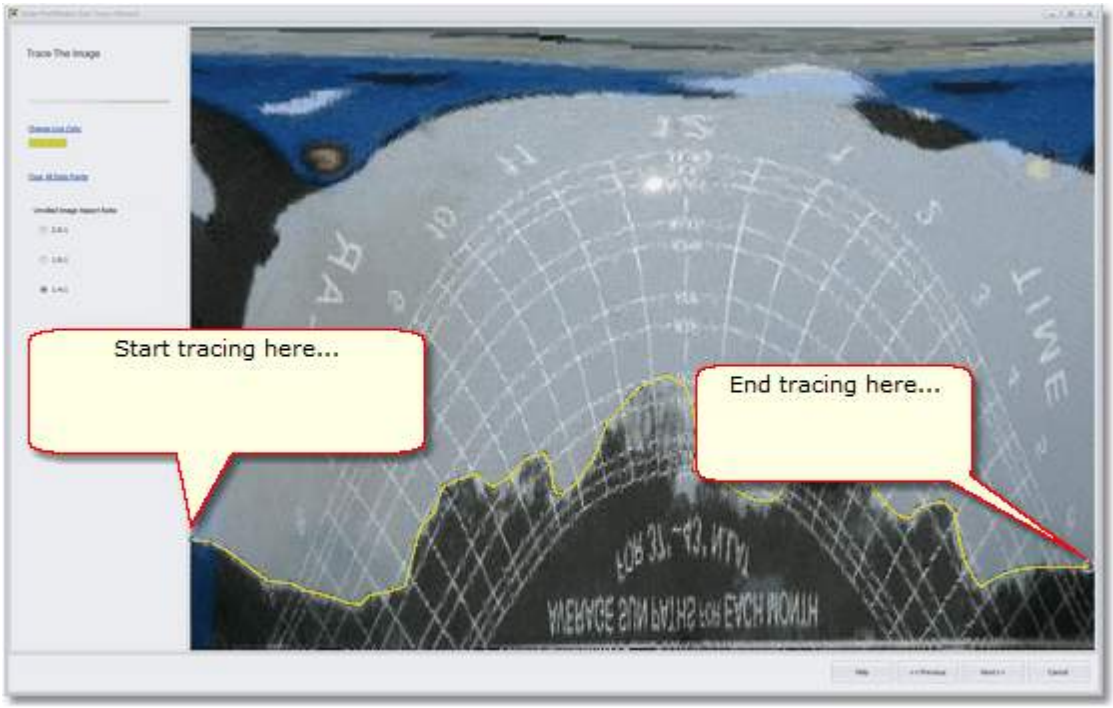
The closer you get these reference points to the indicated position, the more accurate the resulting analysis will be.

Closeup of both Reference Points

Once you have properly set the reference points, click the "Next" button to continue.

Option Settings
The color and thickness of the level to compass line can be changed in the Options User Interface 75 window.

4.4 Image Obstruction Tracing



Trace Obstructions On The Survey Image

Preparing to Trace

You have 3 options for the image aspect ratio; pick the one that maximizes the screen area of the image.

The "Trace the Image" page shows the trace image in a "rolled-out" view (also called rectilinear view) as opposed to the traditionally round "fish-eye" view of previous versions of the SolarPathfinder Assistant software.

How to Trace

Starting on the left side, trace from left to right by clicking (with the left mouse button) on the outline of shading obstruction. Each time you click, you place a red circle, called a data point, which is used to draw the line along the obstruction. Place as many data points as you need to insure that the entire obstruction area is underneath the line.

Manipulating Data Points

The editor enables you to insert, move, or delete data points anywhere along the obstruction line.

Insert Data Point

To insert a data point in the middle of a segment, hold down the control key (sometimes labeled "Ctrl" on your keyboard) and move the mouse to a spot on the obstruction line until the mouse cursor changes to an up arrow, at which time you left-click to insert the new point.

Move Data Point
To move a point, place the mouse cursor over the point until it changes to a hand and then hold down the left button and drag the point to the desired location.

Delete Data Point
Hover the mouse over the point you want to delete, and when the cursor changes to a hand, click on the right mouse button to remove that point.

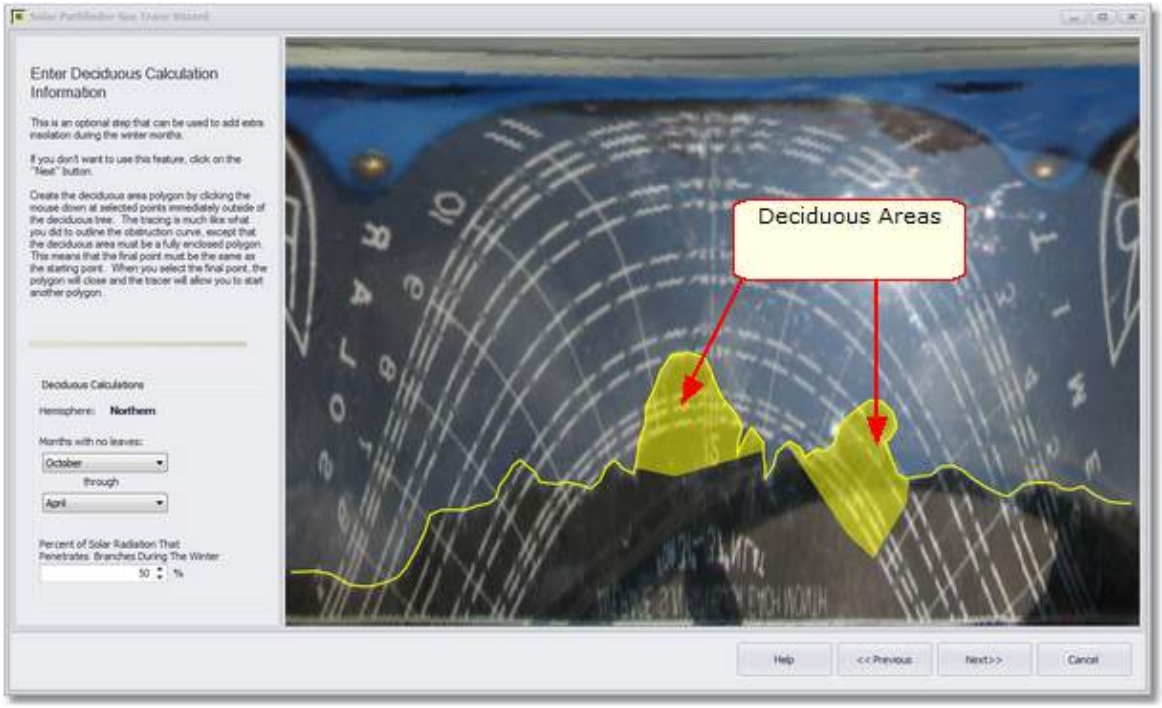
Clear All Data Points

This link gives you a clean state so that you can restart your tracing.

4.5 Enter Deciduous Calculation Information

This is an optional step.

The purpose of this step is to outline the areas of deciduous trees to improve the production calculation for winter months.



Two Deciduous Areas

Select Month Range

Use the two month boxes to select the month range during which there will be no leaves on the deciduous trees.

Select the Deciduous Transparency

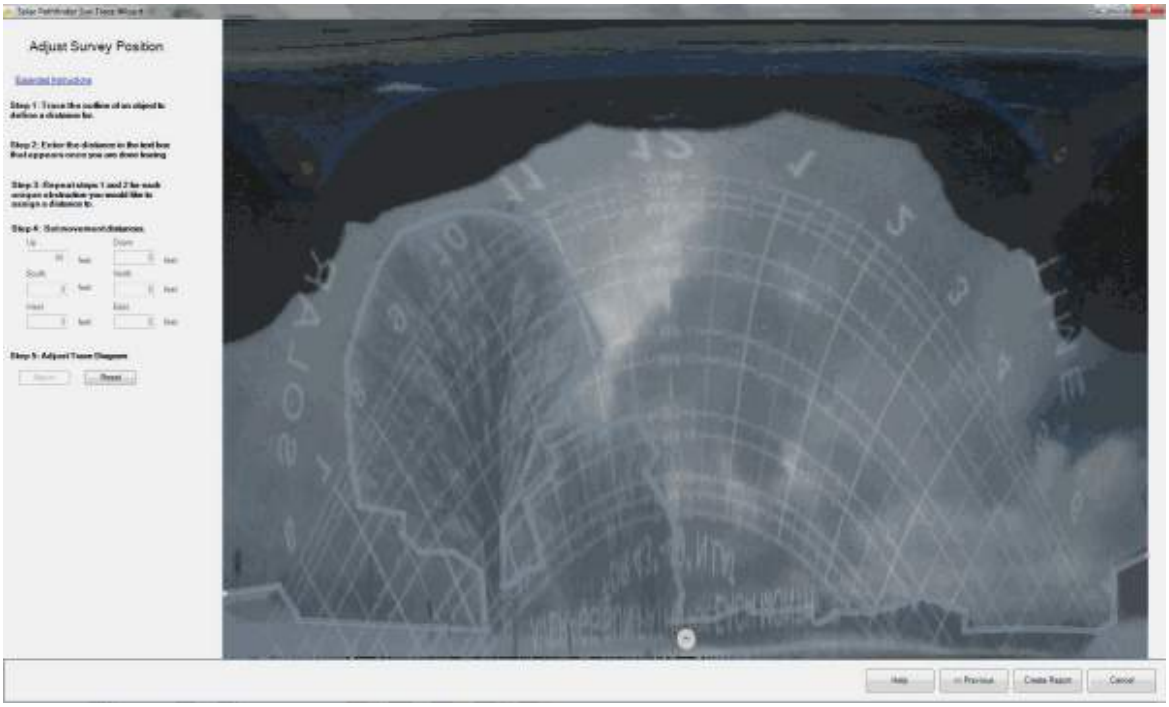
The numeric box is a percentage of the available sunlight that filters through the branches of the tree. The default is 50% but it could be more or less, depending on the thickness of the branches.

Add Deciduous Areas

You can add one or more deciduous areas. To add a deciduous area, use the mouse to add points that surround the area of the deciduous tree, this works similar to the drawing of the obstruction curve. The area will be closed when the last point is the same as the starting point.

4.6 Adjust Survey Position

This is an optional step that requires precise measurements to work well.

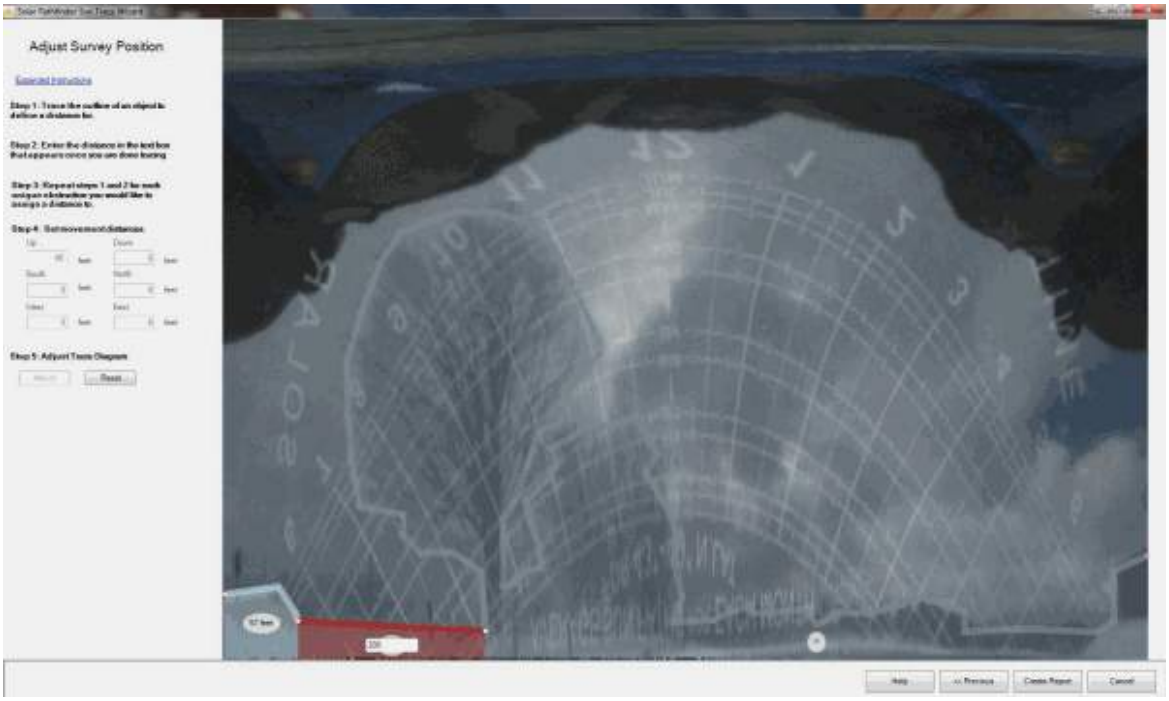


Adjust Survey Position Page

If you don't want to climb up on the roof, or if you don't have a roof to climb up on yet, these adjustments enable you to mathematically model shade many feet removed from the survey location.

To *skip this adjustment*, merely click on the *Create Report* button at the bottom right of this form.

Enter Distance Regions (Steps 1 to 3)

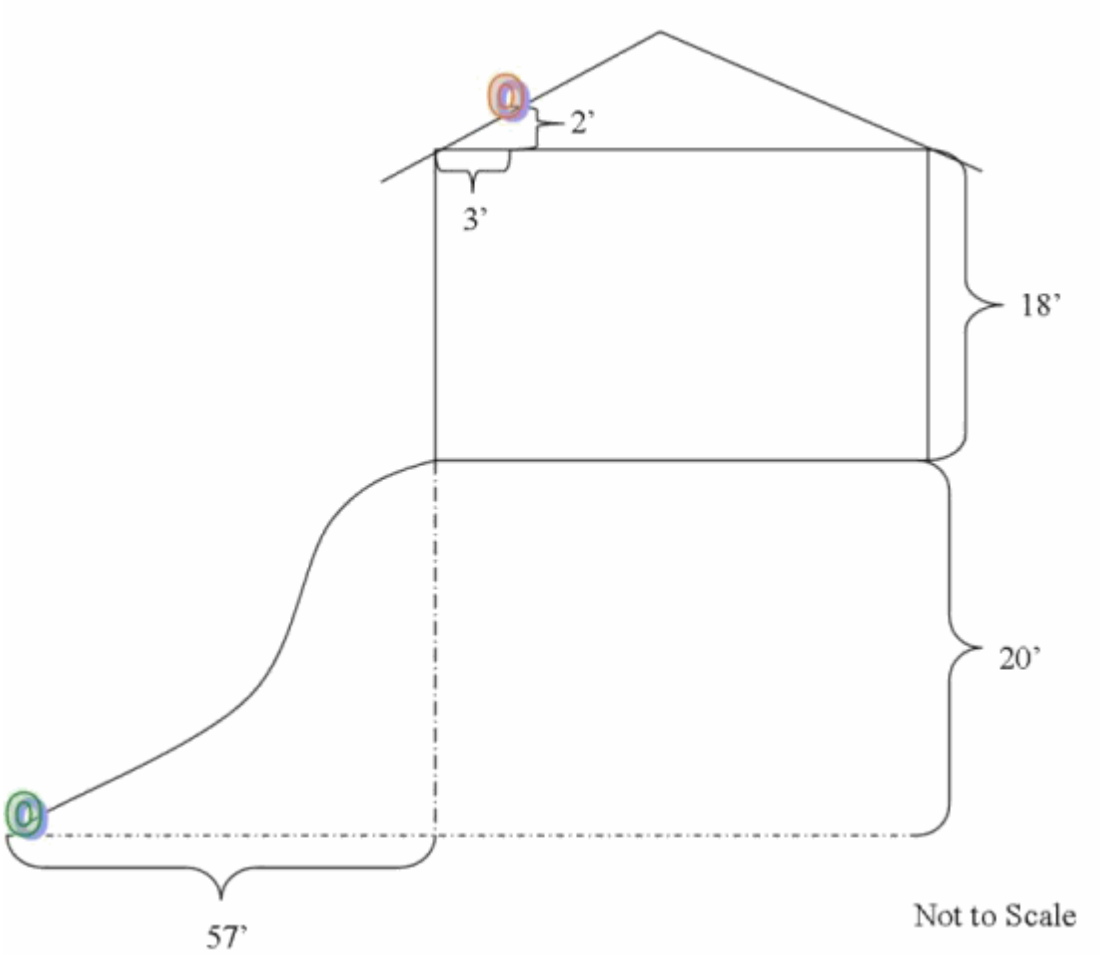


Outline the Collective Obstruction Objects

Use the "pencil"/cursor to outline each object (individually) by holding down the left mouse button and "drawing" around each "pre-outlined" shaded object. Once you have delineated an object and released the left mouse button, the software will highlight that object and prompt you to input the distance that the object is from the SolarPathfinder unit. Each of the objects will be highlighted in a different color. Continue to mark and give the distance to each object.

Enter Movement Distances (Step 4)

Below is an example of how to calculate the movement distances.



Sketch of Movement Distances

The SolarPathfinder unit in the above sketch is located at the bottom of a hill that is 20' lower than the building upon which the array is to be placed. The building is 18' high. The point that the new trace is to be projected is up the roof 2 more feet above that. Therefore, the total height adjustment is 40 feet. That number is placed in the "Up" input box on the left side of this page (under "Step 4" above).

The horizontal distance that the "point of projection" for the new trace (on top of roof in example above) is from the Solar Pathfinder unit is input in the appropriate directional box [i.e. North, South, East, or West]. In the above sketch, this equals 57' from the unit to the building and 3' from the side of the building up the roof. In our example, the "point of projection" for the new trace is due North of the Solar Pathfinder unit. Therefore, the "60" should be put in the "North" box.

NOTE: *Your measurement work will be easier if you only move the unit along the East/West or North/South axis.*

Adjust Button (Step 5)

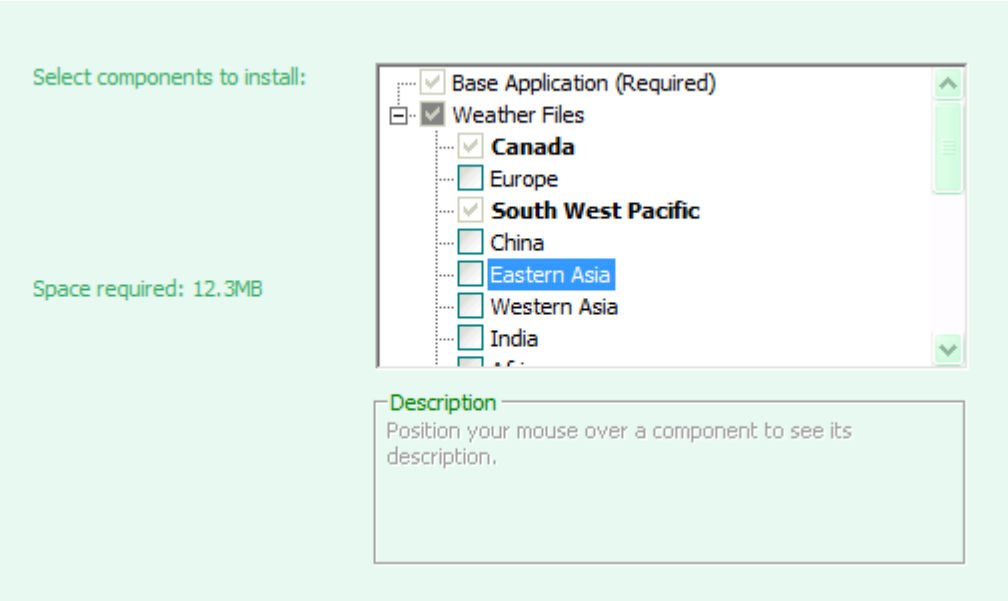
Clicking on the *Adjust* button will recalculate the shading diagram based on the adjustments you entered in Step 2. The *Reset* button will undo any position adjustments you have made.

When you are done, click the *Create Report* button.

5 Reference

5.1 Installing Weather Data

Weather files are added in the installer, so whenever you find that you need additional weather files, merely run the installer to add additional weather stations.



Weather File Selection List

An Internet connection is required during install time because the weather files are downloaded from an Internet server. Because the files are large, you may want to carefully select only the files you need.

Below is a listing of the weather data files. Where the contents of some of the files are counter intuitive, a partial list of the included countries is appended in parenthesis.

Africa (4 MB)

Canada (5 MB)

Central America (3 MB) (Cuba, U.S. Virgin Islands, Puerto Rico, Martinique)

China (25 MB)

Eastern Asia (3 MB)

Europe (16 MB) (Northern and Eastern Europe, Turkey, Syria, Israel)

India (5 MB)

South America (3 MB)

South Western Pacific (7 MB) (Australia, NZ, Guam, Fiji, Philippines, Singapore, Malaysia)

USA AK-AZ (8 MB)
USA CA-CT (8 MB)
USA DE-HI (8 MB)
USA IA-IN (6 MB)
USA KS-ME (6 MB)
USA MI-MT (9 MB)
USA NC-NJ (5 MB)
USA NM-OR (7 MB)
USA PA-TX (8 MB)
USA UT-WY (8 MB)

Western Asia (1.3 MB)

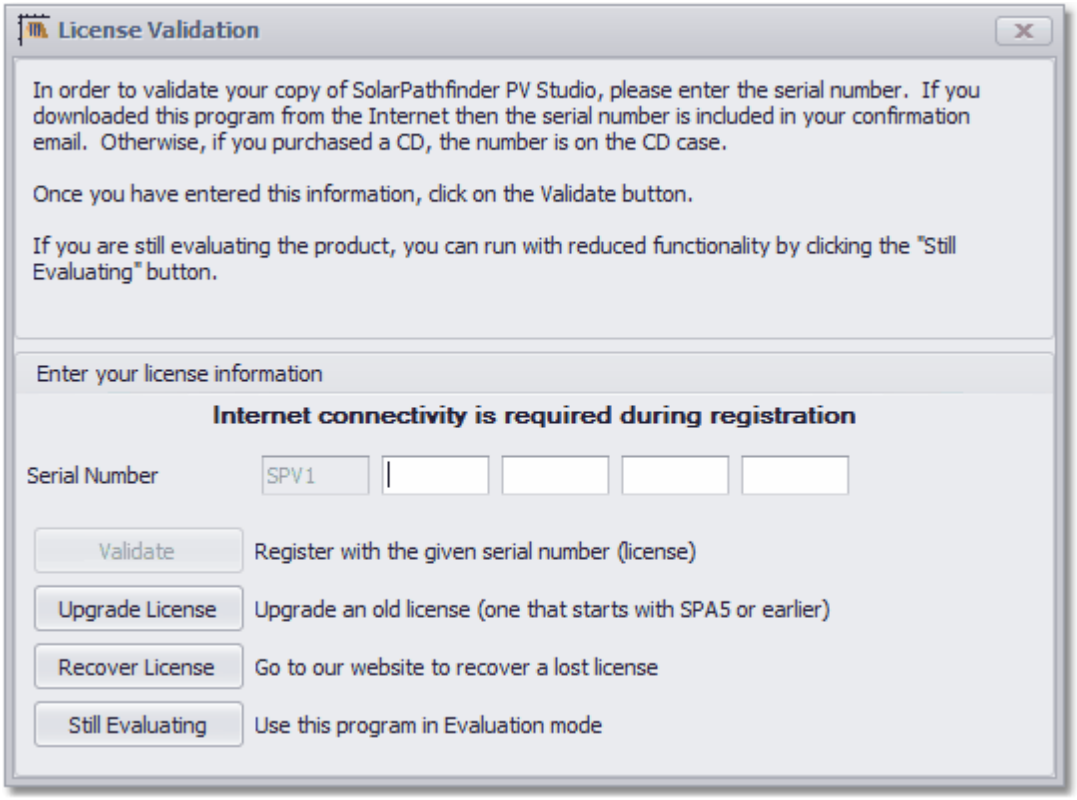
The weather data has been grouped according to the grouping given by the U.S. Department of Energy. Get more information at their website: http://apps1.eere.energy.gov/buildings/energyplus/weatherdata_about.cfm

5.2 License Validation

The first time that you run the application, you will be greeted by the License Validation form. If you purchased the Solar Pathfinder Assistant for download, a serial number was sent to you at your registered email address. If you purchased a physical CD, that serial number should be located on a sticker on the CD case. Either way, enter that serial number into the Serial Number text box. The value is case sensitive, so enter it exactly as it appears on the CD case label. If you copy your serial number from the email into your clipboard (using Ctrl-C) then the serial number will be automatically copied into

the text boxes when this window opens.

If you want to register later, just click on the Evaluation button. You can always come back to this screen by using the Help|Register 53 menu command.



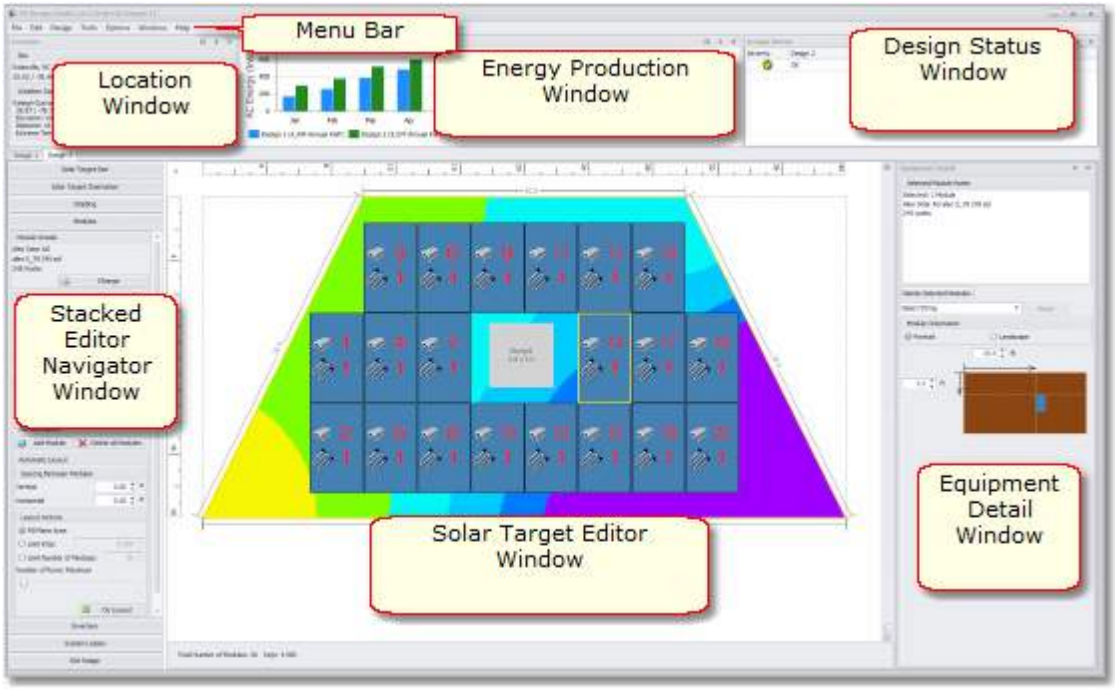
License Validation Form

Once the serial number has been entered, click the Validate button to validate your purchase and generate your license file. If you are simply evaluating the product before purchasing, click the Still Evaluating button. Note that the PDF Report is disabled in evaluation mode.

During license validation, you must have an active internet connection. Also note that you will only have to validate your license once. After successful validation, you will not see this form again.

5.3 PV Studio Main Form

Once you have a completed design, your Main Form window will look something like this:



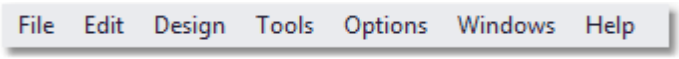
Anatomy of the Main Form

- Menu Bar 49
- Location Window 61
- Energy Production Window 62
- Design Status Window 64
- Stacked Editor Navigator Window 61
- Solar Target Editor Window 60
- Equipment Detail Window 54

See Also: Windows Menu 52

5.3.1 Menu Functions

The Menu Bar is located at the top of the main form, directly underneath the title bar.



Main Form Menu Bar

- File 49 - Manipulate your report
- Edit 50 -Edit your report location
- Design 50 - Manipulate your designs
- Tools 51 - For California sites, upload your design
- Options 51 - Change various program preferences
- Windows 52 - Show or Hide various main form windows
- Help 53 - Registration, Update, and other program help

5.3.1.1 File Menu

The New and Open functions are also available in the QuickStart window that is activated at program startup.

File Menu Functions	
New	Closes an existing report and sets the editor to the initial blank slate.
Open	Closes the existing report and opens a file dialog so that you can select the report you wish to open.
Close	Works just like the "New" function
Save	Writes any changes you have made to an existing report to the hard drive.
Save As...	Used to save new report or to save the currently opened report under a new name.
Create and View PDF Report	Creates the report as a PDF file and opens a PDF reader to read the report. (This function requires that a PDF reader be already installed on your computer.)
Create and View a CSV	Creates a report in the CSV format. This includes

File Menu Functions	
Report	everything from the PDF report except for the images.
Export Image Shading Data	Creates a CSV formatted file with shading data that can be imported into other applications.
Export Horizon Angles	Creates a text file with the ".hor" type which is used as input into PV Syst. It's not known if this data is still being used by anyone. If you encounter any problems with importing this into PV Syst, please let us know.
Export Clean Power Obstruction Data	Creates a text file with the ".XML" type. This report is used to input data for the Clean Power website.
Exit	Saves the current report and shuts down PV Studio.

5.3.1.2 Edit Menu

Location

The Location command is used to edit site specific information. The location dialog window automatically opens whenever you create a new report. See Enter Location Information 7.

5.3.1.3 Design Menu

A report can have from 1 to 4 designs. These functions work on the currently active design.

Design Menu Functions	
Design Name	This menu function contains a text box where you can enter or modify the design name.
Copy	This creates a copy of the current design. Since a report is limited to 4 designs, this function will have no effect if your report already has 4 designs.
Delete	Deletes the current design. If

Design Menu Functions	
	your report only has 1 design, then this function has no effect.
Combine Design Output	This menu item is a selection toggle that displays a check next to this function when it is enabled. When enabled, the output in the production graph window 62 and also in the report will show the combined production of all available designs.

5.3.1.4 Tools Menu

Optimal Orientation Tool

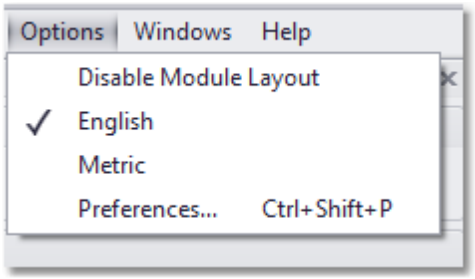
Search a range of orientations to find one that has the best energy production for your location. More information. 92

Upload CSI

The CSI Upload function which is only available in California. See the California Solar Initiative 94 for more details.

5.3.1.5 Options Menu

These menu functions are used to change various aspects of the program behavior.

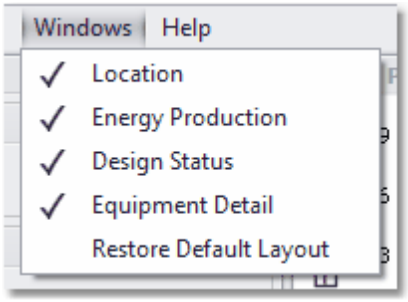


Options Menu Functions	
Disable Module Layout	When this item is checked, the report will not have the module layout step or the inverter connection step. This is a faster and simpler way to complete a report.
English/Metric	These two measurement unit items can be toggled, and the

Options Menu Functions	
	active measurement unit will have a check in front of the label. English units are in feet or inches and metric units are in meters or millimeters.
Preferences...	Opens a new tabbed form to access additional aspects of the program operation that can be modified. See the Options Form 64 for details.

5.3.1.6 Windows Menu

The main form consists of 4 dock-able windows that can each be arranged, re-sized, or hidden. These menu functions provide a fast way to show or hide each of the windows. The Restore Default Layout function will restore all of the windows to a factory default setting.



Windows Show/Hide Functions

Windows Functions	
Location	Show or hide the location window
Energy Production	Show or hide the energy production window
Design Status	Show or hide the design status window
Equipment Detail	Show or hide the equipment detail window
Restore Default Layout	Use this to place all windows back to their original position

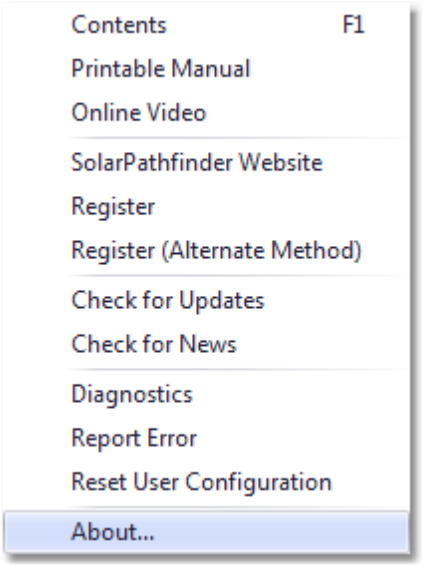
Window Information

- Location Window 61

- Energy Production Window 62
- Design Status Window 64
- Equipment Detail Window 54
- Solar Target Editor Window 60 (this window can't be hidden)

5.3.1.7 Help Menu

The help menu provides a collection of functions to help solve problems with the program operation.



Help Menu Functions	
Contents	Opens the PV Studio integrated help file. The context sensitive help file can be opened on any window by pressing the F1 key.
Printable Manual	Opens the default PDF reader with the Solar Pathfinder User's Manual.
Online Video	Opens a browser window and takes you to a page with PV Studio instructional videos.
SolarPathfinder Website	Opens a browser window and takes you to the SolarPathfinder

Help Menu Functions	
	home page.
Register	Register your program license.
Register (Alternate Method)	Use the off-line method of license validation.
Check for Updates	Checks for the latest version of this program and gives you the option to download it if there is a new version.
Check for News	Opens a window to display program update news.
Diagnostics	Opens a window to display locations of important configuration files.
Report Error	Opens a dialog window that steps you through the process of reporting an error: taking screen shots, explaining the issue, gathering important files, and submitting the report to our server.
Reset User Configuration	Returns the program to a factory default setting (This will remove any company information and images you may have added).
About...	Displays an information form that contains the program version number and the EULA.

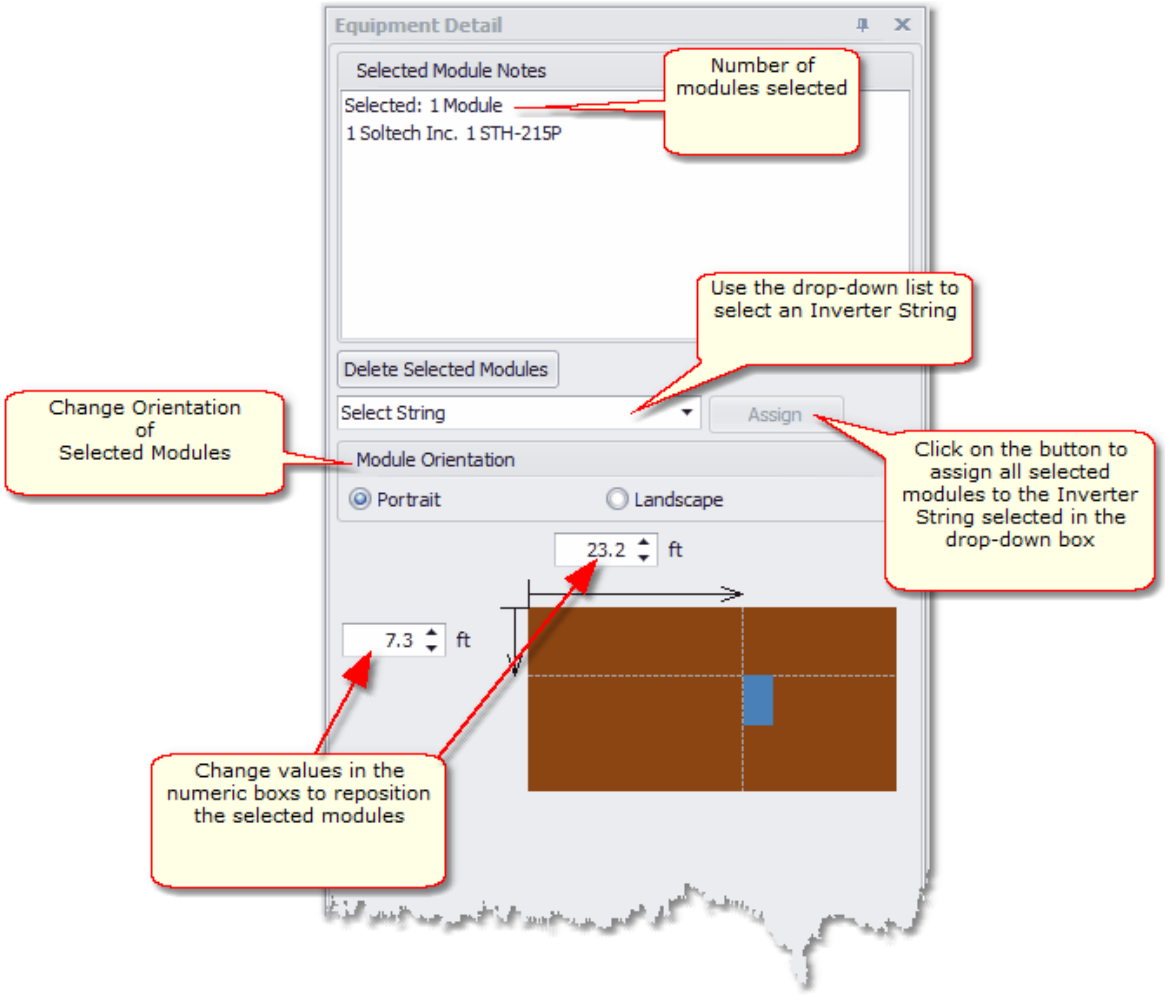
5.3.2 Equipment Detail Window

The Equipment Detail Window contains context specific information depending on which Stacked Navigator 61 window is active and depending on what equipment is selected.

Information In the Equipment Detail Window

5.3.2.1 Module Equipment Detail Window

This window is activated whenever modules are selected in the target editor. The functions in this window only affect the selected modules.



Delete Selected Modules

This button will delete all selected modules.

Module Orientation

Selecting the "Portrait" or "Landscape" radio-buttons will change the orientation of all selected modules.

Assign to String

The "Assign" button is enabled after a string has been selected from the drop-down list. The effect of the button is to place all selected modules into the string chosen from the drop-down list.

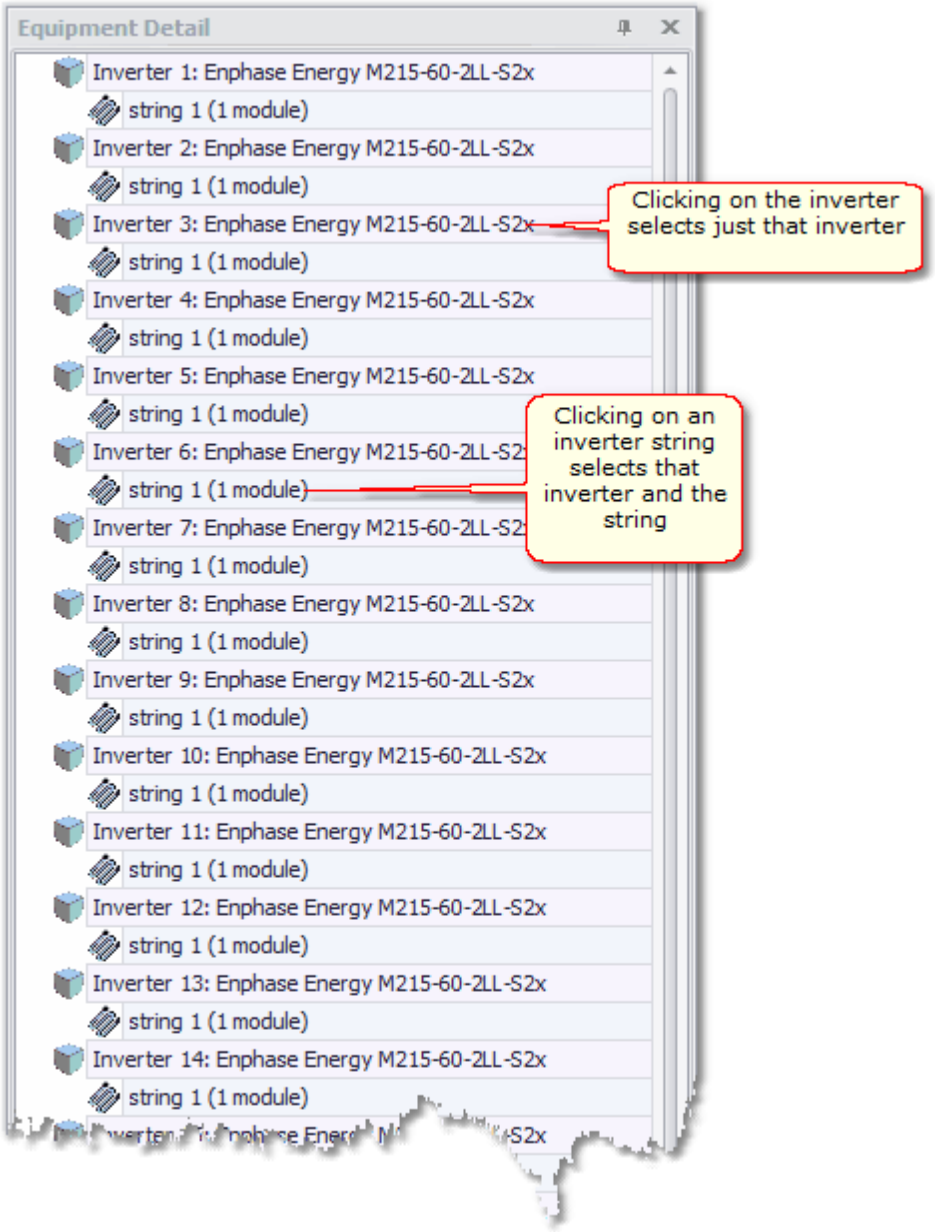
Reposition Selected Modules

Changing the values in one of the two numeric position boxes will move the selected modules to that position.

5.3.2.2 Inverter Equipment Detail Window

This window is activated when the Stacked Navigator 61 is at the Inverters Window 23.

The inverter equipment detail window lists all of the inverters in your design. For each inverter, there is also a list of strings attached to that inverter. Each inverter is assumed to have at least one string.



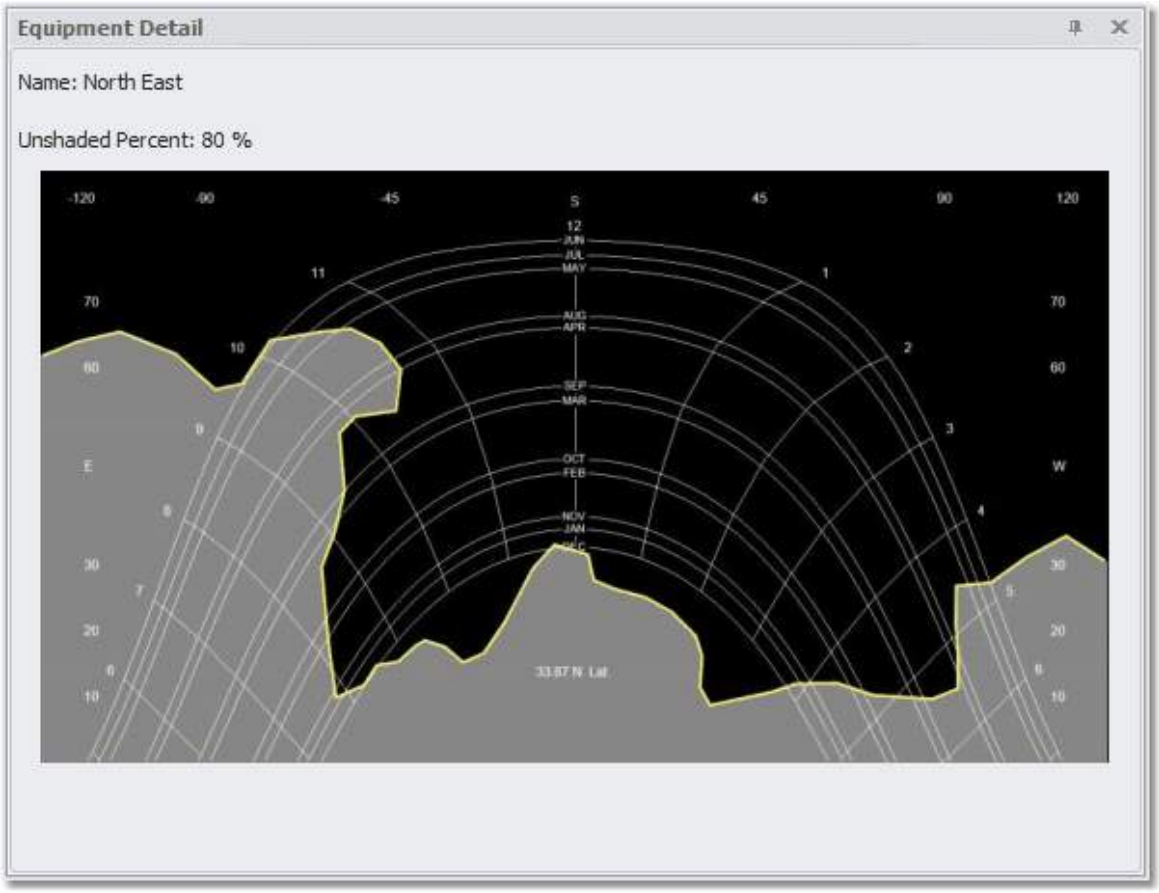
Equipment Detail Window show Inverter Detail

Selection Protocol

- Clicking on the inverter name will select the inverter, but not any particular string. This is an important distinction to remember if what you want to do involves deleting a particular string.
- Clicking on an inverter string selects that string and the inverter it's attached to. This is what you want if your task is to edit or delete that particular string.

5.3.2.3 Survey Equipment Detail Window

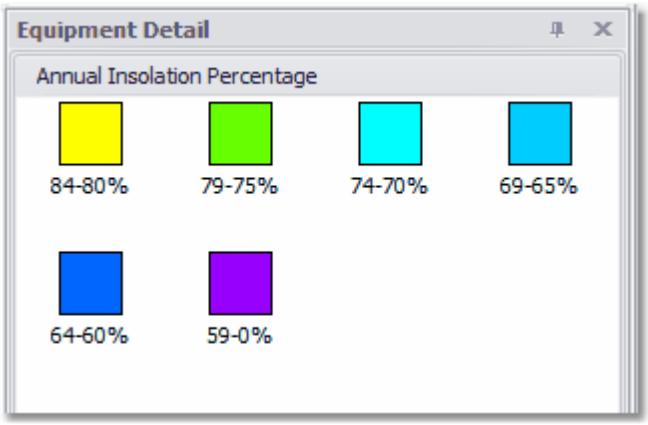
This window is activated when the Stacked Navigator 61 is on the Shading Window 19 and a survey is selected.



The unshaded percent figure tells you the average annual percentage of available sunlight the site receives over the entire year. Another way to look at this figure is that if your unshaded percent is 80%, then you lose 20% of the insolation to shade, which reduces the amount of energy your system can produce.

5.3.2.4 Insolation Map Equipment Detail Window

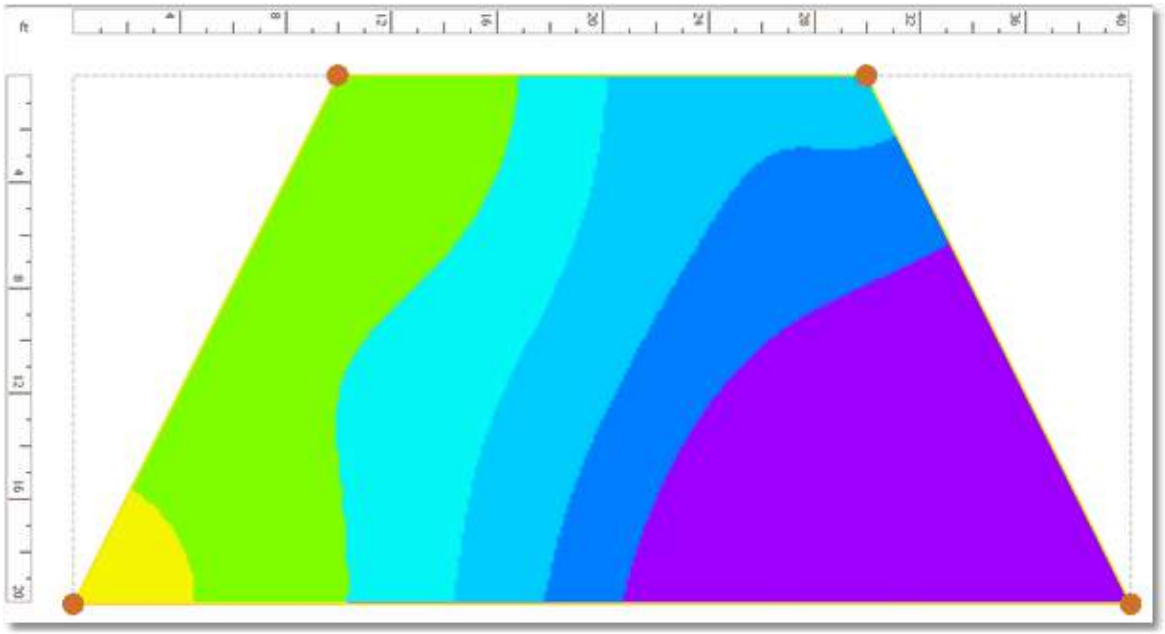
This window can be seen when the Stacked Navigator 61 is on the Shading Window 19 and a survey is not selected.



Equipment Detail showing the Insolation legend

The legend above refers to the percentage of total annual available insolation on the solar target as seen below.

The areas with a higher percentage of insolation get less shade. In general, you will want to avoid the more shady areas of your solar target when placing your PV modules.



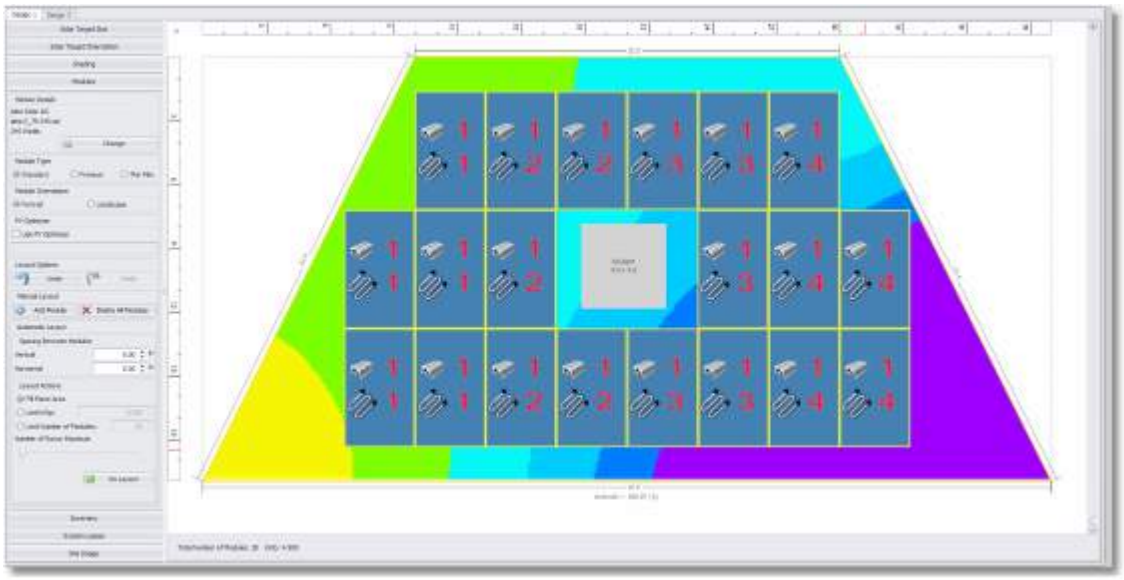
Insolation map of the solar target.

Insolation Map Algorithm

The insolation map is calculated based on the unshaded insolation percent of each survey. The points in between the surveys are calculated using an Inverse Distance Weighting formula called Shepard's Method.

5.3.3 Solar Target Editor Window

The Solar Target Editor window is the default window that cannot be hidden, and the main point of removing the other windows is to provide maximum screen space for manipulating the roof objects in the editor. If all the above windows are hidden, the program window would now look like this:



Solar Target Editor Window with Navigator in Module window on the left

Stacked Editor Navigator

The window on the left side is called the Stacked Navigator Window 61 and is used to manipulate the solar target editor.

Solar Target Editor Modes

The Solar Target Editor behaves differently depending on which stack navigator window is active.

- Solar Target Size - This mode enables you to edit corner points and no-module zones.
- Solar Target Orientation - This mode displays the no-modules zones and the heatmap. It does not allow you to change anything in the editor.
- Shading - In this mode you can create, edit, and place the site shade images.
- Modules - In this mode you can created, edit, and place the modules.

- Inverters - In this mode you can't make any changes to the editor window. The modules of the currently selected inverter 56 or inverter string will be highlighted.

- System Losses - No changes can be made to the editor window.

- Site Image - The solar target editor window is not displayed, but if a site image 27 is selected it will be shown instead.

Mouse Shortcuts

- A right-click on any selected object (no-module zone, corner, survey, & module) to delete that object
- A left-click on the solar target, outside of any module, will enable you to drag a selection rectangle that you can use to select all modules touched by the selection rectangle

Keyboard Shortcuts

- Arrow keys can be used to move selected objects
- Holding down the shift key while using the arrow keys to move selected objects, will move the objects further

5.3.4 Stacked Editor Navigator Window

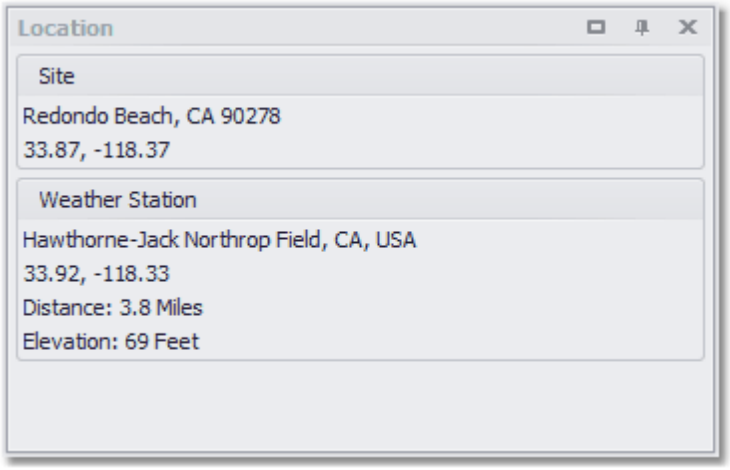
The Stacked Navigator window is attached to the left side of the Solar Target Editor Window and cannot be moved or hidden. There is a split bar between the Stacked Navigator and the Solar Target Editor that enables you to change the width of the Navigator.

For best results, follow the commands from top to bottom.

There are two versions of the stacked navigator depending on whether you choose to do a module layout 13 report.

5.3.5 Location Window

The site location window shows information about the solar target site.



Information About the Survey Site

- City
- State
- Zip Code (USA Only) or Country if outside the USA
- Latitude and Longitude

Weather Station Information

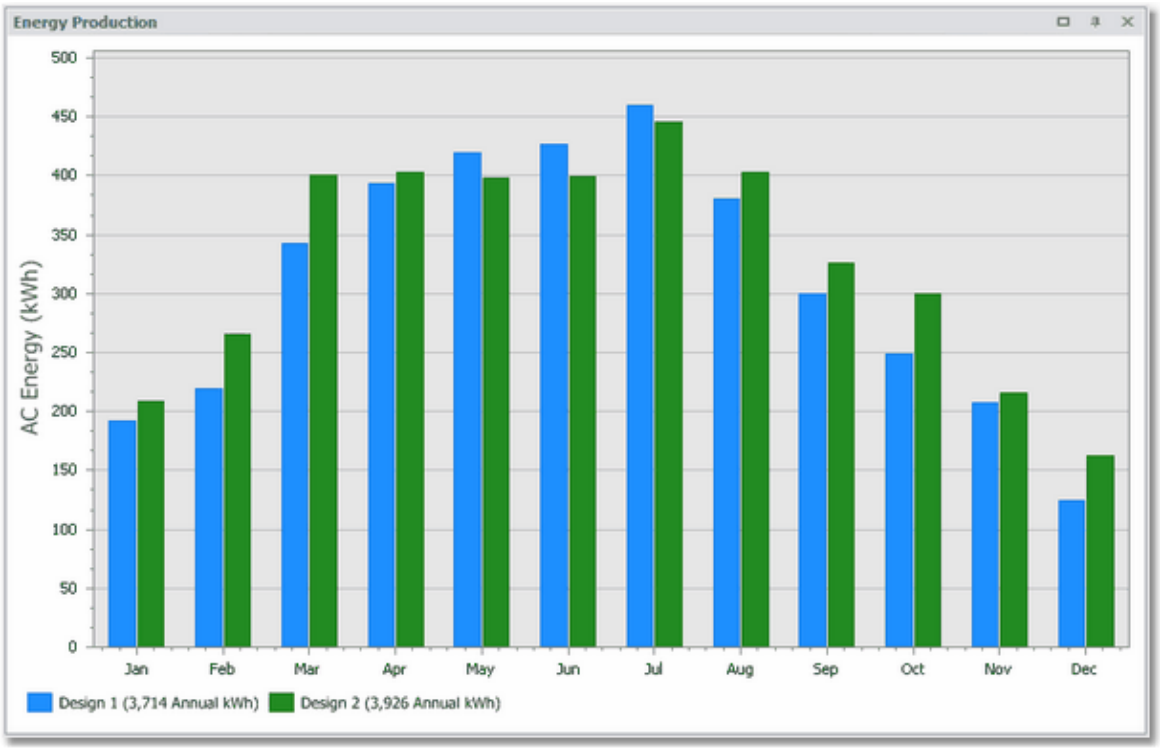
The following information about the selected weather station is provided:

- City
- State
- Country
- Latitude and Longitude
- Distance to the survey site
- Elevation

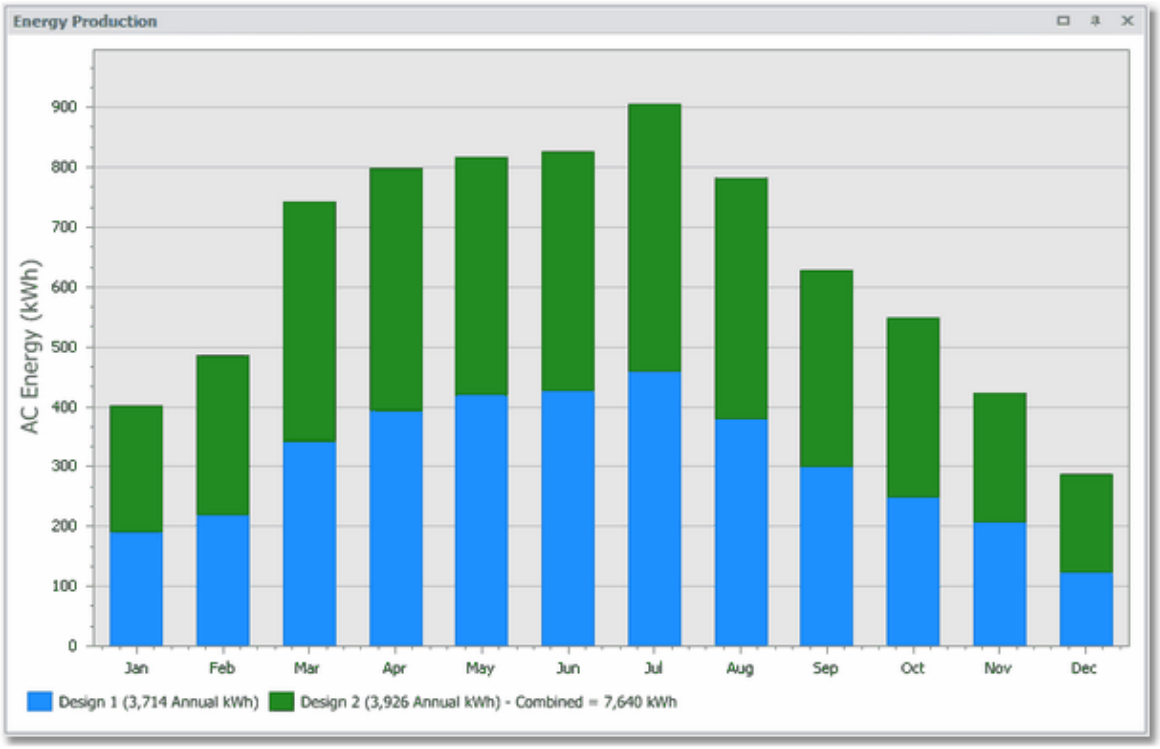
5.3.6 Energy Production Window

This window displays the annual and monthly energy production information for all designs in a bar chart format. The design bars can either be side-by-side, or they can be stacked to show the total production during a month for all designs; the Combine Design Output 50 menu function is used to set the bar chart type.

The legend under the bar chart shows the annual production for each design.



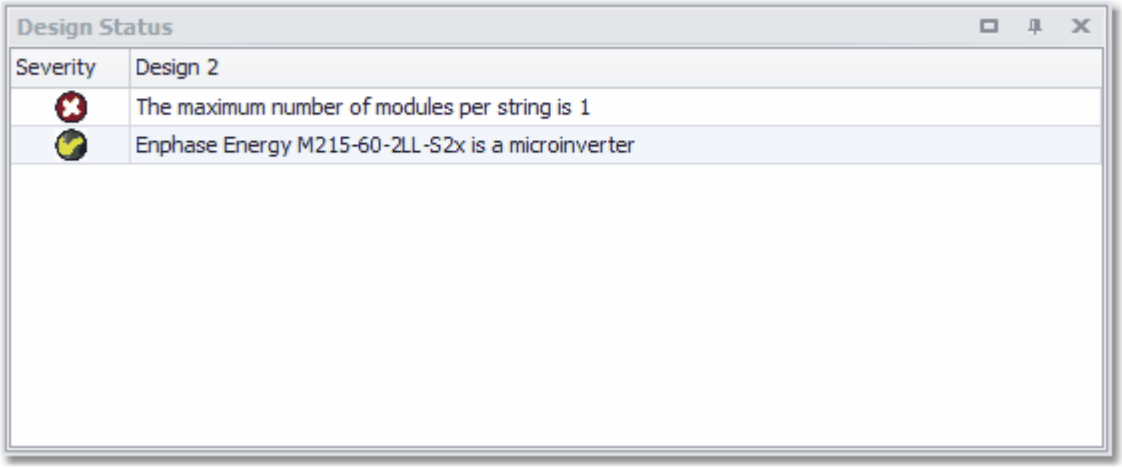
Monthly Energy Design Bars are Side-by-Side



Combine Design Output has been set

5.3.7 Design Status Window

The design status window provides health information about the current design. In effect, it provides you with a task list of items that still need to be fixed to get a workable design.



Status Window with two status messages

Severity Levels

	This is an informational status message.
	Warning message. The issue being warned about should be resolved but it might still produce a workable design.
	Error message. The design is not workable and the issue must be resolved before the design can be considered complete.

5.4 Options Form

Open the options form by selecting "Preferences..." under the Options Menu 51.

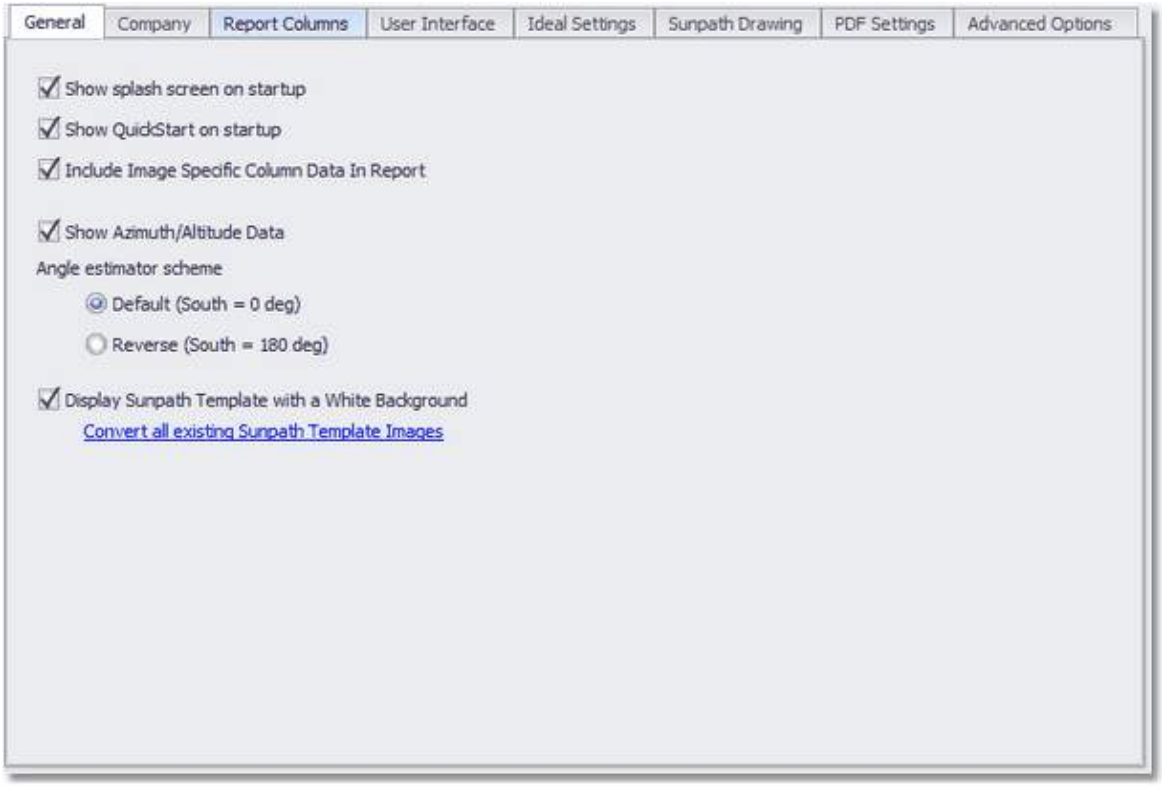
The options form allows you to change the behavior of certain program features.

Options Form Pages

- General 65
- Company 66
- Report Columns 70

5.4.1 General

Miscellaneous options.



Show Splash Screen On Startup

This setting displays a splash screen on program startup.

Show QuickStart On Startup

This setting displays a window near the middle of the program screen when the program starts. Use this to quickly go to your desired task.

Include Image Specific Column Data In Report

Selecting this option will include the column data associated with each site image at the end of the report. This is different from the column data included with each design, which is a weighted average of all the design images.

Show Azimuth / Altitude Data

Select this to display the Azimuth/Altitude data associated with each image in the report.

Azimuth/Altitude Data

Azimuth / Altitude (degrees) where North = 180 degrees

-125	1.0	-80	15.0	-35	22.5	10	16.5	55	10.0	100	4.0
-120 (ENE)	**2.5**	-75	16.5	**-30 (SSE)**	**21.5**	15	15.5	**60 (WSW)**	**9.5**	105	3.0
-115	4.0	-70	18.0	-25	21.0	20	15.0	65	9.0	110	2.5
-110	6.0	-65	19.5	-20	20.5	25	14.0	70	8.0	115	2.0
-105	7.5	**-60 (ESE)**	**21.0**	-15	19.5	**30 (SSW)**	**13.5**	75	7.5	**120 (WNW)**	**1.0**
-100	9.0	-55	22.5	-10	19.0	35	13.0	80	7.0	125	0.5
-95	10.5	-50	24.0	-5	18.5	40	12.0	85	6.0		
-90 (E)	**12.0**	**-45 (SE)**	**24.0**	**0 (S)**	**17.5**	**45 (SW)**	**11.5**	**90 (W)**	**5.5**		
-85	13.5	-40	23.0	5	17.0	50	11.0	95	4.5		

The chart above shows the height of obstructions every 5 degrees for 125 degrees East of South to 125 degrees West of South.

Angle Estimator Scheme

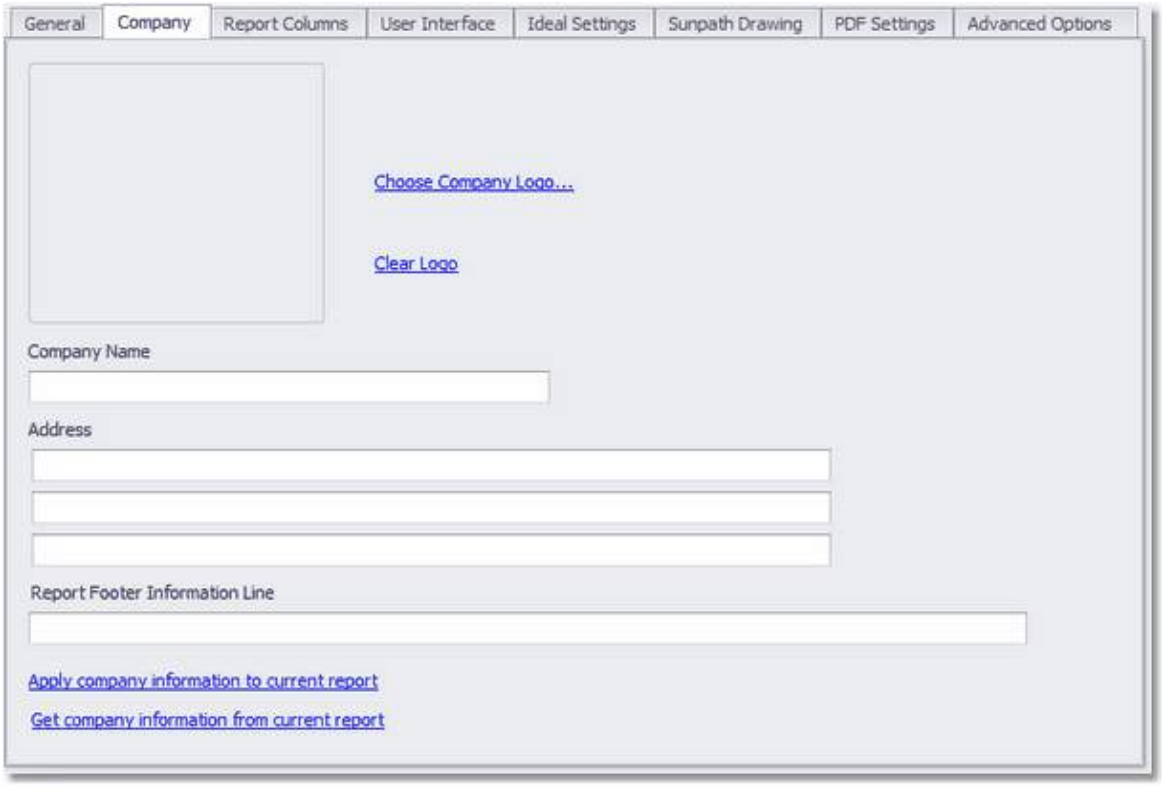
Pick your preferred Azimuth/Altitude orientation. This orientation scheme is used on the sunpath template and also on the Azimuth/ Altitude table.

Display Sunpath Template With A White Background

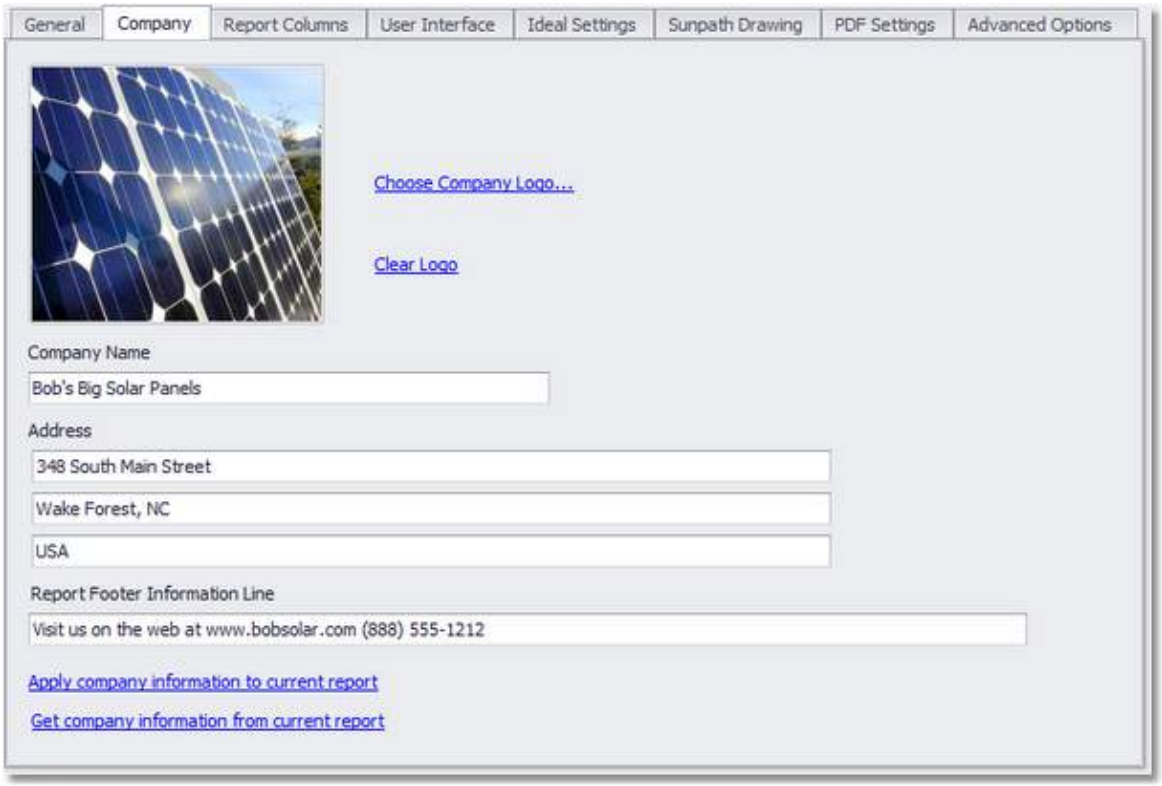
Select to display the sunpath template with a white background and black lines. This setting will save ink on a printed report. Changing this setting will only affect images created from now on. Use the link to change all images in the current report.

5.4.2 Company

The company option screen contains settings that allow you to personalize your reports with your company name, logo and additional information.



Options Window with no modifications



Personalized Comany Information

Choose Company Logo

By default, each report that is generated will have the SolarPathfinder sun logo in the upper left of the report. Should you desire to override this, click on the "Choose Company Logo" link and select your company logo file. The application supports jpeg, gif, bmp, and png files. The logo will appear on the Cover Page and on the Page Headers.

Company Name, Address, and Logo on the Report Cover

Company Logo and Name on the Header of each report page

Company Name

If the company name is filled in, it will appear on the Cover Page and on the Page Headers.

Address

Add up to 3 lines. Any lines left blank will not appear on the report. This will appear on the Cover Page preceded with the "By:" label.

Report Footer Information Line

The report footer contains additional contact information or tag lines that you would like to present to the consumer. This will appear on the Page Footer.

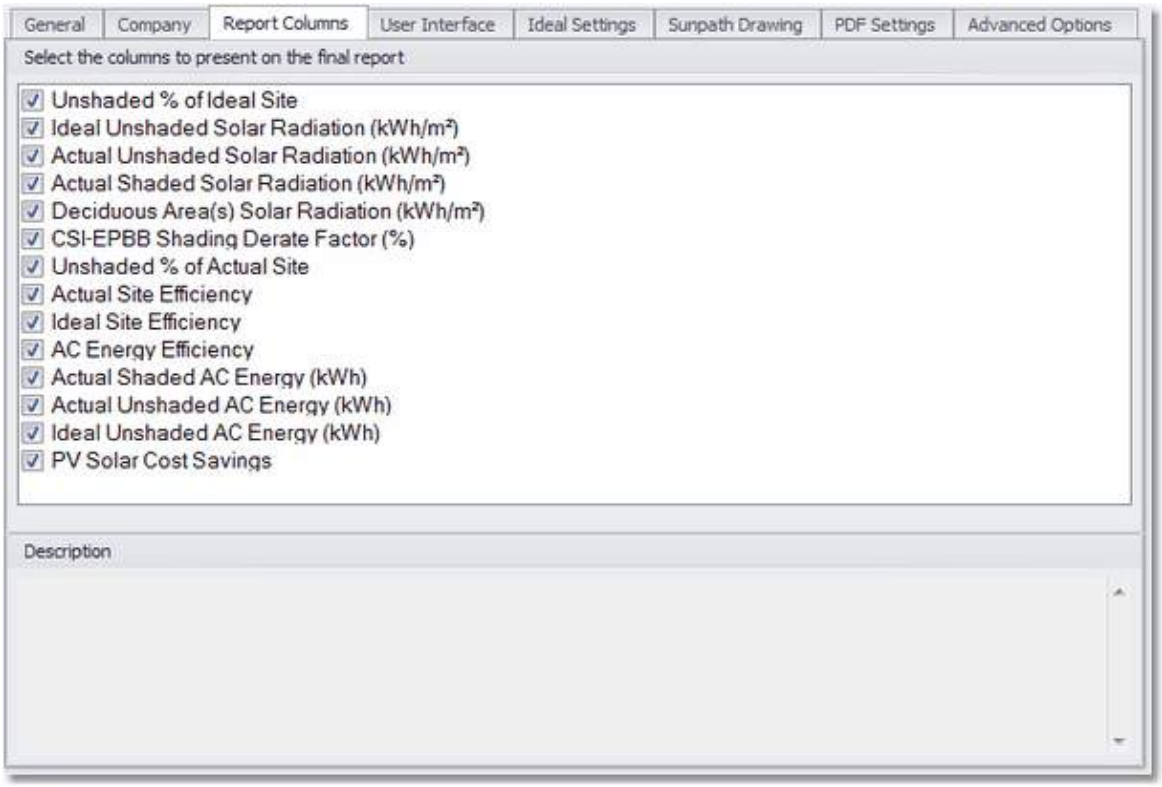
Page Footer

Apply Company Information to Current Report

Company information is saved with each report. Changing company information on the Options form will only affect new reports that are generated. However, if you would like to apply the new information to the currently opened report, click on the "Apply Company Information to Current Report" link at the bottom of the form. Once the Options form is closed, the report will be updated with the information.

5.4.3 Report Columns

Columns that are checked will be included in the report. What follows is a glossary of terms followed by a description of all the columns.



Definitions of the Source Data

Ideal - Refers to the best orientation for your site. Because of various real world situations, it is often impossible to situate the array in an ideal orientation. We use the ideal orientation as a standard to which we compare the actual orientation of the array. Orientation considers both Azimuth and Tilt. For the Northern Hemisphere, the ideal Azimuth is 180° or true South, and for the Southern Hemisphere it is 0° or true North. The ideal tilt is a little more controversial. We consider the ideal tilt to be equal to latitude if the whole year is being considered. However, be aware that the ideal tilt could be very different if you are only considering a particular range of months or if your site has unique weather conditions. You can use the Optimal Orientation Tool 92 to heuristically find the "best" orientation.

Actual - The actual tilt and azimuth of the array.

Unshaded (Unobstructed) - The absence of shade during a particular time period. We also refer to the shade producing object as an obstruction and use the terms Unshaded and Unobstructed interchangeably.

Shaded - The opposite of Unshaded.

(Ideal or Actual) Hourly Solar Radiation - The calculations use hourly historical weather data to obtain this value. This makes it impossible to use monthly average insolation data without significant change to this algorithm. The solar radiation (or insolation), is calculated for a tilted surface. Two calculations are done: the first using the actual tilt and azimuth settings, and a second using the ideal tilt and azimuth settings. These calculations use the PVWatts V1 algorithm, which uses the Perez method, to calculate the solar radiation on a tilted surface. All significant sources of light are considered, direct solar radiation, diffuse solar radiation, including extra diffuse radiation from snow cover.

Deciduous Solar Radiation - This is solar radiation that gets through the branches of trees during the winter time after the leaves have fallen off the trees. The user enters this information in the form of a percentage that is then applied to the Hourly Solar Radiation.

Hourly Unobstructed Percent of Solar Radiation - Also sometimes called the shading data, this is the percent of an hour during which there is no shade on the site. This number can be calculated directly from a paper template where the outline of an obstruction curve has been drawn. The unobstructed percent is based on the amount of daily insolation received during the day and the time at which the insolation is received. An hour of unshaded sun during the middle of the day provides more insolation than an hour of sun in the early morning, say from 8 to 9.

(Ideal or Actual) AC Energy - PVWatts is used to calculate the AC Energy produced by the specified array at the particular site. The "ideal" calculation uses the ideal orientation settings for azimuth and tilt and no shade. The "actual" calculation considers site shade and the actual array orientation.

Unweighted - In regards to solar radiation, all the months are calculated carrying the same "weight" (i.e. the radiation for January with no shading will be given 1/12 of the % of the yearly radiation, as will each of the other months. "Unweighted" is based on monthly availability. Alternatively, "Weighted" means that,

although January shows no shading, its radiation may only be 2 kW/m²/day. Whereas June, with no shading, may have 5 kW/m²/day -- and be "worth" considerably more. "Weighted" is based on actual output.

Definitions of Base Columns

Unshaded % of Ideal Site

Column Title: Unshaded % of Ideal Site Azimuth = [180 or 0] Tilt = [latitude]

Description: This value is the average percentage of the day during which there is no shade. The percentage represents ideal insolation for the site. The ideal value does not come from the ideal settings. For the northern hemisphere the ideal azimuth is true south (azimuth 180) and for the southern hemisphere the azimuth is true north (azimuth 0). The tilt is equal to latitude for PV or Thermal reports and a tilt of zero for Ecological reports.

Ideal Unshaded Solar Radiation (kWh/m²)

Column Title: Ideal Unshaded Solar Radiation Azimuth = [analysis settings] Tilt = [analysis settings] kWh/m²

Description: The total solar radiation that is realized at the current site on a tilted surface (given the ideal azimuth and tilt), but no obstructions. The total value includes the effective solar radiation percent that is realized at the current site for the entire year.

Actual Unshaded Solar Radiation (kWh/m²)

Column Title: Actual Unshaded Solar Radiation Azimuth= [analysis settings] Tilt= [analysis settings] kWh/m²

Description: The total solar radiation that is realized at the current site on a tilted surface (given the actual azimuth and tilt), but no obstructions. The total value includes the effective solar radiation percent that is realized at the current site for the entire year.

Actual Shaded Solar Radiation (kWh/m²)

Column Title: Actual Shaded Solar Radiation Azimuth= [analysis settings] Tilt = [analysis settings] kWh/m²

Description: The total solar radiation that is realized at the current site on a tilted surface (given the azimuth, tilt) and obstructions. The total value includes the effective solar radiation percent that

is realized at the current site for the entire year.

Deciduous Area Solar Radiation (kWh/m²)

Column Title: Deciduous Areas Solar Radiation Transparency = [percent]

Description: The total solar radiation that is realized from the Deciduous Areas given the azimuth and tilt.

Unshaded % Actual Site
Column Title: Unshaded % Actual Site Azimuth= [setting] Tilt= [setting]

Description: This column compares Actual Shaded Solar Radiation with Actual Unshaded Solar Radiation.

Formula = (Actual site[azimuth & tilt] Shaded Solar Radiation) / (Actual site[azimuth & tilt] Unshaded Solar Radiation)

Total Solar Resource Fraction (TSRF)
Column Title: Total Solar Resource Fraction (TSRF) Azimuth= [actual setting] Tilt= [actual setting]

Description: Determines the actual site efficiency considering both orientation as well as shading. This column compares the actual solar radiation values against what could be realized with no obstructions and with ideal orientation.

Formula = (Actual site[azimuth & tilt] Shaded Solar Radiation) / (Ideal settings[azimuth & tilt] Unshaded Solar Radiation)

Ideal Site Efficiency
Column Title: Ideal Site Efficiency % Azimuth= [ideal setting] Tilt= [ideal setting]

Description: Determines the efficiency of a panel location considering only shading values. This column compares the ideal solar radiation values with shading against what could be realized without shading.

Formula = (Ideal settings[azimuth & tilt] Shaded Solar Radiation) / (Ideal settings[azimuth & tilt] Unshaded Solar Radiation)

Definition of CSI Column

CSI-EPBB Shading Derate Factor Percent

Column Title: CSI-EPBB Shading Derate Factor (%)

Description: This column is required by the state of California as part of the California Solar Initiative (CSI). Actual shaded solar radiation divided by actual unshaded solar radiation. Totals only consider May-Oct.

Definitions of PV Watts Columns

Actual Shaded AC Energy (KWH)

Column Title: Actual Shaded AC Energy (KWH) Azimuth = [analysis settings] Tilt = [analysis settings]

Description: The actual amount of energy expected from the array.

Actual Unshaded AC Energy (KWH)

Column Title: Actual Unshaded AC Energy (KWH) Azimuth = [analysis settings] Tilt = [analysis settings]

Description: The unshaded (no obstructions) amount of energy expected from the array for the given azimuth and tilt.

Ideal Unshaded AC Energy (KWH)

Column Title: Ideal Unshaded AC Energy (KWH) Azimuth = [ideal settings] Tilt = [ideal settings]

Description: The unshaded amount of energy expected from the array taking the ideal orientation settings into account.

PV Solar Cost Savings

Column Title: PV Solar Cost Savings [actual cost (i.e. $0.11 / kWh)]

Description: The amount of actual savings that can be expected given the shading and analysis settings.

AC Energy Efficiency

Column Title: AC Energy Efficiency Azimuth = [actual setting] Tilt = [actual setting]

Description: The Actual AC Energy divided by the Ideal AC Energy, expressed as a percentage.

5.4.4 User Interface

These settings affect the calibration window 35 visual elements.

5.4.5 Ideal Settings

By default, "Ideal" means that the azimuth is 180 deg south and tilt is the same as the latitude value of the analysis site. However, you may want to change these values for one reason or another. To do so, enter the information here. This will be applied to all new reports. Note that reports that were saved before this information was entered will still use their old values for ideal tilt and azimuth.

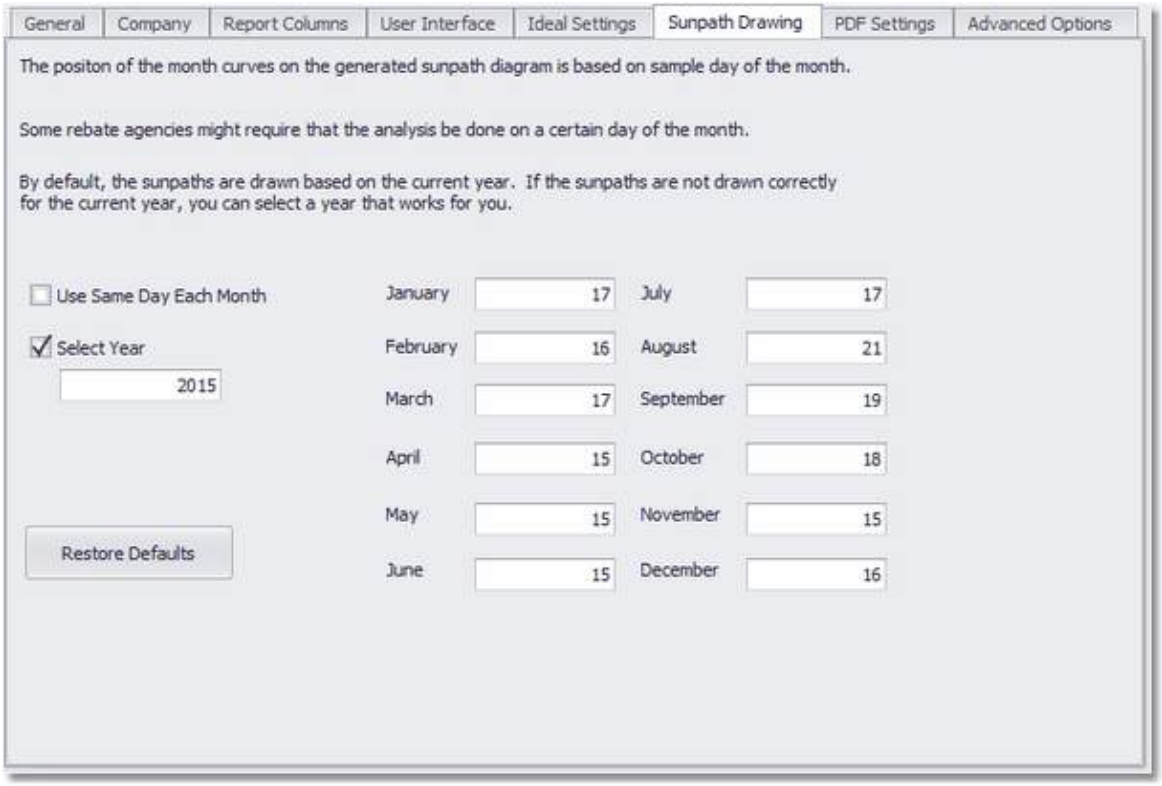
If you have changed these values and would like to go back to the default "ideal" settings, simply click the "Use Default" link beside the appropriate text box.

When you create or edit a report, you can override these values. The above values are used to "pre-populate" the report when you first create a new report.

5.4.6 Sunpath Drawing

The Sunpath Drawing options page gives you some control over how the sunpath diagram is generated. Each month curve on the generated diagram is based on a representative day of that given month. The mid-point day of the month is typically a good option, but

certain jurisdictions might require you to use different values.



Use Same Day Each Month (January)

If this option is checked, all months will use the value entered in the January text box.

Select Year

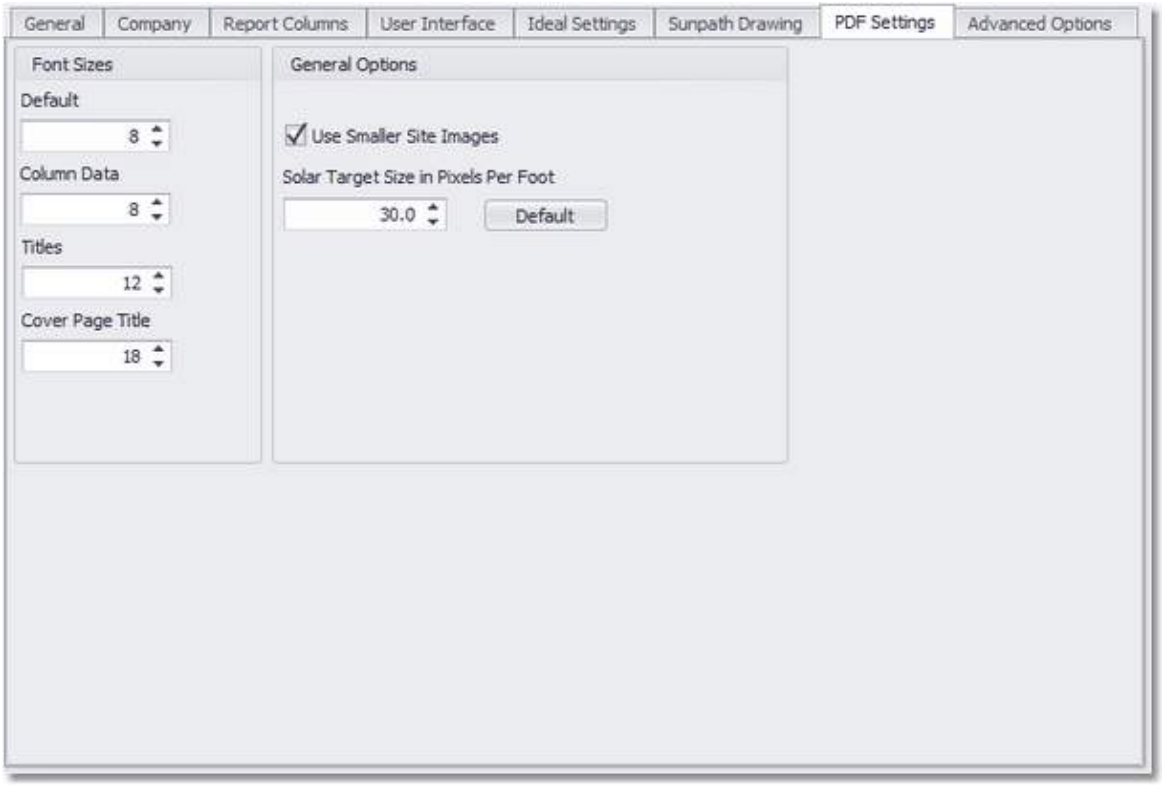
By default the sun's position for the current year is used to generate the sun paths. If you would rather use another year as the basis for solar position, enter it here. Make sure to enter in the full four digit year value because a value of 08 would represent 8 A.D. rather than 2008.

Restore Defaults

Clicking this button restores the sunpath drawing options to their factory default values.

5.4.7 PDF Settings

Settings related to the creation of the PDF report.



PDF Font Sizes

Default - This is the font size used everywhere except where the following fonts are specified.

Column Data - This font is used for the column data.

Titles - This size is used on the page headers and various other places that need a larger font.

Cover Page Title - Font size used on the cover page.

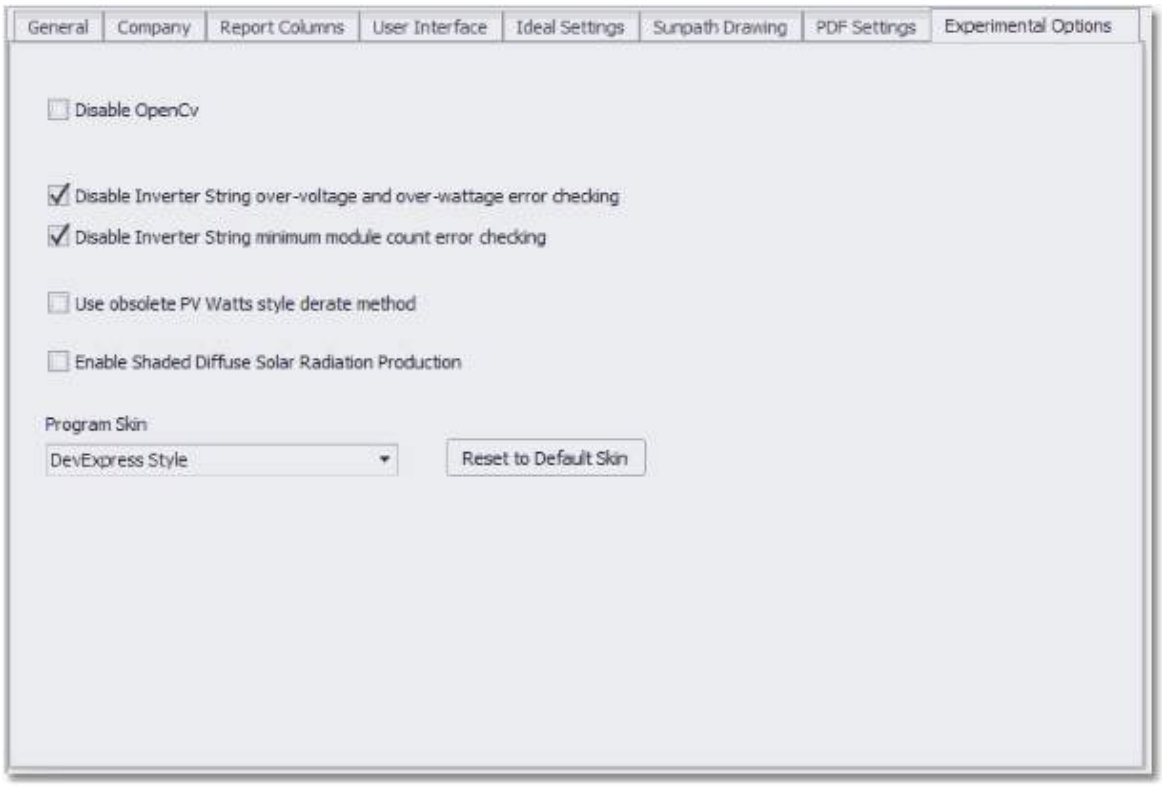
PDF General Options

Use Smaller Site Images

A large physical site may result in an image that cannot be written to the PDF file. Use this setting to make the resulting site image smaller.

5.4.8 Experimental Options

This tab contains experimental options that are used to work around known issues and it also provides a place for testing new features.



Experimental Options

Disable OpenCV

OpenCV is used to aid in calibrating and cropping the site image. The OpenCV libraries have been known not to run on some machines which causes PV Studio to throw an unhandled exception. Use this setting to disable the use of OpenCV.

Disable Inverter String Error Checking

Disables inverter string error checking. This assumes that the Inverter is more tolerant of voltage boundary conditions than the inverter specification seems to indicate.

Use obsolete PV Watts style derate method

The derate method has been replaced with the System Losses method. Enabling this setting will revert the program to using this older method of accounting for losses.

Enable Shaded Diffuse Solar Radiation Production

Diffuse solar radiation will be added to the shaded are in the survey.

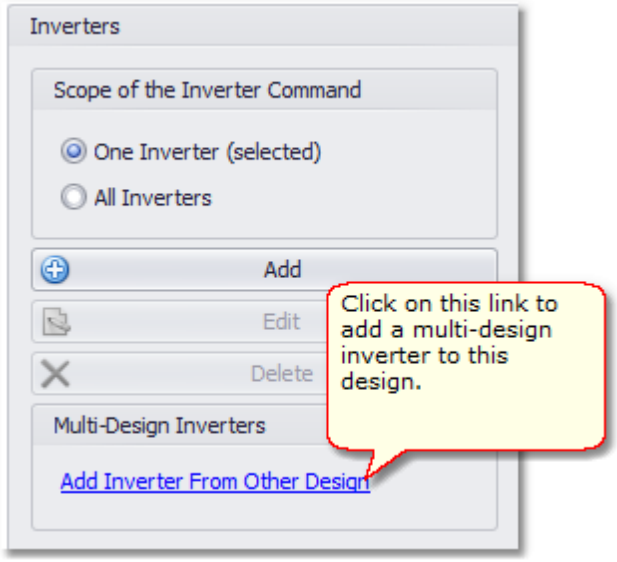
Program Skin

Experiment with different skins for the program appearance. The button will restore the default skin.

5.5 Multi-Design Inverters

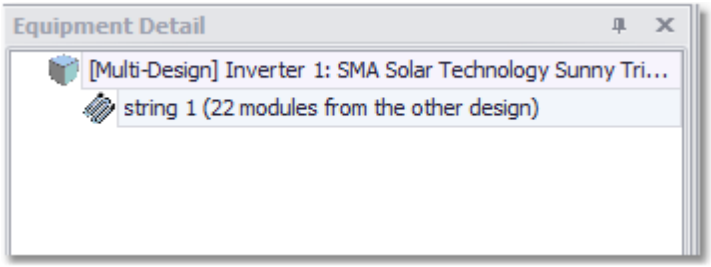
Multi-design inverters are inverters that have modules from 2 or more designs. Each string can only contain modules from one design.

The image below is part of the inverters window 23:

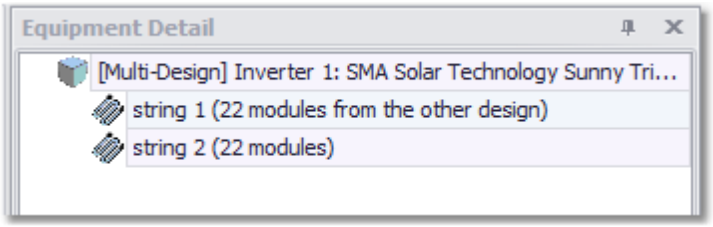


The "Multi-Design Inverters" section will only be visible when there is an available inverter in another design.

Once you've added an inverter from another design, the equipment detail 56 window will look something like this:



Then, once you've added the modules from this design, the equipment detail window will look like this:



The modules from this design have been added to string 2.

5.6 Inverter String Calculations

Inverter string calculations are performed to determine how many modules can be placed onto an inverter string and how many strings can be supported by an inverter. These calculations are affected by the annual minimum and maximum temperatures at your site in addition to the electrical characteristics of a particular module and inverter.

Sample Calculation

Solar Module Specifications for 1 Soltech Inc., 1 STH 260:
- Maximum power at STC = 260 watts
- Maximum power voltage at STC = 31.5 V
- Maximum power current at STC = 8.3 A
- Open circuit voltage at STC = 37.5 V
- Short circuit current at STC = 8.7 A
- Normal operating cell temperature = 50 °C
- Power temperature coefficient = -0.48 %/°C
- Voltage temperature coefficient = -0.37 %/°C
- Current temperature coefficient = 0.09 %/°C

Inverter Specifications for SMA Sunny Boy SB 6000:
- Nominal DC Power rating = 6,350 watts
- Efficiency: 96.8%
- Maximum Input Voltage = 600 VDC
- Maximum Input Current = 25A
- MPP Voltage range 250 V - 480 V
  - Maximum Operating Voltage = 480 VDC
  - Minimum Operating Voltage = 250 VDC
- AC Voltage 240VAC at 60Hz

Location Specifications:
- Historic annual minimum temperature: -12.2 °C

- Historic annual maximum temperature: 36.7 °C

Calculate the Module Max Voltage at Minimum Temperature
STC Temperature = 25 °C (constant)
Temperature difference = Lowest temperature - STC Temperature
= -12.2 - 25 = -37.2 °C
Open Circuit Voltage Adjustment = Temperature Difference * voltage temperature coefficient
= -37.2 * -0.37% = -37.2 * -0.0037 = 0.13764
Max module voltage = Open Circuit Voltage * (1 + open circuit voltage adjustment)
= 37.5 V * (1 + 0.13764) = 42.7 V

Calculate Maximum Modules Per String
Max modules per string = max voltage / max module voltage
= 600 V / 42.7 V = 14 modules
(NOTE: this is also limited by nominal inverter DC power)

Calculate the Module minimum voltage at maximum temperature
Temperature above ambient = 40 °C (constant)
Voltage Adjustment = ((max temperature + temperature above ambient - STC Temperature) * voltage temperature coefficient)
= (36.7 + 40 - 25) * -0.0037 = -0.1913
Minimum voltage = max voltage + (max voltage * voltage adjustment)
= 31.5 V + (31.5V * -0.1913) = 31.5 V + (-6.026) = 25.5 V

Calculate Minimum Modules Per String
Minimum Modules per String = Ceiling(Inverter Minimum Operating Voltage / minimum module voltage)
= Ceiling(250 / 25.5) = Ceiling(9.8) = 10
= 10 + 1 (NOTE: add 1 module to protect against voltage degradation)
= 11

5.7 Unaligned Roof Layout

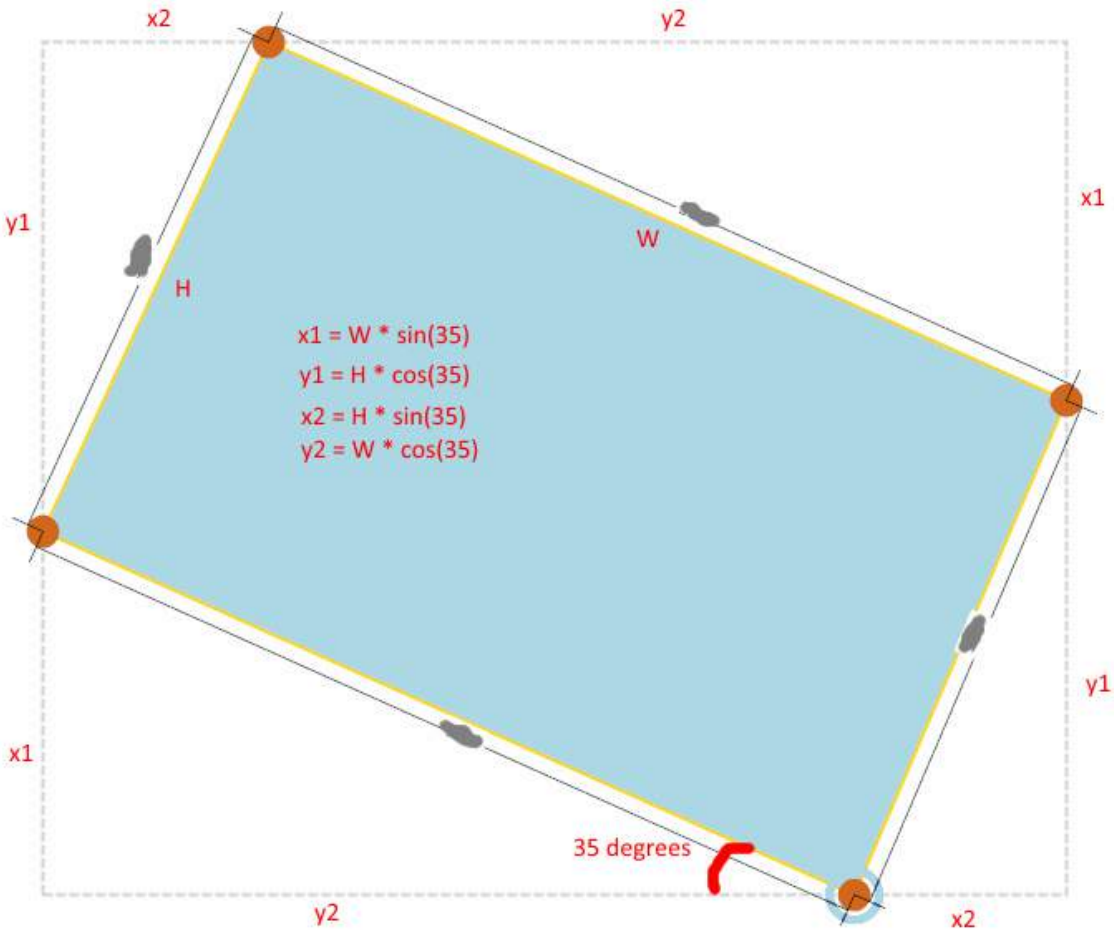
Currently, modules can only be placed on a roof at an an angle parallel with the bottom of the editor. The bottom of the editor window always points in the direction of the Azimuth. This makes it difficult to place skew-aligned modules on a roof. The example below will show you how to work around this problem.

For this example we'll assume that the roof is oriented to Azimuth 215° which is 35° west of due south. This example also assumes that

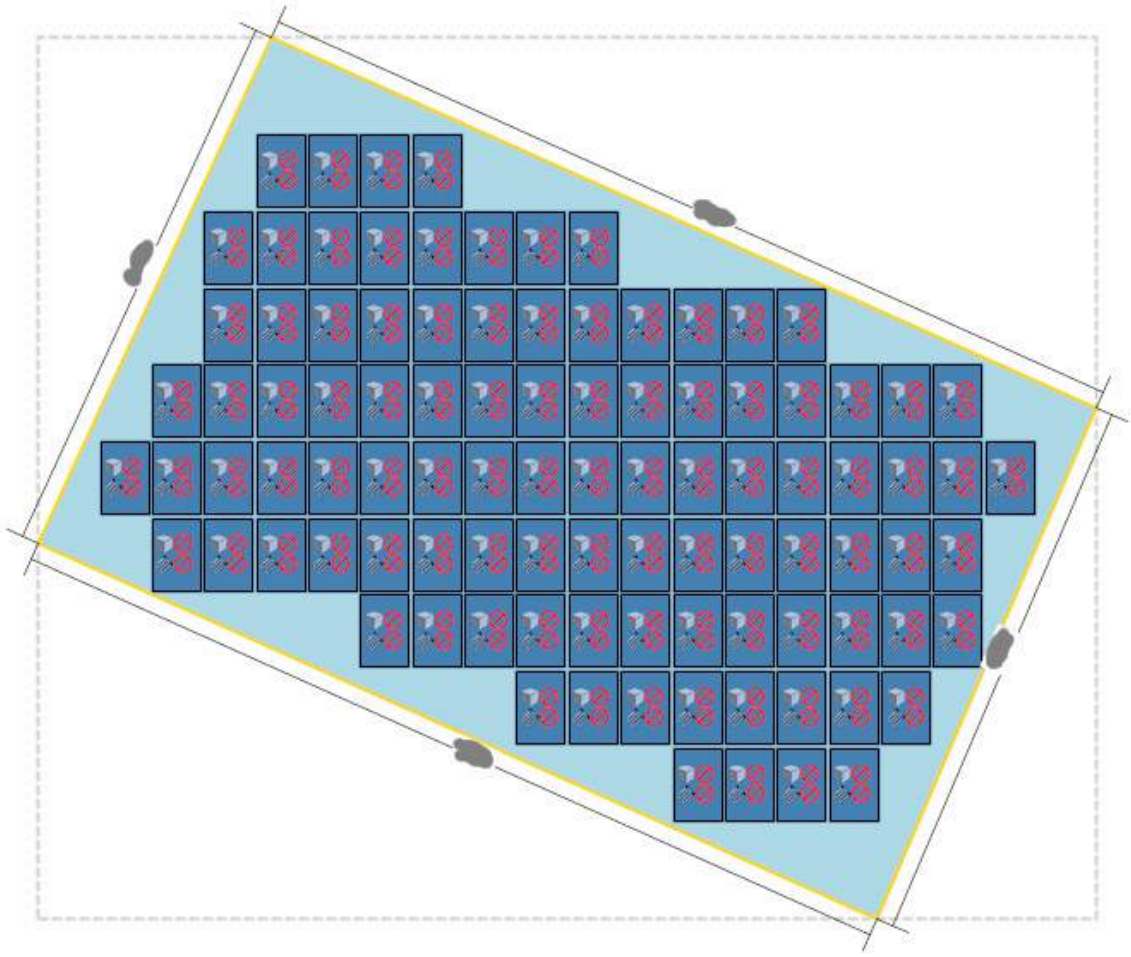
the true Azimuth in the Solar Target Orientation Window is set to 180°.

The second step is to move the four corner points so that the rectangular rooftop is rotated 35 degrees (this is were you enter the angle appropriate for your roof) to the West of true south. You will need to enlarge the workspace to accommodate the rotated rooftop. You can use the arrow keys to do fine adjustments of the selected corner points.

Below is an image of what you're trying to accomplish with the corner points. You know the H and W of the rectangular rooftop and you need to find x1, y1, x2, & y2 to place the corner points in the enlarged editor workspace.



Here is an image of the workspace after it has been automatically filled with modules that are oriented to true south.



5.8 System Size Calculations

Equations for the system size calculations:

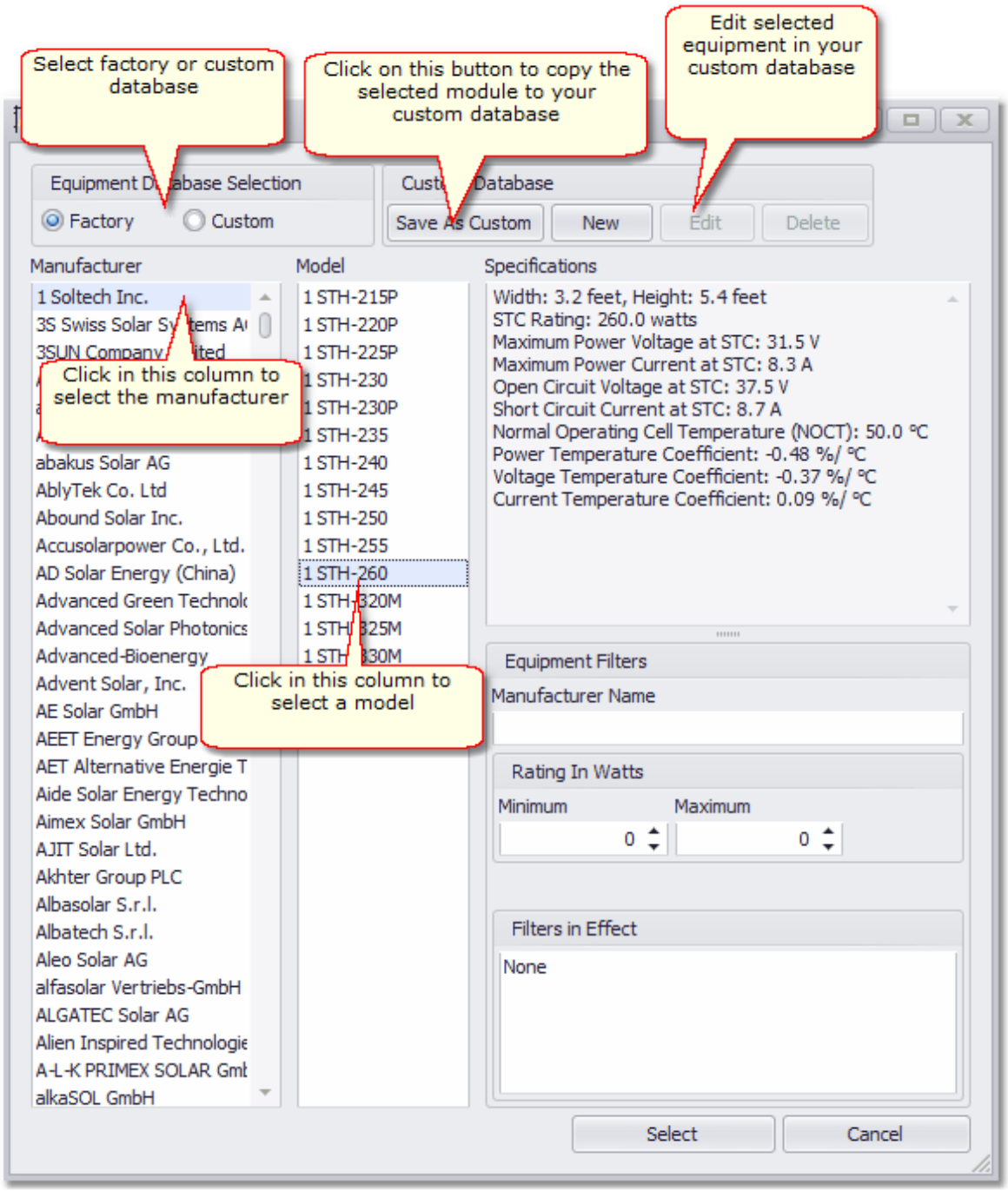
STC System Size = Number of modules times the module STC size (rating)

DC System Size = STC System Size minus the shade losses

AC System Size = DC System Size minus the system losses

5.9 Module Selection Form

The operation of the module selection dialog shares many functions in common with the inverter selection dialog. The first part of this section will discuss only the Module specific features and the common functions will be described afterward.



Module Selection Form

Module Equipment Selection Features

- Specifications - this box lists data about the module. At a minimum, the program needs the STC Rating and the module height and width, but additional information is needed to perform inverter string calculations 81.
- Equipment Filters:
  - Rating In Watts - Shows only modules where the nameplate

wattage falls somewhere in between the minimum and maximum range. If the maximum wattage is 0, then this filter is disabled.

See the Custom Module Editor 87.

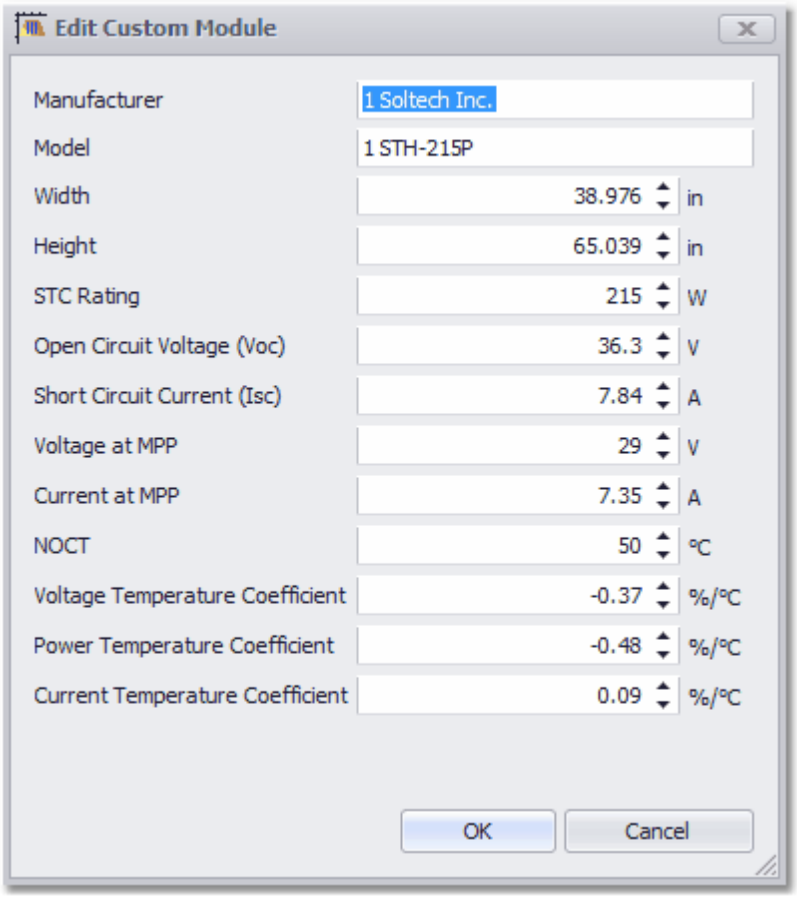
Common Equipment Selection Functions

By default, the first Model of the first Manufacturer is selected. The details of the selected Model are listed in the Specification box near the upper right portion of the dialog window. Select equipment by first clicking on the Manufacturer name in the Manufacturer (leftmost) scroll box. This will highlight the manufacturer name and list available Models in the Model scroll box which is to the immediate right of the Manufacturer scroll box.

- Equipment Database Selection - When the Custom radio button is selected, you will be looking at equipment in your own custom database. The Factory radio button shows the supplied database which cannot be edited.
- Custom Database - Use 'New', 'Edit', and 'Delete' buttons to manage your custom equipment database.
- Save as Custom - Clicking this button copies the currently selected factory equipment into your custom database and opens an editing window.
- Equipment Filters - These filters limit the equipment shown in the Manufacturer and Model scroll boxes.
- Manufacturer Name Filter - The name entered here will match any part of the manufacturer name. Only matching names will be listed in the Manufacturer scroll box on the left.
- Filters in Effect - This lists all the filters that are being applied to the current equipment view. If it is blank, then you will see the entire equipment database.
- Select Button - Closes the dialog and sets the selected equipment as default.

5.10 Custom Module Editor

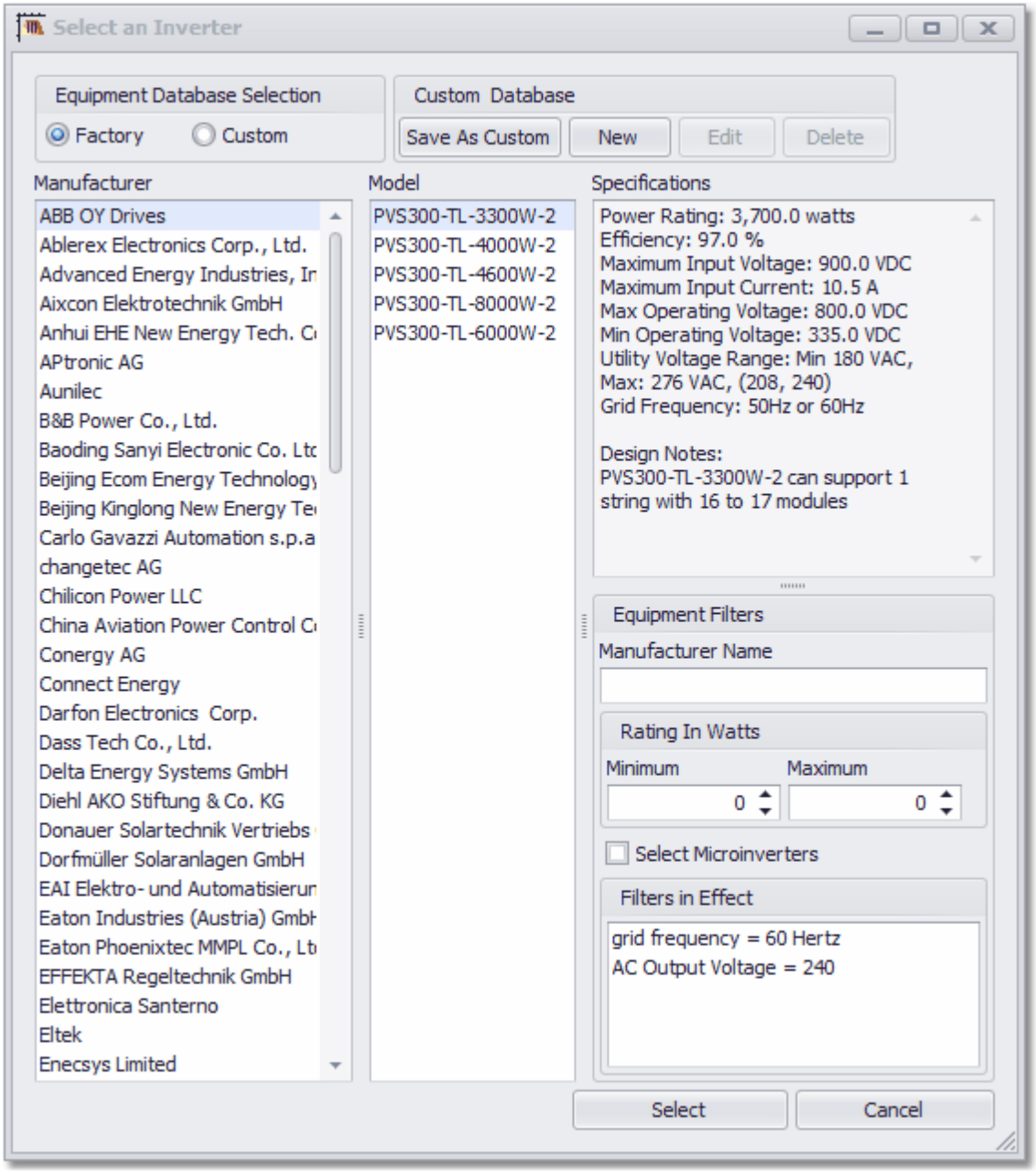
Enter or edit data for your custom module.



All of the listed information must be entered in order to do string calculations 81. If a manufacturer does not provide all of this data, particularly the coefficient values, then use the values from a similar module.

5.11 Inverter Selection Form

The inverter selection dialog window shares some elements in common with the module selection window. Read about the common equipment selection functions 86.



Inverter Selection Form

See the Module Selection Form 84 for notes on other elements of the above form.

Inverter Equipment Selection Functions

- Specifications - This box lists specifications about the inverter. At a minimum, the power rating is required, but other data is necessary in order to perform inverter string calculations 81.
- Rating in Watts - This will limit the displayed inverters to an AC nominal rating between the selected minimum and maximum rating.

If the maximum wattage is 0 then this filter is disabled.

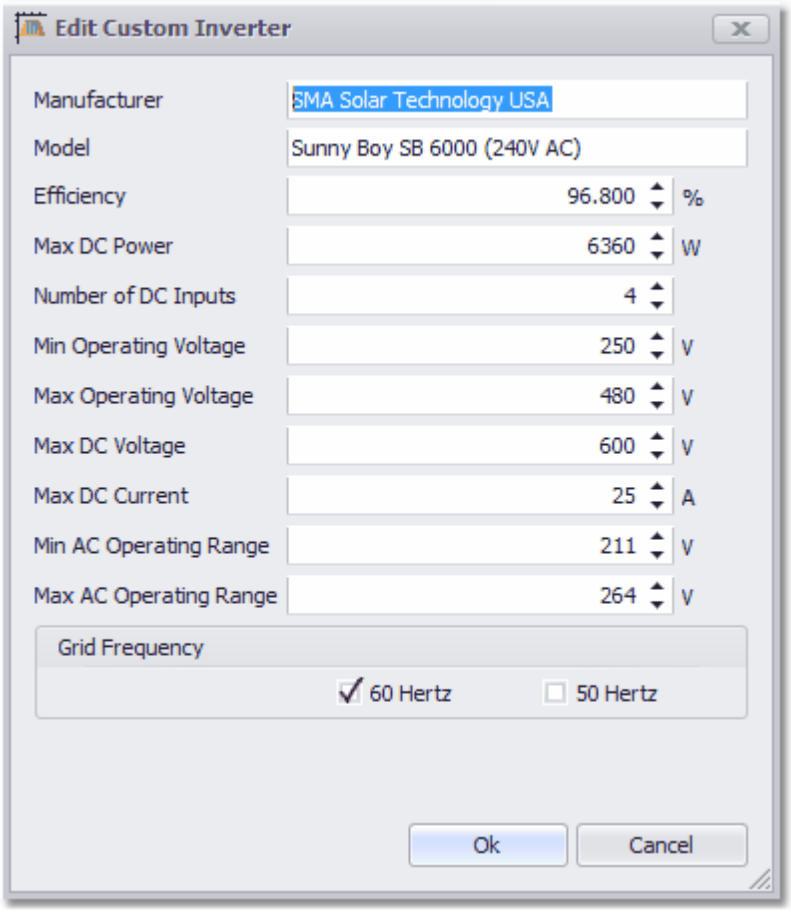
- Select Microinverters - Filters inverters that have a maximum wattage less than 500 watts.
- Filters in Effect - The grid frequency and the AC output voltage filters cannot be changed in this form. These filters are set in the Location Dialog 7 where the AC Output Voltage is the same as the Utility Voltage.

See the Custom Inverter Editor 89.

See the Common Equipment Selection Functions 86.

5.12 Custom Inverter Editor

Enter or edit data for your custom inverter.

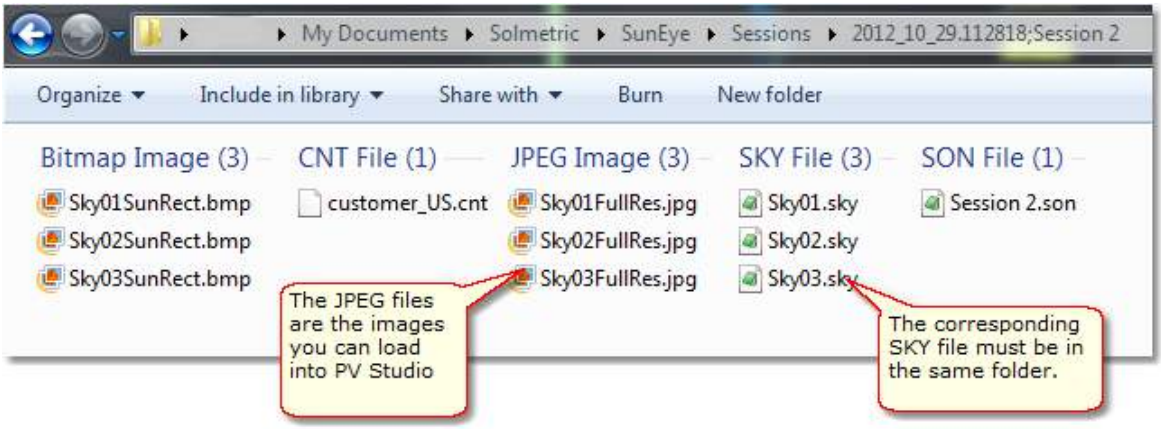


All of the listed information must be entered in order to do string calculations 81.

5.13 Loading Solmetric Sun Eye Images

Solmetric Sun Eye images can be used in place of the SolarPathfinder dome images. This process has been tested on the Sun Eye 210 unit and it is not known if this will also work with the older 110 model. Please let us know if you have any issues and we will do our best to resolve the problem.

This program assumes that the Sun Eye images are in the session folder and that the image names have not been changed. In particular, we expect to find two matching files, 1) SkyNNFullRes.jpg, and 2) SkyNN.sky, where NN can be 01, 02, 03, and so on. So, for example, when you load an image with the name of Sky03FullRes.jpg and if we find a file named Sky03.sky in the same folder, the program assumes that this is a Sun Eye image and will process it accordingly.



Sample SunEye Session Folder

Once the JPEG image is loaded, you will skip the cropping and calibration steps and go directly to the tracing step 39.

5.14 What-if scenarios

To perform "what-if" scenarios, you can copy a current design, and then edit any of your surveys and change orientation settings and shading. For instance, you could see what would happen if you removed a couple of trees in your sample image.

Removing trees for "what if" scenario

Now, comparing the original report with the new report, you can easily see the effects.

Month	PVWatts Unshaded % Ideal Site Azimuth=180.0 Tilt=42.5	Actual Solar Rad w/ Shading Azimuth=180.0 Tilt=42.5 KWH/m /day
January	27.36%	0.89
February	53.35%	2.19
March	90.72%	4.31
April	99.51%	5.03
May	98.81%	5.45
June	98.20%	5.57
July	98.57%	5.66
August	99.20%	5.44
September	99.61%	5.24
October	80.50%	3.79
November	38.98%	1.19
December	27.33%	0.82
Totals	**76.01%**	**--**
	Unweighted Yearly Avg	**Effect: 81.95% Sun Hrs: 3.80**

Original Report

Month	PVWatts Unshaded % Ideal Site Azimuth=180.0 Tilt=42.5	Actual Solar Rad w/ Shading Azimuth=180.0 Tilt=42.5 KWH/m /day
January	41.51%	1.36
February	63.80%	2.61
March	90.72%	4.31
April	99.51%	5.03
May	98.81%	5.45
June	98.20%	5.57
July	98.57%	5.66
August	99.20%	5.44
September	99.61%	5.24
October	80.50%	3.79
November	57.75%	1.77
December	35.69%	1.07
Totals	**80.32%**	**--**
	Unweighted Yearly Avg	**Effect: 85.04% Sun Hrs: 3.94**

New Report

Examining the actual solar radiation with shading, you will see that the "what if" scenario will increase your solar radiation exposure from 81.95% to 85.04%. Also, as a result of the change, the average sun hours for the year is 3.94, which is up from 3.80.

5.15 Optimal Orientation Tool

If your survey location has a lot of shade, this tool will help you find the best array orientation that will provide the greatest kWh production over the entire year.

This tool only works on the site images so you will be asked to select an image to analyze when you run the tool.

Because the tool needs to do a PVWatts calculation for each possible orientation, it can take a long time to run. To make this iteration faster, the tool requires you to give it the ranges of azimuth and tilt it should check.

The azimuth values are always absolute and are not affected by the hemisphere.

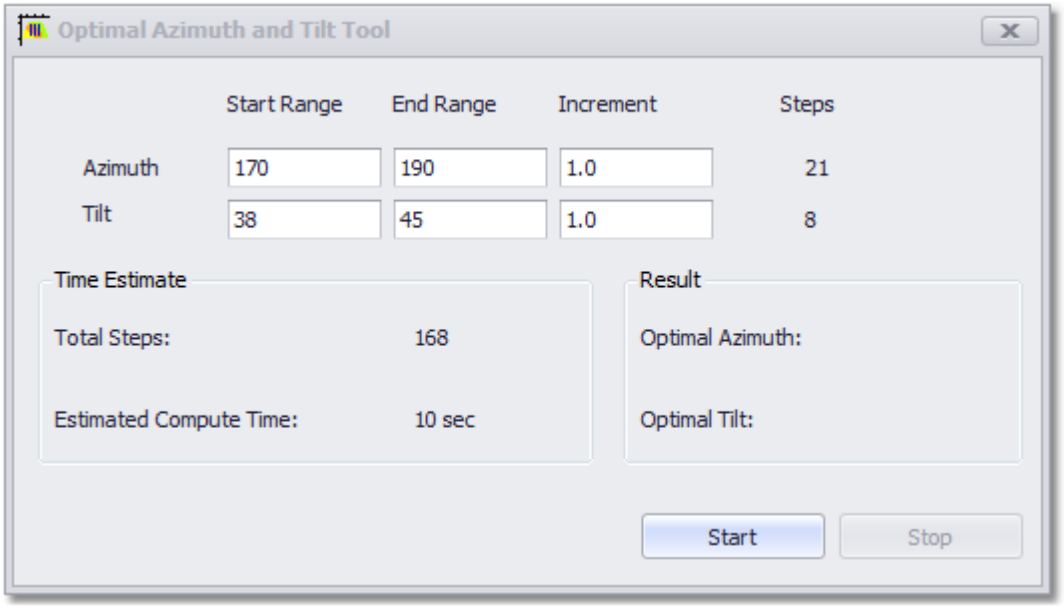
Azimuth Compass Values (both hemispheres):
0 = North

90 = East
180 = South
270 = West

The tilt values are dependent on the hemisphere. In the north, use positive tilts from the horizontal to point south. In the southern hemisphere, use negative tilts to point north. The image below has been filled in to tell the tool that the Azimuth range of 170 to 190 degrees should be checked. The step value tells it to increment the step by 1.0, so it would check 170, 171, 172, ..., 189, 190. The step values work the same way for the tilts and the numerically lower value should be the start value.

The **Total Steps** value tells you how many unique orientations will be checked with PVWatts.

The **Estimated Compute Time** tells you approximately how long you will have to wait for an answer once you click on the **Start** button.



One point to look out for is when the result is on the azimuth or tilt boundary set by you. When this happens, readjust the boundaries and do another run.

The results produced by this tool do not alter the report. If you want to make changes to the report you will need to note these results and manually edit the report with the new values for azimuth or tilt.

5.16 California Solar Initiative (CSI)

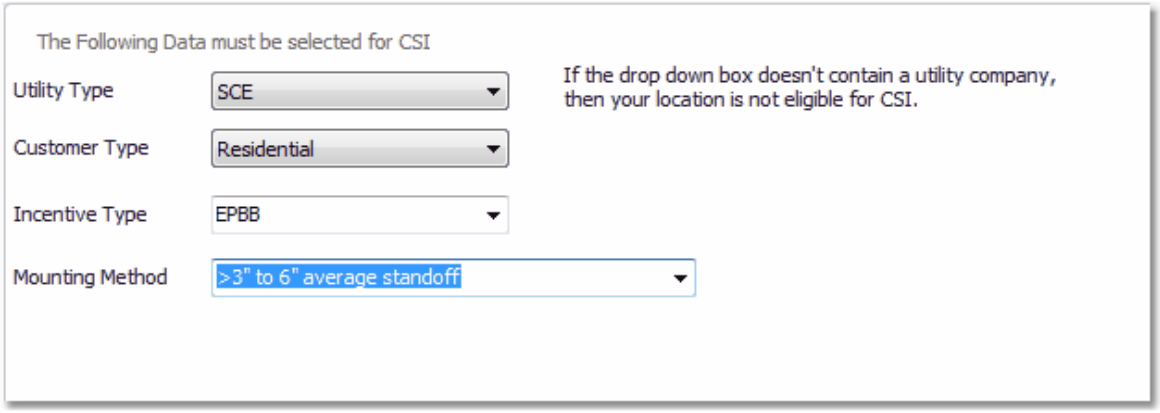
PV Studio has the ability to submit report data to the CSI web site to determine the EPBB Design Factor and calculate the incentive. The incentive information calculated by the web page will be included on your final report.

To create a CSI report, you must first have a site within California that is eligible for CSI. The eligibility is determined by site Zip Code. Once an eligible Zip Code is entered in the Location Dialog 71, a checkbox will become visible near the bottom of the Site Location Finder group.

Once the CSI checkbox has been "checked", the report has been enabled for CSI.

See the Location Dialog 71 page to see what the checkbox looks like.

When the CSI checkbox is checked and after the Next Button is clicked, you will see this input form:



Utility Type

Select the utility company you are serviced by. If the drop down box does not contain a utility company then the site is not eligible for CSI incentives.

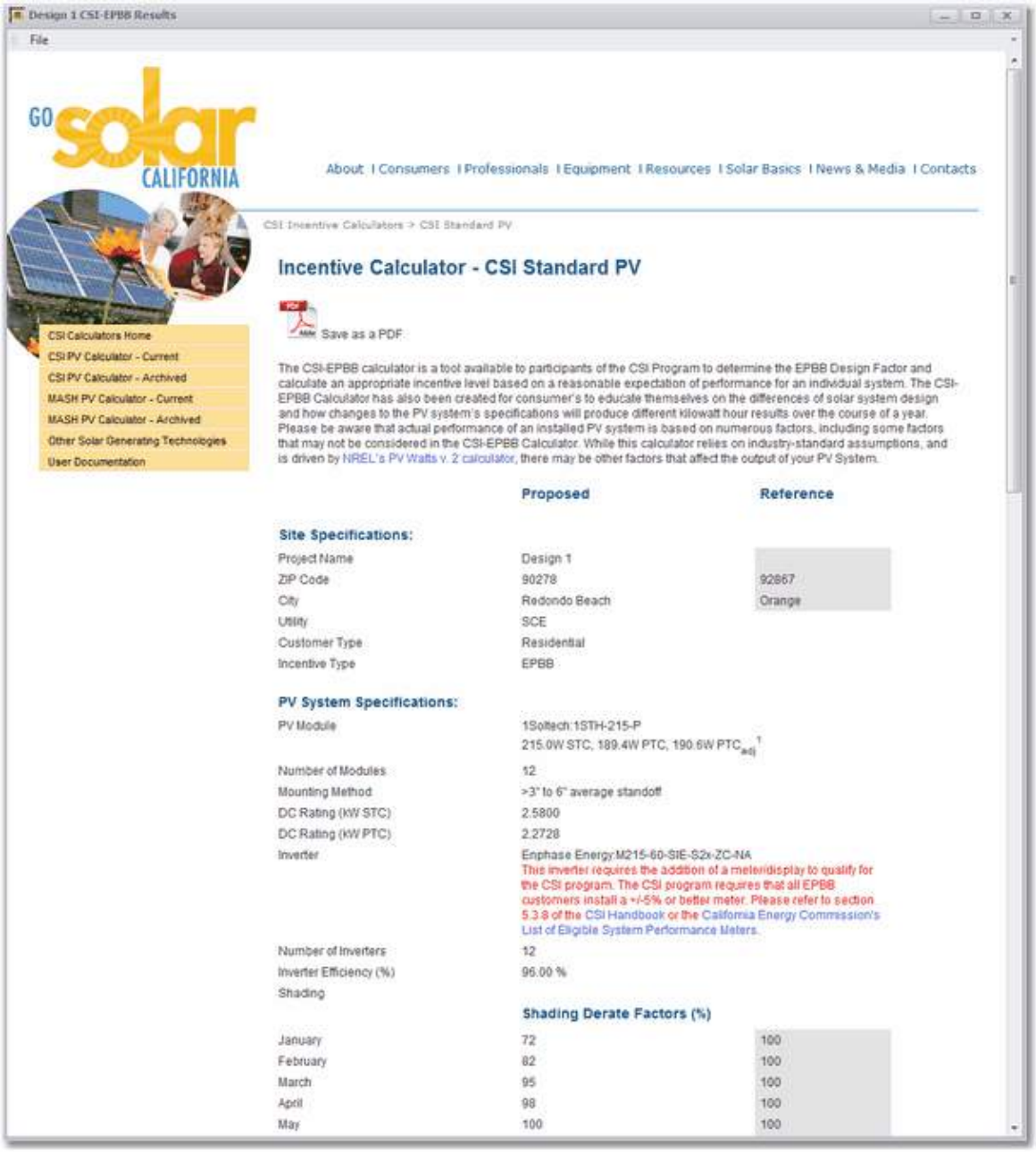
Incentive Type

Currently only EPBB is supported by PV Studio. If you need PBI, please contact SolarPathfinder Customer Support 97.

Internet Access

When you generate your PDF report, Internet access will be required to access the CSI website to obtain incentive information for this

report. Once the data has been received, a new window will be displayed with the information. Please examine this information closely because some of this data is not processed by PV Studio.

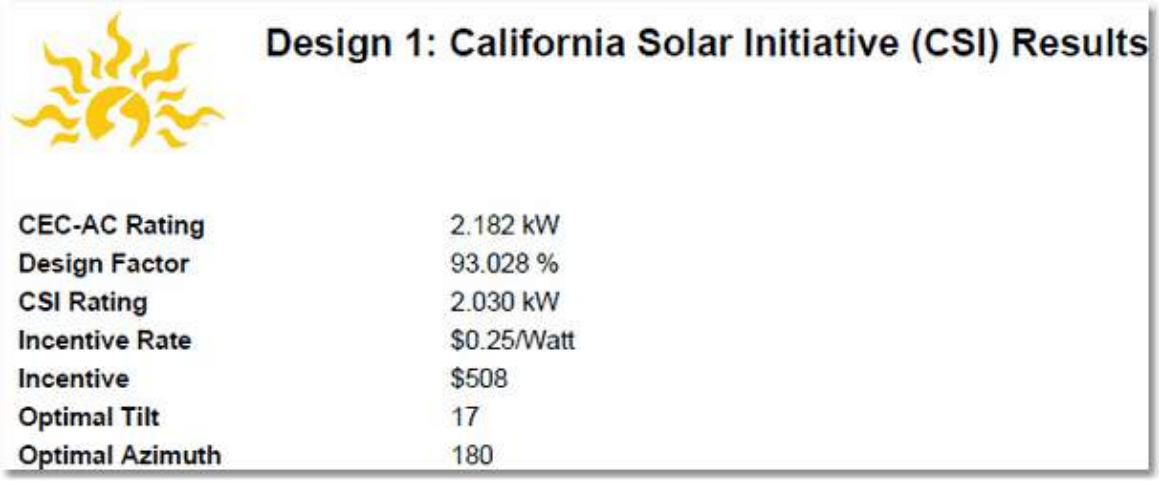


CSI Website calculation results

You can also upload your data to the website at anytime by using the "Tools | Upload CSI" menu function.

CSI Data on Your Report

The CSI specific data in your report will look like this:



Design 1: California Solar Initiative (CSI) Results

CEC-AC Rating	2.182 kW
Design Factor	93.028 %
CSI Rating	2.030 kW
Incentive Rate	$0.25/Watt
Incentive	$508
Optimal Tilt	17
Optimal Azimuth	180

CSI Excerpt from Report

You can enter data on the CSI site directly by going to www.csi-epbb.com

CSI Errors

If your report has CSI errors, you will not be able to upload it to the CSI website. There are several reasons for CSI errors:

- The site analysis location might not be in California.
- The site analysis location was entered using latitude/longitude instead of zip code.
- The report was not configured to use approved panels and inverters.
- The report does not have at least 4 trace images.

5.17 Paper Template Discrepancies

The application uses digital versions of the template for report generation. If you do use a paper template on the Pathfinder unit, you may notice some slight discrepancies between where you traced the reflection on the Pathfinder image and where the report says that the trace actually is. There are several possible reasons for this:

1. The magnetic declination that is used for rotation is exact. When you manually rotate your Pathfinder for magnetic declination, it is possible that the manual rotation amount differs from the calculated rotation amount. As such, the paper template will be over or under rotated when performing tracing. Note that this will not affect the calculations as you will be tracing the reflection on the dome. The

paper template location does not come into play when analyzing an image.

2. Paper templates can shift. Although the paper templates fit onto the level triangle relatively well, these templates can shift slightly from handling. As such, the resulting trace may not agree with what you can see by inspection. These errors will not be great. Note that the error is in the location of the paper template and not in the application. The application does not concern itself with the location or orientation of the paper template.

3. Camera parallax issues. When you take a picture of the Pathfinder unit, your camera should be facing directly down at the Pathfinder. If you are taking the picture from an angle, you will introduce parallax and the level will appear to be in a slightly different location. This can easily be seen during the calibration step as the gray lines will indicate where the level should be in an ideal picture.

5.18 Online FAQ

This FAQ answers questions about the SolarPathfinder Unit: Online FAQ (www.solarpathfinder.com/faq).

5.19 Disclaimers

Equipment Database

We do our best to provide you with a reliable equipment database, but unfortunately mistakes and oversights do happen. It is in your best interest that you double-check the equipment specifications provided by this database with the manufacturer data sheets before building your design. SolarPathfinder cannot be held responsible for any damage that results from the use of this database. Please notify us immediately of any database errors at assistant@solarpathfinder.com.

5.20 Technical Support

Should you require technical support, you can contact SolarPathfinder via email at assistant@solarpathfinder.com or with a phone at (317) 501-2529.

You can also check out the web site (www.solarpathfinder.com) for frequently asked questions and tips, as well as program updates.

Index

Note: The page numbers in this index point to the start of the numbered section that contains the keyword or concept. Because of this, the keyword might possibly be found several pages after page listed in this index.

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