CASSYS: Canadian Solar System Simulation Software

Interface User Manual

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1. Interface Layout

- User-defined cells have a white background and have a border around the cell.

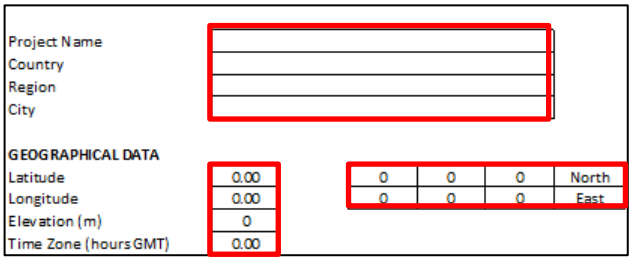


Figure 1: Example of User-Defined cells

- Cells containing calculated values have a purple background and a border around the cell.

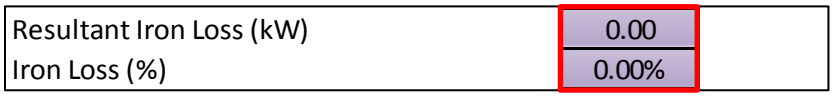


Figure 2: Example of Calculated cells

- Cells containing values from the database have a light blue background.

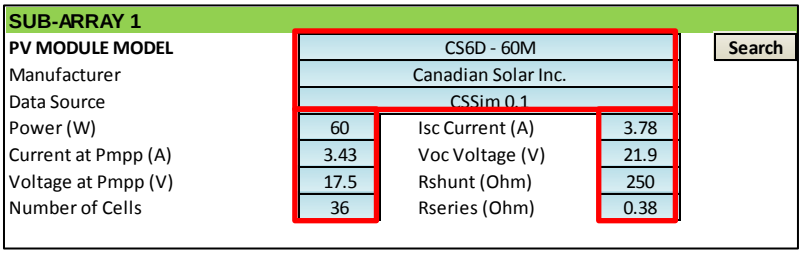


Figure 3: Example of cells containing database values

- All links have no underline, are colored black, and are in bold print.

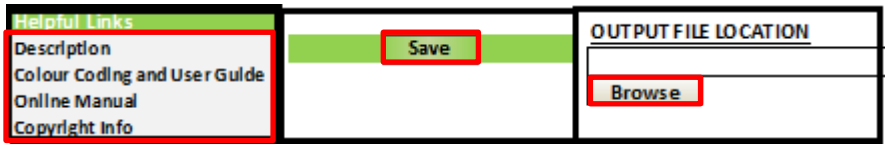


Figure 4: Example of Links

- On each page is a Navigation panel used to go to the previous page, the Intro sheet, or the next page respectively.

Figure 5: Navigation Panel

2. Creating a New Site Definition

Intro Page

On the Intro page click 'New' to clear out all the fields. After all the fields are cleared, you can click on one of the links on the side to start entering information about the solar site. It is recommended to start on the 'Site' page first.

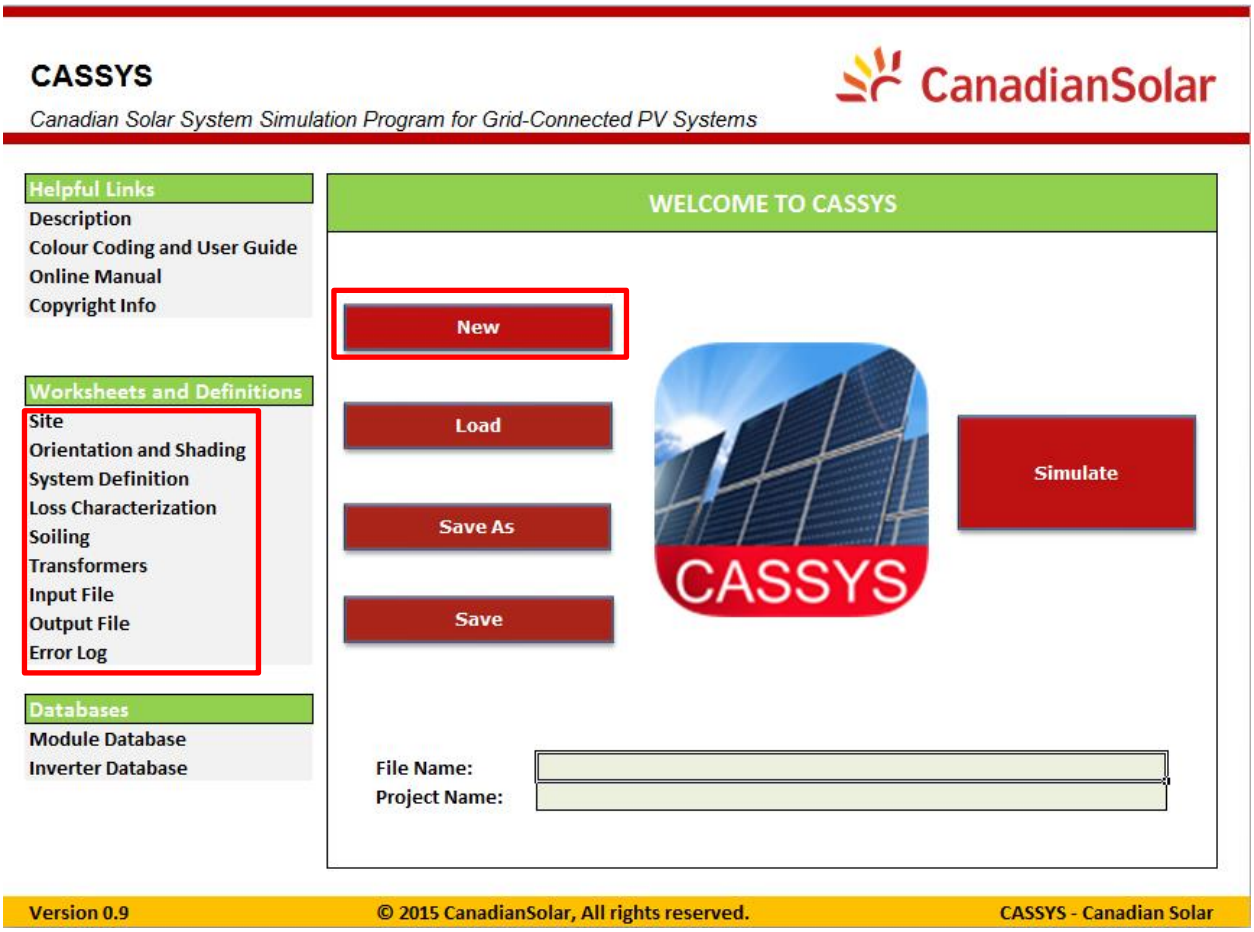


Figure 6: Intro Page - Creating a new site definition

Site Page

Fill out all of the fields except for albedo. The albedo can be defined as either a single yearly value or have separate values for each month. Click the ‘Frequency’ box for a drop-down list and select either ‘Yearly’ or ‘Monthly’ based on your needs.

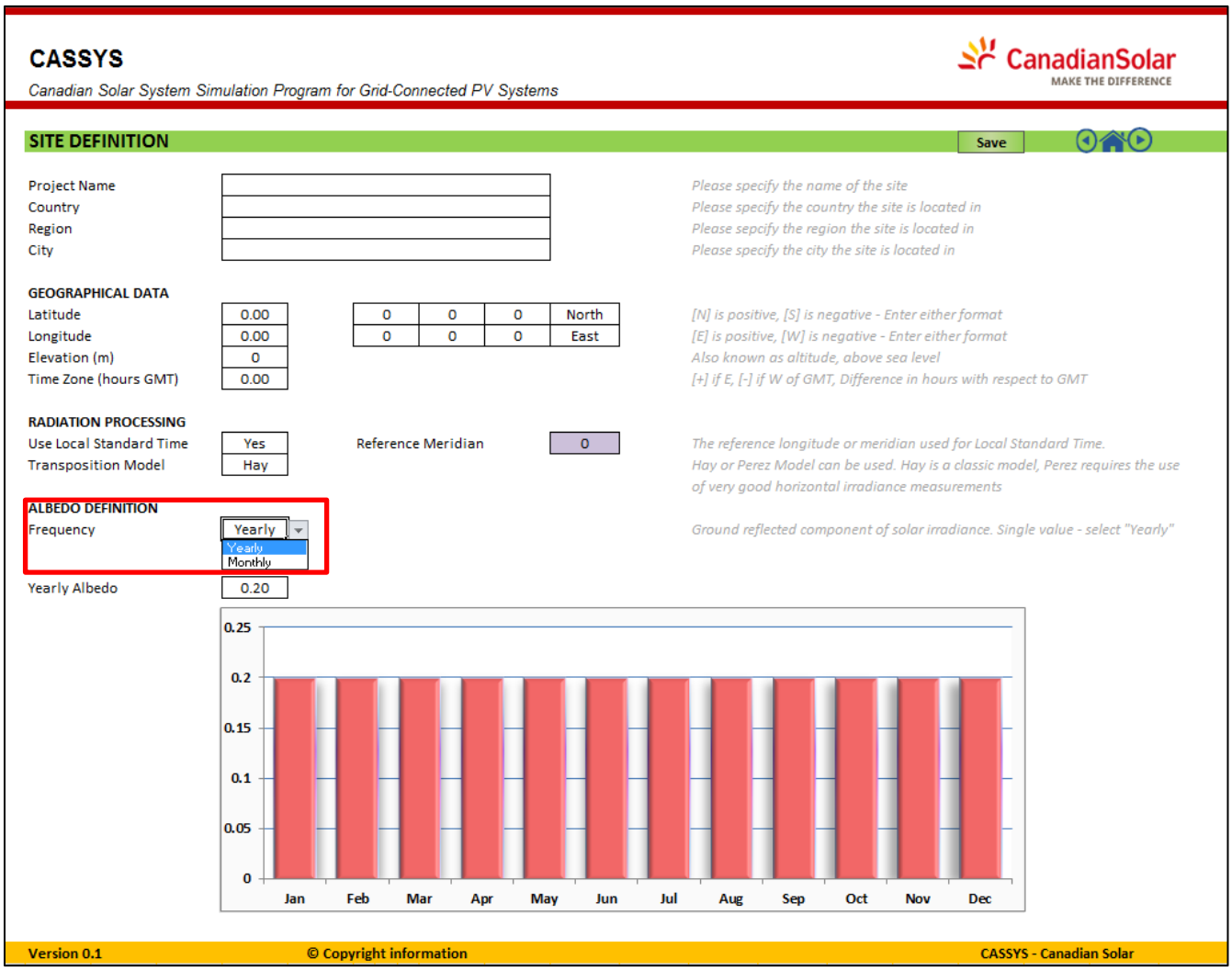


Figure 7: Site Page – Overview

The chart and rows will update based on your selection, as shown below:

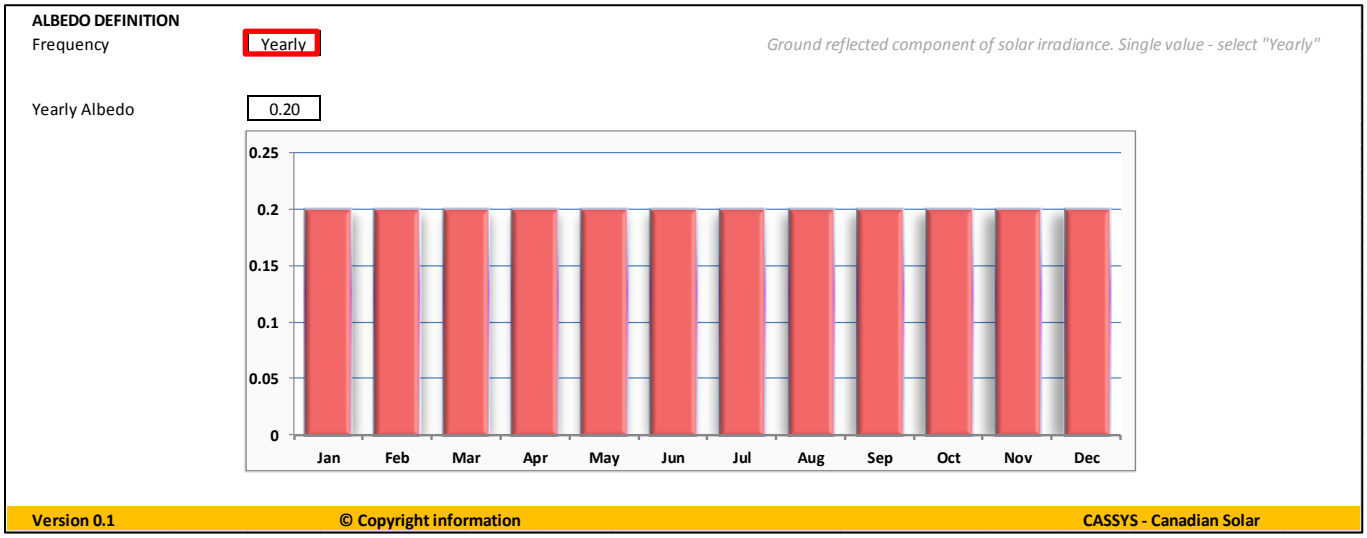


Figure 8: Site Page - Yearly Albedo

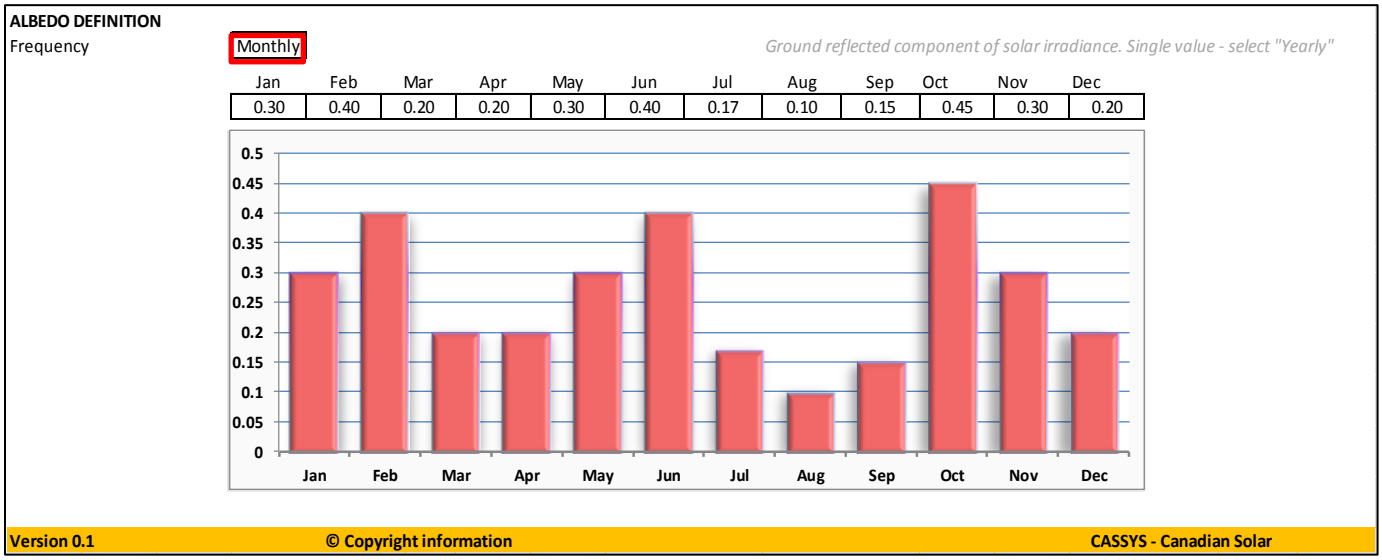


Figure 9: Site Page - Monthly Albedo

Orientation and Shading Page

On the Orientation and Shading page, use the drop down menu to choose an array type. Currently CASSYS supports the choice of the following array types: Fixed Tilted Plane, Fixed Tilted Plane Seasonal Adjustment, Unlimited Rows, Single Axis Elevation Tracking (E-W), Single Axis Horizontal Tracking (N-S), Tilt and Roll Tracking, Azimuthal (Vertical Axis) Tracking, and Two Axis Tracking. The type of array you choose will show or hide the fields relevant to the array type. Selecting Unlimited Rows or either of the Single Axis Tracking array types will allow you the option to use cell based shading effect. Select in the drop down whether you wish to use this or not. Afterwards, fill in the rest of the fields.

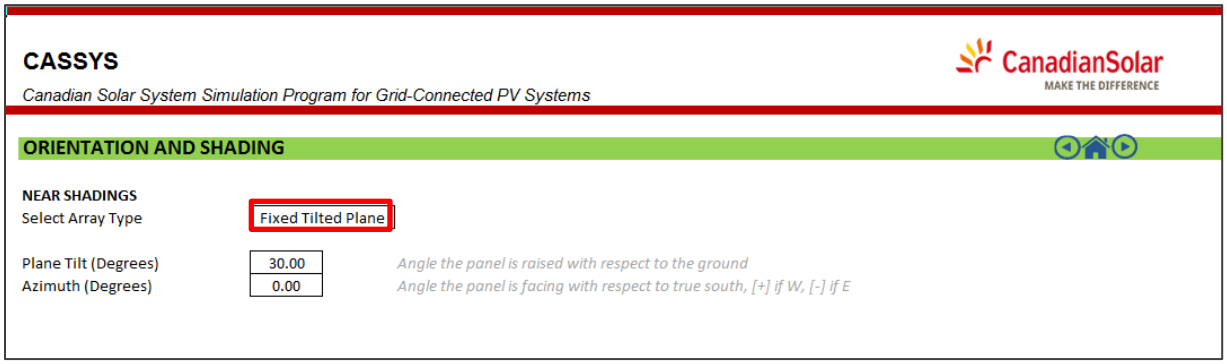


Figure 10: Orientation and Shading Page - Fixed Titled Plane

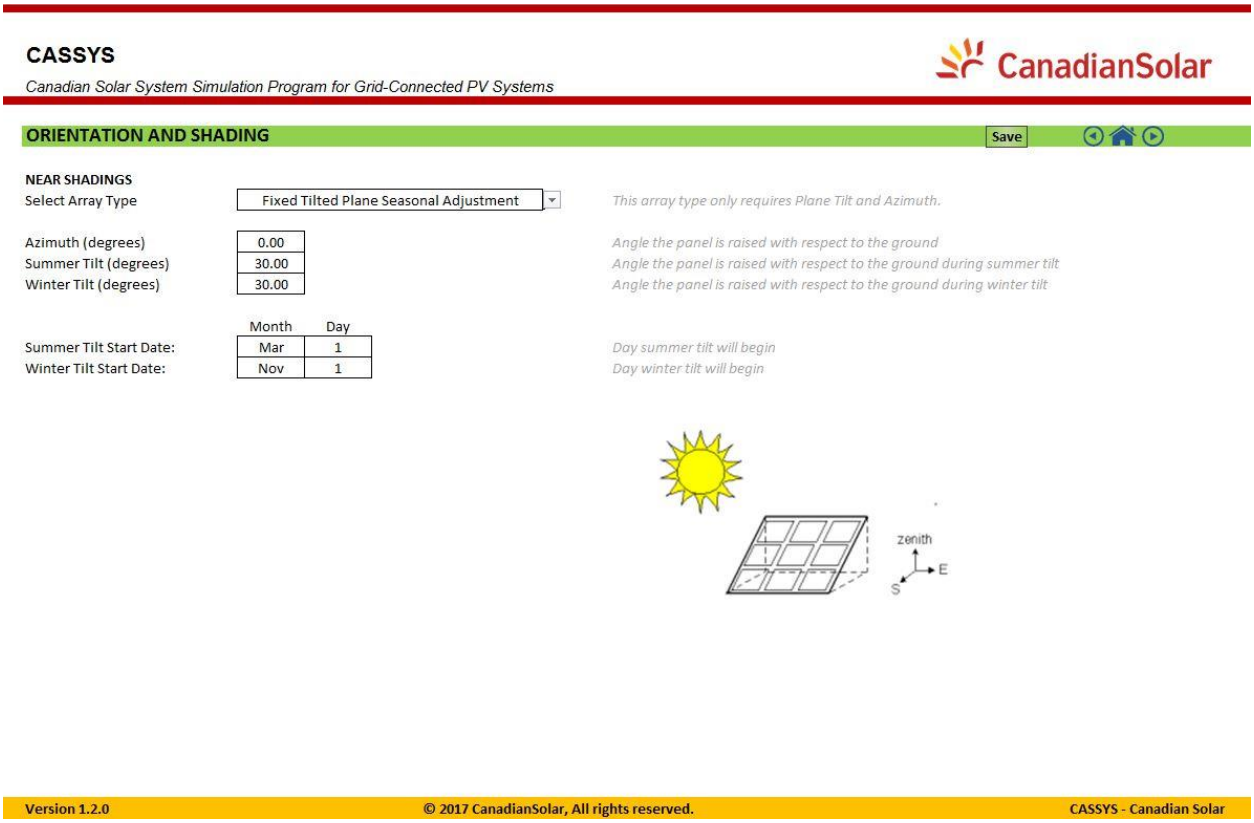


Figure 11: Orientation and Shading Page - Fixed Titled Plane Seasonal Adjustment

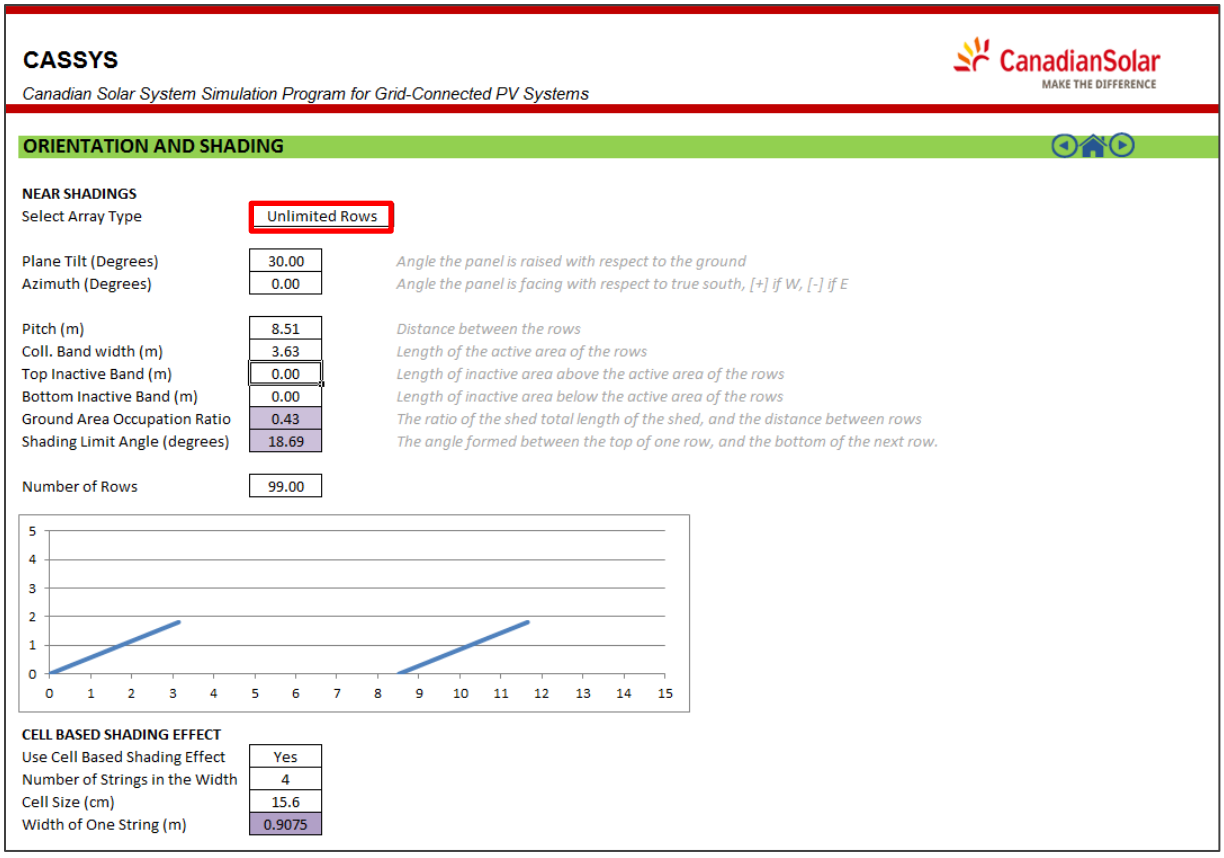


Figure 12: Orientation and Shading Page - Unlimited Rows

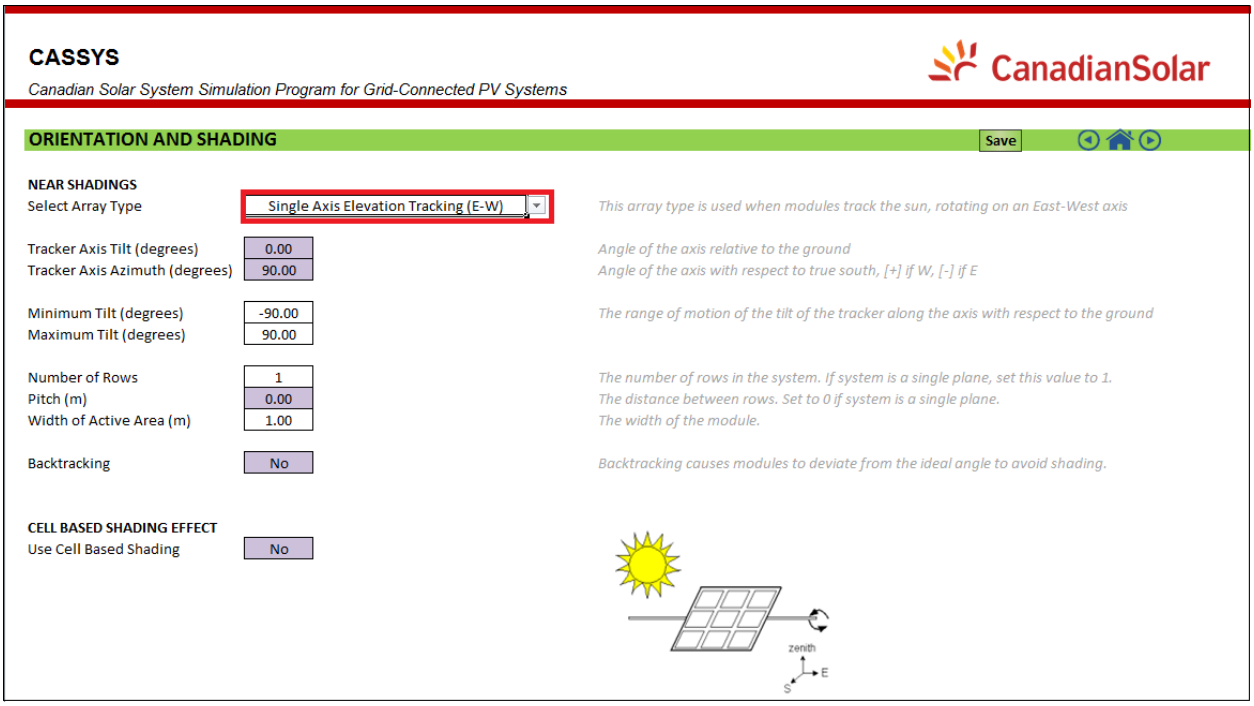


Figure 13: Orientation and Shading Page - Single Axis Elevation Tracking (E-W)

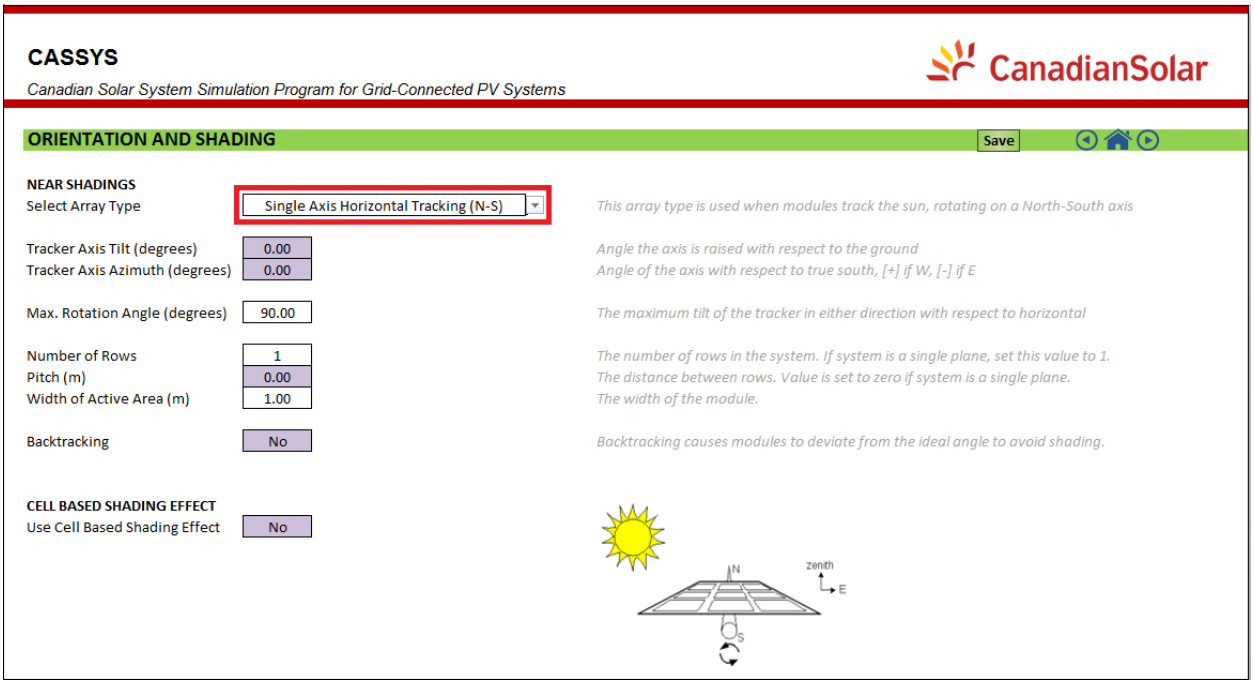


Figure 14: Orientation and Tracking Page - Single Axis Horizontal Tracking (N-S)

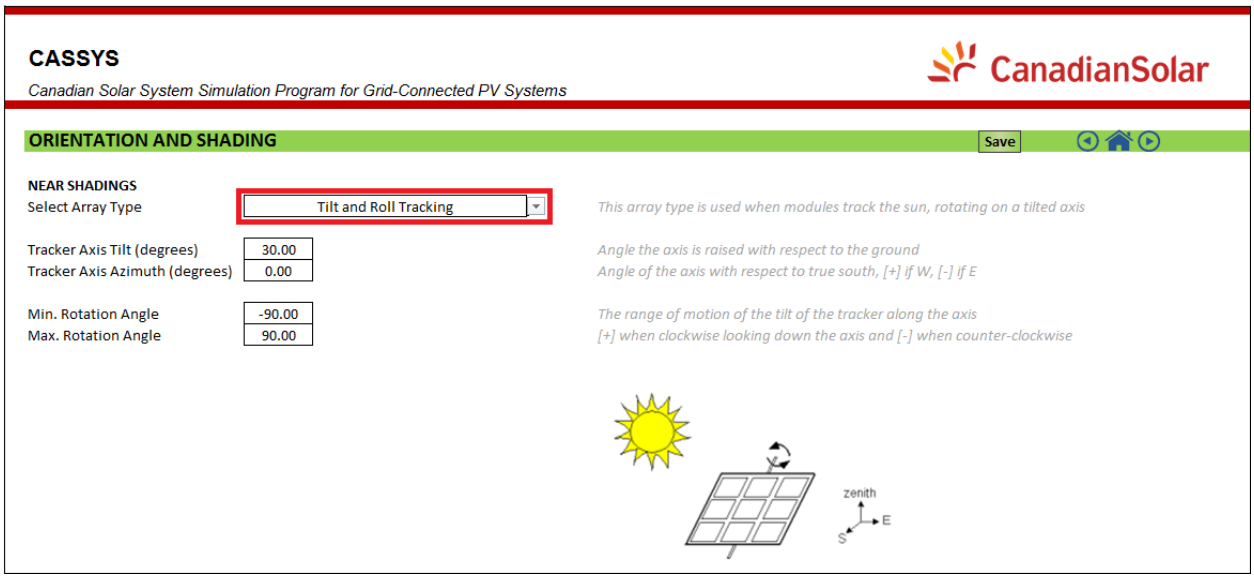


Figure 15: Orientation and Shading Page - Tilt and Roll Tracking

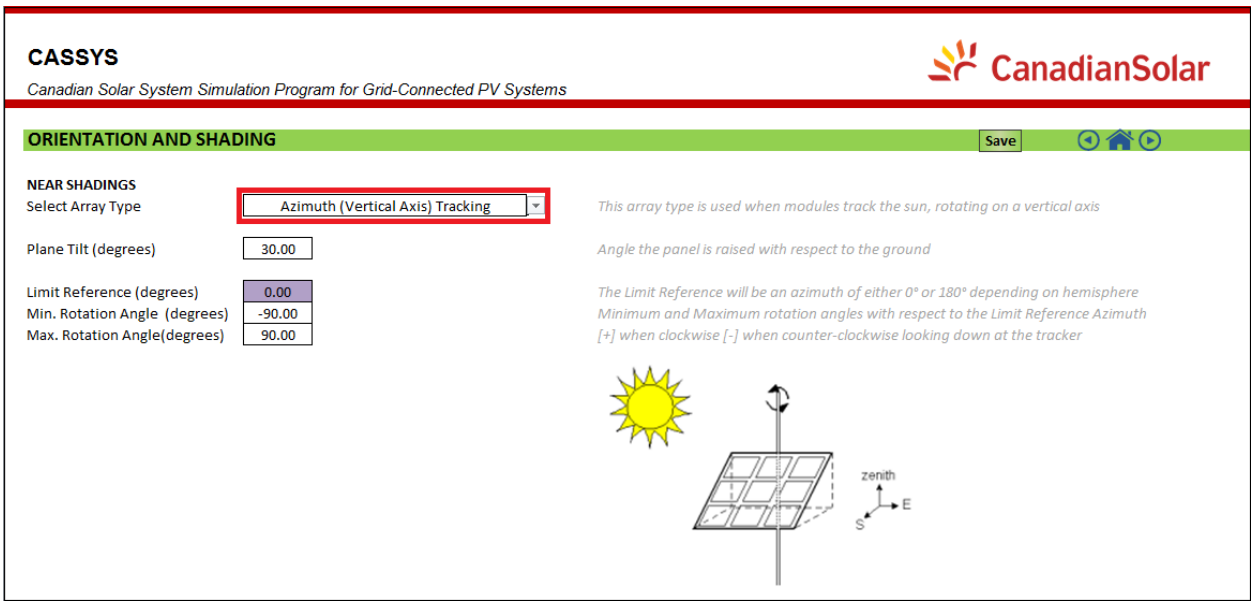


Figure 16: Orientation and Shading Page - Azimuth (Vertical Axis) Tracking

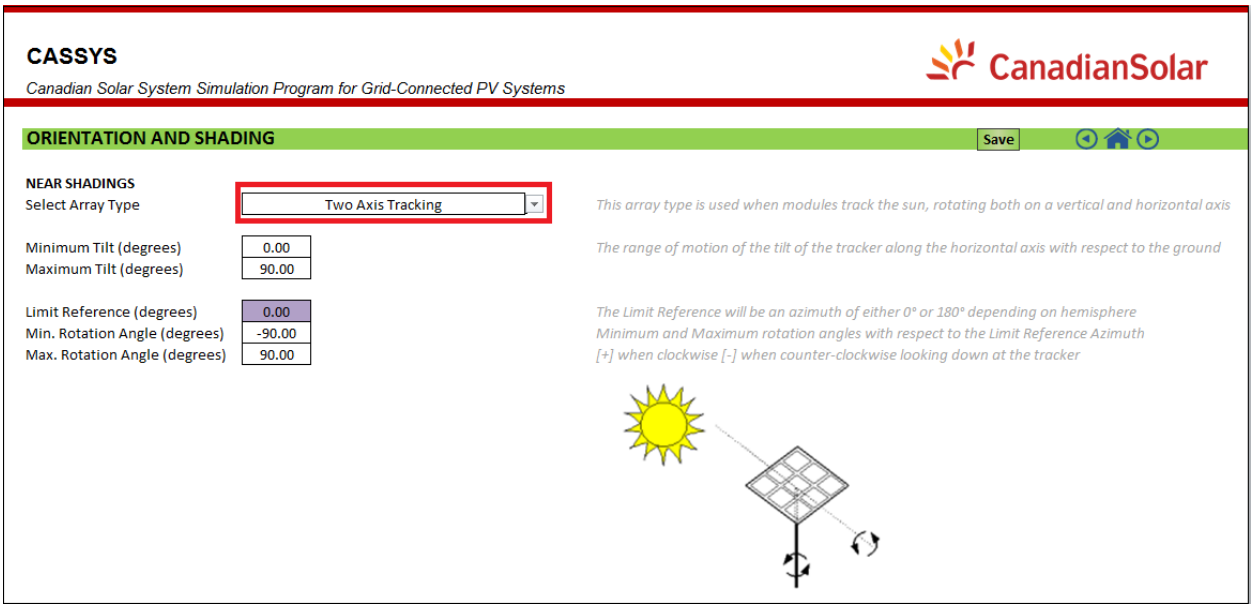


Figure 17: Orientation and Shading Page - Two Axis Tracking

Horizon Page

On the Horizon Page you can define a horizon profile for the system. You must set the 'Define Horizon Profile?' selection box to either 'Yes' or 'No'. This will either show or hide the inputs on the sheet. Next you must decide how many horizon points you wish to define. This will unhide the specified number of rows to define the horizon points. Lastly, you must put in the azimuth and elevation values for the horizon profile. If an azimuth value occurs more than once the cell fill will turn red and when saving the profile a warning will pop up. Duplicate values will be ignored by the program. The Horizon Information section will also sort all the points by the Azimuth value from least to greatest.

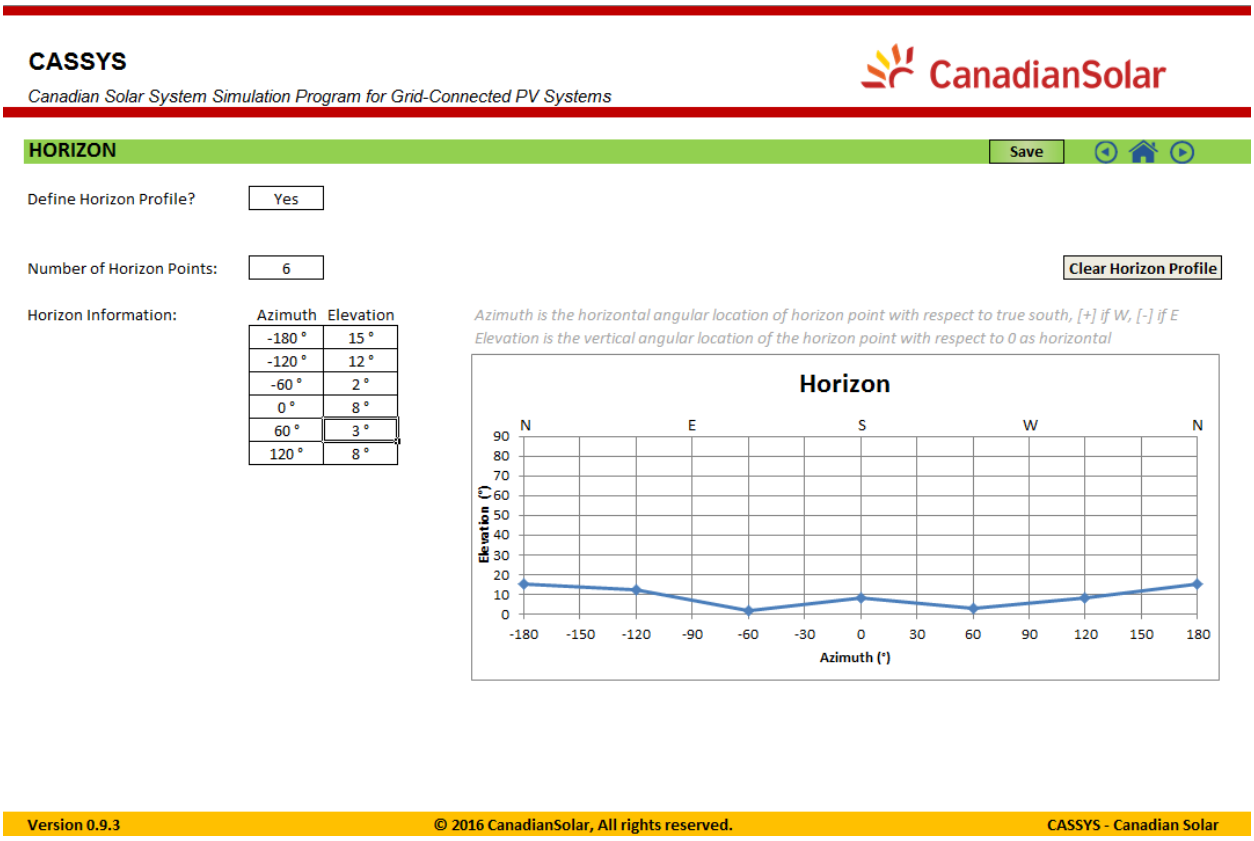


Figure 18: Horizon Page - 6 horizon points defined

System Page

On the System page you can specify the number of sub-arrays in a field. To choose an array PV module or inverter, you must click the 'Search' link and pick the manufacturer, model and data source of the module or inverter using the list in the GUI. Fill in the loss fraction fields as well as the other user defined fields for the PV modules and inverters. There is also the ability to change the AC wiring loss to be defined at either STC or at the inverters nominal power via a drop down tab. *(To add a new module or inverter, see Add Module or Inverter)*

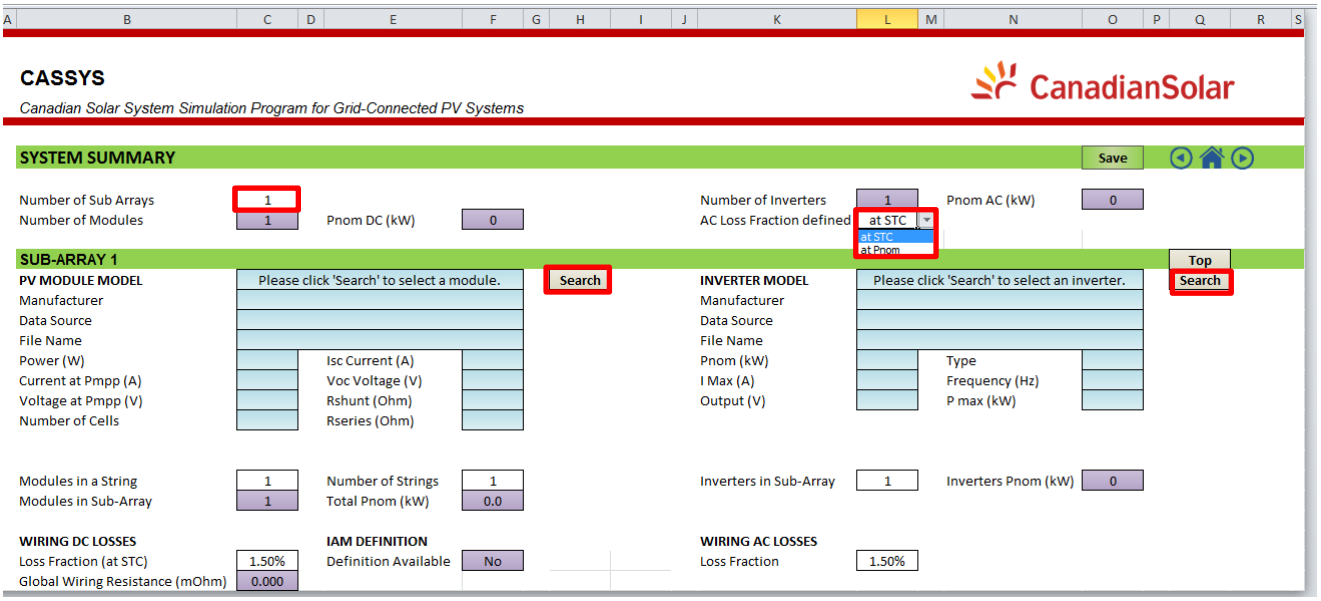


Figure 19: System Page - Specifying Number of Sub-Arrays

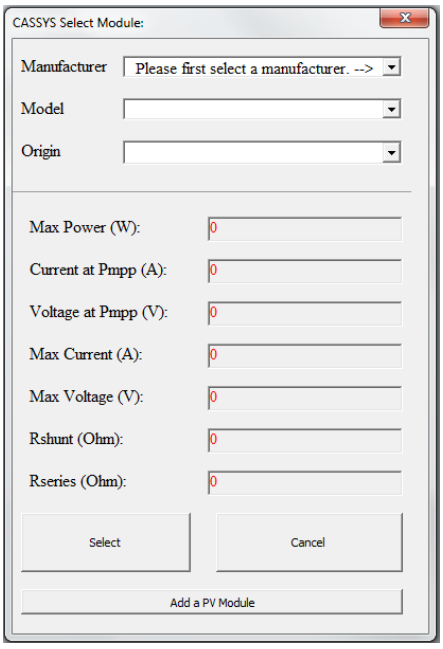


Figure 20: PV Module Selection GUI

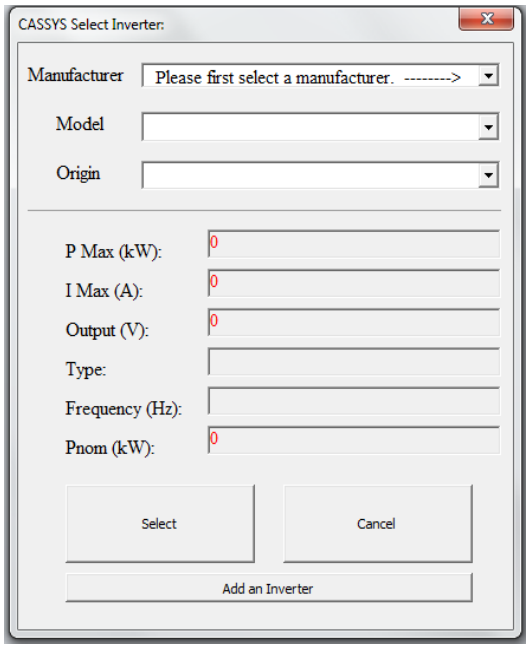


Figure 21: Inverter Selection GUI

Losses Page

On the Losses page, first set ‘Use Measured Module Temperature’ to TRUE or FALSE by clicking on it and using the drop-down list. This field should be set to TRUE if you can provide reliable module temperature data in the input file. If the field is set to FALSE, then heat loss factors must be provided and the Faiman model will be used during simulation.

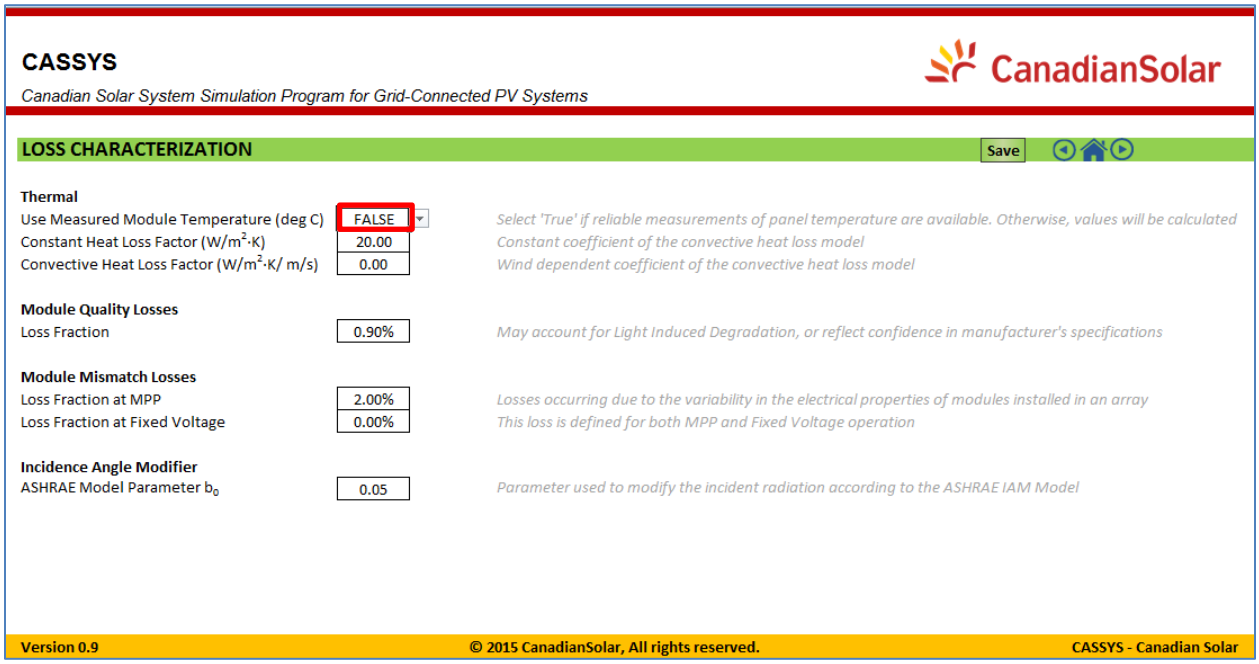


Figure 22: Losses Page – Overview

Soiling Page

The Soiling page, like the Orientation and Shading page, has a drop-down list that shows or hides the yearly and monthly soiling losses depending on what is chosen.

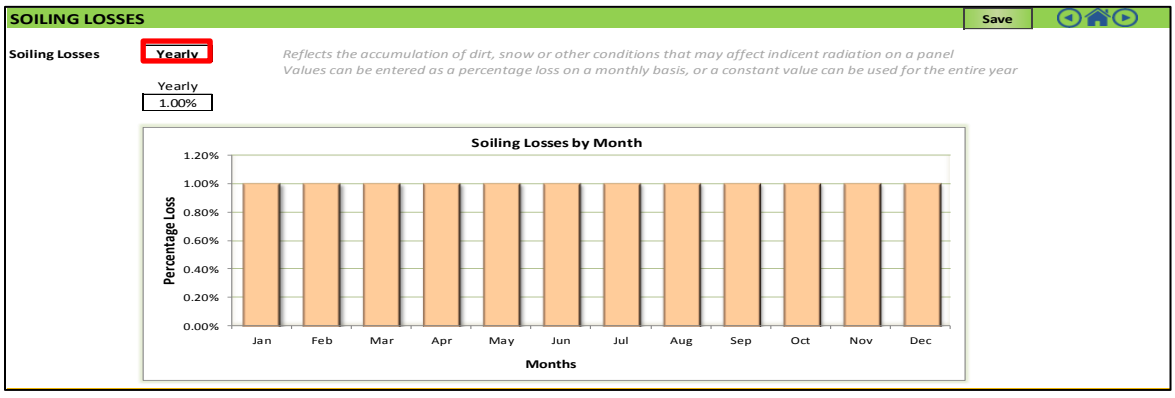


Figure 23: Soiling Page - Yearly Soiling Losses

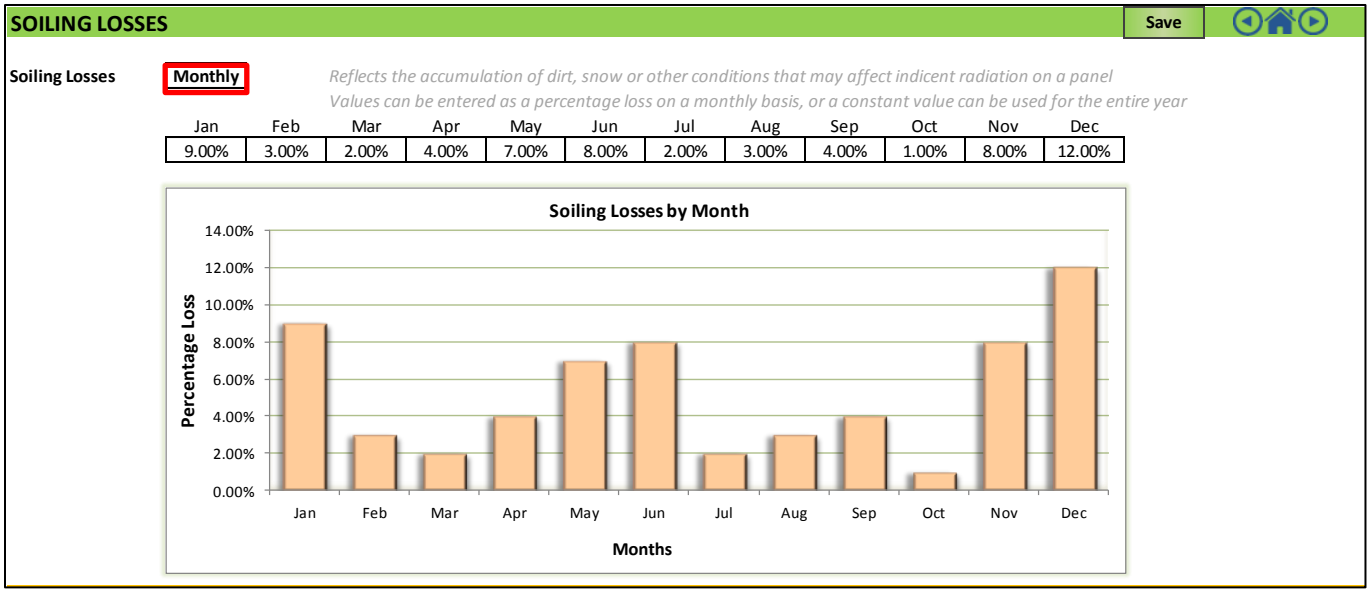


Figure 24: Soiling Page - Monthly Soiling Losses

Transformer Page

On the transformer page, fill in the nominal power of the transformer, iron loss and full load loss (these are typically available from transformer specs or test sheets). In the drop down list choose whether or not it is disconnected at night. This sheet contains a graph to illustrate the iron and resistive losses based on the amount of power being fed into the transformer.

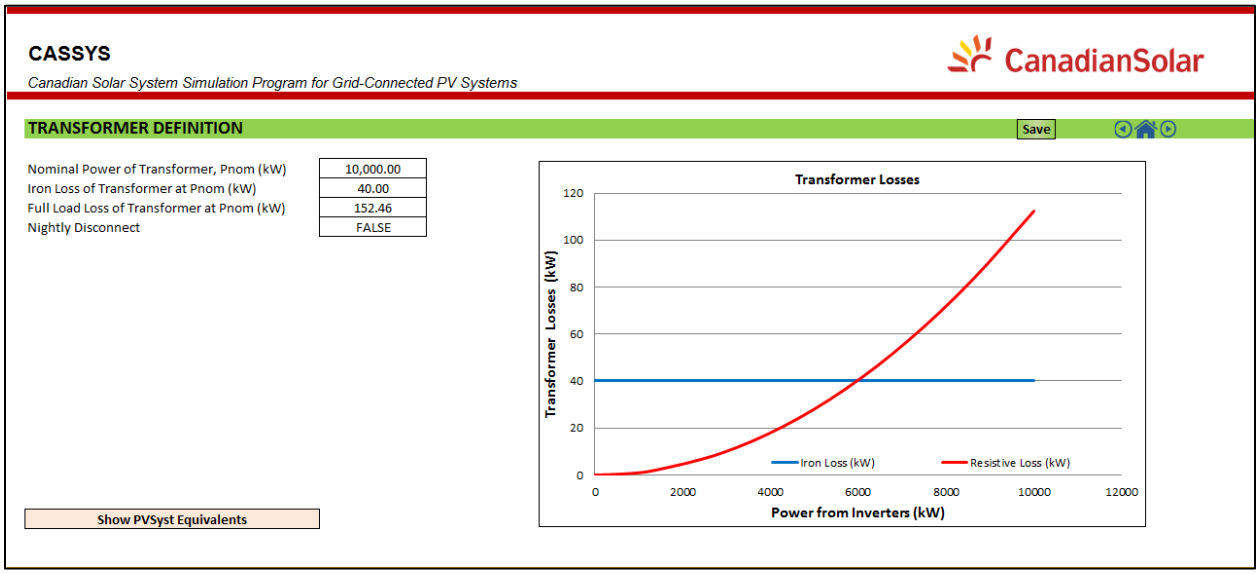


Figure 25: Transformer Page – Overview

CASSYS also provides a calculator to convert transformer sizing parameters used in some versions of the PVsyst program to values used in CASSYS, and vice-versa. To access this calculator, click on the '*Show PVsyst Equivalents*' button at the b. This unhides a section showing equivalent numbers that are used in PVsyst (Figure 26). PVsyst lets the user specify

the iron loss and resistive/inductive losses as a percentage of the *AC capacity at STC*. The 'AC capacity at STC' is hypothetical value that correspond to the output that would be delivered by all inverters if they were able to accept the STC power from the arrays. In practice, for modern systems with large DC:AC overbuilds, this value does not correspond to anything physical since the inverters will be clipping long before the arrays can reach STC power. Furthermore, electrical engineers size the transformers based on the actual AC power expected as an input (that is, the sum of the AC power that all inverters can deliver at a given time), not the AC capacity at STC. For that reason, CASSYS has moved away from the PVsyst model in favour of a more physical model based only on resistive loss and full load loss. Nevertheless, the calculator enables to conveniently move from one model to another. Changes in the CASSYS model itself will result in changes in the PVsyst values, and vice versa. This is particularly useful when one wants to recreate with CASSYS a simulation originally created in PVsyst.

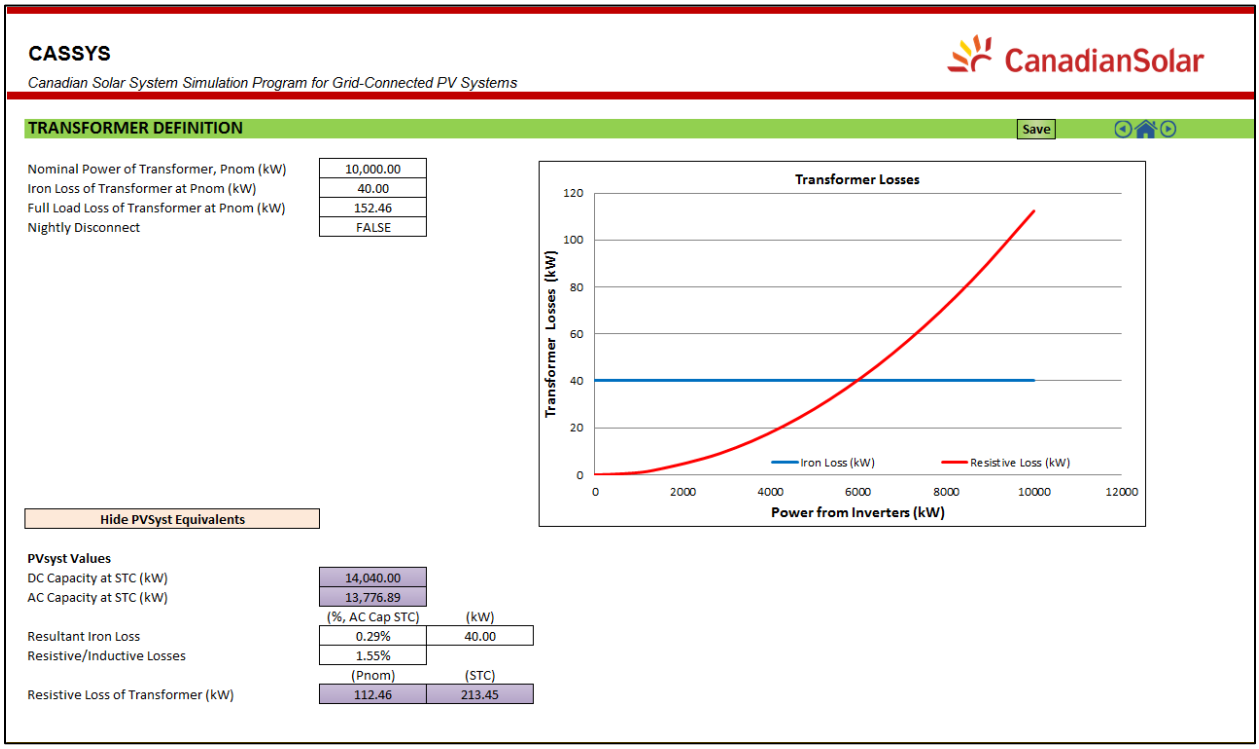


Figure 26: Transformer Page – PVsyst Equivalents

Climate File Page

On the Input File page, click the browse link and select the input file (in .csv, tm2, tm3 or .epw format) for the simulation from the dialog box. Alternatively, you can type in the path to the input file in the field. If the file is valid, a preview of the first 11 lines of the input file should appear in the bottom half of the page for a .csv file. In the delimiter field, type in the delimiter used to separate the cell values of the csv file. Enter the number of rows to skip in the input file (if the numerical data begins on line 3, then change the value of 'Rows to Skip' to 2 so that CASSYS starts reading the file from the third row; the column headers are always assumed to be on line 1 and skipped over). Finally, in the Time Series Characteristics box select when the time intervals are averaged at (Beginning, Middle, or End) from the drop-down list and enter the nominal time step. For .tm2, .tm3 and .epw files the system already knows how to read those files so long as they follow their standard format, if not an error will appear.

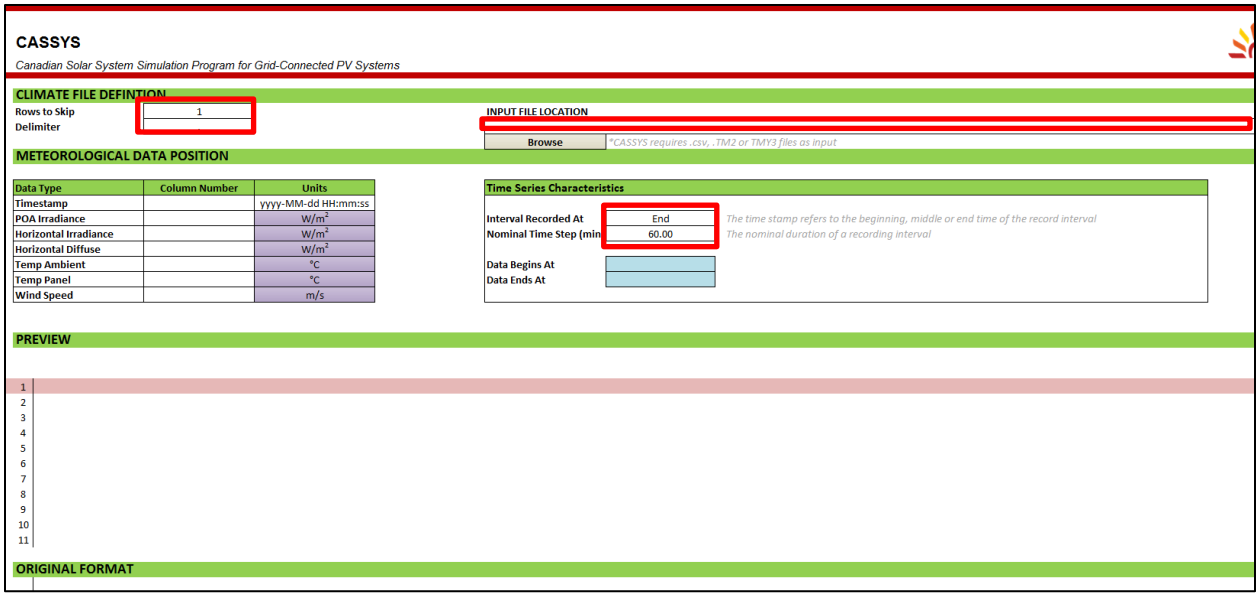


Figure 27: Input File Page - Overview

Once you select an input file, the following preview should appear:

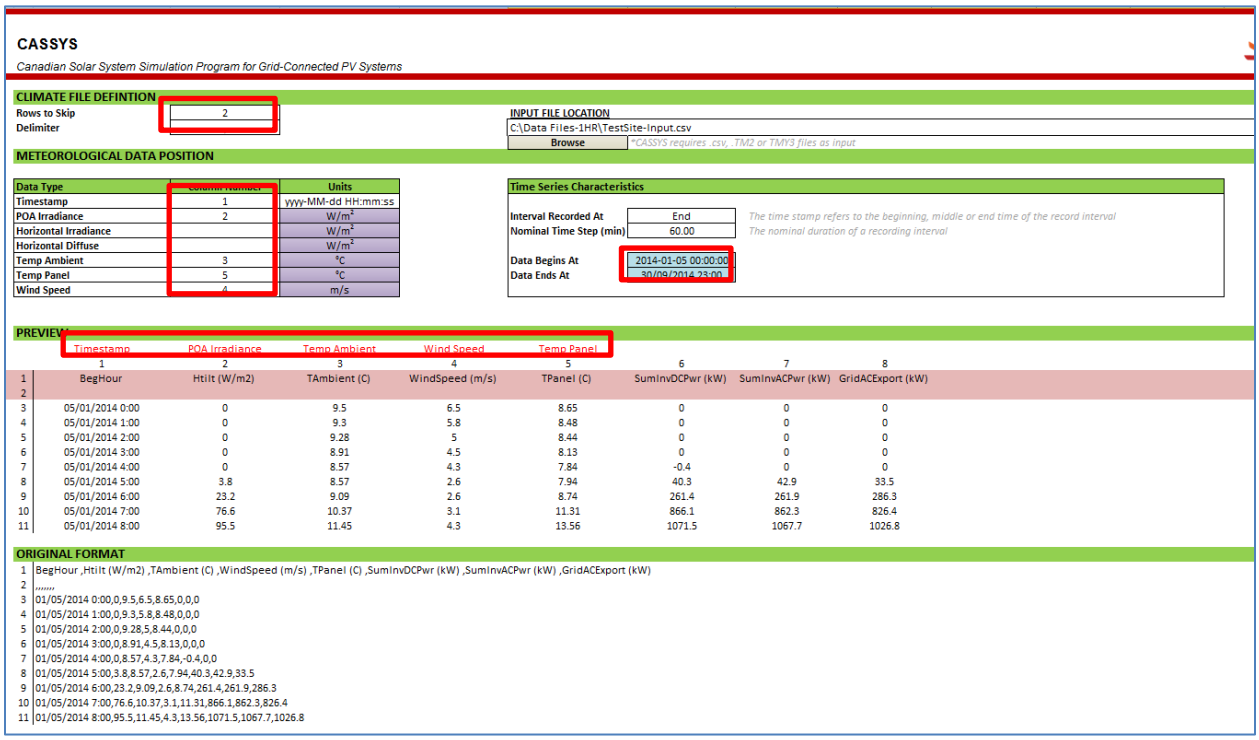


Figure 28: Input File Page - Example Input File

Enter the corresponding column number of each input parameter for the input file you have provided. For example, 'TAmbient' is shown as column 3 in the input file preview. Simply enter a '3' into the Column Number box next to Temp Ambient; a header label should appear for you to confirm if you selected the correct column. If you do the same for the Timestamp column (in this case column 1) a preview for the beginning and end dates will appear so that you can verify whether or not the input file data is correct. Also notice that the 'Rows to Skip' field in the top left corner is set to 2, since the data starts on the third line as seen in the preview.

Output File Page

The output file page allows you to specify the parameters which appear in the output file and the Summary sheet after running a simulation. To select the output file where the simulation data is inserted, click 'Browse' or alternatively type in the file path manually. On the left side, you can collapse or expand sections by clicking directly on the '+' or '-' buttons.

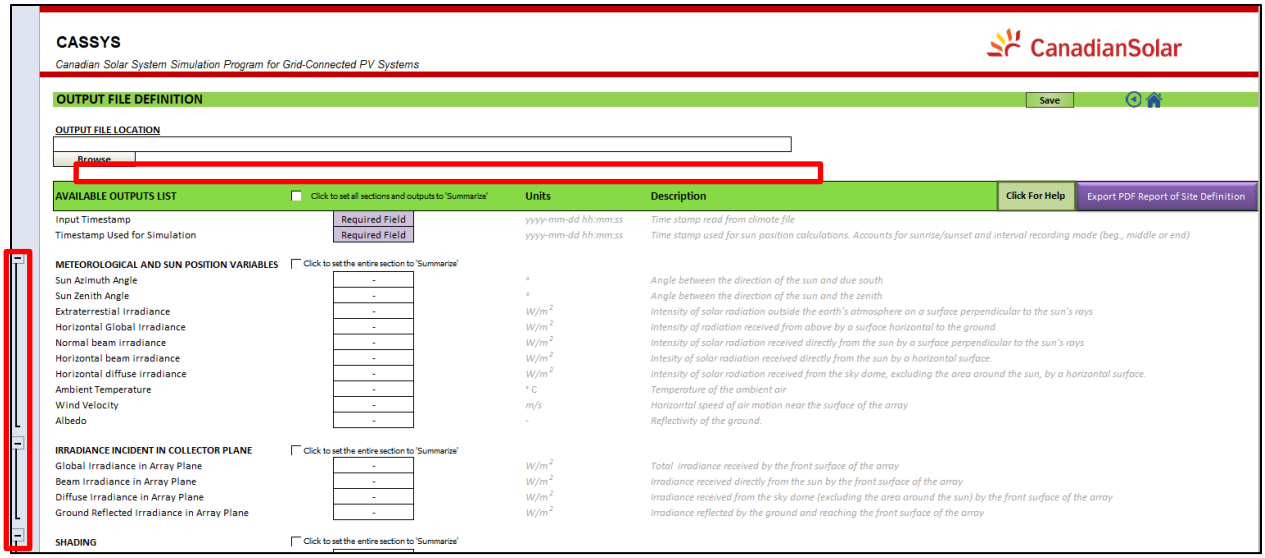


Figure 29: Output File Page Overview

To specify a desired output parameter that will appear in the output file, change its corresponding box to the right to 'Yes'. There are multiple ways to select output parameters, as shown below:

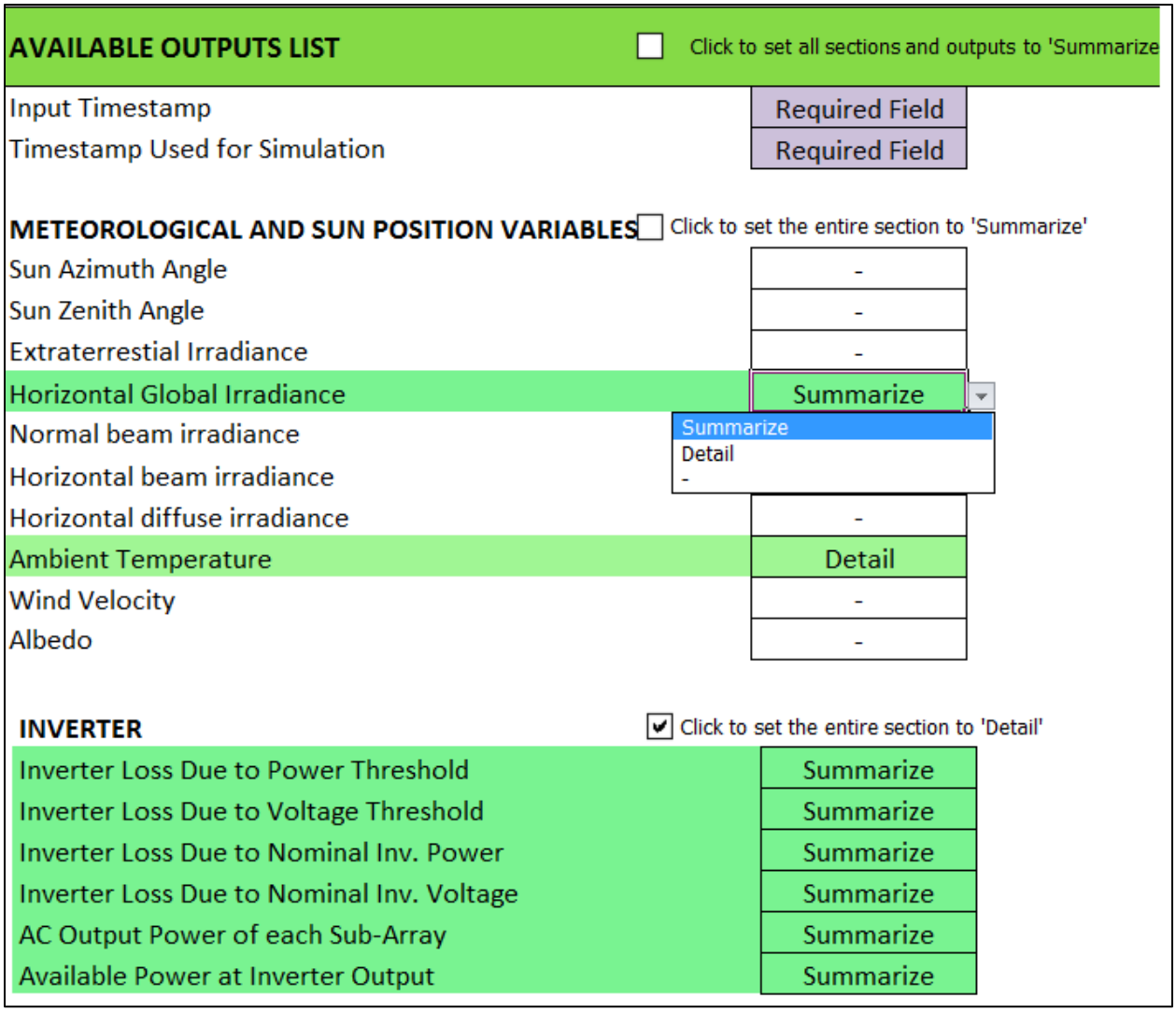


Figure 30: Output File Page - Selecting Output Parameters

Figure 18 demonstrates the selection of parameters with either individual selections or a checkbox. To select outputs individually, click on the box to the right of an output parameter and select 'Summarize', 'Detail' or '-' from the drop-down list. If a particular section is of interest/unwanted, you can check the checkbox next to the section title to set all the parameters in that section to 'Summarize', `Detail', or '-', as shown in Figure 23. Last, if you would like to change all outputs at once, check the checkbox at the top of the page next to 'Available Outputs List', which will change all output parameters at the same time. When an option is selected, the cell row will be highlighted with a bright green or light green, or white based on if Summarize, Detail, or '-' was selected, respectively.

A brief description of the three options:

1. The 'Detail' option will write the simulation results of the selected parameter into the output file.

2. The ‘Summarize’ option not only prints the simulation results into the output file and Results sheet, but the selected parameter will also be summarized on the Summary page by a pivot table using the most logical method (either Sum or Average).
3. Selecting ‘-‘ means that the parameter will be ignored during simulation; no simulated data for this parameter will be output.

At this point, is recommended that you click on the ‘Save’ button on the banner or on the Intro page to save all your site information to a .csyx file, or you can return directly to the Intro page by clicking on the house icon on the banner to simulate the current site.

3. Running the Simulation

- To simulate the current site definition, click the Simulate button on the Intro page. If you would like to simulate another site definition that you previously saved as a .csyx file, then load it first (*see* *Loading a Site Definition*) before clicking on Simulate.

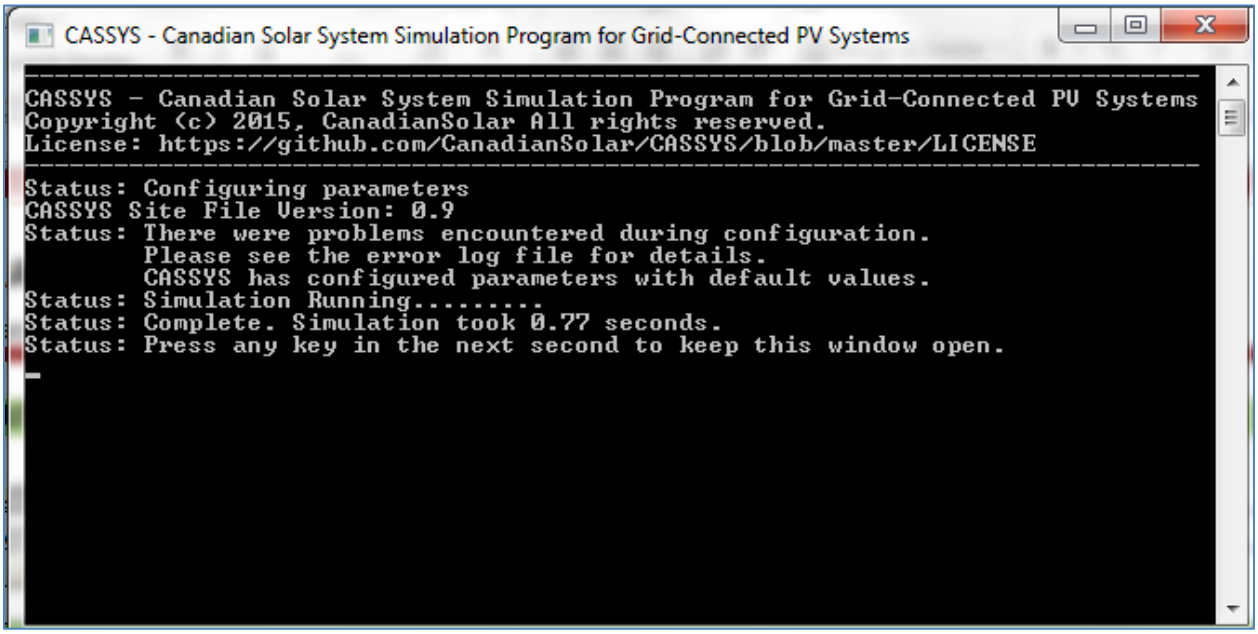


Figure 31: Simulation Console

- When the simulation is completed, the results page, report page and chart builder page will be unhidden and the site will be loaded onto the interface.
- The results page contains the simulated data which has been saved to the output file.
- The report sheet is a detailed report of the simulated site definition.
- The chart builder allows the user to create charts using the data in the results sheet (*see* *Chart Building*)

4. Loading a Site Definition

1. To load a previously saved site definition, go to the Intro sheet and click the load link
2. Select the .csyx file containing the Farm configuration information from the dialog box

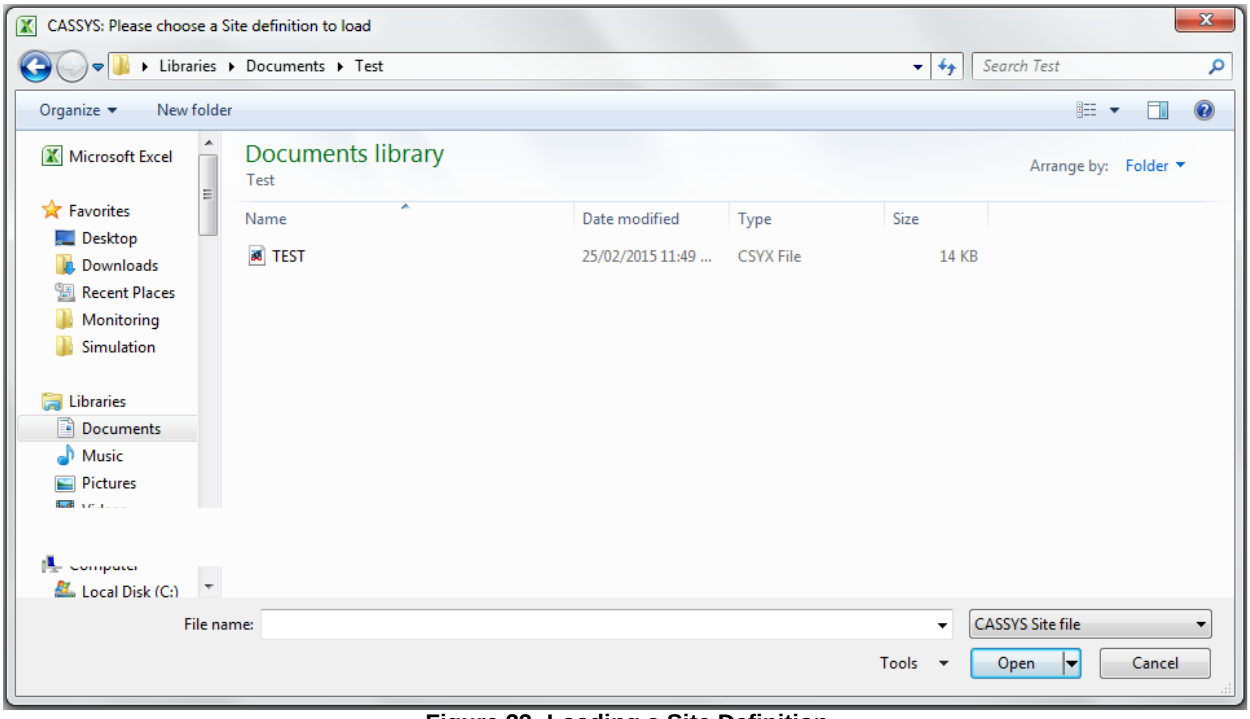


Figure 32: Loading a Site Definition

5. Chart Building

1. To define the number of y values, just select the number from the list in the corresponding chart section

2. To define the x and y values, select them using the x and y values lists

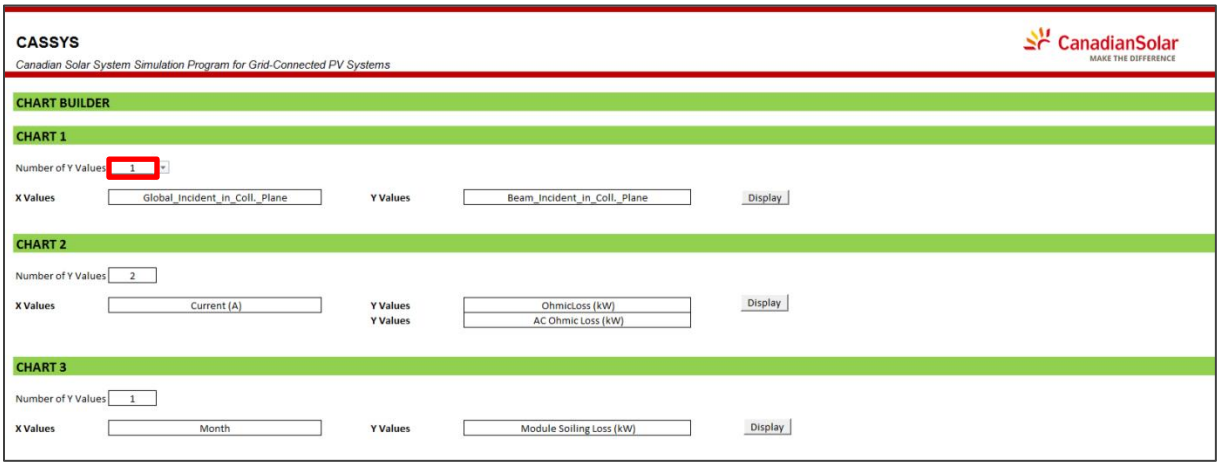


Figure 33: Chart Builder Sheet – Declaring number of y-values

3. To create the chart click the display button, you will be automatically taken to the new chart when it is completed

6. Adding New PV Modules and Inverters

1. You can add or define a new PV Module or Inverter either by using the ‘Add or Import PV module/Inverter’ button at the top of the Database sheets, or on the ‘Search’ userform on the System page. Both buttons will open up the following selection box:

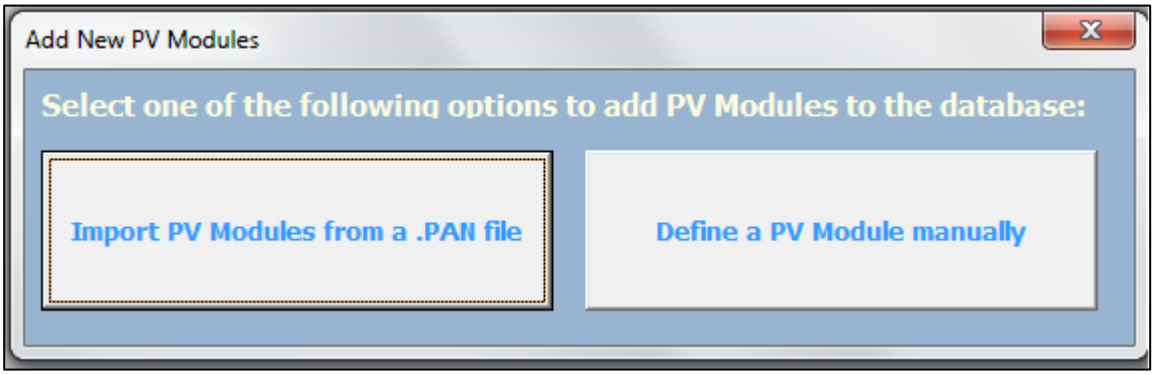


Figure 34: Adding PV Module or Inverters

The left option allows you to choose a PVSyst PAN file (or OND file in the case of inverters) to import into the CASSYS database. Note that CASSYS supports both OND files before PVSyst version 6 and above (this restriction does not apply to PAN files). Clicking the option on the right opens the following GUIs:

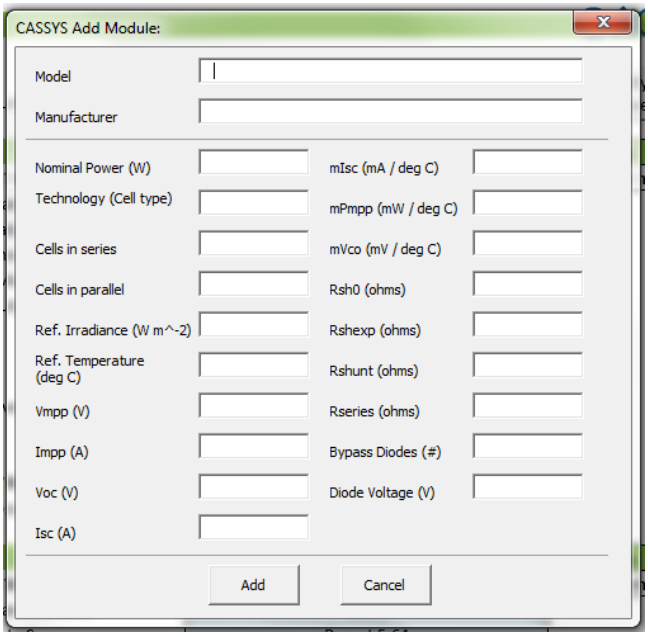


Figure 35: Add PV Module GUI

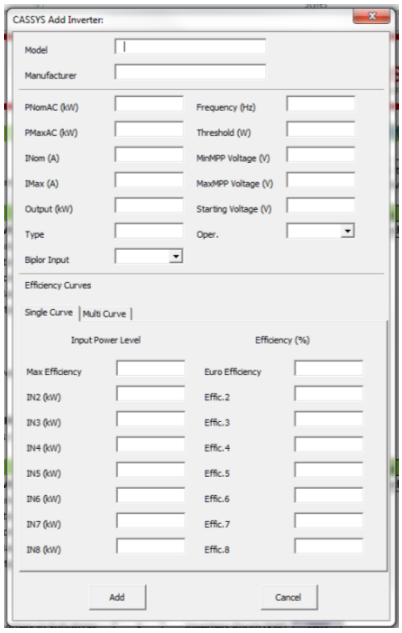


Figure 36: Add Inverter GUI

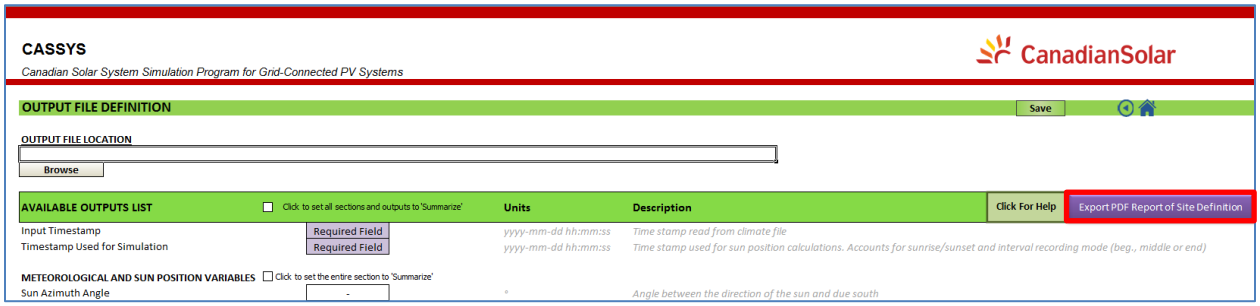
1. A GUI will appear, fill in all of the fields with the appropriate values

2. Creating an Inverter also has the option of choosing between single or multiple curve efficiencies
3. Depending on which efficiency sheet is selected the new inverter will either contain single or multiple efficiency curves
4. Choose you desired efficiency curve format, note that you must define all three of the curves for the multiple curve formats
5. When you are finished click the add button.

7. Saving a Report

CASSYS supports a PDF export of the site definition for future reference or when replicating a simulation when a .csyx file is not available to load.

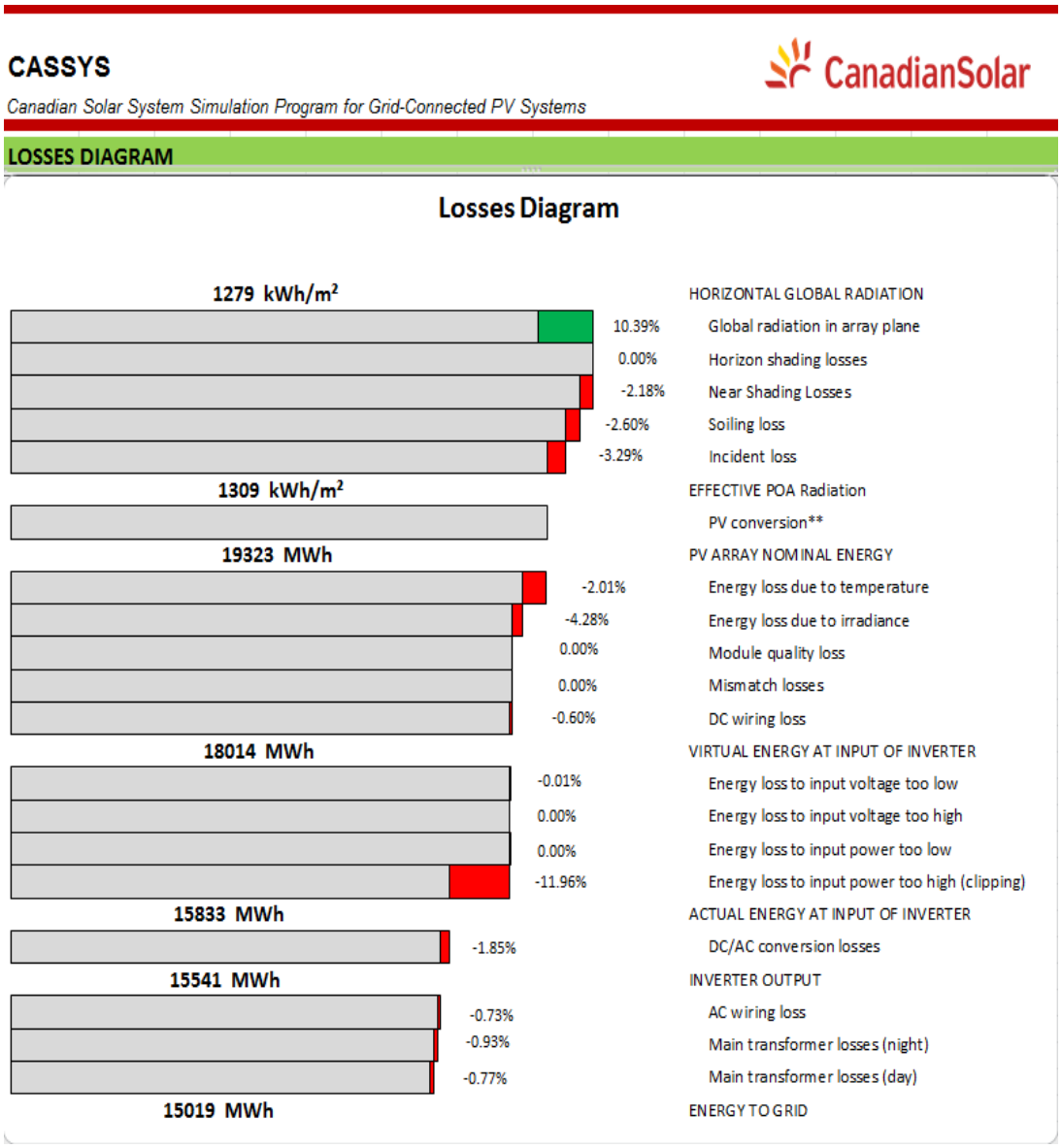
Simply navigate to the Output File page, and click on the ‘Export PDF Report of Site Definition’ button.



A Browse dialog box should appear. Navigate to the location where you would like the report to be saved, enter the desired filename and click ‘Save’. The report will be exported to the specified location and the file should automatically open for your verification.

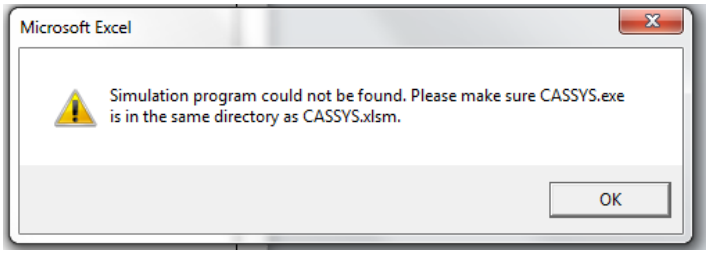
8. Loss Diagram

CASSYS has a loss diagram that is an output from the simulation which maps the losses of the entire PV system in a visual diagram. The diagram shows losses due to environmental factors, component efficiencies, resistances and more. The values displayed are the gain or loss, in percent, of the initial sub-system value (shown bolded) due to the corresponding loss factor. The only exception to this is at the top of the chart, in the radiation section, where the percentages correspond to the losses, in percent, of the "Global radiation in array plane" and the percentage shown for the "Global radiation in array plane" corresponds to the percent difference between the "Global radiation in array plane" and the "HORIZONTAL GLOBAL RADIATION".



9. CASSYS Troubleshooting

Simulation program could not be found:



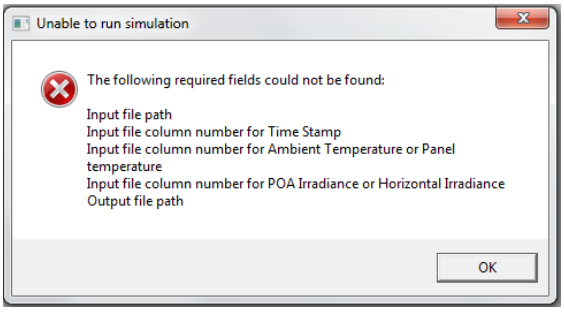
Error description:

The program used to run the simulation is separate from the CASSYS interface, and is named CASSYS.exe. If you encounter this message, this means that CASSYS.exe is not in the same directory as the CASSYS interface.

Solution:

Place the CASSYS.exe file into the same parent folder or path as the CASSYS interface (for example, if the CASSYS interface (CASSYS.xlsm) is saved in "C:\ExampleFolder\CASSYS.xlsm" then make sure that CASSYS.exe is in the location "C:\ExampleFolder\CASSYS.exe". If further issues persist or you can not locate CASSYS.exe, then re-download CASSYS from the website.

Unable to run simulation, the following fields could not be found:



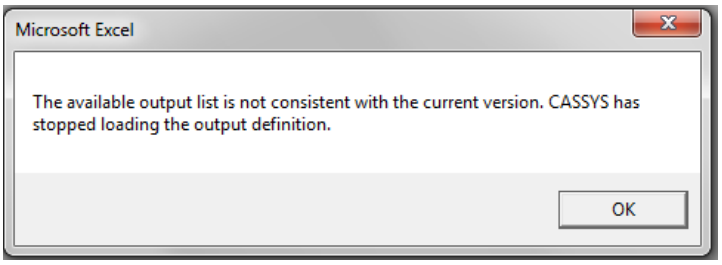
Error description:

This error occurs when the Simulate button is clicked but the fields required to run the simulation were not filled in.

Solution:

Fill in all of the fields listed by the message with valid inputs, or verify that a file is properly loaded before clicking the Simulate button again.

The Available Output List is not consistent with the current version:



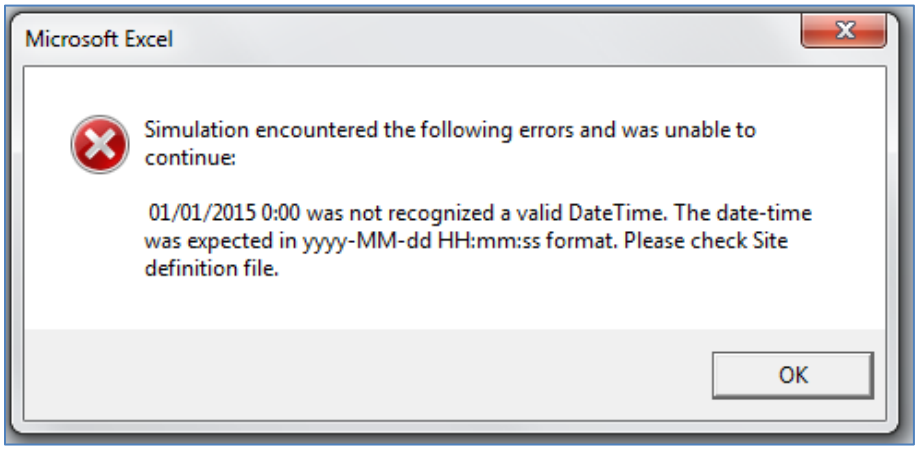
Error Description:

The .csyx file is incorrectly defined as the output file list has no parameters.

Solution:

Load the .csyx file you were trying to simulate first, click 'Save' and then simulate the file again.

Simulation error: "Not recognized as a valid DateTime"

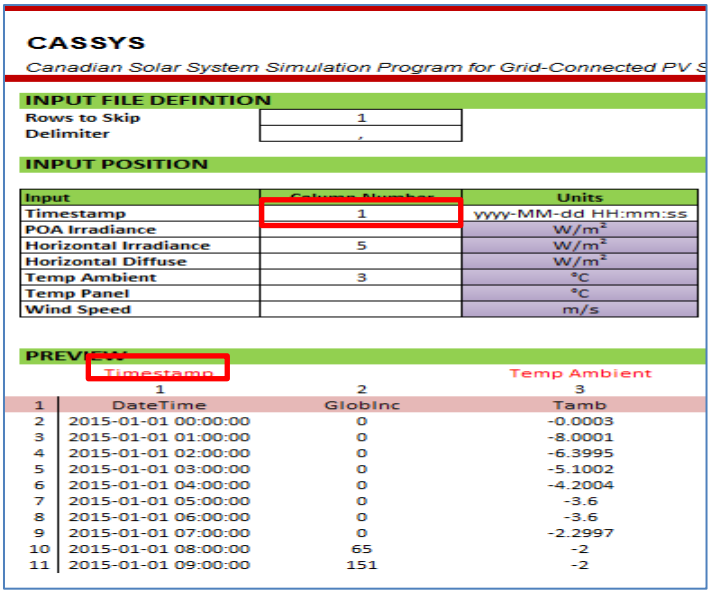


Error Description:

The simulation requires the 'Timestamp' column of the input file to be formatted as a date to run.

Solution:

1. First go to the Input File page and ensure that the column number you have inputted for ‘Timestamp’ is correct. The following is a picture of a correctly numbered input file:



CASSYS

Canadian Solar System Simulation Program for Grid-Connected PV S

INPUT FILE DEFINTION

Rows to Skip	1
Delimiter	,

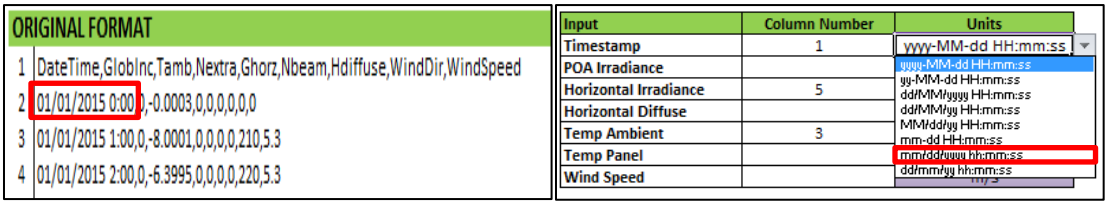
INPUT POSITION

Input	Column Number	Units
Timestamp	1	yyyy-MM-dd HH:mm:ss
POA Irradiance		W/m²
Horizontal Irradiance	5	W/m²
Horizontal Diffuse		W/m²
Temp Ambient	3	°C
Temp Panel		°C
Wind Speed		m/s

PREVIEW

	Timestamp		Temp Ambient
	1	2	3
1	DateTime	GlobInc	Tamb
2	2015-01-01 00:00:00	0	-0.0003
3	2015-01-01 01:00:00	0	-8.0001
4	2015-01-01 02:00:00	0	-6.3995
5	2015-01-01 03:00:00	0	-5.1002
6	2015-01-01 04:00:00	0	-4.2004
7	2015-01-01 05:00:00	0	-3.6
8	2015-01-01 06:00:00	0	-3.6
9	2015-01-01 07:00:00	0	-2.2997
10	2015-01-01 08:00:00	65	-2
11	2015-01-01 09:00:00	151	-2

2. Next, make sure that the ‘Units’ dropdown box on the ‘Timestamp’ row corresponds to the units provided in the input file (which can be seen from the ‘Original Format’ preview). In the following picture, the format “mm/dd/yyyy hh:mm:ss” should be selected:



ORIGINAL FORMAT

1	DateTime,GlobInc,Tamb,Nextra,Ghorz,Nbeam,Hdiffuse,WindDir,WindSpeed
2	01/01/2015 0:00,0,-0.0003,0,0,0,0,0,0
3	01/01/2015 1:00,0,-8.0001,0,0,0,0,210,5.3
4	01/01/2015 2:00,0,-6.3995,0,0,0,0,220,5.3

Input	Column Number	Units
Timestamp	1	yyyy-MM-dd HH:mm:ss
POA Irradiance		yyyy-MM-dd HH:mm:ss
Horizontal Irradiance	5	yy-MM-dd HH:mm:ss
Horizontal Diffuse		dd/MM/yyyy HH:mm:ss
Temp Ambient	3	dd/MM/yy HH:mm:ss
Temp Panel		MM/dd/yy HH:mm:ss
Wind Speed		mm-dd HH:mm:ss
		mm/dd/yyyy hh:mm:ss
		dd/mm/yy hh:mm:ss

3. Try to run the simulation again. If the simulation fails with the same error again, then the problem lies in the input file itself. Open the input file and make sure that the dates of the ‘Timestamp’ column are in a DateTime format (e.g mm/dd/yyyy hh:mm:ss).

4. Save the input file, close it and run the simulation again. The error should no longer occur.

Enable Macro Page Visible:

Error Description:

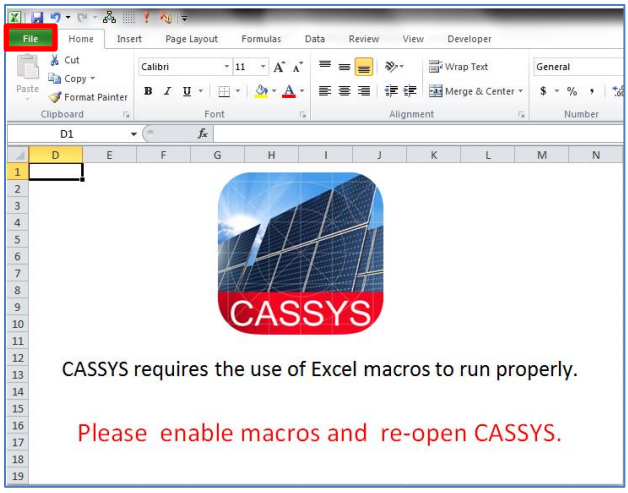
If you see this page, it means that macros have not been enabled in your Excel program. Macros are necessary for CASSYS to function, and it is critical that macros are enabled before continuing.

The following page provides several different methods of enabling macros

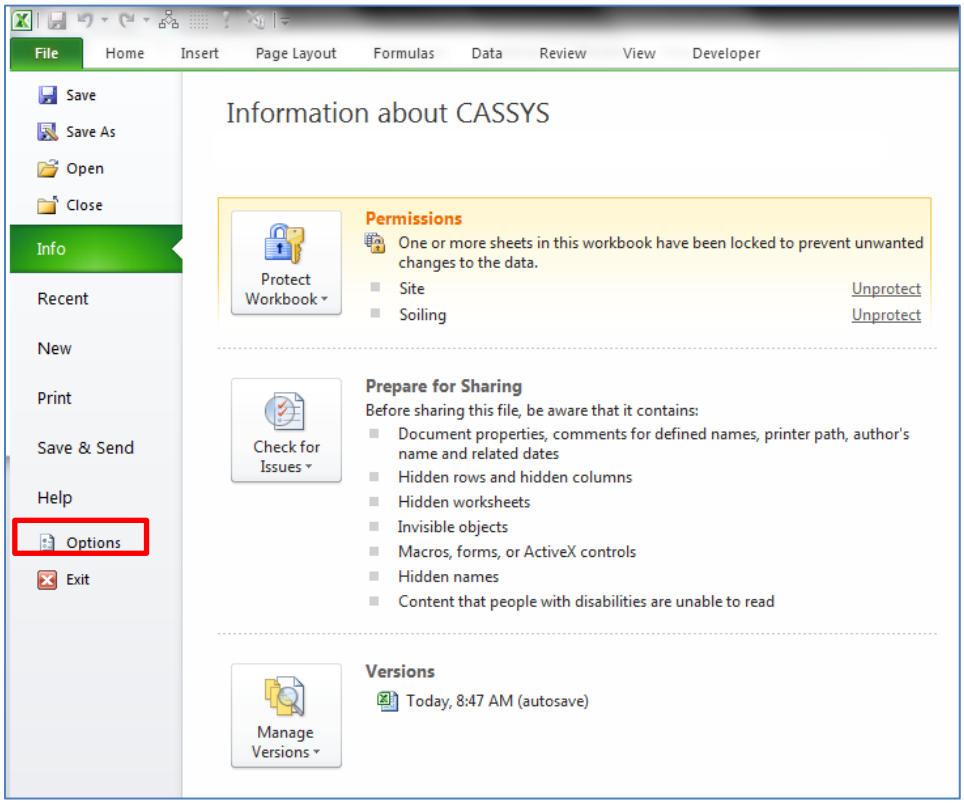
Solution:

Excel 2010

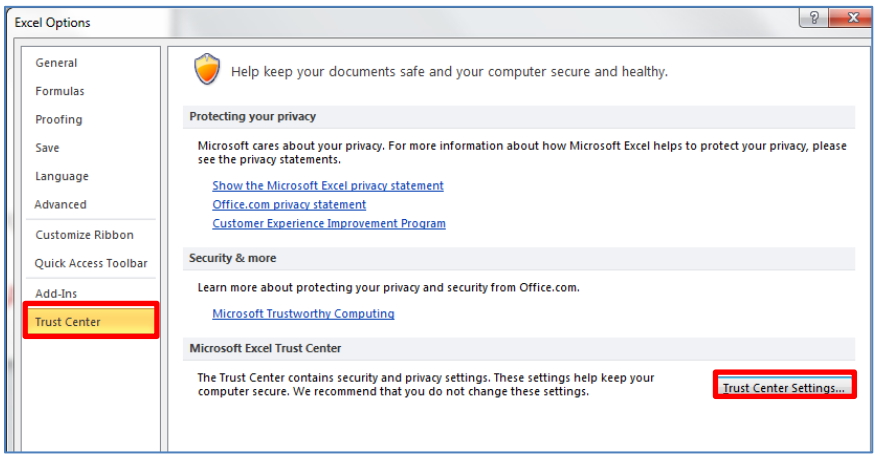
1. **Click on the 'File' tab in the top left corner of Excel.**



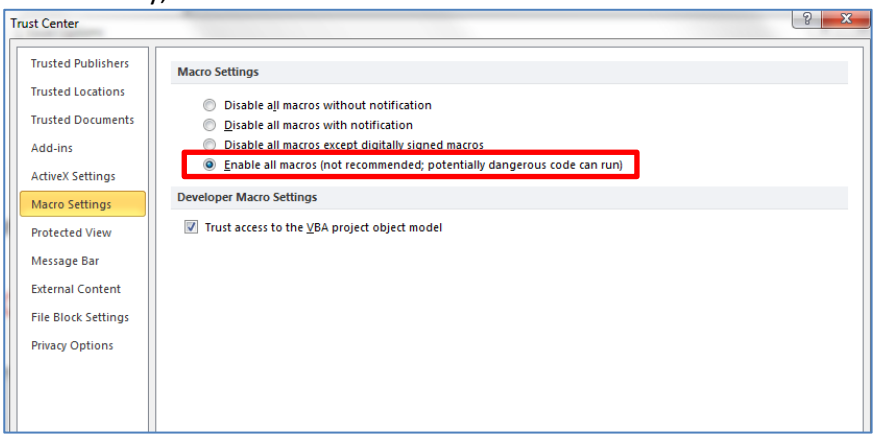
2. **On the left side bar, click on the button named 'Options'**



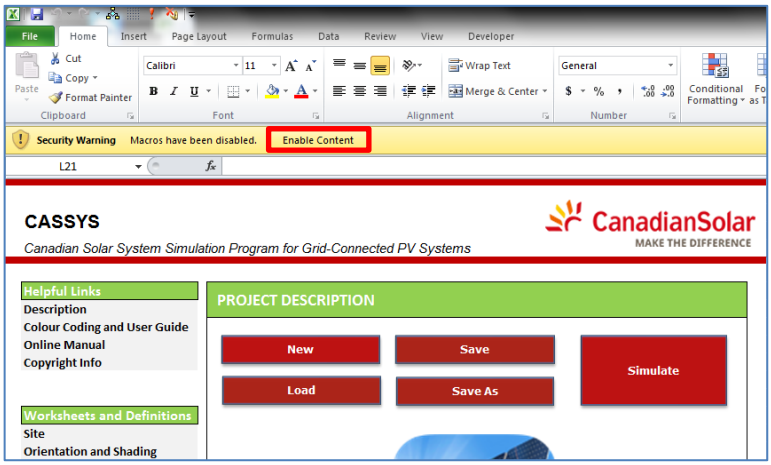
3. **Click on the 'Trust Center' Tab and then on 'Trust Center Settings'**



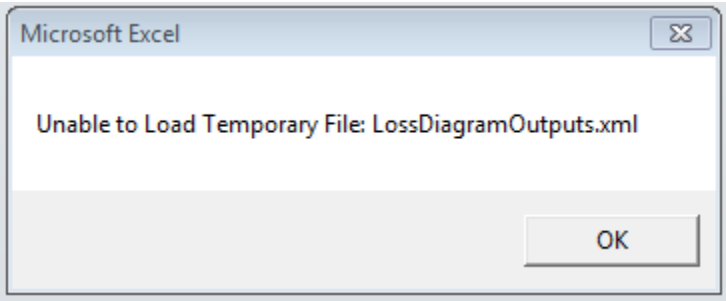
4. Finally, make sure that ‘Enable all macros’ is selected.



5. Alternatively, if you only want CASSYS macros to run, you can select ‘Disable all macros with notification’ in the window above and when CASSYS opens, click ‘Enable content’.



Unable to Load Temporary File: LossDiagramOutputs.xml:



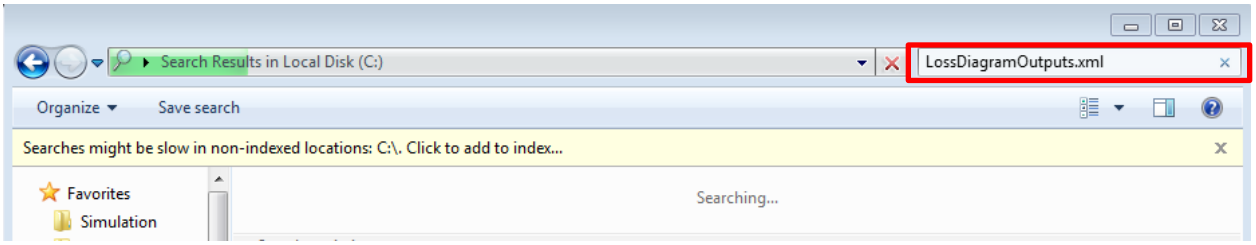
Error description:

This error occurs at the end of the simulation when the interface is attempting read an output file from the engine, but is unable to find it.

This error should be a very rare occurrence and is not crucial to the output of the simulation. i.e. the simulation was able to run just fine (so long as no other errors had occurred) and the values obtained from the simulation are still valid.

Solution:

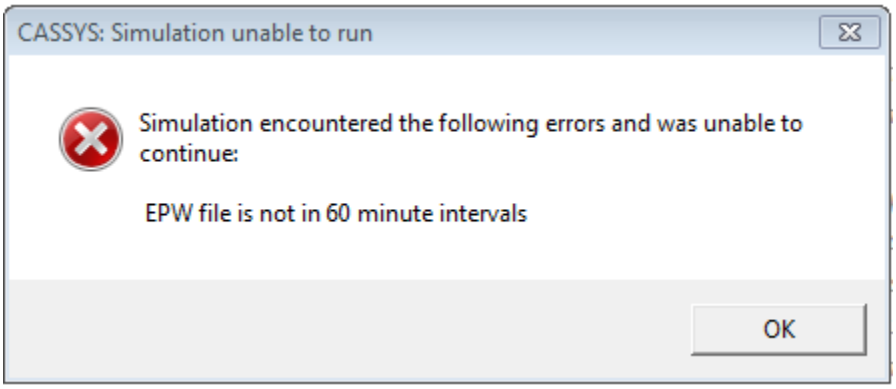
1. Search local drive for "LossDiagramOutputs.xml" to see if this has been outputted in a different location.



2. If the desired file was found in a different directory, move the engine and interface of CASSYS to that location and re-run the simulation.

3. If the file could not be found on your computer attempt to fix any other errors that may have occurred, then re-run the simulation.

CASSYS: Simulation unable to run:



Error description:
Simulation encountered the following errors and was unable to continue:

EPW file is not in 60 minute intervals

This error indicates an invalid time step format in the epw input file used as the system assumes all epw files have a time step of 60 minutes.

Solution 1:

1. Convert the epw to a compatible csv using excel and complete the simulation at the desired time step.

Solution 2:

1. Filter the epw so that it only has the weather values at every hour and change the minute value from 60 to 5 within the epw. These modifications can be done using notepad++ and/or excel.