



**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.

Project Name					
Country					
Region					
City					
<b>GEOGRAPHICAL DATA</b>					
Latitude	0.00	0	0	0	North
Longitude	0.00	0	0	0	East
Elevation (m)	0				
Time Zone (hours GMT)	0.00				

**Figure 1: Example of User-Defined cells**

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

Resultant Iron Loss (kW)	0.00
Iron Loss (%)	0.00%

**Figure 2: Example of Calculated cells**

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

<b>SUB-ARRAY 1</b>			
<b>PV MODULE MODEL</b>	CS6D - 60M		
Manufacturer	Canadian Solar Inc.		
Data Source	CSSim 0.1		
Power (W)	60	Isc Current (A)	3.78
Current at Pmpp (A)	3.43	Voc Voltage (V)	21.9
Voltage at Pmpp (V)	17.5	Rshunt (Ohm)	250
Number of Cells	36	Rseries (Ohm)	0.38

**Figure 3: Example of cells containing database values**

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

<b>Helpful Links</b>	<b>Save</b>	<b>OUTPUT FILE LOCATION</b>
<a href="#">Description</a> <a href="#">Colour Coding and User Guide</a> <a href="#">Online Manual</a> <a href="#">Copyright Info</a>		<input type="text"/> <input type="button" value="Browse"/>

**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.


The screenshot displays the CASSYS (Canadian Solar System Simulation Program for Grid-Connected PV Systems) interface. The header includes the CASSYS logo and the CanadianSolar logo. A sidebar on the left contains three sections: 'Helpful Links' (Description, Colour Coding and User Guide, Online Manual, Copyright Info), 'Worksheets and Definitions' (Site, Orientation and Shading, System Definition, Loss Characterization, Soiling, Transformers, Input File, Output File, Error Log), and 'Databases' (Module Database, Inverter Database). The 'Site' link in the 'Worksheets and Definitions' section is highlighted with a red box. The main content area, titled 'WELCOME TO CASSYS', features a central graphic of solar panels with the CASSYS logo. To the left of the graphic are four buttons: 'New' (highlighted with a red box), 'Load', 'Save As', and 'Save'. To the right is a 'Simulate' button. Below the buttons are input fields for 'File Name:' and 'Project Name:'. The footer contains the version number 'Version 0.9', the copyright notice '© 2015 CanadianSolar, All rights reserved.', and the text 'CASSYS - Canadian Solar'.

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.

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**SITE DEFINITION**

Save



Project Name  
 Country  
 Region  
 City

Please specify the name of the site  
 Please specify the country the site is located in  
 Please specify the region the site is located in  
 Please specify the city the site is located in

**GEOGRAPHICAL DATA**

Latitude  
 Longitude  
 Elevation (m)  
 Time Zone (hours GMT)

0.00  
 0.00  
 0  
 0.00

0	0	0	North
0	0	0	East

[N] is positive, [S] is negative - Enter either format  
 [E] is positive, [W] is negative - Enter either format  
 Also known as altitude, above sea level  
 [+] if E, [-] if W of GMT, Difference in hours with respect to GMT

**RADIATION PROCESSING**

Use Local Standard Time  
 Transposition Model

Yes  
 Hay

Reference Meridian  
 0

The reference longitude or meridian used for Local Standard Time.  
 Hay or Perez Model can be used. Hay is a classic model, Perez requires the use of very good horizontal irradiance measurements

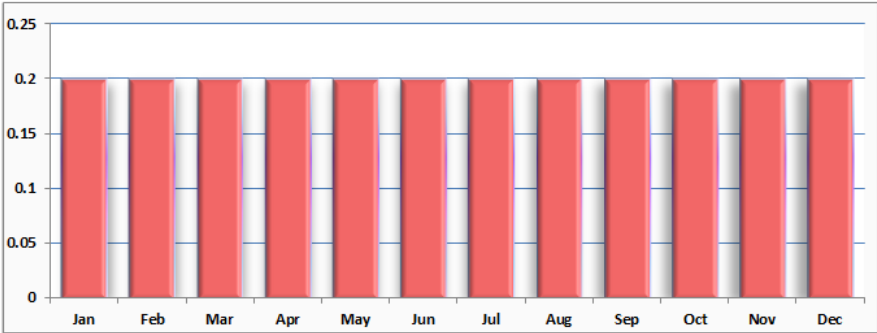
**ALBEDO DEFINITION**

Frequency

Yearly  
 Yearly  
 Monthly

Ground reflected component of solar irradiance. Single value - select "Yearly"

Yearly Albedo  
 0.20

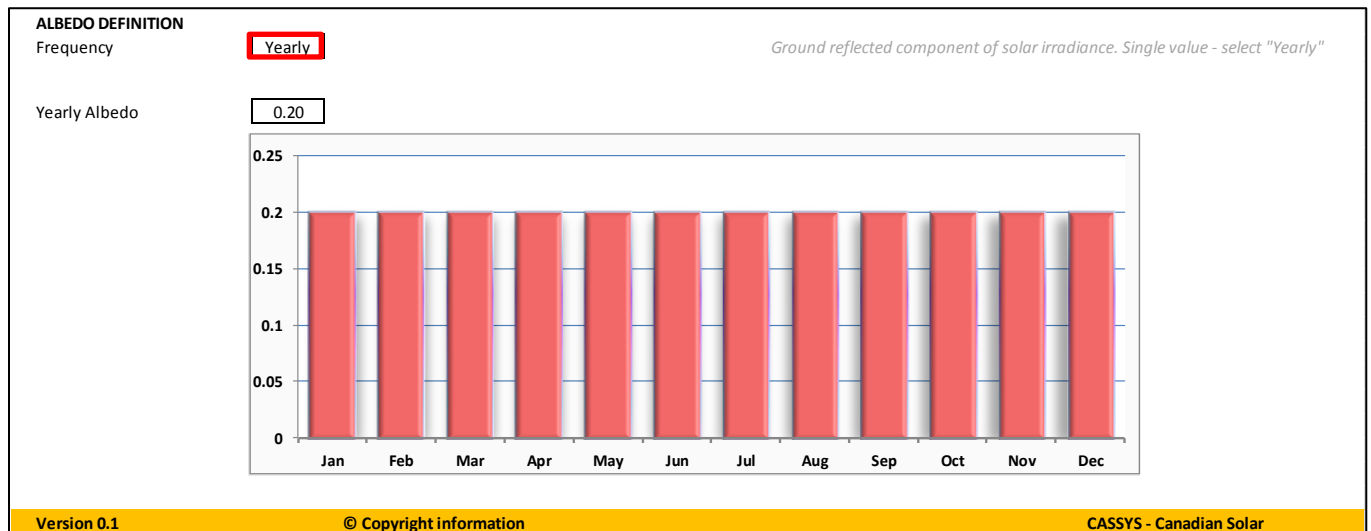


Month	Albedo Value
Jan	0.20
Feb	0.20
Mar	0.20
Apr	0.20
May	0.20
Jun	0.20
Jul	0.20
Aug	0.20
Sep	0.20
Oct	0.20
Nov	0.20
Dec	0.20

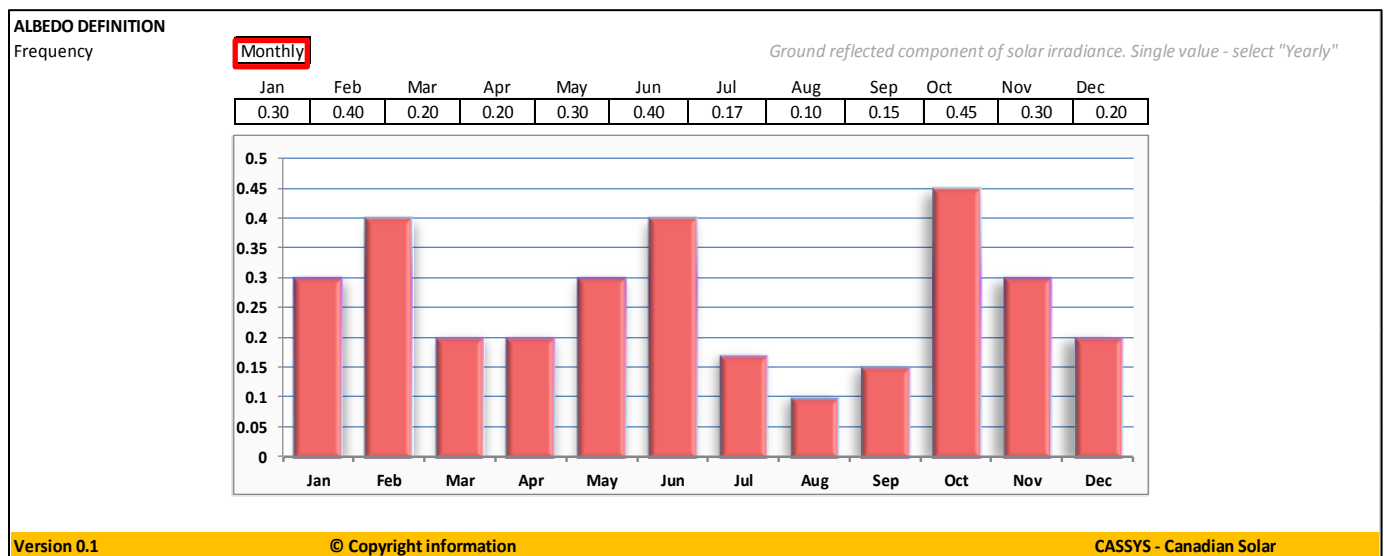
Version 0.1
 © Copyright information
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Figure 7: Site Page – Overview

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.

The screenshot shows the 'ORIENTATION AND SHADING' section of the CASSYS interface. The 'NEAR SHADINGS' section has a 'Select Array Type' dropdown menu with 'Fixed Tilted Plane' selected. Below this, there are two input fields: 'Plane Tilt (Degrees)' with a value of 30.00 and 'Azimuth (Degrees)' with a value of 0.00. To the right of these fields, there are two explanatory lines: 'Angle the panel is raised with respect to the ground' and 'Angle the panel is facing with respect to true south, [+] if W, [-] if E'. The Canadian Solar logo is in the top right corner.


Figure 10: Orientation and Shading Page - Fixed Titled Plane

The screenshot shows the 'ORIENTATION AND SHADING' section of the CASSYS interface for the 'Fixed Tilted Plane Seasonal Adjustment' array type. The 'NEAR SHADINGS' section has a 'Select Array Type' dropdown menu with 'Fixed Tilted Plane Seasonal Adjustment' selected. Below this, there are three input fields: 'Azimuth (degrees)' with a value of 0.00, 'Summer Tilt (degrees)' with a value of 30.00, and 'Winter Tilt (degrees)' with a value of 30.00. To the right of these fields, there are three explanatory lines: 'This array type only requires Plane Tilt and Azimuth.', 'Angle the panel is raised with respect to the ground', 'Angle the panel is raised with respect to the ground during summer tilt', and 'Angle the panel is raised with respect to the ground during winter tilt'. Below these fields, there are two tables for 'Summer Tilt Start Date' and 'Winter Tilt Start Date'. The 'Summer Tilt Start Date' table has columns for 'Month' and 'Day', with 'Mar' and '1' respectively. The 'Winter Tilt Start Date' table has columns for 'Month' and 'Day', with 'Nov' and '1' respectively. To the right of these tables, there are two explanatory lines: 'Day summer tilt will begin' and 'Day winter tilt will begin'. The Canadian Solar logo is in the top right corner. At the bottom of the page, there is a diagram showing a sun, a tilted solar panel, and a coordinate system with 'Zenith', 'S', and 'E' labels.

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



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**ORIENTATION AND SHADING**

**NEAR SHADINGS**  
 Select Array Type

Unlimited Rows

Plane Tilt (Degrees)
 30.00
 Angle the panel is raised with respect to the ground

Azimuth (Degrees)
 0.00
 Angle the panel is facing with respect to true south, [+] if W, [-] if E

Pitch (m)
 8.51
 Distance between the rows

Coll. Band width (m)
 3.63
 Length of the active area of the rows

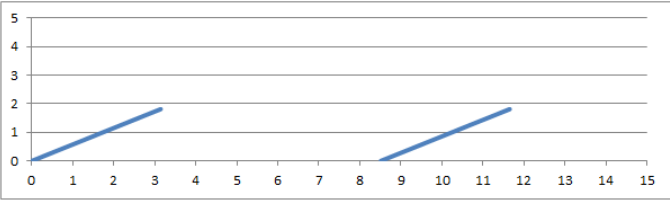
Top Inactive Band (m)
 0.00
 Length of inactive area above the active area of the rows

Bottom Inactive Band (m)
 0.00
 Length of inactive area below the active area of the rows

Ground Area Occupation Ratio
 0.43
 The ratio of the shed total length of the shed, and the distance between rows

Shading Limit Angle (degrees)
 18.69
 The angle formed between the top of one row, and the bottom of the next row.

Number of Rows
 99.00



**CELL BASED SHADING EFFECT**  
 Use Cell Based Shading Effect

Yes


Number of Strings in the Width
 4

Cell Size (cm)
 15.6

Width of One String (m)
 0.9075

Figure 12: Orientation and Shading Page - Unlimited Rows

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**ORIENTATION AND SHADING**

**NEAR SHADINGS**  
 Select Array Type

Single Axis Elevation Tracking (E-W)

Tracker Axis Tilt (degrees)
 0.00
 Angle of the axis relative to the ground

Tracker Axis Azimuth (degrees)
 90.00
 Angle of the axis with respect to true south, [+] if W, [-] if E

Minimum Tilt (degrees)
 -90.00
 The range of motion of the tilt of the tracker along the axis with respect to the ground

Maximum Tilt (degrees)
 90.00

Number of Rows
 1
 The number of rows in the system. If system is a single plane, set this value to 1.

Pitch (m)
 0.00
 The distance between rows. Set to 0 if system is a single plane.

Width of Active Area (m)
 1.00
 The width of the module.

Backtracking
 No
 Backtracking causes modules to deviate from the ideal angle to avoid shading.

**CELL BASED SHADING EFFECT**  
 Use Cell Based Shading

No

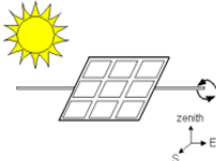


Figure 13: Orientation and Shading Page - Single Axis Elevation Tracking (E-W)

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ORIENTATION AND SHADING

Save

NEAR SHADINGS

Select Array Type

Single Axis Horizontal Tracking (N-S)

Tracker Axis Tilt (degrees)

0.00

Tracker Axis Azimuth (degrees)

0.00

Max. Rotation Angle (degrees)

90.00

Number of Rows

1

Pitch (m)

0.00

Width of Active Area (m)

1.00

Backtracking

No

CELL BASED SHADING EFFECT

Use Cell Based Shading Effect

No

This array type is used when modules track the sun, rotating on a North-South axis

Angle the axis is raised with respect to the ground

Angle of the axis with respect to true south, [°] if W, [-°] if E

The maximum tilt of the tracker in either direction with respect to horizontal

The number of rows in the system. If system is a single plane, set this value to 1.

The distance between rows. Value is set to zero if system is a single plane.

The width of the module.

Backtracking causes modules to deviate from the ideal angle to avoid shading.

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

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ORIENTATION AND SHADING

Save

NEAR SHADINGS

Select Array Type

Tilt and Roll Tracking

Tracker Axis Tilt (degrees)

30.00

Tracker Axis Azimuth (degrees)

0.00

Min. Rotation Angle

-90.00

Max. Rotation Angle

90.00

This array type is used when modules track the sun, rotating on a tilted axis

Angle the axis is raised with respect to the ground

Angle of the axis with respect to true south, [°] if W, [-°] if E

The range of motion of the tilt of the tracker along the axis

[°] when clockwise looking down the axis and [-°] when counter-clockwise

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

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**ORIENTATION AND SHADING**

Save

**NEAR SHADINGS**  
 Select Array Type

Azimuth (Vertical Axis) Tracking

Plane Tilt (degrees)
 

30.00

Limit Reference (degrees)
 

0.00

Min. Rotation Angle (degrees)
 

-90.00

Max. Rotation Angle(degrees)
 

90.00

This array type is used when modules track the sun, rotating on a vertical axis

Angle the panel is raised with respect to the ground

The Limit Reference will be an azimuth of either 0° or 180° depending on hemisphere  
Minimum and Maximum rotation angles with respect to the Limit Reference Azimuth  
[+] when clockwise [-] when counter-clockwise looking down at the tracker

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

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**ORIENTATION AND SHADING**

Save

**NEAR SHADINGS**  
 Select Array Type

Two Axis Tracking

Minimum Tilt (degrees)
 

0.00

Maximum Tilt (degrees)
 

90.00

Limit Reference (degrees)
 

0.00

Min. Rotation Angle (degrees)
 

-90.00

Max. Rotation Angle (degrees)
 

90.00

This array type is used when modules track the sun, rotating both on a vertical and horizontal axis

The range of motion of the tilt of the tracker along the horizontal axis with respect to the ground


The Limit Reference will be an azimuth of either 0° or 180° depending on hemisphere  
Minimum and Maximum rotation angles with respect to the Limit Reference Azimuth  
[+] when clockwise [-] when counter-clockwise looking down at the tracker

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.

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**HORIZON**

Save   

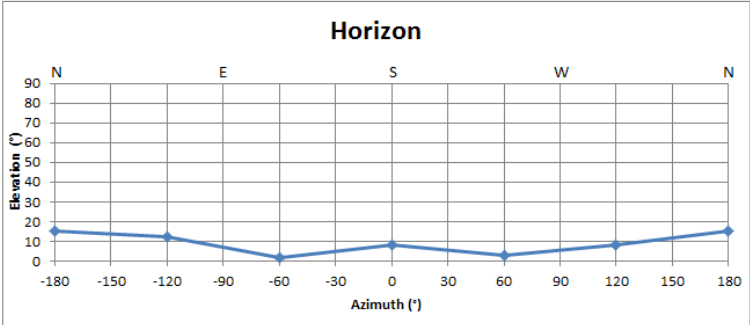
Define Horizon Profile?

Number of Horizon Points:  Clear Horizon Profile

Horizon Information:

Azimuth	Elevation
-180 °	15 °
-120 °	12 °
-60 °	2 °
0 °	8 °
60 °	3 °
120 °	8 °

*Azimuth is the horizontal angular location of horizon point with respect to true south, [°] if W, [-°] if E*  
*Elevation is the vertical angular location of the horizon point with respect to 0 as horizontal*



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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](#))

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**SYSTEM SUMMARY** [Save] [Home] [Refresh]

Number of Sub Arrays:  Number of Modules:  Pnom DC (kW):  Number of Inverters:  Pnom AC (kW):  AC Loss Fraction defined:

**SUB-ARRAY 1** [Top] [Search]

**PV MODULE MODEL** [Please click 'Search' to select a module.] [Search]

Manufacturer:  Data Source:  File Name:  Power (W):  Current at Pmpp (A):  Voltage at Pmpp (V):  Number of Cells:  Isc Current (A):  Voc Voltage (V):  Rshunt (Ohm):  Rseries (Ohm):

Modules in a String:  Number of Strings:  Modules in Sub-Array:  Total Pnom (kW):

**WIRING DC LOSSES** Loss Fraction (at STC):  Global Wiring Resistance (mOhm):  **IAM DEFINITION** Definition Available:

**WIRING AC LOSSES** Loss Fraction:

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

CASSYS Select Module:

Manufacturer:  Model:  Origin:

Max Power (W):  Current at Pmpp (A):  Voltage at Pmpp (V):  Max Current (A):  Max Voltage (V):  Rshunt (Ohm):  Rseries (Ohm):

[Select] [Cancel]

Add a PV Module

Figure 20: PV Module Selection GUI

CASSYS Select Inverter:

Manufacturer:  Model:  Origin:

P Max (kW):  I Max (A):  Output (V):  Type:  Frequency (Hz):  Pnom (kW):

[Select] [Cancel]

Add an Inverter

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.

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**LOSS CHARACTERIZATION** Save

**Thermal**

Use Measured Module Temperature (deg C) FALSE

Constant Heat Loss Factor ( $\text{W/m}^2\cdot\text{K}$ ) 20.00

Convective Heat Loss Factor ( $\text{W/m}^2\cdot\text{K/ m/s}$ ) 0.00

*Select 'True' if reliable measurements of panel temperature are available. Otherwise, values will be calculated*  
*Constant coefficient of the convective heat loss model*  
*Wind dependent coefficient of the convective heat loss model*

**Module Quality Losses**

Loss Fraction 0.90%

*May account for Light Induced Degradation, or reflect confidence in manufacturer's specifications*

**Module Mismatch Losses**

Loss Fraction at MPP 2.00%

Loss Fraction at Fixed Voltage 0.00%

*Losses occurring due to the variability in the electrical properties of modules installed in an array*  
*This loss is defined for both MPP and Fixed Voltage operation*

**Incidence Angle Modifier**

ASHRAE Model Parameter  $b_0$  0.05

*Parameter used to modify the incident radiation according to the ASHRAE IAM Model*

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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.

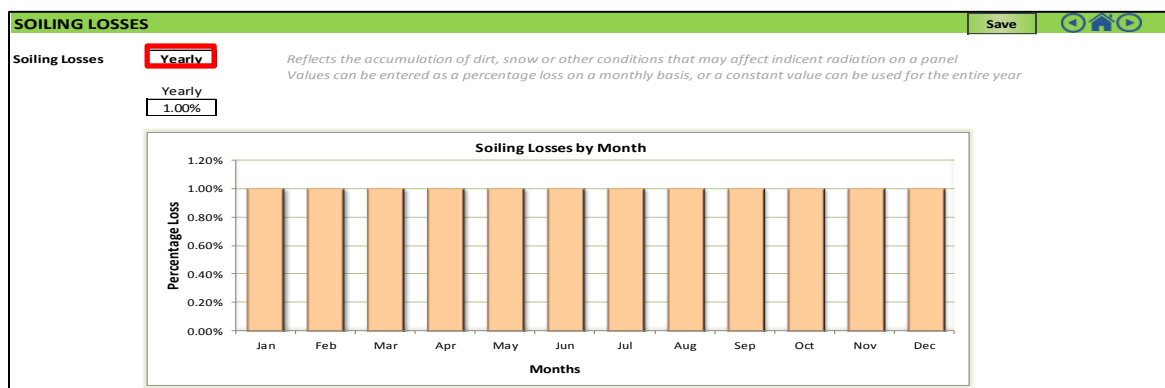


Figure 23: Soiling Page - Yearly Soiling Losses

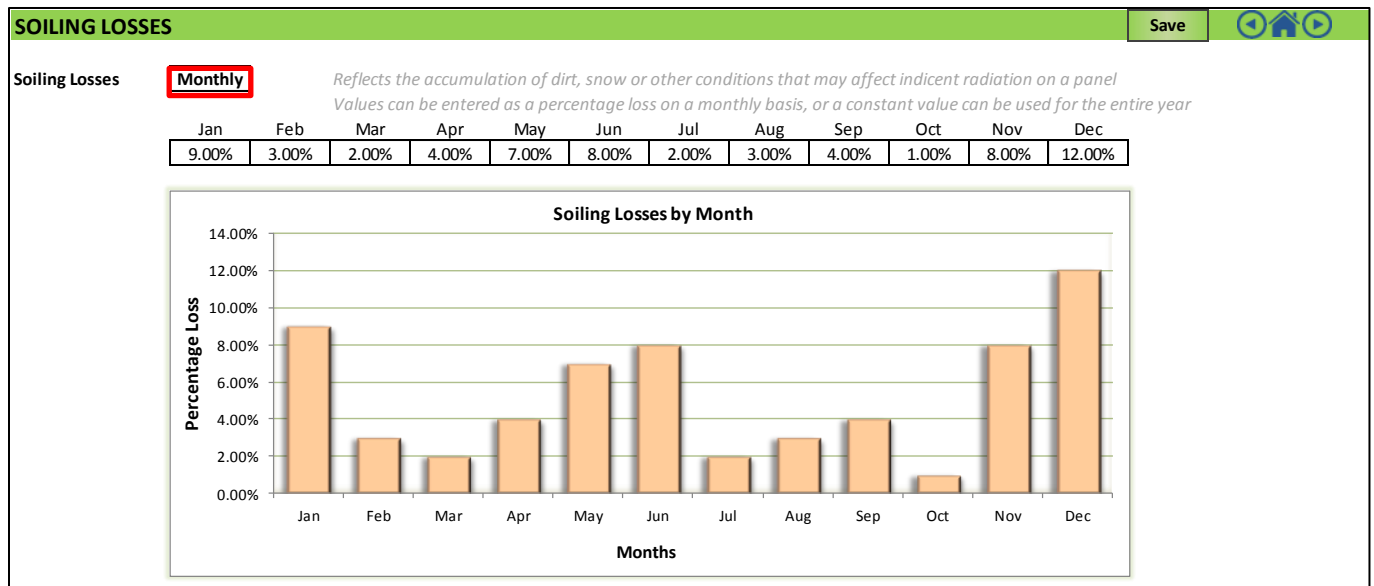


Figure 24: Soiling Page - Monthly Soiling Losses

## 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.

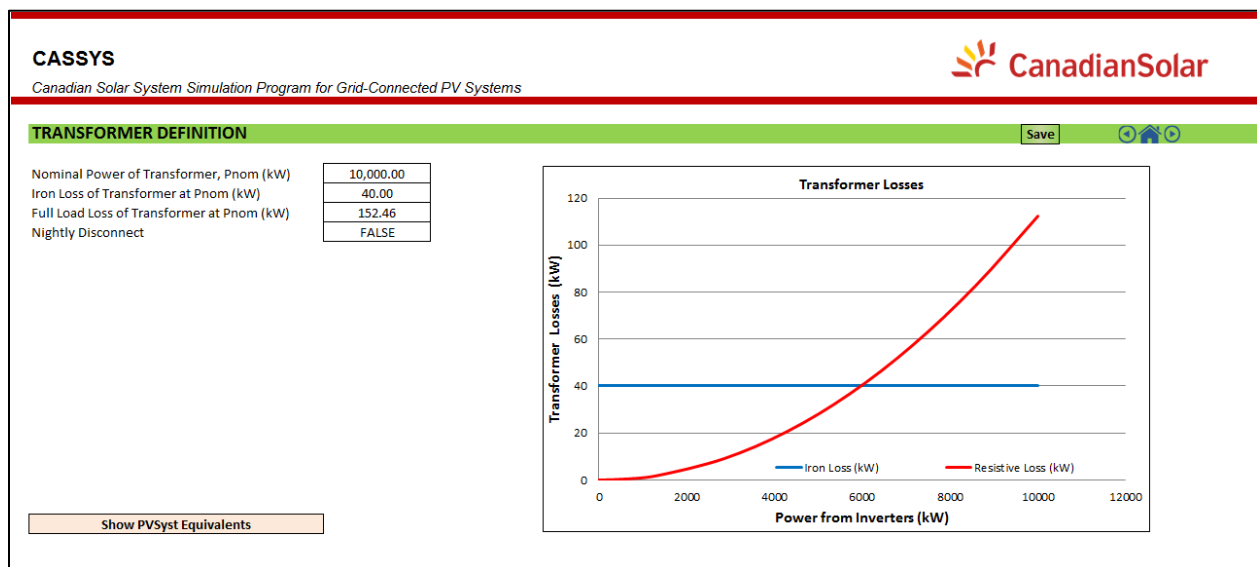


Figure 25: Transformer Page – Overview

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.

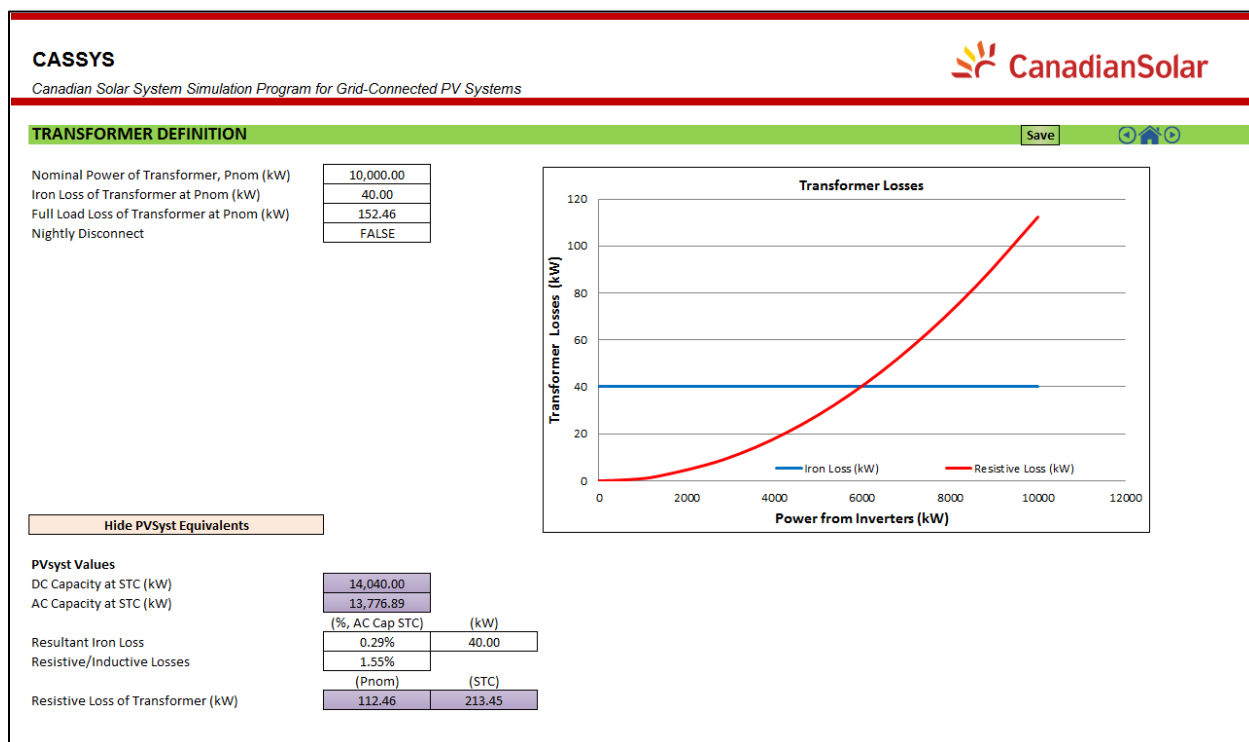



Figure 26: Transformer Page – PVsyst Equivalents

## 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.



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---

**CLIMATE FILE DEFINITION**  
 Rows to Skip   
 Delimiter

**INPUT FILE LOCATION**  
 \*CASSYS requires .csv, .TM2 or TMY3 files as input.

---

**METEOROLOGICAL DATA POSITION**

Data Type	Column Number	Units
Timestamp		yyyy-MM-dd HH:mm:ss
POA Irradiance		W/m <sup>2</sup>
Horizontal Irradiance		W/m <sup>2</sup>
Horizontal Diffuse		W/m <sup>2</sup>
Temp Ambient		°C
Temp Panel		°C
Wind Speed		m/s

**Time Series Characteristics**  
 Interval Recorded At  The time stamp refers to the beginning, middle or end time of the record interval  
 Nominal Time Step (min)  The nominal duration of a recording interval  
 Data Begins At   
 Data Ends At

---

**PREVIEW**

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	

---

**ORIGINAL FORMAT**

Figure 27: Input File Page - Overview

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

**CASSYS**  
 Canadian Solar System Simulation Program for Grid-Connected PV Systems

**CLIMATE FILE DEFINITION**  
 Rows to Skip:   
 Delimiter:

**INPUT FILE LOCATION**  
 C:\Data Files-1HR\TestSite-Input.csv  
 Browse \*CASSYS requires .csv, .TMY2 or .TMY3 files as input

**METEOROLOGICAL DATA POSITION**

Data Type	Column Number	Units
Timestamp	1	yyyy-MM-dd HH:mm:ss
POA Irradiance	2	W/m <sup>2</sup>
Horizontal Irradiance		W/m <sup>2</sup>
Horizontal Diffuse		W/m <sup>2</sup>
Temp Ambient	3	°C
Temp Panel	5	°C
Wind Speed	4	m/s

**Time Series Characteristics**  
 Interval Recorded At:  The time stamp refers to the beginning, middle or end time of the record interval  
 Nominal Time Step (min):  The nominal duration of a recording interval  
 Data Begins At:   
 Data Ends At:

**PREVIEW**

	1 Timestamp	2 POA Irradiance	3 Temp Ambient	4 Wind Speed	5 Temp Panel	6 SumInvDCPwr (kW)	7 SumInvACPwr (kW)	8 GridACExport (kW)
1	BegHour	HtIrr (W/m <sup>2</sup> )	TAmbient (°C)	WindSpeed (m/s)	TPanel (°C)	SumInvDCPwr (kW)	SumInvACPwr (kW)	GridACExport (kW)
2								
3	05/01/2014 0:00	0	9.5	6.5	8.65	0	0	0
4	05/01/2014 1:00	0	9.3	5.8	8.48	0	0	0
5	05/01/2014 2:00	0	9.28	5	8.44	0	0	0
6	05/01/2014 3:00	0	8.91	4.5	8.13	0	0	0
7	05/01/2014 4:00	0	8.57	4.3	7.84	-0.4	0	0
8	05/01/2014 5:00	3.8	8.57	2.6	7.94	40.3	42.9	33.5
9	05/01/2014 6:00	23.2	9.09	2.6	8.74	261.4	261.9	286.3
10	05/01/2014 7:00	76.6	10.37	3.1	11.31	866.1	862.3	826.4
11	05/01/2014 8:00	95.5	11.45	4.3	13.56	1071.5	1067.7	1026.8

**ORIGINAL FORMAT**  
 1 BegHour ,HtIrr (W/m<sup>2</sup>) ,TAmbient (°C) ,WindSpeed (m/s) ,TPanel (°C) ,SumInvDCPwr (kW) ,SumInvACPwr (kW) ,GridACExport (kW)  
 2 #####  
 3 05/05/2014 0:00,0,9.5,6.5,8.65,0,0,0  
 4 01/05/2014 1:00,0,9.3,5.8,8.48,0,0,0  
 5 01/05/2014 2:00,0,9.28,5.8,8.44,0,0,0  
 6 01/05/2014 3:00,0,8.91,4.5,8.13,0,0,0  
 7 01/05/2014 4:00,0,8.57,4.3,7.84,-0.4,0,0  
 8 01/05/2014 5:00,3.8,8.57,2.6,7.94,40.3,42.9,33.5  
 9 01/05/2014 6:00,23.2,9.09,2.6,8.74,261.4,261.9,286.3  
 10 01/05/2014 7:00,76.6,10.37,3.1,11.31,866.1,862.3,826.4  
 11 01/05/2014 8:00,95.5,11.45,4.3,13.56,1071.5,1067.7,1026.8

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.

**CASSYS**  
 Canadian Solar System Simulation Program for Grid-Connected PV Systems

**OUTPUT FILE DEFINITION**

Save

**OUTPUT FILE LOCATION**  
  

Browse

AVAILABLE OUTPUTS LIST	<input type="checkbox"/> Click to set all sections and outputs to 'Summarize'	Units	Description	Click For Help	Export PDF Report of Site Definition
Input Timestamp	Required Field	yyyy-mm-dd hh:mm:ss	Time stamp read from climate file		
Timestamp Used for Simulation	Required Field	yyyy-mm-dd hh:mm:ss	Time stamp used for sun position calculations. Accounts for sunrise/sunset and interval recording mode (beg., middle or end)		
<b>METEOROLOGICAL AND SUN POSITION VARIABLES</b> <input type="checkbox"/> Click to set the entire section to 'Summarize'					
Sun Azimuth Angle	-	°	Angle between the direction of the sun and due south		
Sun Zenith Angle	-	°	Angle between the direction of the sun and the zenith		
Extraterrestrial Irradiance	-	W/m <sup>2</sup>	Intensity of solar radiation outside the earth's atmosphere on a surface perpendicular to the sun's rays		
Horizontal Global Irradiance	-	W/m <sup>2</sup>	Intensity of radiation received from above by a surface horizontal to the ground		
Normal beam irradiance	-	W/m <sup>2</sup>	Intensity of solar radiation received directly from the sun by a surface perpendicular to the sun's rays		
Horizontal beam irradiance	-	W/m <sup>2</sup>	Intensity of solar radiation received directly from the sun by a horizontal surface.		
Horizontal diffuse irradiance	-	W/m <sup>2</sup>	Intensity of solar radiation received from the sky dome, excluding the area around the sun, by a horizontal surface.		
Ambient Temperature	-	°C	Temperature of the ambient air		
Wind Velocity	-	m/s	Horizontal speed of air motion near the surface of the array		
Albedo	-	-	Reflectivity of the ground.		
<b>IRRADIANCE INCIDENT IN COLLECTOR PLANE</b> <input type="checkbox"/> Click to set the entire section to 'Summarize'					
Global Irradiance in Array Plane	-	W/m <sup>2</sup>	Total irradiance received by the front surface of the array		
Beam Irradiance in Array Plane	-	W/m <sup>2</sup>	Irradiance received directly from the sun by the front surface of the array		
Diffuse Irradiance in Array Plane	-	W/m <sup>2</sup>	Irradiance received from the sky dome (excluding the area around the sun) by the front surface of the array		
Ground Reflected Irradiance in Array Plane	-	W/m <sup>2</sup>	Irradiance reflected by the ground and reaching the front surface of the array		
<b>SHADING</b> <input type="checkbox"/> Click to set the entire section to 'Summarize'					

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:

AVAILABLE OUTPUTS LIST <input type="checkbox"/> Click to set all sections and outputs to 'Summarize'	
Input Timestamp	Required Field
Timestamp Used for Simulation	Required Field
<b>METEOROLOGICAL AND SUN POSITION VARIABLES</b> <input type="checkbox"/> Click to set the entire section to 'Summarize'	
Sun Azimuth Angle	-
Sun Zenith Angle	-
Extraterrestrial Irradiance	-
Horizontal Global Irradiance	Summarize
Normal beam irradiance	Summarize
Horizontal beam irradiance	Detail
Horizontal diffuse irradiance	-
Ambient Temperature	Detail
Wind Velocity	-
Albedo	-
<b>INVERTER</b> <input checked="" type="checkbox"/> Click to set the entire section to 'Detail'	
Inverter Loss Due to Power Threshold	Summarize
Inverter Loss Due to Voltage Threshold	Summarize
Inverter Loss Due to Nominal Inv. Power	Summarize
Inverter Loss Due to Nominal Inv. Voltage	Summarize
AC Output Power of each Sub-Array	Summarize
Available Power at Inverter Output	Summarize

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:

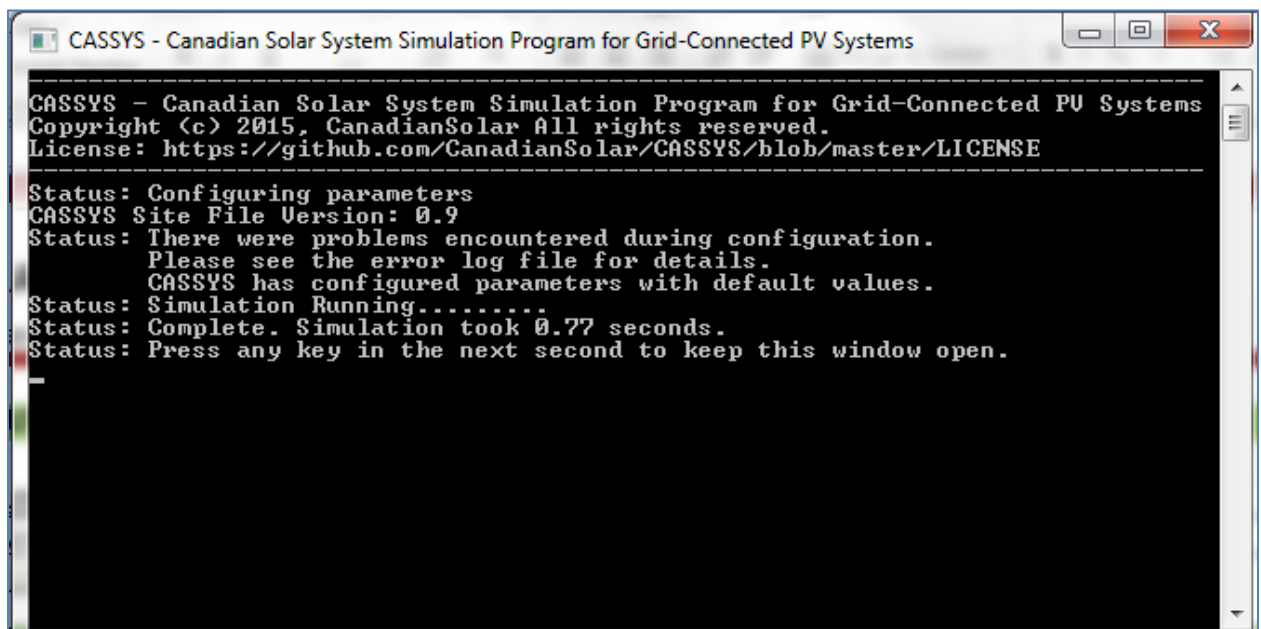
1. The 'Detail' option will write the simulation results of the selected parameter into the output file.

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, it 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.



```
CASSYS - Canadian Solar System Simulation Program for Grid-Connected PV Systems
CASSYS - Canadian Solar System Simulation Program for Grid-Connected PV Systems
Copyright (c) 2015, CanadianSolar All rights reserved.
License: https://github.com/CanadianSolar/CASSYS/blob/master/LICENSE
-----
Status: Configuring parameters
CASSYS Site File Version: 0.9
Status: There were problems encountered during configuration.
Please see the error log file for details.
CASSYS has configured parameters with default values.
Status: Simulation Running.....
Status: Complete. Simulation took 0.77 seconds.
Status: Press any key in the next second to keep this window open.
```

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

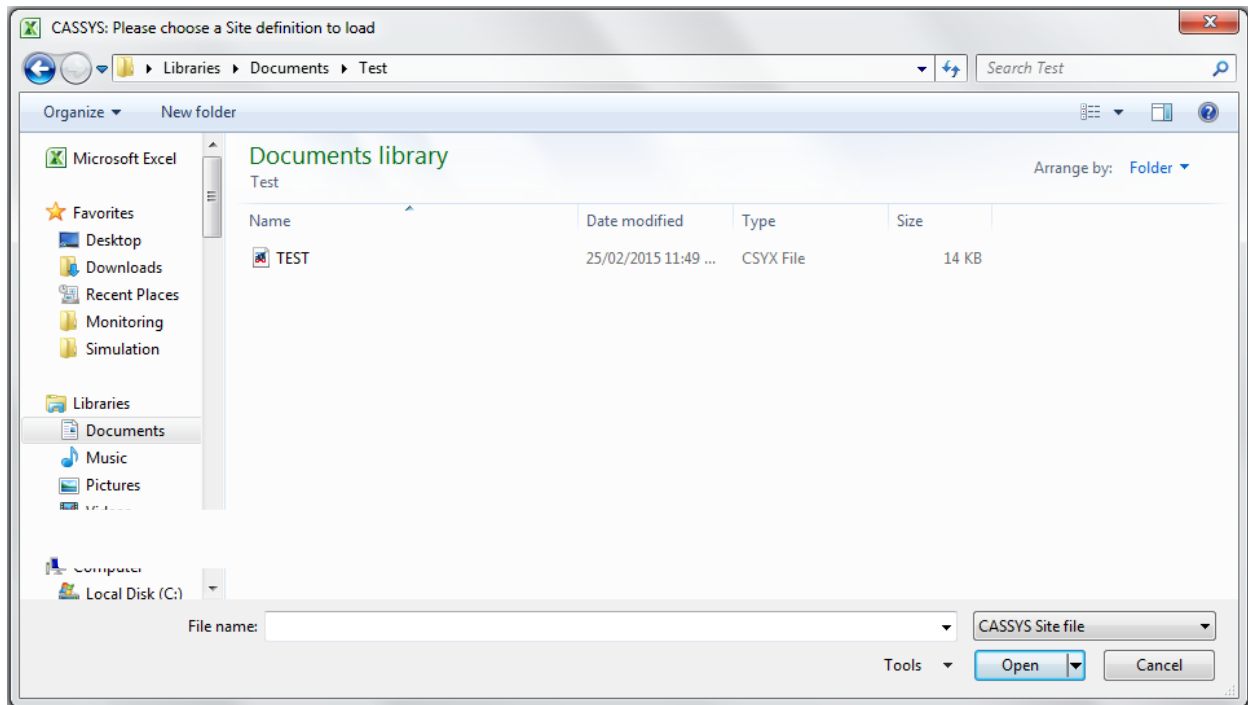


Figure 32: Loading a Site Definition

## 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

The screenshot shows the CASSYS interface with the 'CHART BUILDER' section. It contains three charts, each with a 'Number of Y Values' dropdown, an 'X Values' list, a 'Y Values' list, and a 'Display' button.

Chart	Number of Y Values	X Values	Y Values	Display
CHART 1	1	Global Incident in Coll. Plane	Beam Incident in Coll. Plane	Display
CHART 2	2	Current (A)	Ohmic Loss (kW) AC Ohmic Loss (kW)	Display
CHART 3	1	Month	Module Soiling Loss (kW)	Display

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:

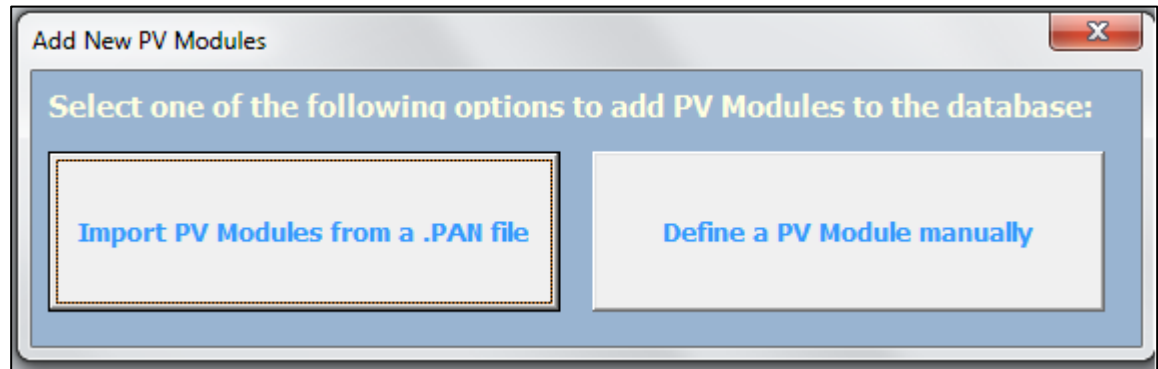


Figure 34: Adding PV Module or Inverters

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:

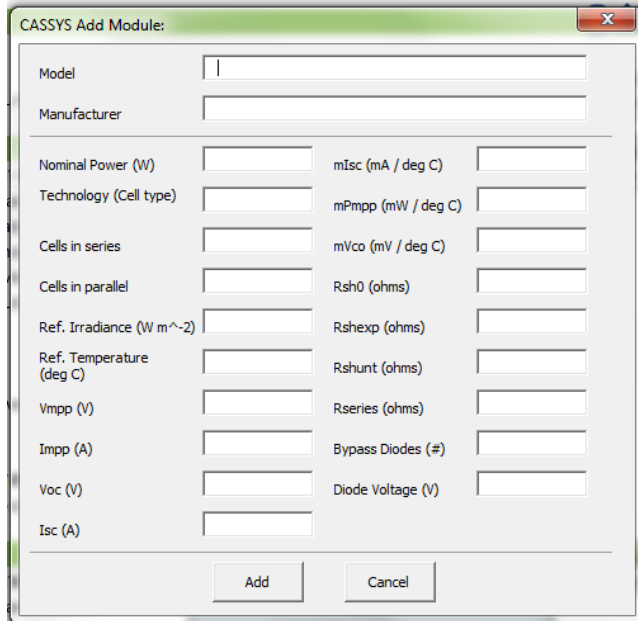


Figure 35: Add PV Module GUI



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.

**CASSYS**  
Canadian Solar System Simulation Program for Grid-Connected PV Systems

**OUTPUT FILE DEFINITION** Save

OUTPUT FILE LOCATION  
  
Browse

AVAILABLE OUTPUTS LIST	<input type="checkbox"/> Click to set all sections and outputs to 'Summarize'	Units	Description	<span>Click For Help</span>	<span>Export PDF Report of Site Definition</span>
Input Timestamp	<span>Required Field</span>	yyyy-mm-dd hh:mm:ss	Time stamp read from climate file		
Timestamp Used for Simulation	<span>Required Field</span>	yyyy-mm-dd hh:mm:ss	Time stamp used for sun position calculations. Accounts for sunrise/sunset and interval recording mode (beg., middle or end)		

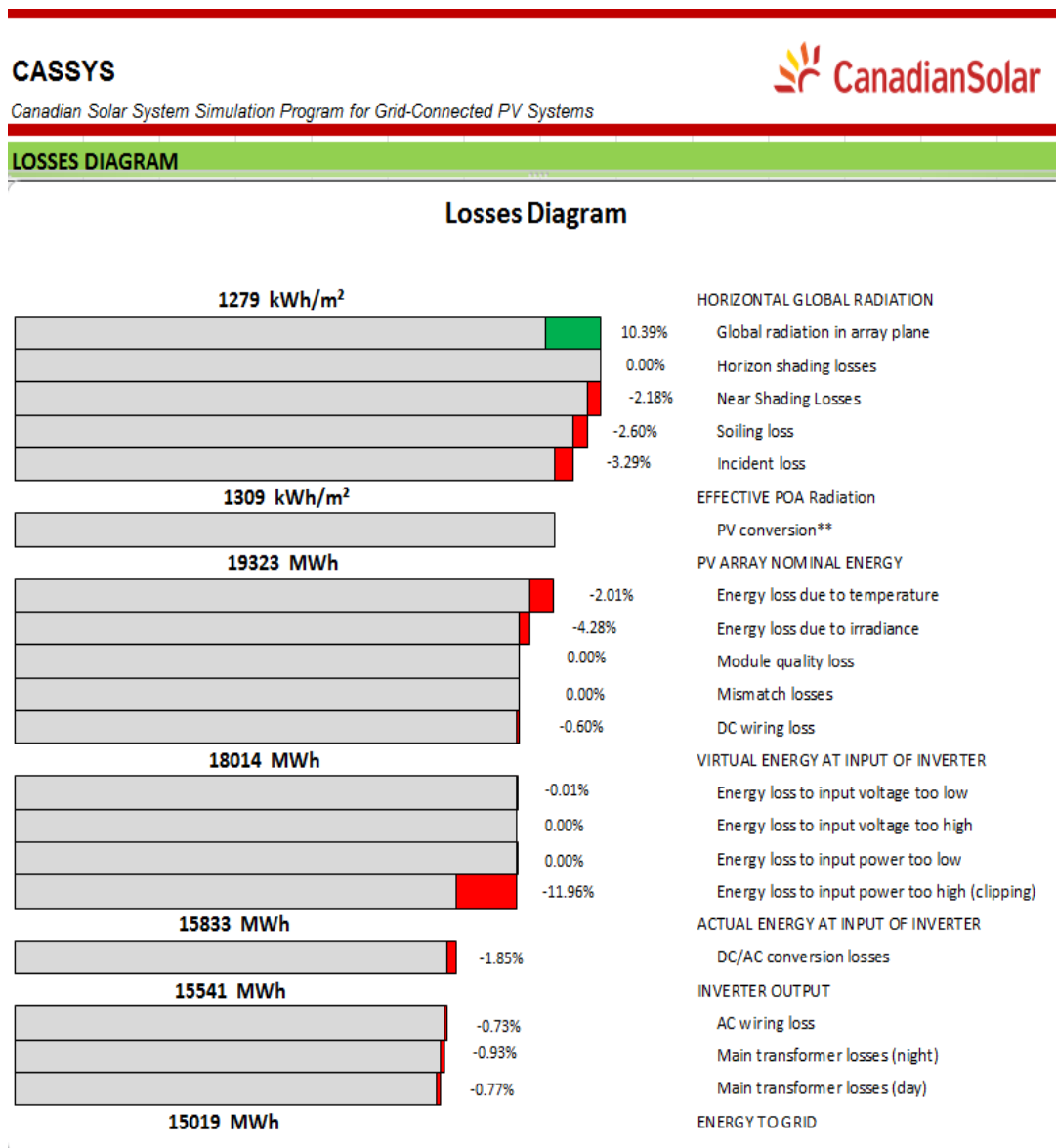
**METEOROLOGICAL AND SUN POSITION VARIABLES** ☐ Click to set the entire section to 'Summarize'

Sun Azimuth Angle  ° Angle between the direction of the sun and due south

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.

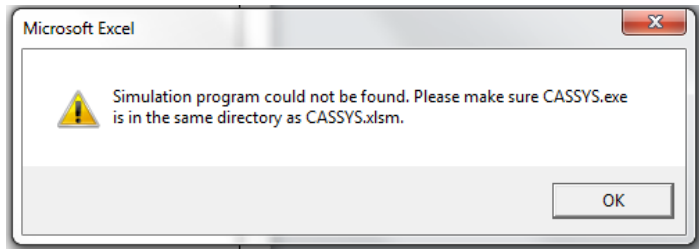
## 8. Loss Diagram

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:



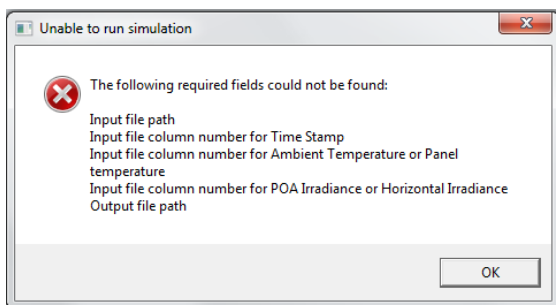
#### Error description:

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:



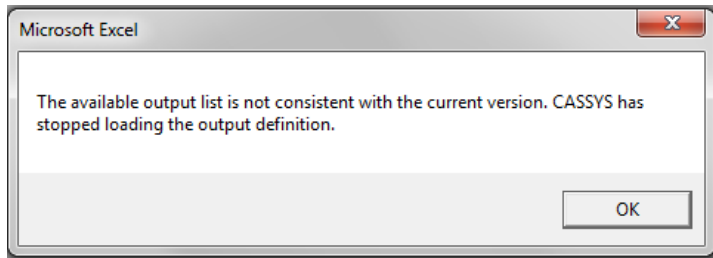
#### Error description:

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:



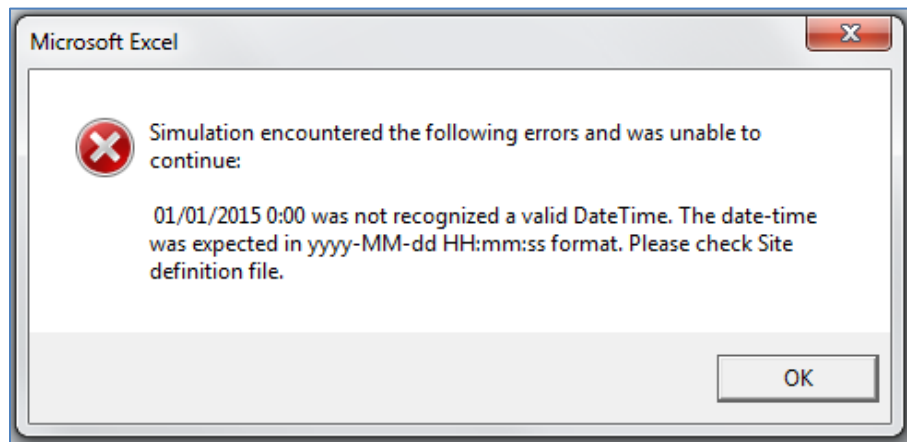
#### Error Description:

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 DEFINITION**

Rows to Skip: 1  
Delimiter: ,

**INPUT POSITION**

Input	Column Number	Units
Timestamp	1	yyy-MM-dd HH:mm:ss
POA Irradiance		W/m <sup>2</sup>
Horizontal Irradiance	5	W/m <sup>2</sup>
Horizontal Diffuse		W/m <sup>2</sup>
Temp Ambient	3	°C
Temp Panel		°C
Wind Speed		m/s

**PREVIEW**

	1 Timestamp	2 GlobInc	3 Temp Ambient
1	DateTime		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 0:00:00,-0.0003,0,0,0,0,0,0
3	01/01/2015 1:00:00,-8.0001,0,0,0,0,210,5.3
4	01/01/2015 2:00:00,-6.3995,0,0,0,0,220,5.3

**Input**

Input	Column Number	Units
Timestamp	1	yyy-MM-dd HH:mm:ss
POA Irradiance		W/m <sup>2</sup>
Horizontal Irradiance	5	W/m <sup>2</sup>
Horizontal Diffuse		W/m <sup>2</sup>
Temp Ambient	3	°C
Temp Panel		°C
Wind Speed		m/s

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:**



CASSYS requires the use of Excel macros to run properly.

**Please enable macros and re-open CASSYS.**

### Error Description:

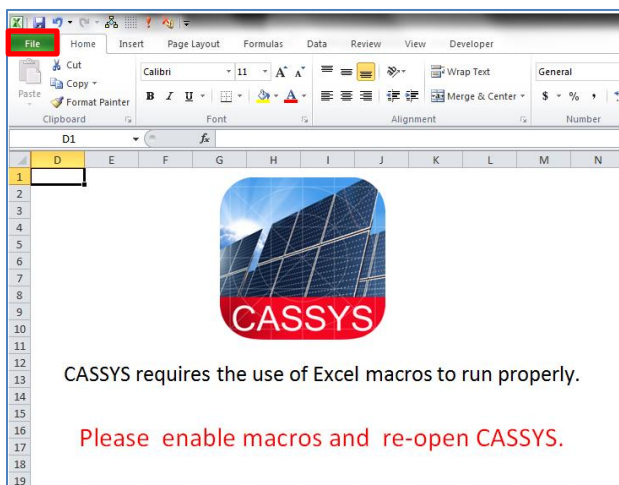
If you see this page, it means that macros have not been enabled in your Excel program. Macros are necessary for CASSYS to function, and it is critical that macros are enabled before continuing.

The following page provides several different methods of enabling macros

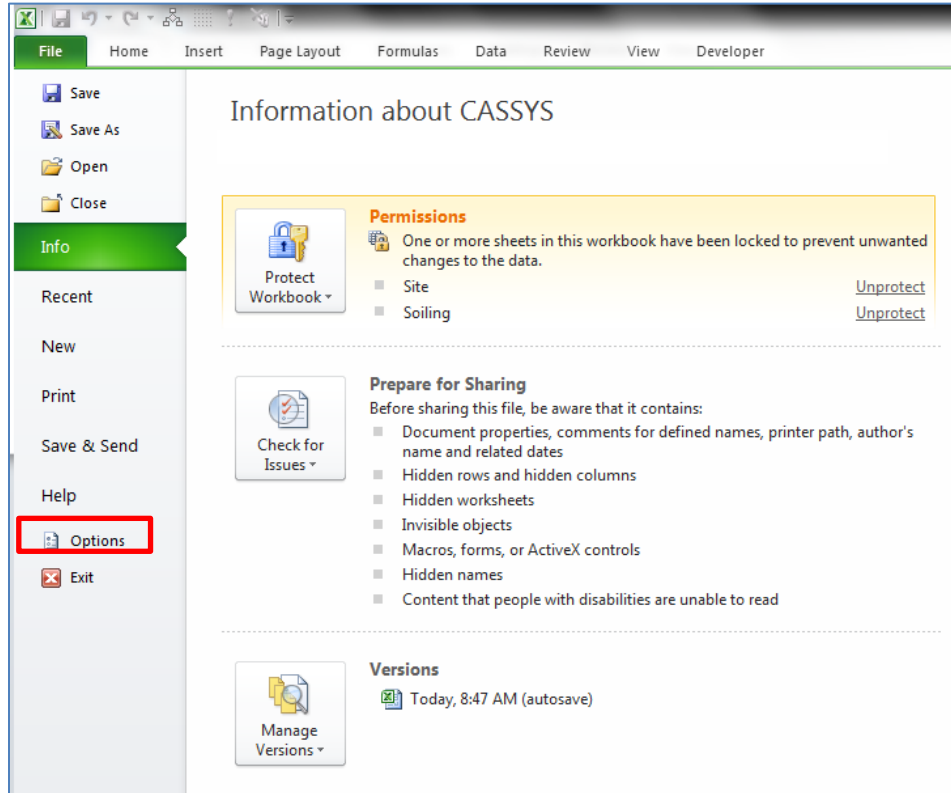
### Solution:

#### Excel 2010

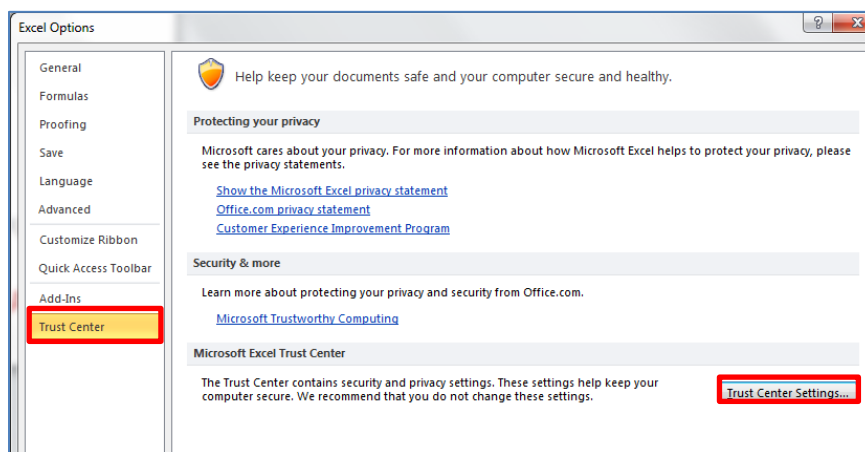
1. Click on the 'File' tab in the top left corner of Excel.



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

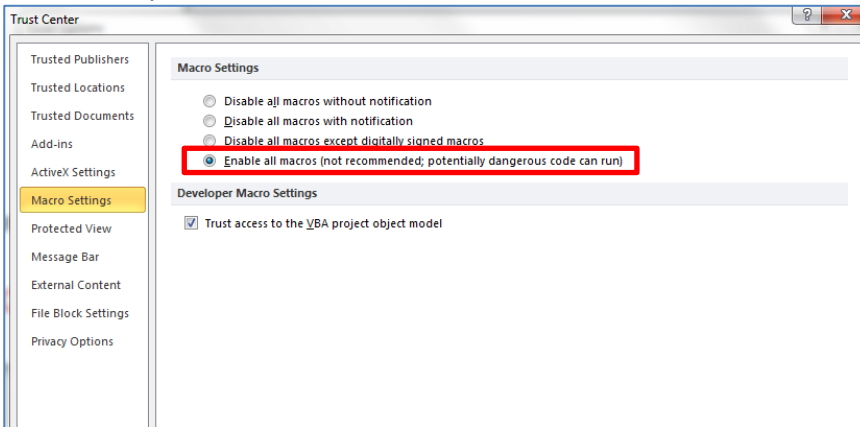


## 3. Click on the 'Trust Center' Tab and then on 'Trust Center Settings'

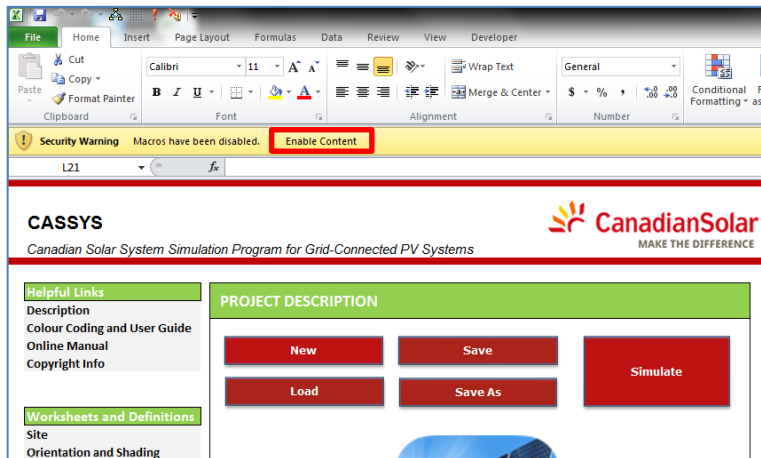




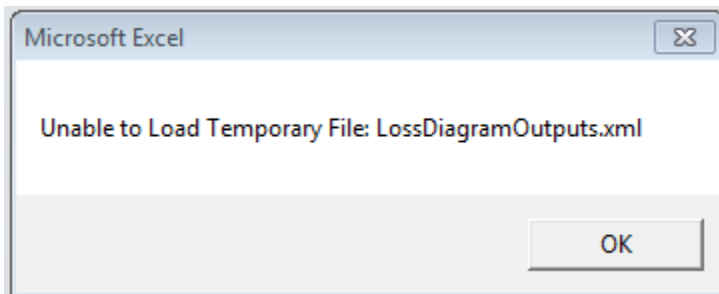
4. Finally, make sure that 'Enable all macros' is selected.



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:**



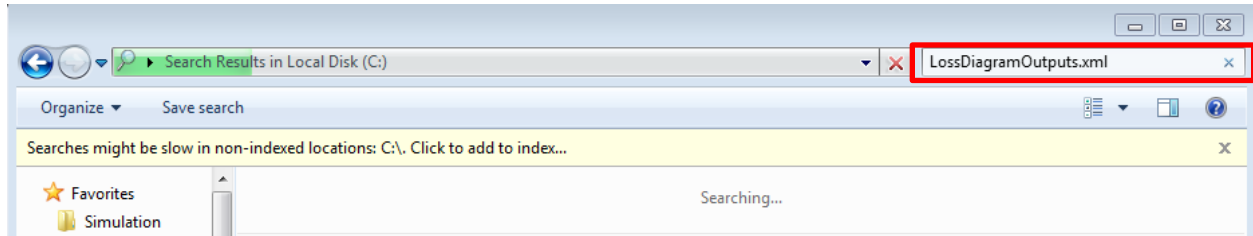
**Error description:**

This error occurs at the end of the simulation when the interface is attempting to 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.

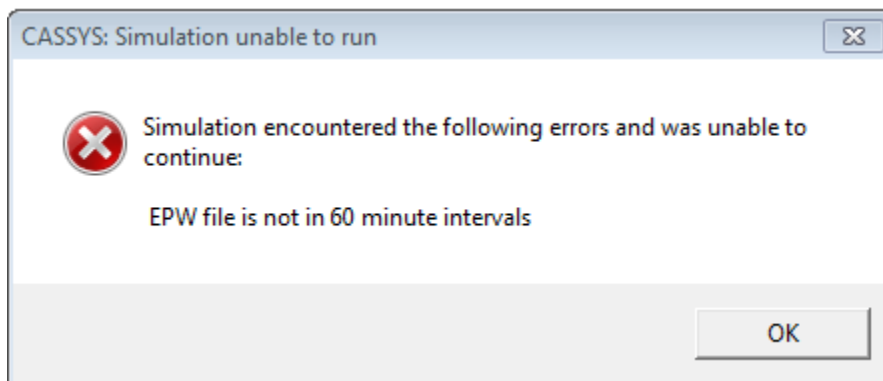
**Solution:**

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.