Penton Energy

Consulting

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1. PEC-EnergyPlus-Toolbox

Having spent a portion of my professional working life using BLAST in the mid 1980's to the early 1990's I have recently only begun to catch up with many of the advances in energy simulation and its integration with 3D building modeling software. EnergyPlus of course has its roots in both the BLAST and DOE–2 programs. BLAST (Building Loads Analysis and System Thermodynamics) and DOE–2 were both developed and released in the late 1970s and early 1980s as energy and load simulation tools. I began writing the PEC-EnergyPlus-Toolbox as a way of doing a "deep dive" into the EnergyPlus world in order to speed up my learning curve. The primary focus of the toolbox, at least in this early phase, is to focus on the multitude of output data, both in ASCII CSV format and SQLite format. The tool was written hopefully to provide a high level of user convenience when working with these output data files. All of my current development has been with Visual Studio 10, .Net 4.0 framework and EnergyPlus 8.8. I hope to keep evolving this application as I learn more and circumstances allow.

1.1 Toolbox Treeview GUI

To open an EnergyPlus CSV data file or an EnergyPlus SQL file simply browse to an output file as seen in figure 1 here. Once a file of this type is selected it is added to the Treeview seen here. The primary difference between selecting a CSV file or a SQL file is as follows. In order to work with the CSV data a date/time field must be selected to work with any the time-series data contained in the file. With a SQL file the data is contained in SQLite database tables which require that a table be selected in order to be utilized by the toolbox.

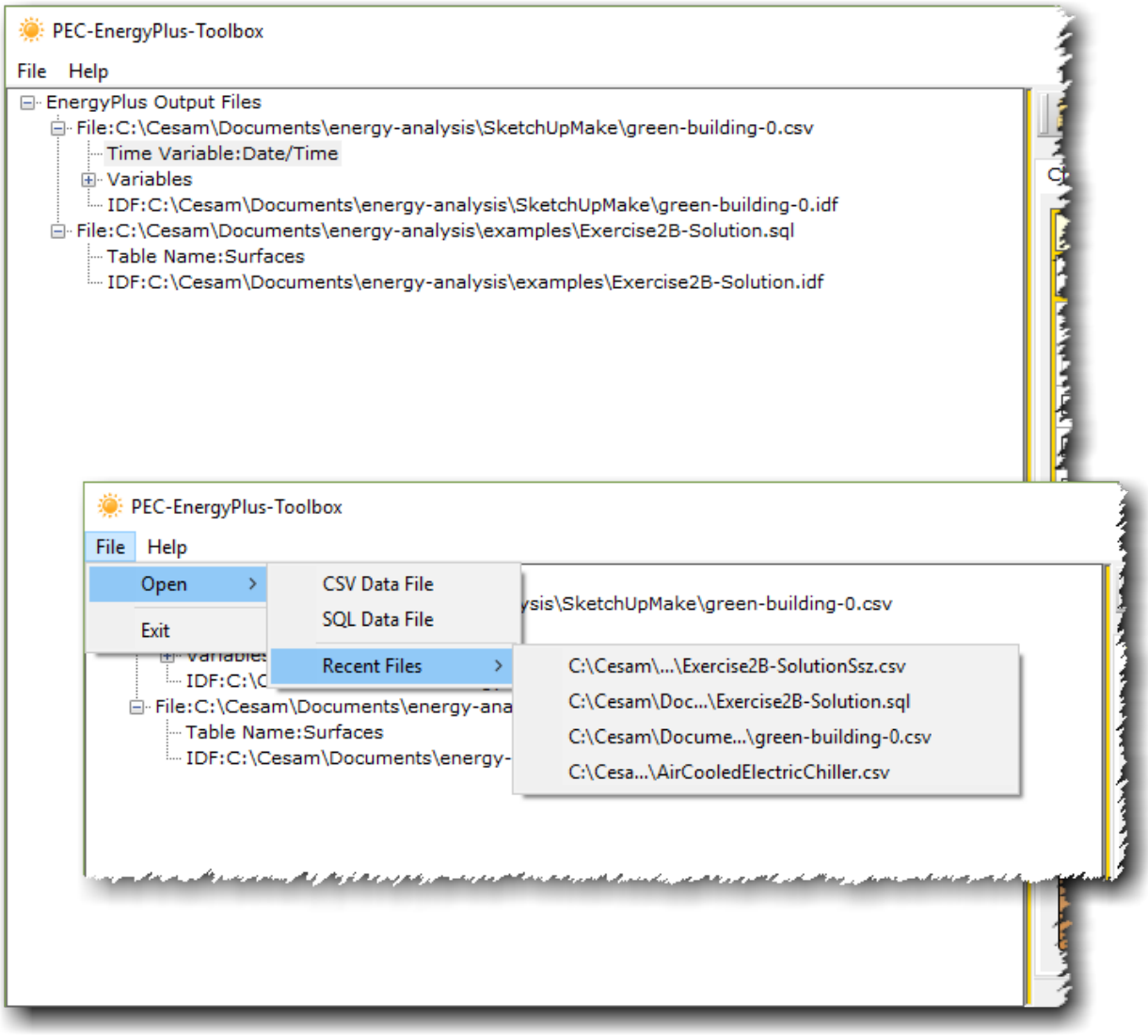


Figure 1 - Opening Data Files

Most items in the help menu are self explanatory. The Download ER Diagram menu item is a PDF file of a SQL entity-relationship diagram built from standard table structure found in a SQL output file.

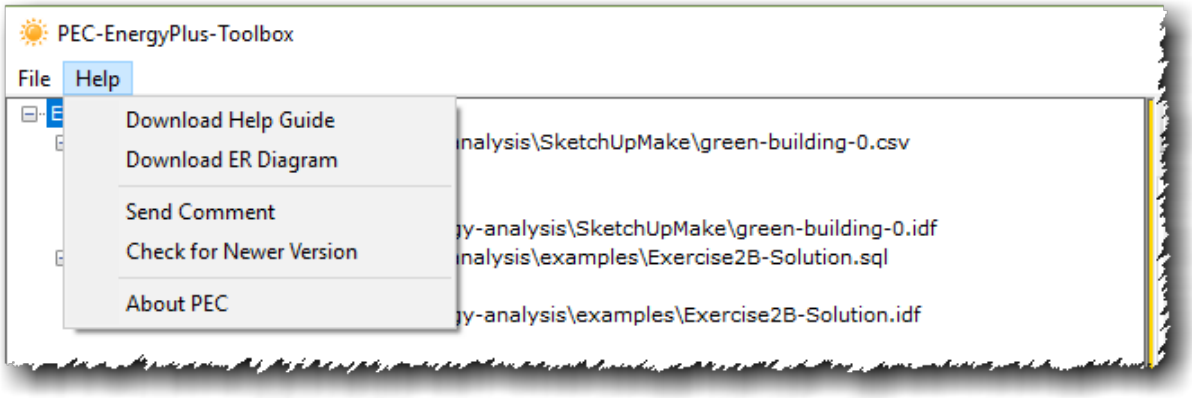


Figure 2 - GUI Help Menu

As stated previously to interact with a CSV or SQL file a CSV date/time field or a SQL table name field must be selected. To do this with a CSV file click on the <Select Time Variable> node in the treeview and a dropdown list will become visible from which a date/time variable is selected. Similarly, for a SQL file click on the <Select Table Name> node in the treeview and select a table name from the dropdown list that will appear.

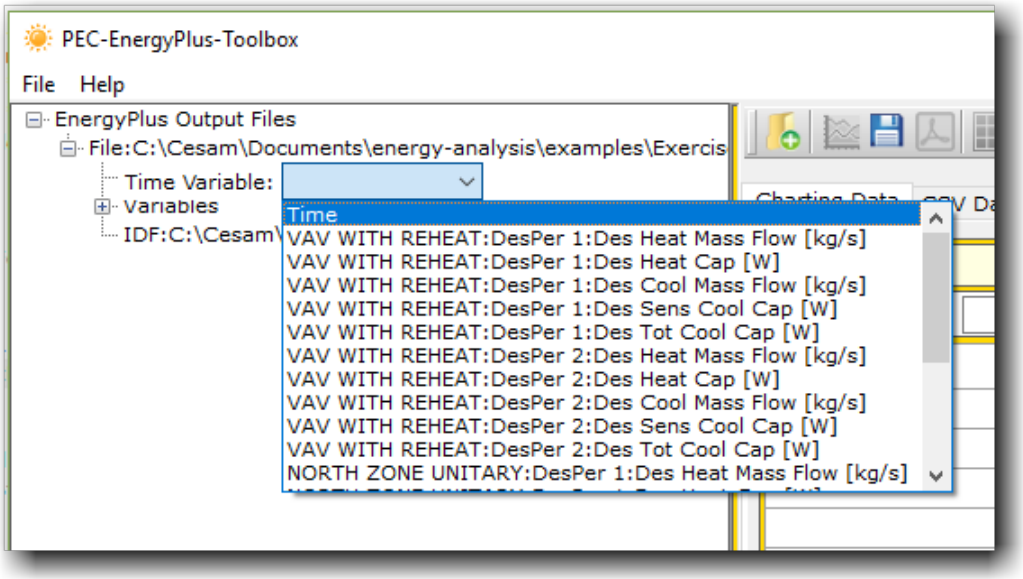


Figure 3 - Selecting CSV Time Variable

1.2 CSV File Processing

Loading CSV data requires multiple passes of the data in order to properly authentic the veracity of the data and reformat date/time values such that hours are sequenced from 00 to 23, in lieu of 01 to 24, with 00 representing the first hour of the next day.

Open CSV file and load all raw text removing any blank rows. All variables are read from the column header.

Step 1

After selecting the date/time variable each date/time text value is converted to a real date/time with each day ending and beginning at hour 00.

Step 2

Each record is read once again loading all data for each variable for each date/time row.

Step 3

Each variable is read again with the maximum and minimum values extracted for display in the variable table on the first tab.

Step 4

1.3 GUI Toolbar

Toolbar functions are as described in Figure 4 - GUI Toolbar.

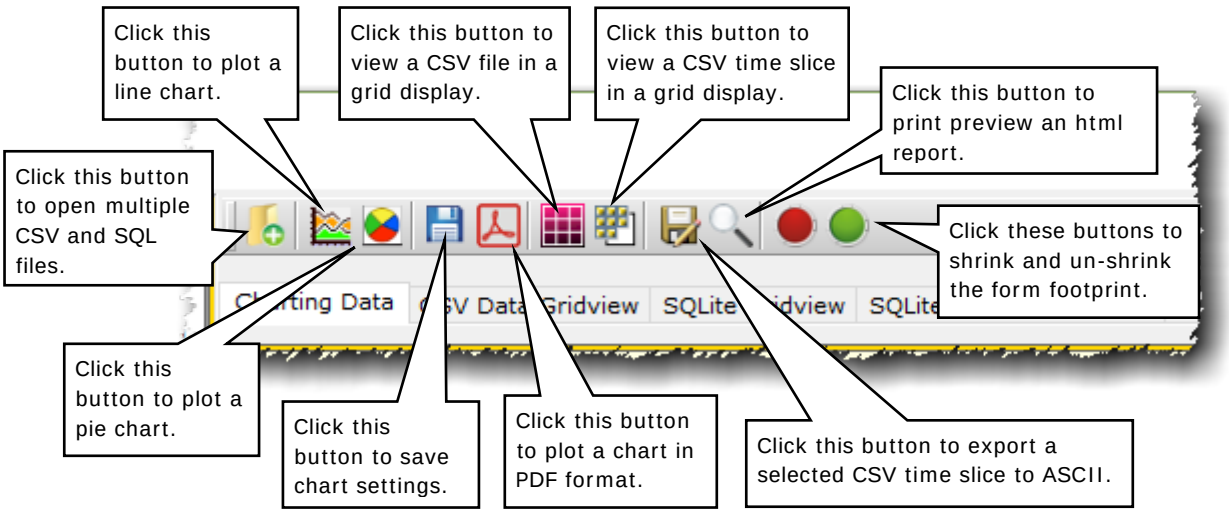


Figure 4 - GUI Toolbar

1.4 Main GUI

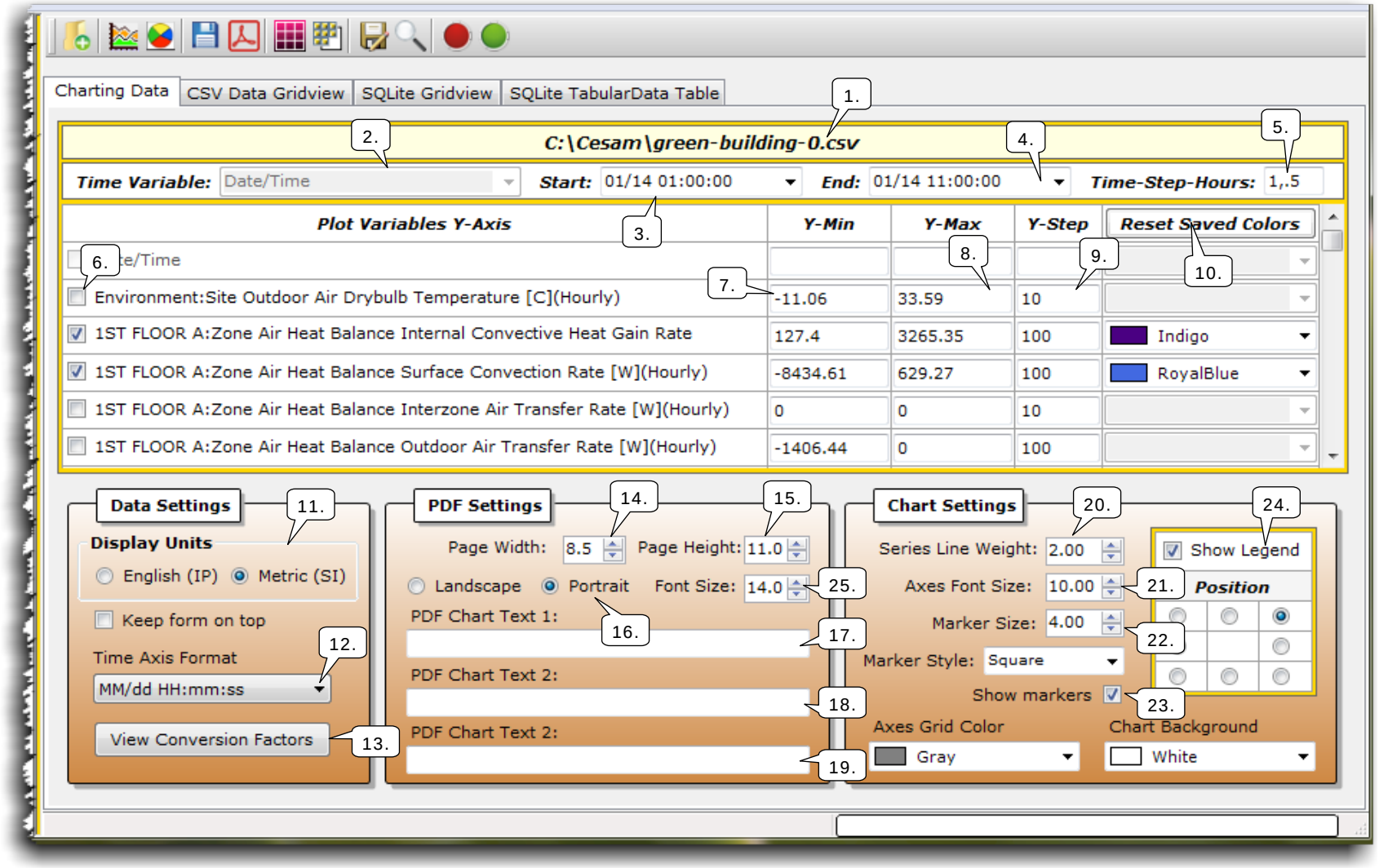


Figure 5 – Main GUI

1. This label displays the active CSV data file. The CSV data file is made active once a date/time field is selected from the treeview.

2. The selected date/time variable is displayed here. This is a read-only display of the selected date/time variable.

3. Select from this list the start date/time value

4. Select from this list the ending date/time value.

5. Enter the values that represent the major and minor time steps on the horizontal axis. The values should be entered in hours. For example 24, 2 would be 24 hours (one day for each major tic mark and 2 would be a minor tic mark every 2 hours on the horizontal axis.

6. Check the box for the variable to be plotted on the chart. A maximum of four variables can be plotted on a chart.

7. This value is the minimum value of the variable and it represents the minimum value for the vertical axis. Enter a value of your choice if required.

8. This value is the maximum value of the variable and it represents the maximum value for the vertical axis. Enter a value of your choice if required.

9. This number is the value for each tic mark in the chart on the vertical axis. Enter a value of your choice to improve chart readability.

10. Select from this list the color of the plotted line series on the chart.

11. Optionally display the variable values in IP units. If this option is changed after selecting the date/time field, the date/time field must be reselected in order to convert data to IP values.

12. Select from this list the format of the date/time values plotted in a chart and the format of the date/time values seen in the time start and end dropdown lists.

13. Click this button to view all the conversion factors hard-coded into the application.

14. Set the page width of any PDF chart that is generated.

15. Set the page height of any PDF chart that is generated.

16. Set the page orientation of the PDF output file with these option buttons.

17. Enter any text to print above the chart in the top-left corner of an output PDF file.

18. Enter any text to print above the chart in the top-center corner of an output PDF file.

19. Enter any text to print above the chart in the top-right corner of an output PDF file.

20. Change the line weight of the plotted line in a chart.

21. Change the font size of both the vertical and horizontal axes text size.

22. Change the size of the markers used on a plotted line in a chart.

23. Check this box to show data point markers.

24. Use this box to change the location of the legend used with a line chart.

25. Adjust the font size of the optional chart text.

1.5 Line Chart

To construct a line chart check a variable as seen in Figure 6 - Line Chart Configuration. Each minimum and maximum value for each variable is seen in the adjacent text boxes. These values are used to build the vertical axis of the line chart. Each variable will have its own vertical axis. Up to four variables for a chart may be selected. It is recommended to enter a nominal upper and lower value to round off axis values and often two or more variables with the same lower and upper values will be easier to read. Based on the minimum and maximum values read from the data a tic interval for the vertical axis is determined. Change this value to make the chart more readable as required.

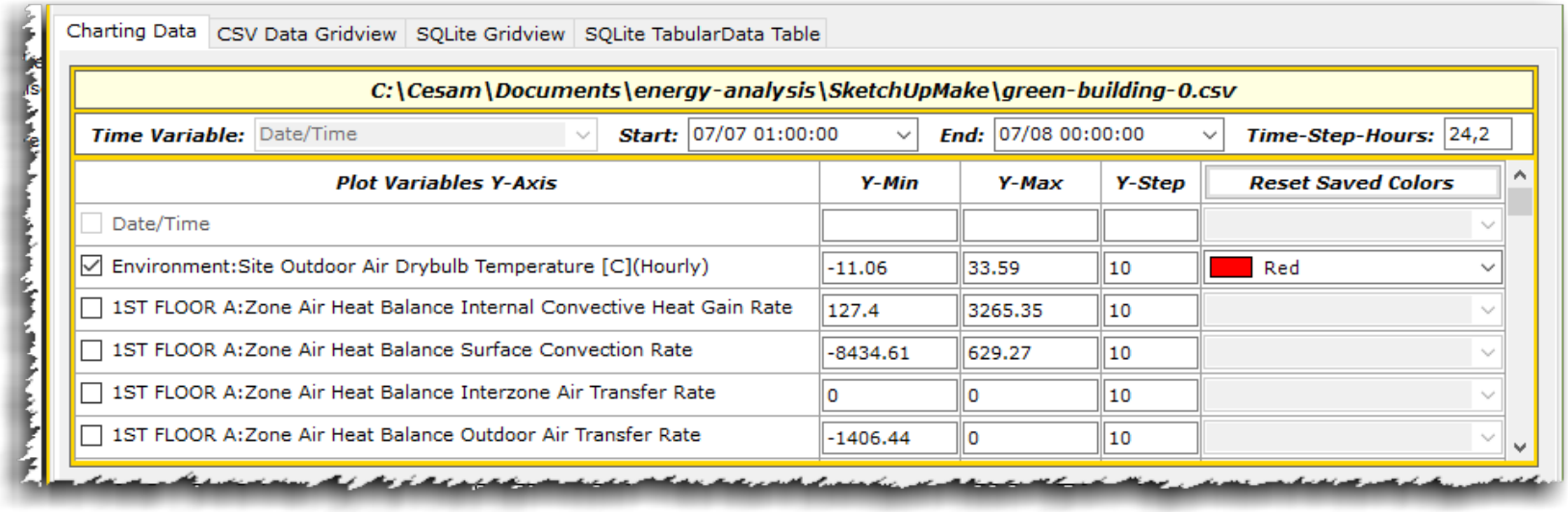


Figure 6 - Line Chart Configuration

Each variable may have its own color assigned be selecting a color from its color list. These selections are remembered for reuse. To reset all colors back to black click the reset saved colors button. The horizontal axis represents a date/time interval and the start and end times are selected from the two lists seen in the figure. The time-step-hours textbox contains a simple text string that represents the interval of time steps between the x-axis major and minor intervals. The first number is the major time step and the second number is the minor time step. Both numbers have unit of hours. A value less than one is represented a decimal number i.e. 2, .50.

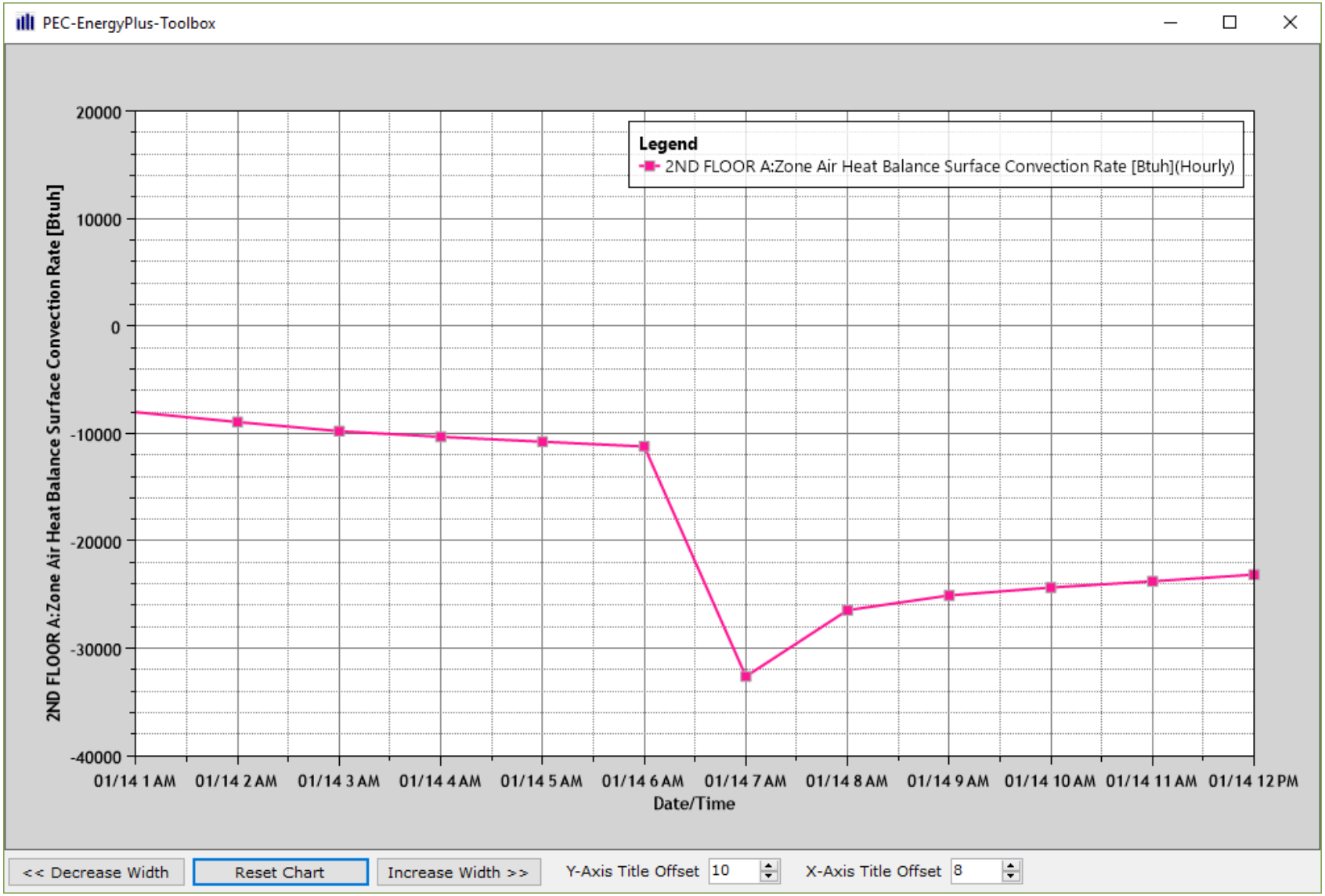


Figure 7 - Line Chart

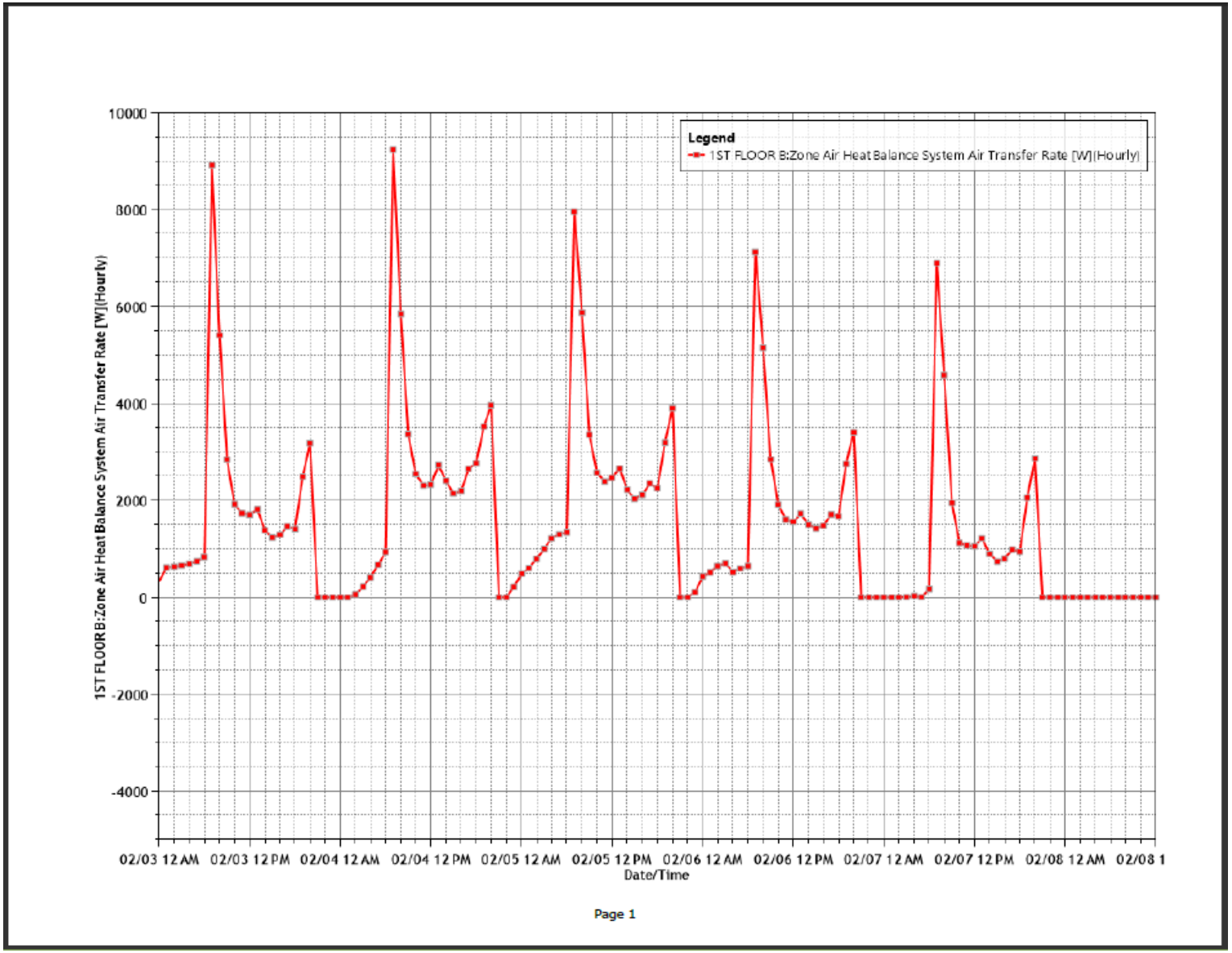
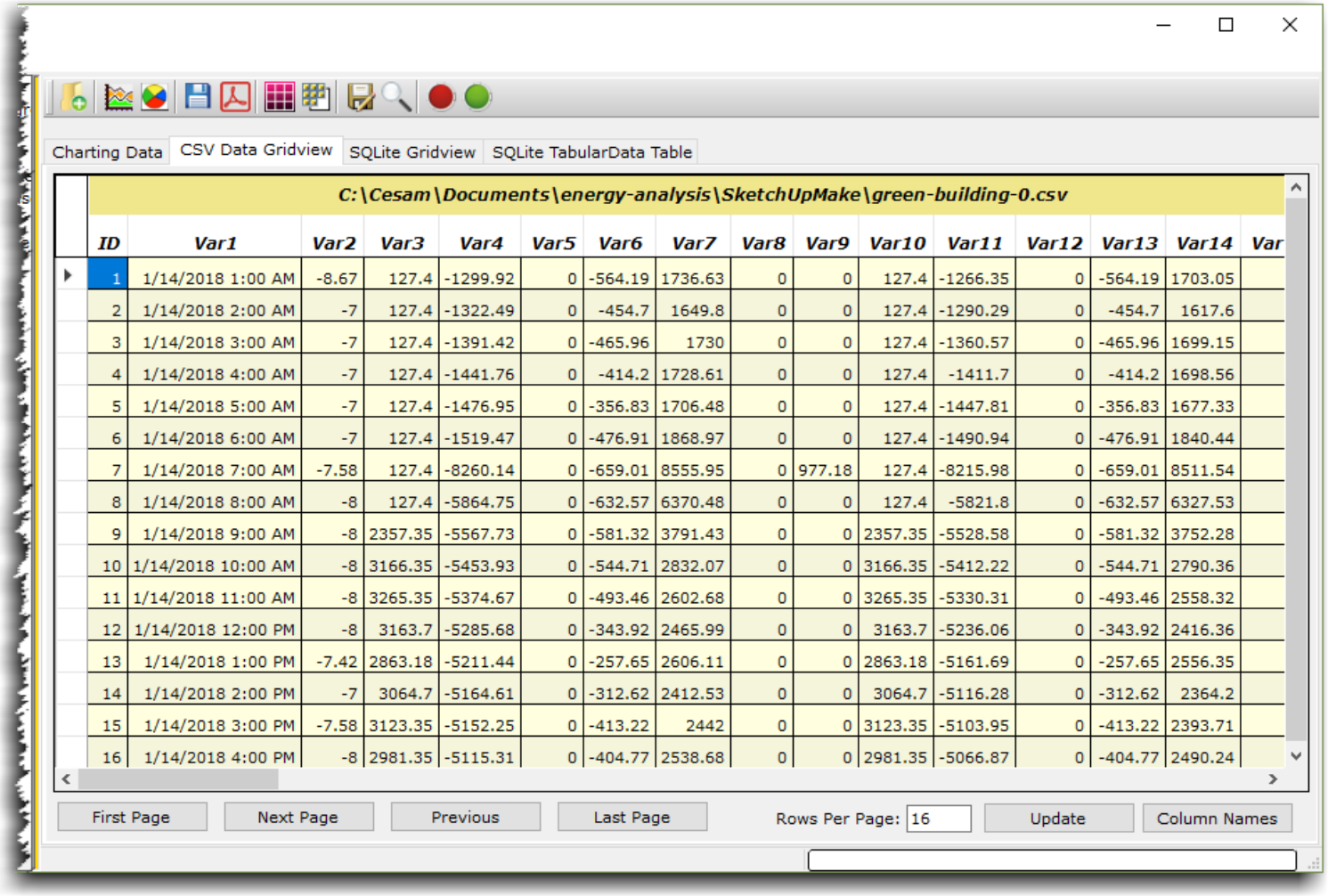


Figure 8 - PDF Chart Output

1.6 CSV Data Gridview

After a CSV file is loaded click the view CSV file button from the main toolbar to populate this grid. All column headings are aliased for better viewing due to the lengthy nature of some data column headings. To see a mapping



ID	Var1	Var2	Var3	Var4	Var5	Var6	Var7	Var8	Var9	Var10	Var11	Var12	Var13	Var14	Var
1	1/14/2018 1:00 AM	-8.67	127.4	-1299.92	0	-564.19	1736.63	0	0	127.4	-1266.35	0	-564.19	1703.05	
2	1/14/2018 2:00 AM	-7	127.4	-1322.49	0	-454.7	1649.8	0	0	127.4	-1290.29	0	-454.7	1617.6	
3	1/14/2018 3:00 AM	-7	127.4	-1391.42	0	-465.96	1730	0	0	127.4	-1360.57	0	-465.96	1699.15	
4	1/14/2018 4:00 AM	-7	127.4	-1441.76	0	-414.2	1728.61	0	0	127.4	-1411.7	0	-414.2	1698.56	
5	1/14/2018 5:00 AM	-7	127.4	-1476.95	0	-356.83	1706.48	0	0	127.4	-1447.81	0	-356.83	1677.33	
6	1/14/2018 6:00 AM	-7	127.4	-1519.47	0	-476.91	1868.97	0	0	127.4	-1490.94	0	-476.91	1840.44	
7	1/14/2018 7:00 AM	-7.58	127.4	-8260.14	0	-659.01	8555.95	0	977.18	127.4	-8215.98	0	-659.01	8511.54	
8	1/14/2018 8:00 AM	-8	127.4	-5864.75	0	-632.57	6370.48	0	0	127.4	-5821.8	0	-632.57	6327.53	
9	1/14/2018 9:00 AM	-8	2357.35	-5567.73	0	-581.32	3791.43	0	0	2357.35	-5528.58	0	-581.32	3752.28	
10	1/14/2018 10:00 AM	-8	3166.35	-5453.93	0	-544.71	2832.07	0	0	3166.35	-5412.22	0	-544.71	2790.36	
11	1/14/2018 11:00 AM	-8	3265.35	-5374.67	0	-493.46	2602.68	0	0	3265.35	-5330.31	0	-493.46	2558.32	
12	1/14/2018 12:00 PM	-8	3163.7	-5285.68	0	-343.92	2465.99	0	0	3163.7	-5236.06	0	-343.92	2416.36	
13	1/14/2018 1:00 PM	-7.42	2863.18	-5211.44	0	-257.65	2606.11	0	0	2863.18	-5161.69	0	-257.65	2556.35	
14	1/14/2018 2:00 PM	-7	3064.7	-5164.61	0	-312.62	2412.53	0	0	3064.7	-5116.28	0	-312.62	2364.2	
15	1/14/2018 3:00 PM	-7.58	3123.35	-5152.25	0	-413.22	2442	0	0	3123.35	-5103.95	0	-413.22	2393.71	
16	1/14/2018 4:00 PM	-8	2981.35	-5115.31	0	-404.77	2538.68	0	0	2981.35	-5066.87	0	-404.77	2490.24	

Figure 9 - CSV Gridview

of the column aliases to the actual column names click the Column Names button in the bottom right. The format of the mapping is seen here in Figure 10 - Column Name Mappings and opens in the notepad.exe application for you. Additionally,

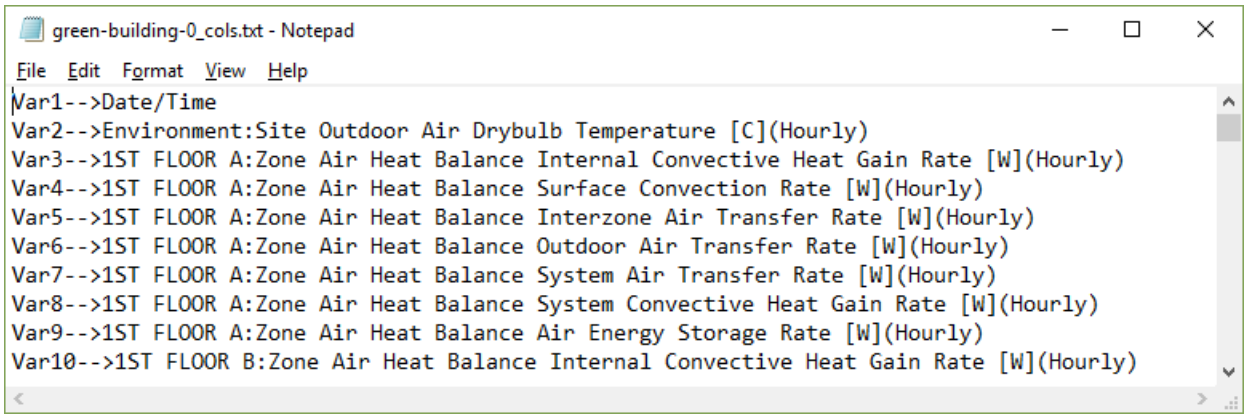


Figure 10 - Column Name Mappings

hovering your mouse cursor over a column heading will display the entire column name in a tooltip. To view more rows per page enter a value into the rows per page textbox and click the update button.

1.6.1 CSV Time Slice

To create a CSV time slice check as many variables from the variables display, set the start and end date/time(s) and click the time slice button on the main toolbar. The grid is then filled with the selected data. Next click the export time slice button to write the grid display to a csv text file.

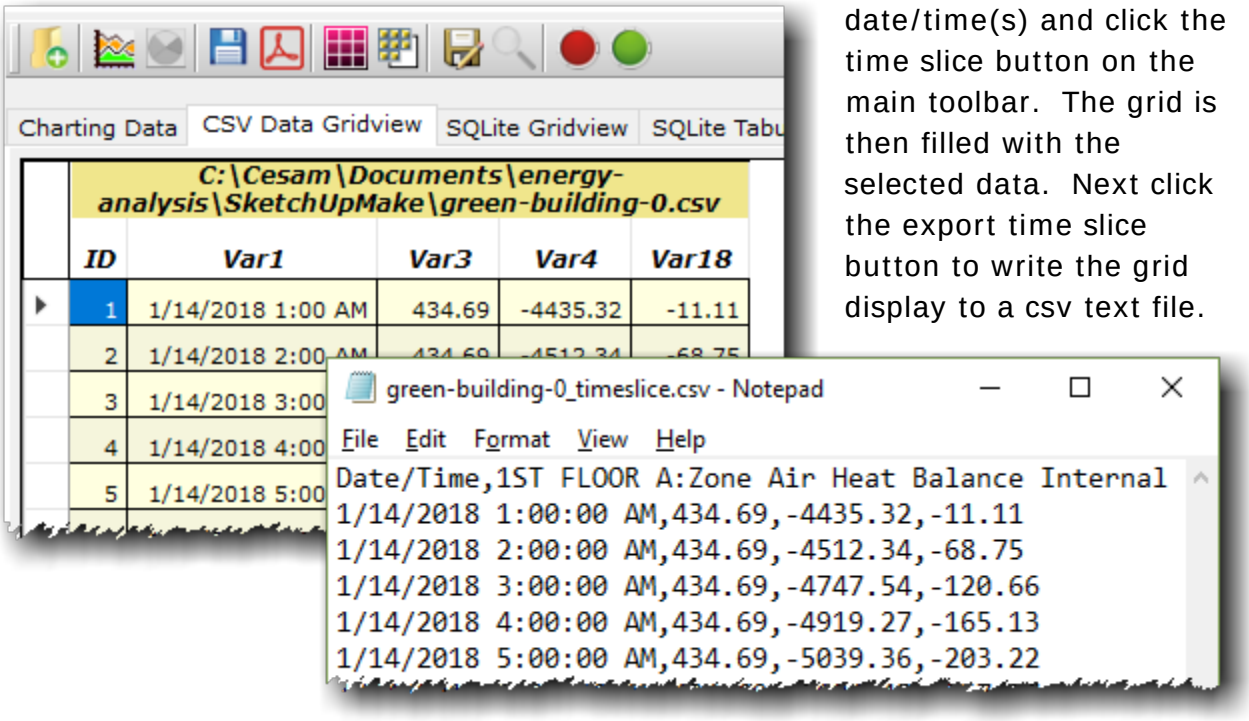


Figure 11 - CSV Time Slice

1.7 SQL Data Gridview

When an EnergyPlus SQL tabular data file is loaded, that is when a table is selected from the combo on the treeview the data in the file is displayed in the grid located on the tab seen in Figure 12 - SQL Data View.

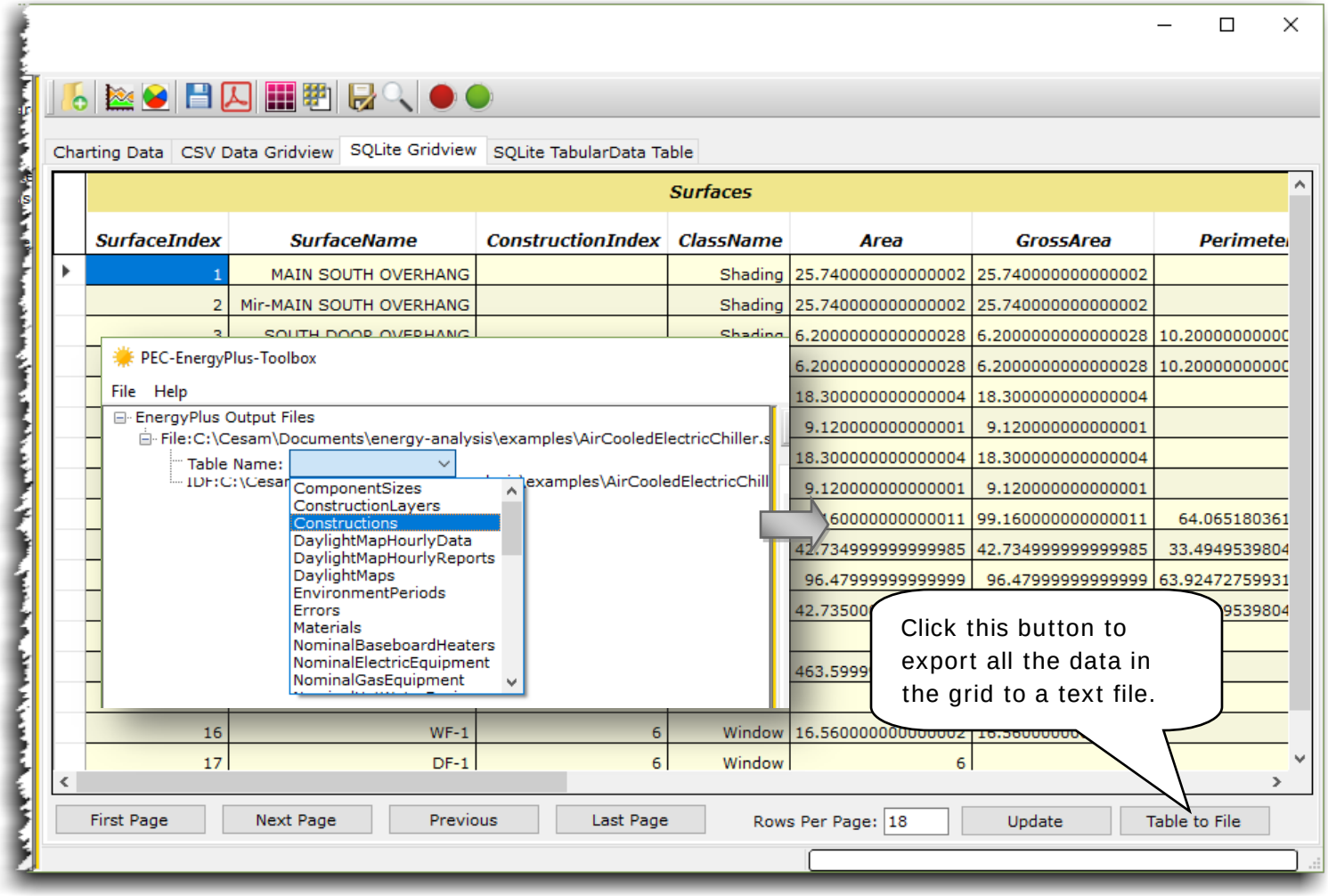
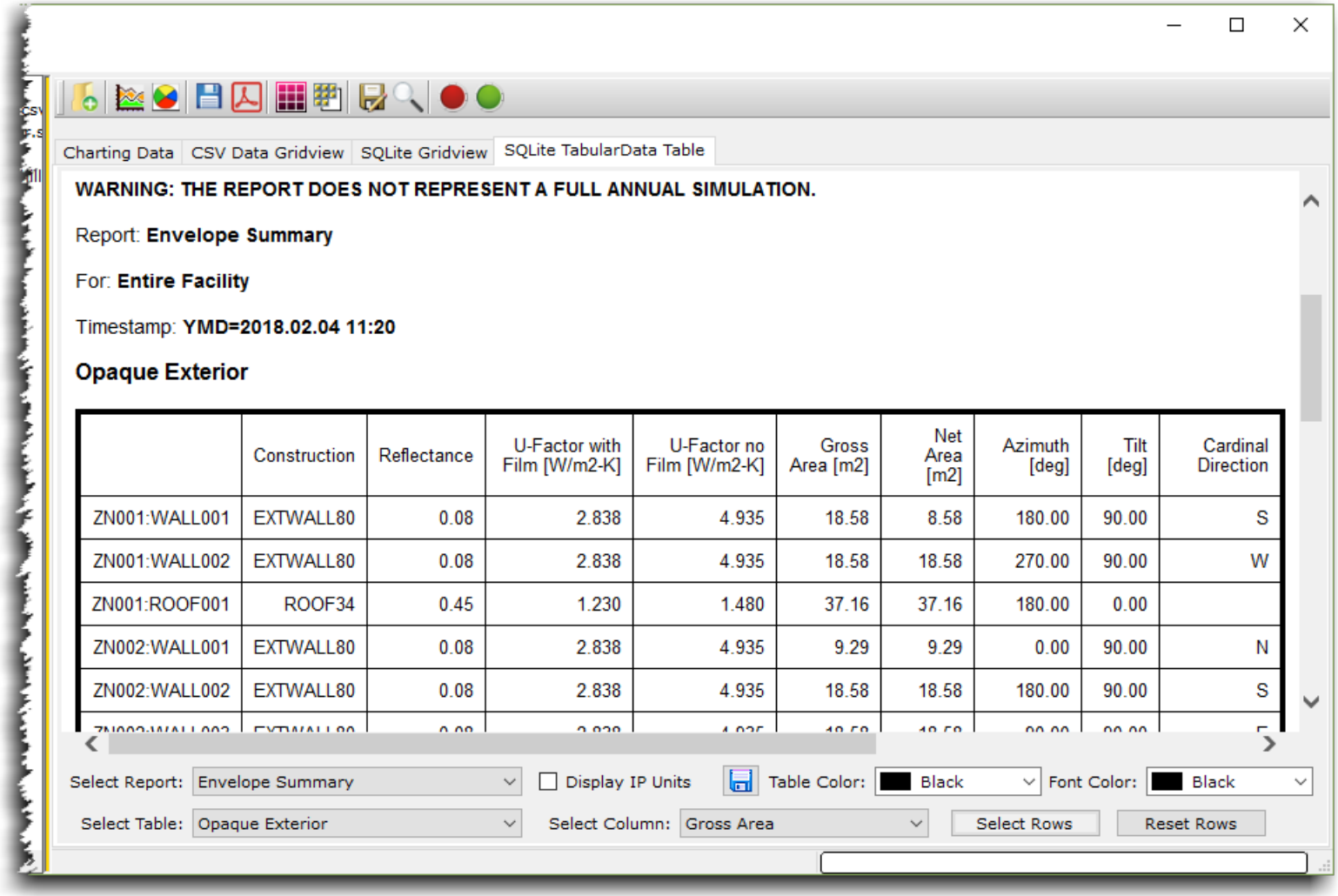


Figure 12 - SQL Data View

1.8 SQL TabularData Table

One table of significance that is available for use, assuming a SQL output file has been loaded, is the TabularData



	Construction	Reflectance	U-Factor with Film [W/m2-K]	U-Factor no Film [W/m2-K]	Gross Area [m2]	Net Area [m2]	Azimuth [deg]	Tilt [deg]	Cardinal Direction
ZN001:WALL001	EXTWALL80	0.08	2.838	4.935	18.58	8.58	180.00	90.00	S
ZN001:WALL002	EXTWALL80	0.08	2.838	4.935	18.58	18.58	270.00	90.00	W
ZN001:ROOF001	ROOF34	0.45	1.230	1.480	37.16	37.16	180.00	0.00	
ZN002:WALL001	EXTWALL80	0.08	2.838	4.935	9.29	9.29	0.00	90.00	N
ZN002:WALL002	EXTWALL80	0.08	2.838	4.935	18.58	18.58	180.00	90.00	S

Figure 13 - TabularData Output

table. When the table TabularData is selected all of this data is available from the SQLite TabuarData tab seen in Figure 13 - TabularData Output. This data is the same data used to build the EnergyPlus HTML report assuming that option has been established in the IDF input file.

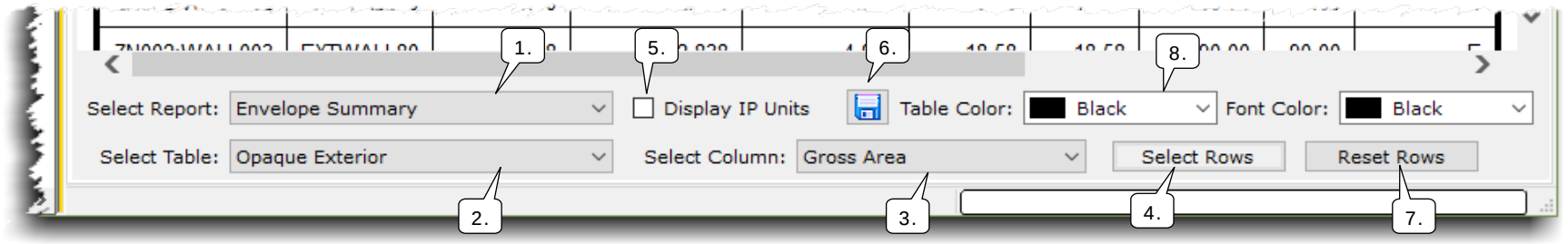


Figure 14 - TabularData Tab Controls

1. Select from this list any of the available reports queried from the selected SQL file. Once selected all of the tables contained in a report are queried from the data and an HTML report is built and displayed as seen in Figure 13 - TabularData Output. Also on this list is an option to select all tables.

1.9 Pie Chart Generation

Any of the data in a table can be extracted to build a pie chart. By picking a report, then a table, and then a column heading, all of the rows of the selected column are used in building the pie chart. However, any row with a value 0.0 is automatically omitted from the pie chart.

2. Select from this list a table contained in the selected report. Once selected all the column headings from that table are queried.

3. Select from this list a table column heading. By default all of the rows of the selected column are used. If a blank row is encountered, typically in front of a total or sub-total, only the rows up to the blank are used.

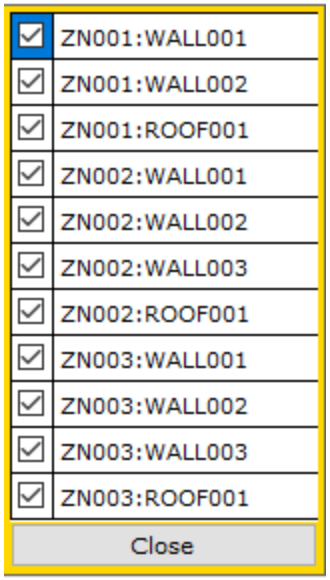


Figure 15 - Row Selection

4. Click this button to select specific rows of data to use in building a pie chart. Once clicked the dialog seen in Figure 15 - Row Selection is opened. From this dialog you can select only the rows you need in your pie chart.

5. Check this box to convert all the units in any HTML report to IP units. Uncheck to return to default units.

6. Click this button to save the current HTML report to an HTML file.

7. Click this button to reset the row selection dialog back to its default configuration.

8. Select from this list the desired table line color.

1.9.1 Pie Chart

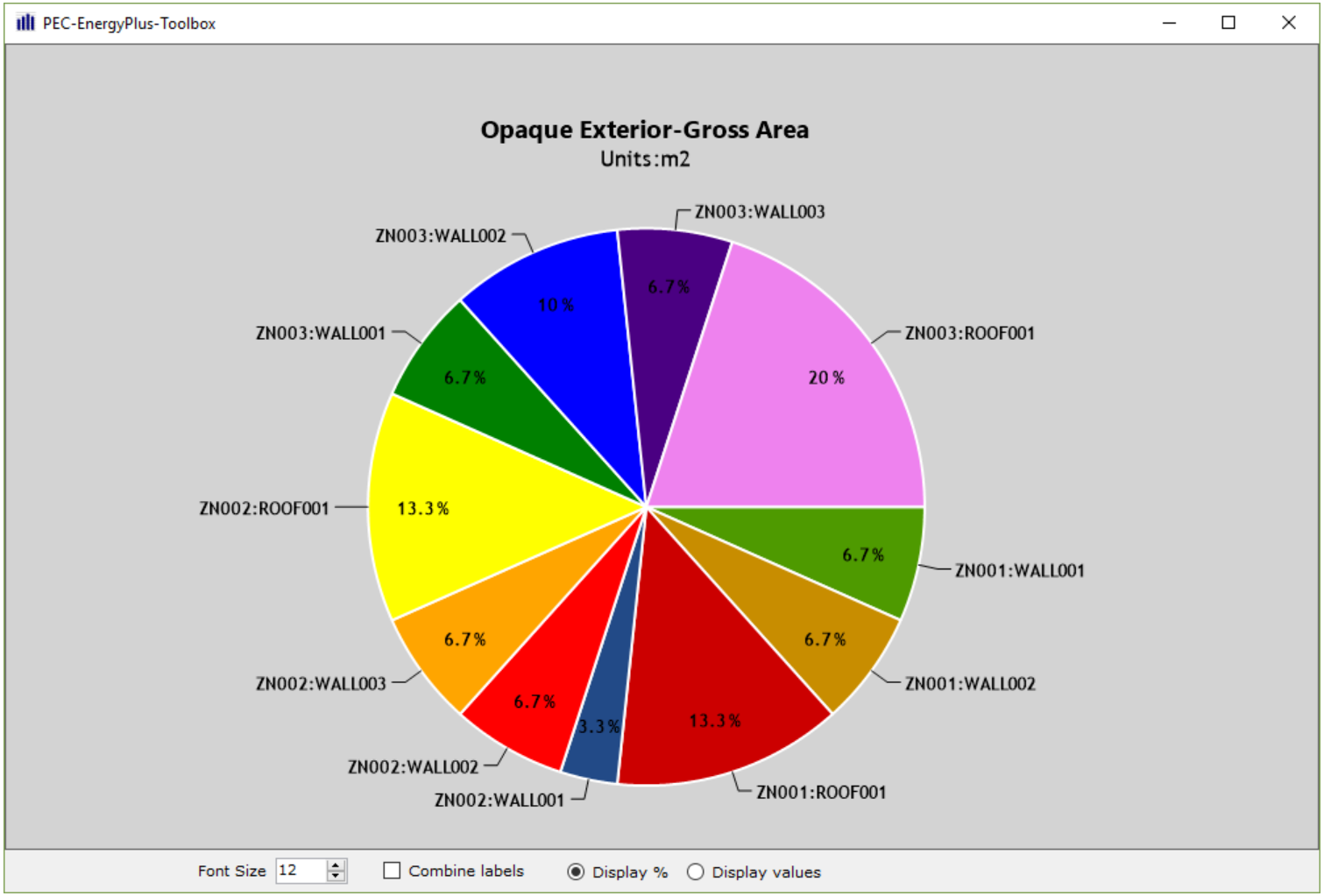


Figure 16 - Pie chart