Asim User Guide

**Purpose:** to enable a user to get started with a basic Asim model as quickly and painlessly as possible.  This Guide should appear easy (short) to read and provide sequential steps to download, install, and run (but not alter) a sample simulation.

**Audience:** beginner Asim user who doesn’t know anything (and may not need to know much) about the model

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# Getting Started

## Downloading Asim

Asim can be downloaded from GitHub. GitHub is an online open source software repository.

Navitage to the following url: <http://github.com/thinkofanumber/asim>

Intro –

About GitHub?

## Using the Microsoft Installer

The recommended method of installing Asim is by using the Microsoft Installer package (.msi file). This requires administrator privileges.

To install Asim, double click or run the installer file and follow the prompts.

## Using the zip file

Use the zip file if you don’t have administrator access to your account.

|  |  |
| --- | --- |
| ! | * You will have to manage installing and removing new versions * There are more configuration options to set * **Asim must be extracted to a local directory, not a networked directory.** |

To install Asim using the zip file:

1. Right click the zip file provided and extract files to the desired folder.
2. The Asim folder contains the user interface spreadsheet, documents, and the software necessary to run Asim. Figure 1 is a screenshot of what files are included when you first open the Asim folder.

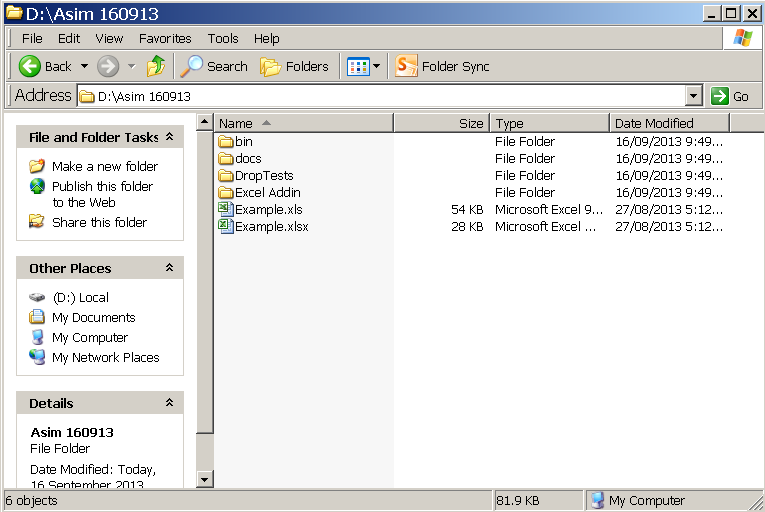


Figure 1: file contents of Asim when first extracted from the zip file.

## A first look at the user interface

|  |  |
| --- | --- |
| ! | Throughout this guide, Excel 2003 screenshots and .xls file extensions have been used. The Asim model is compatible with Excel 2010 and .xlsx files. Both may be used for all examples given |

When you open the Example.xls spreadsheet it should look similar to Figure 2.

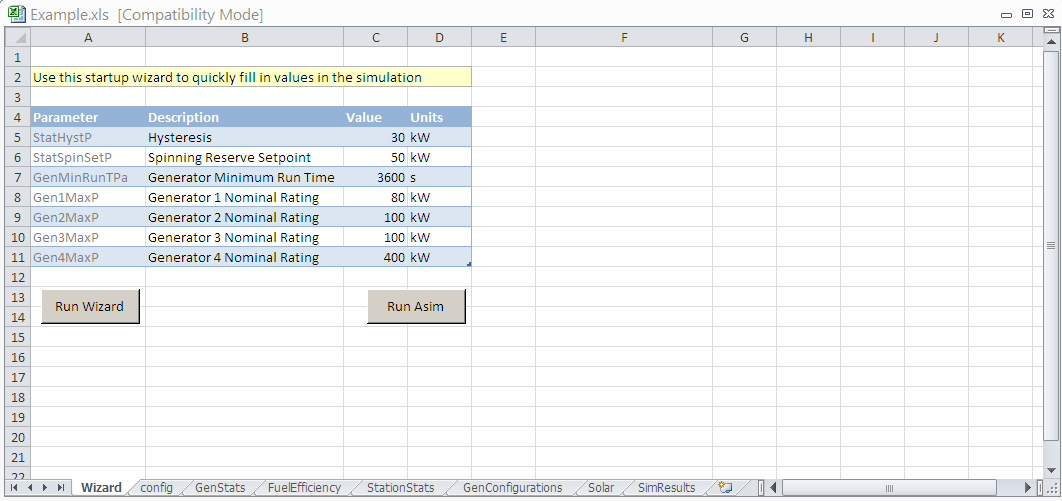
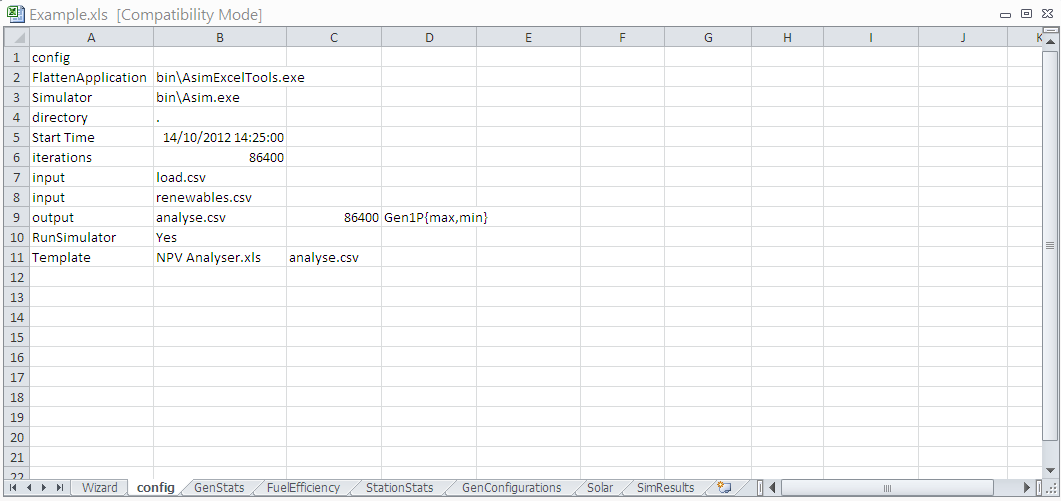


Figure 2: First look at the user interface of Asim and the Wizard tab

The Wizard tab can be used to easily set common values used for the simulation. To use the Wizard:

1. Enter the required values in the Value column
2. Click Run Wizard. This will copy the entered values into the following tabs in their correct position.
3. Click Run Asim to start a simulation

Figure 2 shows the worksheet tabs that are used to set up the simulation. These are outlined in Chapter 2. Click on the Configtab to view the Asim program options.



Option value

Option name

### FlattenApplication/Simulator

The *Flatten Application* and *Simulator* file paths (to AsimExcelTools.exe and Asim.exe) should be set already. If not, read on to see how to set up the file paths.

The following instructions demonstrate how to set up the *FlattenApplication* path to AsimExcelTools.exe. These same steps can be followed to also set up the *Simulalor* path to Asim.exe.

The paths can be set up either by using an **Absolute Path** or a **Relative Path**

#### Absolute Path

1. Select the cell adjacent to the cell containing FlattenApplication.
2. A popup similar to Figure 3 will appear. Locate where you have saved the Asim folder and open the bin folder. Select the AsimExcelTools.exe.

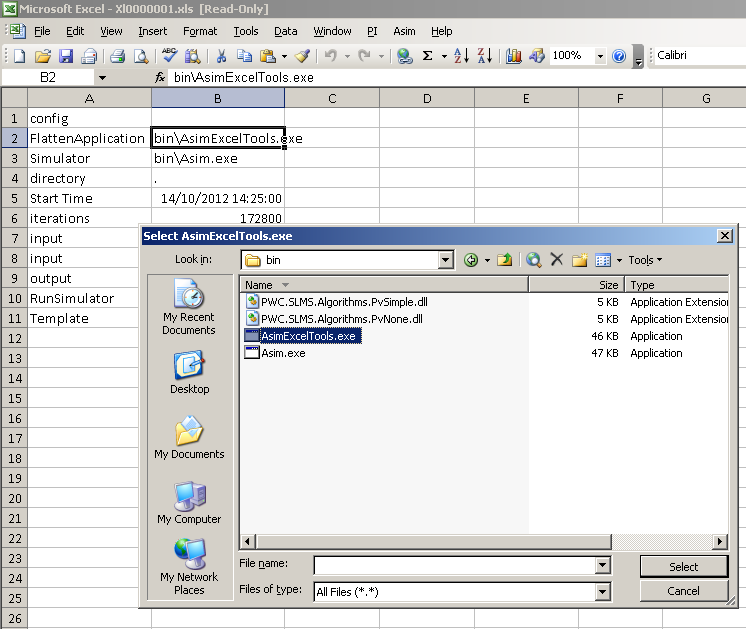


Figure 3: FlattenApplication popup

1. The cell adjacent FlattenApplication will now have an absolute path reference to AsimExcelTools.exe shown in Figure 4 and the path name to AsimExcelTools.exe is now the full path name, for example:

F:\userguide example\Asim\bin\AsimExcelTools.exe

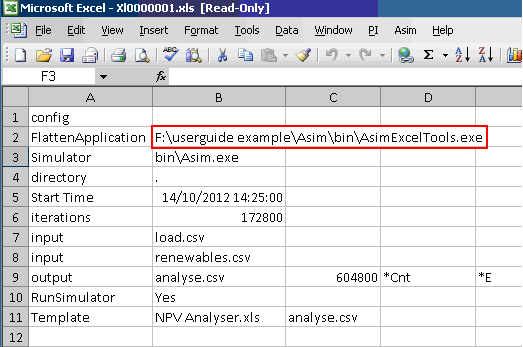


Figure 4: Absolute path to AsimExcelTools.exe

#### Relative path

Alternatively you can set up a relative path to AsimExcelTools.exe to the current directory by simply specifying the location of AsimExcelTools.exe relative to the current directory. For example if the current directory of the Example.xls spreadsheet is F:\userguide example\Asim then the path can be set to bin\AsimExcelTools.

### Directory

The directory is where input and output files are read from and written to. It is recommended that the directory path be set the same to where the input files are located. The “.” simply states that the directory path is the current directory.

### Start Time

The Start Time cell must be in human readable time format such as: dd/mm/yyyy hh:mm:ss AM/PM. Or yyyy-mm-ddThh:mm:ss.

The Start Time cell has two functions.

1. If the input has a date/time stamp then the start time specified will be located in the input file and the values corresponding from that point onwards will be used. For example: Input time series data ranges from 01/01/2013 to 27/05/2013 and Start time is 02/02/2013 the all data before 02/02/2013 in the input file will not be used in simulation.
2. If the input files are specified in seconds since simulation start then the start time simply initialises the first output line to the start time. More on input files is discussed in chapter x.

### Iterations

The Iterations cell specifies the time period in which the simulation is run over. Clicking on the cell will bring up a box shown in Figure 5. Entering a time period will convert that period into seconds. For example for a simulation run over 1 year enter 1 in the year box and the iteration cell would contain the number 31536000 which is the number of seconds in 1 year.

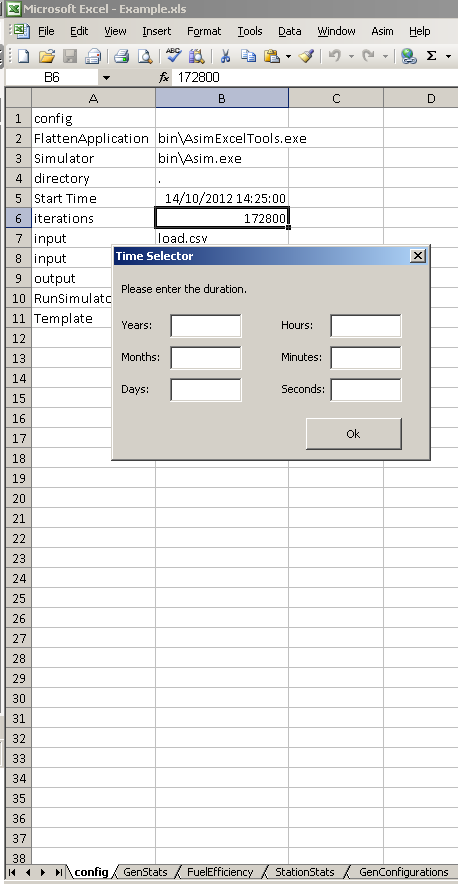


Figure 5: iterations popup

# Running a Simulation

What follows is a step-by-step example Asim simulation based on an example solar/diesel mini-grid in the Northern Territory. Please note that the data included in this demonstration is example data only, it is not real data.

Three input files are used for the simulation: the community load profile, the solar output and a scaling factor applied to the load to account for community load growth projections.

* Asim Example Load.csv = Time series kW community load profile
* Asim Example PV.csv = Time series kW solar PV system output
* ScaleLoad.csv = Scaling factor applied to load, to incorporate annual load growth projections in the simulation

## Step 1: Selecting inputs

First, open up Example.xls and create another input field for the ScaleLoad.csv file.

1. Insert a new row, by right clicking row 7 and selecting insert.

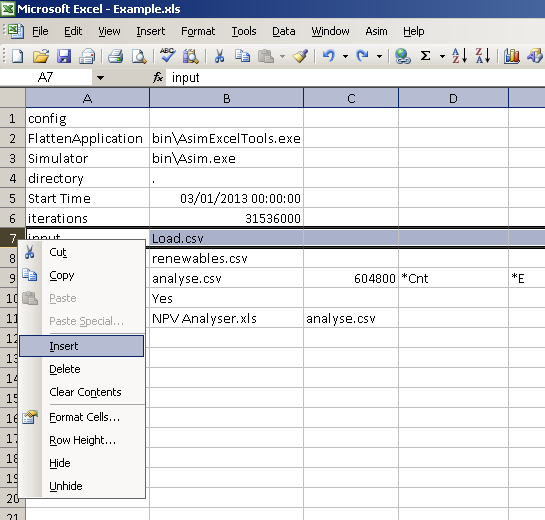


Figure 6: Inserting a new row

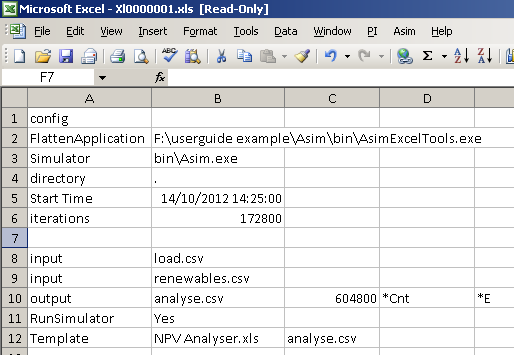


Figure 7: Config tab with new row inserted

1. Now select cell A7 and a dropdown menu should appear, select input.

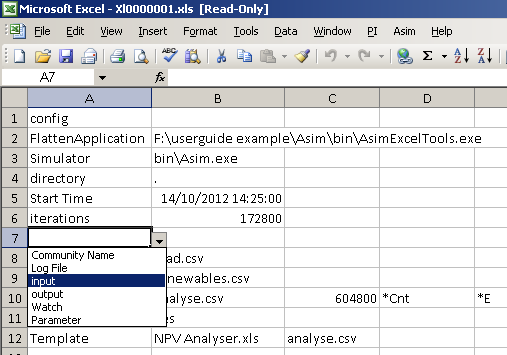


Figure 8: Input field selected from dropdown menu

1. A new input field has been created. In the adjacent cell select the file ScaleLoad.csv.
2. Select cell B7, a pop up should appear allowing you to select the input file. If this method is chosen then it will set an absolute path to the input file. This is shown in Figure 9.

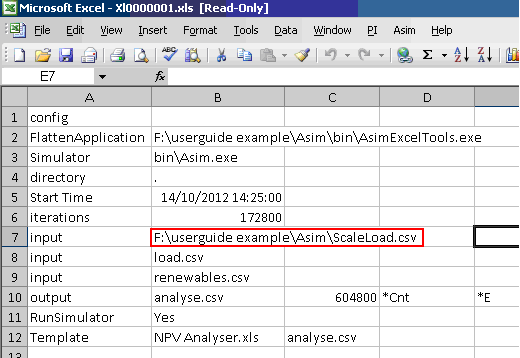


Figure 9: Absolute path to ScaleLoad.csv file

1. An alternative method is to exit the pop up by pressing the escape key and writing in the file name ScaleLoad.csv into Cell B7.

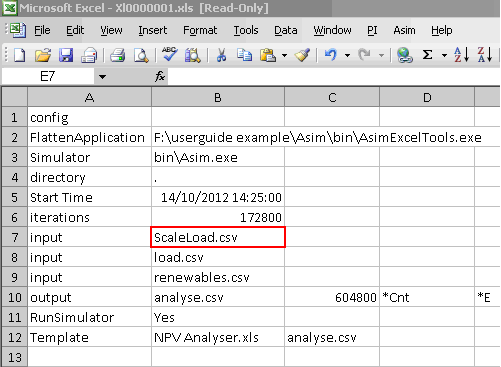


Figure 10: relative path to ScaleLoad.csv input file

1. Input Titreeload.csv and TitreePV.csv into the remaining fields respectively. The Example.xls config worksheet should now look like Figure 11.

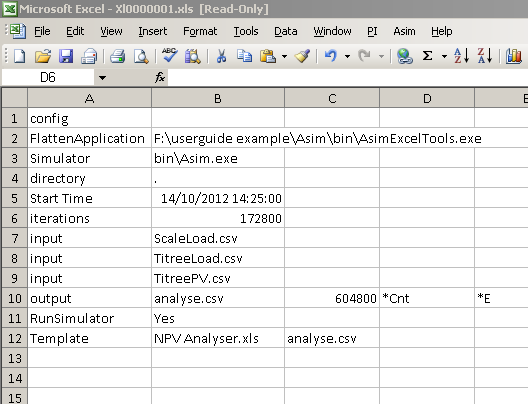


Figure 11: What Example.xls spreadsheet should look like at this point.

## Step 2: Configuring GenStats tab

Step 2 will go through setting up the GenStats tab to configure the generators to be used in the Asim simulation. The GenStats tab should look similar to what is shown in Figure 12.

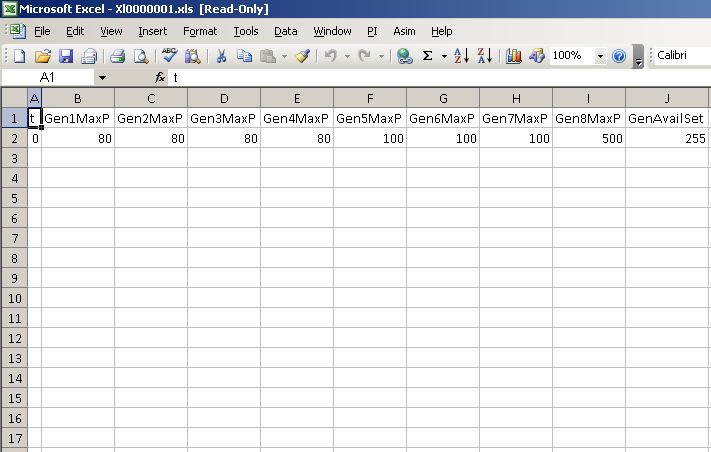


Figure 12: Genstats tab

At our example site, there are three diesel generators which have capacities of 500kW, 450kW and 700kW.

1. Gen1MaxP 🡪 Gen8MaxP are the capacities of generators 1 to 8. The simulator can take up to 8 generators. In this example 3 generators are used.
2. Select the cell under Gen1MaxP and enter the value of 500. Do the same for Gen2MaxP and Gen3MaxP using values of 450 and 700 respectively. The values assigned to Gen4MaxP 🡪 Gen8MaxP can remain as these will not be used in our demonstration (refer Figure 13).
3. Select the cell below GenAvailSet and a pop up with tick boxes should appear.

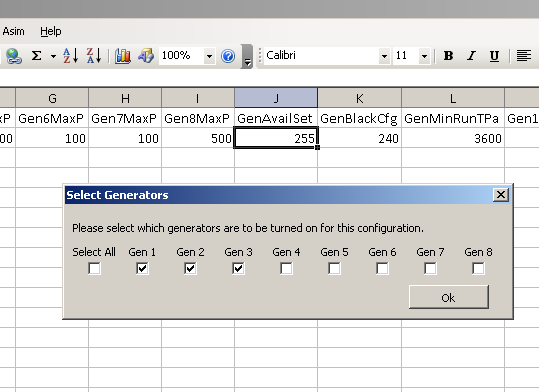


Figure 13: GenAvailSet tick box pop up

1. GenAvailSet determines which generators are available for use. In this case, since there are 3 generators on site, select the boxes Gen1, Gen2 and Gen3.
2. GenBlackCfg determines which generators to start in case of a black start. If you leave all boxes unchecked Asim automatically determines which engines to bring online (how does it decide? Last set running b4 outage?). For this example we leave all boxes unchecked.
3. GenMinRunTPa is the minimum run time for all engines. Minimum run times for individual engines can be specified also in which the software takes the maximum of generator specific minimum run times and the master minimum run time. In this example set GenMinRunTPa to 2 hours which is 7200 seconds.

Note: it is possible to run a simulation that takes account of existing run hours on a generator. To do this create a new input file that sets Gen#RunCt for each generator at t=0. Similarly, to model a new generator being added to the configuration e.g. old age/load growth, the same method can be used to reset Gen#RunCnt at the same time as set replacement occurs.

## Step 3: Configuring the FuelEfficiency tab

\*\*This whole section needs to be updated when the revised model version is released with updated efficiency calcs\*\*

The FuelEfficiency tab is where the user can specify the fuel efficiency curve for each generator. The FuelEfficiency tab looks similar to Figure 14.

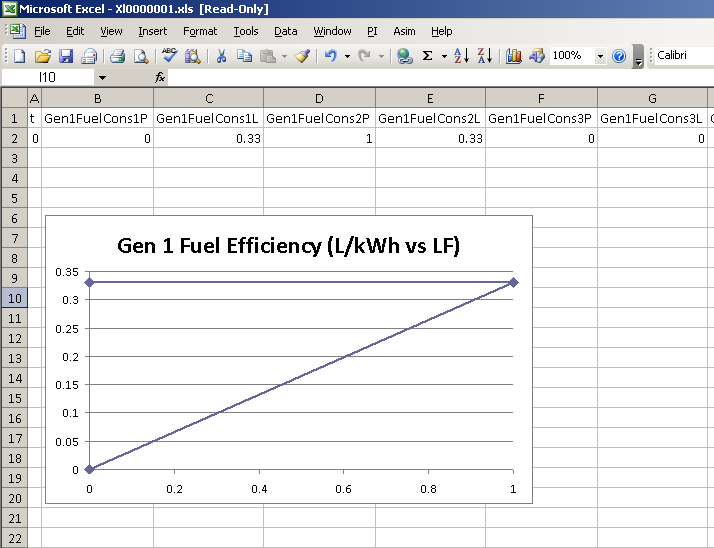


Figure 14: FuelEfficiency tab

Two parameters (for each generator) Gen1FuelCons1P 🡪 Gen1FuelCons5P and Gen1FuelCons1L 🡪 Gen1FuelCons5L. the parameter ending in P is the load factor point (or the x-axis when referring to the graph in Figure 14) and the parameter ending in L is the fuel efficiency (in L/kwh) at the corresponding load factor point (1 = 100%, 0.1 = 10% etc).

|  |  |
| --- | --- |
| **Load %** | **L/kWh** |
| **100** | **0.262** |
| **90** | **0.261** |
| **80** | **0.261** |
| **70** | **0.266** |
| **60** | **0.273** |
| **50** | **0.284** |
| **40** | **0.301** |
| **30** | **0.329** |
| **20** | **0.386** |
| **10** | **0.549** |

Table 1: Fuel Efficiency for one engine

\*\*Note: we should model from 0% to 110% loading (full working range)\*\*

Table 1 is the fuel efficiency for one of the generators, in this example the same values will be used for the other 2 generators.

Selecting 5 points (evenly spaced) from table 5 generate the fuel curve by setting Gen1FuelCons1P 🡪 Gen1FuelCons5P and Gen1FuelCons1L 🡪 Gen1FuelCons5L accordingly.

|  |  |  |  |
| --- | --- | --- | --- |
| Gen1FuelCons1P | 0.1 | Gen1FuelCons1L | 0.549 |
| Gen1FuelCons2P | 0.3 | Gen1FuelCons2L | 0.329 |
| Gen1FuelCons3P | 0.6 | Gen1FuelCons3L | 0.273 |
| Gen1FuelCons4P | 0.8 | Gen1FuelCons4L | 0.261 |
| Gen1FuelCons5P | 1.0 | Gen1FuelCons5L | 0.262 |

Figure 15 shows what the FuelEfficiency tab should now look like. The graph will show the curve for generator 1 only.

Enter the data for the other generators as required. In this example we just use the one curve for all three generators.

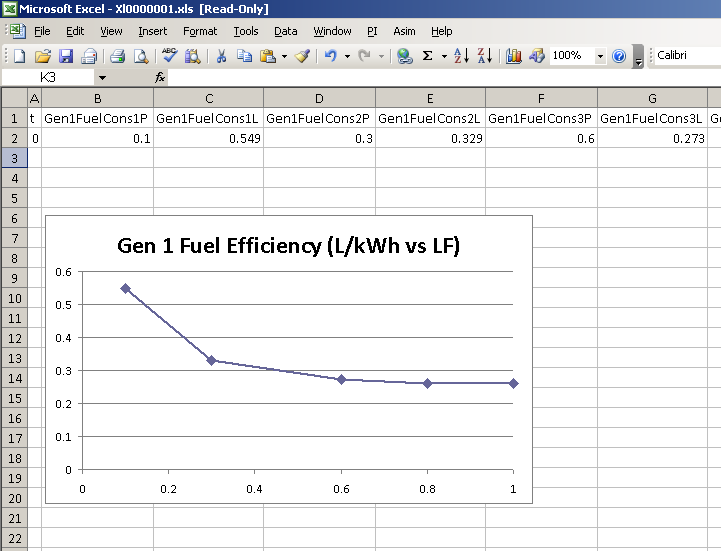


Figure 15: FuelEfficiency tab with fuel curve data entered.

## Step 3: Configuring StationStats tab

StationStat tab contains the stations parameters such as spinning reserve and change down hysteresis.

Figure 16shows what the page should look like.

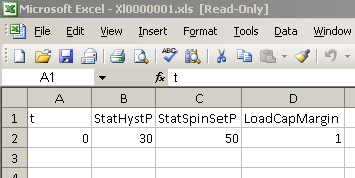


Figure 16: StationStats tab

StatHystP and StatSpinP are the station's hysteresis and spinning reserve respectively. The LoadCapMargin is used for the redundancy alarm and is discussed in greater detail in Chapter 4 under the section Redundancy Alarm. .

For our example, station spinning reserve is 45kW and hysteresis is 35kW.

1. Select the cell below StatHystP and enter 35
2. Repeat for StatSpinP but enter 45
3. Leave LoadCapMargin as 1

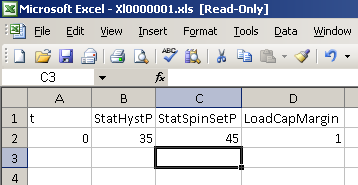


Figure 17: StationStats with data entered

## Step 4: Configuring GenConfiguration tab

The GenConfiguration tab determines which generators to call up and in what priority. GenConfig1 takes precedence over GenConfig2 and so forth. Figure 18 shows what the GenConfiguration tab looks like when first opened

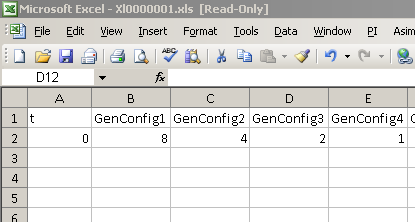


Figure 18: GenConfiguration tab

1. Select the cell under GenConfig1 and a pop up box should appear
2. Tick the box to determine which generator to call up for that config

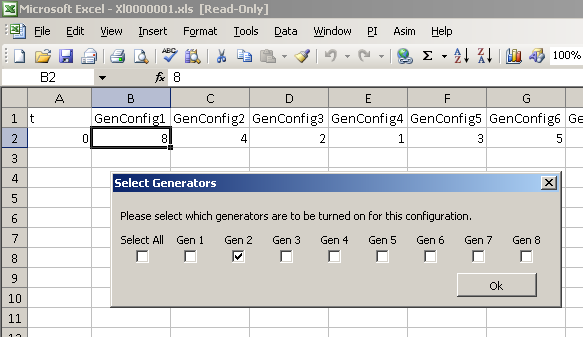


Figure 19: GenConfig1 pop up box

1. Keep repeating for GenConfig2 🡪 GenConfig 19 or until sufficient generator call ups are scheduled. In Asim up to 256 configs are possible (28) for a 8 set station.

In this example, the smallest engine is used when possible therefore the order in which generators are called up is from smallest total capacity to largest total capacity. i.e. the first configuration is Gen 2 only, the second is Gen 1 only, the third is Gen 3 only. A fourth configuration can be added where sets 1 and 2 operate in parallel, however the load profile never exceeds Gen 3's capacity, so this configuration is never used.

## Step 5: Configuring the Solar Tab

The Solar tab is where you set the maximum ramp up and ramp down rates (in kW/s) for the solar. Figure 20 is what the tab should look like when first using the Asim.

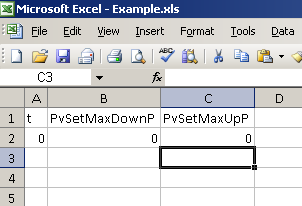


Figure 20: Solar Tab

For this example PvSetMaxDownP and PvSetMaxUpP are both 0.

The Ramp rates are used to control the rate in which solar is increased or decreased per unit time. Ramp up rate is usually applied to limit the amount power output by the solar so that it smoothly transitions from off or low power to full/almost full power.

Ramp down rate is similar but to limit how fast the power drops from a larger output to a smaller output. Ramp down rate is only possible if the power system includes a storage device.

It is possible to model the effects of ramping down solar using the PvSetMaxDownP but this does not model the storage system itself.

## Step 6: Creating outputs

After all the tabs are filled out and configured to match the power station, the next step is to set up the output files. The Config worksheet should look similar to Figure 21.

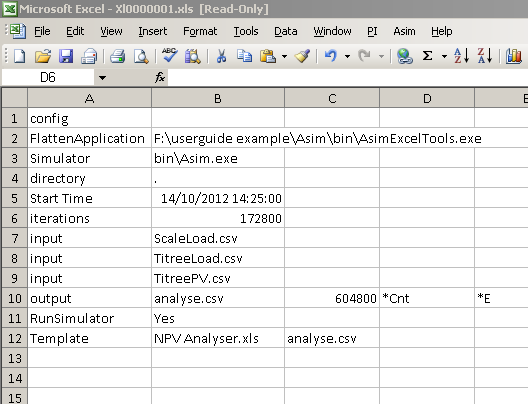


Figure 21: What config tab should look like at this point

In this example 2 outputs will be specified. One is to analyse the day to day operations and the other is to calculate economics over a 20 year period.

1. Create another row either at row 11 or row 9, moving the contents of the row down.
2. Select the empty cell and pick output from dropdown menu. Worksheet should now look like Figure 22
3. In the adjacent cell type in the name of the output file. The file does not have to exist as the simulator creates the output file. In this example the names will be operations.csv and econ\_analysis.csv.
4. Cells C10 and C9, which are adjacent to the output file names, are where you specify the time resolution of the output. In this example operations.csv will use 10 minute resolution and econ\_analysis.csv will use monthly resolution. Click on the C9/C10 cell to set time resolution; a popup box appears which allows you to select the unit of time. The simulator will automatically convert the time unit back into seconds.

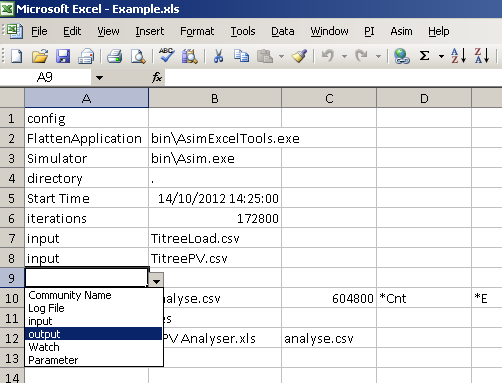


Figure 22: Creating a new output field

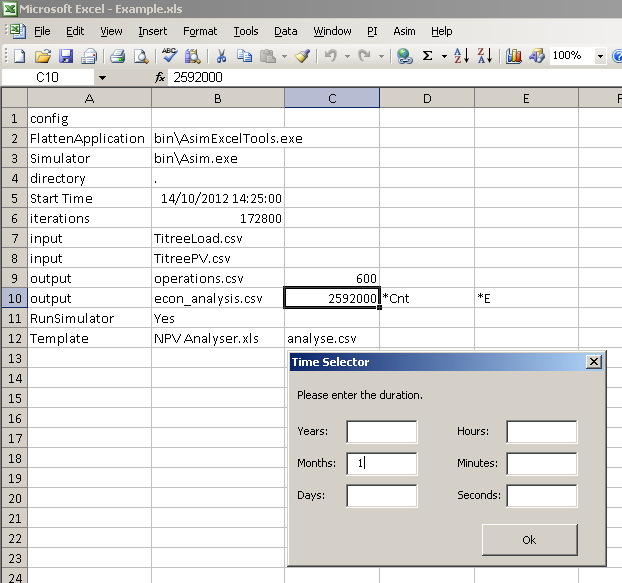


Figure 23: Setting the time resolution for the outputs

1. Now that the time resolution is set we specify which output statistics are required. Table 2 shows which output statistics are specified for the two different outputs. For more information on variable names refer to Ch4 ‘Output Statistic Nomenclature’.

|  |  |
| --- | --- |
| Operations.csv | Econ\_analysis.csv |
| LoadP{ave} | Gen[1-3]FuelCnt |
| Gen[1-3]P{ave} | Gen[1-3]RunCnt |
| PvP{ave} | Gen[1-3]StartCnt |
| PvSpillP{ave} | Gen[1-3]E |
|  | PvE |

Table 2: Output statistics specified in config tab

1. To enter the desired output statistics select the cell next to the output resolution for operations.csv and enter the output statistic in each subsequent cell from the first
2. Repeat step 6 but for econ\_analysis.csv with the output statistics shown in column 2 in Table 2.
3. The output rows should now look like Figure 24. Now the outputs have been set up, its time to move onto templates.

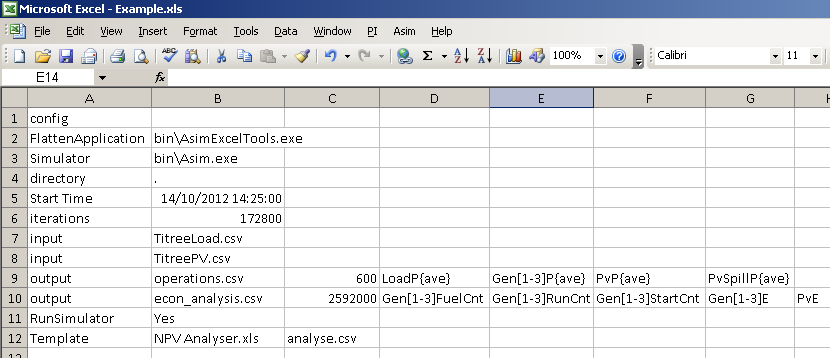


Figure 24: Output fields with output statistics entered

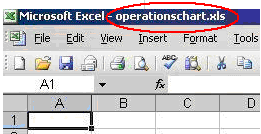
NOTE: The statistics nomenclature is discussed in further detail in Chapter 4.

## Step 6: Creating Templates

Templates are user-created Excel spreadsheets which can report the output statistics in any way the user wants. In this example one user defined template will be created and one preconfigured template will be used.

The template yet to be created is an operations template which will be used to plot the operations of a station for 1 day. The preconfigured template to be used is called NPV analyser which calculates economics of the system (including service requirements, O&M and capital costs for new sets) based on run hours, fuel consumption and number of starts of each generator.

1. Creating a user template. Create a new blank spread sheet and rename sheet 3 to “autofill”. The simulator will look for “autofill” and place all output data into this worksheet.
2. Save this new Excel spreadsheet under the name “operationschart.xls” (for this example) making sure it is saved in the same directory as the inputs files.
3. The operationschart.xls template will be blank for now until we fill the “autofill” tab with some raw data. This will be done because it is easier to build a template with data.



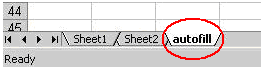


Figure 25: Empty template

NOTE: Templates must be either Excel 2007 above or 2003 Excel spreadsheet file format not .csv. For example .xlsx for 2007 and above and .xls for 2003.

1. NPV analyser.xls template has already been created and ready to use. (it should of come with the software package).
2. In the config spreadsheet, insert a new template field by typing the text “Template” below the existing template entry (see Figure 26).
3. Adjacent to the template fields write the file names of the templates “NPV analyser.xls” and “operationschart.xls”. It doesn’t matter which order the templates are specified as long as the correct output files are linked to them. This will be discussed over the next few points.
4. The fields next to the template file names, in column C, is where output files are specified. These entries determine which output file is placed into which template. For “NPV analyser.xls” enter “econ\_analysis.csv” in the adjacent cell. Similarly For “operationschart.xls” enter “operations.csv” adjacently NOTE: These csv files will accumulate output data during the simulator. The template files will be populated with the csv file data, allowing further manipulation by the user..
5. The config tab is now complete and should look similar to Figure 26

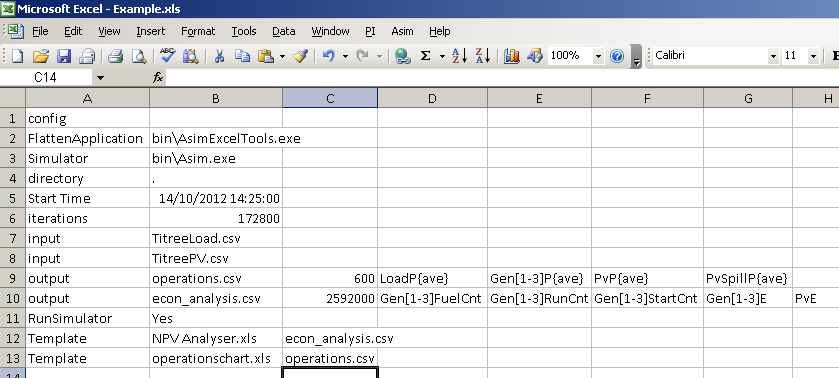


Figure 26: Config tab afte templates have been entered

Before the simulation is run the time period and start time must be set. The start time used in this example is the first time stamp used in the input file Titreeload.csv, which is 2013-01-01T16:30:06.299. Next we specify the time period in which we would like the simulation to run for. For this example, for simplicity, we will run the simulation over 1 year

Now that config tab is ready for simulation we will run the simulation once so that the operationschart.xls template will contain some output data. From there we can the set up the template to show the day to day operations.

The config tab should now look like what is shown in Figure 27

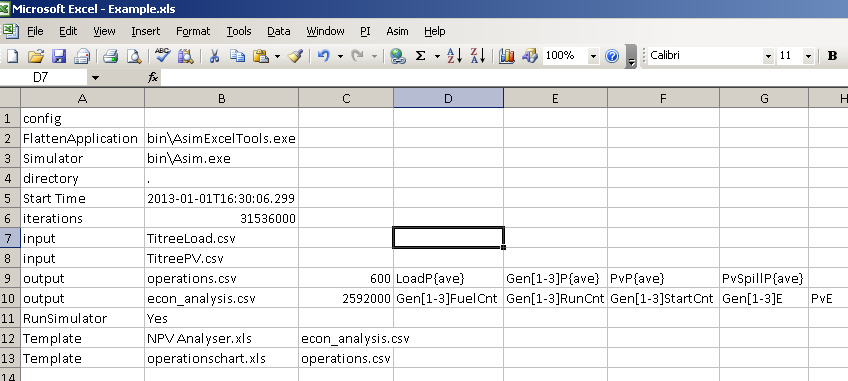


Figure 27: Config tab ready for simulation

Now we’re ready for simulation, on the top of the Excel window there should be Asim next to the help dropdown menu. Select Asim and a dropdown menu with two options will appear. Select Run (making sure it is turned on) and the simulation will run for some time and both template files should open in Excel. Ignore the NPV analyser for now as we will reproduce it again after operationschart.xls has been modified.

In this example, the two output files produced are:

2013-06-12-15-29-20 NPV analyser.xls

2013-06-12-15-29-20 operationschart.xls

When a simulation is run the outputs are named by the date and time at which the simulation was run, prefixed to the specified template name.

Opening “2013-06-12-15-29-20 operationschart.xls” will bring up an empty spreadsheet with the “autofill” tab filled with output data. Now the data can be manipulated within spreadsheet to report day to day operations.

In Figure 28 we have created 2 plots one containing load, generator outputs and PV output and the other showing actual PV output compared with PV spill. This example assumes that the user knows how to use Excel and create plots .

NOTE: Once the charts have been completed, remember to save the file as “operationschart.xls” and not “2013-06-12-15-29-20 operationschart.xls”. This will overwrite the previous “empty” operationschart.xls template.

Now both templates are ready for use a simulation can be run.

## Step 7: Running the simulation

A simulation has already been run to prepare the operationschart.xls template. Now a simulation will be run to produce some results.

Before running the second simulation change the start time to 03/01/2013 00:00:00 or 2013-01-03T00:00:00. Doing so specified a different start time and will produce different results from the first simulation. This simple step allows different simulation periods to be executed while re-using graphs and other calculations, showing the power and flexibility of Asim.

Run the simulation and wait for templates to be populated. Once the templates have been populated the following results should be populated.

Figure 29 shows the contents of NPV analyser.xls. Over the 12 month and 4 days simulation period costs have been tallied for O&M and Diesel. The energy produced in kWh is also tallied allowing a cost of electricity to be calculated and a PV % contribution to be determined.

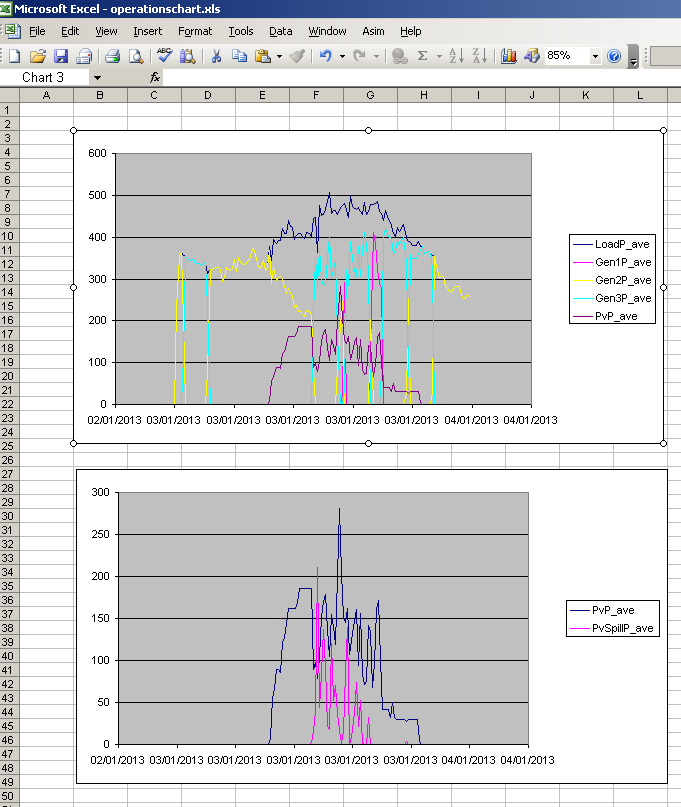


Figure 28: Report from opertionschart.xls

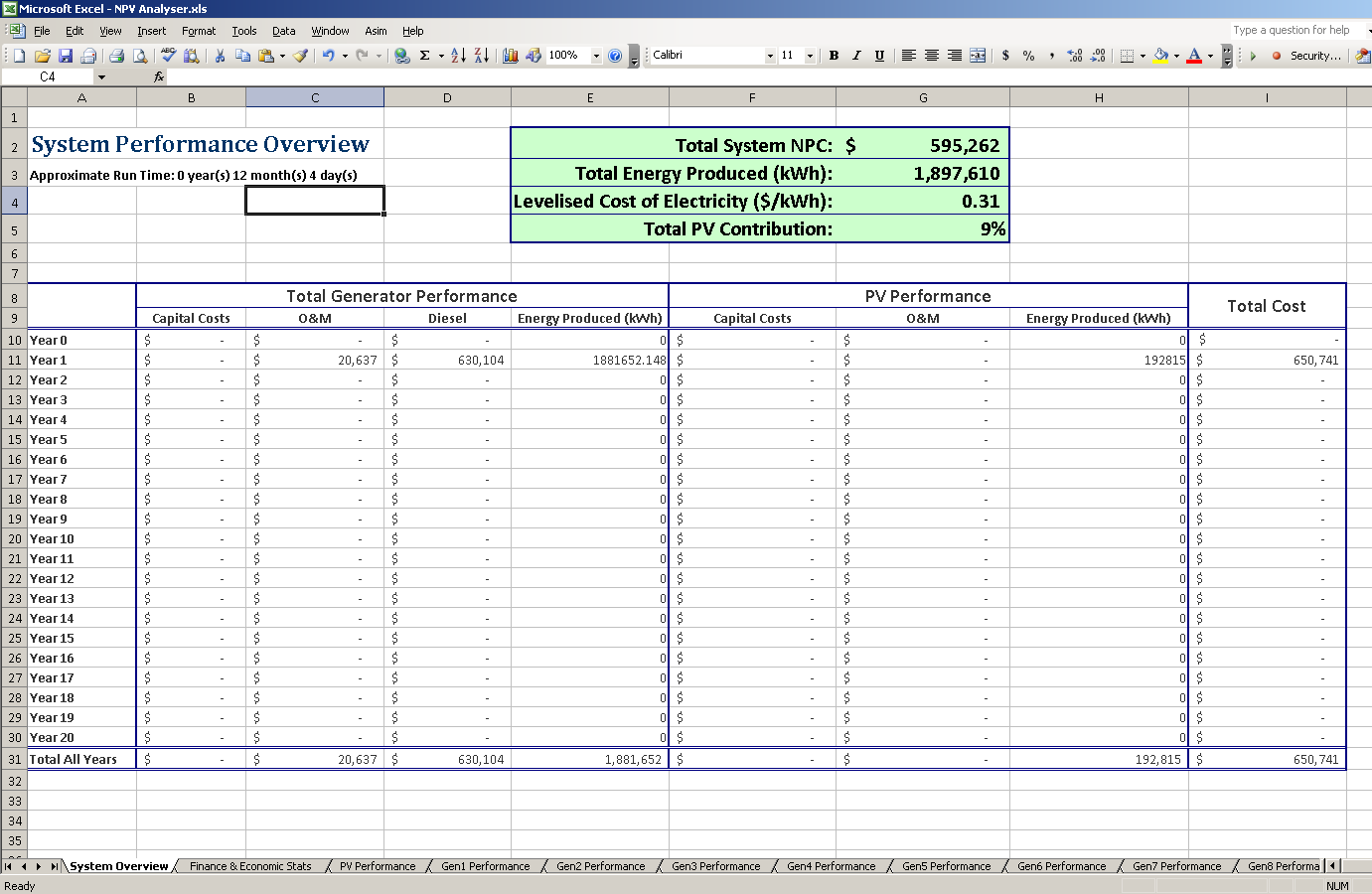


Figure 29: NPV analyser results

# Description of inputs, outputs and templates.

## Inputs

### Introduction to input files

Before running a simulation all inputs needed to be used in simulation need to be created first. There are three main types of input files which are:

* Load
* Solar
* Sheddable load

### Creating input files

To create an input file open a blank workbook and place the parameter ‘t’ in cell A1. The content of the column under “t” is the time series data for your input. There is some flexibility in the choice of time series data. The different time series compatible with the Asim software are:

* Human readable time such as ISO8601 and formats like “29-march-20110 00:30:03.740”
* Seconds since Epoch
* Relative time: number of seconds since the start of simulation

After making a choice in which time stamp is best for desired simulation the worksheet should look something like what is shown in Figure 30 or Figure 31 Figure 30 is in seconds since simulation which means that each second of “simulation time” (which is one iteration) a value is read from the input file.

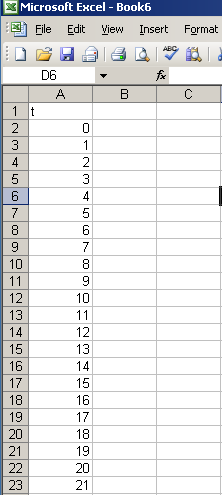


Figure 30: Time series in seconds since simulation start

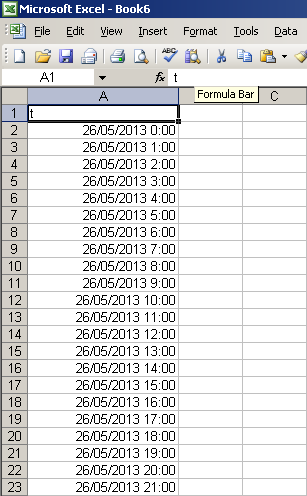


Figure 31: time series in human readable time

Once the time series is set up the input values need to be inserted in column B. this could be load data, solar data, sheddable load data etc.

Once the input has been chosen, insert the input name in cell B1. Below is a summarised list of the available inputs. In this example LoadP is used as an input, which is station load, and PvAvailP, which is output from a solar farm both in kW.

The Input files should now look similar to what is shown in Figure 32 and Figure 33.

After naming the input files they are ready to be used for simulation.

NOTE: The input files must be saved as .csv file format.

NOTE: If data is imported rather than created just remember to rename the variable headings to the appropriate headings.

NOTE: In Excel 2003, the maximum number of rows is 65536, enough for approximately 18.2 hours @ 1 second data interval. In Excel 2007 and 2010, the row count increases to 1048576, approximately 12.1 days @ 1 second.

Whilst using Excel is convenient, it is not an ideal tool for generating large 1 second time series data with. However, the multi input file flexibility of Asim would allow 36 x ~ 10 days CSV files to be specified as long as each time stamp was unique in every file.

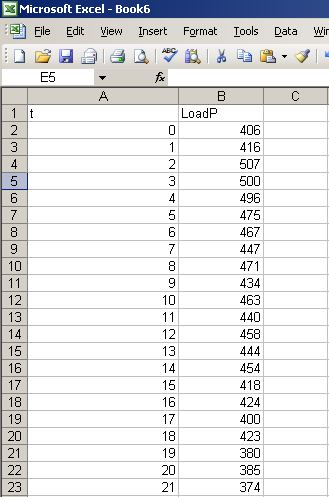


Figure 32: Station load input

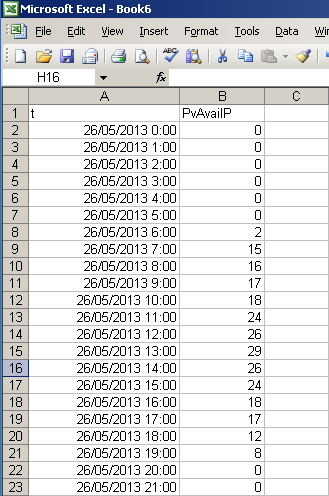


Figure 33: Solar farm output

### Multiple inputs

The user has great flexibility with input files; any number of input files can used. If the user specifies a time with a specific value of the input, at that time, then that value will change at that specified simulation time. For example if the user wanted to change the capacities of several generators mid simulation then the user would specify the time in which the change occurs and the new value of Gen#MaxP . This is shown below in Figure 34. which shows that after 1 year of simulation the capacities of generators 1 and 2 are changed from their initial capacity to 500kW and 750kW respectively.

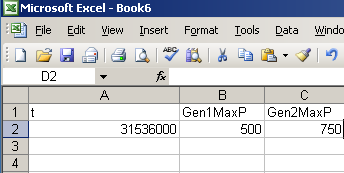


Figure 34: Capacities being changed mid simulation

### Input tabs

The tabs from GenStats to Solar are all considered inputs. The simulator generates .csv files for each of the tabs mentioned above and these are used as inputs during simulation. Therefore users have the ability to add in extra parameters, selected from the input variable list, or change values at certain times of simulation.

For example in the Solar tab additional information can be added that the user might need to declare before simulation. PvMaxLimP sets a maximum of PV allowed into the system; adding this variable into row 1 column D in the Solar tab and a value below this cell will set the variable PvMaxLimP to the value you enter before simulation run. Figure 35 shows this.

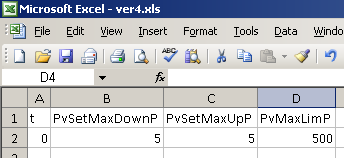


Figure 35: Solar tab with extra variable added.

You can also create a tab with additional information. For example the user might want a service schedule tab to bring generators offline for certain time periods. To do this you just have to create a new tab, name it what you like and add the information in the spreadsheet. An example of a service schedule is shown in Figure 36.

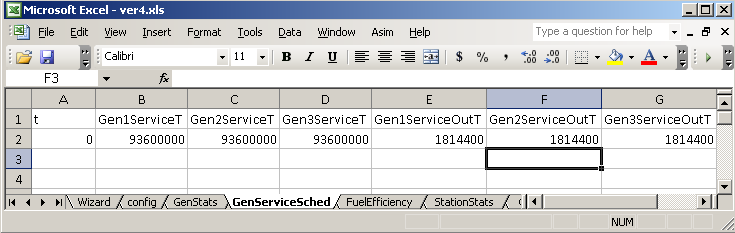


Figure 36: New tab created with service schedule example

In Figure 36 the variable Gen1ServiceT, which is found in the input variables list, is the amount of run hours (Gen#RunCnt) elapsed before taken offline. The value beneath is 26000 hours converted into seconds. Gen1ServiceOutT is the amount of time the generator is offline for, i.e. performing the service.

## Output files

### Introduction to output files

Output files are used to display the output of specified parameters in a .csv file. The user has the ability to specify multiple outputs. For each output variable, its resolution can be specified e.g. from 2 second sums to annual sums of each variable. In addition, key values such a maximum, minimum and averages can be determined.

### Creating output files

Select the number of outputs desired by selecting output in the dropdown menu in column A. Then in the adjacent cells you name the different output files, time resolution of output and the output variables desired respectively.

For example if a 1 year simulation was run and you wanted to know daily peak values, daily operations and total energy produced, fuel consumption and run hours for the year you select 3 output fields from the drop down menu shown in Figure 37.

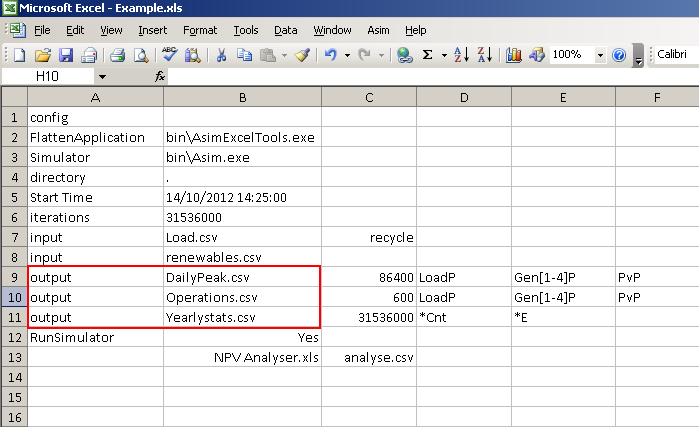


Figure 37: Output fields

Figure 37 shows the three different output fields, the file names are created by the user by entering the name of the file in the adjacent cell. The simulator will create these output files.

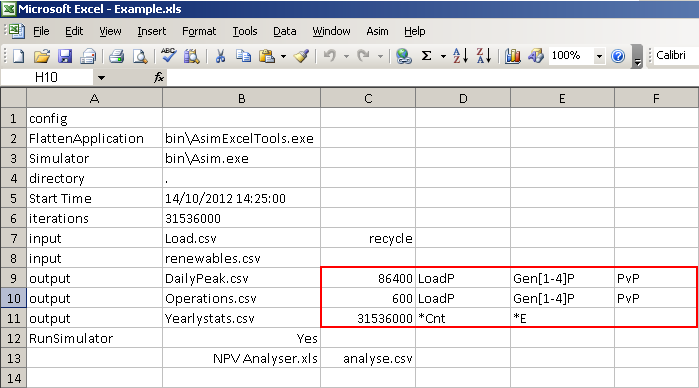


Figure 38: Output time resolution and output parameters

Figure 38 shows the output resolution of each output file. The simulation run is still 1 year.

The first output file DailyPeak.csv outputs data every day of simulation (for 1 year that is 365 data points). Cells D9 to F9 specify the output parameters (which are listed in Asim manual). Therefore the first output will produce a .csv file named DailyPeak.csv with Load, Generator 1-4 power output and solar output.

The second output field (row 10) will produce data of 10 minute resolution, still over 1 year, with the same statistics. This will allow the user to graph the daily operation of the power station since the variables are of sufficient resolution.

The third output field (row 11) will produce an output .csv file named Yearlystats.csv with data resolution of 1 year (therefore only 1 row of data will be produced). This will allow the user to see the fuel consumption, energy produced in kWh and run hours of each generator for the year.

There is no limit to the number of output fields however this will effect simulation run time.

## Setting up a template

### Introduction to templates

Templates are user created worksheets that output data is copied to. A template is set up by the user before simulation which performs specified tasks. Examples of a template will be shown in the next section. The template gives the user the most flexibility with the Asim software it allows the following tasks to be conducted

* Analyse system performance
* Perform economic analysis
* Project planning
* Asset Management
* Station optimisation
* And many more

### Creating a Template

To create a template open a new Excel workbook and name one of the tabs “autofill”. The “autofill” tab is the worksheet where the output data is placed. If a template does not contain a tab named “autofill” then the simulator will create one and place the output data into the worksheet.

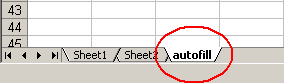


Figure 39: autofill tab

Once the template(s) have been created they can be used in the simulator by selecting template in the dropdown menu. The adjacent cell should contain the template file name as .xls or .xlsx file format depending on the version of Excel and the next cell should contain the output data that the template will receive.

NOTE: The more templates in the simulator the slower it takes to run.

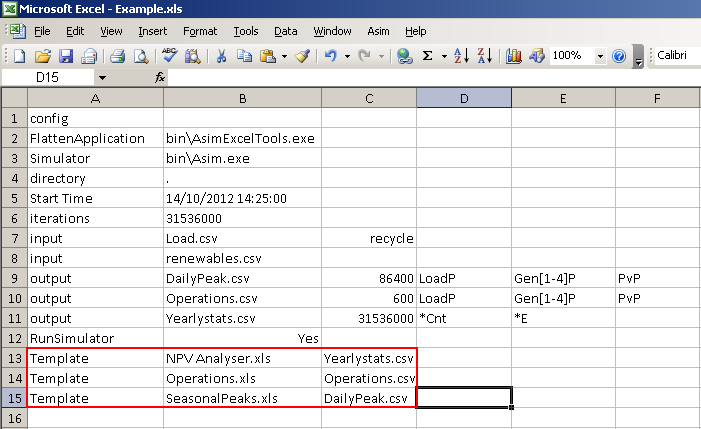


Figure 40: Config tab showing multiple templates

# Specific input scenarios

## Load

Asim reads load data as kW values and records the load value for each date stamp specified. For example if the load data supplied has data every 10 min then Asim will record the value for the first instance of the data point then keep that value for 600 samples (Asim is based on a 1 second cycle therefore 10 min is 600sec = 600 samples) until the next date stamp is reached in which the new data point will override that value of the previous one.

Load data can also be scaled using a scaling input. To find out more on the scaling input refer to Chapter 4 under “Scaling”.

Load data can also be recycled which is ideal for applying load growth for future years. The function Recycle is discussed more in depth in Chapter 4 under “Recycle”

## Solar

Asim reads solar data as kW values and records each solar value for each date stamp specified.

Asim only accepts one solar input therefore if your system has several PV farms then they need to be added and treated as one input.

The amount of solar allowed into the system (simulated) is based on not exceeding the load and keeping the generator at or above its minimum load requirement. There are other control methods provided by Asim which will be discussed in Chapter 4 under “Solar Controller”.

Solar input data can also be recycled and scaled.

Solar has several parameters that Asim uses to describe solar, these parameters can be found in the Asim manual that comes with the Asim software package.

## Sheddable load

Sheddable load, in how Asim treats it, is a form of load management. It allows the power system to shed customer loads in order to decrease the load demand in certain conditions.

Asim treats all sheddable load as an aggregate load therefore to model multiple sheddable loads you must add the value of all sheddable loads into one.

Asim allows users to set the latency of shedding the load and the maximum off time of the sheddable load. These parameters are listed in the Asim manual.

When Sheddable load is online it adds to spinning reserve therefore the generators are able to reach potentially 100% load factor. The Sheddable load becomes offline when a generator reaches 98% of its load factor and becomes online when generator load factor reaches 92% or when the maximum off time is reached.

Sheddable load's function is to improve system stability in the presence of solar. It allows time for generators to call up or down when solar is cut out, due to cloud-over event, or when a load spike occurs.

It can also improve system performance by allowing a generator to stay online for longer by covering the spinning reserve set point.

## Changing Variables Mid Simulation

The list of input variables provided in **Error! Reference source not found.** and also in the Asim manual are interchangeable. This means that they all can be changed mid simulation.

Load, solar and sheddable load data are always changing because they are time series data.

Other inputs such as generator capacities, available generators, station spinning reserve and even generator configurations can all be changed. The format to do so is to provide a time series file with these variable names and values. You can specify a date and time or seconds since simulation start. This allows for many uses like

* Replacing generators due to end of life
* Changing generator scheduling due to increase capacity
* Service schedule (bring generator offline for certain time periods)
* Increase maximum solar allowed into the system
* Changing spinning reserve due to increase in largest load.

## Validation mode

Validation mode allows the user to input individual generator data and Asim will produce statistics based on generator output. For example: PWC used generator data from their data base to determine if the simulated power station produced statistics that were similar to the real system.

To set up validation mode follow the steps below:

* Select “parameter” from the drop down menu
* The cell adjacent to “parameter” (column B) write the text “GeneratorStats”
* This will turn of the simulator and just calculate statistics such as run hours, fuel consumption based on generator output.

Figure 41 shows what it should look like in the config tab.

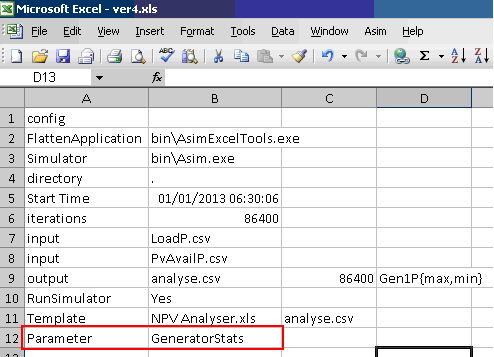


Figure 41: Parameter set to GeneratorStats for validation mode.

## Redundancy alarm

Asim has a function where it will alert the user when new capacity needs to be installed. It does this by checking the capacity of all generators minus the largest and compares this to the peak load. If peak load is less than or equal to this capacity then the alarm is raised.

Sum GenMaxP <= LoadP \* LoadCapMargin alarm is raised. LoadCapMargin is a variable that allows the user to set what percentage of the peak load will set this alarm. At PWC LoadCapMargin is nominally 1.25 i.e. N-1 ≥ 125% of peak load.

The variable that describes this alarm is LoadCapAl which must be specified on the output field in the config tab to be seen in outputs.

## Recycle

Recycle is a function that allows Asim to reuse input data. Once it reaches the last data point in the input file Asim will jump to the beginning of the input file and start again. This in conjunction with the scaling function (explained below) will allow for load growth simulations using one year's worth of data.

To activate this function simply enter the text “recycle” in the cell adjacent to your input file name cell.

This is shown in Figure 37 above the word recycle is used and is present next to the input file name..

## Scaling

Scaling allows the user to scale input data by using an input scaling file. The scaling function contains a multiplier and offset constant which is applied to the variable before iteration.

An example of what the input scaling file looks like refer to Table 3

|  |  |
| --- | --- |
| **t** | **>StatP** |
| **0** | **\*1+0** |
| **31536000** | **\*1.1+0** |
| **63072000** | **\*1.2+0** |
| **94608000** | **\*1.3+0** |
| **126144000** | **\*1.4+0** |

Table 3: scaling input file example

In this case the variable StatP is scaled by 10% per annum and a new value of StatP is then created. This new value of StatP is then scaled by 10% and a new StatP value is created etc. Essentially the variable StatP is coumpunded annually by 10%. To do this I assume that we would also have to set recycling up too.

StatP is station output – not sure why we would scale that variable. Should this example use LoadP ? Is it possible to add an offset too (what is the + 0 term?)

For more information on scaling refer to the Asim manual.

## Output statistic nomenclature

There are several methods in which way we can specify outputs statistics to produce desired statistics in our reporting. Below summarises the different methods.

* Gen[1-8]P, square brackets are used to specify more than 1 generator for the different statistics.
* Gen1P{ave,max}, curly braces specifies which output statistic is desired if the output resolution is greater than 1 second. A detailed description of the different summary statistic, such as max, min, and ave is in the Asim manual. Gen1P{ave,max} only produces Gen1\_max and Gen1\_ave.
* \*Cnt, while cards can be used to populate similar statistics. \*Cnt produces all statistics that contain the text Cnt.

A mix of the methods above can also be used, for example: Gen[1-3]P{ave} produces average power output for generators 1 to 3.

# Troubleshooting

* When running Install Addin.BAT it comes up with violation error

Before running Install Addin.BAT make sure that all Excel windows are closed. If all windows are closed and the error still appears check task manager to see if there are any instances of Excel still running. To do this press Ctrl+Alt+Del and task manager should be one of the options.

* Wizard comes up with error or pop up boxes don’t appear

Make sure that macros are enabled and the Asim Add in is selected. For more information about macro security and the Asim Add in refer to the Excel add in installation guide

* Output shows all zeros for each output statistics

Make sure that the start time is within the input data range.

* Some of my output statistics are constant halfway through

Check to see if you have stated recycle next to the input or if the time period of simulation does not exceed the input data range in you don’t want the data to be recycled.

* Error appears saying time stood still or went backwards

Make sure the time series in your input data is increasing. You should be able to look at where this error occurred by referring to the line the error occurred at in the SimResults tab

* My results doesn’t seem right

Make sure that all your station parameters are set, this includes generator capacities, minimum run times, available generators, generator configuration.