# User Interface Guide

*For Energy Exemplar PLEXOS® for Power System software*

## Prerequisites

Before reading this guide you should complete reading the article *Power System Modelling 101*. Read this guide in conjunction with *Concise Modelling Guide*.

## Version

This document is current as at PLEXOS Version 6.202 and was last modified 8 June 2011.

## Document Conventions

The following conventions are used:

- PLEXOS classes are shown underlined like Generator
- Properties are shown in brackets like Generator [Max Capacity]
- Collections are shown bracketed like Generator [Fuels]

## About This Document

This document provides an introduction to *PLEXOS® for Power Systems* software, its features, core data concepts, the graphical user interface, and an overview of its modelling features. It makes references to other articles contained in the PLEXOS Help system where you can find more detail on particular features.

## Contents


Introduction ..... 5
2 Technical Requirements ..... 6
2.1 Requirements ..... 6
3 Graphical User Interface ..... 7
3.1 Getting started ..... 7
3.2 Ribbon-style Menu ..... 7
Main Ribbon Commands ..... 8
Backstage Menu ..... 8
3.3 Additional commands with Input files ..... 10
3.4 Additional commands for solution files ..... 12
4 Input – Interface Layout ..... 14
4.1 Overview ..... 14
4.2 Document Tabs ..... 15
4.3 Explorer pane ..... 16
4.4 Data pane ..... 17
Objects grid ..... 17
Memberships grid ..... 18
Properties grid ..... 19
4.5 Filtering Data ..... 19
4.6 Sorting Data ..... 19
4.7 Clipboard Operations ..... 20
4.8 Tree Navigation ..... 20
5 Entering Data in PLEXOS ..... 22
5.1 Objects ..... 22
Create an object using the objects grid ..... 22
Enter a list of objects ..... 22
Create an object using the wizard dialog ..... 24
Import data from an external file ..... 25
5.2 Categories ..... 26
5.3 Memberships ..... 29
Colour codes of the Membership tree ..... 30
Memberships in the Static Property Grid ..... 30
Creating memberships in the Memberships grid ..... 31

Creating memberships by drag-and-drop ..... 31
Membership Editor ..... 31
5.4 Properties ..... 33
Property tree ..... 33
Static data grid ..... 34
Multi-band data ..... 34
Dynamic data grid ..... 35
Dynamic Data grid columns ..... 35
Data Fill Tools ..... 39
System vs. second-level properties ..... 40
Validation rules ..... 41
5.5 Data Files ..... 42
File formats ..... 44
Multi-band file data ..... 45
Data Files and Dates ..... 45
Visualising and Editing Text Files ..... 46
5.6 Scenarios ..... 48
Example ..... 48
Model Scenarios collection ..... 48
Apply a Scenario to Existing Data ..... 49
Scenario Priority ..... 50
Viewing all Data tagged with Scenarios ..... 50
Deleting Scenarios ..... 50
5.7 Variables ..... 51
5.8 The System object ..... 52
6 Tracking Changes ..... 53
6.1 Changes in Current Session ..... 53
6.2 Two Versions on Disk ..... 54
6.3 Comparison in PLEXOS Connect ..... 55
6.4 Compare Tool Functions ..... 55
7 Configuration ..... 56
8 Protecting Data ..... 58
9 PLEXOS Settings ..... 60
9.1 File Settings ..... 62
Units of Data ..... 62

Assemblies ..... 62
10 Simulation ..... 63
10.1 Model ..... 63
10.2 Horizon ..... 64
Planning Horizon ..... 64
Chronological Horizon ..... 65
10.3 Report ..... 66
Report Attributes ..... 66
Report Field List ..... 67
10.4 Execution ..... 71
10.5 Detailed Simulation Settings ..... 77
10.6 Models and scenarios ..... 78
11 Visualising the System ..... 79
11.1 Membership Viewer ..... 79
11.2 Visualization Export ..... 80
Exporting ..... 80
12 Solution files ..... 81
12.1 Log File ..... 81
12.2 Phases, Periods Types, and the Property List ..... 82
12.3 Numeric Format ..... 83
12.4 Data views ..... 84
12.5 Aggregate query ..... 87
12.6 Limiting Objects in a Result ..... 87
12.7 Apply a Criterion ..... 87
12.8 Excel ..... 88
12.9 Clipboard ..... 88
12.10 Charting ..... 88
12.11 Zooming ..... 89
12.12 Second y-axis ..... 89
12.13 Retaining query results ..... 90
12.14 Refreshing Solution Values ..... 91
12.15 Repeating Previous Queries ..... 91
12.16 Saving a Solution View ..... 91
12.17 Solution Comparison ..... 92
13 References ..... 94

## Introduction

This document provides a reference for the graphical user interface (GUI) of *PLEXOS® for Power Systems*. The GUI provides functionality to create, view, and modify files. This guide gives an overview over the technical requirements, introduces the main interface elements and gives guidance on entering data as well as viewing the solutions.

# 2 Technical Requirements

This chapter provides information on the technical requirements that must be fulfilled in order to run PLEXOS.

## 2.1 Requirements

PLEXOS requires one of the following Windows editions:

- Windows XP with SP2 or higher
- Windows XP (x64 Edition) with SP2 or higher
- Windows Vista (32-bit or 64-bit Edition) with SP1 or higher
- Windows 7 (32-bit or 64-bit Edition)

In addition:

- Microsoft .NET 4.0 Framework

Unlike earlier versions of PLEXOS, version 6 does not require Microsoft Access, although it can interact with Access and Excel.

# 3 Graphical User Interface

This chapter introduces the main interface elements of the PLEXOS GUI.

## 3.1 Getting started

The GUI is started by selecting the "PLEXOS 6.*x*" icon from the desktop or the item from the Start menu in Windows under the Energy Exemplar program group.

***NOTE:*** *The licence file is inspected at start-up. If the licence is missing, invalid, or it has expired the interface will not start. For help with licensing, contact the PLEXOS support desk at* support@energyexemplar.com *for help with licensing.*

## 3.2 Ribbon-style Menu

The desktop user interface of PLEXOS implements a modern ribbon style of menus. The ribbon consolidates all functionality to create and edit databases, run models and review simulation results and invoke the (optional) PLEXOS Connect® client-server functions. The menu icons are organized in the main tabs "File", "Home" and "Window". The "Home" tab includes the generic toolbar with commands such as "New", "Open" and "Copy" (see *Figure 1*). Additional commands are provided under the Program Button (top-left corner button).

**Figure 1: Home tab with initial set of commands**

Dependent on whether you open an input database file or a solution file, the "Home" tab extends to accommodate command icons relevant to the operations for the respective file type.

**Figure 2: Home tab extended with commands related to an input file**

The Window tab contains additional commands dependent on the type of file open:

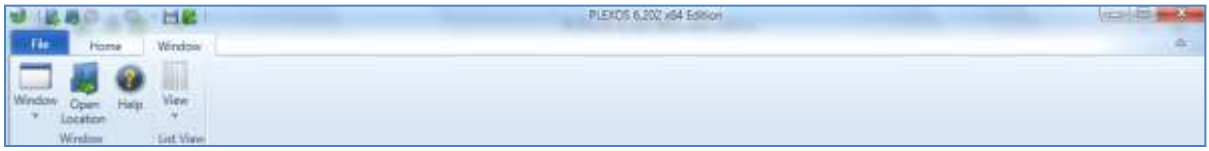



**Figure 3: Window tab with different View options for an input file**

**Figure 4: Window tab with different View options for a solution file**

## Main Ribbon Commands

The commands available in the Home tab and their functionality are described below:

### New

Creates a new file representing a power system: there is always one database file (XML file) representing the system, its elements as objects and their relationships and data.

### Open

Launches the file open dialog box where you can select an existing file to open. Note that a list of recently opened files is available by clicking the Program Button.

### Connect

Opens the PLEXOS Connect Launch Control program which allows you to upload/download files to/from the client-server system.

### Save

Saves changes made to the currently open file. Note that edits are not saved automatically, but you will be prompted to save changes if you attempt to close the current file when there are unsaved changes: choosing "no" in this case discards any changes you have made since the last save.

***NOTE:*** *Whenever you save an input file a backup copy is made under the same name but with extension BAK. You can restore this backup by changing the extension to XML.*

## Backstage Menu

Clicking on the File tab

opens up the Backstage Menu that gives access to further commands such as Program Settings and Help. The names of the most recently opened files are also displayed on the menu. These are shown in two groups, the first being input files, the second output files. To open a listed database, simply click on the file.

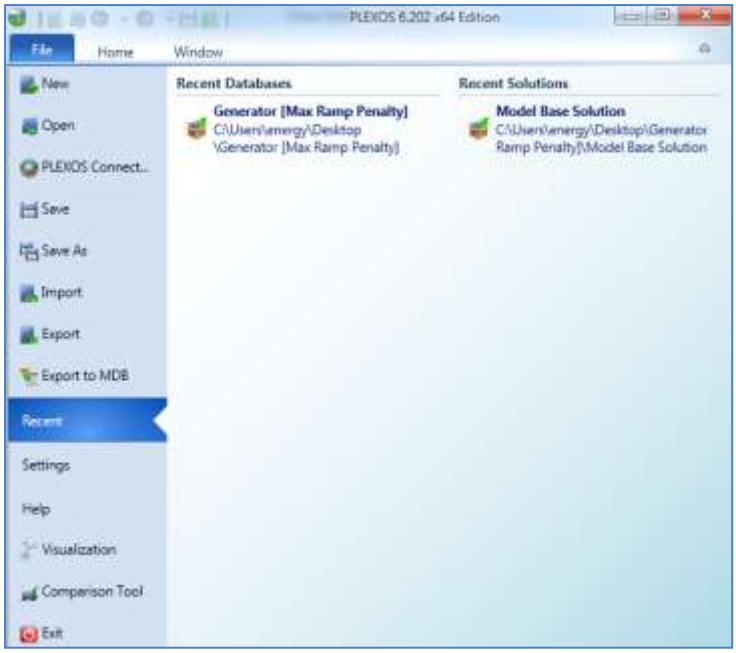



Figure 5: Backstage view

Some of the additional items in the Backstage Menu are described below:

## Import

Launches the Import Wizard for importing data from other programs or data exported from another PLEXOS database.

## Settings

Opens a dialog box where you can change global settings for the PLEXOS software related to View (*e.g.* Tree display, Font) and Execution (*e.g.* File Delimiter, Data Validation, Parallel Execution).

## Comparison Tool

Launches the comparison tool which allows you to compare two versions of an input database and examine/merge changes. This feature is particular useful when used in conjunction with PLEXOS Connect client-server.

## Help sub menu commands

The items on the Help menu are:

### *Contents*

Opens the PLEXOS help file.

### *Energy Exemplar Home*

Opens the Energy Exemplar home page in your web browser.

### *About PLEXOS*

Displays the PLEXOS "About" box in which you can find the full PLEXOS Version Number in the format *x.y* R*z* where *x* is the major version, *y* the minor version and *z* the revision level. For

example 6.200 means major version 6 with minor version 200. To exit this window, click with the mouse or press any key.

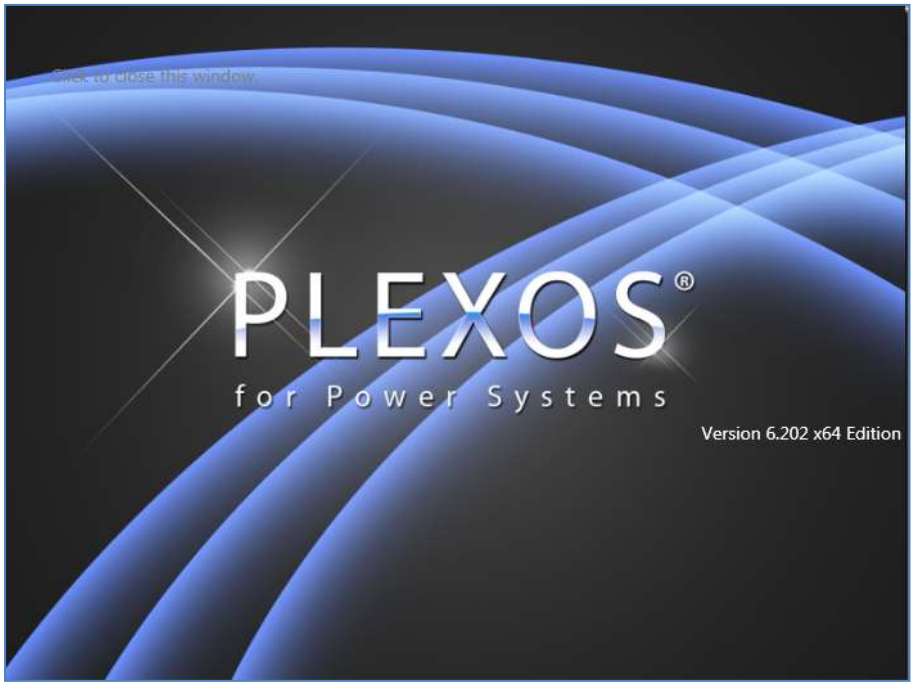



**Figure 6: PLEXOS About Box**

### Close

Closes the current file and prompts to save changes (if any were) made since the last save.

## 3.3 Additional commands with Input files

Use the "New" command to create a new file and open it, or the "Open" command to open an existing file. A recently opened file can be opened from the list of files in the Backstage menu.

For example, choosing the Open command from the Ribbon will bring up the file browser to select either the database file in XML format or the solution file in a zipped XML format.

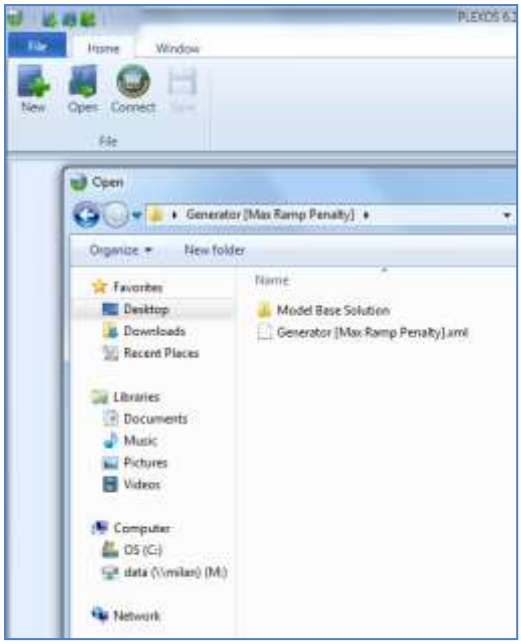



**Figure 7: Opening a database file**

These additional items appear on the Ribbon when an input file is loaded:

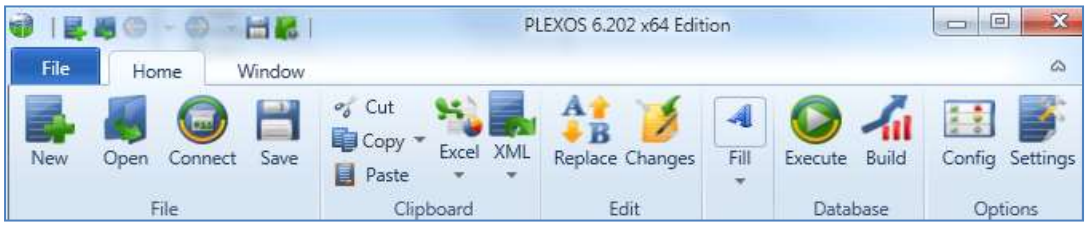



**Figure 8: Home tab with commands related to the input file**

## Cut, Copy, Paste

Provides clipboard operations for the data grids: see the section Clipboard Operations.

## Excel

Transfers data from the data grids in the input or solution file to an Excel spreadsheet: see the section Clipboard Operations.

## Export, Import

Provides export/import functions to XML on the clipboard, so that objects can be copied from one input database to another: see the section Clipboard Operations.

## Replace

Performs find and replace operations on the data grids.

## Changes

Launches the input file compare (see Tracking Changes) and shows changes you have made in the *current session* comparing to the version of the input file currently on disk. This also allows

you to reject changes performed, reverting to the saved version and perform a Save As to a new file.

### Fill Column, Up, Down, Selection, Property

Fills the grid with data; these commands can be used to add new data in bulk, or to copy a value or tag down a column, or to tag the selection with a new Scenario for example: see Models and scenarios on page 78.

### Execute

Opens the Execute dialog box where you can select Models and Projects to execute and start a simulation or batch of simulations.

### Build

Opens the Build dialog box where you can use the built-in text file building functions to create series of text input data such as load forecasts and wind generation profiles.

### Config

Opens the Configuration form where you can select the type of input data that are available for each class of object in the input database.

### Settings

Opens the settings form for the input database where you can change settings such as the units of data.

The following additional commands are available from the Backstage view when an input file is open:

### Save As

Saves the current file to a file with a new name and opens that new file. The original file is retained on disk, but note that changes made since the last save will appear only in the new file.

### Export to MDB

Exports the current XML format database to a Microsoft® Access format database that is compatible with the PLEXOS 5.2*x* versions[1].

### Transmission

Allows for the export of transmission data to one of the supported graphical formats.

## 3.4 Additional commands for solution files

The following commands are available when a solution file is open.

[1] Note that this option is only available on computers that have Microsoft Access installed.

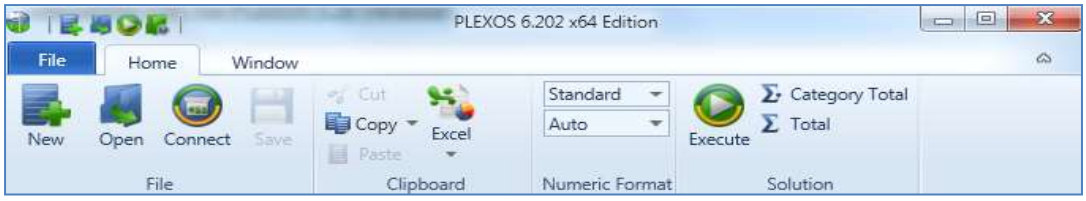



**Figure 9: Home tab with commands related to the solution file**

These commands are discussed in the section Solution files.

# 4 Input – Interface Layout

## 4.1 Overview

Figure 10 shows how an input file is displayed when first opened in PLEXOS. The window is divided into two sections: the Explorer pane (sections labelled 1-3 on the left), and the Data pane (on the right). The Explorer pane has two tabs each with a tree: the System tree and the Simulation tree. The Data pane consists of three tabs: the Objects tab, the Memberships tab, and the Properties tab. The Explorer pane is split into two further sections that display information in tree layout for the selected collection or object.

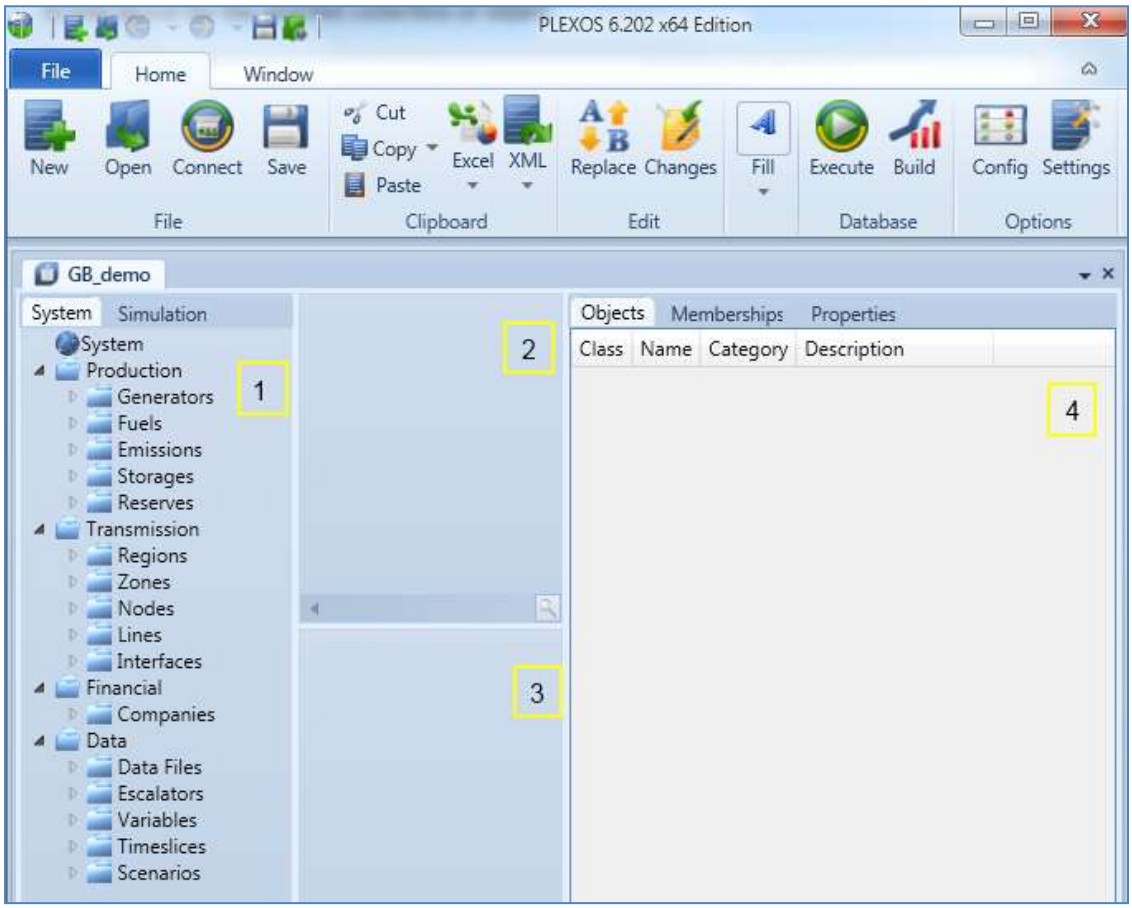



**Figure 10: Input file open in PLEXOS**

The numbering in Figure 10 refers to:

1. The Main Tree with the System and Simulation tabs: This tree shows the Objects in the database organized into Collections according to the object class (type of object).
2. Membership Tree: This tree displays all relationships between objects.
3. The Properties Tree: this tree lists the properties available for the class of objects selected in the Main Tree.
4. Data pane: This consists of three grids: Objects, Memberships and Properties.

You can use the borders between each section to resize the grid and tree areas as you need. Simply hover the mouse over the boundary until you see the resizing arrows and drag the

resizing handle to the position need. The relative size of the trees and grids is stored so that next time you start the interface your settings are restored.

## 4.2 Document Tabs

Each file you open in PLEXOS is shown in a document tab. The close button on the top right corner of the tab (as highlighted below) closes the tab and therefore closes the file.

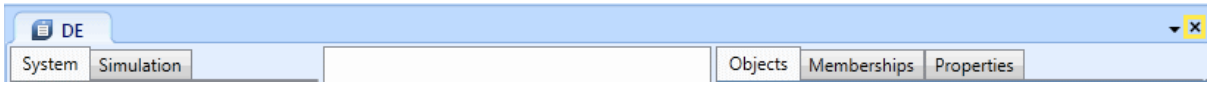
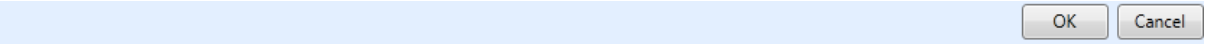



Figure 11: Closing Tabs

Whenever you open a new form in PLEXOS such as the Execute form in Figure 57, the window fills the entire document tab area. These windows always provide a button to close the window in the bottom right area as in the following:




Make sure you use these buttons to close the active form, since closing the document tab will close the entire file, not just the active form.

The document tabs can also be freely arranged by either floating or docking the windows. Right click on the tab to see the list of options:

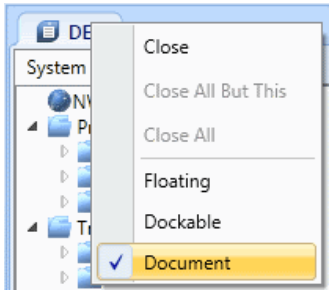



Figure 12: Windows Arrangements

Figure 13 shows a document floating: in this case it is an open CSV file floating over a database. Figure 14 shows the same window docked. You can also create groups of tabbed documents, for example you can have several CSV files open in a tab group, and your database in another tab group.

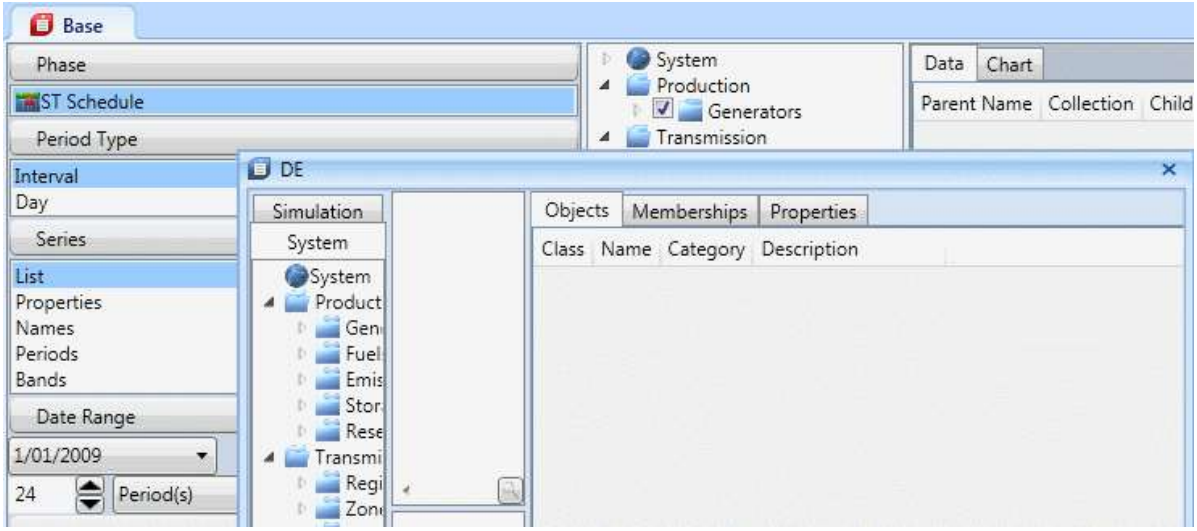



Figure 13: Floating Window

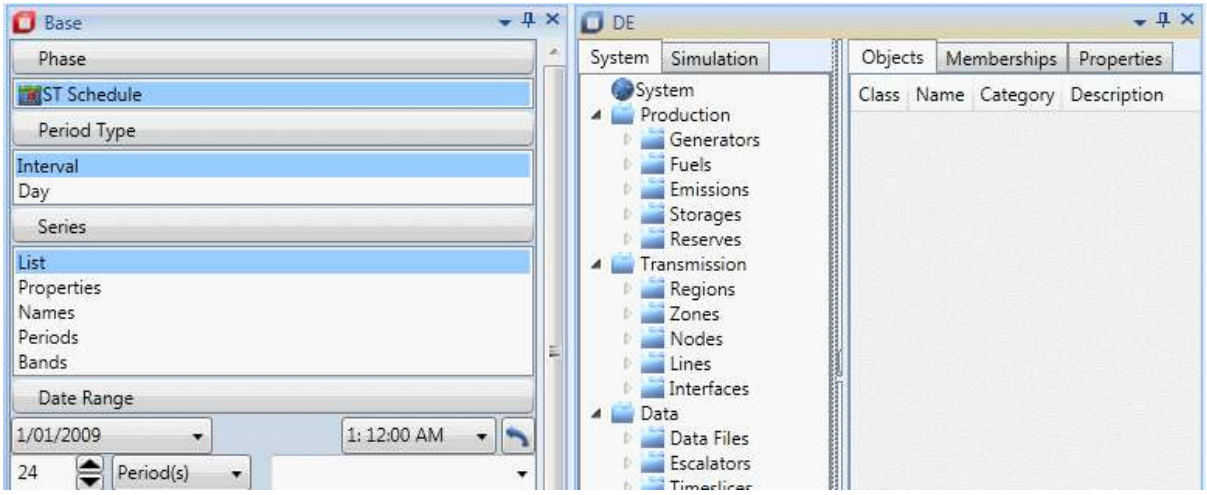



Figure 14: Docked Window

## 4.3 Explorer pane

The Explorer pane displays the objects defined in the file. All objects pertain to either the *System* (defining the physical and economic elements of a power system) or *Simulation* (related to the execution of simulations), and are managed within the appropriate tree.

Objects are displayed in a hierarchical form beginning with the System object and its collections. Nodes can be expanded and collapsed using the controls that appear next to them.

Clicking on a node in the tree changes the contents of the Memberships tree, Properties tree, and Data pane. When a collection is selected, data are displayed that pertain to all the objects in that collection, but when an object is selected, data are displayed that pertain only to the object in that collection.

A 'find' functionality is available in each tree (System tree, Simulation tree, Membership tree and Properties tree) through the magnifying glass icon as in Figure 15, to quickly find an object within a collection. To start a find operation, click the find button, then type the name or part of

the name you wish to search for. To narrow the scope of the search, select a collection or category of objects under the collection; the find will then only look in nodes under the selected node.

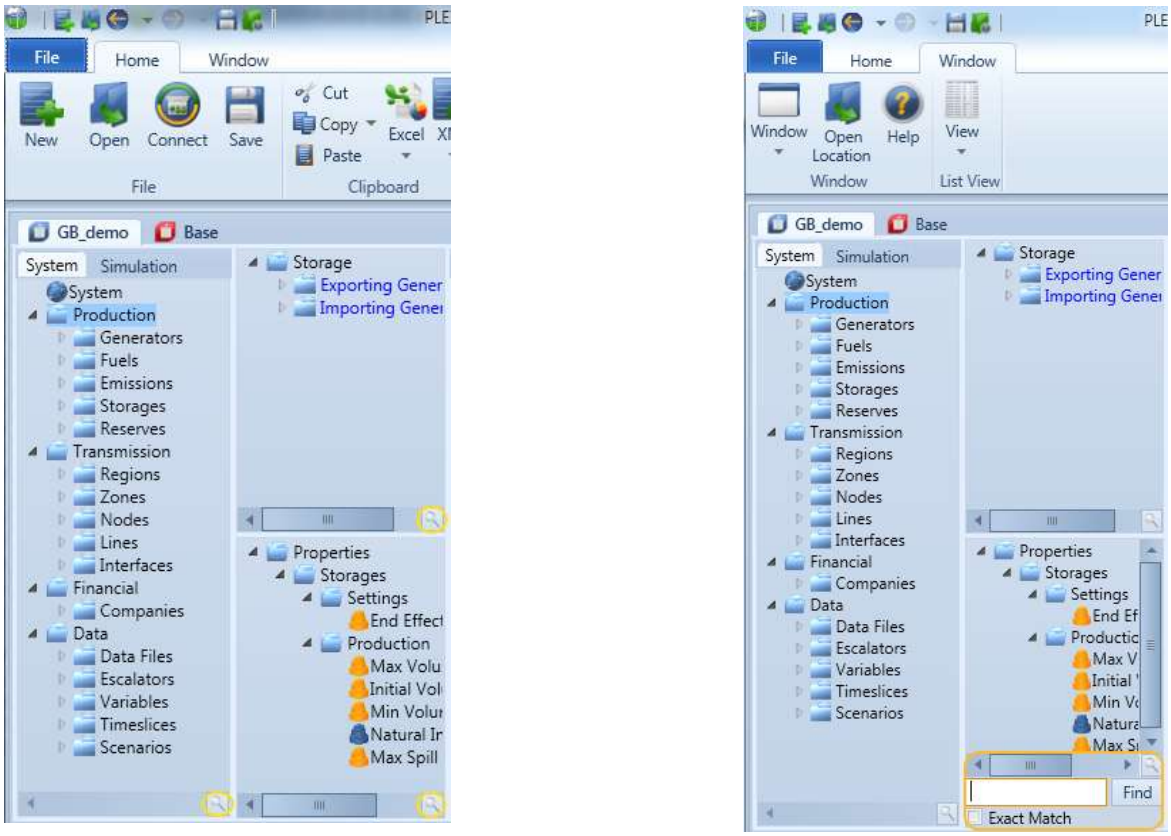



Figure 15: Find function in trees

When the find locates a matching object it opens the tree to show the object. The object is selected in the tree, but you will need to click the object for the Data pane and other windows to update to show the data for that object. If no match is found the find box will be displayed in red.

## 4.4 Data pane

The PLEXOS GUI provides full data editing functionality. The object-oriented approach makes it easy to manipulate data across multiple objects simultaneously. For example, it is possible to display and edit the data for all Generator objects at one time.

The tab control on the Data pane changes the type of data being displayed.

### Objects grid

The Objects grid displays lists of objects. From this window, objects can be added, renamed, or deleted. In Objects view, the Data pane shows these fields:

#### Class

Name of the class the object belongs to.

#### Name

Name of the object: can be up to 50 characters, which can include spaces and many other special characters including any Unicode.

### Category

Name of the object's category. This is optional and used only to sort the objects. Categories are defined directly on the corresponding System collection and can be selected in the *Category* drop-down box in the Data grid.

### Description

A description of the object (up to 255 characters).

## Memberships grid

The Memberships grid shows what collections objects belong to: other than the default System collections, which are managed 'behind the scenes'. These memberships affect the way objects interact. For example:

- For a generator to inject energy into a node, the Generator must have a Node object in its [Nodes] collection.
- Some collections take only one member, but many can take one than one, for example a generator can inject power into multiple nodes (more than one Node as members of its Generator [Nodes] collection), and it can generate using one or more fuels (Fuel objects as members of its Generator [Fuels] collection).

In Memberships view and with a system collection selected in the tree, the Data pane shows these fields:

### Collection

Name of the collection in the format "ParentClass.CollectionName"

### Parent Name

Name of the object that owns the collection

### Child Name

Name of the object contained in the collection

The direction of the collection's parent/child is predetermined and these relationships are displayed in the Memberships grid only in the defined direction though they are displayed in the trees in both directions. In general PLEXOS defines the parent/child relationship where the relationship is most commonly a one-to-one.

In the PLEXOS Object Model data can be defined on objects *only when they belong to a collection*. The Properties grid displays data defined on objects as members of collections. All objects must belong to one of the System collections, and most object properties are defined as members in those collections. However, you only need to create memberships between non-system objects as the System memberships are managed automatically by PLEXOS.

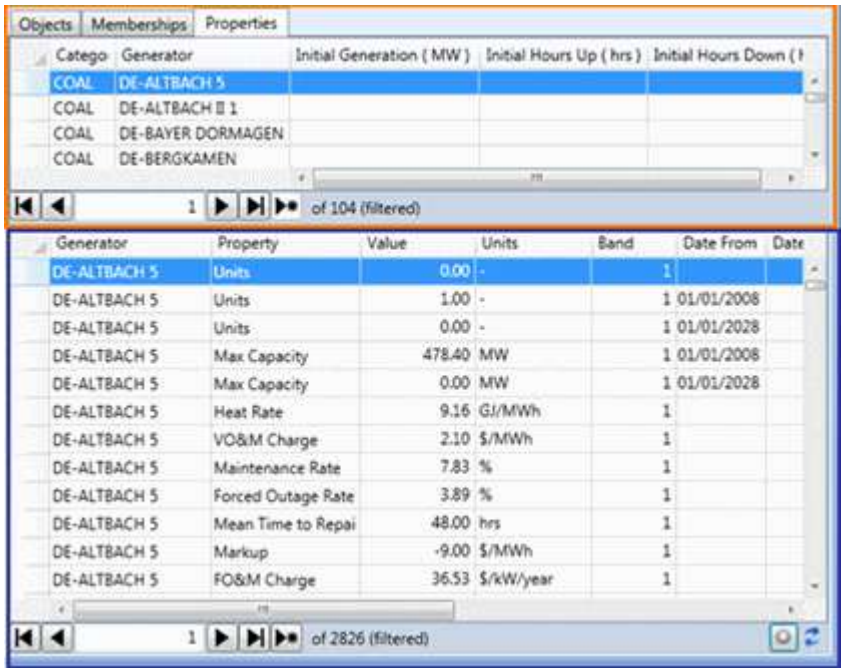
For example, the number of units installed at a generator is a property that is defined when the Generator object is a member of the System [Generators] collection, but the transport charge specific to delivery of a given fuel to that generator is a property of the Fuel object when it is a member of the Generator object's [Fuels] collection. These memberships are referred to as *second-level memberships*, as opposed to System memberships.

### Properties grid

In the Properties grid the properties of the respective objects are set. The data pane is split into two sections, the Static property grid and the Dynamic property grid.

The static property grid contains properties are defined with a single 'static' value.

Dynamic properties can take a different value according to a number of defined rules. Note that properties can be moved from the static to dynamic grid using the Configuration window: see Configuration on page 56.




*Static Property grid*

*Dynamic Property grid*

**Figure 16: Static and Dynamic Properties grids**

## 4.5 Filtering Data

The GUI supports filtering and sorting of data in the lower (dynamic data) section of the Data grid.

One way of filtering is to select of a subset of data from the trees. For example, to display a list of all Generator [Max Capacity] property values for generators, click on the Generators collection in the System tree, then on the Properties tab of the Data Pane. Finally, click on the [Max Capacity] property in the Properties tree.

Data can be further filtered using the filter button in the bottom right of the Data Table allows you to filter according to the contents of the current selected cell in the data grid. The filtering can be inclusive or exclusive. To switch between inclusive and exclusive modes, click on the button next to the filter button. To clear the current filter click the filter button again to toggle it off.

## 4.6 Sorting Data

Data in the grids are sorted by default according to:

- Collection: System collections display first then second-level collections i.e. those involving a membership of two non-system objects.
- Membership: which are sorted first by object category and then alphabetically on object name.
- Property order: this is a pre-defined ordering of the properties. The order is set to place the most commonly used properties near the top of the list.

In the dynamic properties grid the data are further sorted by the data tag fields (Date From, Date To, *etc*).

The default sort order can be overridden temporarily at any time by clicking on the column of the grid you wish to sort by.

## 4.7 Clipboard Operations

The Cut, Copy, and Paste commands provide clipboard operations for all data grids. These allow you to copy data to an external program in plain text format. Note that only the current selection is copied:

- To make a selection simply drag across the cells you want to copy.
- To copy entire rows drag down the row selectors;
- Similarly with columns, hover over the first column until you see the selection arrow (downward facing arrow) then drag across the column headers to select multiple columns.
- You can also use SHIFT and CTRL keys in combination with the arrow keys to make multiple selections.

When copying from a grid, by default only the content of the cells is copied. If you also want the columns headers to be copied to the clipboard, then use the right mouse button "Copy (With Headers)" command instead.

As an example, consider the selection shown here:

Objects | Memberships | Properties

| Category | Generator | Units | Max Capacity ( MW ) | Min Stable Level ( MW ) | Fuel Price ( $/GJ ) | Heat Rate ( GJ/MWh ) | Max Capacity Factor Day ( % ) |
|---|---|---|---|---|---|---|---|
| - | 1.Baseload | 1 | 450 | 0 | 1.5 | 10 | |
| - | 2.Intermediate | 1 | 250 | 0 | 5 | 8 | |
| - | 3.Peaker | 1 | 200 | 0 | 8 | 9 | |
| - | 4.Hydro | 1 | 500 | 0 | | | 20 |

**Figure 17: Selection to Copy**

This selection will paste by default as tab-delimited table of text without the titles. Selecting the "Copy (With Headers)" however will cause the column titles to be included.

## 4.8 Tree Navigation

The trees in PLEXOS can be navigated using mouse-clicks or by using the keyboard arrow keys. From the membership tree you can use the right-mouse-button **Locate** command to jump the main tree to the location of any object referred to in the membership tree. For example you might click a Generator in the main tree then locate one of the Fuel objects it uses.

As you navigate through the trees in PLEXOS, the program keeps a track the nodes you have visited. You can then use the navigation history (back and forward) buttons on the shortcut menu bar to return to any previously visited node, or more forward again. This is similar to the back and forward buttons on typical web browsers, and is very useful if you want to jump back and forth between two points in the tree *e.g.* between a Generator and the Fuel it uses.

# 5 Entering Data in PLEXOS

In this section the main features related to entering and defining input data in PLEXOS are explained.

## 5.1 Objects

Objects are the fundamental building blocks of a PLEXOS model. All power system elements like generators and transmission lines are objects, as are more abstract elements such as data scenarios and options.

There are multiple ways to create new objects:

- Enter the name of the new object on the Objects grid. } *Data grid*
- Paste a list of names into the data grid on the Objects grid. } *Data grid*
- Use *New Object* command in the wizard dialog of the system collections. } *Wizard*
- Import objects from external text files: see the *Import and Export* PLEXOS help article.

### Create an object using the objects grid

1. Select the system collection (folder in the Main tree) for the type of object(s) you wish to create, *e.g.* click the Generators collection to create a Generator.
2. Select Objects tab in the data grid.
3. Type a name for the new object, and optionally a category and description: see Figure 18.

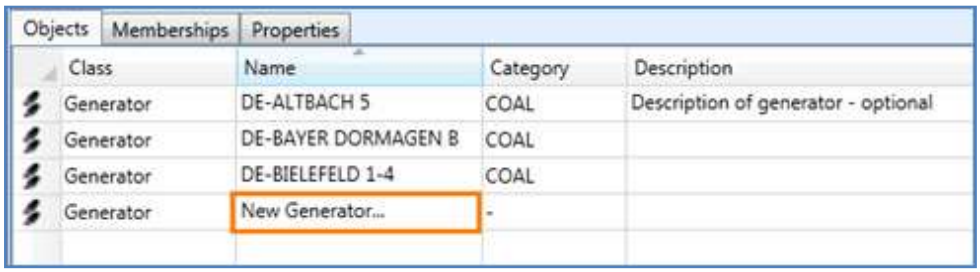



**Figure 18: Create an Object by typing its name**

### Enter a list of objects

If the objects are all the same class:

1. Prepare the list of object names (must be unique names) in a program like Excel (see Figure 19).
2. Copy the list of names to the clipboard.
3. In the System or Simulation tree select the class of objects you want to paste, *e.g.* Generators (Figure 20).
4. On the Objects Grid, highlight the *Name* cell of the New Record row (the last row of the grid). Note the cell must be completely highlighted, not put in edit mode (see Figure 21).
5. Paste the contents of the clipboard. You will be prompted to confirm the operation.

***NOTE:*** *You can also paste the object category name at the same time as the object name as long as you have defined the categories first: see Categories.*

**Figure 19: List of Names in Excel**

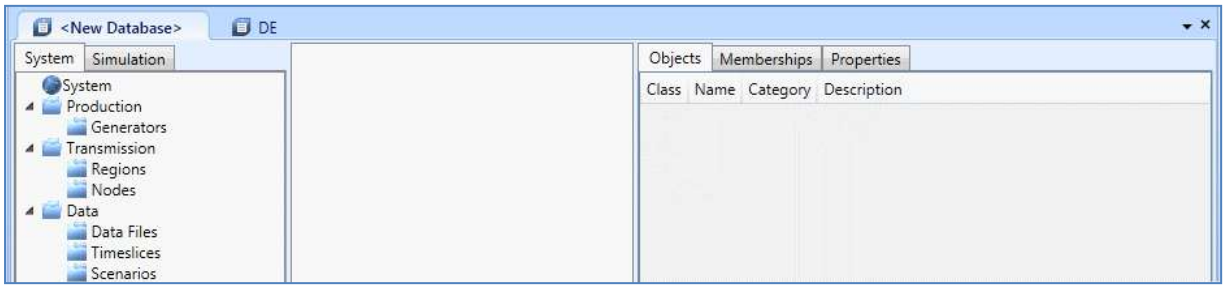



**Figure 20: Selecting a System collection**

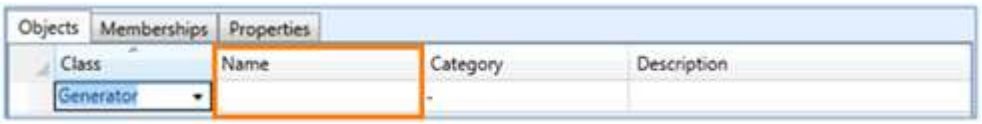



**Figure 21: Name field of New Record row**

If the objects are of different classes:

1. Prepare the list of object classes and names in a program like Excel (see Figure 22).
2. Copy the list of classes and names to the clipboard.
3. In the System or Simulation tree select the System object.
4. Select the Objects Grid.
5. Select the *Class* and *Name* cells in the New Record row: make sure you highlight both cells together by dragging across them starting at the top left of the *Class* cell.
6. Paste the contents of the clipboard.

| | A | B | C |
|---|---|---|---|
| 1 | Class | Name | |
| 2 | Fuel | DE-PC-CCS | |
| 3 | Fuel | DE-OIL | |
| 4 | Fuel | DE-NON-FOSSIL | |
| 5 | Fuel | DE-SOLAR | |
| 6 | Fuel | DE-WIND-ON | |
| 7 | Fuel | DE-WIND-OFF | |
| 8 | Fuel | DE-URANIUM | |
| 9 | Fuel | DE-GAS | |
| 10 | Fuel | DE-COAL | |
| 11 | Fuel | DE-BFGAS | |
| 12 | Generator | DE-ALTBACH GT | |
| 13 | Generator | DE-ALTBACH II 1 | |
| 14 | Generator | DE-AHRENSFELDE | |
| 15 | Generator | DE-ALTBACH 5 | |
| 16 | Generator | DE-BARMEN II | |
| 17 | Generator | DE-BAYER DORMAGEN | |
| 18 | Generator | DE-ALTBACH II 1 GT | |
| 19 | Generator | DE-AUDORF | |
| 20 | Generator | DE-BOXBERG III | |
| 21 | Generator | DE-BUSCHHAUS | |
| 22 | Generator | DE-CHARLOTTENBURG 4-5 | |
| 23 | Generator | DE-BUER | |
| 24 | Generator | DE-CHEMNITZ NORD 2 | |
| 25 | Generator | DE-COTTBUS | |
| 26 | | | |

**Figure 22: List of objects of various classes in Excel**

## Create an object using the wizard dialog

Follow these steps to create an object using the new object wizard:

1. Click the right mouse button on the appropriate system collection in the primary tree, *e.g.* the Generators collection.
2. Select "New Object", *e.g. New Generator* command.
3. In the dialog that appears (Figure 23) enter a name for the new object, and optionally select a category and type a description, then click OK.

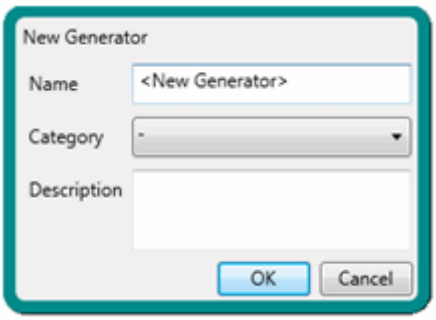



**Figure 23: Create an object using a wizard**

The object will be created in the database and the *common object properties dialog* will appear (Figure 24). As suggested by the name this dialog is common to objects of all classes except simulation settings.

The *common object properties dialog* has two lists: Memberships (1) and Properties (2).

## Memberships

Lists the collections available and all memberships defined on the object, *i.e.* you get one entry here per membership or one 'blank' line if the collection is empty. This allows you to quickly review the memberships for the object. Note that if a required membership is missing the text "missing" appears next to the collection name. You can double-click any collection/membership to add/remove memberships. There are also commands available on the right-mouse button click.

## Properties

Lists the properties that have been activated for this class of object. If the property has not been defined for the object then the value column shows a blank, otherwise all defined values are listed. You can edit the values directly in this grid.

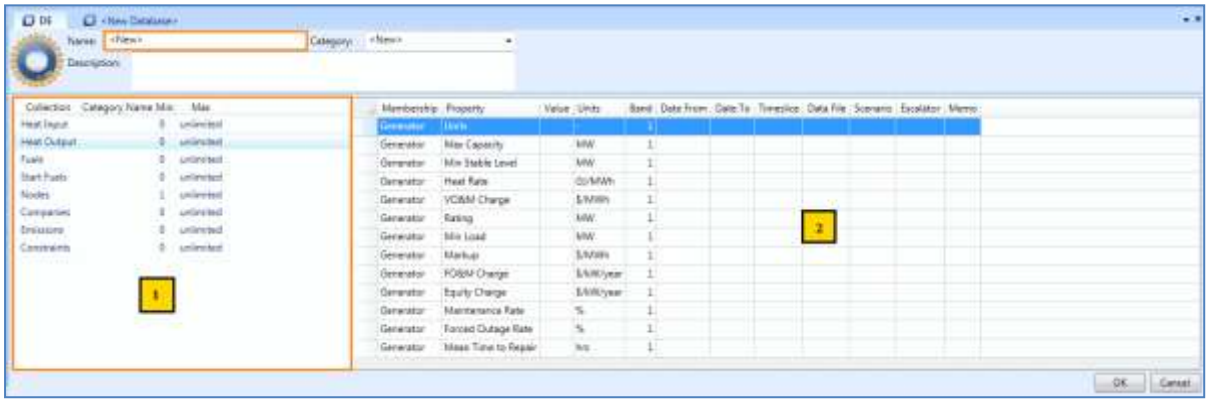



**Figure 24: Common Object Property Dialog**

## Import data from an external file

To import data from an external file, select the Import command from the Backstage:

This will bring up the PLEXOS Import Wizard (Figure 25). Follow the instructions to quickly import data files in compatible format. For more details refer to the *Import and Export* PLEXOS help article.

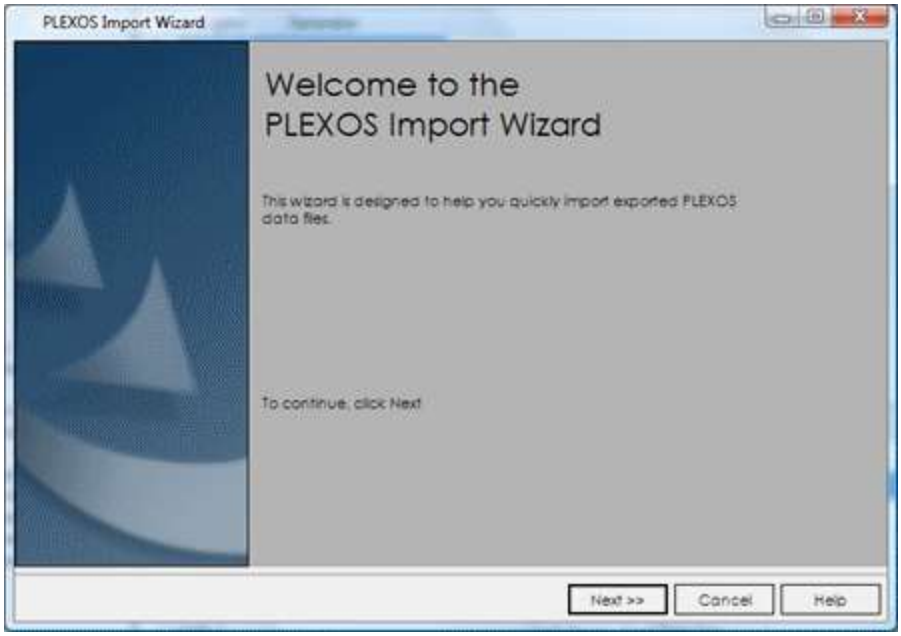



Figure 25: PLEXOS Import Wizard

## 5.2 Categories

Grouping objects into categories improves ease of navigation in the tree view of objects in both input and solution databases. Note that categories are also used in the Solution Viewer when running automatic aggregate queries on data. All classes of objects can be categorized, but only one categorization can be defined for each class.

***NOTE:*** *The categorization of objects does not affect the way the objects are formulated in the simulation; it is purely an organizational tool. However, it will result in the order of objects being read differently, and this can affect the generation of random seeds for modelling, e.g. forced outages of Generators. If you want to be able to re-order, or add/ remove objects without affecting the random seeds, set the individual random seed properties of objects like Generator and Line, e.g. Generator [Random Number Seed].*

To create and edit categories, select the *Categorize* command from the pop-up menu of the collection of objects *e.g.* to categorize your generators right-click the [Generators] collection in the System tree: see Figure 26.

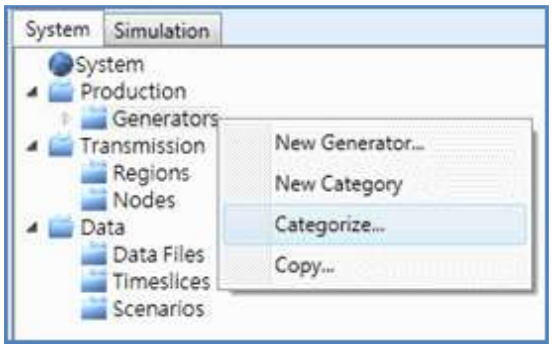



Figure 26: Categorize command

Figure 27 shows the Category editor. From this window you can:

- add, delete, or rename categories;
- change the order that categories appear in; and;
- change the assignment of objects to categories.

***TIP:*** *You can delete a sequence of categories by repeatedly pressing DEL and Y (to confirm the delete).*

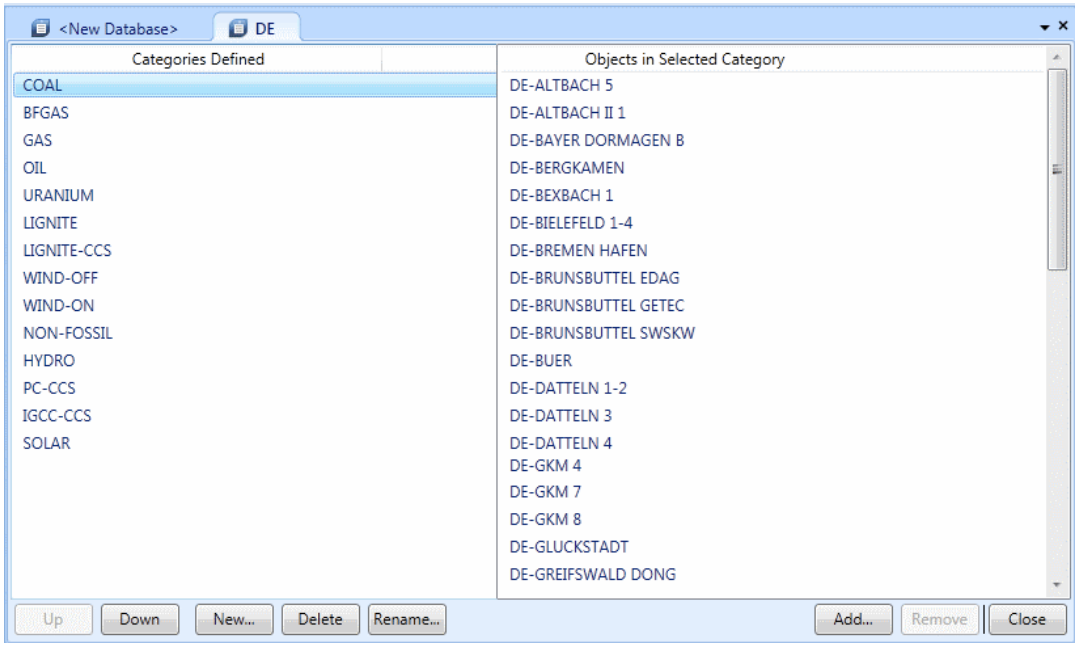



**Figure 27: Category editor**

Once the categories are defined and objects have been assigned to those categories the System and Simulation trees will display your objects inside the categories: showing the categories as folders (see Figure 28). The categories are used throughout the interface by PLEXOS to organize your objects, and they are passed through to the solution database. Objects inside the categories are always sorted in alphabetical order, whereas the categories display in the order you define in the Category editor.

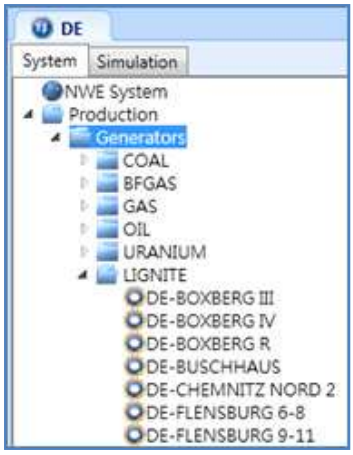



**Figure 28: Example Generator categories**

## 5.3 Memberships

Memberships are the method used to define functional and logical relationships between objects.

Memberships always involve two objects:

- A parent object
- A child object

For example, a generator can burn one or more fuels, and each such relationship is stored as the membership of the Fuel in the Generator [Fuels] collection. However, this is not enough information to uniquely identify the relationship; hence we also require a collection name. For example Generators and Fuels can be related in two ways (Generator [Fuels] and Generator [Start Fuels]) so we must also specify the *collection name* when defining a membership.

Hence each membership (relationship) is uniquely defined by using three fields:

- Collection
- Parent Name
- Child Name

For example, the Generator "DE-ALTBACH 5" is defined as using the Fuel "DE-COAL" as follows:

- Collection = Generator.Fuels
- Parent Name = DE-ALTBACH 5
- Child Name = DE-COAL

Most memberships have a natural 'complement' *e.g.* "DE-ALTBACH 5" belonging to [Generators] collection of the Fuel "DE-COAL" is the *complement* of the above membership (see Figure 29). In the PLEXOS database, memberships are stored only once, but can be viewed/ created/ edited in either direction in the interface. Membership complements are shown in blue in the trees.

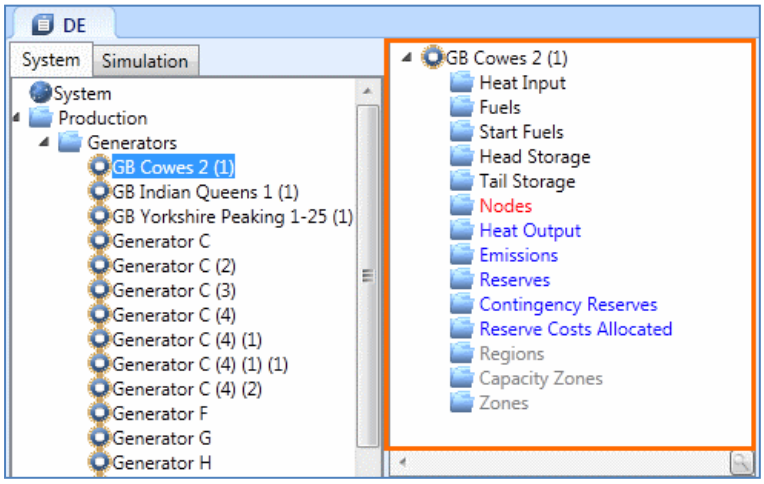



Figure 29: Example Memberships

## Colour codes of the Membership tree

Memberships are displayed in the Memberships Tree as in Figure 29. There are four colour codes for memberships displayed in the tree:

### Black

This is the membership displayed the same way it is stored in the database *e.g.* Generator [Fuels] is the 'direction' this type of membership is stored in.

### Blue

A complement of a membership *e.g.* Fuel [Generators] meaning that the membership is actually stored in the other direction to that shown. You can add/remove *etc*. complements exactly as if they were normal memberships, so this distinction is only relevant for those automating the production of a PLEXOS input file external to the GUI.

### Red

This type of membership *e.g.* Generator [Nodes] is required to have at least one member.

### Grey

This is not a membership defined directly by data, but one that PLEXOS has *inferred* from other memberships *e.g.* Region [Generators] is implied by the combination of Node [Region] and Generator [Nodes]. These inferred memberships are informational only and cannot be created/edited directly, but they are particularly useful in the solution view.

There are multiple ways to create new memberships:

- Memberships can be defined directly in the Memberships grid either by adding rows using the dropdown lists or by pasting a list of memberships.
- Memberships can be created using drag-and-drop.
- Memberships can be created and amended using the Memberships Editor.

## Memberships in the Static Property Grid

Certain one-to-one memberships, such as the Region that a Node belongs to or the Line Node From and Node To memberships, can be edited directly in the static grid of the Properties tab. This convenient input method is not available for all memberships such as Generator to Node, which is allowed to be one-to-many and thus cannot be displayed in the static grid.

An example of memberships displayed this way is shown in Figure 30.

Memberships that are one-to-many must be created using of the other methods described below.

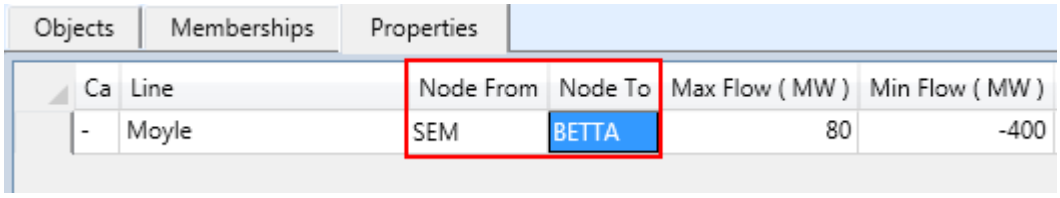



**Figure 30: Memberships in the static property grid**

## Creating memberships in the Memberships grid

To create a membership directly in the Memberships grid select the Collection, the Parent Name and the Child Name from the respective drop-down box (see Figure 31 below).

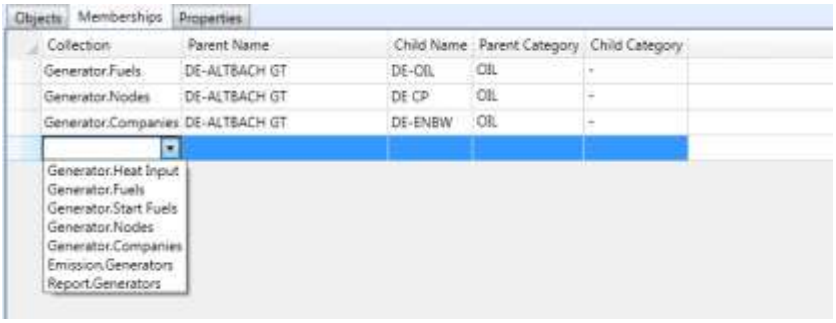



**Figure 31: Creating memberships in the Memberships grid**

Note that you need only select the parent or child in the membership if you first select an object in the Main tree, and collection in the Memberships tree.

You may also paste a list of memberships into this grid just as you can to create objects.

## Creating memberships by drag-and-drop

To create memberships just drag-and-drop objects into the collections. For example to add a fuel to a generator's [Fuels] collection, first make sure the Fuel object is visible, then select the Generator so the Membership tree shows its collections, then drag the Fuel object from the System tree onto the Memberships tree and on to the [Fuels] collection of the Generator object.

***TIP:*** *You can drag-and-drop inside the System tree itself, simply pick up the object you want to add and drag it onto the object you want to add it to. If the object is not visible then you can hover over the folder containing it for a few seconds until it opens automatically. Note that if there are multiple collections that contain the type of object you are dragging, PLEXOS will pick the first in the list, so you might need to check which collection the object was added to.*

## Membership Editor

When creating or editing an object using a wizard you will see membership editing screens as shown in Figure 32. This membership editor is the primary and most convenient/ powerful way of editing memberships. You can use the **Add/ Remove** buttons to create/ delete memberships in the database. To access the Membership editor you can either double-click the collection you want to edit from the Memberships tree, or choose the *Memberships* command from the right-click menu for the collection. You can also access the editor from the common object property form by double-clicking the membership you want to edit.

You can use the **New** command to create a new object and add it to the collection all in one action.

There are also commands available on the right mouse button click, including **Copy** which will, in one action, copy the selected object to a new name and add it as a membership.

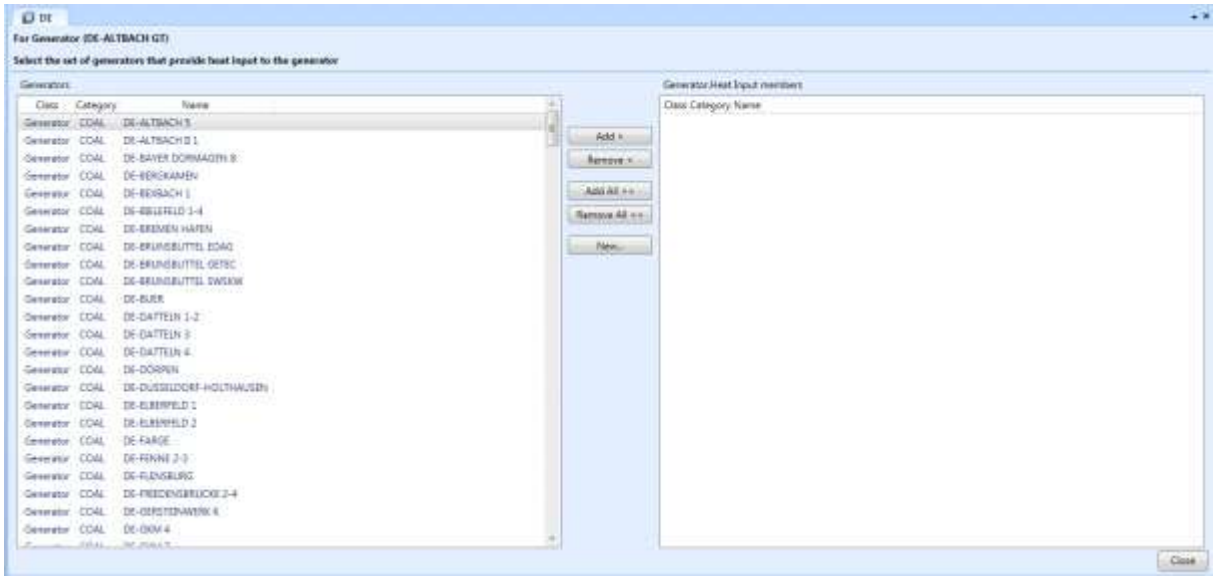



**Figure 32: Membership editor**

## 5.4 Properties

Properties are basic elements used to store the data associated with a power system *e.g.* load, generation capability, transmission data, *etc*.

### Property tree

The Property tree (Figure 33) allows you to:

- Browse by collection, *e.g.* System level or second-level properties (those involving two non-System objects)
- Browse by property group, *e.g.* "Unit Commitment" in the System [Generators] collection
- Browse to individual properties

The Property tree shows only the properties that have been enabled in Configuration see page 56.

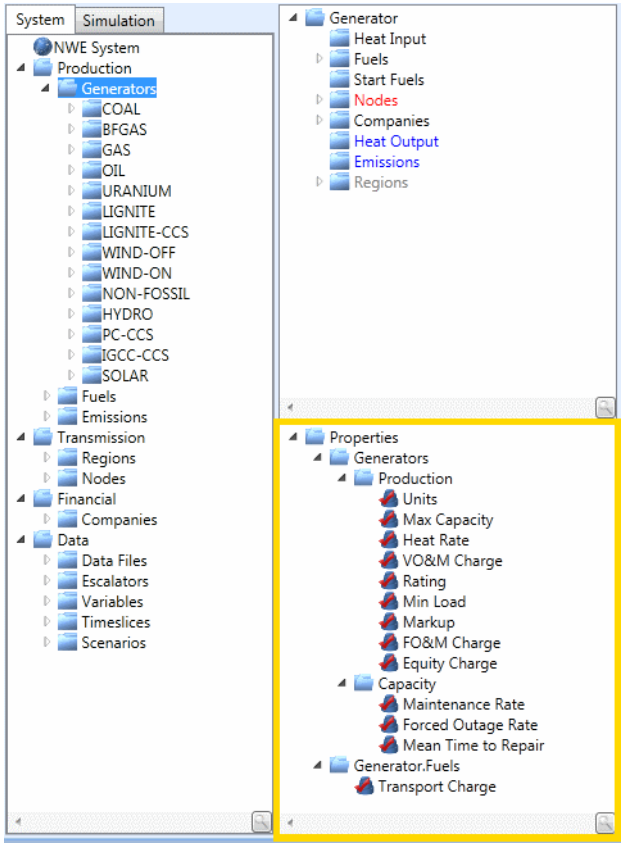



**Figure 33: Property Tree**

Properties can be either single-point (static) data or multi-value (dynamic) data:

### Static

Static properties values are set once and cannot change over time or in any other way: they appear as yellow icons in the Property tree.

### Dynamic

Dynamic properties are flexible and can change over time and according to other rules: they appear as blue icons in the Property tree.

Most properties can be set to either static or dynamic, but some properties are logically static-only and these are referred to as Attributes. The attributes are shown at the top of the Property tree using a yellow icon. A black border around an attribute indicates that the value in the grid for that attribute is set to a non-default value.

### Static data grid

When entering static (or dynamic data), first select the class of objects to which the data apply *e.g.* Generators in the System tree. Then select the Properties grid. The grid will now show the objects of that type and the available properties in columns as in Figure 34.

***NOTE:*** *By default some properties are configured static, some dynamic depending on what the most common usage of the property is; but most properties can be switched freely between static and dynamic entry using the Configuration Manager: see* Configuration *on page 56.*

Entering data at this point is as simple as typing the appropriate numbers in the grid provided. Alternatively, you may paste data into the cells by first highlighting (dragging over or using SHIFT-arrow keys) and then pasting.

To obtain a template for data entry, *e.g.* in Excel: select the entire grid using the grid selection button (highlighted in red in Figure 34) and copy and paste into Excel. This will copy the columns and rows with existing data. You may now edit those data and paste back the new numbers. Note that when pasting back, you should paste only the grid cells not the row or column titles.

***NOTE:*** *The object names are provided for reference only and cannot be modified in this view. To change an object's name use the data grid on the Objects tab.*

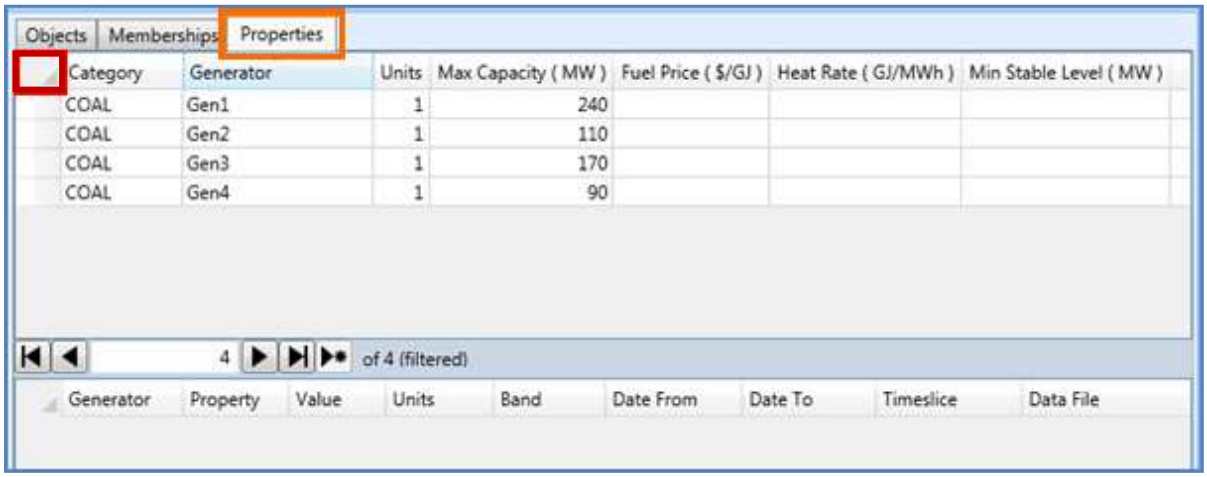



**Figure 34: Static data grid**

### Multi-band data

Some data can be configured to be entered in multiple bands, *e.g.* Generator [Offer Quantity] and [Offer Price] are usually entered in pairs with multiple bands (or tranches). Another example is heat rate parameters, which are often described by a multi-point function. PLEXOS uses the

concept of numbered *bands* for all such multi-point data. In the static grid, multi-band data are shown in a sequence of columns with the band number on the second, third, *etc.* column as in Figure 35.

Objects | Memberships | Properties

| Category | Generator | Offer Quantity ( MW ) | Offer Quantity (Band 2) | Offer Quantity (Band 3) | Offer Price ( $/MWh ) | Offer Price (Band 2) | Offer Price (Band 3) |
|---|---|---|---|---|---|---|---|
| - | Gen1 | 100 | 50 | 100 | 0 | 46 | 56 |
| - | Gen2 | 200 | 100 | 70 | 0 | 38 | 150 |

**Figure 35: Multi-band static data**

For dynamic data however, the band becomes a column as in Figure 36.

## Dynamic data grid

Dynamic data are edited in a list format. These additional fields are available for dynamic data (Date From, Date To, Timeslice, Escalator, Condition, Filename, Variable, and Scenario).

***NOTE:*** *For efficient input of lengthy data series, e.g. loads, generator bids etc., data points may 'point' to text files using the Filename field: see* Data Files *on page 42.*

## Dynamic Data grid columns

In the data grids the membership fields for each property are displayed only when viewing all properties, *i.e.* when the System object is selected. In all other views, these fields are hidden, and are automatically updated by the PLEXOS interface. This means that when entering properties it is usually only necessary to specify the following fields:

### Name

The name of the object

### Property

The name of the property: to get help on a property, select the property either in the data grid, or in the Property tree and press *F1*.

### Value

The value the property takes

***NOTE:*** *When you select a particular object in the System or Simulation tree, PLEXOS hides the Name field since this is implied by your selection. Further, when you select a property in the Property tree, the default value is set for the Property field, and you need only provide (type or paste in the value).*

Apart from these essential fields, the other available fields are:

## Units

This field shows what units PLEXOS expects for the data. This field is read-only, and is shown purely for information: you can change the system of units used in the current database: see File Settings on page 62.

## Band

Used to mark the band number for multi-band data (see above)

| Generator | Property | Value | Units | Band | Date From | Date To |
|---|---|---|---|---|---|---|
| CHP_1 | Heat Rate Incr | 8.5 | GJ/MWh | 1 | | |
| CHP_1 | Heat Rate Incr | 9 | GJ/MWh | 2 | | |
| CHP_1 | Heat Rate Incr | 11 | GJ/MWh | 3 | | |

**Figure 36: Multi-band dynamic data**

## Date From

Sets the date from which the entered value applies. Note that unless you provide a time part here the *Date To* is inclusive *i.e.* the value applies from midnight at the start of the day.

Note further that dates are always displayed and entered according to the local regions settings of your Windows computer. For example "3/04/2010" is the 3rd of April 2010 in the UK, but is the 4th of March 2010 in the USA. Changing the regional settings does not change the date stored by PLEXOS, it will only change the display format and convention expected when entering dates.

*Example:*

| Property | Value | Units | Band | Date From | Date To | Timeslice | Data File | Memo |
|---|---|---|---|---|---|---|---|---|
| Rating | 400 | MW | 1 | 01/01/2010 | | | | |

**Figure 37: Dynamic data using Date From field**

The value 400 will apply from 1/01/2010 and if no other values are defined before that, the default value for that property will apply: in the case below it zero.

So it is best to provide a "default" as well: below the default is set to 370 MW.

| Property | Value | Units | Band | Date From | Date To | Timeslice | Data File | Memo |
|---|---|---|---|---|---|---|---|---|
| Rating | 370 | MW | 1 | | | | | |
| Rating | 400 | MW | 1 | 01/01/2010 04:00:00 | | | | |

**Figure 38: Date From with undated value**

You can also use a time part *e.g.* 1/1/2010 4:00 am.

***NOTE:*** *The date format used is based on your regional settings in Windows, set in the Control Panel.*

## Date To

Sets the date up to until the entered value applies. Note that unless you provide a time part here the *Date To* is inclusive *i.e.* the value applies up to midnight at the end of the day. Note the simulator reads data in date order (*Date From* then *Date To*), so it is most often *not* required to use the *Date To* field since, values are read in sequence with one overwriting the previous and so on. *Date To* is usually only used for defining outage using [Units Out] as in this example:

| Property | Value | Band | Units | Date From | Date To | Timeslice | Data File | Memo |
|---|---|---|---|---|---|---|---|---|
| Units Out | 1 | 1 | - | 01/01/2010 | 03/03/2010 | | | |
| Units Out | 2 | 1 | - | 03/03/2010 | 04/04/2010 | | | |

**Figure 39: Dynamic data using Date To field**

In this case, one unit will be out-of-service from 1/01/2010 until the end of 3/03/2010 and two units will be out from the beginning of 3/03/2010 to 4/04/2010.

You can override the end time by providing a time part to the date *e.g.* 4/04/2010 4:00am.

Note that *Date To* can also be used without giving *Date From* in which case the value applies from the start of the planning horizon.

## Timeslice

In this field you can name a defined Timeslice object or combine Timeslices and *patterns*.

**Figure 40: Timeslices**

The data in the field will then apply only to the specified time periods. Patterned data will repeat across the planning horizon, *e.g.* if different values should apply to peak versus off-peak hours.

Timeslices are essentially shortcuts for defining a pattern using the syntax described below. To define one simply create a Timeslice object and set the [Include] property equal to -1 (for true) with the pattern that applies to it. When editing properties for a Timeslice object itself the *Timeslice* field in the data grid takes the name *Pattern* instead indicating that a pattern is expected not another Timeslice name, though in fact you can use other Timeslice names inside the definition of a Timeslice.

Similarly to dates, if you provide a value only for certain periods, the default value will apply in other periods, thus it is best to define a "complete" set of Timeslices for a datum *e.g.* PEAK with OFF-PEAK.

| Timeslice | Property | Value | Band | Units | Pattern | Date From | Date To |
|---|---|---|---|---|---|---|---|
| PEAK | Include | -1 | 1 | Yes/No | H9-19 | | |
| OFF-PEAK | Include | -1 | 1 | Yes/No | H1-8, 20-24 | | |

**Figure 41: Timeslice defined with hourly patterns**

Another example of a useful "complete" Timeslice set is:

| Timeslice | Property | Value | Band | Units | Pattern | Date From | Date To |
|---|---|---|---|---|---|---|---|
| SUMMER | Include | -1 | 1 | Yes/No | M5-10 | | |
| WINTER | Include | -1 | 1 | Yes/No | M11-12, 1-4 | | |

**Figure 42: Timeslice defined with monthly patterns**

Patterns use the following syntax:

| Symbol | Description | Range | Examples |
|---|---|---|---|
| H *or* h | Hour of day | 1-24 | H1 = 12:00am to 1:00am, H12 = 11:00am to 12:00pm |
| W *or* w | Day of week | 1-7 | D1 = Sunday, D2 = Monday |
| M *or* m | Month of year | 1-12 | M11 is November |
| D *or* d | Day of month | 1-31 | D1 = first day of the month |
| P *or* p | Interval of day | 1, … | P48 = last interval of a half-hourly day |

Other supported syntax:

- List of periods: H1,2,5
- Range of periods: H6-9
- List and Range: H1,2,5-10
- Use commas to "AND" patterns together *e.g.* H1-3,D2-6 means the pattern applies only the time 12:00am – 2:59am on weekdays Monday to Friday
- Use semi-colon to "OR" patterns *e.g.* H1-3,W2-6; H12-18,W1-7 means the pattern applies the time 12:00am – 2:59am on weekdays Monday to Friday, or 11:00am – 5:59pm on weekdays Sunday to Saturday
- Use an exclamation mark to as "NOT" e.g. "!SUMMER" would include all periods that are not defined by the Timeslice "SUMMER"

You can prefix the numbers with "0" to help with sorting in the property display *e.g.* M01, M02: this is highly recommended especially for patterns using a single code like these monthly examples.

## Data File

The *Data File* field is allowed for all properties where the value may vary period-by-period and is more conveniently input as a list of values in a text file outside of PLEXOS. The value in this field is interpreted either as the name of a Data File object, or as the name of a text file that contains the data. See the section Data Files on page 42 for more details.

## Escalator

Escalators allow you to automatically link a value, *e.g.* fuel price, to an index. Escalator objects are used to automatically change a datum over time according to the value of a user-defined index.

The following shows a basic example of an Escalator called "CPI" and its application to a fuel price. The example in Table 1 shows how a 3% compounding escalation in fuel prices would be modelled. Note that in PLEXOS you may create as many escalators as you need and apply them to any input data as in Table 2.

| Escalator | Property | Value | Units | Date From |
|---|---|---|---|---|
| CPI | Index | 1 | - | 1/01/2004 |
| CPI | Index | 1.03 | - | 1/01/2005 |
| CPI | Index | 1.0609 | - | 1/01/2006 |
| CPI | Index | 1.092727 | - | 1/01/2007 |

**Table 1: Escalator defining a 3% compounding index**

Example application of the escalator to fuel prices:

| Fuel | Property | Value | Units | Escalator |
|---|---|---|---|---|
| Gas | Price | 6 | $/MMBTU | CPI |

**Table 2: Application of the Escalator**

## Condition

Conditions allow you to make a property's value dynamic according to simulation conditions. In this field you can name a defined Condition or combine condition names using the same syntax as for timeslices. Refer to the *Condition Class* article in the PLEXOS Help for more information on conditions.

## Variable

The data will be provided by the sample values of a Variable object: see Variables on page 51.

## Scenario

Tags the datum with a Scenario name: see Scenarios on page 48.

## Data Fill Tools

The ribbon Fill commands can help you quickly fill new data or modify existing data:

**Figure 43: Data Fill Ribbon**

These commands apply to the dynamic properties grid only.

When you have a single cell selected:

**Column**: Copies the selected cell's value into the entire column (all visible rows).

**Up**: Copies the selected cell's value into all rows above the selected row.

**Down**: Copies the selected cell's values into all rows below the selected row.

When you have one or more entire rows selected:

**Selection**: Allows you to modify all column values in one action. For example you might want to apply a Timeslice or Scenario to the selected rows of data

When you have a property selected in the Property tree:

**Property**: Can be used to add new rows of that property for all selected objects.

### System vs. second-level properties

As well as static versus dynamic properties, there is the following important distinction between properties:

1. The majority of data are stored as System-level properties for objects. For example, the Generator property [Max Capacity] is stored on the membership of the Generator to the System [Generators] collection.
2. Certain other properties exist on memberships to the collections inside other objects, *e.g.* the property [Transport Charge] is specific to a Fuel when it is a member of a Generator's [Fuels] collection.

*Example:*

The [Max Capacity] of the "DE-OFFENBACH" generator is a system-level property (belongs to the Generator object alone) and is stored as:

- Collection = "Generators"
- Parent Name = "System"
- Child Name = "DE-OFFENBACH"
- Property = "Max Capacity"
- Value = 660

The cost of transporting the fuel "DE-COAL" to the "DE-OFFENBACH" generator involves both the Fuel and the Generator and hence this property is stored as:

- Collection = Generator.Fuels
- Parent Name = "DE-OFFENBACH"
- Child Name = "DE-COAL"
- Property = "Transport Charge"
- Value = 0.54

Properties like this are called *'second-level'* properties because they refer to collections inside objects, rather than the *'first-level'* properties which are inside the System. In the Property tree, second-level properties are listed in separate folders underneath the class name as shown in Figure 44 where the Generator [Fuels] collection is highlighted and showing the [Transport

Charge] property. Figure 45 shows the static property grid for these second-level properties. Note how this grid shows both a parent and a child for each datum.

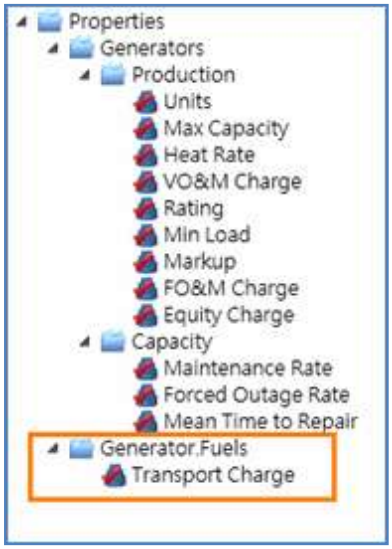



Figure 44: Second-level property tree

Objects | Memberships | Properties

| Child Category | Parent Category | Parent Name | Collection | Child Name | Transport Charge ( $/GJ ) |
|---|---|---|---|---|---|
| - | COAL | DE-OFFENBACH | Generator.Fuels | DE-COAL | 0.5374206 |
| - | COAL | DE-ALTBACH | Generator.Fuels | DE-COAL | 1 |
| - | COAL | DE-KARLSRUHE WEST | Generator.Fuels | DE-COAL | 0.4989923 |
| - | COAL | DE-BRUNSBUTTEL EDAG | Generator.Fuels | DE-COAL | 0.5374206 |
| - | COAL | DE-HANNOVER COAL | Generator.Fuels | DE-COAL | |

Figure 45: Second-level property grid

## Validation rules

At runtime PLEXOS performs a number of tests on your data to check for logical mistakes or the use of ambiguous combinations of dynamic property fields. Execution will not proceed if any of these validation rules fail, and you will be informed of the required corrections.

Examples of rules that are checked are:

- Values are within a range defined by the validation rules for the property.
- The band field is only used on properties that are allowed to be multi-band.
- Properties are not defined multiple times with different values.

## 5.5 Data Files

It is recommended that all bulky data are entered into PLEXOS indirectly by storing the data in external text files, rather than entering those data directly into the database. Use of external files is also a convenient way to update data that change frequently, for example, the load forecast, without having to edit the database itself. In the extreme, one can place all data outside of the input database, using the database only as a shell defining the objects and their relationships. However in most usage scenarios there will be a mix of database and external text file data.

When referring to a file on disk use either a relative or full path *e.g.*:

LOAD1.csv
LOADS\LOAD1.csv
C:\DATA\LOADS\LOAD1.csv

Relative paths are always with respect to the input database location. Text input files must be formatted in one of the (many) allowable format (for more details on file formats refer to the help document Text File Formats [1]). The default delimiters are comma (CSV file) or tab (TXT file), but these can be changed in Protecting Data

To protect data from accidental change you can lock various parts of the database to editing. The locking controls are settable by database and are located under the **Settings** menu on the **Home** ribbon. The **Locks** tab contains the controls shown in Figure 54.

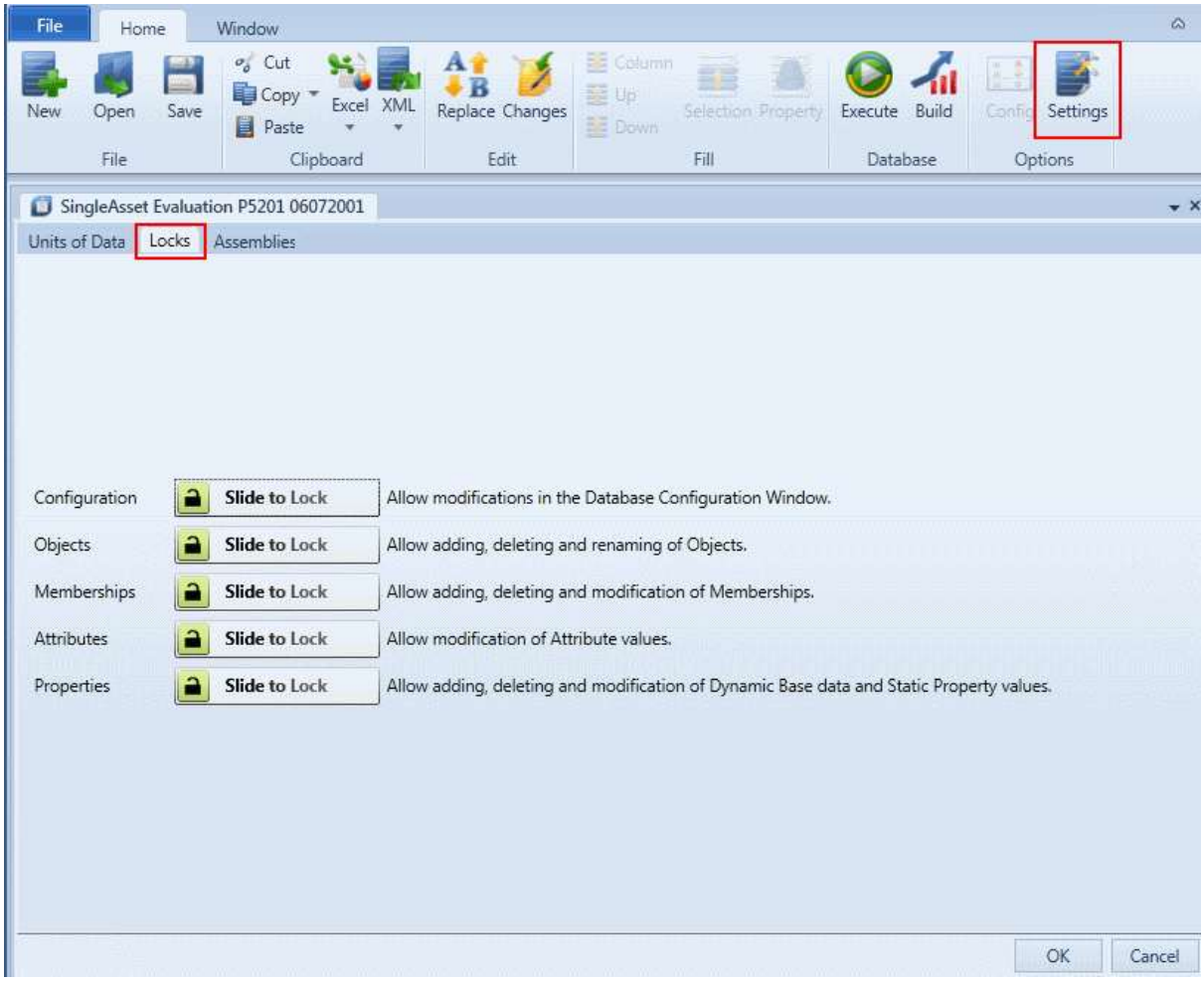



Figure 54: Locks Settings for Current Database

The locks are enabled or disabled by sliding the lock image across the slider control. Figure 55 shows the options all in the locked state.

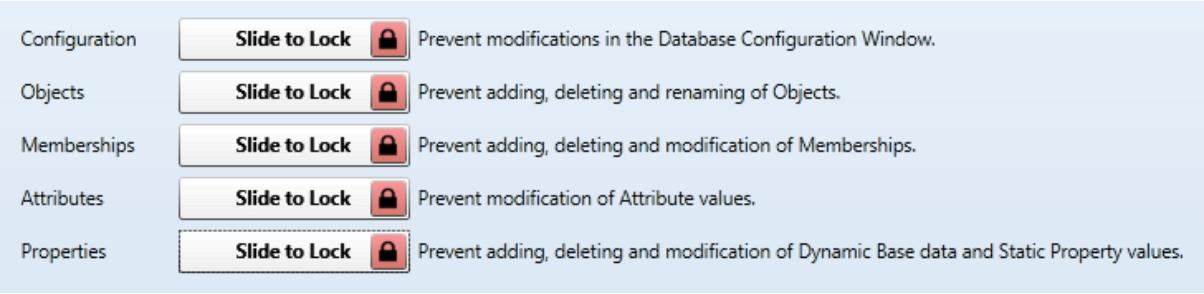



Figure 55: Locks in Locked State

## Configuration

Locks or unlocks the Configuration window. Locking this prevents the user from enabling or disabling features such as collections and properties or changing the dynamic/static status of properties. The Configuration screen is still accessible but is placed in a read-only state.

### Objects

Locks or unlocks the Objects grid. Locking this prevents adding, deleting, editing or renaming any object. The Objects grid is placed in a read-only state as are the name, category and description controls on the class forms.

### Memberships

Locks or unlocks the Memberships grid. Locking this prevents adding, deleting or editing memberships.

### Attributes

Locks or unlocks object attributes. This applies particularly to simulation settings pages. Locking this prevents the user from changing simulation options such as Production or Transmission settings.

### Properties

Locks or unlocks properties. Locking this prevents adding, deleting or editing properties. There are two levels to this control as described below.

The Scenario [Locked] attribute allows you to choose which data can be edited and which are locked. For data that are *not* marked with a Scenario the Properties Lock option directly controls the lock/unlock status. But for data marked with a Scenario the Scenario attribute [Locked] controls the locking. The row marker for the Properties Grid shows a lock symbol for the rows that are locked (the base data). The Scenario data are by default Unlocked.

PLEXOS Settings (see page 62) to any delimiter to suit your local requirements.

### File formats

The help document Text File Formats [1] describes the available formats, but in general the files must begin with a header describing the columns in the file. The available columns are:

- Year, Month, Day, Period
- Name
- Pattern
- Band
- Value

Additional fields then define the data for either periods of day, bands, or for specific objects. The above fields can be used in many different combinations to suit the type of data you are defining. For example monthly data can be defined with the Year and Month columns alone.

For text file formats other than those listing all period values in columns, the data may be 'compressed' by removing duplicate values as in Table 3:

| Year | Month | Day | Period | Value |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 2004 | 1 | 1 | 1 | 22.50 |
| 2004 | 1 | 1 | 15 | 35.00 |
| 2004 | 1 | 1 | 20 | 15.12 |
| 2004 | 1 | 2 | 3 | 22.50 |
| 2004 | 1 | 7 | 1 | 55.00 |

**Table 3: Example text file input with missing values**

## Multi-band file data

Multi-band data can be stored in text files with either:

- each column being a band; or
- a specific *Band* column

You must set the *Band* field in the PLEXOS dynamic properties grid equal to the number of bands of data you want to read for that object. Alternatively you can read different bands from different files, by defining multiple entries each with a unique band number and Data File.

| Generator | Property | Band | Value | Data File |
|---|---|---|---|---|
| Adelaide | Offer Quantity | 10 | 0 | Generator_Offer_Quantity.csv |
| Adelaide | Offer Price | 10 | 0 | Generator_Offer_Price.csv |
| Adelaide | Offer Quantity | 10 | 0 | Generator_Offer_Quantity.csv |
| Adelaide | Offer Price | 10 | 0 | Generator_Offer_Price.csv |

**Table 4: Band property used with Data File field**

## Data Files and Dates

Data File can be qualified with *Date From* and *Date To*, so that you can read different periods of data from separate files as in Table 5.

| Property | Band | Value | Date From | Date To | Data File |
|---|---|---|---|---|---|
| Load | 1 | 0 | 1/01/2010 | 31/12/2010 | Load 2010.csv |
| Load | 1 | 0 | 1/01/2011 | 31/12/2011 | Load 2011.csv |

**Table 5: Data File used with a date range**

## Visualising and Editing Text Files

PLEXOS provides some functions to view and edit existing text data files. To open an existing file choose File / Open from the Program button menu, and change the file filter to "Text Files (CSV, TXT)". The file is opened as a new tab in the PLEXOS interface as in Figure 46. From this view you can browse the data as well as editing it. Use the Save command to save changes to the file.

| A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | AA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | MONTH | DAY | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 2007 | 1 | 1 | 3025 | 2777 | 2542 | 2380 | 2263 | 2201 | 2212 | 2205 | 2111 | 2306 | 2598 | 2884 | 3127 | 3146 | 3075 | 3069 | 3392 | 3645 | 3602 | 3509 | 3388 | 3282 | 3140 | 3190 |
| 2007 | 1 | 2 | 2833 | 2547 | 2382 | 2293 | 2246 | 2271 | 2492 | 2879 | 3076 | 3360 | 3564 | 3660 | 3737 | 3670 | 3667 | 3753 | 4172 | 4429 | 4298 | 4143 | 3981 | 3732 | 3487 | 3420 |
| 2007 | 1 | 3 | 3028 | 2727 | 2550 | 2457 | 2397 | 2435 | 2700 | 3110 | 3365 | 3618 | 3757 | 3870 | 3966 | 3888 | 3891 | 3935 | 4254 | 4500 | 4365 | 4223 | 4022 | 3780 | 3506 | 3462 |
| 2007 | 1 | 4 | 3073 | 2768 | 2584 | 2500 | 2469 | 2507 | 2776 | 3221 | 3429 | 3692 | 3791 | 3846 | 3910 | 3793 | 3808 | 3886 | 4237 | 4497 | 4356 | 4271 | 4077 | 3804 | 3537 | 3488 |
| 2007 | 1 | 5 | 3101 | 2776 | 2599 | 2525 | 2479 | 2519 | 2781 | 3204 | 3428 | 3661 | 3756 | 3799 | 3831 | 3707 | 3680 | 3673 | 3969 | 4350 | 4261 | 4148 | 3939 | 3662 | 3459 | 3489 |
| 2007 | 1 | 6 | 3152 | 2828 | 2602 | 2480 | 2420 | 2400 | 2495 | 2669 | 2776 | 3065 | 3266 | 3357 | 3411 | 3339 | 3288 | 3336 | 3774 | 4138 | 4051 | 3859 | 3645 | 3423 | 3259 | 3361 |
| 2007 | 1 | 7 | 3066 | 2761 | 2538 | 2403 | 2320 | 2290 | 2321 | 2364 | 2363 | 2607 | 2907 | 3135 | 3402 | 3419 | 3314 | 3266 | 3516 | 3788 | 3773 | 3651 | 3537 | 3330 | 3129 | 3118 |
| 2007 | 1 | 8 | 2818 | 2577 | 2439 | 2380 | 2356 | 2408 | 2753 | 3457 | 3725 | 3865 | 3897 | 3918 | 3956 | 3859 | 3904 | 4016 | 4383 | 4552 | 4366 | 4207 | 3994 | 3745 | 3453 | 3350 |
| 2007 | 1 | 9 | 2989 | 2730 | 2574 | 2498 | 2450 | 2508 | 2841 | 3496 | 3659 | 3764 | 3769 | 3782 | 3842 | 3754 | 3792 | 3892 | 4225 | 4508 | 4339 | 4212 | 4022 | 3736 | 3435 | 3311 |
| 2007 | 1 | 10 | 2953 | 2702 | 2555 | 2504 | 2481 | 2526 | 2859 | 3527 | 3702 | 3813 | 3826 | 3838 | 3862 | 3741 | 3768 | 3852 | 4203 | 4556 | 4356 | 4179 | 4049 | 3757 | 3497 | 3399 |
| 2007 | 1 | 11 | 3048 | 2781 | 2635 | 2558 | 2515 | 2565 | 2895 | 3551 | 3742 | 3846 | 3876 | 3894 | 3936 | 3821 | 3879 | 3937 | 4157 | 4523 | 4403 | 4317 | 4118 | 3820 | 3528 | 3448 |
| 2007 | 1 | 12 | 3080 | 2796 | 2667 | 2599 | 2558 | 2598 | 2920 | 3563 | 3803 | 3883 | 3888 | 3906 | 3934 | 3812 | 3826 | 3846 | 4069 | 4357 | 4232 | 4109 | 3858 | 3614 | 3404 | 3447 |
| 2007 | 1 | 13 | 3099 | 2809 | 2596 | 2482 | 2407 | 2418 | 2518 | 2716 | 2859 | 3180 | 3389 | 3504 | 3561 | 3484 | 3424 | 3416 | 3602 | 4088 | 4027 | 3830 | 3635 | 3388 | 3213 | 3306 |
| 2007 | 1 | 14 | 3047 | 2788 | 2596 | 2482 | 2400 | 2363 | 2388 | 2444 | 2448 | 2739 | 3028 | 3207 | 3370 | 3309 | 3179 | 3152 | 3374 | 3841 | 3829 | 3685 | 3590 | 3365 | 3130 | 3127 |
| 2007 | 1 | 15 | 2835 | 2598 | 2454 | 2386 | 2361 | 2432 | 2786 | 3454 | 3666 | 3810 | 3849 | 3878 | 3949 | 3833 | 3851 | 3923 | 4181 | 4512 | 4361 | 4227 | 3991 | 3746 | 3426 | 3330 |
| 2007 | 1 | 16 | 2979 | 2736 | 2599 | 2537 | 2505 | 2555 | 2897 | 3595 | 3753 | 3879 | 3899 | 3910 | 3948 | 3837 | 3902 | 4002 | 4268 | 4576 | 4409 | 4276 | 4099 | 3806 | 3458 | 3356 |

**Figure 46: Text file open in PLEXOS**

The Data File class of objects allows you to conveniently view data in a text file in a more sophisticated way. For example:

1. Create Data File called "North Load"
2. Set the *Data File* [Filename] property to point to the text file (type the filename in the *Filename* field as in Figure 47)
3. Then use the name "North Load" anywhere in the *Data File* fields as necessary
4. Having created a Data File object and the associated text file you can use the right-mouse button *View* command to display the data in the text file: see Figure 48.

| Data File | Property | Value | Band | Units | Timeslice | Date From | Date To | Filename | Memo |
|---|---|---|---|---|---|---|---|---|---|
| North Load | Filename | 0 | 1 | - | | | | NORTH.csv | |
| Southeast Load | Filename | 0 | 1 | - | | | | SE.csv | |
| Southwest Load | Filename | 0 | 1 | - | | | | SW.csv | |

**Figure 47: Data File [Filename] property**

Options for viewing are shown in Figure 48 and include:

- View as Time Series or Duration Curve
- Log scale or standard scale
- Zoom In/Out (Zoom In by dragging over the chart)

***NOTE:*** *Multi-year data are automatically separated into annual series and the legend shows the 'energy' maximum values of the series. You can change this to a full chronology by un-checking the "Annual Summary" box.*

**Figure 48: Viewing a Data File**

Returning to the dynamic data grid, the following additional fields may be available if you define any of the following objects in your database:

## 5.6 Scenarios

Scenario objects allow data to be labelled with a particular scenario name. Scenarios are created in the same ways as other objects. Once created:

- the Scenario name appears in the list of *Scenarios* for dynamic properties;
- any property can be tagged with that scenario name.

Model objects (the objects that are executed during a simulation) have a [Scenarios] collection. Adding a Scenario to this collection instructs PLEXOS to use all the properties tagged with that scenario name as well as all properties that have no tag, with scenario data taking priority.

### Example

| Property | Value | Units | Date From | Scenario |
|---|---|---|---|---|
| Units | 0 | - | | |
| Units | 1 | - | 1/01/2012 | New Builds |
| Max Capacity | 120 | MW | | |
| Heat Rate | 9 | GJ/MWh | | |
| Forced Outage Rate | 8 | % | | |
| Forced Outage Rate | 12 | % | | High EFOR |
| Mean Time to Repair | 24 | hrs | | |
| Mean Time to Repair | 36 | hrs | | High EFOR |

Table 6: Example use of Scenarios

In the example in Table 6 the [Units] property is 1 only when the "New Builds" Scenario is included in the executing Model. Likewise the higher values of [Forced Outage Rate] and [Mean Time to Repair] are used only when the Scenario "High EFOR" is included.

### Model Scenarios collection

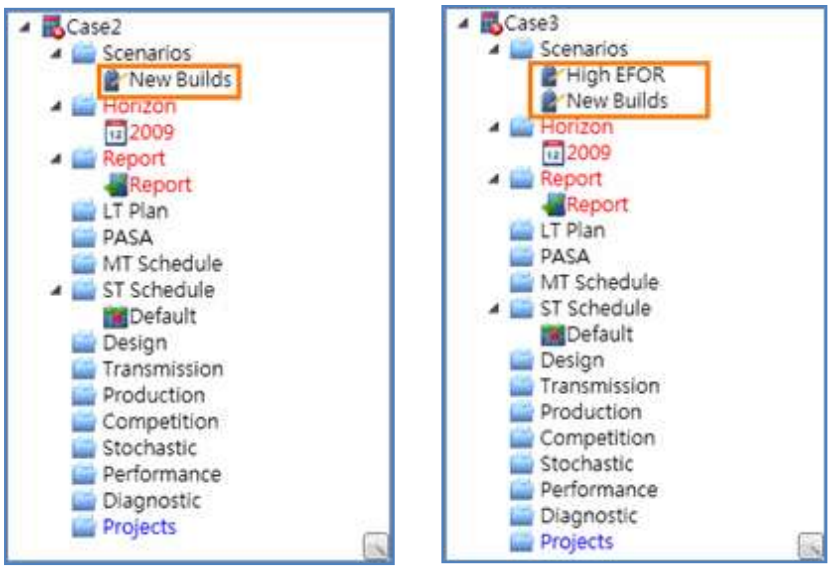



Figure 49: Model memberships linking to Scenarios

Figure 49 we show two Model membership trees. The Model "Case 2" includes only the "New Build" Scenario, while "Case 3" includes both "New Build" and "High EFOR". The following is the set of data that will be used in Model "Case 2".

| Property | Value | Units | Date From | Scenario |
|---|---|---|---|---|
| Units | 1 | - | 1/01/2012 | |
| Max Capacity | 120 | MW | | |
| Heat Rate | 9 | GJ/MWh | | |
| Forced Outage | 8 | % | | |
| Mean Time to | 24 | hrs | | |

Table 7: Data used in Model "Case 2"

And the data used by Model "Case 3" is:

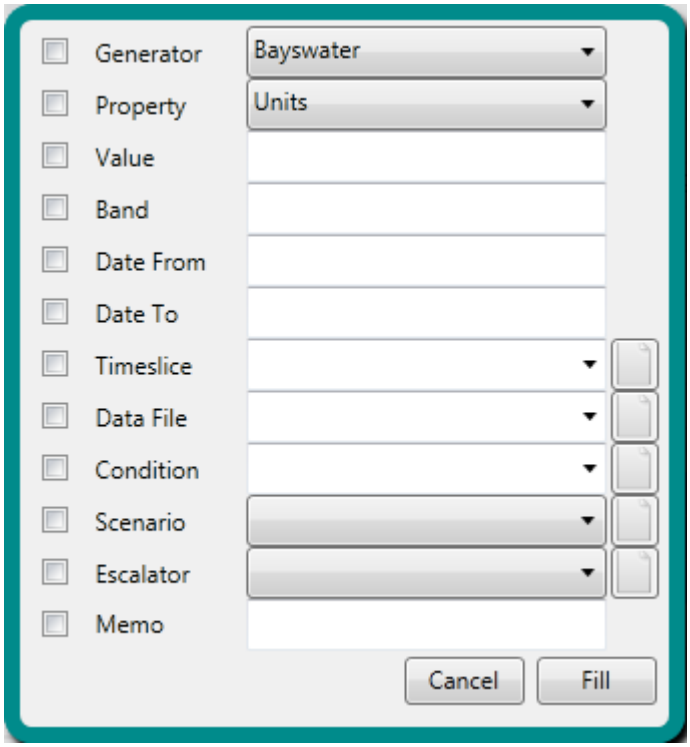
| Property | Value | Units | Date From | Scenario |
|---|---|---|---|---|
| Units | 1 | - | 1/01/2012 | |
| Max Capacity | 120 | MW | | |
| Heat Rate | 9 | GJ/MWh | | |
| Forced Outage | 12 | % | | |
| Mean Time to | 36 | hrs | | |

Table 8: Data used in Model "Case 3"

## Apply a Scenario to Existing Data

If you have existing data that you wish to 'tag' with a Scenario, use the *Selection* ribbon command in the Fill group:

Clicking the *Selection* command opens the following dialog box, from which you can select an existing Scenario or create a new Scenario and Fill the Scenario tag for all selected rows with the *Fill* button.




### Scenario Priority

Where two scenarios specify values for the same datum in the same time period, the scenarios are read in alphabetical order. Although this behaviour can be overridden using the Scenario [Priority] attribute.

### Viewing all Data tagged with Scenarios

Selecting a Scenario object in the PLEXOS interface and the Properties grid displays all the properties in the database that are tagged with that Scenario name.

### Deleting Scenarios

When you delete a Scenario object you are presented with two options:

1. Delete all data associated with that Scenario.
2. Promote the data to 'base' level, *i.e.* keep the data but remove the Scenario tags.

## 5.7 Variables

Variable objects form the foundation of the stochastic modelling in PLEXOS. They are not tied to any particular element of power system data and thus are completely generic. This means that any datum in the input file (except another Variable) can be made stochastic, *i.e.* not just the 'usual' elements such as load, hydro and fuel price. And further, any number of variables (stochastic elements) may be included any model: up to the limit of practicality of sampling across multiple variables.

There are two approaches allowed for randomizing a datum:

1. Directly define a set of chronological sequences that can be randomly selected when sampling: these sequences can be correlated, *e.g.* the load in two regions may be correlated, but each can be supplied with a set of load trances with various associated probabilities.
2. Define the expected value and information on how errors are distributed and allow the PLEXOS engine to generate the required samples.

Once the Variable input is defined and any correlations entered, there are then options for:

- How many stochastic samples are generated
- How the simulation of LT Plan, MT Schedule, and ST Schedule handles stochastic data: you can choose to run a single 'expected value' sample, multiple independent samples, or a stochastic optimization which finds the single optimal solution accounting for uncertainty.

See the PLEXOS Help topic on the Variable class for more information and examples.

## 5.8 The System object

The System object (at the top of the System tree) is useful for displaying all data in the input file and it can also be used to bulk-enter objects, memberships, and properties.

When the Data Pane is on the Objects grid the data grid shows all objects in the input file. You can create objects in this view by selecting the class type and entering the object name. The grid will remember the type of object you have created so you can keep entering names in a sequence.

When you look at memberships from the System object you see the memberships in a condensed format as in Figure 50. You can enter memberships in this format by pasting in a list. Likewise with properties, the dynamic grid shows the collection in a similar format. If you are pasting data into the property grid at the System level you must use this format to identify the membership for the data.

The format for a collection is:

Parent Class.Collection Name

The format for an object is:

Class ( name )

You must use this exact format (including the spaces around the object name).

Objects | Memberships | Properties

| Collection | Parent Name | Child Name | Parent Category |
|---|---|---|---|
| Generator.Nodes | PL Ostroleka B ST 2 | CP POL_N00 | Coal |
| Generator.Nodes | PL Ostroleka B ST 3 | CP POL_N00 | Coal |
| Generator.Nodes | PL Polaniec (Tadeusza Kosciuski) ST | CP POL_S00 | Coal |
| Generator.Nodes | PL Poznan-Karolin ST 1 | CP POL_N00 | Coal |
| Generator.Nodes | PL Poznan-Karolin ST 2 | CP POL_N00 | Coal |
| Generator.Nodes | PL Poznan-Karolin ST 3 | CP POL_N00 | Coal |
| Generator.Nodes | PL Rybnik ST | CP POL_S00 | Coal |
| Generator.Nodes | PL Siekierki 6 | CP POL_N00 | Coal |
| Generator.Nodes | PL Siekierki 7 | CP POL_N00 | Coal |

**Figure 50: Memberships of a Generator object**

# 6 Tracking Changes

PLEXOS includes a tool for comparing/merging changes between versions of your input databases (XML files). There are three ways in which this tool is launched and used:

1. During an editing session so that you can review changes made since the last time you saved the file, and optionally compare/merge changes into a new file using Save As.
2. To compare two versions of an input file that you have saved on disk.
3. To compare two versions of input saved on the server through PLEXOS Connect.

## 6.1 Changes in Current Session

To review the changes you have made to the database since the last time you saved the file, click the Changes button on the Home ribbon.

This launches the compare tool as in Figure 51.

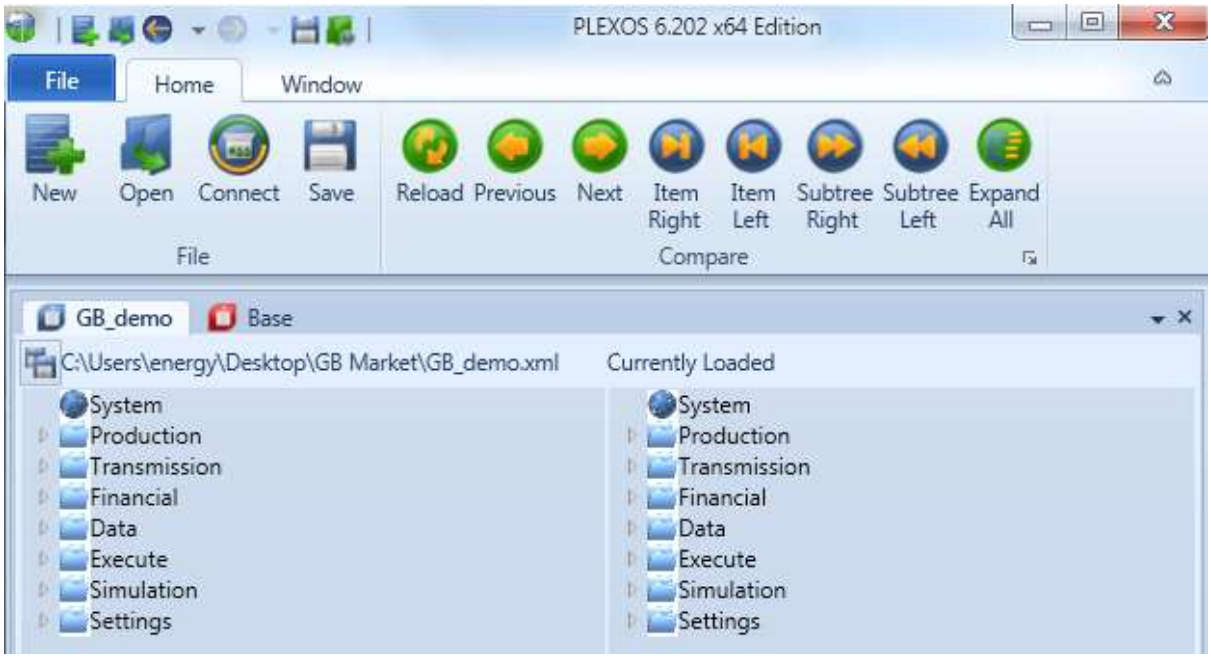


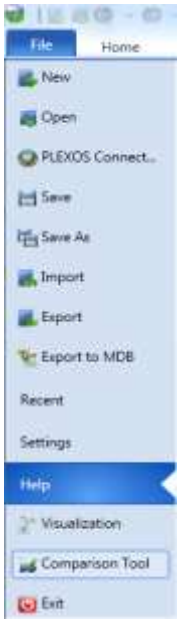

Figure 51: Compare tool launched using Changes command

Use the Expand All command to show all changes as in Figure 52. In this example the [Units] property of a Generator has been changed in the current session.

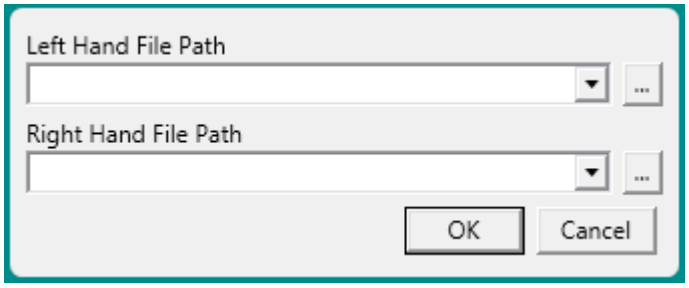
Figure 52: Compare tool showing editing changes in current file

## 6.2 Two Versions on Disk

Use the **Comparison Tool** command from the File Tab to launch the tool independent of the current session.




A dialog box prompts you to browse for the two file versions. Use the browse buttons to select the files. PLEXOS does not manage versions of your input automatically unless you are using the PLEXOS Connect feature. Thus to use the tool this way you must have previously saved two versions of the same input database.




Once you have selected the two input file versions to compare, press OK to start the comparison.

## 6.3 Comparison in PLEXOS Connect

Please refer to the documentation for PLEXOS Connect for details on how to launch the comparison tool from that program.

## 6.4 Compare Tool Functions

The comparison tool provides navigation commands that allow you to move sequentially through the changes in the file. Colour codes indicate data edits and additions.

You can also merge changes from one version to another using the Item Right, Item Left, Subtree Right, Subtree Left commands. Once you have merged a set of changes into a 'final' version use the Save command in the tool window (left hand side) to save the 'hybrid' version to a new filename.

# 7 Configuration

To keep the user interface clear of unnecessary elements PLEXOS hides any class of objects, collections and properties that are not specifically enabled using the Configuration Manager for the database. When you create a new file a default set of classes, collections and properties are enabled but in most circumstances you will need to expand this set.

In addition, the default is that most enabled properties are static properties meaning that their value is constant *i.e.* cannot vary over time, be read from an external file or be subject to a data Scenario or vary stochastically using a Variable. Using the Configuration Manager you can change the status of most properties from static to dynamic or vice versa.

To access the Configuration Manager click the *Configuration* button on the main toolbar/ribbon.

An example is shown in Figure 53.

The following functions can now be performed:

- Enable a class of objects by ticking the box next to the class name in the left-most list *e.g.* the Node class is disabled by default.
- Enable a collection by ticking the box next to the collection (folder) *e.g.* the Generator Heat Input collection is disabled by default.
- View the available properties by navigating through the tree of folders of the selected class
- Enable or disable a property by ticking/un-ticking the box next to the property name

Enabled properties are added to the right-most list where attributes such as “Dynamic”, “Bands” and “Default“ values are displayed. Change a property from/to dynamic data entry by ticking/un-ticking the box in the “Dynamic” column associated with the property. Change the number of bands for entry using the spinner control in the Bands column *e.g.* Generator [Offer Quantity], or Generator [Heat Rate] as shown in Figure 53.

Note that you can toggle the entire database to "All Dynamic" mode by ticking the box in the bottom-left corner. In “All Dynamic” mode all properties that are allowed to be dynamic are locked to that entry mode.

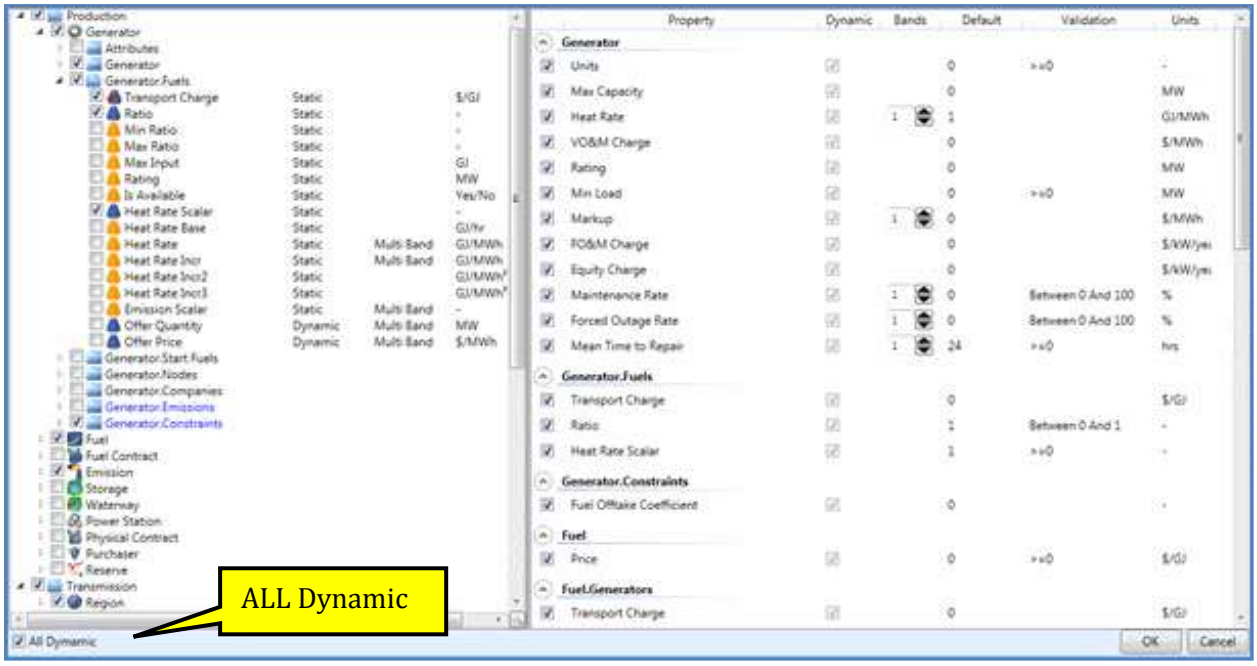



Figure 53: Configuration manager

# 8 Protecting Data

To protect data from accidental change you can lock various parts of the database to editing. The locking controls are settable by database and are located under the **Settings** menu on the **Home** ribbon. The **Locks** tab contains the controls shown in Figure 54.

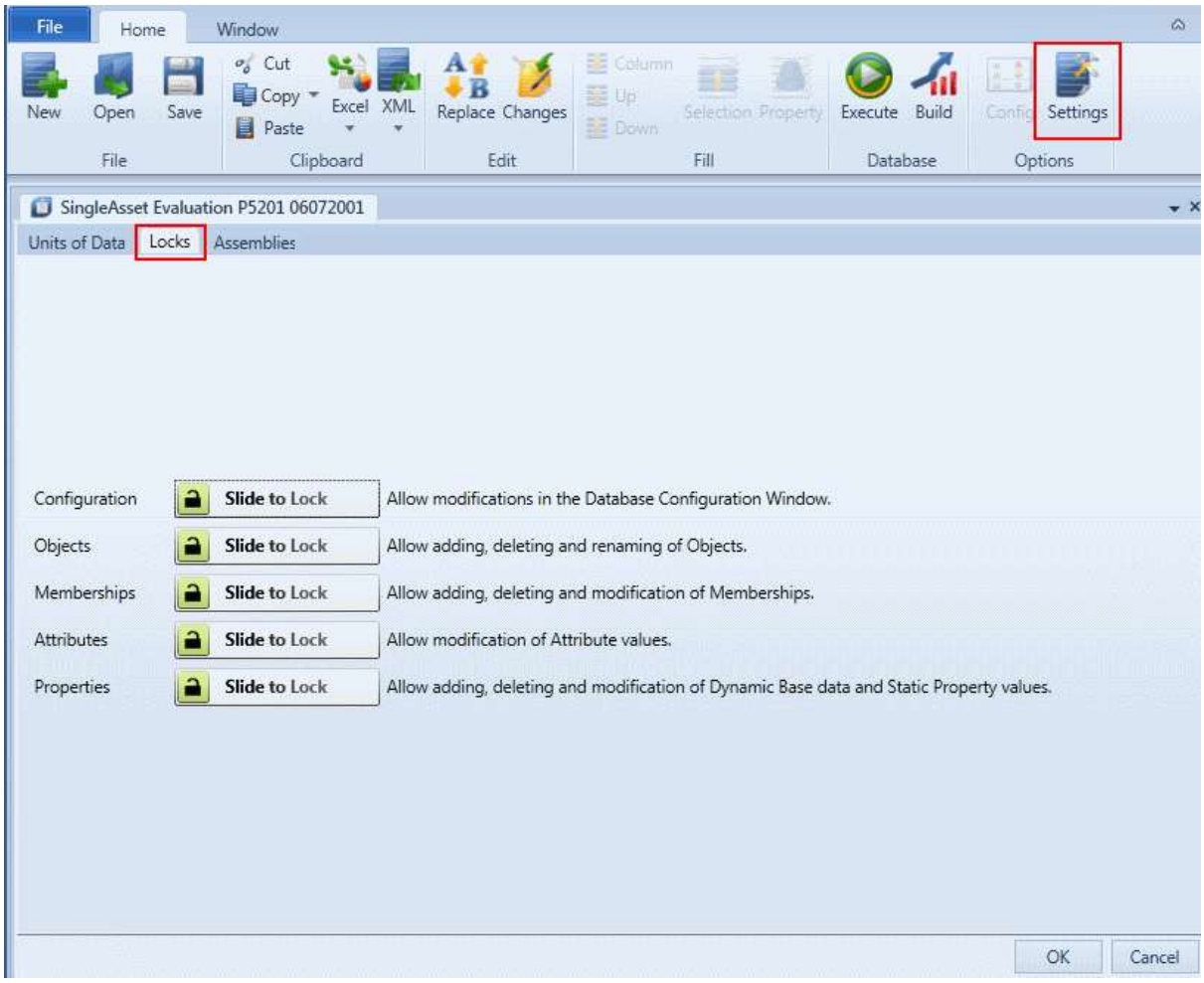



Figure 54: Locks Settings for Current Database

The locks are enabled or disabled by sliding the lock image across the slider control. Figure 55 shows the options all in the locked state.

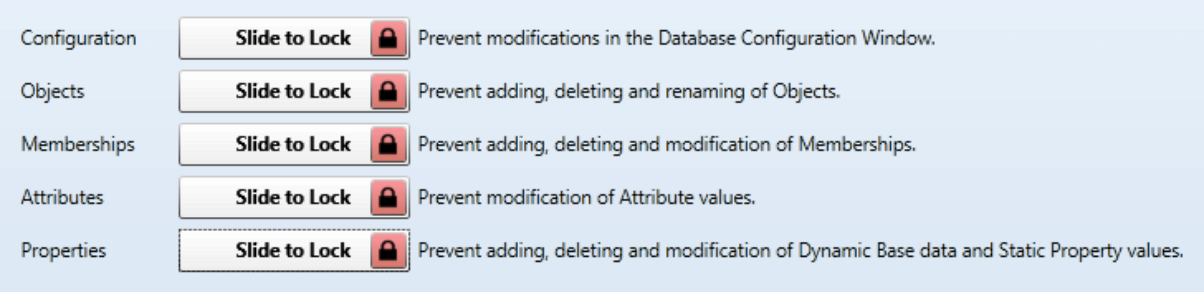



Figure 55: Locks in Locked State

### Configuration

Locks or unlocks the Configuration window. Locking this prevents the user from enabling or disabling features such as collections and properties or changing the dynamic/static status of properties. The Configuration screen is still accessible but is placed in a read-only state.

### Objects

Locks or unlocks the Objects grid. Locking this prevents adding, deleting, editing or renaming any object. The Objects grid is placed in a read-only state as are the name, category and description controls on the class forms.

### Memberships

Locks or unlocks the Memberships grid. Locking this prevents adding, deleting or editing memberships.

### Attributes

Locks or unlocks object attributes. This applies particularly to simulation settings pages. Locking this prevents the user from changing simulation options such as Production or Transmission settings.

### Properties

Locks or unlocks properties. Locking this prevents adding, deleting or editing properties. There are two levels to this control as described below.

The Scenario [Locked] attribute allows you to choose which data can be edited and which are locked. For data that are *not* marked with a Scenario the Properties Lock option directly controls the lock/unlock status. But for data marked with a Scenario the Scenario attribute [Locked] controls the locking. The row marker for the Properties Grid shows a lock symbol for the rows that are locked (the base data). The Scenario data are by default Unlocked.

# 9 PLEXOS Settings

PLEXOS settings are accessed from *PLEXOS Settings* command on the File menu. The settings form is shown in Figure 56. The View tab is used to set font size in the tree and grid views as well as the controlling which property fields are displayed by default. Further you can control how object categories are displayed.

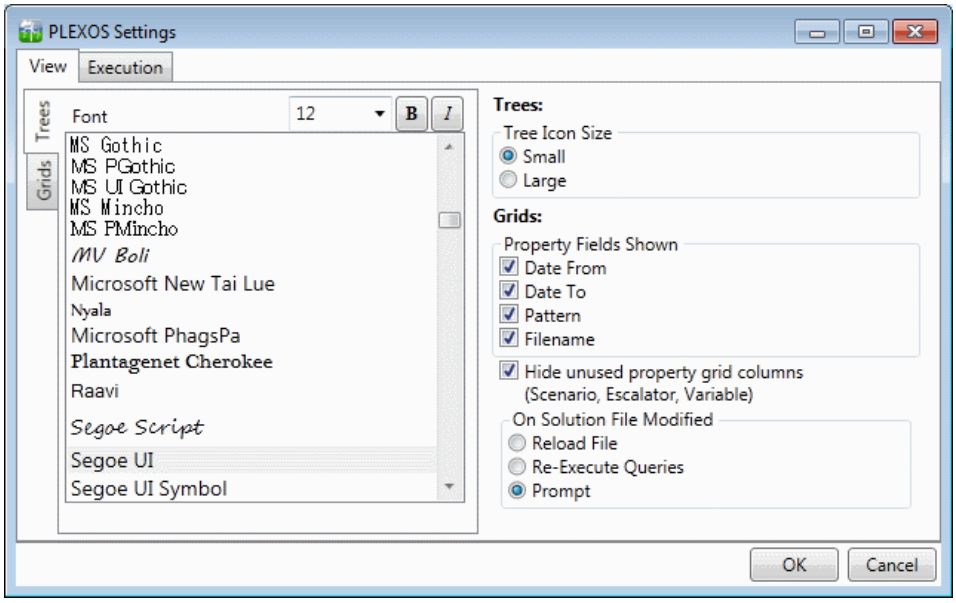



Figure 56: View Settings

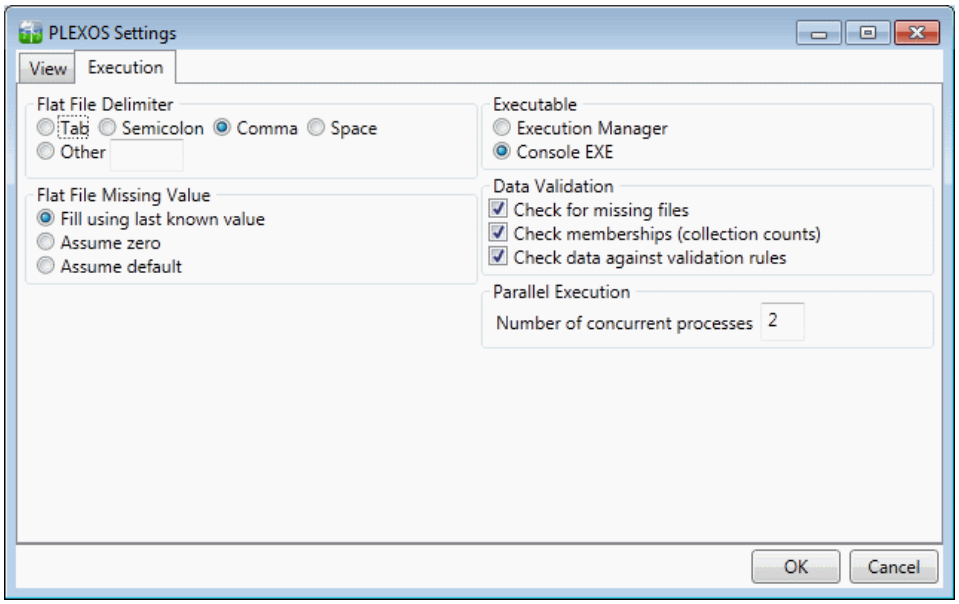



Figure 57: Execution Settings

The options on the Execution tab (Figure 57) are the following:

## Flat File Delimiter (default = Comma)

Sets the default delimiter for text input files: see the help article *Text File Formats.*

### Flat File Missing Value (default = Fill using last known value)

Controls how missing values are handled when reading data from external text files: : see the help article *Text File Formats*.

### Executable (default = Console EXE)

Selects the style of execution window:

***Execution Manager***

A graphical execution window that monitors and reports on the progress of your model runs. This tool allows you to chart some simulation outputs as they are produced. In addition the Execution Manager uses separate process for each Model or Project run in a batch, which can reduce memory fragmentation.

***Console EXE***

A simple console window execution. This option uses the smallest amount of resources.

***TIP:*** *The console version has the advantage that it can be easily paused (PAUSE key) and interrupted (CTRL-BREAK).*

### Parallel Execution

The option **Number of concurrent processe**s sets the number of execution streams that can be run in parallel using the **Execute in Parallel** feature of the Execution window.

### Data Validation (default = ON)

These options control the scope of data validation that occurs at the start of execution:

***Check for Missing Files***

Parses the database for links to external files and checks that those files exist before continuing the simulation.

***Check Memberships***

Checks that any required memberships are defined and that any relevant collections are not over-populated and issues appropriate error messages.

***Check Properties***

Runs a series of logic and other checks over the defined properties and issues appropriate error messages.

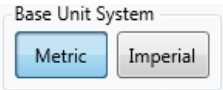
## 9.1 File Settings

The Settings form is accessed from the *Settings* toolbar command and controls two aspects related to the current input file:

- The units used for certain properties like heat rates, fuels, and emissions; and;
- The list of assemblies to be loaded at runtime which contain customizations written by the user.

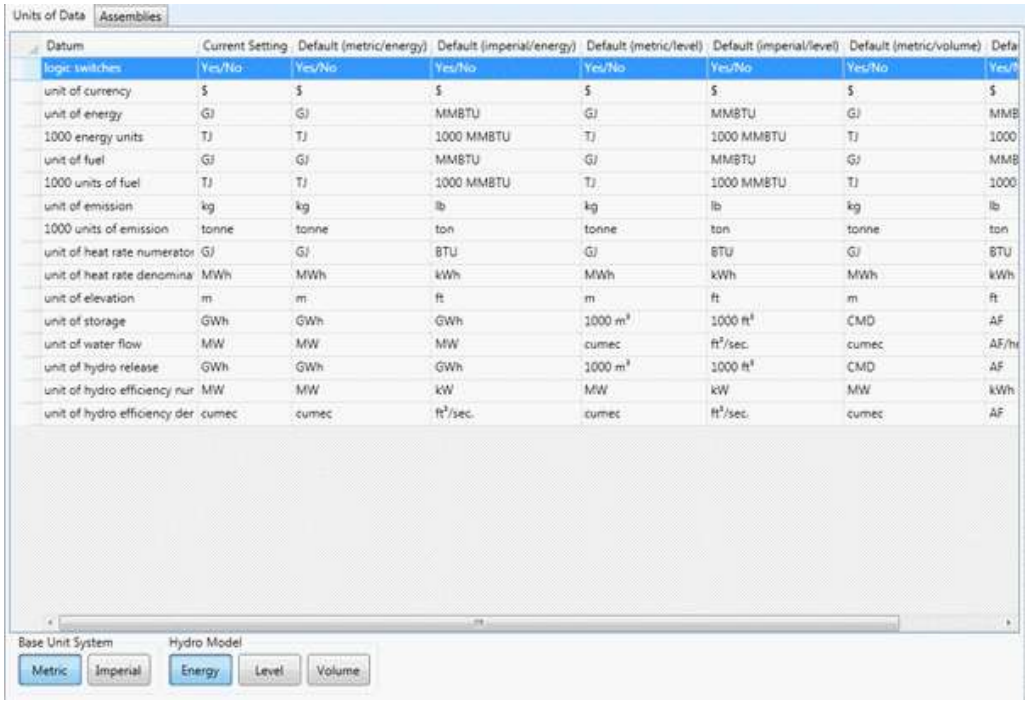
### Units of Data

PLEXOS supports two Unit systems – Metric and Imperial US,




and within that, three systems for defining Hydro data – Energy, Level and Volume.

For detailed information on units of data and unit conversions, please refer to the *Concise Modeling Guide* PLEXOS help article.




| Datum | Current Setting | Default (metric/energy) | Default (imperial/energy) | Default (metric/level) | Default (imperial/level) | Default (metric/volume) | Defa |
|---|---|---|---|---|---|---|---|
| logic switches | Yes/No | Yes/No | Yes/No | Yes/No | Yes/No | Yes/No | Yes/N |
| unit of currency | $ | $ | $ | $ | $ | $ | $ |
| unit of energy | GJ | GJ | MMBTU | GJ | MMBTU | GJ | MMB |
| 1000 energy units | TJ | TJ | 1000 MMBTU | TJ | 1000 MMBTU | TJ | 1000 |
| unit of fuel | GJ | GJ | MMBTU | GJ | MMBTU | GJ | MMB |
| 1000 units of fuel | TJ | TJ | 1000 MMBTU | TJ | 1000 MMBTU | TJ | 1000 |
| unit of emission | kg | kg | lb | kg | lb | kg | lb |
| 1000 units of emission | tonne | tonne | ton | tonne | ton | tonne | ton |
| unit of heat rate numerator | GJ | GJ | BTU | GJ | BTU | GJ | BTU |
| unit of heat rate denomina | MWh | MWh | kWh | MWh | kWh | MWh | kWh |
| unit of elevation | m | m | ft | m | ft | m | ft |
| unit of storage | GWh | GWh | GWh | 1000 $m^3$ | 1000 $ft^3$ | CMD | AF |
| unit of water flow | MW | MW | MW | cumec | $ft^3$/sec. | cumec | AF/h |
| unit of hydro release | GWh | GWh | GWh | 1000 $m^3$ | 1000 $ft^3$ | CMD | AF |
| unit of hydro efficiency nur | MW | MW | kW | MW | kW | MW | kWh |
| unit of hydro efficiency der | cumec | cumec | $ft^3$/sec. | cumec | $ft^3$/sec. | cumec | AF |

Figure 58: Units of Data Settings

### Assemblies

The Assemblies tab allows you to list custom dynamic link libraries that will be loaded at runtime. These DLL can be used to customise many of the functions in the simulation, as well as provide entirely customised reports. Please refer to the *Automation* PLEXOS help article for more information.

# 10 Simulation

The details that PLEXOS needs to set up for a simulation run are:

1. A *planning horizon* over which to run the simulation (defined by a Horizon object)
2. A selection of fields to *report* in the solution file (defined by a Report object)
3. A selection of *algorithms* to run: we will refer to these as *simulation phases*.

Beyond this there are a set of objects that control detailed simulation settings, and these are described later.

A new PLEXOS input file is already set up to execute a simulation for a single day using the full chronological model (ST Schedule simulation phase).

## 10.1 Model

In PLEXOS the Model class acts as a container for all the settings required to define a simulation run. The complete functionality of the Model class is described later. For the time being we describe how to review/change the basic settings so that you can execute a simulation.

To begin, open the Model properties window. You do this by going to the Simulation tree, opening the Models collection and double-clicking the Model you want to execute. By default there is a just one Model in this collection. The Model properties window is shown in Figure 59. The tabs in this window allow you to review all the simulation settings such as Horizon, Report, *etc*.

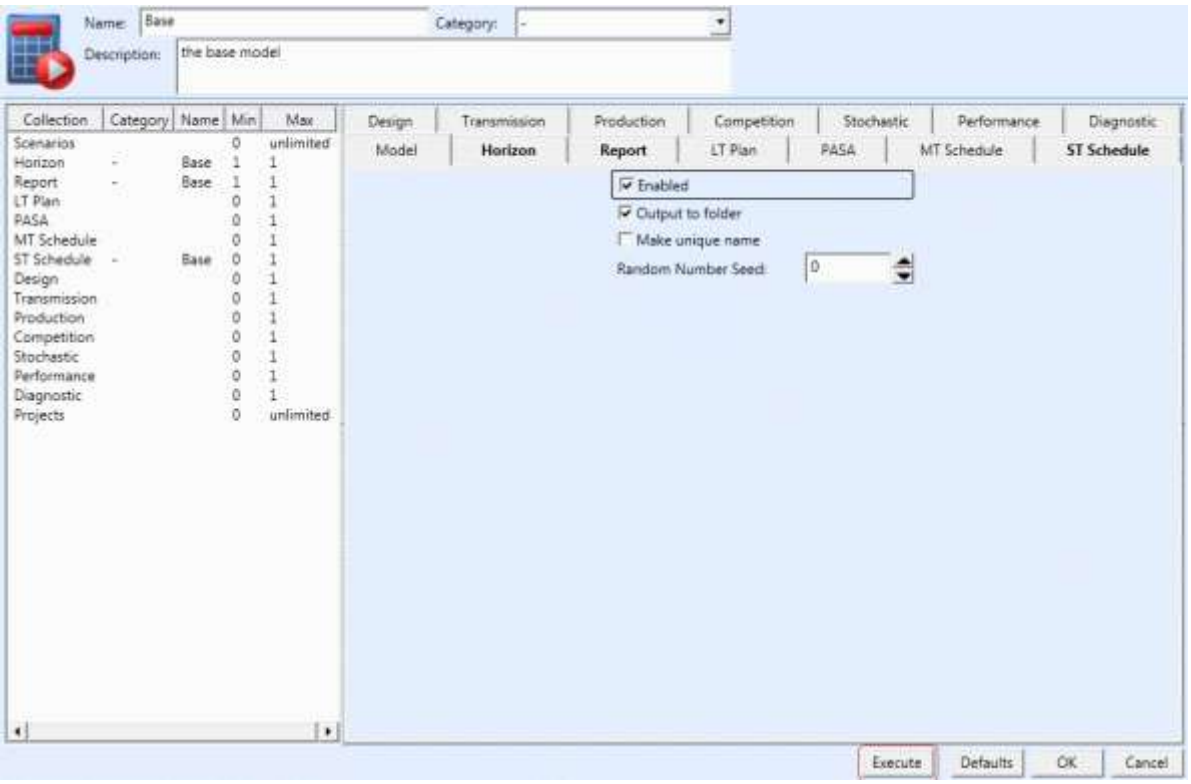



Figure 59: Model properties window

Note that the Model can be executed immediately using the **Execute** command on this form. But in general you can launch multiple Models in a batch using the **Execute** command from the program ribbon.

## 10.2 Horizon

The Horizon "Base" Properties are shown in Figure 60. Note that you can also access the properties for the Horizon directly from the Horizon object in the Simulation tree.

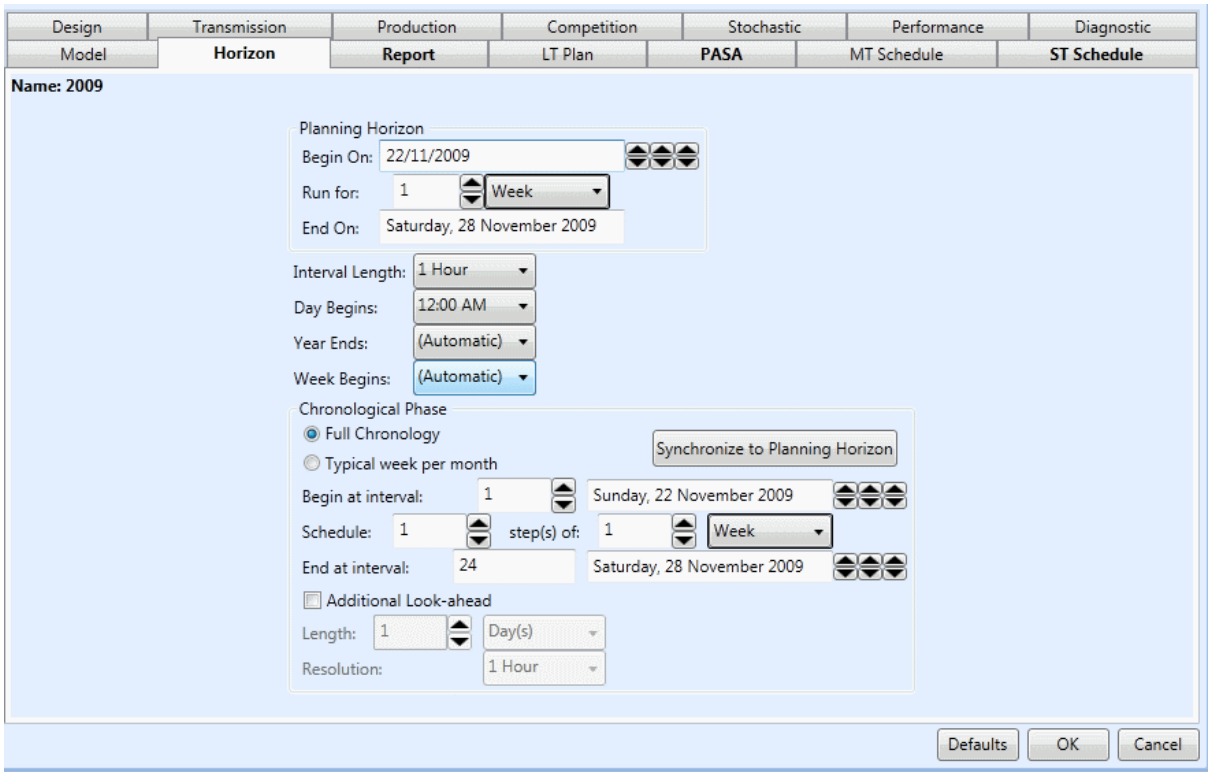



Figure 60: Model Horizon properties

The elements on this form are:

### Planning Horizon

The simulation will run across the entire planning horizon.

### Begin on (Horizon [Planning From])

Sets the start date of the planning horizon

### Run for (Horizon [Step Count], [Step Type])

Determines how many days/weeks/months/years the planning horizon is to run over

### End on

Reports the end of the planning horizon based on the *Begin on*, and *Run for* settings

### Interval Length (Horizon [Intervals per Day])

Sets the duration of each interval (or "trading period") in the market: this is converted to the Horizon property [Intervals per Day], for example hourly is converted to 24 intervals per day

### Day Begins (Horizon [Day Beginning])

Sets the time (hour of the day) at which the day starts from the point of view of the market

### Year Ends (Horizon [Fiscal Year Ending])

Determines when the year will end: this can be set manually by choosing a month or set automatically

### Week Begins (Horizon [Week Beginning])

Determines what day of the week a week starts on, this can also be chosen manually or set to automatic

## Chronological Horizon

The chronological horizon applies to the ST Schedule simulation phase, which is the default simulation method.

### Begin at Interval

Allows the selection of the starting point for ST Schedule: this date and interval must be inside the planning horizon:

### Schedule

Indicates how many intervals and what size to step forward from the starting date and interval. When these settings are updated the end date and interval are calculated automatically. ST Schedule uses a very detailed mathematical model of the system, thus it usually necessary from a computational point of view to solve the horizon in steps. Generally, steps of one week at a time are adequate for moderate sized systems. If only a few intervals/days are required then the ST Schedule can be set to solve in a single step.

### End at Interval

This is automatically calculated based on *Schedule* selections (see above).

### Synchronize to Planning Horizon

Sets the chronological horizon to match the planning horizon as closely as possible: there may be a mismatch if the planning horizon for example is in years and the chronological model is running in weeks, in which case you might need to add some additional time to the planning horizon to fit the chronological horizon, *e.g.* your planning horizon would need to be 53 weeks long to model a year with weekly chronological steps.

### Additional Look-ahead

Extends each step of ST Schedule by a number of intervals/days/weeks which improves decisions such as unit commitment or pumped storage dispatch. This is because the optimization has more 'look-ahead': The planning horizon must be long enough to cover the look-ahead of the last step.

## 10.3 Report

There are two aspects to the Report settings:

1. The types of data reported: every simulation interval, daily summary, weekly, etc
2. The list of properties reported: referred to as the *Field List* for the Report.

From the Model properties window you can select the Report tab to see the types of data reported on, as in Figure 61.

### Report Attributes

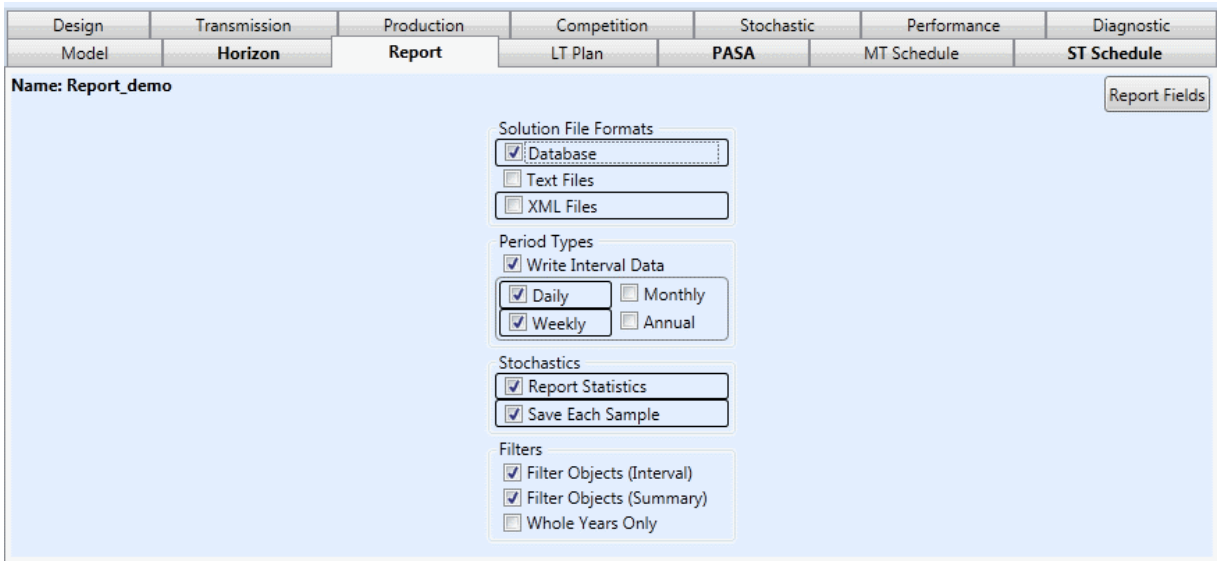



**Figure 61: Model Report properties**

The Report form has the following options:

### Solution file formats

Determines which output formats are used to write the solution data for each executed Model:

#### *Database*

If Microsoft Access is installed on the computer PLEXOS can write MDB solution files (compatible with older PLEXOS versions), but it cannot open them in the user interface. Therefore it is recommended to upgrade to (zipped) XML solution file format.

#### *Text Files*

The solution is written to a set of text files arranged in a folder structure. These text files are in a format that can be read back into PLEXOS as input. Thus this option is suitable when you want to run a sequence of simulations with one simulation reading some aspects of the solutions of previous simulations, for example running a day-ahead and then real time simulations.

#### *XML*

By default, PLEXOS uses zipped-XML format for solution files. Zipped-XML means that the solution files are written as a ZIP file which contains a combination of XML and binary data. Zipped-XML is approximately 10 times more efficient in terms of file size than MDB, and there is no limit on the size of the solution file (MDB is limited to 2GB). Zipped-XML is the format required for use with PLEXOS Connect client-server.

PLEXOS opens these ZIP files to view/ query the solution. The files have the same naming convention as previous PLEXOS versions, *e.g.* Model "Base" will have solution file "Model Base Solution.zip".

### Period Types

PLEXOS can automatically summarize the period-by-period simulation results by day/week/month/year and this option allows you to choose which of these summaries are written to the solution file. You can also choose to turn off writing of interval-by-interval data.

### Stochastic

When running a simulation with multiple Monte Carlo or other samples you can choose to write statistics for each output (Min, Max, and Standard Deviation of values) or even report every sample's results. By default only the mean value will be reported. Note that in the Field List for the Report you can choose exactly which properties have their sample results and/or statistics reported, thus you have complete control over the degree of output of every field.

### Filters and Membership List

The Memberships list on this form allows you to choose which objects are reported on. By default (empty Report collections) all objects will be reported, but for example you might want to report only a selection of Generator objects. To do this first you would add those Generator objects to the [Generators] collection of the Report (by double-clicking the [Generators] collection in the Memberships lists and using the Membership editor), then you can choose how this "filter" is applied, *i.e.* do you want to report only those objects' interval data, summary data, or both. These controls allow you to precisely control the amount of data reported.

### Report Field List

The list of properties that will be output is edited in the Report Field List. To access this screen you need to open the property window for the Report object as in Figure 62. This can be accessed by clicking the **Report Fields** button the Model Report tab or by opening the property window for the Report object itself (double click the Report object in the Simulation tree or from any Membership window) or select "Report Fields" menu item from the Report object context menu.

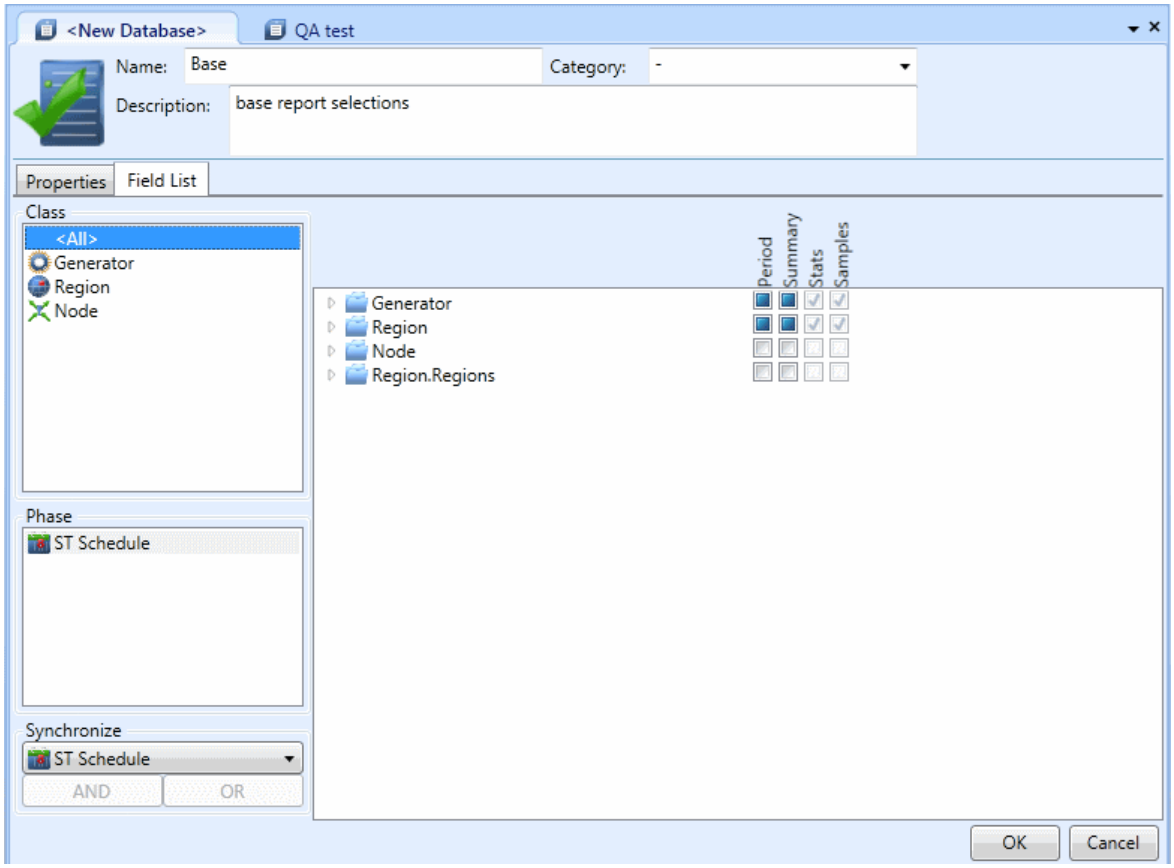



Figure 62: Report Field List

On the left-hand side is:

- The list of classes for which at least one object is defined in the database.
- The list simulation phases for which at least one simulation phase object (LT Plan, PASA, MT Schedule, or ST Schedule) is defined in the database.
- Additional controls to aid synchronising selection of properties between simulation phases.

The right-hand side shows the properties available for reporting grouped by class using a tree view with those properties selected indicated with a tick. When you select a particular class in the left-hand side the tree expands automatically to show the selected properties as in Figure 63.

Pressing F1 (help) key with any property selected will open the help file with that property's description as the current page.

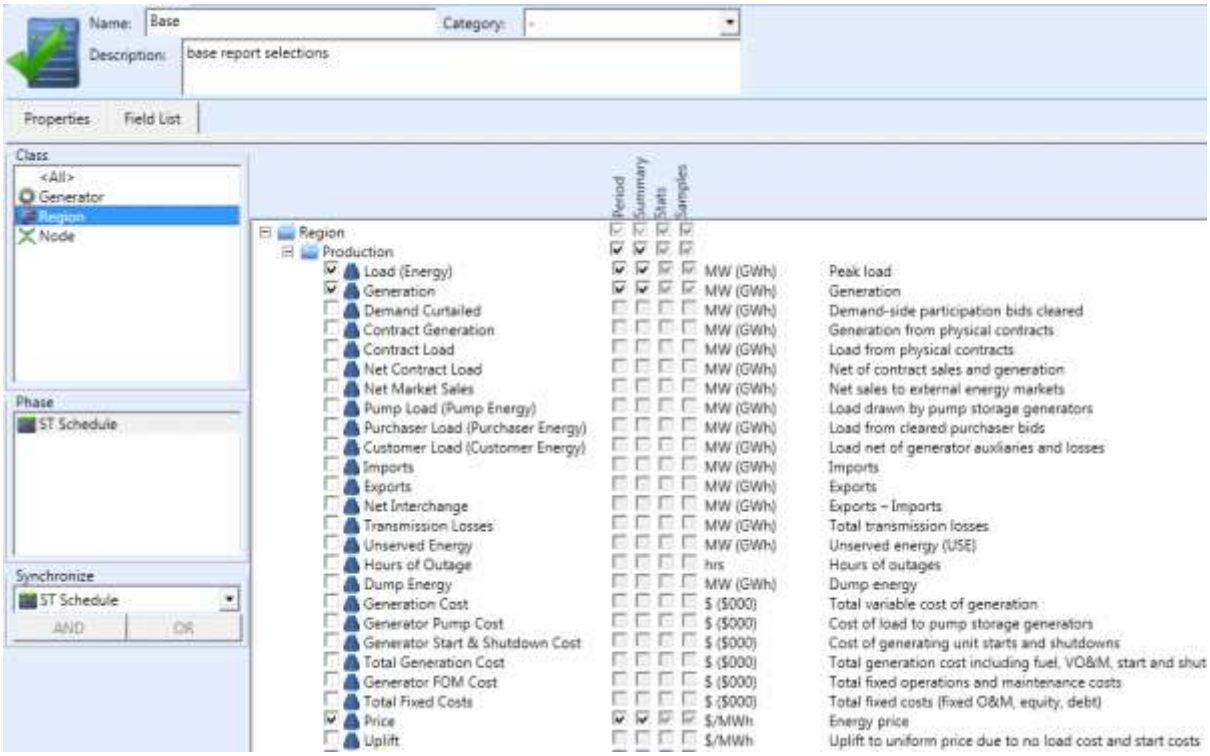



**Figure 63: Report Field List for Class**

You are able to set the following attributes for each enabled property:

## Period

Check this box to report the property for every simulation interval (period).

## Summary Data Fields

Check this box to report the property for all selected summary period types (according to the list of selected period type in the Report property window).

## Statistics

Check this to report minimum, maximum and standard deviation of the property values when running a multiple-sample simulation.

## Samples

Check this to report every sample value when running a multiple-sample simulation.

***NOTE:*** *For transmission modelling there are additional reporting switches that can be set in Transmission attributes (e.g. the kV level at which transmission reporting begins).*

Report field selections are set by simulation phase. The phases LT Plan, MT Schedule, and ST Schedule all share the same list of report properties. PASA uses a subset of those properties. Having the flexibility to select properties by phase allows for very precise control of the report selections and hence of the simulation run time and output file size.

If you have made a series of property selections in one phase e.g. in ST Schedule and wish to synchronise those selections with another phase e.g. MT Schedule, use the **AND** and **OR** buttons:

### AND Command

The **AND** command will select all properties in the two phases where the property is selected in both field lists, and deselect all other properties for those phases.

### OR Command

The **OR** command will select all properties in the two phases where the property is selected in either field list, and deselect all other properties for those phases.

## 10.4 Execution

When all data have been entered and the horizon and reports settings have been established PLEXOS has all the information it needs to execute a simulation.

Model objects are the execution control objects for the PLEXOS simulation engine. Any newly created database will contain one Model. The best way to think of a Model is that it is a collection of controlling parameters, settings, and options that in combination comprise a run of the simulator[2]. An input file can contain any number of Model objects each representing a unique simulation 'run'. Model objects can vary in their:

- Horizon object
- Report object
- the Scenario objects they use and hence the data connected to those scenarios
- market design, transmission, production, competition, stochastic, performance, and diagnostic settings

To execute the currently enabled Model(s) do the following:

1. Click *Execute* from the main toolbar
2. The Execute window appears (as shown in *Figure 43*)
3. Click OK to begin execution

Elements on the *Execute* form are the following:

### Models

Lists available Model objects

### Models to be executed

Lists Model objects that are selected for execution

### Add

Adds the selected Model object to the list of those to be executed

### Remove

Removes the selected Model object to the list of those to be executed

### Execute

Begins execution of the selected models

### Execute In Parallel

Executes a number of simulations in parallel.

### Components of selected Model

In the Components list, each class can be configured by right-clicking and selecting *Properties*.

A properties dialog will then be displayed:

- Horizon: see above

[2] Importantly because they are an integral part of the Object Model they are subject to the same referential integrity rules of all other PLEXOS® objects, so your simulation settings will not become orphaned from the System they control.

- Report: see above
- LT Plan: see the article *Capacity Expansion Planning*
- PASA: see the *PASA* in the Help system
- MT Schedule: see the *MT Schedule* in the Help system
- ST Schedule: see the *ST Schedule* in the Help system

For a description of the Design, Transmission, Production, Competition, Stochastic, Performance, and Diagnostic items see the Help system for these classes.

Multiple models can be executed in parallel or sequentially. The **Execute** command will queue all selected Model objects for execution and run them *in sequence* in the order shown in the Execute window.

## 11 The Execute in Parallel command is available when more than one Model is selected for execution. This command will launch multiple streams of execution *in parallel*. The number of streams is controlled by Protecting Data

To protect data from accidental change you can lock various parts of the database to editing. The locking controls are settable by database and are located under the **Settings** menu on the **Home** ribbon. The **Locks** tab contains the controls shown in Figure 54.

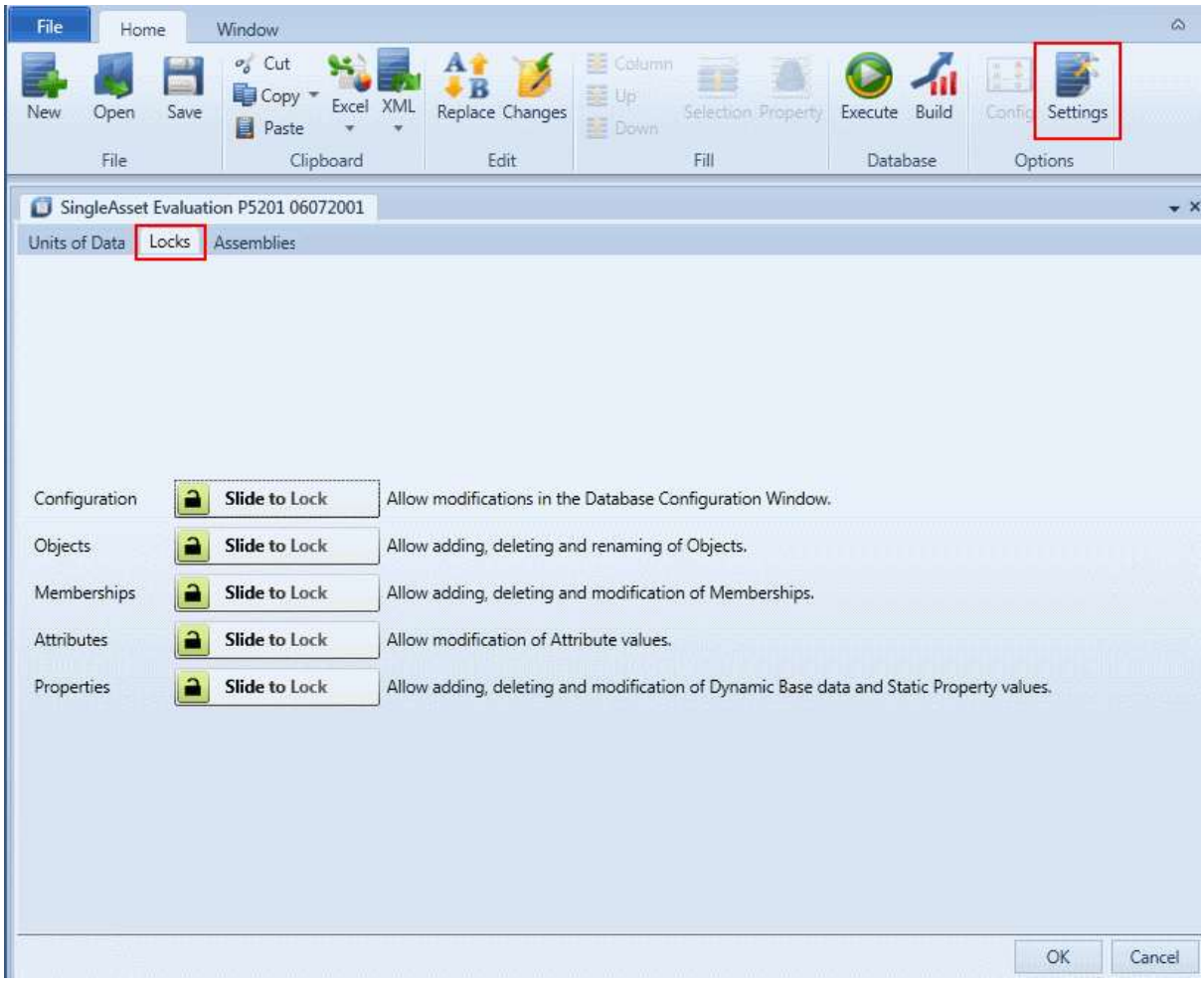



Figure 54: Locks Settings for Current Database

The locks are enabled or disabled by sliding the lock image across the slider control. Figure 55 shows the options all in the locked state.

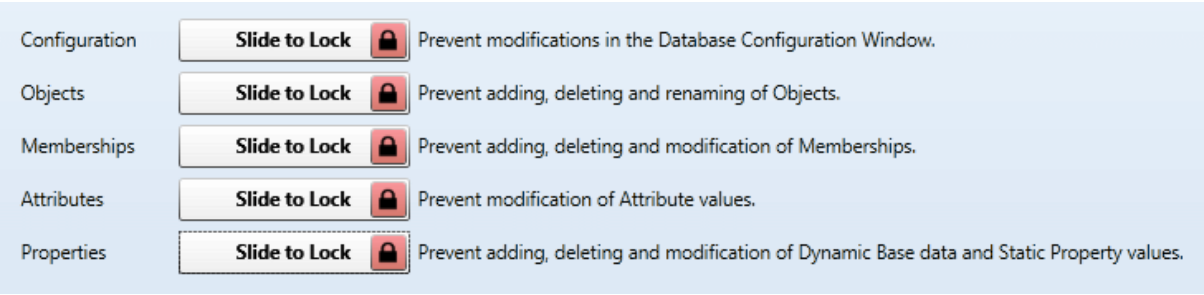



**Figure 55: Locks in Locked State**

## Configuration

Locks or unlocks the Configuration window. Locking this prevents the user from enabling or disabling features such as collections and properties or changing the dynamic/static status of properties. The Configuration screen is still accessible but is placed in a read-only state.

## Objects

Locks or unlocks the Objects grid. Locking this prevents adding, deleting, editing or renaming any object. The Objects grid is placed in a read-only state as are the name, category and description controls on the class forms.

## Memberships

Locks or unlocks the Memberships grid. Locking this prevents adding, deleting or editing memberships.

## Attributes

Locks or unlocks object attributes. This applies particularly to simulation settings pages. Locking this prevents the user from changing simulation options such as Production or Transmission settings.

## Properties

Locks or unlocks properties. Locking this prevents adding, deleting or editing properties. There are two levels to this control as described below.

The Scenario [Locked] attribute allows you to choose which data can be edited and which are locked. For data that are *not* marked with a Scenario the Properties Lock option directly controls the lock/unlock status. But for data marked with a Scenario the Scenario attribute [Locked] controls the locking. The row marker for the Properties Grid shows a lock symbol for the rows that are locked (the base data). The Scenario data are by default Unlocked.

PLEXOS Settings and defaults to two streams. For example if 10 Models are run and two streams of execution are set, then each stream will run five Model objects each. Execution within a stream is sequential. The Model objects are assigned to streams such that the Models run in approximately the same order as they would under sequential execution.

Note that:

- You may need multiple licences to run more than one stream in parallel.
- You should only use as many streams of execution as your computer is capable of handling. For example a computer with 8 cores and 8GB RAM might be able to run four streams of execution in parallel (depending on the size of the individual Models), but a computer with only 2 cores and 2GB might not be able to run more than a single Model at a time.

The solution data for each Model will be sent to separate output files/folders: see the Help on the Project class for a description of how to save multiple Model results into a single output database.

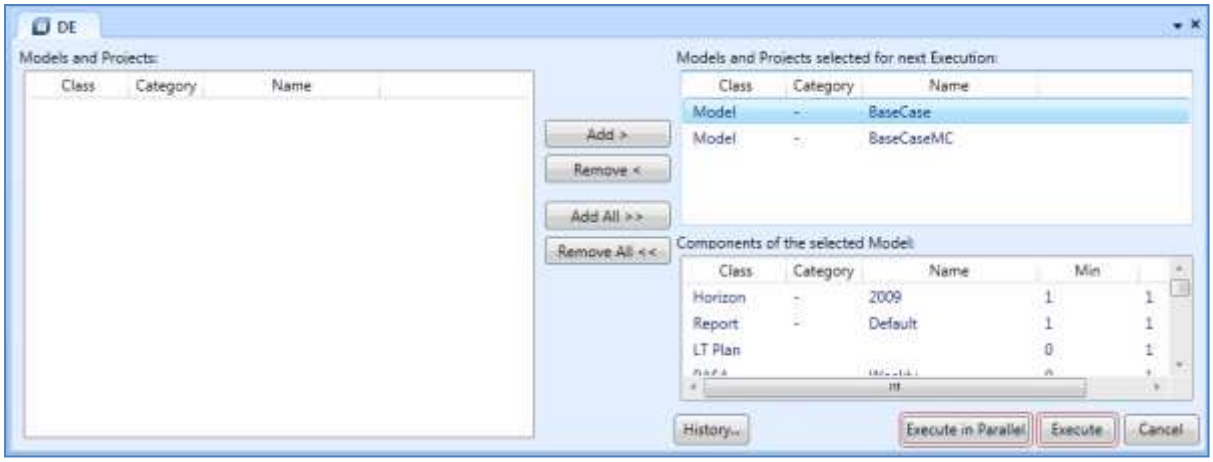



**Figure 64: Execution window**

The Execution dialog box shows:

- Progress indicators for each of the solvers (Pre-schedule, MT Schedule, and ST Schedule) and associated sub-processes
- Elapsed time
- Conditions indicator: either "No Warnings", "x Warning(s)", or "Error"
- A read-out of all log, warning, and error messages

***NOTE:*** *Any error messages that cause execution to fail will appear in the log window. This log is also written to disk under the same name as the solution file, but with ".txt" extension.*

By default, the solution file is written to the same directory as the file with the name "Model xxx Solution.zip", where xxx is the name of the Model object executed.

***IMPORTANT:*** *Existing solution files are overwritten without warning!*

The time of the execution can vary widely and depends on:

- The number and complexity of the objects defining the problem
- The resolution (hourly, 5-minute)
- The type of algorithm(s) being executed
- The mathematical solver employed

Execution time is very dependent on the size of the mathematical programming problem(s) that need to be formulated and solved.

## 11.1 Detailed Simulation Settings

Simulation settings are contained in a number of separate components defined in objects of the *Settings* group (see *Figure 39*, in section 5.9). A Model then uses the settings by having memberships with those objects. The settings objects (called Model *components*) that will be used by a Model are displayed in the Model property dialog (*Figure 45*). This dialog is accessed via the right-mouse button pop-up menu for the Model in the Simulation tree.
In order to locate the Model object pop-up menu:

1. Select the Simulation tree
2. Open up the Models collection
3. Right click on the Model object you wish to edit and select *Properties* (*Figure 44*)

To change a simulation setting you need to access the properties of the components. For example, to change the settings related to the horizon (the timeframe over which the simulation is run), select the Horizon tab in the Model properties window as in Figure 59. You can also access these properties directly on the Horizon object itself from the Simulation tree or anywhere you see the object in a Membership list.

***TIP:*** *Double-clicking the object in the Memberships list will also bring up the Memberships editing form where you can change the associated component.*

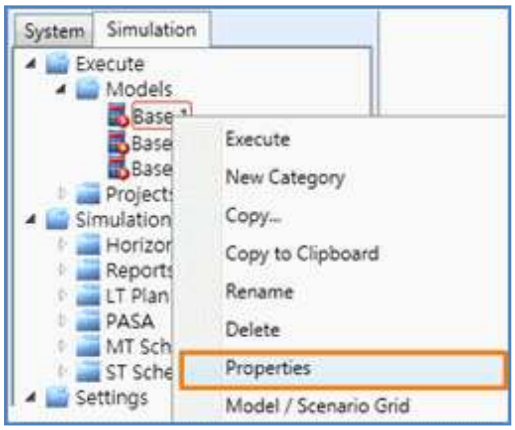



**Figure 65: Model pop-up menu**

***NOTE:*** *The component list shown below is also available from the Execute dialog as in* Figure 64.

## 11.2 Models and scenarios

For a problem of any complexity you may wish to change the values of certain data according to a number of possible scenarios. When PLEXOS executes your simulation it actually executes the system as defined by a Model object, not all the data in the file. As well as having separate settings such as Horizon and other options, Model objects have a collection called [Scenarios].

A Scenario is an object that is used to 'tag' (or label) some data: see the section Scenarios on page 48 for more details.

The list of Scenarios used by a Model is defined by the memberships and can be viewed in the Memberships tree under the Model.

The dynamic property grid will show all the Scenario data for the selected model when you select the Scenarios collection under a Model.

For convenience you can also use the Model/Scenario Grid to review and change the memberships of Models and Scenarios. This grid is accessed from the right-mouse button menu of a Model or the Models collection. Use the checkboxes to turn on/off a Scenario in a Model. This causes the appropriate membership to be created/deleted.

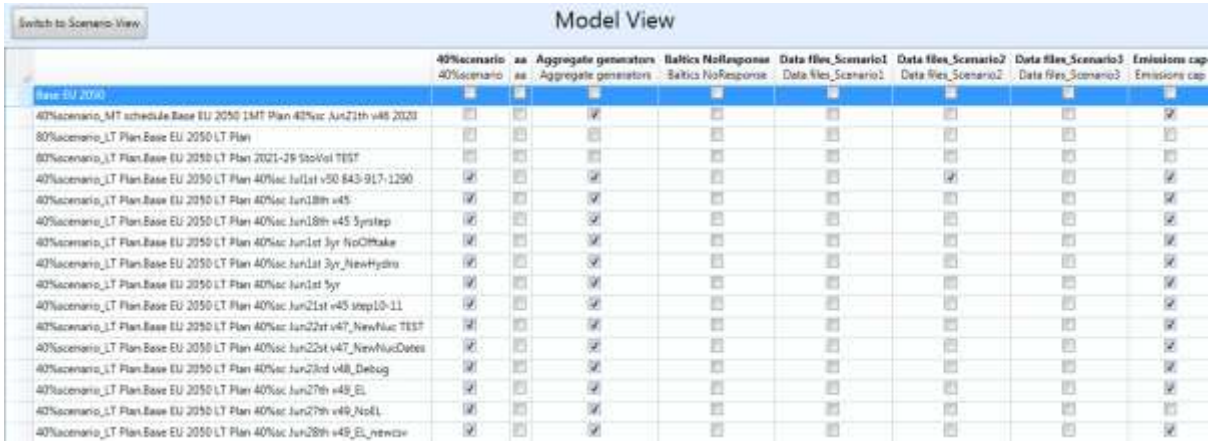



Figure 66: Model Scenario Grid

# 12 Visualising the System

The following graphical features are available in PLEXOS to aid with visualising the system:

1. Membership Viewer: allows you to trace the sequence of memberships between objects
2. Transmission Export: shows the entire transmission network or selected parts in a fully graphical manner

## 12.1 Membership Viewer

This feature is available as a right-mouse command of any object in the Main Tree or Simulation Tree. The viewer allows you to follow the relationships between objects. In Figure 67 we show the membership view for a Generator. The first panel shows all the memberships for the Generator (the 'root object'), the second shows the memberships for the selected child object in the first panel (for example all the memberships involving the Node the Generator connects to). The third panel shows all the memberships for the selected object in the second panel. You can change the selections in any panel to show the corresponding memberships in the other panels. To change root object, just double-click any object in any of the panels. This allows you to keep following a trial of memberships through the database.

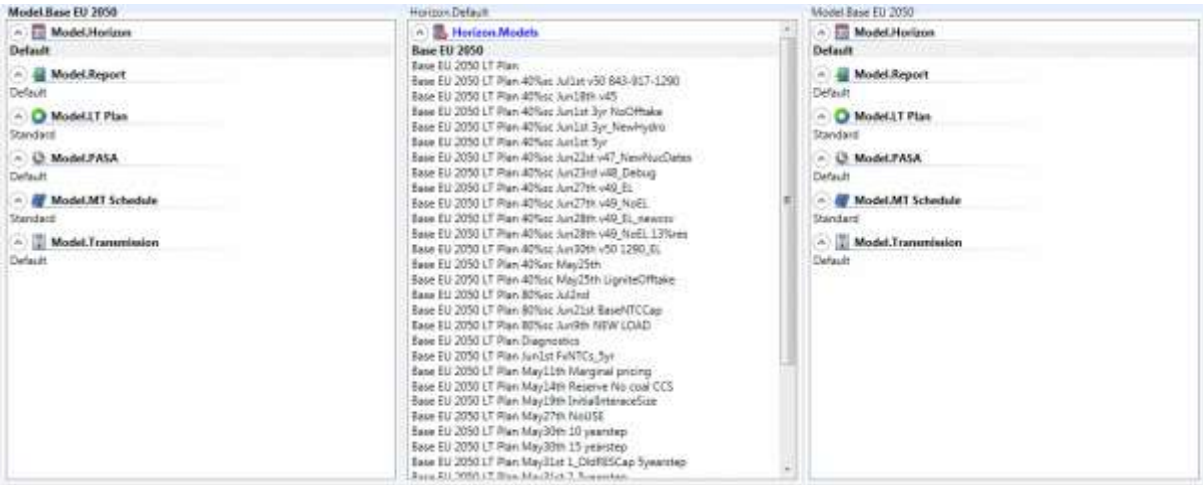



Figure 67: Membership Viewer

On the Window ribbon tab you will find the Membership Map command. Clicking this opens a window that draws a basic map of all the memberships you click as in Figure 68.

Figure 68: Membership Map

## 12.2 Visualization Export

PLEXOS can export the transmission schema to one of a number of standard formats that can be viewed in visualisation tools. The schema can be saved with or without coordinates. If you wish to enter the exact coordinates you can enter them on the attributes:

- Node [Latitude] and Node [Longitude]
- Generator [Latitude] and Generator [Longitude]
- Storage [Latitude] and Storage [Longitude]

### Exporting

To export the power system including nodes, lines, transformers and connected generators and storages and waterways select the **Visualization** command from the Backstage menu. The menu allows you to write to one of these formats:

**Google Earth (KML)**: can be opened directly in Google Earth.

**Geographical Mark-up Language (GML)**: can be read by many third-party tools.

For more detail see the "Visualization" section of the PLEXOS help file.

# 13 Solution files

Model solution files are named "Model <ModelName> Solution.zip" and Project solution databases are named "Project <ProjectName> Solution.zip". PLEXOS can open these solution files directly. The GUI provides a convenient and powerful way to query, chart, and export the solution data as well as reviewing the simulation log file.

***NOTE:*** *Only properties selected in the Report screen prior to executing the Model are available in the solution database.*

When you open a solution file in the GUI you are presented with the view shown in Figure 69.

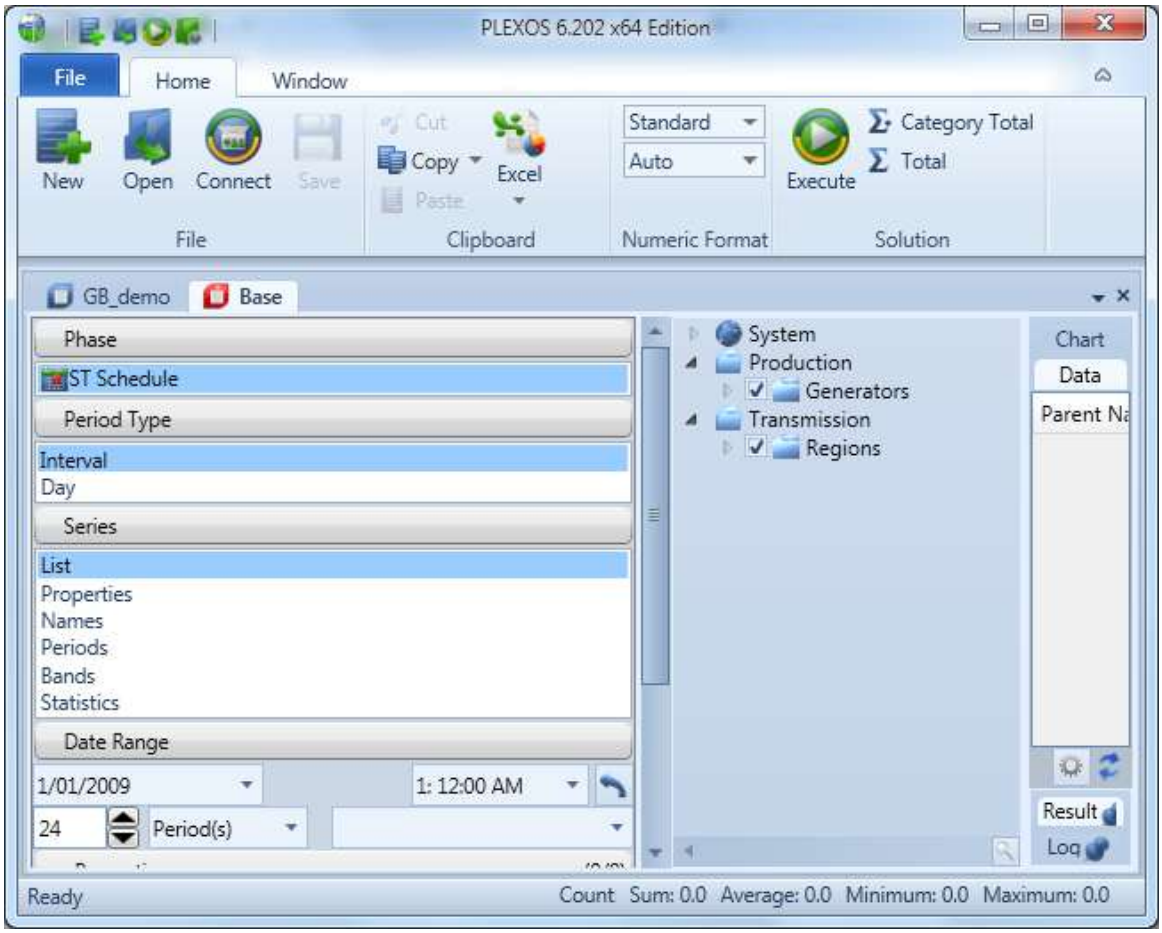



**Figure 69: Solution file view**

## 13.1 Log File

Firstly notice that three tabs are provided by default. The last of these tabs contains the log file of the simulation as shown in Figure 70. You can use the find (magnifying glass button) to search the log.

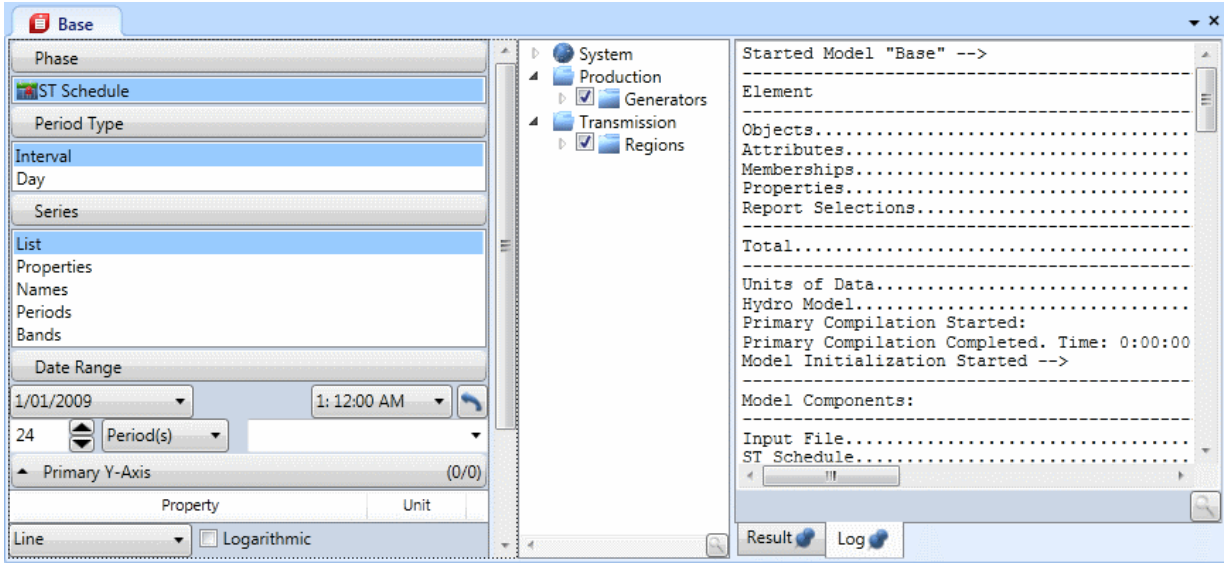
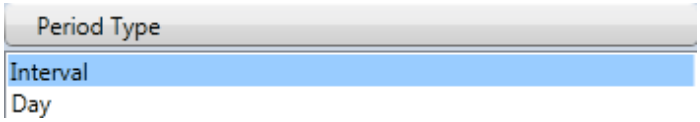



Figure 70: Solution log file view

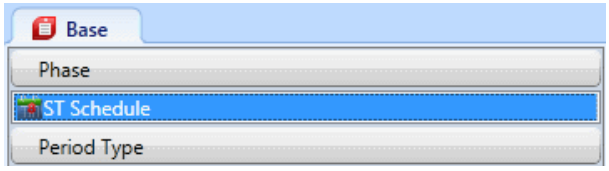
## 13.2 Phases, Periods Types, and the Property List

When you open a solution database, PLEXOS scans the file to see which period types of data are written into the file: the Period Type selector then shows only the available types as in this example. Refer to Report on page 66 for details of how to select period type for reporting.




Summary data (day, week, month, year) are available in the solution database if these data were selected in the Report screen. Summary data are usually in thousands of units, *e.g.* GWh rather than MW. Most views show the Units column or the Unit in the column heading (properties view).

Simulations are usually composed of more than one simulation phase (algorithm such as ST Schedule). The list of phase solution stored in the solution files are listed in the phase selector:




As shown Figure 71, the list of properties that are available are shown when you select a collection.

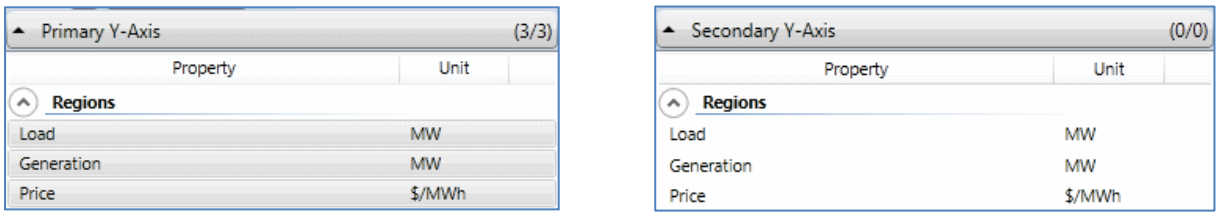



Figure 71: Available solution properties for collection

Selecting a different period type changes the list of available properties. The list of available properties shows the collection name, property name, and units for each datum. Most properties belong to System collections, *e.g.* [Generators] [Generation]. Some models will have second-level properties, *e.g.* in Generator [Fuels] [Cost] is the cost of the fuel used for each fuel by each generator.

You can select any property or group of properties (using the CTRL key + mouse click).

Click the query execute command to see the data:

Shown in Figure 72 are data in the default *List View*. In List View there is a single column of values, the other columns show the collection and (optional) category for the objects associated with the data.

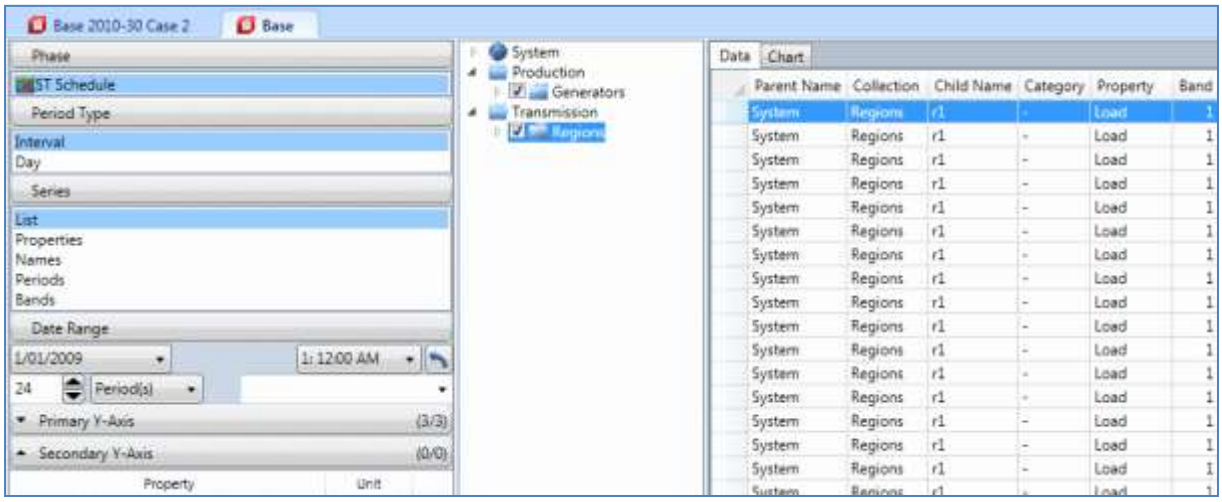
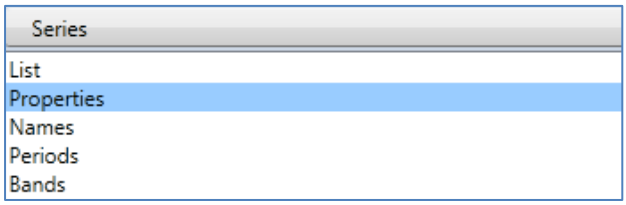


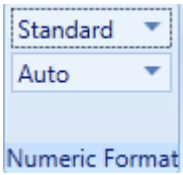

Figure 72: Solution data in List view

There are several alternate grid layouts available:




## 13.3 Numeric Format

Use the Numeric Format ribbon commands to apply a different number format to the query results. The default is "Standard" which is based on the scheme of the same name in the Windows Regional Settings.



## 13.4 Data views

In *Properties View*, the property names are shown in columns. The unit for the data is also shown in the column titles.

Data | Chart

| Parent Name | Collection | Child Name | Category | Band | Date | Generation (GWh) | Hours of Operation (hrs) | Capacity Factor (%) |
|---|---|---|---|---|---|---|---|---|
| NWE System | Generators | DE-AHRENSFELDE | - | 1 | 2009 | 0.28 | 2.00 | 1.11 |
| NWE System | Generators | DE-ALTBACH 5 | - | 1 | 2009 | 56.93 | 119.00 | 70.83 |
| NWE System | Generators | DE-ALTBACH GT | - | 1 | 2009 | 0.00 | 0.00 | 0.00 |
| NWE System | Generators | DE-ALTBACH II 1 | - | 1 | 2009 | 51.68 | 143.00 | 85.12 |
| NWE System | Generators | DE-ALTBACH II 1 GT | - | 1 | 2009 | 0.13 | 2.00 | 1.19 |
| NWE System | Generators | DE-AUDORF | - | 1 | 2009 | 0.00 | 0.00 | 0.00 |
| NWE System | Generators | DE-BARMEN II | - | 1 | 2009 | 1.88 | 23.00 | 13.33 |
| NWE System | Generators | DE-BAYER DORMAGEN | - | 1 | 2009 | 5.15 | 17.00 | 5.48 |
| NWE System | Generators | DE-BAYER DORMAGEN B | - | 1 | 2009 | 13.71 | 131.00 | 61.31 |

**Figure 73: Solution Properties view**

In *Names View*, the object names are shown in columns. The property names are shown in the rows.

Data | Chart

| Parent Name | Collection | Category | Property | Band | Date | Units | DE-AHRENSFELDE | DE-ALTBACH 5 | DE-ALTBACH GT | DE-ALTBACH II 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| NWE System | Generators | - | Available Energy | 1 | 2009 | GWh | 24.62 | 80.37 | 29.30 | 60.72 |
| NWE System | Generators | - | Capacity Factor | 1 | 2009 | % | 1.11 | 70.83 | 0.00 | 85.12 |
| NWE System | Generators | - | Fuel Offtake | 1 | 2009 | TJ | 3.30 | 521.33 | 0.00 | 444.51 |
| NWE System | Generators | - | Generation | 1 | 2009 | GWh | 0.28 | 56.93 | 0.00 | 51.68 |
| NWE System | Generators | - | Hours of Operation | 1 | 2009 | hrs | 2.00 | 119.00 | 0.00 | 143.00 |
| NWE System | Generators | - | Installed Capacity | 1 | 2009 | MW | 152.00 | 478.40 | 222.00 | 361.40 |
| NWE System | Generators | - | Markup | 1 | 2009 | $/MWh | 0.00 | -9.00 | 0.00 | -9.00 |
| NWE System | Generators | - | Net Profit | 1 | 2009 | $000 | -117.33 | -1,724.95 | -156.65 | -1,510.96 |
| NWE System | Generators | - | Net Revenue | 1 | 2009 | $000 | 1.20 | -153.33 | 0.00 | -85.15 |
| NWE System | Generators | - | Price Received | 1 | 2009 | $/MWh | 76.04 | 32.88 | 0.00 | 31.89 |
| NWE System | Generators | - | SRMC | 1 | 2009 | $/MWh | 71.82 | 35.57 | 88.52 | 33.54 |
| NWE System | Generators | - | Start Fuel Offtake | 1 | 2009 | TJ | 0.00 | 0.00 | 0.00 | 0.00 |

**Figure 74: Solution Names view**

In *Periods View*, the periods are shown in the columns, and the object names, and properties are shown in the rows. The columns are labelled according to the type of data being shown:

- Annual data shows the year ending
- Monthly data shows the month and year
- Weekly data shows the date the week ends
- Daily data shows the date
- Period data shows the date at the start of each day and the time in other periods

Data | Chart

| Parent Name | Collection | Child | Category | Band | Date | Production (tonne) | Price ($/kg) | Shadow Price ($/kg) | Cost ($000) |
|---|---|---|---|---|---|---|---|---|---|
| NWE System | ST Emissions | CO2 | - | 1 | 22/11/2009 | 788152.89183194 | 0.01 | 0.01 | 7881.5289183194 |
| NWE System | ST Emissions | CO2 | - | 1 | 23/11/2009 | 936442.284802313 | 0.01 | 0.01 | 9364.42284802313 |
| NWE System | ST Emissions | CO2 | - | 1 | 24/11/2009 | 943339.166974287 | 0.01 | 0.01 | 9433.39166974287 |
| NWE System | ST Emissions | CO2 | - | 1 | 25/11/2009 | 856404.940369382 | 0.01 | 0.01 | 8564.04940369382 |
| NWE System | ST Emissions | CO2 | - | 1 | 26/11/2009 | 900621.067131611 | 0.01 | 0.01 | 9006.21067131611 |
| NWE System | ST Emissions | CO2 | - | 1 | 27/11/2009 | 1003477.50979566 | 0.01 | 0.01 | 10034.7750979566 |
| NWE System | ST Emissions | CO2 | - | 1 | 28/11/2009 | 840103.132312087 | 0.01 | 0.01 | 8401.03132312087 |

**Figure 75: Solution Periods view with weekly data**

*Bands View* is used to show multi-band data such as Generator [Offer Quantity], [Offer Price], [Offer Cleared].

| Property | Units | Date | Time | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Offer Quantity | MW | 06-Jul-03 | 12:00 AM | 40.00 | 19.00 | 18.00 | 19.00 | 19.00 | 18.00 | 19.00 | 19.00 | 18.00 | 19.00 | 37.00 |
| Offer Price | $/MWh | 06-Jul-03 | 12:00 AM | 0.00 | 7.18 | 6.80 | 7.32 | 7.40 | 7.24 | 7.59 | 7.75 | 7.74 | 8.13 | 8.30 |
| Offer Cleared | MW | 06-Jul-03 | 12:00 AM | 40.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Generation | MW | 06-Jul-03 | 12:00 AM | 40.00 | | | | | | | | | | |

**Figure 76: Solution Bands view**

*Samples View* is only available in solution files that contain the solution to multiple samples (*e.g.* Monte Carlo draws, or multiple random samples of data: see Report Field List on page 67). Each sample's result is shown in a column.

| Property | Units | Band | Date | Time | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unserved Energy | MW | 1 | 01-Jan-02 | 12:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 1:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 2:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 3:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 4:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 5:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 6:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 7:00 AM | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 8:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 9:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 10:00 AM | 0 | 10 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 11:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 12:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 1:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 2:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 3:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 4:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 5:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 6:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 7:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 8:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 9:00 PM | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 10:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 11:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Figure 77: Solution Samples view**

*Statistics View* is only available where the statistics have been saved. The columns shown are Maximum, Minimum, Std Dev and Mean.

| Property | Units | Band | Date | Time | Maximum | Minimum | Std Dev | Mean |
|---|---|---|---|---|---|---|---|---|
| Unserved Energy | MW | 1 | 01-Jan-02 | 12:00 AM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 1:00 AM | 10.00 | 0.00 | 2.24 | 0.50 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 2:00 AM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 3:00 AM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 4:00 AM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 5:00 AM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 6:00 AM | 10.00 | 0.00 | 2.24 | 0.50 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 7:00 AM | 10.00 | 0.00 | 2.24 | 0.50 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 8:00 AM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 9:00 AM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 10:00 AM | 10.00 | 0.00 | 3.08 | 1.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 11:00 AM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 12:00 PM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 1:00 PM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 2:00 PM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 3:00 PM | 10.00 | 0.00 | 2.24 | 0.50 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 4:00 PM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 5:00 PM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 6:00 PM | 10.00 | 0.00 | 2.24 | 0.50 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 7:00 PM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 8:00 PM | 0.00 | 0.00 | 0.00 | 0.00 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 9:00 PM | 10.00 | 0.00 | 2.24 | 0.50 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 10:00 PM | 10.00 | 0.00 | 2.24 | 0.50 |
| Unserved Energy | MW | 1 | 01-Jan-02 | 11:00 PM | 0.00 | 0.00 | 0.00 | 0.00 |

**Figure 78: Solution Statistics view**

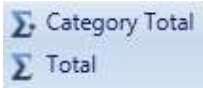
*Models View* is only available for Project databases (*i.e.* database containing the solution to multiple Models). Each Model's result is shown in a column.

| Property | Units | Band | Date | Time | LP | MIP | NI |
|---|---|---|---|---|---|---|---|
| Generation | MW | 1 | 01-Jan-05 | 12:00 AM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 1:00 AM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 2:00 AM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 3:00 AM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 4:00 AM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 5:00 AM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 6:00 AM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 7:00 AM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 8:00 AM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 9:00 AM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 10:00 AM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 11:00 AM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 12:00 PM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 1:00 PM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 2:00 PM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 3:00 PM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 4:00 PM | 0 | 0 | 0 |
| Generation | MW | 1 | 01-Jan-05 | 5:00 PM | 4.992 | 4.992 | 4.992 |
| Generation | MW | 1 | 01-Jan-05 | 6:00 PM | 7.50800002 | 7.50800002 | 7.50800002 |
| Generation | MW | 1 | 01-Jan-05 | 7:00 PM | 5 | 5 | 5 |
| Generation | MW | 1 | 01-Jan-05 | 8:00 PM | 0 | 0 | 0 |

**Figure 79: Solution Models view**

## 13.5 Aggregate query

The data in a collection or category can be automatically summarized to totals using the sum commands:




## 13.6 Limiting Objects in a Result

By default, all objects that were selected for reporting appear in any query. You can limit the objects shown in two ways. Firstly by selecting a category of objects in the tree, and secondly by using the check boxes next to each object. The solution tree shows tick marks next to each object, and these can be used to exclude/include objects from the queries. In the example in Figure 80, all generators belonging to the categories "GAS", "OIL" and "URANIUM" will be excluded from the next query result.

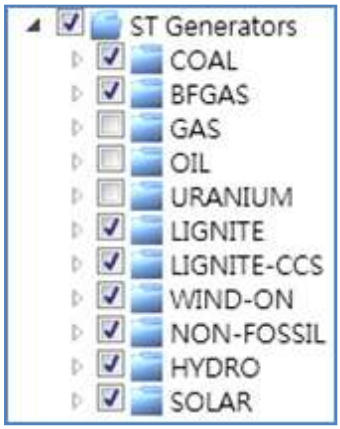
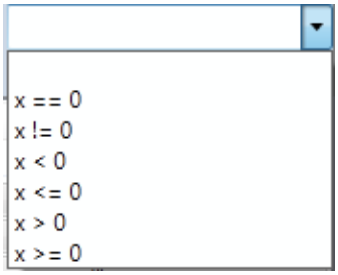



Figure 80: Use of checkboxes

## 13.7 Apply a Criterion

You may want to see only data that pass some criterion. You can use the dropdown next to the period range selector to accomplish this:




Select one of the criteria from the list and execute your query. Only data passing this criterion are displayed. This criterion is also applied when charting data. It is very useful for limiting the returned records of number of series when querying data that are mostly zero values such as [Unserved Energy].

## 13.8 Excel

The *Copy to Excel* function conveniently copies the current query's result to Excel.

This button has a dropdown menu of available options. If no existing Excel instance is running the only available option is to copy the selected data to a new Excel Workbook. But if you have Excel open already the dropdown list allows you to choose from two other options:

- Copy the data to a new Excel Worksheet in a Workbook of your choosing; or
- Copy the data to a block beginning at the current selection the Worksheet of your choosing.

If there is no selection in the data grid then all data are copied, but if a selection is made, only the selected data are copied.

This command supports all versions of Excel from Version 9 through 14.

## 13.9 Clipboard

Data can be copied from the data grid to any application using the standard Copy/ Paste functions on the toolbar.

## 13.10 Charting

PLEXOS includes the Chart Director application embedded into the solution viewer. Any selected query can be viewed as a chart. PLEXOS reads the queried data and creates data series automatically, *e.g.* if you select data from the [Regions] collection, one series is created for each Region object and each property. Therefore you can view chart data from any view.

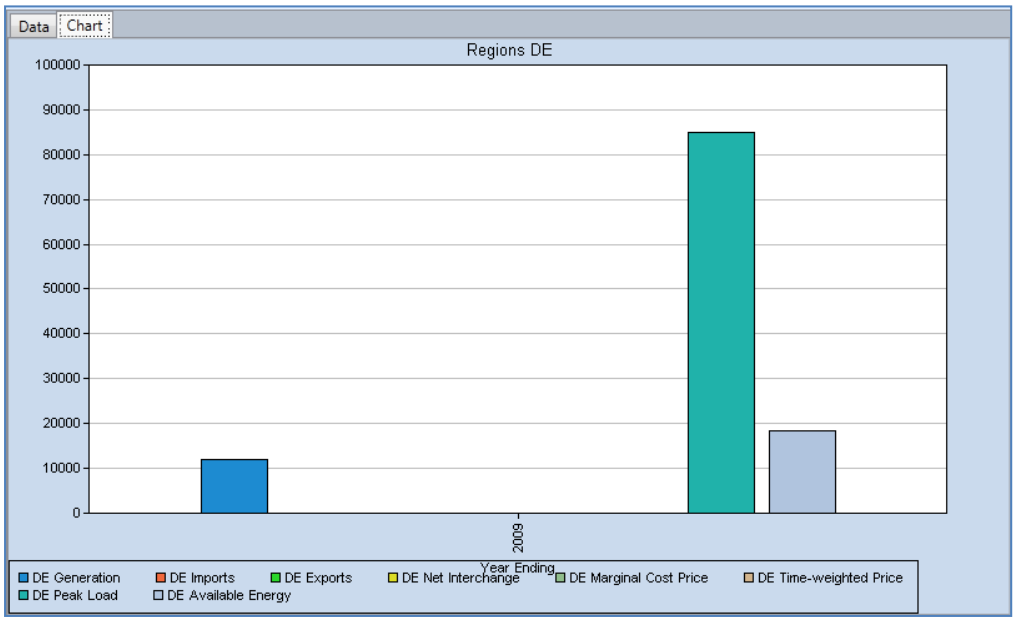



Figure 81: Chart view in PLEXOS

Several chart types are available (from the toolbar):

- A spline chart is suitable for viewing capacity and generation data *e.g.* Region [Available Capacity] or [Generation]
- Stacked charts are useful because they show the total with a breakdown by object
- 3D charts improve the readability of some types of data

Other notes about charts:

- Data that are highly volatile, *e.g.* [Price], is often shown using a logarithmic scale. Tick the Logarithmic check box on either the Primary or Secondary axis tabs.
- By default the chart shows a time series, but you can select a duration curve. A duration curve shows data in order from highest to lowest and is often used to show price, or transmission line flow data.

## 13.11 Zooming

Dragging over the chart causes the query to zoom-in. You can continue zooming in, or reset the data range using the Reset toolbar command. Note that, after you have zoomed in, the date range is set to match so any subsequent queries show the same data range.

## 13.12 Second y-axis

The property list box has two tabs: one for the primary y-axis and one for the secondary y-axis. You can chart any combination of data, even data from different collections on the two available axes. For example you might show the Region Price on the primary y-axis and the generation of several generators on the secondary as in Figure 82.

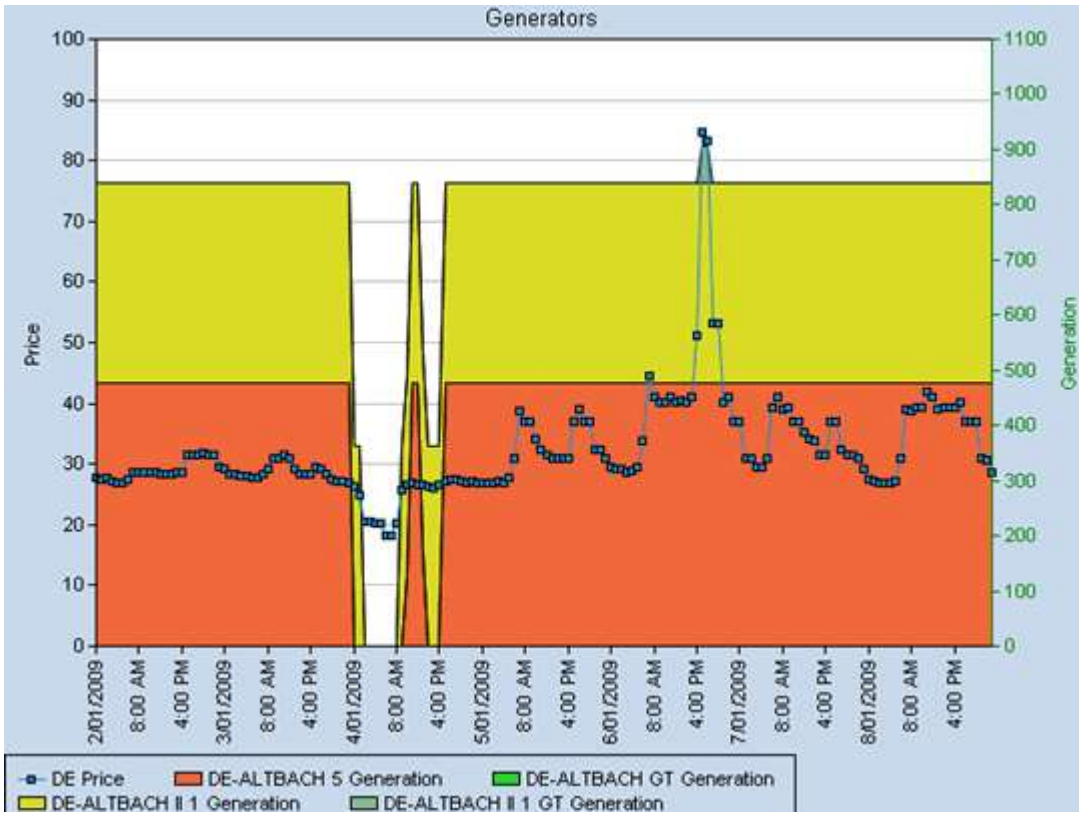
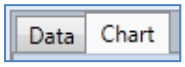


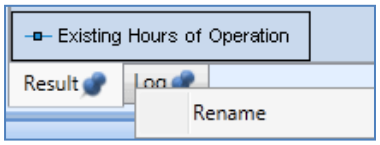

Figure 82: Use of secondary y-axis

## 13.13 Retaining query results

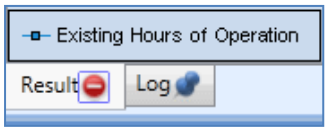
With every new query the Data and Chart viewer are overwritten with the new data. To retain the results of the previous query, you can pin-down the views by simply clicking on the blue pin in the Data and Chart tabs.




You have also the option to rename the tabs by right-clicking on the respective tab. An example is shown in Figure 83.




Hoovering over the pin, the cancel button will appear which allows you to close the tab.



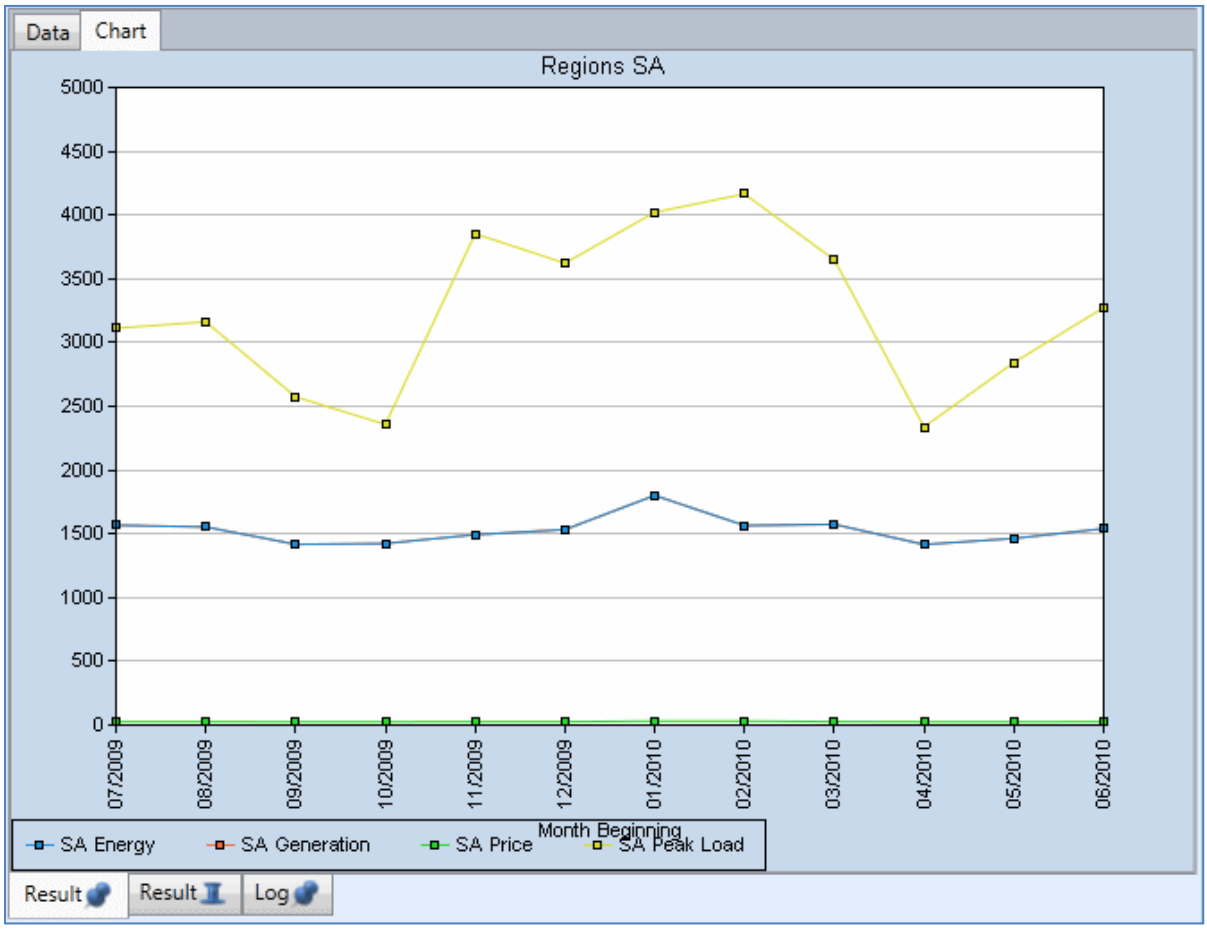




Figure 83: Pinned Data and Chart tabs

## 13.14 Refreshing Solution Values

You can safely leave open the solution database while another simulation is running and overwriting the file. When the new solution database is written, PLEXOS will notify that the currently open file is out-of-date and give you the following options:

- Open the updated solution database in a new file tab; or
- Refresh all currently open Result tabs with the updated data.

Choosing the Refresh option is convenient in that it will rerun all queries with the updated solution data, but opening a new tab is useful if you want to compare the old and new results.

## 13.15 Repeating Previous Queries

On the Windows tab of the ribbon menu there is a **History** command. Clicking this opens a window that records all the queries you have recently executed.

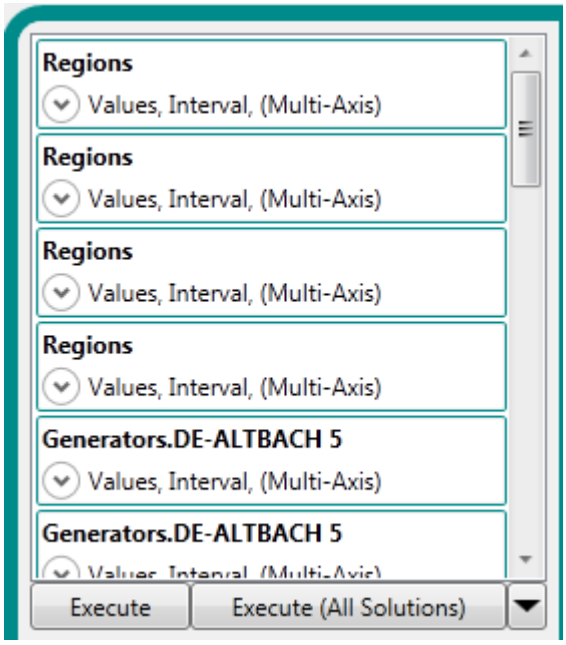
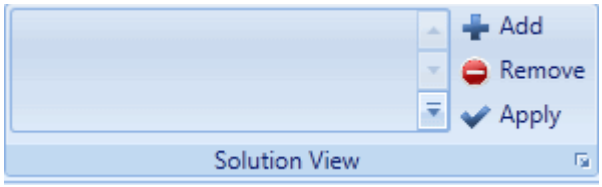



Figure 84: Previous Queries History

This window hovers over the main window, and can be used to re-execute any query you have done in the past on any solution window.

## 13.16 Saving a Solution View

The Window tab also includes the Solution View group of controls:




This acts like a gallery where you can save Solution Views, being a set of Result tabs containing grids and charts so that you can reload that view with another Solution File either in the same

session or at any time in a future session. This feature allows you to create and save Solution Views like “templates”.

To use the feature:

- Execute the set of Results you want to keep as a Solution View template. For example you might make a chart of Region Price on one Result tab, and an Area Chart of Generator Generation on another tab.
- Click Add to add the view to the gallery.
- Give the view a name and optional description to remind of what the view is about.

The named Solution View will appear in the gallery in the current and future sessions until you remove it.

## 13.17 Solution Comparison

The Window tab on the Ribbon of the PLEXOS interface contains the following controls which can be used to compare two result queries from different solution files:

The **+** button is used to set the first and second results to compare. To use this feature:

1. On the first solution file, perform the query you want to compare with another.
2. Click the top **+** button to add that file to the comparison.
3. Switch to the second file, open the **History** window and the **Execute** command from that window to repeat the query you last performed on the first file.
4. Click the bottom **+** button to add that file to the comparison

Now click the **Compare** button. Figure 85 shows an example comparison Chart tab.

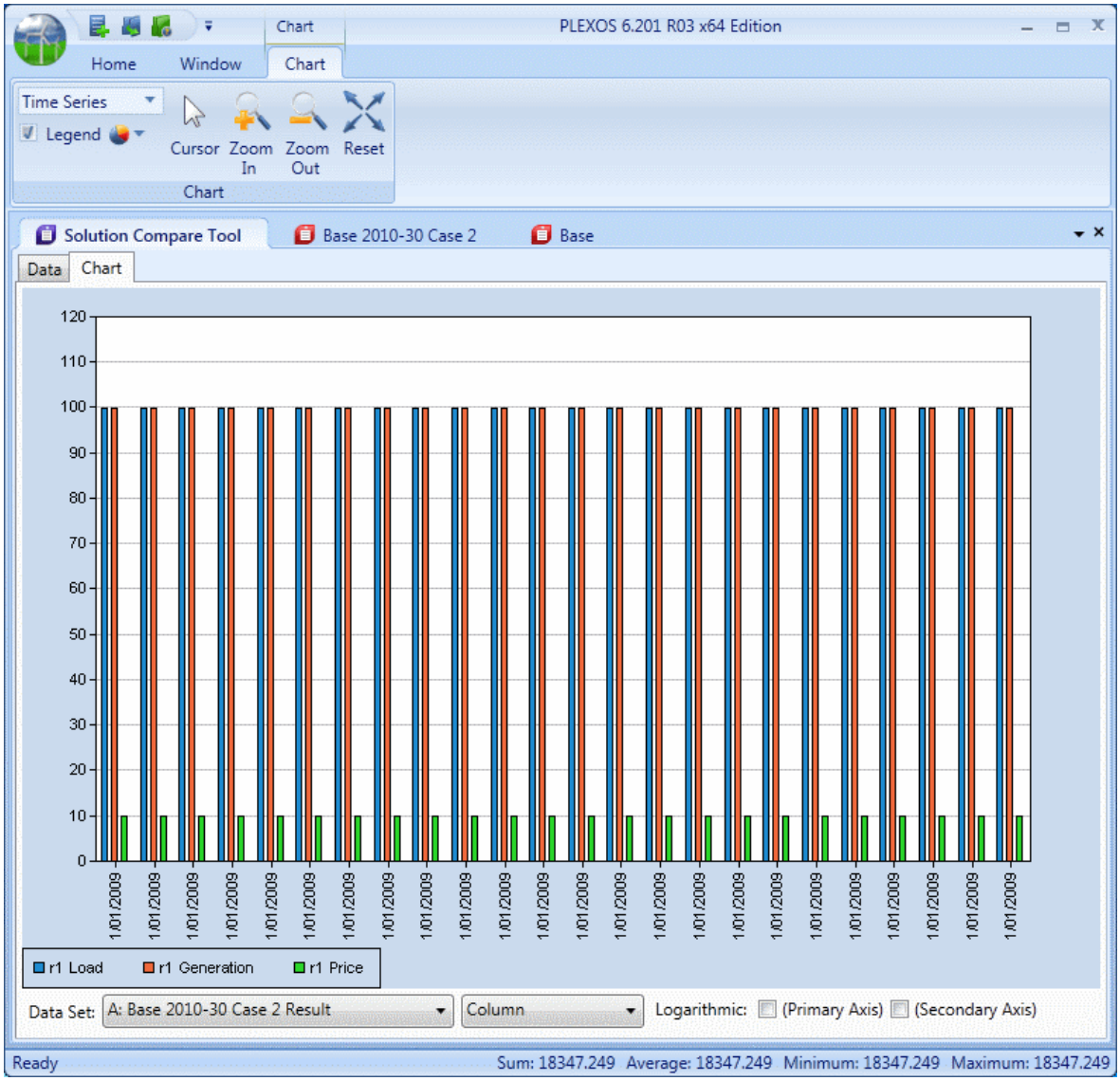



Figure 85: Solution comparison chart

# 14 References

1. *Text File Formats*. Energy Exemplar.. PLEXOS for Power Systems help system.
2. *Concise Modelling Guide*. Energy Exemplar. PLEXOS for Power Systems help system.