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1. INTRODUCTION

This help file describes the front-end application program for running scenarios of the Environment Canada Clean Air & Climate Change CGE model.

The model is written in the GAMS/MPSGE language and the front-end is written in Microsoft Excel.

2. INSTALLATION

2.1. RUNNING FROM A MEMORY STICK

If the system is delivered on a memory stick, just insert the USB stick in a USB port on your computer, browse to the file system on the memory stick and click on [CleanAir.xls](#).

2.2. ZIP FILE WITHOUT GAMS

If the zip file containing the model has no GAMS system, it is assumed you have a GAMS system installed. If you don't have an installed and licensed GAMS system you can download a GAMS system from <http://download.gams-software.com/>. The front-end will work with either a Windows 32 bit GAMS system or a Windows 64 bit GAMS system. If you don't have a 64 bit Windows Operating System or if you are not sure you should use the 32-bit GAMS system. The 32 bit GAMS system will run on top of both a 32 bit Windows Operating System and on a 64 bit Windows Operating System, but the 64 bit GAMS system will only run on top of a 64 bit Windows Operating System. If you need an evaluation license to run the model you can request a license from erwin@amsterdamoptimization.com. The license file is called gamslice.txt and needs to be placed in the GAMS system directory (this is the directory where gams.exe is located).

After installing GAMS by running the windows_x86_32.exe (or windows_x86_64.exe) install program downloaded from the above site, you can unzip the model zip file in any directory, and run the front-end by clicking on CleanAir.xls.

Note: it is not needed to add GAMS to the path; the front-end will be able to locate an installed GAMS system for you.

2.3. ZIP FILE WITH GAMS

If the zip file containing the model includes a GAMS system, you can just unzip the zip file into any directory and run the front-end program CleanAir.xls.

2.4. EXCEL 2007

The spreadsheet is distributed as an .xls file. If you have Excel 2007 such as spreadsheet is loaded in "compatibility mode". This means that the smaller limits on the number of rows of previous versions are in effect. If you want to use the extended capabilities of Excel 2007, you can save the spreadsheet as an .xlsm file (Macro-enabled spreadsheet). This version will now use all the Excel 2007 facilities.

See the table below for some differences in the limits of different Excel versions:

	Excel < 2007	Excel 2007
Row limit	65,536 rows	1,048,576 rows
Column limit	256 columns	16,384 columns
Max unique items per Pivot field	32,500 items per field	1,048,576 items per field
Max rows in a pivot table	65,536 rows	1,048,576 rows
Max columns in a pivot table	255 rows	1,048,576 rows
Max number of fields in a pivot table	255 fields	16,384 fields

2.5. DEVELOPER NOTE

The spreadsheet can be renamed without harm. The spreadsheet will search for GAMS according to the setting GamsSystem and GamsDir in the Configuration sheet.

3. SECURITY

The spreadsheet contains macros and VBA (Visual Basic for Applications) code. Your security settings may prevent macros and VBA code to run. In many cases you just can allow Excel to execute macros, but in some cases you may need to consult your system administrator for instructions.

It may be convenient to designate the directory where the spreadsheet is located as a trusted location. This will allow the spreadsheet to run without being asked questions about unsigned macros.

4. STARTING THE SPREADSHEET

The spreadsheet can be launched by clicking on CleanAir.xls. If needed tell Excel to allow running macros (see the previous paragraph).

The first thing that happens is a splash screen to show. You can click it to make it go away or you can wait a few seconds until it disappears.

4.1. SPLASH SCREEN CONFIGURATION

If you prefer the splash screen to wait a shorter time until it removes itself or if you prefer not to have the splash screen to appear at startup time at all, you can change the setting SplashDelay in the Configuration sheet. A SplashDelay of zero will bypass the splash screen altogether. After changing the number save the spreadsheet, close it and reopen the spreadsheet.

5. SYSTEMATIC SENSITIVITY ANALYSIS

This section describes how a large number of scenario's can be evaluated using a compact input grid.

5.1. SELECTING ITEMS

Scenarios are created in sheet 1 (SSA). In the Item column please select some scalars available from the drop down list. The description and the default will automatically be updated to reflect your choice.

	A	B
1	item	description
2	epsilon	<i>Supply elasticity of cotton imports</i>
3	eta	<i>Demand elasticity of textile exports</i>
4	tm0	<i>Base year tariff on grain</i>
5	epsilon	
6	eta	
7	etaL	
8	tm0	
9		

Figure 1: scenario items

The list of available items is maintained by the developer in sheet ScenarioSettings.

To remove an item, use the DEL key. Automatically, the accompanying description and default will also be removed.

If you type a non-existing item (e.g. xxxx) the description will be #N/A as the lookup for the item will fail. If you then press the run button anyway an error will appear about not being able to find xxxx.

5.2. ENTERING VALUES

The values can be entered in the grid under the header Values:

values

9	10	11							
1									

Figure 2: input grid

For any item you need to specify at least one value.

As this is Excel, it provides quick short cuts to generate data. For instance Auto-fill can be used to quickly create an increasing list of numbers:

values

8	9			
			11	

Figure 3: AutoFill in Excel

When you are done you can press the Run button.

5.3. RUNNING GAMS

The spreadsheet will call GAMS to solve the model a number of times. The number of scenarios to evaluate is equal to the number of possible combinations of the input values. This can quickly become a large number. E.g. 3 inputs with 5 possible values give $5 \times 5 \times 5 = 125$ scenarios to evaluate. 4 inputs with 6 values each gives $6^4=1296$ model evaluations.

When the RUN button is pressed, first the values are interpreted. The values are compared to their bounds as specified in the ScenarioSettings sheet. If outside their bounds the run is aborted with an error message.

Each list of values is terminated by the first empty cell. I.e. consider

values

8		9	10	
3	4	5		

Figure 4: empty cell terminates list

The values 9 and 10 will be discarded as the empty cell between 8 and 9 terminates the list.

Once we are ready to start GAMS a form is shown that shows the progress log from GAMS:

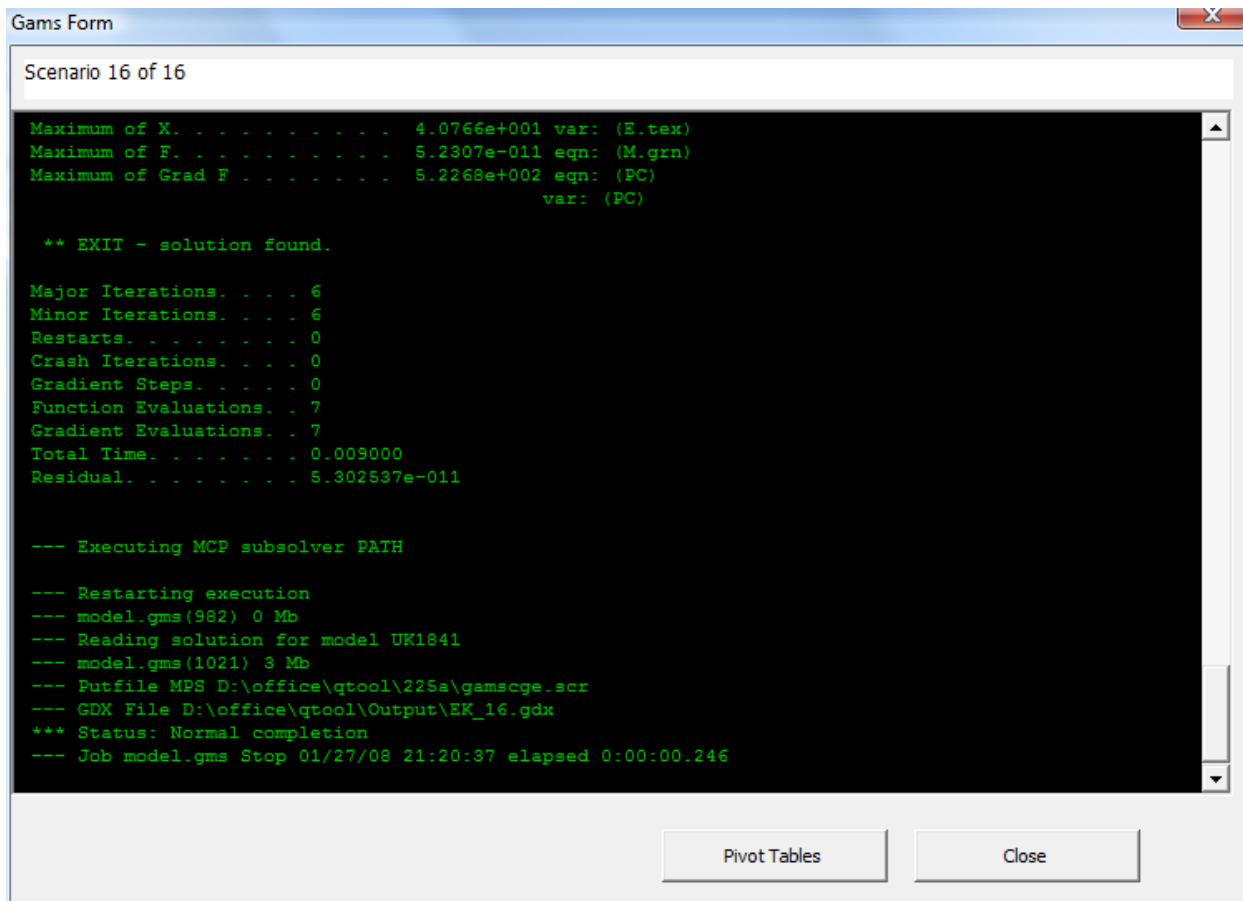


Figure 5: Gams Log Form

While the scenarios are being evaluated the pivot tables button is not enabled and the close button is changed to a Stop button. If you press the stop button, the solver does not stop immediately. Instead, the current scenario is allowed to finish, and then the program will interrupt the scenario loop.

If the complete set of scenarios is evaluated the pivot tables button is enabled and you can press it to create pivot reports.

After pressing the Pivot Tables button a series of new sheets are created. The important sheets are the pivot tables:

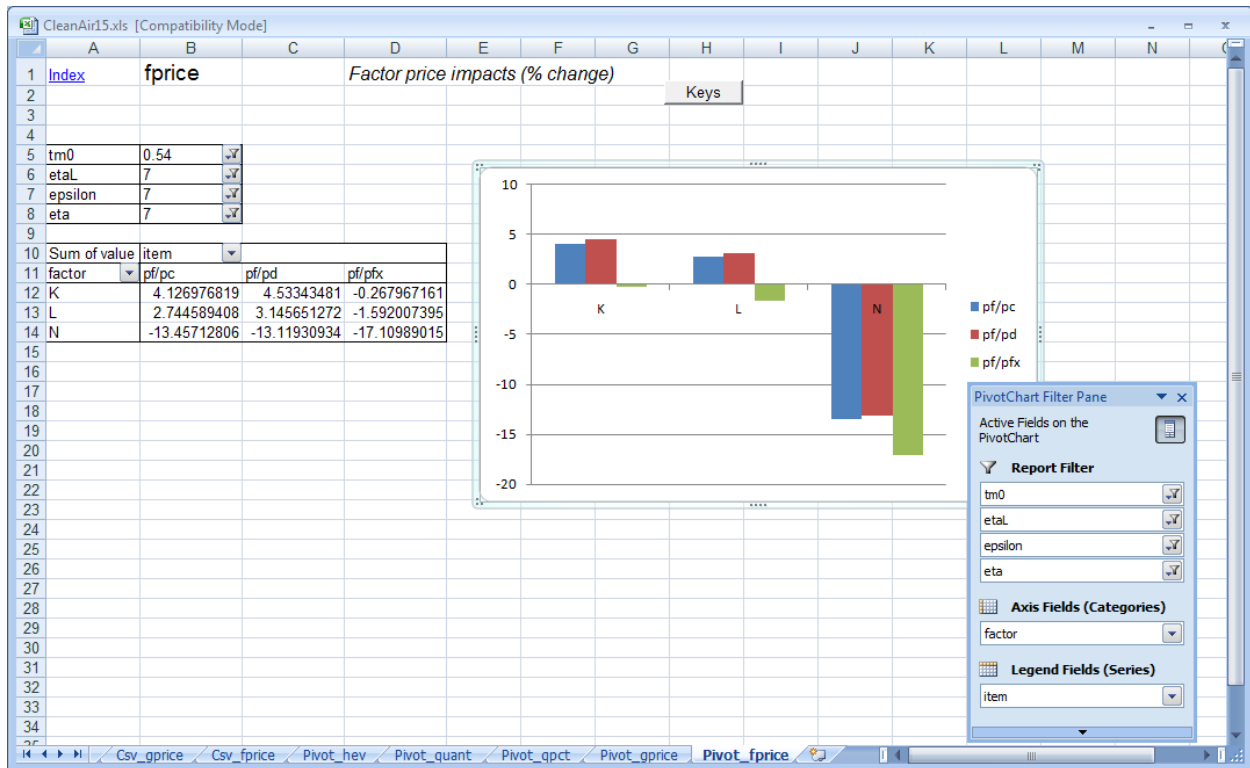


Figure 6: Generated Pivot Table and Pivot Chart

For more information on what can be done with pivot tables we point to some of the books listed in the references.

6. PIECEMEAL SENSITIVITY ANALYSIS

This input sheet allows you to specify individual scenarios.

An example input is given by:

Piecemeal Sensitivity Analysis

scenario	description	inputs						
		epsilon	eta	etaL	tm0			
ref	reference case	10	10	10	0.54			
epsilon20	Piecemeal sensitivity analysis : epsilon=2	20	10	10	0.54			
eta20	Piecemeal sensitivity analysis : eta=20	10	20	10	0.54			
etaL20	Piecemeal sensitivity analysis : etaL=20	10	10	20	0.54			
tm025	Piecemeal sensitivity analysis : tm0=0.25	10	10	10	0.25			

Figure 7: PSA input

Here five scenarios are specified, with values for the input parameters.

7. CONFIGURATION

The configuration screen looks like:

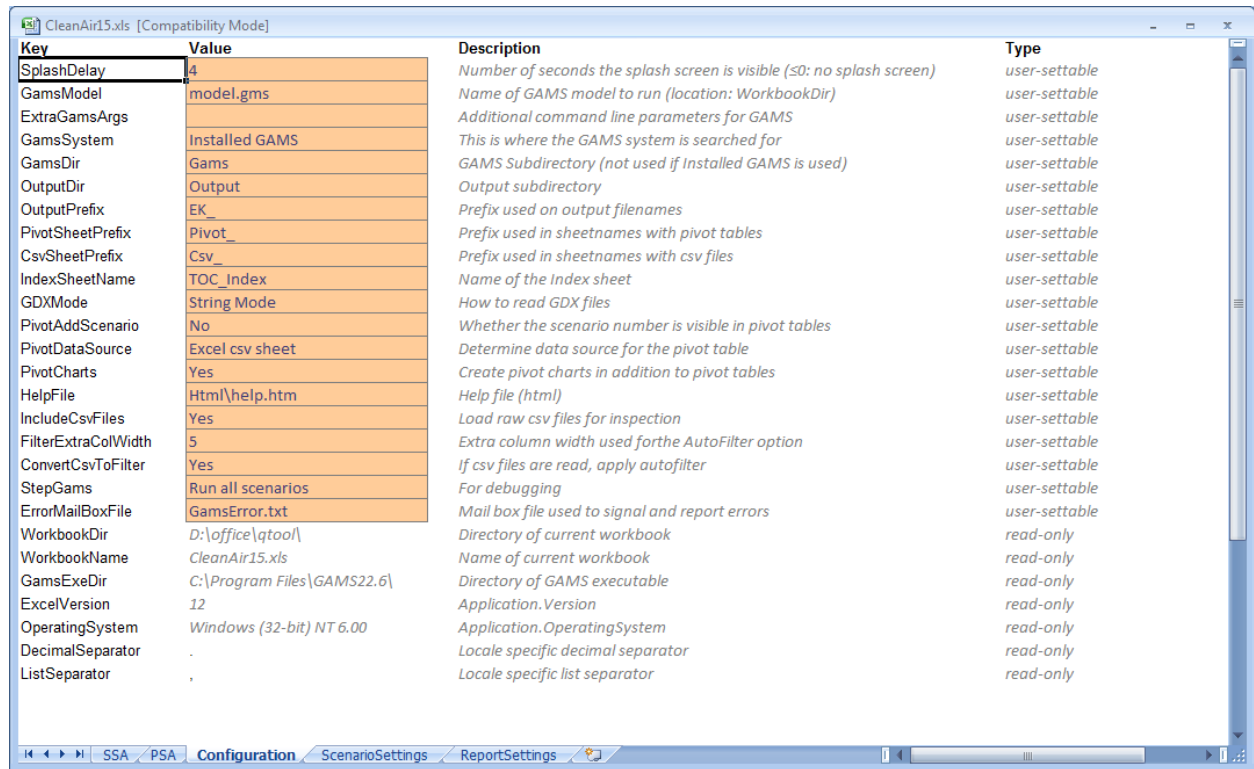


Figure 8: Configuration Sheet

A number of settings can be changed, while some other items are read-only: these cannot be changed by the user.

Key	default	Description
SplashDelay	4	Number of seconds the splash screen will linger before it removes itself. If you set this to zero no splash screen will appear.
GamsModel	model.gms	<p>Name of the GAMS model to run when the run button is pressed. The model does not have to do the scenario looping: this is performed in the spreadsheet code. It will need to interpret environment variables of the form %scenarioitem%. They are passed on through the command line.</p> <p>An example of call is:</p> <pre>Gams model.gms -eta=10 -epsilon=10 -etaL=10 -tm0=0.54 O=output\EK_1.lst GDX=output\EK_1.gdx LO=3</pre> <p>The location of this file is next to the spreadsheet in the same directory. (The directory is listed under WorkbookDir).</p>
ExtraGamsArgs	Empty	<p>Here you can specify additional command line parameters for GAMS. Note that the command line parameters l=filename, O=filename, GDX=filename and LO=3 are provided by the spreadsheet and are not available through this option.</p> <p>An example is to specify a restart file if the scenarios are shocks:</p> <pre>-r=basecase</pre>
GamsSystem	Installed GAMS	The system can operate in two modes. First it can use an installed GAMS version. Second it can use a GAMS run-time system placed in a subdirectory next to the spreadsheet. Note: a change in this setting requires the spreadsheet to be saved and reopened before taking effect.
GamsDir	Gams	If a run-time GAMS system is used, this is the subdirectory where it is expected to be. This option is not used when an installed GAMS version is used: the system will locate such a GAMS system for you.
OutputDir	Output	Output directory located next to the spreadsheet. If not found it will be created. In this directory output files are being created such as listing files (.LST),.gdx files (.GDX), comma-separated data files (.CSV)
OutputPrefix	EK_	Prefix used in output filenames. This is to make it safer to identify and remove files.
PivotSheetPrefix	Pivot_	Sheets with pivot tables will have this prefix. This makes it easy to find them later and to remove them.
CsvSheetPrefix	Csv_	If csv files are imported they will appear in a sheet with this prefix. This makes it easy to find them later and to

		remove them.
IndexSheetName	TOC_Index	Name of the index sheet. This sheet contains a table of contents for all generated output sheets.
GDXMode	String Mode	String Mode or Raw Mode. Raw Mode can be faster for large data sets, but it assumes that the UEL layout does not change for the different scenarios as the UEL table is only read once.
PivotAddScenario	No	Add the scenario number as page field. Note that for PSA input we add a scenario ID automatically. This ID is a string and is taken from the PSA input sheet, while the scenario number is an integer that is automatically generated.
PivotDataSource	External csv file	Use the external csv files as a data source for forming the pivot tables. The Windows ODBC Text Driver is used to access the csv files. If needed an alternative route can be used: set IncludeCSVFiles to Yes and use Excel as data source. If you use IncludeCSVFiles=Yes then it is advised to use PivotDataSource=Excel sheet. The data is readily available inside Excel. If you have large data sets, with the total number of records exceeding the Excel limit (65,536 rows for Excel versions before Excel 2007), then it is advised to use IncludeCSVFiles=No and PivotDataSource=External Csv File. This allows you to generate very large pivot tables that would otherwise be too large to import.
PivotCharts	No	Add pivot chart to the pivot table. This is a short cut and essentially the same as running the Pivot Chart Wizard with default settings.
ChartLocation	Same sheet as pivot table	If PivotCharts=Yes then the program can place the pivot chart on the same sheet as the pivot table. It can also create a separate chart sheet and place the pivot chart there.
HelpFile	Html\Help.htm	This file is opened when the Help button is pressed.
IncludeCsvFiles	Yes	If set to Yes the intermediate CSV files are imported to the spreadsheet. Extra sheets of the form Csv_xxxx are created and depending on setting ConvertCsvToFilter, the AutoFilter option is applied to make it easier to navigate. Note: if number of records in the CSV file exceeds the row limit, Excel may truncate the table. For Excel 2007 this limit is large (1,048,576 rows), but for older Excel versions the maximum number of rows is 65,536.
FilterExtraColWidth	5	If AutoFilter for CSV files is used this option can be used to generate a little bit extra space to allow the drop down boxes not to hide any headers.
ConvertCsvToFilter	Yes	If CSV files are imported to the spreadsheet, apply the AutoFilter option to make the tables more manageable.
StepGams	Run all scenarios	For debugging: stop after each single scenario. By default this option is turned off.
ErrorMailBoxFile	GamsErrors.txt	If this file is present after a GAMS run, the spreadsheet will

		stop evaluating further scenarios and show the error message. The model developer should make sure his/her model writes messages to this file (in the "current" directory).
TempDir	Read-only	This is where Windows suggests to store scratch files.
WorkBookDir	Read-only	This is where the spreadsheet file was opened. Other files are expected to be located in this directory.
WorkbookName	Read-only	Name of the spreadsheet. You can rename the spreadsheet file as you like.
GamsExeDir	Read-only	This is where the GAMS system was found.
ExcelVersion	Read-only	Informational: the version number for Excel. E.g. Excel 2007 is version 12.
OperatingSystem	Read-only	Informational: the name of the operating system
DecimalSeparator	Read-only	Different language settings use different decimal separators. In the US the decimal dot is used, while in many European countries a decimal comma is used. This setting is used to write correct csv files.
ListSeparator	Read-only	In the US a csv file has comma separated values. However if the comma is decimal separator, in many cases a semi-colon is used instead. This setting is used to write correct csv files.

	A	B	C	D	E
1	eta	epsilon	etaL	tm0	value
2	9	9	9	0.5	-0.149858229
3	9	9	9	0.54	-9.85E-02
4	9	9	10	0.5	-0.148359273
5	9	9	10	0.54	-0.096728193
6	9	10	9	0.5	-0.148211409
7	9	10	9	0.54	-9.67E-02
8	9	10	10	0.5	-0.146700335
9	9	10	10	0.54	-9.49E-02
10	10	9	9	0.5	-0.138109399
11	10	9	9	0.54	-8.59E-02
12	10	9	10	0.5	-0.136526087
13	10	9	10	0.54	-8.40E-02
14	10	10	9	0.5	-0.136304035
15	10	10	9	0.54	-8.40E-02
16	10	10	10	0.5	-0.134707361
17	10	10	10	0.54	-8.21E-02
18					

Figure 9: example of a csv file imported in Excel

8. SCENARIO SETTINGS

The Scenario Settings sheet should be maintained by the modeler. It lists the inputs that the model can handle together with a description, a lower and upper bound and a default value. The bounds are used to validate the user input: if they are outside the bounds GAMS will not be called.

	A	B	C	D	E
1	scalar	description	lowerbound	upperbound	default
2	epsilon	Supply elasticity of cotton imports	0	50	10
3	eta	Demand elasticity of textile exports	0	50	10
4	etaL	Elasticity of transformation in land	0	50	10
5	tm0	Base year tariff on grain	0	1	0.54
6					

Figure 10: scenario settings

In this case the model should check for %epsilon%, %eta%, %etaL% and %tm0%. They can appear on the GAMS command line, but only if the user decides to do so. It is therefore advised to have in the model something like:

```
$if not set tm0      $set tm0 0.54
$if not set epsilon $set epsilon 10
$if not set eta      $set eta 10
$if not set etaL     $set etaL 10
```

9. REPORT SETTINGS

This is also a sheet maintained by the model builder. It looks like:

	A	B	C	D
1	parameter	indexnames	row	col
2	hev			
3	quant	s,item	s	item
4	qpct	s,item	s	item
5	gprice	s,item	s	item
6	fprice	factor,item	factor	item
7				

Figure 11: report settings

This sheet lists the pivot tables to generate and the names of the GAMS parameters that are displayed in these pivot tables. The index names are used in the pivot tables: the GAMS domain names can be different. The row and col columns indicate if an index is initially configured to be a pivot table RowField or a pivot Column field.

10. LANGUAGE SETTINGS

The program tries to navigate carefully between the GAMS convention of always using US notation (decimal point) and the advanced international settings used in Excel. When writing the CSV files that are used as external data source for the pivot tables, care is taken to make sure that the decimal separator and list separator of the current locale are being used. This means that for a German Windows version, the CSV file can look like:

```
"epsilon";"eta";"factor";"item";"value"
8,1;3,5;"K";"pF/pfx"; 0,656075588523497
8,1;3,5;"K";"pF/pd"; 3,99997032739801
8,1;3,5;"K";"pF/pc"; 3,65790458466631
8,1;3,5;"N";"pF/pfx";-16,9447696928289
8,1;3,5;"N";"pF/pd";-14,185592504206
```

On a standard English/US system the same file will look like:

```
"epsilon","eta","factor","item","value"  
8.1,3.5,"K","pF/pfx",-0.551672822147986  
8.1,3.5,"K","pF/pd", 4.70178520057902  
8.1,3.5,"K","pF/pc", 4.30464358151212  
8.1,3.5,"N","pF/pfx",-17.4563780094176  
8.1,3.5,"N","pF/pd",-13.0959280604119
```

The decimal separator and the list separator are listed in read/only cells in the Configuration sheet (note: these values are determined when the workbook is opened; however the CSV output routine will interrogate Excel for these settings just after hitting the run button; this may lead to a discrepancy if language settings are changed while Excel is running).

In addition to the CSV files a file called schema.ini is written to the output directory. This file looks as follows when German language settings are used:

```
[EK_hev.csv]  
Format=Delimited(;  
DecimalSymbol=,  
col1=eta Float  
col2=epsilon Float  
col3=etaL Float  
col4=tm0 Float  
col5=value Float  
  
[EK_quant.csv]  
Format=Delimited(;  
DecimalSymbol=,  
col1=eta Float  
col2=epsilon Float  
col3=etaL Float  
col4=tm0 Float  
col5=s Char  
col6=item Char  
col7=value Float  
  
[EK_qpct.csv]  
Format=Delimited(;  
DecimalSymbol=,  
col1=eta Float  
col2=epsilon Float  
col3=etaL Float  
col4=tm0 Float  
col5=s Char  
col6=item Char  
col7=value Float  
  
[EK_gprice.csv]  
Format=Delimited(;  
DecimalSymbol=,  
col1=eta Float  
col2=epsilon Float  
col3=etaL Float  
col4=tm0 Float  
col5=s Char  
col6=item Char  
col7=value Float  
  
[EK_fprice.csv]  
Format=Delimited(;  
DecimalSymbol=,  
col1=eta Float  
col2=epsilon Float  
col3=etaL Float  
col4=tm0 Float  
col5=factor Char  
col6=item Char
```

col7=value Float

This file is used by Windows when using the ODBC Text Driver to read the CSV files.

11. REFERENCES

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