

VEDA-SAGE_§

Version 1.5.11

KanORS Inc./HALOA Inc.
Montréal, Canada

*VEDA (Versatile Data Analyst) is a flexible, user-friendly tool for the management of the SAGE
(A System for Analysis of Global Energy) model database.*

§ Veda [Sanskrit,=knowledge, cognate with English wit, from a root meaning know], oldest scriptures of Hinduism and the most ancient religious texts in an Indo-European language. The authority of the Veda as stating the essential truths of Hinduism is still accepted to some extent by all Hindus. The Veda is the literature of the Aryans who invaded NW India c.1500 B.C. and pertains to the fire sacrifice that constituted their religion. The Vedic hymns were probably first compiled after a period of about 500 years during which the invaders assimilated various native religious ideas. The end of the Vedic period is about 500 B.C. Tradition ascribes the authorship of the hymns to inspired seer-poets (rishis). [The Columbia Encyclopedia, 6th edition New York: Columbia University Press, 2000.]

Table of contents

1. Introduction.....	1
2. Installation of VEDA-SAGE and setting up the license.....	2
3. Organization of data in VEDA-SAGE.....	3
3.1. Content and location of files.....	3
3.2. The import process.....	7
3.3. Impacts of imports on edited data.....	7
3.4. Concepts of database, scenario and run.....	9
4. File menu.....	10
4.1. New Database [Ctrl N].....	10
4.2. Open Database [Ctrl O].....	11
4.3. Close Database.....	11
4.4. Delete Database [Ctrl T].....	11
4.5. Compact Database [F12].....	11
5. Module 1.....	12
5.1. Import [F6].....	12
5.2. Browse/Edit [F7].....	13
5.3. RES [F8].....	22
5.4. Solve [F9].....	24
6. Module 2.....	26
6.1. Demands.....	26
6.1.1. Demands Manager.....	26
6.1.2. Edit/view single demands.....	27
6.1.3. View multiple demands.....	29
6.1.4. Manage driver data.....	30
6.1.5. Manage calibration/sensitivity series.....	32
6.1.6. Demand projection.....	33
6.2. Technology Repository.....	33
6.2.1. Select and view technologies.....	33
6.2.2. Import technologies.....	36
6.2.3. Delete scenarios.....	37
6.3. Trades.....	37
6.3.1. Trade link Region matrix.....	37
6.3.2. Trade parameters (R matrix).....	39
6.3.3. Trade parameters (Time series).....	41
6.4. User constraints.....	42
6.4.1. User constraints definitions.....	42
6.4.2. User constraints coefficients.....	47
6.4.3. Quality Check.....	50
6.4.4. Delete.....	50
6.4.5. Copy.....	50
6.4.6. Add Default Values.....	52
6.4.7. Add.....	52
6.4.8. Edit.....	56
6.5. Scenario data.....	59

6.5.1.	Import.....	59
6.5.2.	Delete	61
6.6.	Synchronize.....	61
7.	Tools menu.....	61
7.1.	Views	61
7.2.	Set RES Colors	61
7.3.	Units.....	61
7.4.	Comments	61
7.5.	User Options	62
8.	Window menu.....	62
8.1.	Cascade	62
8.2.	Tile Horizontally	62
8.3.	Tile Vertically	62
9.	Help menu.....	62
9.1.	About.....	62
9.2.	Contents	62
9.3.	Search.....	62
9.4.	Contact Us.....	62
10.	Reference guide	63
10.1.	File Menu	63
10.2.	Modules – 1.....	63
10.2.1.	Import [F6].....	63
10.2.2.	Browse/Edit [F7].....	64
10.2.3.	RES [F8]	65
10.2.4.	Solve [F9].....	65
10.3.	Modules – 2.....	65
10.3.1.	Demands	65
10.3.2.	Technology Repository.....	66
10.3.3.	Trades.....	66
10.3.4.	User constraints.....	67
10.3.5.	Scenario data.....	68
10.3.6.	Synchronize.....	69
10.4.	Tools menu.....	69
10.5.	Window menu.....	69
10.6.	Help menu.....	69

List of figures

Figure 1. VEDA-SAGE Database Configuration	6
Figure 2. Template Manager	12
Figure 3. Filter or search form	14
Figure 4. How to view technology parameters (after transformation)?	18
Figure 5. How to compare electricity plant costs?	18
Figure 6. How to compare demands from different scenarios?	19
Figure 7. Browse/Edit Data Selection	21
Figure 8. How to navigate in the Inter Regional Exchanges (IRE) view of the RES?	23
Figure 9. How to navigate in the RES?	24
Figure 10. Solve Form	25
Figure 11. How to view demand driver and calibration/sensitivity series selections?	27
Figure 12. How to edit a demand?	28
Figure 13. How to compare multiple demands?	30
Figure 14. How to compare demand drivers?	31
Figure 15. How to import new demand drivers?	32
Figure 16. Manage Calibration/Sensitivities Series	33
Figure 17. How to view and edit new technology availability by region?	35
Figure 18. Technology Viewer	36
Figure 19. How to declare energy commodity trade links?	39
Figure 20. How to declare energy commodity trade parameters (matrix)?	40
Figure 21. How to view and declare energy commodity trade parameters (time series)?	42
Figure 22. How to view or edit user constraints definition?	45
Figure 23. How to convert existing user constraints to market shares?	47
Figure 24. How to view or edit user constraints coefficients?	49
Figure 25. How to view or edit relaxation factors for user constraints?	50
Figure 26. Delete User Constraints	51
Figure 27. Copy User Constraint Across Regions	51
Figure 28. How to create a new user constraint?	54
Figure 29. How to create a new set of market shares?	56
Figure 30. How to edit the bigset or the subset of a user constraint?	58
Figure 31. How to create and solve a new scenario?	60
Figure 32. How to solve a scenario with a global constraint on emissions?	60

List of tables

Table 1. List of regions and sectors for the SAGE model	4
---	---

List of questions

Question I. How to create a new database?	11
Question II. How to browse the entire database?	15
Question III. How to view technology parameters (after transformation)?	16
Question IV. How to compare electricity plant costs?	16
Question V. How to compare demands from different scenarios?	17
Question VI. How to navigate in the Inter Regional Exchanges (IRE) view of the RES?	22
Question VII. How to navigate in the RES?	23
Question VIII. How to view demand driver and calibration/sensitivity series selections?	27
Question IX. How to edit a demand?	28
Question X. How to compare multiple demands?	29
Question XI. How to compare demand drivers?	31
Question XII. How to import new demand drivers?	32
Question XIII. How to view and edit new technology availability by region?	34
Question XIV. How to view new technology parameters (before transformation)?	35
Question XV. How to import new technologies in the database?	37
Question XVI. How to declare energy commodity trade links?	38
Question XVII. How to declare emission permit trading?	39
Question XVIII. How to declare energy commodity trade parameters (matrix)?	40
Question XIX. How to view and declare energy commodity trade parameters (time series)?	41
Question XX. How to view or edit user constraints definition?	45
Question XXI. How to convert existing user constraints to market shares?	46
Question XXII. How to view or edit user constraints coefficients?	48
Question XXIII. How to view or edit relaxation factors for user constraints?	49
Question XXIV. How to create a new user constraint?	53
Question XXV. How to create a new set of market shares?	55
Question XXVI. How to edit the bigset or the subset of a user constraint?	57
Question XXVII. How to create and solve a new scenario?	59
Question XXVIII. How to solve a scenario with a global constraint on emissions?	60

1. Introduction

The VEDA (VERsatile Data Analyst) family of softwares constitutes a suite of powerful Windows based tools designed to help the user of mathematical energy¹ models with the tasks of browsing, maintaining, and analyzing the large and complex databases attached to such models. The VEDA suite consists of a front-end component (known as VEDA-FE), for the analysis and maintenance of the input data, and a back-end component (known as VEDA-BE) for the analysis of results. The front-end component must be closely matched to each specific model, whereas the back-end component applies to a variety of models.

This User's Guide provides a complete user oriented description of the VEDA-FE (front-end) software as it applies to the MARKAL model, and more specifically to the SAGE model (A System for Analysis of Global Energy) resident at the Energy Information Administration (EIA), an agency of the United States Department of Energy (USDOE)². SAGE is a MARKAL-based world bottom-up energy model with 15 linked regions. All examples will be taken from the SAGE model. In the rest of this manual, we shall therefore refer to the software as **VEDA-SAGE**. Other version of this guide will also exist for general MARKAL models and for TIMES models. Moreover, there is a separate Users' Guide³ describing VEDA-BE version 4, which applies a to wide variety of models, including (but not limited to) energy bottom-up models such as MARKAL, SAGE, and TIMES.

VEDA-SAGE is a flexible shell that allows the users to browse, to analyze, and to edit the input data of the SAGE model. Section 2 helps the user with the installation of VEDA-SAGE. Section 3 presents the general structure of the software and the organization of the databases. The subsequent sections (4 to 9) describe in detail the various functionalities of VEDA-SAGE for each menu item. Section 10 consists of a reference guide introducing the main commands of the menu. This Users' Guide also contains a list of 'How to...' questions to guide the user with specific tasks during the utilization of VEDA-SAGE. These questions are related to the main possibilities of the software and the answers consist in explaining in detail how to execute specific tasks with examples.

We would appreciate to hear from the users with comments or suggestions on the software or this Users' Guide. KanORS contact information:

Attn. Amit Kanudia,
GERAD, 3000 Cote-Ste-Catherine,
Montreal, Quebec, Canada, H3T 2A7
Fax: +1-305-422-0554
E-mail: amit@KanORS.com

¹ Some tools from the VEDA suite of softwares apply to a more general class of models than energy related ones.

² The SAGE documentation is available at <http://www.eia.doe.gov/bookshelf/docs.html>.

³ The Users' Guide, describing VEDA-BE version 4, is available at <http://www.kanors.com/userguidebe.htm>.

2. Installation of VEDA-SAGE and setting up the license

This section aims at guiding the user to the installation of VEDA-SAGE and to the updating of the VEDA-SAGE.EXE program.

First, follow these steps to install VEDA-SAGE on your computer:

- Go to the download page of the KanORS website: <http://www.kanors.com/EIAdnld.htm>.
- Download and unzip the VEDA-SAGE installation package (e.g. *VedaSage-1.5.11: Installation (Zipped msi file)*) at any location on your computer. User name and password may be obtained from KanORS: amit@KanORS.com.
- Double-click on the saved file to open the installation window 'Welcome to the VEDA SAGE Setup Wizard'.
- If a version of VEDA-SAGE is already installed:
 - o Choose to remove VEDA-SAGE and click the '**Finish**' button.
 - o Once VEDA-SAGE has been successfully removed, click the '**Close**' button to exit and go to the next step for installing the new version.
- If this is the first ever installation, then the installer will guide you through the steps required to install VEDA-SAGE on your computer:
 - o Click the '**Next**' button.
 - o The installer will install VEDA-SAGE in a folder by default (C:\Program Files\VEDA SAGE\). Click the '**Next**' button to install in this folder. Otherwise, use the '**Browse...**' button to select any existing folder or type a new folder name (e.g. C:\SAGE1p0\). Note that earlier, the application had to be installed in C:\SAGE1p0\. This requirement is not valid anymore.
 - o Click the '**Next**' button to start the installation.
 - o Once VEDA-SAGE has been successfully installed, click the '**Close**' button to exit.
- Double-click on the gray icon created on the desktop to start using VEDA-SAGE.

Second, update the VEDA-SAGE.EXE program if necessary. Periodically, there may be new versions of the VEDA-SAGE.EXE program. Follow these steps to update the software to the latest version:

- Go to the download page of the KanORS website: <http://www.kanors.com/EIAdnld.htm>.
- Download and unzip the EXE update (e.g. *VedaSage-1.5.8: from version 1.4.1 to above*) in the application folder (e.g. C:\SAGE1p0\). The VEDA-SAGE version already installed on your computer should be as recent as what is specified (e.g. *from version 1.4.1 to above*). Otherwise, a more recent version of VEDA-SAGE needs to be installed before the update (see above).

The first time VEDA-SAGE is opened, a license code is required. Follow these instructions to get a license code online:

- Click the '**Get Key Online** (www.KanORS.com)' button.
- Once in the KanORS website, enter your e-mail address (your initial license code will appear automatically) and click the '**Generate**' button.
- The license code for VEDA-SAGE will be mailed immediately from KanORS Consulting Inc as an attached file.

- Save the license file in the VEDA-SAGE installation folder C:\SAGE1p0\.
- Double-click on the VEDA-SAGE icon on the desktop to start using the application. Your license code will appear automatically. Enter your e-mail, name and organization and click the **‘Register Me Now’** button.
- Once your license has been successfully updated, click **‘OK’** and VEDA-SAGE will launch automatically.

3. Organization of data in VEDA-SAGE

This section presents a synthetic picture of the organization of data flows in the shell. The main function of VEDA-SAGE is to support the user in four main aspects of model management, as follows:

- a) Constructing the initial model’s database, using a variety of Excel source files as initial inputs, as well as internal functions;
- b) Browsing the components of the model via a variety of textual and graphic views;
- c) Modifying the model’s input data;
- d) Launching model runs.

In the SAGE situation, the first task of constructing an initial model database is accomplished using a set of *templates* whose function is to transform raw data from a variety of sources into an initial SAGE model. This guide is addressed to the SAGE case. Other model histories will be tackled in future manuals for other versions of VEDA-FE.

This section is divided into four parts presenting: the content and location of the external files and the databases (section 3.1), the import process of data into VEDA-SAGE (section 3.2), the impacts of imports on edited data (section 3.3) and the concepts of database, scenario and run of the model (section 3.4).

3.1. Content and location of files

The SAGE database is constructed by VEDA from Excel files and Access databases (see Figure 1). All VEDA-SAGE files are stored in two folders (and their sub-folders): the application folder (*e.g. C:\SAGE1p0*), where VEDA-SAGE is installed, and the template folder (*e.g. C:\SAGE TEMPLATES*), which can be anywhere on the computer. The Excel files are:

The Base Year Data files (<Region>_HIST.xls; e.g. AFR_HIST.xls). There are 15 files, one for each of the 15 regions (see Table 1), and they are located in the template folder. These files contain the energy statistics and balances of the International Energy Agency (IEA) and data from the Office of Energy Markets and End Use (EMEU) at the initial time-period. These files cannot be renamed.

The SAGE templates (<Region>_<Sector>_<Version>.xls; e.g. AFR_ELC_V7p0.xls). There are 75 such templates, one for each of the five sectors (see Table 1), for each region. The regional templates deal with broad sectors of the Reference Energy System (RES). The first two parts of the file name cannot be changed, but the version can change. They contain:

- The model's basic structure (defining end-uses and sub-regions within a region).
- The fuel consumption by end-use in the base year.
- The energy production by fuel in the base year.
- The base-year end-use demands.
- The existing technology stock.
- The user constraints.
- The emission coefficients by fuel (VEDA-SAGE computes technology level coefficients based on the fuel inputs).
- Other parameters (demand elasticities, discount rate, transmission efficiency, etc.).

In each sector, the energy production and consumption are calibrated in the templates to match the IEA/EMEU statistics for the initial time-period. In order to achieve calibration at future periods, certain user constraints are also constructed within each template. ELC describes all central electricity and heat production including combined heat and power (CHP); IND deals with the industrial end-uses, and the industrial auto-electricity and CHP production; RES and TRA describe the end-uses in the respective sectors; UPS describes fossil fuel extraction, renewable potential, and various fuel transformation processes including petroleum refineries.

Table 1. List of regions and sectors for the SAGE model

Regions		Sectors	
AFR	Africa	ELC	Electricity production
AUS	Australia and New Zealand	IND	Industries
CAN	Canada	RES	Residential-Commercial-Agriculture
CHI	China	TRA	Transportation
CSA	Central and South America	UPS	Upstream
EEU	Eastern Europe		
FSU	Former Soviet Union		
IND	India		
JPN	Japan		
MEA	Middle East		
MEX	Mexico		
ODA	Other Developing Asia		
SKO	South Korea		
USA	United States		
WEU	Western Europe		

The technology repository (<TechRep>.xls; e.g. TechRep.xls). There is one file for the base scenario, which is located in the application folder. It contains the complete technical and economic data for all new technologies; they are listed on a separate sheet for each sector, the sector being specified by the sheet name. The user can create other files (with different names) to import new technologies into the repository and run different new technology scenarios. New commodities cannot be added through this facility; new commodities have to be defined in the templates first. They need to be in the same format than the reference technology repository.

The driver's files (<Drivers>.xls; e.g. HighMacGDP.xls). There is one sample file in the application folder. A list of drivers, used to project demands, is already included in the Access database for demands. The user can create other files (with different names) to import new drivers in the database and run different demand projection scenarios (e.g. low economic growth and high economic growth cases).

The scenario files (<Scenarios>.xls; e.g. Sce_ZDMFR.xls). There is one sample file in the application folder. The user can create a large variety of files (with different names) to import new scenario data in the database (e.g. bounds on emissions, technological discount rates, investment costs, etc.). Any parameter for an existing technology or commodity can be added through this facility.

The transformation file (SAGE_QDATA.xls). There is one transformation file, located in the application folder. This file is used to regionalize model parameters. The user can use arithmetic operations, to modify any technology parameter, or absolute values to replace existing ones or to insert new parameter values in the database. The user can only edit the original file, but cannot create other transformation files. Moreover, this file cannot be renamed.

At this point, it is useful to give indications to the user as for the utilization of scenario's files or the transformation file for modifying/augmenting the database. There are two basic differences: the scenario file is processed only when the scenario is imported, while the transformation file is processed each time the template import process is launched; the scenario file can be used only to add parameters, while the transformation file can be used to modify the existing values, in addition. A general guideline to choose between the two options while adding parameter information is that if an elaborate filter specification is being used to identify elements, and the user expects the resulting set to vary with changes in TechRep, then it is safer to use the transformation file approach; for example, to specify technology-specific discount rates for gas-based power plants. If the set of elements is stable, then the scenario approach would save processing time; for example, declaring emission bounds.

The information and instructions in these external Excel files are used to create the final VEDA-SAGE database, using some intermediate Access databases. None of the Access databases require any direct intervention from the user. They come with the installation and are modified exclusively through the interface. However, it is useful to give some precisions to understand the whole configuration of VEDA-SAGE. The various Access databases are:

Intermediate databases: These databases are located in the templates folder. They contain the model data at three distinct steps of the main import process. The first one (*TmplData.mdb*) contains only the template data, while the second one contains new technology data in addition (*TmplData1.mdb*) and the third one contains the user constraint data in addition of the first two (*TmplData2.mdb*).

Module 2 databases: These databases are located in the application folder. They contain the model data of four main modules of the interface: the demands projections (*Demands.mdb*), the new technology repository (*TechRep.mdb*), the user constraints (*Adratios.mdb*) and the energy/emission permit trades (*Trades.mdb*).

Multiple functionalities are built upon these databases, which offer the user powerful and intuitive ways to view and edit information. These are grouped into two main menus. The module 1 menu deals with the entire model database, while the module 2 menu deals with the main module 2 databases of VEDA-SAGE: Demands, Technology Repository, Trades, User constraints, and Scenario Data. These functionalities are explained in detailed for each menu in

the following sections. However, they are briefly introduced here in order to get a comprehensive view of the system.

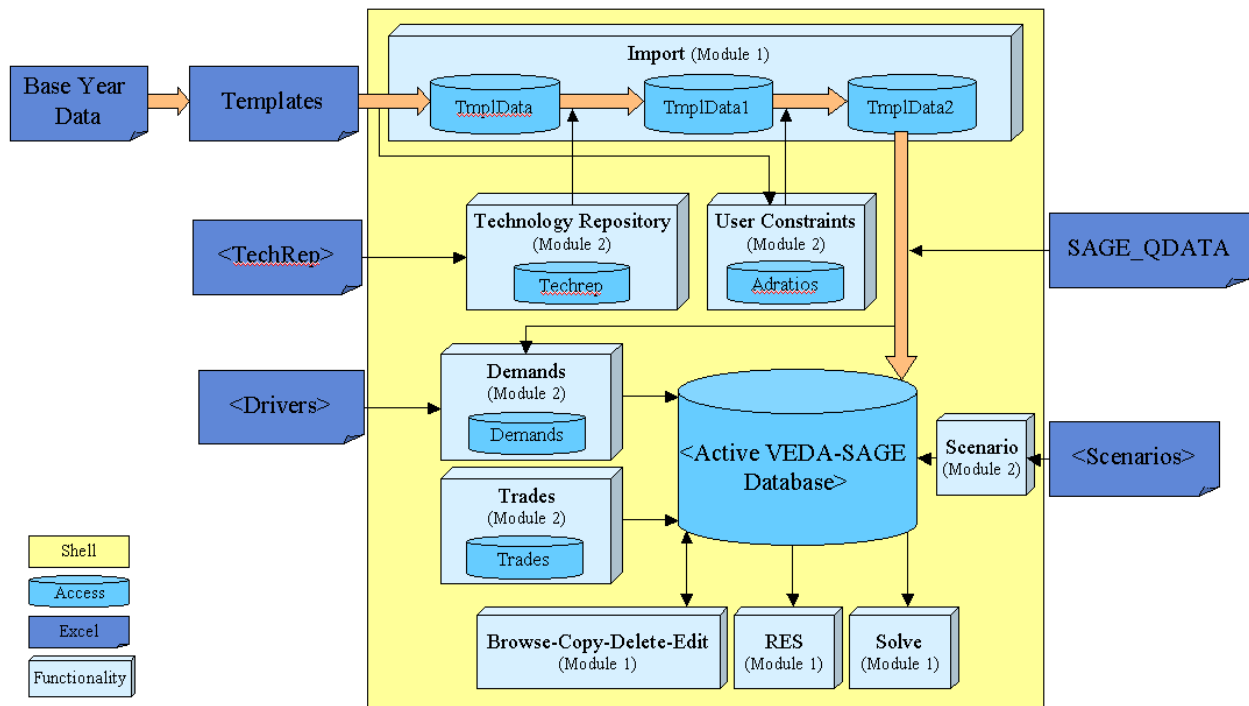
Module 1 menu:

- *Import:* To import the information from the templates, as well as the information from the new technology and the user constraint modules. It compiles all these data, along with a transformation process (via the *SAGE_QDATA.xls* file), into a VEDA-SAGE database. Orange block arrows on Figure 1 represent this import process.
- *Browse-Copy-Delete-Edit:* To browse the complete database and to copy, delete or edit data.
- *RES:* This function allows seeing a graphical representation of the regional RES and of the endogenous trade links.
- *Solve:* To set various model and solver options, and to submit runs.

Module 2 menu:

- *Demands:* To view and edit demand projections and to manage driver data and calibration/sensitivity series.
- *Technology Repository:* To view, select and modify the new technologies to be used in each region, and to import new technologies in the repository.
- *Trades:* To declare trade links and parameters between regions for energy commodities and emission permits.
- *User constraints:* To view and edit user constraint/market share definitions and coefficients, to delete or copy user constraints and to add new user constraints.
- *Scenario Data:* To import new scenario data in the database.

Figure 1. VEDA-SAGE Database Configuration



3.2. The import process

Orange block arrows on Figure 1 represent the main import process of files to create the active VEDA-SAGE database. This import process is launched via the Import menu (module 1) and each step is associated with a different color in the template manager (see also section 5.1):

- *Step 1 (Yellow: IEA Update)*. To update the energy numbers in the templates from the Base-Year files (IEA/EMEU databases). This step is required for all sectors of regions for which this file has been modified.
- *Step 2 (Red: Template Import)*. To read the information in the templates. This step is required for each template that has been modified. Databases affected: TmplData.MDB.
- *Step 3 (Orange: Technology Repository)*. To import the new technologies. Databases affected: TmplData1.MDB, TechRep.MDB.
- *Step 4 (Pink: User Constraints)*. To generate the user constraints. Databases affected: TmplData2.MDB, Adratios.MDB.
- *Step 5 (Green: Transformation)*. To compile all above information, along with the transformation file (SAGE_QDATA.xls), into the VEDA-SAGE database.
- *Blue color* indicates that the import process is complete.

Therefore, as a first step, the user imports the information from the templates (<Region>_<Sector>_<Version>.xls; e.g. AFR_ELC_V7p0.xls) and from the new technology (TechRep.mdb) and the user constraint (Adratios.mdb) databases. All these data are compiled, along with a transformation process (SAGE_QDATA.xls) into a VEDA-SAGE database. With the information included in the other two modules (Demands.mdb and Trades.mdb), these data constitute the active VEDA-SAGE database. Afterward, the user can also import new data, compiled in Excel files, from various menus (module 2) of VEDA-SAGE: new technologies (e.g. TechRep2.xls) via the Technology Repository menu, new demand drivers (e.g. HighMacGDP.xls) via the Demands menu and any new scenario data (e.g. Sce_ZDMFR.xls) via the Scenario Data menu.

The user can use the multiple VEDA functionalities to view or edit the entire SAGE database. The impacts of importing on edited data are described in the next section. More especially, it consists in clarifying, which changes are permanent and which ones are temporary (until the next import process).

3.3. Impacts of imports on edited data

It is exceedingly important for the user to know which actions performed through VEDA-SAGE functionalities have a permanent impact, and which actions have a temporary impact only, “permanent” being defined as something that survives the import process. The user can edit data through the browser of the module 1 menu (for the whole database), and from the functionalities of the module 2 menu (for specific databases): Demands, Technology Repository, Trades, User constraints, and Scenario Data. The impacts of importing on edited data are explained according to the different steps of the import process described above.

Browser: The user can edit any data of the model from the browser. All base scenario modifications are temporary; they are lost with future imports of templates (from step 2). However, since the import process is performed on a region basis, the import of templates for a particular region will not affect the modifications done in the database for other regions.

- The only way to retain modifications for the base scenario is to use the copy function to create a new scenario.
- As for other scenarios than base, modifications are lost only if that particular scenario is re-imported (via the Scenario Data function of module 2 menu).

Technology Repository: From this functionality, the user can modify the selection of the new technologies available for each region. These modifications are saved only in the module database (TechRep.mdb). Consequently, a re-import is required from step 3, for regions and sectors involved, to update the VEDA-SAGE database. Future imports of templates (from step 2) do not affect these modifications.

- The user cannot edit the new technology parameters at this level. These modifications are done directly in the technology repository Excel file (*e.g. TechRep.xls*). Then, this file is re-imported via the technology repository (module 2 menu) and the main import process is needed from step 3 for all regions. Since the new technology repository is built on a sector basis, a modification in one or more sectors has an impact on all regions at the same time.
- The selection of the new technologies available in each region remains valid when the same new technologies (with the same name, but with the same or different parameter values) are re-imported from this module. If other new technologies are imported (*e.g. TechRep2.xls*), it is the user's responsibility to make the selection of new technologies available in each region.
- At this point, one needs to perform the import step after importing new technology definitions, and/or changing technology selections. This is to assign the fuel combustion based emission coefficients, and to regenerate the user constraints.

User constraints: From this functionality, the user can modify the definition or the coefficients of existing user constraints, and create new user constraints. These modifications are saved only in the module database. Consequently, one needs to perform the import operation from step 4, for regions and sectors involved, to update the database. A clear distinction is maintained between the constraints read from the templates, versus those created within the application. While either can be modified within the application, the ones that come from the templates are restored to the template definitions when the import operation is performed. However, the import process does not affect the ones defined within the application. Finally, relaxation factor provides an easy way to relax user constraints. To summarize:

- A re-import process from step 3 (technology repository) will not affect the user constraint definition and coefficient modifications.
- The relaxation factors applied to existing user constraints within VEDA are retained, since they are not read from the templates.
- The new user constraints and market shares created within VEDA are retained.

Demands: From this functionality, the user can modify demand projections through a selection of drivers and calibration/sensitivity series. These modifications are updated in the database as the

user saves and exits the module and any other import is needed. Future imports of templates (from step 2) do not affect these modifications for future periods (2005 to 2050). However, imports of templates affect the base year value (i.e. at the time-period 2000), because it is where they are calculated. If the base year values have changed in the templates, the new demand projections are calculated during the import process. This calculation is based on the driver and the calibration/sensitivity series that are selected for each demand. Changes are updated in the active database as the user exits this module. Therefore, no need to perform the import step after making modifications in the demand module.

Trades: From this functionality, the user can create, and then modify, trade links and parameters. These declarations and modifications are updated in the database as the user saves and exits the module and any other import is needed. Future imports of templates (from step 2) do not affect any of the declarations and modifications.

- There is only one exception: if some of the technologies created for the endogenous trades qualify for some user constraints. At this point, nothing informs the user, if trade declarations or modifications required a re-import of user constraints. It is the user's responsibility to re-import the user constraints (from step 4) for the appropriate regions and sectors.

Changes are updated in the active database as the user exits this module. Therefore, no need to perform the import step after making modifications in the demand module.

In summary, a re-import of templates (from step 1 or step 2) overwrites edited base year demand values (2000 period), user constraint definition and coefficients, existing technology parameters and other parameters existing in the templates (demand elasticities, discount rate, etc.) for regions that need to be imported. On the other hand, re-importing templates does not affect demand projections (from 2005 to 2050), new technology selection (by regions) and parameters values, any trade links or parameter values and any other scenario data than base.

3.4. Concepts of database, scenario and run

It is important to define the concepts of active database, scenario and run as they are mentioned in this guide.

Active database. The previous sections describe in detail the concept of an active VEDA-SAGE database and explain the impacts of imports on edited data within a single active database. However, the user can create several versions of the active database (but can open only one at the same time). It is useful to explain the impacts of creating a new active database on edited data.

To create a new active database, it is necessary to re-import data. If the previous active database was complete (*Step 6; Blue: Complete*), an import is needed from the transformation stage (*Step 5; Green: Transformation*). Given that all data are compiled in Access databases, the import process is not required from the first steps when these databases have not changed. If the previous active database was not complete for some regions and sectors (*Step 1,2,3 or 4*), an import is needed from the same stage. In this case, an import is also needed from the transformation stage (*Step 5; Green: Transformation*) for all other sectors of those regions for which the database was not completed. Indeed, imports of templates will have impacts on edited

data as explained in the previous section. Within a new active database, it is also necessary to re-import the scenario's files, the driver's files and other technology repositories for other scenarios than base.

To create different active databases, the same Access files are always updated with imports. In other words, only one copy of each of the Access database is used at the same time to create the active database. Consequently, it is not possible to keep several active databases in VEDA-SAGE with different changes in the various modules. Nevertheless, it should be mentioned that there exists an indirect way to store alternate databases, by making copies of the four Access databases (*Demands.mdb*, *TechRep.mdb*, *Adratos.mdb*, *Trades.mdb*), into specific directories. Later, these copies may be brought back to the VEDA directory to become the active database.

Scenario. The base scenario, as defined in this guide, includes data from the templates (<Region>_<Sector>.xls), from the transformation file (*SAGE_QDATA.xls*) and from the four module databases (*Demands.mdb*, *TechRep.mdb*, *Adratos.mdb*, *Trades.mdb*). The concept of other scenarios applies to any other data imported into the active database from external Excel files: new technologies (e.g. *TechRep2.xls*) via the Technology Repository menu, new demand drivers (e.g. *HighMacGDP.xls*) via the Demands menu and any new scenario data (e.g. *Sce_ZDMFR.xls*) via the Scenario Data menu. Each of these extra files constitutes a different scenario.

Run of the model: The model is always solved using the base scenario information, and one or more other scenario(s). The other scenarios can be included or excluded at the time of solving. Therefore, different runs (with different names) can be sent using the base scenario information plus different other scenario data (see section 6.5.1). The run name appears as the name of the results files for VEDA-BE.

The following sections aim at explaining all the menus in a detail manner. The File menu deals with managing databases. The Modules-1 menu deals with the entire model: importing a database, setting up, viewing textually or graphically, browsing/editing, or running the model. The Modules-2 menu deals with the main sectoral manipulation modules of VEDA-SAGE: Demands, Technology Repository, Trades, User constraints, and importing new Scenario data.

4. File menu

4.1. New Database [Ctrl N]

This function creates a new active database. A window opens and 'VEDASAGE_Data' is the name used by default for new databases. The user can enter a different name and click 'OK'. This is the first step required when the software is used for the first time on a computer. A second window opens. If a database with the same name exists already, the user can decide to overwrite the existing database. Otherwise, a message indicates that the new database (<Name>.MDB) is open currently.

The system databases (demands, technology repository, trades, user constraints) load and a window opens from which the user can specify the path where the templates are stored to import them into the user active database. If a path has already been declared, it will be identified and highlighted by default and the user can click **'OK'** to use the same path. To declare a new path, the user can use the **'New'** button, locate the templates folder, click **'OK'**, highlight the new path in the first window and click **'OK'**. The template manager will load automatically (see section 5.1). One can also delete paths from this window using the **'Delete'** button.

Question I. How to create a new database?

Menu Path: File, New Database.

- a) Choose a name for the new database (e.g. TESTJuly17) or use the name by default (VEDASAGE_Data) and click **'OK'**.
- b) If the first message is "A Database with this name exists already. Do you want to overwrite the existing database?", click **'Yes'** to overwrite or click on **'No'** to cancel and re-start the process using a different name. If the message is "TESTJuly17.MDB is open currently!", click **'OK'** to confirm.
- c) Select the path where the templates are stored (e.g. C:\SAGE TEMPLATES). If the right path is already declared, highlight it and click **'OK'**. To create a new path, click **'New'**, locate the right path and click **'OK'**. Highlight the new path and click **'OK'**.
- d) Click the **'IMPORT DATA'** button to start the import process (see section 5.1). This will bring all the cells (templates) to 'blue' from whichever state (color) they are in. This step may take up to two hours for a complete import. Once all the cells are blue, the import is completed.

4.2. Open Database [Ctrl O]

This function is to open an existing VEDA-SAGE database. All existing databases are displayed in a list and the user can highlight one and click **'OK'**. A message confirms the name of the open database: 'VEDASAGE_Data.MDB is open currently'. The user can click **'OK'** and the database will load. From this step, one can browse and edit the database (see section 5.2).

4.3. Close Database

This function automatically closes the database that is currently opened.

4.4. Delete Database [Ctrl T]

This function is to delete existing VEDA-SAGE databases. All existing databases are displayed in a list and the user can highlight one and click **'OK'**. One can close the window to cancel the operation.

4.5. Compact Database [F12]

This function is to compact the database that is currently opened. Access files increase in size as write and delete operations are performed in the tables, resulting in increased execution time.

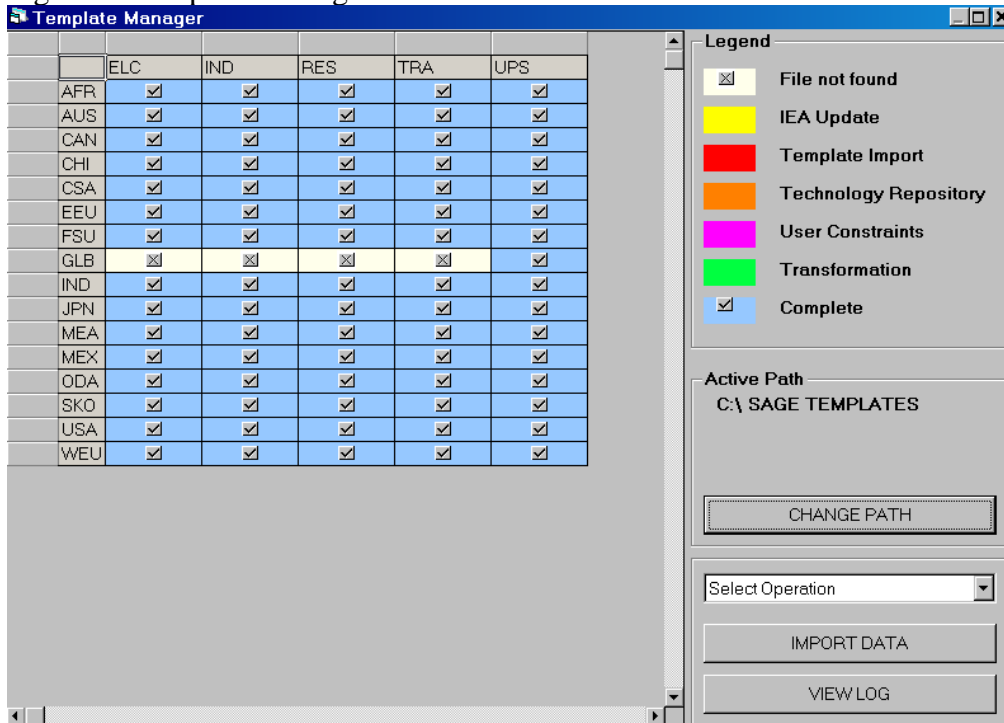
This may be corrected by compacting, which reduces the size. The active database (created by the user), as well as the system databases (demands, technology repository, trades and user constraints), are compacted.

5. Module 1

5.1. Import [F6]

This function allows the user to import the data from the templates, as well as the data from the new technology and the user constraint modules. These data are compiled, along with a transformation process, into a VEDA-SAGE database (see also section 3.1 for more information on the files involved and section 3.2 for the import process). This function is also called the template manager (see Figure 2).

Figure 2. Template Manager



Template manager and color legend. The left side of the window contains a matrix with the 15 regions in ordinate (16 regions with the global region) and the 5 sectors in ordinate, where each cell corresponds to one of the 75 templates. On the right side of the window, a first section contains a color legend allowing the user to follow the status of the import process.

- File not found (off white): Indicates that one or more templates are missing from the folder where they are stored. This is the case for the global region (GLB), since only an upstream template is used for emission permit trading purposes, see section 6.3.1.
- IEA Update (yellow): Updates the base-year energy numbers in the templates from the Base Year Data files located in the template folder. These files have numbers based on EMEU/IEA databases.

- Template Import (red): Imports the SAGE templates into the (Access) databases.
- Technology Repository (orange): Imports only the new technologies from the repository. This repository exists in the application folder (TechRep.mdb).
- User Constraints (pink): Generates the user constraints from the ADratios.mdb file located in the application folder.
- Transformation (green): Compiles all above information, along with transformations indicated in the SAGE_QDATA.XLS file, into a VEDA-SAGE database. The SAGE_QDATA file located in the application folder contains user-defined instructions to update and/or insert regional data, by which the user can modify or add new regional specifications, such as technology costs or bounds.
- Complete (blue): Import and processing is completed. The user may now submit a run (section 5.4).

In each cell of the matrix, a check mark indicates if the template is active. The user can deactivate some templates by removing check marks; these templates will then be ignored during the import process.

Active Path. Below the legend, a second section shows the active path for the templates folder. The user can specify an alternate folder of templates by clicking the '**CHANGE PATH**' button and following the instructions of the section 4.1.

Import functions. The third section includes the import functions. In the combo, the user can select the following operations:

- Update IEA Data: To update the base-year energy numbers (yellow) and import the templates.
- Template Import: To import the templates (red).
- UConstraint: To generate the user constraints (pink).
- Transformation: To start the import process at the transformation level (green).
- Edit: To open and edit templates.

For any of these options, the user has to select the templates (region/sector) to import by clicking in the cells of the matrix and clicking the '**OK**' button. *Note that clicking in a cell outside the matrix activates all the templates of the corresponding column or row.* Only those templates (region/sector), for which there are check marks, will be imported. Then, the user can click the '**IMPORT DATA**' button. At any time, even if no operation is selected, the user can click the '**IMPORT DATA**' button to start the import processing. This brings all the cells (templates) to 'blue' from whichever state (color) they are in. As for the '**VIEW LOG**' button, it allows seeing the pre and post-transformation data values.

5.2. Browse/Edit [F7]

Browse. This function allows to browse the entire active database and to edit data if wanted. The user can create views (tables) of the database by setting filters on the various dimensions: scenario, region, technology, commodity, parameter and others (bound, sector, time slice, year). *Note that it is possible to set a filter for only one of these other attributes (bound, sector, time slice, year) at the same time. For example, the user cannot select time slices and years at the*

same time. However, it is possible to set additional filters later on the table that is created (see other functions below). Beside each attribute header, a number in brackets indicates the number of elements that are selected. Right clicking on attribute boxes gives a menu with three functions to help selecting or un-selecting:

- Reset list: To un-select all elements of the list.
- Select all: To select all elements of the list.
- Search: To search for elements to include or to exclude in the selection using their short names (codes) or their long names (description). This function gives access to a filter/search form. *Note that the results of successive searches in a same attribute box are incremental to the previous ones by default. The user can uncheck the Make incremental Selection box at the bottom-left part of the search form or reset the list (right-click menu) before each search.*


See Figure 3 for an example of filter/search form. This facility exists in most of the menus and windows. It helps to filter/search for elements to include or to exclude in a particular selection of scenarios, regions, technologies, commodities, technology parameters, demands, drivers, sensitivity and calibration series, user constraints, etc. Depending on menus/windows, different buttons give access to this form, like **'Search'**, **'Filter'** or the binocular button .


Figure 3. Filter or search form

For technologies and commodities, this menu has three additional functions:

- Show Code/Show Description: To switch between short names (Show Code) and long names (Show Description) of elements.
- Process information/Commodity Information: To get information on one selected element, like Description, Sets (DMD, TCH, etc.), Scenarios, Regions and Unit.

- Goto RES: To go to the RES (Reference Energy System) section of the selected technology or commodity (see section 5.3 for RES information).

Furthermore, below the technology and the commodity attribute boxes, a combo contains a list of sets related to these attributes (like DM, ELC, ENT, MAT, etc. for commodities). Choosing one of these sets displays only the commodities that belong to it. Finally, the user can click the **'Browse'** button to view his data selection. A table will be created at the bottom-left part of the window and some buttons will be available on the right side.

Layout. On browsing, VEDA automatically creates a layout depending on the dimensions that turn up with multiple elements. It is possible to reconfigure the table created by dragging and dropping the dimensions (attributes) in rows or in columns. Therefore, the user specifies the layout of the table by deciding if a dimension should appear in rows or in columns, and in what nesting order, i.e. from the outermost to the innermost position. While dropping, a green bar will indicate valid drop positions on the window. If a dimension is not displayed in a row or in a column (but at the top of the table), the values related to that dimension will be summed up. Some dimensions should never be put on the page, since the sum of its values makes no sense, such as the scenario dimension. Furthermore, by clicking on the '-' sign to the left of every element, the user can sum up all the values along the dimensions to the right of this tab. At the left side of the table, a section contains options related to 'Data Values'. It is possible to view 'Time Series' and/or 'TID' (Time Independent Data) by checking appropriate boxes. It is also possible to increase or decrease the number of decimals using these buttons .

Question II. How to browse the entire database?

Menu: Module-1, Browse/Edit (or F7).

- Select the elements to view for each attribute (scenario, region, technology, commodity, parameter and others like bound, sector, time slice and year). If no element is selected for an attribute, all of them will be included in the selection. Beside each attribute header, a number in brackets indicates the number of elements that are selected. (See the 'Browse' paragraph above for more information on selection functionalities).
- Click the 'Browse' button to view the data selection.
- Modify the layout by dragging and dropping the dimensions (attributes) in rows or in columns. A green bar indicates valid drop positions (see the 'Layout' paragraph above for more information).
- Apply additional filters on one or more dimensions of the table to specify a smaller number of elements if necessary. Select the 'Apply Filter' option from the right-click menu in the appropriate dimension.
- Click the **'Browse'** button to reset the initial list of elements selected in each dimension (before the application of additional filters).
- It is possible to edit data using the **'Edit'** or the **'Edit in Excel'** button. However, the changes are temporary until the next import of templates, technology repository, transformation file or any other scenario files (see section 3 for a better understanding of the import process).

Question III. How to view technology parameters (after transformation)?

You want to view the cost and the start period of technologies consuming coal, which are available in the residential sector for Australia and Canada in the base scenario (see Figure 4). *Note that the technology parameters viewed from the browser are the final values, i.e. after the transformation process using the SAGE_QDATA.xls file. To see the original values before the transformation process, use the technology viewer option (see Question XIV).*

Menu: Module-1, Browse/Edit (or F7).

- a) Select the elements to view for each attribute:
 - Scenario: Base.
 - Region: AUS and CAN.
 - Technology: Select all technologies starting with R (for residential) and containing the letters COA (for coal) using the search function. It is possible to include elements where short name is starting like R__COA. *Note that underscores may be used as a wild card and comma may be used as or.* Only the technologies that are relevant for the selected parameters will appear in the table. In this example, 19 items are found in the search form, but only 8 technologies appear in the table.
 - Commodity: Ignore.
 - Parameter: INVCOST, FIXOM and START.
 - Others: Ignore.
- b) Click the '**Browse**' button to view the data selection.
- c) Modify the layout: The parameter dimension has been moved from a row to the outermost position in column.
- d) Apply additional filters: Ignore.

Question IV. How to compare electricity plant costs?

You want to compare the costs of electricity plants in all regions in the base scenario (see Figure 5).

Menu: Module-1, Browse/Edit (or F7).

- a) Select the elements to view for each attribute:
 - Scenario: Base.
 - Region: Ignore.
 - Technology: Select all technologies that belong to the ELE set simply by using the combo below. Another approach would be to select all technologies that belong to the CON set and select the ELC sector (this way allows to get the heat plants also, but not all the cogeneration technologies of the industrial and the upstream sectors).
 - Commodity: Ignore.
 - Parameter: INVCOST, FIXOM and VAROM.

- Others: Years 2000 and 2050 since most of the costs are specified for these two periods (or the ELC sector if the second approach is used).
- b) Click the '**Browse**' button to view the data selection.
- c) Modify the layout: The region dimension has been moved from a row to the innermost position in column and the parameter dimension has been moved from the outermost to the innermost position in column.
- d) Apply additional filters: Ignore (or Years 2000 and 2050 if the second approach is used).

Question V. How to compare demands from different scenarios?

You want to compare end-use demands of the base case with those of a high macro economic growth case in China (see Figure 6).

Menu: Module-1, Browse/Edit (or F7).

- a) Select the elements to view for each attribute:
 - Scenario: Base and Highmacro.
 - Region: CHI.
 - Technology: Ignore.
 - Commodity: Ignore.
 - Parameter: DEMAND.
 - Others: Ignore.
- b) Click the '**Browse**' button to view the data selection.
- c) Modify the layout: The scenario dimension has been moved from the outermost to the innermost position in column.
- d) Apply additional filters: A filter is applied on the commodity dimension to select the commercial and the residential end-use demands. It is possible to include elements where short name is starting like C__ (for commercial demands) and R__ (for residential demands). It is also possible to select only the commercial and the residential end-use demands from the beginning using the search form (because it is not possible to select more than one commodity sets, such as DM_COM and DM_RES).

Figure 4. How to view technology parameters (after transformation)?

The screenshot shows the VEDA_SAGE interface with several filter panels at the top: Scenario (1) with 'BASE' selected; Region (2) with 'AUS' selected; Technology (8) with 'RH1COA000' selected; Commodity with 'A_BIOCAP' selected; Parameter (3) with 'FIXOM' selected; and Others with 'Bound' selected. A 'Data Values' panel shows 'Time Series' and 'TID' checked. A 'Select Technologies...' dialog box is open in the foreground, showing a list of 19 selected items including RESCOA000, RH1COA000, RH1COA005, RH2COA000, RH2COA005, RH3COA000, RH3COA005, RH4COA000, RH4COA005, RHWCOA000, and RHWCOA005. Below the dialog, a table displays the following data:

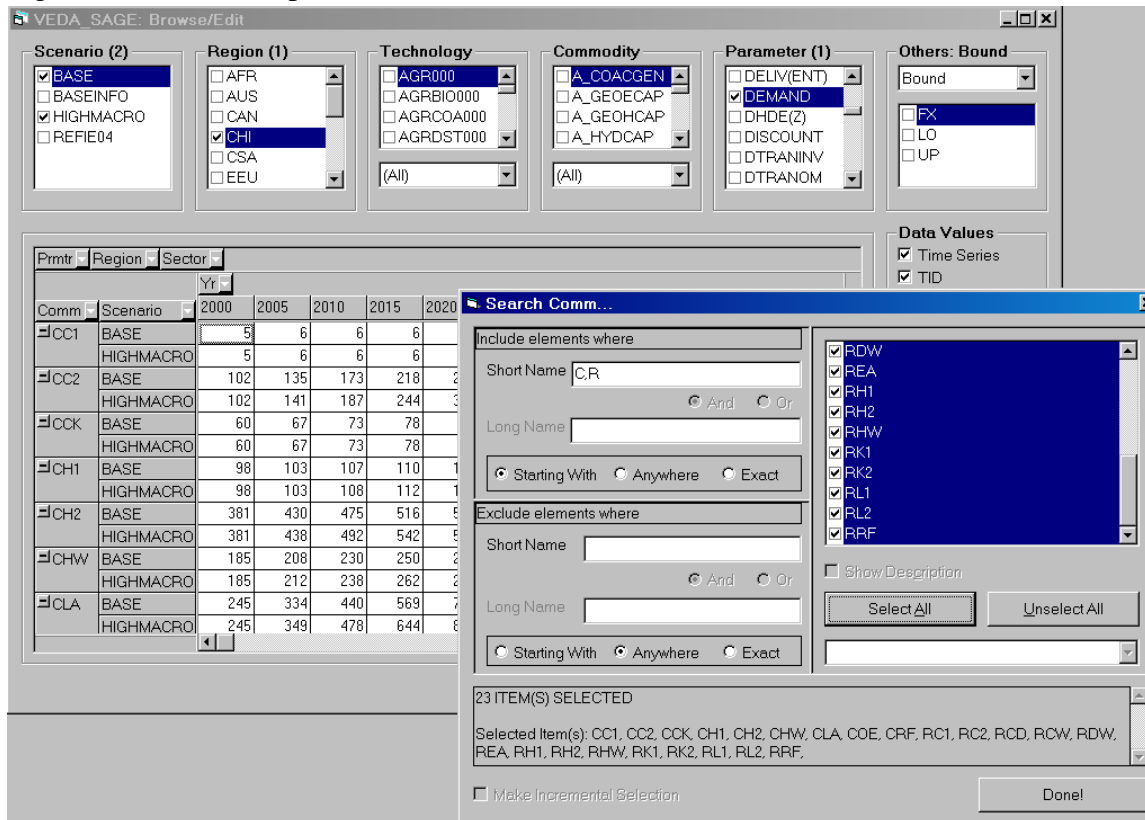
Region	Tech	2000	2050	2000	2050	TID
AUS	RH1COA005	3	3	98	98	2005
	RHWCOA005	1	1	75	75	2005
	RK1COA005	24	24	250	250	2005
CAN	ROTCOA005	6	6	0	0	2005
	RH1COA005	4	4	79	79	2005
	RHWCOA005	1	1	60	60	2005
	RK1COA005	30	30	200	200	2005

Figure 5. How to compare electricity plant costs?

The screenshot shows the VEDA_SAGE interface with filter panels: Scenario (1) with 'BASE' selected; Region with 'AFR' selected; Technology with 'AGRELC000' and 'ELE' selected; Commodity with 'A_BIOCAP' selected; Parameter (3) with 'VAROM' selected; and Others: Year(2) with '2050' selected. A 'Data Values' panel shows 'Time Series' and 'TID' checked. A table displays the following data:

Tech	Pmtr	Region									
		AFR	AUS	CAN	CHI	CSA	EEU	FSU	IND	JPN	MEA
EBIOCR105	FIXOM	42	48	60	36	42	42	42	36	60	
	INVCOST	2125	2125	1700	1530	2125	1700	2125	1530	2380	2
	VAROM	2	2	3	2	2	2	2	2	3	
EBIOCR105	FIXOM	53	60	75	45	53	53	53	45	75	
	INVCOST	2500	2500	2000	1800	2500	2000	2500	1800	2800	2
	VAROM	3	3	4	2	3	3	3	2	4	
EBIOWAW105	FIXOM	28	32	40	24	28	28	28	24	40	
	INVCOST	2375	2375	1900	1710	2375	1900	2375	1710	2660	2
	VAROM	2	2	3	2	2	2	2	2	3	
EBIOWSW105	FIXOM	70	40	50	30	35	35	35	30	50	
	INVCOST	8750	4375	3500	3150	4375	3500	4375	3150	4900	4
	VAROM	7	4	5	3	4	4	4	3	5	
FRIOPT100	FIXOM	42	48	60	36	42	42	42	36	60	

Figure 6. How to compare demands from different scenarios?

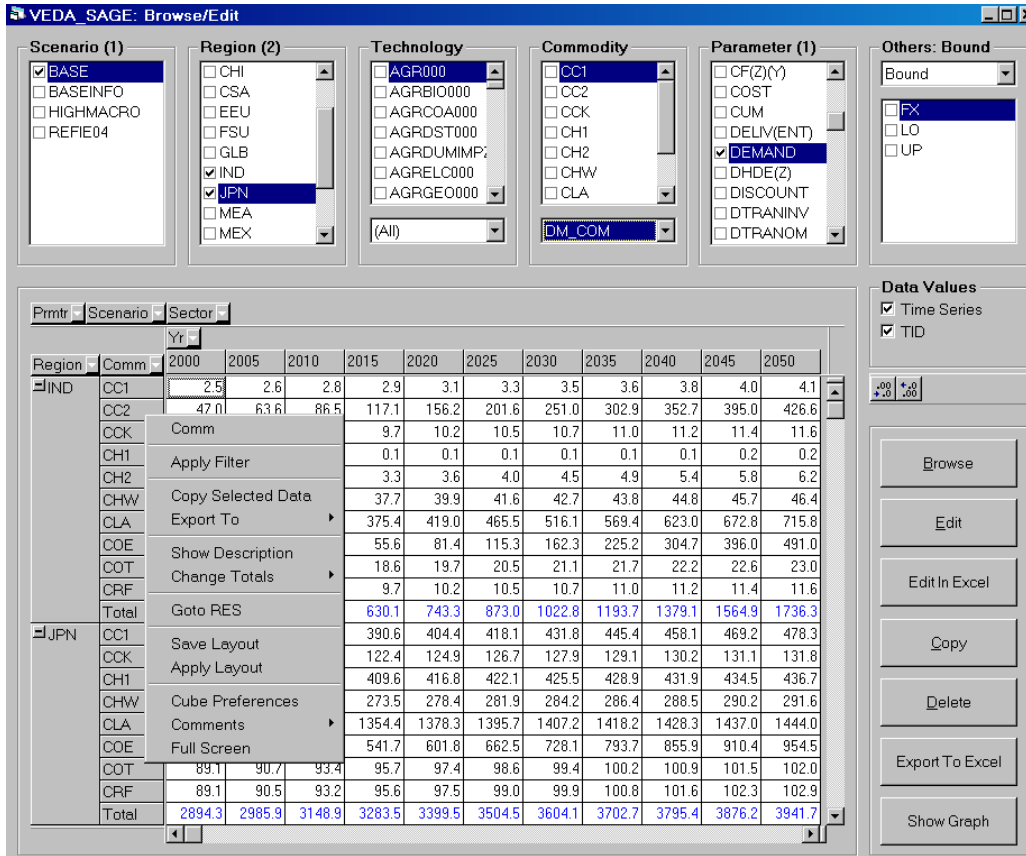


Other functions. Right clicking in each dimension of the table created gives a menu with various functions (see Figure 7). Some functions are linked to particular dimensions, while others are valid for the whole table irrespective where the right-click is done. The first item of the menu is always the dimension from which the right-click has been done.

- Apply Filter: For each dimension, the default is to include all elements currently shown in the table. The list of elements may be viewed by clicking on the tab of that dimension. To specify a smaller set of elements, the user can apply a filter by right clicking on one table dimension. A window opens, where the user can search for elements to include or to exclude using their short names (codes) or long names (descriptions). Once a filter is applied to one dimension, two more options will be available in the menu, which are 'Remove Filter' for that dimension and 'Remove all Filters' for all dimensions. Clicking the '**Browse**' button resets the initial list of elements selected in each dimension (before filtering).
- Copy Selected Data: From anywhere in the table, it is possible to copy selected data to eventually paste them somewhere else. If no data are selected, all visible data of the table will be copied.
- Export To: From anywhere in the table, it is possible to export the table to an Excel, Word, Html or Text file. A file will automatically be saved in the application folder.
- Show Code/Show Description: Only for technology and commodity dimensions, this function allows to switch between short names (Code) and long names (Description) of elements.

- Change Totals: This function applied to each dimension. It allows to create additional rows or columns in the table and to show the ‘Sum’ or the ‘Average’ of elements of a particular dimension (and dimensions in innermost positions) by subtotals for each element of the dimension at the previous hierarchical level. The user can select ‘None’ to remove additional rows or columns.
- Goto RES: Only for technology and commodity dimensions, this function allows to go to the RES section of the selected technology or commodity (see section 5.3).
- Save Layout: From anywhere in the table, this function is to save the table layout for future use on other tables.
- Apply Layout: From anywhere in the table, this is to apply a previously saved layout to a table (Save Layout).
- Cube Preferences: From anywhere in the table, this function is to set the user preferences that will be used by default as regards to the table layout. When choosing this function, a window opens where there are three tabs:
 - o The ‘General’ tab allows to specify the Number Format (number of decimals), Row and Column Alignment (Left Top, Right Center, etc.), Row and Column Style (Flat, Raised Heavy, etc.), Cursor Style (Light or Heavy) and Grid Style (None, Flat, Raised, Sunken).
 - o The ‘Color’ tab allows to specify Back and Fore colors, Fields Back and Fore colors, Heading Back and Fore colors, Totals Back and Fore colors, Grid and Printer Grid colors.
 - o The ‘Font’ tab allows to specify Font, Font Style and Size for text and number in fields, headings, totals, etc. All these preferences remain valid until the user changes them.
- Comments: This function applies to selected values. The user can select values and ‘Apply’ a ‘New’ comment. A window opens where it is possible to enter a comment text. It is also possible to view the ‘Existing’ comments, which are listed in a window. The cells associated to the comments are colored and the user can decide to keep the colors ‘Visible’ or not. Since it is possible to enter many comments, a color ‘Legend’ allows the users to distinguish the various comments.
- Full Screen/Undo Full Screen: To maximize the size of the table or to bring back the original size.

Figure 7. Browse/Edit Data Selection



Finally, other functions are available on the right side of the table (see Figure 7).

‘Edit’. This function is to edit data. The user can click the **‘Edit’** button, make some changes and click the **‘UPDATE VALUES’** button. This button is deactivated when some elements of the tables are aggregated (the dimension is not displayed in a row or in a column, but at the top of the table). A message also indicates to the user that the values may not be edited if a filter is applied in one or more dimensions at the layout level. The modifications done in the base scenario through this functionality are temporary until the next import process (see section 3.3).

‘Edit in Excel’. This function allows the user to temporarily export the table in Excel and to edit the values. The user can save the Excel table if needed (by default in the application folder). After closing the Excel file and going back in VEDA-SAGE, the user can decide to update the changes made in the Excel file to the database or not. This button is deactivated when some elements of the tables are aggregated (the dimension is not displayed in a row or in a column, but at the top of the table). A message also indicates the user that the values may not be edited if a filter is applied in one or more dimensions at the layout level. The modifications done in the base scenario through this functionality are temporary until the next import process (see section 3.3).

‘Copy’. This function is to copy existing elements of a dimension. A window opens and the user can select the dimension and the existing elements to copy, give a name and a description to the new elements and press the **‘Proceed’** button. Some simple numerical transformations are also

possible via arithmetic operations (+,-,/*). This button is deactivated when some elements of the tables are aggregated (the dimension is not displayed in a row or in a column, but at the top of the table).

Delete. This function is to delete the records which are selected in the browser. The user can click **Yes** to proceed or **No** to cancel the task.

Export to Excel. This function is to export and save the table in Excel. A window opens and the user can specify a location on the computer and give a name to the Excel file. Clicking on the **Open** button will automatically save the file and open it. The layout of the Excel table will be the same than that specified in the browser. Clicking the **Cancel** button will abort the operation.

Show Graph. This function is to visualize a graphical representation of the data selected (or all data if no selection is done). Standards graph options are available as well as editing functions like **Swap X and Y Axis**, **Show/Hide Legend** and other **Graph Settings** (title, color, etc.). It is also possible to **Export Graph as Excel Chart**.

5.3. RES [F8]

This function allows seeing a graphical representation of the RES (Reference Energy System) of the regions. The idea is to view a diagram of a portion of the RES centered at a particular process or commodity and the various flows of energy and materials in and out of a process. When opening the RES, a representation of the **Inter Regional Exchanges** (the regional energy trades as specified by the user at see section 6.3), is illustrated by default. The regions appear in abscissa and the commodities in ordinate. The user can click on the arrow buttons to view more commodities or move the scroll bar to view more regions. The mouse pointer (without clicking) allows viewing the description of the element identified below the RES. At this level, it is possible to set a filter on regions (minimum two regions) or on commodities by clicking the check boxes on the right side of the window (search forms open). *Note that filters on region and commodity, as set using these check boxes, are valid only for the 'Inter Regional Exchanges' view and will remain valid for this view when the user navigates in other views of the RES.*

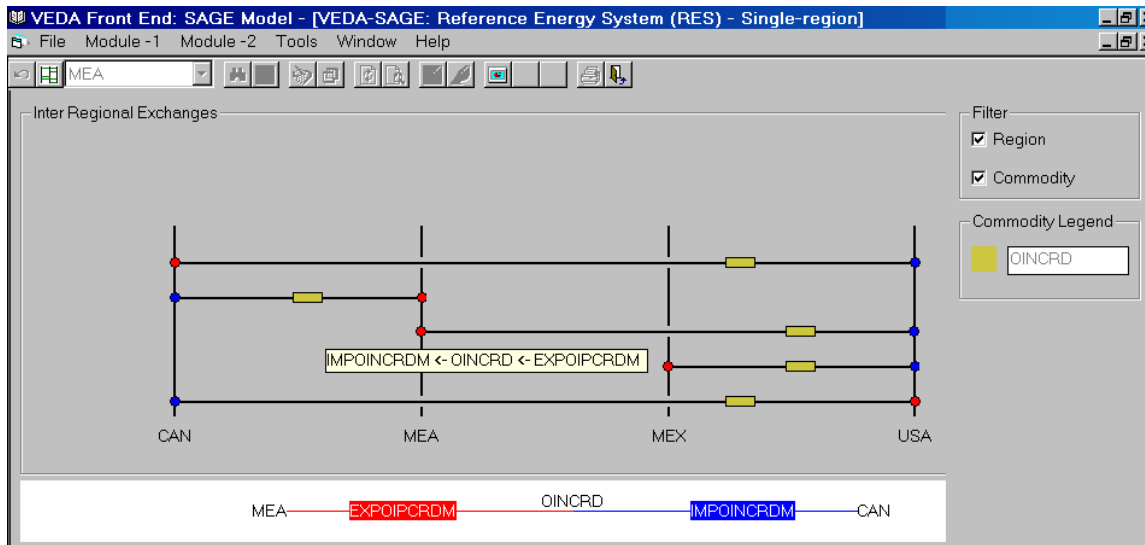
Question VI. How to navigate in the Inter Regional Exchanges (IRE) view of the RES?





You want to see the oil trade links between the Middle East and the North American countries (see Figure 8).

Menu: Module-1, RES (or F8).

- a) Set a filter on regions by checking the appropriate box on the right side of the screen: MEA and CAN, USA, MEX.
- b) Set a filter on commodities by checking the appropriate box on the right side of the screen: OINCRD.
- c) Use the mouse pointer to view short name of commodities and technologies: the pointer shows the OINCRD trade link between MEA and CAN, and associated import and export technologies.
- d) Click on any commodity or technology to navigate in others views of the RES.

Figure 8. How to navigate in the Inter Regional Exchanges (IRE) view of the RES?



The user can navigate downstream or upstream of the current RES view by clicking on any element of the diagram, and thus trace processes and commodities as far backward or forward as wanted from the point of initial access to the RES. The RES view will always be centered on the selected process or commodity. The un-do button  allows going back to the previous view, while this button  allows going back to the 'Inter Regional Exchanges' view (the first view). In order to navigate through the RES, it is also possible to select a region from the combo or to search for a commodity or a process to bring at the center of the shown RES portion by clicking the binocular buttons   (see Figure 3 for an example of search form). Other functions exist such as: show central item information, switch between the code and the description of elements, set commodity and process color and export diagram to Power Point. It is also possible to view the description/name of elements by using the mouse pointer (when the RES view shows their name/description).

Question VII. How to navigate in the RES?

You want to see natural gas flows in the commercial sector of Latin and Central America (see Figure 9).

Menu: Module-1, RES (or F8).

- a) If regional energy trade links are declared (see section 6.3), click on any commodity or technology of the 'Inter Regional Exchanges' view to access other views of the RES and activate more functions (buttons). Otherwise, you will directly access another view of the RES where these functions are activated.
- b) Select a region in the combo: CSA
- c) Search for a commodity using the first binocular button: It is possible to include the element where short name start with COMNGA.
- d) Navigate in the RES by clicking on any element of the diagram.

- Solver: To select the solver CPLEX or XPRESS (radio button) and the CPLEX solver options. Clicking the ‘**CPLEX Options**’ button opens a window where the following options are available; options in *italic* are selected by default (see this document for more information <http://www.gams.com/solvers/cplex.pdf>):
 - o Scaling: Non, *Standard*, Aggressive
 - o Solution Algorithm: Primal Simplex, Dual Simplex, Network Simplex, *Barrier*
 - o Infeasibilities: *Check Re Run*, *Check IIS*, *Quick*, Minimize Candidates
 - o Barrier options (activate only when ‘Barrier’ is chosen for ‘Solution Algorithm’)
 - Algorithm: *Infeas Estimate Start*, Infeas Constant Start, Standard
 - Cross Over: None, Automatic, *Primal*, Dual
 - Ordering: Automatic, Approx Min Degree, *Approx Min Fill*, Nested Dissection

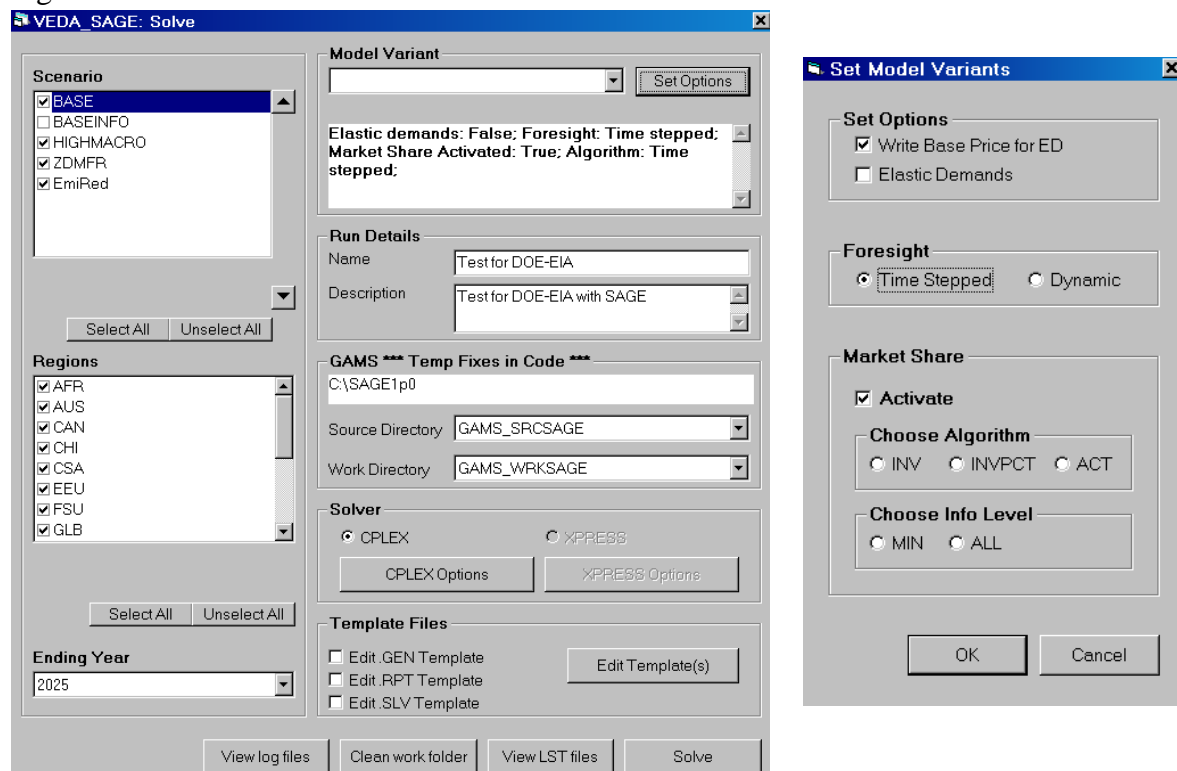
After changing the options, the user can click the ‘**Load SAGE Defaults**’ button to get back the options by default, click ‘**Save**’ to keep valid the new set of options or click ‘**Cancel**’ to keep valid the latest saved set of options.

- Template Files: This function is to edit these run control files only for the current run. The user can check ‘Edit .GEN Template’, ‘Edit .RPT Template’, and/or ‘Edit .SLV Template’ and click the ‘**Edit Template(s)**’ button. Reopening the solve form will reinstate the control files from the templates. The templates themselves may be edited through the tools-options menu.

At the bottom of the window, there are four buttons:

- **View log files**: This function is to view the log files created by GAMS for the last run that was performed.
- **Clean work folder**: This function is to delete files related to the previous runs.
- **View LST files**: This function is to view LST files for previous runs.
- **Solve**: To send runs. A dos window opens, and GAMS is called with the control and DD files generated above.

Figure 10. Solve Form



6. Module 2

6.1. Demands

The demand module includes six main functions: Demands Manager (section 6.1.1), Edit/view single demands (section 6.1.2), View multiple demands (section 6.1.3), Manage driver data (section 6.1.4), Manage calibration/sensitivity series (section 6.1.5) and Demand projection (section 6.1.6). The main window of this module allows selecting a scenario in the ‘Select Scenario Name’ combo and contains buttons to access the six main functions. For a better understanding of the organization of the files and the nature of the modifications (temporary or permanent), as regard to the import process, see section 3.1 and section 3.3 respectively.

6.1.1. Demands Manager

This function allows to view and edit the selection of driver, calibration series and sensitivity series used to project multiple demands (see Figure 11). These series are defined as follow:

- *Driver*: Economic and demographic projections used to project energy service demands. These drivers are specified exogenously by the user on a regional basis and for the entire time horizon. Currently, there are three general drivers (population, gross domestic product (GDP), GDP per capita) available for each region in the demands module. The user can specified more sector specific drivers (passenger and freight traffic, commercial area, industrial production, etc.).
- *Sensitivity series*: Assumptions regarding each service demands sensitivity to changes in the driver.
- *Calibration series*: Factors that account for assumed structural changes in the energy system.

On the left part of the window, a table contains the list of demands for all regions, as well as the driver and the calibration and the sensitivity series used to project each of them. On the right side of the window, the user can filter demands by region, short name (code) and long name (description). Clicking the ‘**Filter**’ button updates the table with only the regions and demands that have been filtered. The ‘**Filter by selection**’ button allows to filter user constraints based on contents of the active cell (e.g. if the cursor is in the normalization column, which has ‘IN’, this will display all user constraints that have ‘IN’ in the normalization column). It may be used to isolate user constraints for the same region, demand, description, driver, sensitivity or calibration series.

The user can change the driver or the series associated to a particular demand by double clicking in the appropriate cell of the table. A combo appears with the list of available options. It is also possible to select the same driver or the same series for all the regions and demands of the table (filtered or not) using the combo above each column. Right clicking in any cell of a particular demand (in any column on a particular row) allows to view the driver and the series numbers for each period. The user can ‘**Reset**’ the original options or ‘**Save**’ the new changes and ‘**Close**’ the window.

Question VIII. How to view demand driver and calibration/sensitivity series selections?

You want to know which demands are projected using the GDP driver in Western Europe (see Figure 11).

Menu: Module-2, Demands, Demands Manager.

- Select the region: WEU.
- Click the **'Filter'** button. Only demands for this region will appear in the table.
- Select the driver or the series of interest by activating an appropriate cell: click in any cell of the driver column where the GDP appears.
- Click the **'Filter by selection'** button. Only the demand projections that use this particular driver will appear in the table.
- It is also possible to modify the driver and the series selections by double-clicking in the appropriate cells. The options available are listed in combos. For example, the driver of the other commercial demand (COT) is changed to the GDP per capita (GDP/Pop).
- Click the **'Save'** button to keep the changes or click the **'Reset'** button to cancel the changes.
- For a better view or comparison of demand projections, see Question IX and Question X.

Figure 11. How to view demand driver and calibration/sensitivity series selections?

Region	Demand	Description	Driver	Calibration	Sensitivity
WEU	AGR	Agricultural demand	GDP (1997 US dollars)	Series56	Series5
WEU	CC1	Commercial Cooling - Region 1	GDP (1997 US dollars)	Series56	Series20
WEU	CH1	Commercial Space Heat - Region 1	GDP (1997 US dollars)	Series56	Series10
WEU	CHW	Commercial Hot Water	GDP (1997 US dollars)	Series56	Series10
WEU	CLA	Commercial Lighting	GDP (1997 US dollars)	Series56	Series20
WEU	COE	Commercial Office Equipment	GDP (1997 US dollars)	Series56	Series100
WEU	COT	Commercial Other	GDP/Pop	Series56	Series3
WEU	ICH	Chemicals	GDP (1997 US dollars)	Series56	Series40
WEU	IIS	Iron and Steel	GDP/Pop	Series56	Series9
WEU	ILP	Pulp and Paper	Population (IEO 2002)	Series56	Series66
WEU	INF	Non-ferrous metals	Total Housing Stock	Series56	Series29
WEU	INM	Non Metals	GDP (1997 US dollars)	Series56	Series69
WEU	IOI	Other Industries	GDP (1997 US dollars)	Series56	Series56
WEU	NEU	Non Energy Uses	GDP (1997 US dollars)	Series56	Series11
WEU	OND	Other non-specified consumption	GDP (1997 US dollars)	Series56	Series56
WEU	TAD	Domestic Aviation	GDP (1997 US dollars)	Series56	Series37
WEU	TAI	International Aviation	GDP (1997 US dollars)	Series56	Series47
WEU	TRC	Road Commercial Trucks Demand	GDP (1997 US dollars)	Series56	Series24
WEU	TRH	Road Heavy Trucks Demand	GDP (1997 US dollars)	Series56	Series24
WEU	TRM	Road Medium Trucks Demand	GDP (1997 US dollars)	Series56	Series24
WEU	TTF	Rail-Freight	GDP (1997 US dollars)	Series56	Series16
WEU	TWD	Domestic Internal Navigation	GDP (1997 US dollars)	Series56	Series11
WEU	TWI	International Navigation	GDP (1997 US dollars)	Series56	Series11

6.1.2. Edit/view single demands

This function is to view and edit selection of drivers, calibration and sensitivity series used to project single demands (see Figure 12). In the top-left corner of the window, the user can select the scenario, the region and the demand to view or edit. The driver, the calibration series and the sensitivity series used to project this demand, as well as the original data values of the demand, are shown in a table.

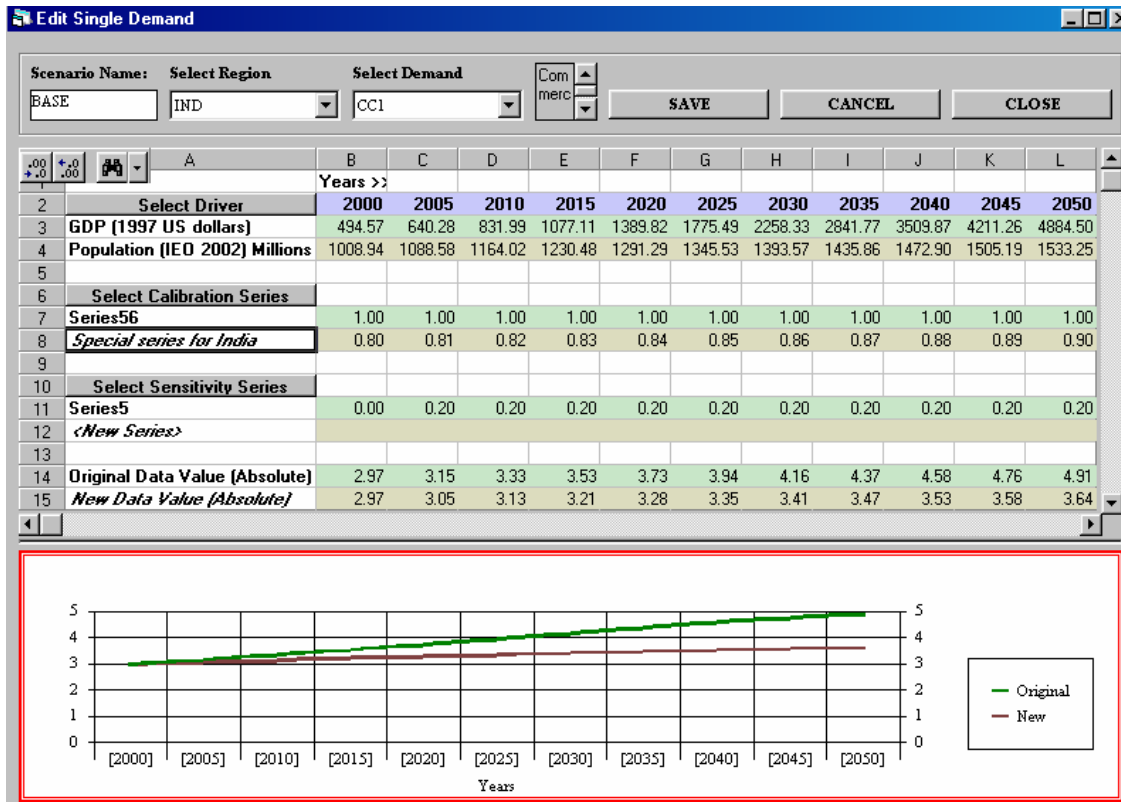
Question IX. How to edit a demand?

You want to decrease the commercial cooling demand of India in the base case (see Figure 12).

Menu: Module-2, Demands, Edit/view single demands.

- Select the scenario: BASE.
- Select the region: IND.
- Select the demand: CC1.
- Select a different driver by clicking the 'Select Driver' gray button: Population rather than GDP using the search form that lists all the drivers available for a region.
- And/or select a different calibration or sensitivity series by clicking the gray buttons and using the search form. It is also possible to create new series by typing new numbers in rows below the original series and to give them a name: for example the new calibration series called 'Special series for India' and that is increasing in time.
- Compare the original and the new demand projections calculated in the last two rows and in the graph below.
- Click the 'SAVE' button to keep the changes (and to set them as options by default) or click the 'CANCEL' button to reset the original values.
- If needed, compare this new demand projection with other demand projections for the same region or with the same demand projection for other regions (see Question X).

Figure 12. How to edit a demand?



There are two different ways of editing demands. First, the user can select new options for drivers and series by clicking on the ‘**Select Driver**’, ‘**Select Calibration Series**’ and ‘**Select Sensitivity Series**’ buttons. In the three cases, a window opens where it is possible to search for elements using their short names (codes) or their long names (description). Second, the user can manually enter new numbers in rows below the original calibration and sensitivity series, create new ones and give them a name. This second option is not available for the drivers; drivers cannot be modified or created manually. The user can only import different drivers (see section 6.1.4) and select one that is already in the list. Below the table, a graph allows to compare the new projection (calculated after editing) to the original projection. The user can ‘**CANCEL**’ or ‘**SAVE**’ the changes and ‘**CLOSE**’ the window. After saving the changes, the new drivers and series will appear as the options by default.

6.1.3. View multiple demands

This function is to compare one or more demands for one or more regions and for one or more scenarios (see Figure 13). In the left part of the window, the user can select the scenarios, the regions and the demands to compare and click the ‘**View**’ button. Then, a graphical representation of the selected demands is shown in the right part of the window. The user can switch between absolute values (by default) and relative values, using the radio button ‘Use Absolute Values’ or ‘Use Relative Values’ and clicking the ‘**View**’ button each time. A search button allows to select elements (Regions, Demands, Years, End Year) to include or to exclude in the selection using their short names (codes) or their long names (description). If no element is selected for a dimension, all of them will be included in the graph.

Furthermore, a few options are possible for the active demand. To activate a demand, the user can click on it in the graph or select it in the ‘Options Select Series’ combo. It is possible to ‘Show Markers’ and ‘Show Statistics’ by checking boxes (Minimum, Maximum, Mean, Regression and Standard Deviation). A button allows to change the line color of that demand in the graph. Finally, it is also possible to directly go to the ‘Edit/View single demands’ window for the active demand by clicking the ‘**Edit**’ button (see section 6.1.2). *Note that it is possible to delete lines in the graph. The user can select a line with the mouse and press ‘Delete’ on the keyboard. The graph scale will be adapted automatically to the new demand values. This option is relevant when the values of a demand are too high compared to others. This delete operation acts only on the graph display (the demands are not actually deleted from the database.*

Question X. How to compare multiple demands?

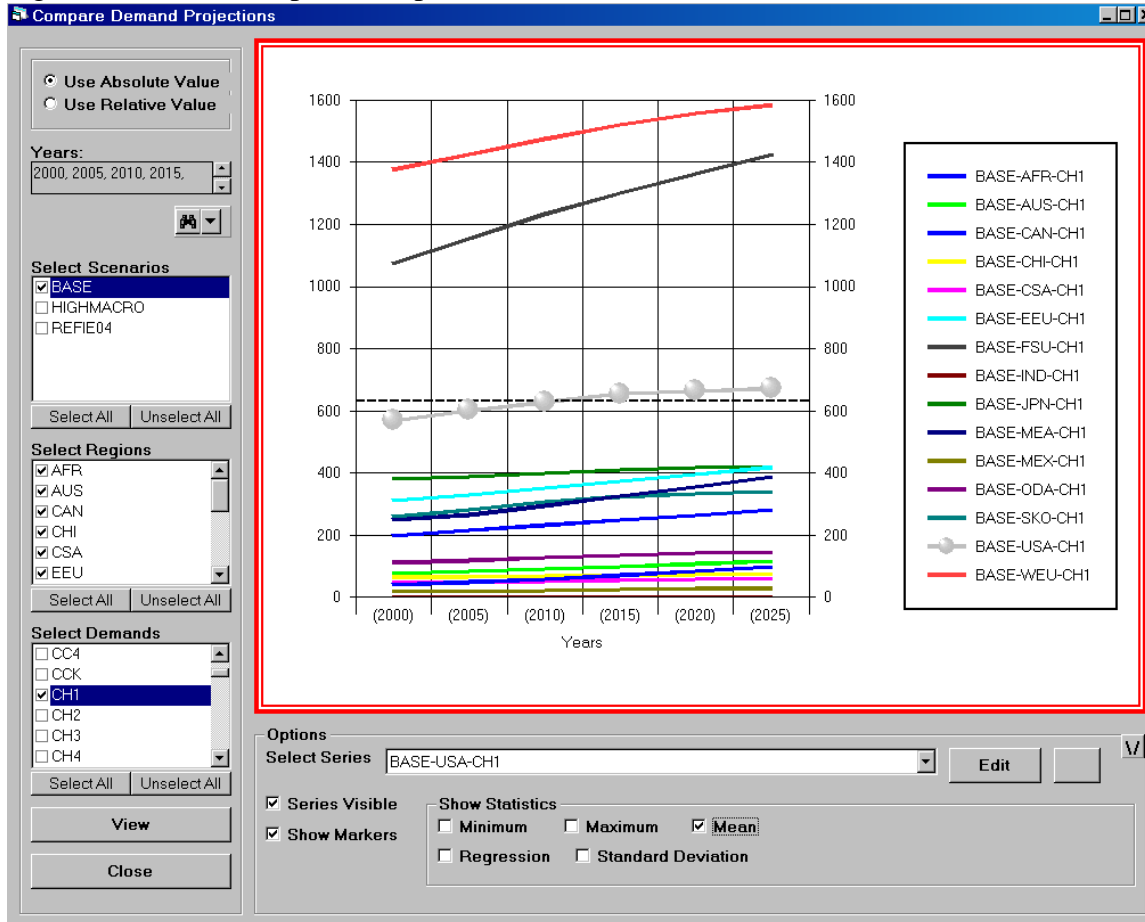
You want to compare commercial space heating demands of all regions up to 2025 in the base case (see Figure 13).

Menu: Module-2, Demands, View multiple demands.

- a) Select the years by clicking the binocular button and on ‘Select End Year’: 2025. By default, all 5-years periods up to 2025 will be included in the graph. From the same binocular button, it is also possible to click on ‘Select Years’ and to choose the different periods to include.
- b) Select the scenarios: BASE

- c) Select the regions: All regions, by using the ‘**Select All**’ button, or ignore (all regions will be included automatically).
- d) Select the demands to compare: CH1
- e) Click the ‘**View**’ button.
- f) Active a demand with the mouse directly in the graph or in the combo below the graph. In this example, the CH1 demand of the USA is active. It is possible to show markers and to view statistics (mean in this example) for that demand. Finally, the user can decide to edit the active demand by clicking the ‘**Edit**’ button (see Question IX).

Figure 13. How to compare multiple demands?



6.1.4. Manage driver data

This function is to compare one or more drivers for various regions and scenarios (see Figure 14). In the left portion of the window, the user can select the scenarios, the regions and the drivers to compare and then click the ‘**View**’ button. Then, a table and a graphical representation of the selected drivers are shown in the right portion of the window. The user can select the time periods in the ‘Years’ box. A search button allows to select elements (Scenarios, Regions, Drivers, Years, End Year) to include in or to exclude from the selection, using short names (codes) or long names (descriptions).

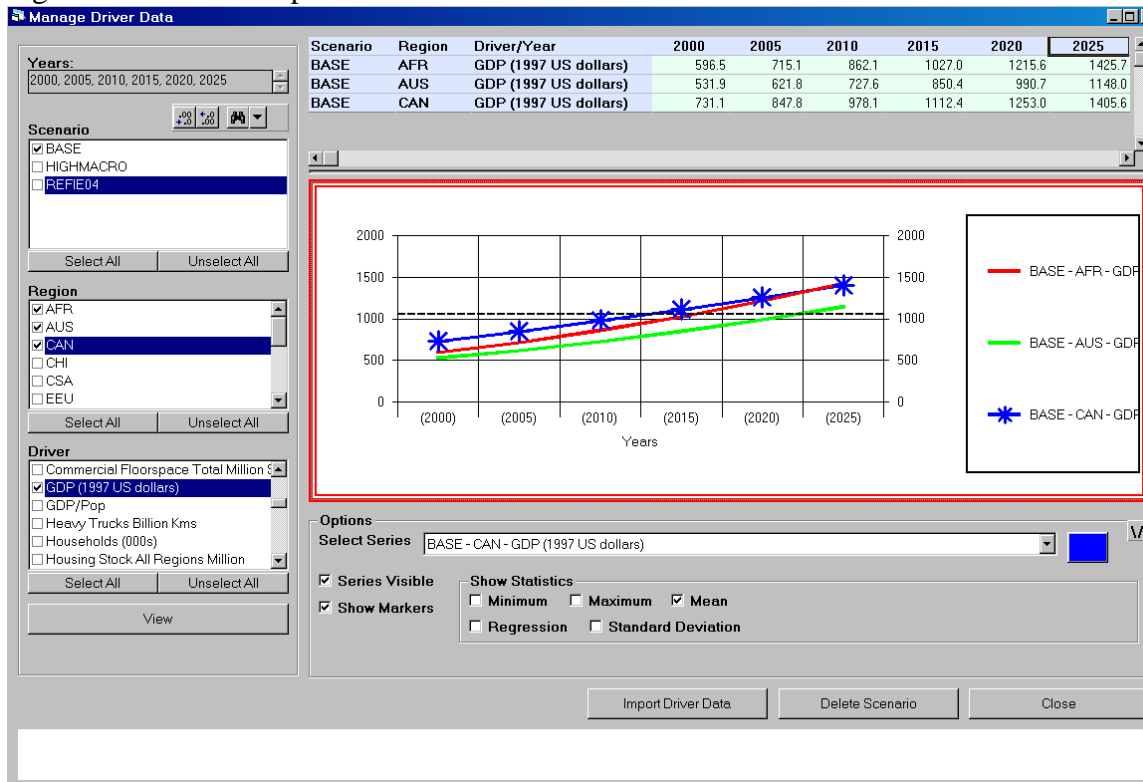
Question XI. How to compare demand drivers?

You want to compare the GDP driver for a few regions up to 2025 in the base case (see Figure 14).

Menu: Module-2, Demands, Manage Driver Data.

- Select the years by clicking the binocular button and on 'Select Years': All periods up to 2025.
- Select the scenario: BASE.
- Select the regions: for example AFR, AUS and CAN.
- Select the driver to compare: GDP (1997 US dollars).
- Click the 'View' button.
- Activate a driver with the mouse directly in the graph or in the combo below the graph. In this example, the GDP driver of CAN is active. It is possible to show markers and to view statistics (the average, in this example) for that driver.
- The drivers cannot be edited directly from VEDA-SAGE. The user can only import different drivers by clicking the 'Import Driver Data' button (see Question XII).

Figure 14. How to compare demand drivers?



Furthermore, some options are possible for the active driver. To activate a driver, the user can click on it in the graph or select it in the 'Options Select Series' combo. It is possible to 'Show Markers' and 'Show Statistics' by checking boxes (Minimum, Maximum, Mean, Regression and Standard Deviation). A button allows to change the line color of that demand in the graph. Finally, it is also possible to import new drivers and to delete existing ones. Clicking the 'Import

Driver Data’ button opens a window where the user can locate and open the file containing the new drivers to add. Clicking the **‘Delete Scenario’** button opens a window where the user can select the scenarios to delete. The base scenario may not be deleted.

Question XII. How to import new demand drivers?

You want to import a new set of GDP drivers to create a high growth economic case.

First in Excel:

- a) Prepare a file (*e.g. HighMacGDP.xls*) containing the drivers to import (see an example in Figure 15 for the special declarations needed for the import process).
- b) Name the scenario using the declaration `^DRVR_Scenario`: In this case, the scenario is called ‘HighMacro’. This is the name that will be retained in VEDA-SAGE and not the name of the Excel file, which may be different.

Menu: Module-2, Demands, Manage Driver Data.

- c) Click the **‘Import Driver Data’** button.
- d) Locate and open the Excel file. The import process may take a few minutes.
- e) A new scenario will be created, in which all demands projected with the GDP driver will be projected with the high growth GDP driver. Other demand projections will remain the same.
- f) To know which demands are projected using the GDP driver, see Question VIII; to compare the two sets of GDP drivers (reference and high growth case), see Question V; to compare the two sets of demand projections, see Question XI.
- g) To solve a new high growth scenario, select the HIGHMACRO scenario along with the BASE scenario (which should always be selected) in the Solve Form (Figure 10).

Figure 15. How to import new demand drivers?

		^DRVR_Scenario: HighMacro										
		^DRVR_Table										
ID: Region	Driver/Yr	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
AFR	GDP (1997 US dollars)	596	750	949	1186	1473	1813	2187	2585	2994	3399	3781
AUS	GDP (1997 US dollars)	532	653	801	983	1202	1461	1741	2034	2328	2611	2870
CAN	GDP (1997 US dollars)	731	890	1077	1286	1521	1791	2067	2338	2592	2815	2997

6.1.5. Manage calibration/sensitivity series

This function allows the user to view, add, edit or delete series (see Figure 16). Clicking the **‘Add New’** button adds a row at the bottom of the table where the user can enter new values and a new series name. To edit an existing series, the user can put the cursor in the row of the series to edit and click the **‘Edit’** button. The cells of this row appear in a different color and the user can enter new values. In both cases, it is possible to **‘Cancel’** or **‘Save’** the changes. To delete an existing series, the user can select a particular series by putting the cursor in the row of the series to delete and click the **‘Delete’** button. If the series is currently being used, a message indicates that this series may not be deleted. A search button allows to select elements

(Calibration/Sensitivity Series) to include or to exclude in the selection using their short names (codes) or their long names (description).

Figure 16. Manage Calibration/Sensitivities Series

	A	B	C	D	E	F	G	H	I	J	K	L
1	Series/Year	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
2	Series1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	Series10	0.0000	0.3000	0.2800	0.2500	0.2000	0.1500	0.1000	0.1000	0.1000	0.1000	0.1000
4	Series100	0.0000	2.0000	2.0000	2.0000	2.0000	1.9000	1.8000	1.7000	1.6000	1.5000	1.4000
5	Series101	0.0000	2.0842	1.7480	1.6371	1.4439	1.2735	1.1232	0.9906	0.8737	0.7706	0.6797
6	Series102	0.0000	2.2000	1.7000	1.6500	1.4000	1.3000	1.1000	1.0000	0.9000	0.8000	0.6500
7	Series103	0.0000	2.4000	2.3000	2.2000	2.1000	2.0000	1.9000	1.8000	1.7000	1.6000	1.5000
8	Series104	0.0000	2.5000	3.0000	2.5000	2.0000	1.9000	1.8000	1.7000	1.6000	1.5000	1.4000
9	Series105	0.0000	0.9581	0.7947	0.8803	0.8146	0.7537	0.6975	0.6454	0.5972	0.5526	0.5113
10	Series106	1.0000	1.0166	1.0335	1.0507	1.0681	1.0859	1.1039	1.1222	1.1409	1.1598	1.1791
11	Series107	1.0000	1.0000	1.0500	1.0500	1.0500	1.0500	1.0500	1.0500	1.0500	1.0500	1.0500
12	Series108	1.0000	1.0381	1.0776	1.1186	1.1612	1.2054	1.2513	1.2989	1.3483	1.3997	1.4530
13	Series109	1.0064	1.0394	1.0736	1.1089	1.1454	1.1830	1.2219	1.2621	1.3036	1.3465	1.3907
14	Series110	0.0000	0.3000	0.2800	0.2700	0.2600	0.2606	0.2586	0.2567	0.2547	0.2528	0.2509
15	Series111	1.0000	1.0500	1.0450	1.0350	1.0250	1.0100	1.0000	1.0000	1.0000	1.0000	1.0000
16	Series12	0.0000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
17	Series13	0.0000	0.3500	0.3500	0.3500	0.3500	0.3500	0.3500	0.3500	0.3500	0.3500	0.3500
18	Series14	0.0000	0.3002	0.9424	1.0552	0.9792	0.9087	0.8432	0.7825	0.7261	0.6738	0.6252
19	Series15	0.0000	0.3882	0.5206	0.5547	0.5249	0.4967	0.4700	0.4447	0.4208	0.3982	0.3768
20	Series16	0.0000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000
21	Series17	0.0000	0.4252	0.2987	0.2646	0.2626	0.2606	0.2586	0.2567	0.2547	0.2528	0.2509
22	Series18	0.0000	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
23	Series19	0.0000	0.4700	0.4600	0.4200	0.4100	0.4000	0.4000	0.3900	0.3900	0.3800	0.3700
24	Series2	0.0000	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500
25	Series20	0.0000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
26	Series21	0.0000	0.5500	0.5500	0.5500	0.5500	0.5500	0.5500	0.5500	0.5500	0.5500	0.5500
27	Series22	0.0000	0.5562	0.6868	0.3668	0.2118	0.1224	0.0707	0.0408	0.0236	0.0136	0.0078

6.1.6. Demand projection

This function projects the base year values for the future time-periods, using the selected driver and sensitivity/calibration series. This is done for all regions and demands. Normally this function should not be needed, as this activity is performed automatically, each time a demand, a driver or a sensitivity/calibration series is edited. However, it is possible that some demand operation is not updated automatically. Any irregularities in demand projection calculation may be corrected using this function. A message indicates to the user that ‘This will calculate data values. It will take time. Do you want to continue?’.

6.2. Technology Repository

The technology repository module includes three main functions: Select and view technologies (section 6.2.1), Import technologies (section 6.2.2) and Delete scenarios (section 6.2.3). The main window of this module contains buttons to access the three main functions. For a better understanding of the organization of the files and the nature of the modifications (temporary or permanent), as regard to the import process, see section 3.1 and section 3.3 respectively.

6.2.1. Select and view technologies

This function allows to select or unselect technologies in various regions and sectors (see Figure 17). This facility applies only with the new technologies, not the existing technology stock. The left side of the window contains a matrix with the list of new technologies as rows and the 15 regions as columns. The user can select or unselect the new technologies that are allowed in each

region. For that purpose, there are some selection and filter facilities on the right side of the window. First, the user must choose scenario, sector and region(s). Only the new technologies relevant to this scenario and this sector will appear in the table for the selected regions. It is not possible to view new technologies for more than one scenario and one sector at the same time (by default, the table contains the new technologies of the electricity sector for the base scenario in all regions). Second, the user can also filter technologies using their code (short name) or their description (long name) and/or filter technologies that are already selected or unselected. Clicking the '**Filter**' button updates the table and shows only the technologies that have been filtered. Then, the user can easily select or unselect some technologies. Clicking in a cell above a region selects all the technologies for this region.

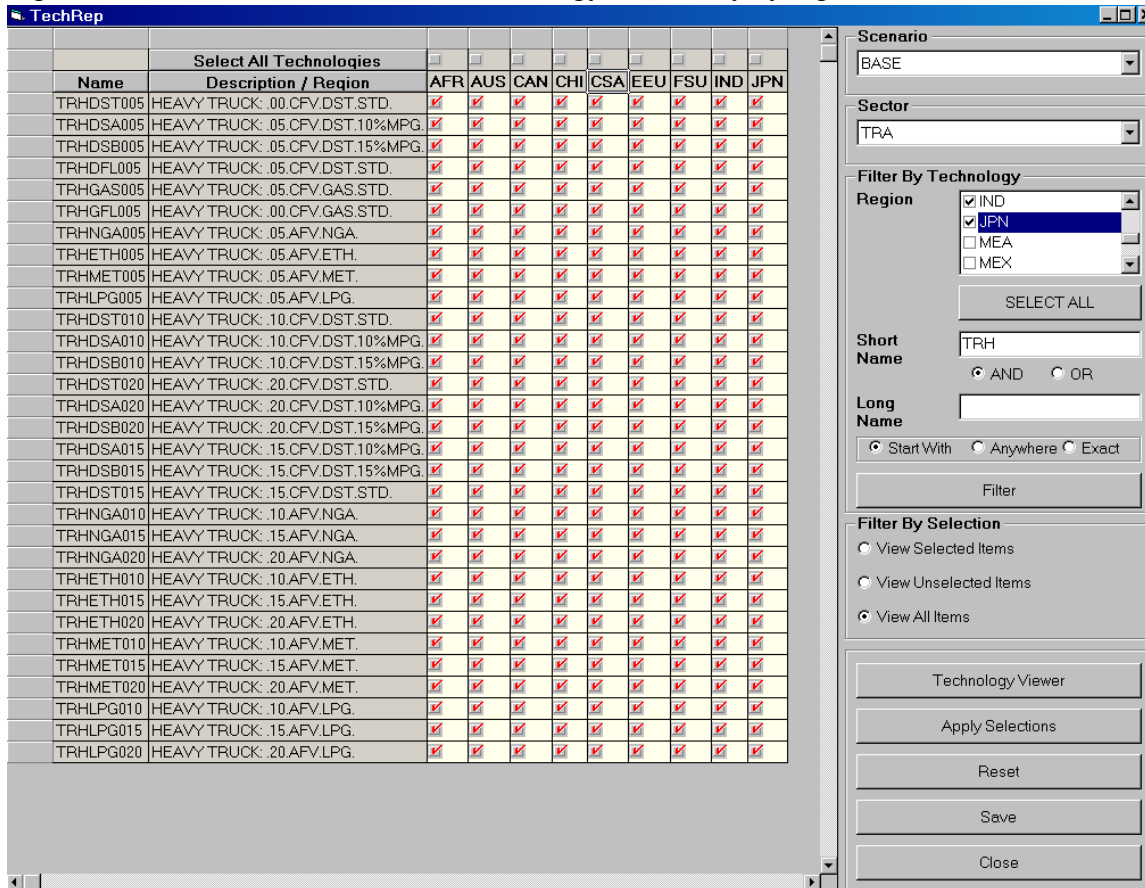
Question XIII. How to view and edit new technology availability by region?

You want to view and/or edit the new heavy truck technology availability in a few regions (see Figure 17).

Menu: Module-2, Technology Repository, Select and view technologies.

- a) Select the scenario in the first combo: BASE.
- b) Select the sector in the second combo: TRA for transport.
- c) Select the regions: for example AFR, AUS, CAN, CHI, CSA, EEU, FSU, IND and JPN.
- d) Specify the technology type: It is possible to include the new technologies whose short name starts with TRH (Heavy trucks).
- e) Click the '**Filter**' button. It is also possible to set a filter by selection using the radio button to view only the selected items or the unselected items. To view the parameter values of these technologies, click the '**Technology Viewer**' button (see Question XIV).
- f) Select or unselect some technologies in some regions if needed.
- g) Click the '**Save**' button.

Figure 17. How to view and edit new technology availability by region?



‘**Technology Viewer**’ button: This function allows to view the parameters of the technologies that are selected (see Figure 18). Editing technology parameters is not permitted at this level (the only way to edit technology data is to modify the Excel input file (TechRep.xls) and re-import the technology scenario). As for the browser, it is possible to re-configure the table created by dragging and dropping the dimensions (attributes) in rows or in columns (see section 5.2). Moreover, right clicking in each dimension of the table created gives a menu with two options, which are ‘Apply Filter’ (to specify a smaller set of elements) and ‘Copy Selected Data’ (to paste data in Excel for example). If no data are selected, all visible data of the table will be copied.

Question XIV. How to view new technology parameters (before transformation)?

You want to view the new heavy truck technology parameter values as they are specified in the technology repository (the TechRep.xls file) (see Figure 18). *Note that the technology parameters viewed from the technology viewer are the original values, i.e. before the transformation process using the SAGE_QDATA.xls file. To see the updated values after the transformation process, use the browser function (see Question III).*

Menu: Module-2, Technology Repository, Select and view technologies.

- a) Select the scenario in the first combo: BASE.
- b) Select the sector in the second combo: TRA for transport.

- c) Select the regions: It is not necessary to select any region, since the parameter values (before transformation) are the same for all regions.
- d) Specify the technology type: It is possible to include the new technologies whose short name starts with TRH (Heavy trucks).
- e) Click the **'Filter'** button. It is also possible to set a filter by selection using the radio button to view only the selected items or the unselected items.
- f) Click the **'Technology Viewer'** button to view the parameter values of the technologies that are filtered. It is possible to re-configure the table by dragging and dropping the dimensions (attributes) in rows or in columns. It is possible to specify a smaller set of elements for any dimension by right clicking in a particular column (or row) of the table and selecting 'Apply Filter'. Editing technology parameters is not permitted at this level.

Figure 18. Technology Viewer

Tech	Description	Prmtr	Comm	Yr	TID	
TRHDFL005	HEAVY TRUCK: .05.CFV.DST.STD.	CAPUNIT		2000	1.00	
		CF			1.00	
		EFF			0.06	
		FIXOM			60.00	
		INVCOST			1280.00	
		LIFE				15.00
		MA(ENT)	TRADST		1.00	
		OUT(DM)	TRH		1.00	
		START				2005.00
TRHDSA005	HEAVY TRUCK: .05.CFV.DST.10%MPG.	CAPUNIT		2000	1.00	
		CF			1.00	
		EFF			0.07	
		FIXOM			60.00	
		INVCOST			1400.00	
		LIFE				15.00
		MA(ENT)	TRADST		1.00	
		OUT(DM)	TRH		1.00	
		START				2005.00

'Apply Selections' button: This function is to apply a technology selection from an existing scenario to a new one. Once a new technology scenario has been imported (see section 6.2.2), the user can select the regions where each technology should be available, manually or with this functionality. This handles only those technologies that are common to both scenarios.

Finally, the user can reinstate the last saved selection by clicking the **'Reset'** button or store the technology selections by clicking the **'Save'** button.

6.2.2. Import technologies

This function is to import new technologies into the repository. A window opens where the user can locate and open the file where the new technologies are stored, such as the main technology repository located in the application folder (TechRep.xls) or any other files. The user can create other files to import new technologies; data is expected to be in the format of the main technology repository (TechRep.xls) located in the application folder. Technologies for each sector are expected to be on a separate sheet, and each sheet is expected to have a scenario identifier. *Note that 'scenario' here refers to an alternate set and selections of technologies.*

Consequently, the scenarios are defined at a sector level. Once the file is located, another window opens where the user can name the scenario (by sector) and proceed with the import. The scenario name may be the same for all sectors. Then, the new scenario appears in the scenario combo of the 'Select and View Technologies' window and contains the list of the technologies included in the Excel file. **In progress.** The user can select regions where each technology should be available or use the 'Apply Selections' functionality with an existing scenario (see section 6.2.1).

Question XV. How to import new technologies in the database?

(In progress).

First in Excel:

- a) Prepare a file containing the new technology data to import. They need to be in the same format of the technology repository (the TechRep.xls file) located in the application folder. The new technologies are listed on a separate sheet for each sector and each sheet is expected to have a scenario identifier.

Menu: Module-2, Import technologies.

- b) Locate and open the Excel file where the new technologies are stored.
- c) Enter a scenario name for each of the sector in which new technologies are imported. The scenario name may be the same for all sectors.
- d) Define the new technology availabilities for the various regions (see Question XIII). The new scenario name will appear in the first combo (with the base scenario).

6.2.3. Delete scenarios

This function is to delete new scenarios that have been created (at the sector level) at section 6.2.2. The base scenario may not be deleted.

6.3. Trades

The trade module includes three main functions: Trade links Region matrix (section 6.3.1), Trade parameters (or R matrix, see section 6.3.2) and Trade parameters (Time series, see section 6.3.3). The main window of this module contains buttons to access the three main functions. For a better understanding of the organization of the files and the nature of the modifications (temporary or permanent), as regard to the import process, see section 3.1 and section 3.3 respectively.

6.3.1. Trade link Region matrix

This function is to declare energy and permit trading links by commodity on a full region-region matrix (see Figure 19). On the top-left part of the window, the user can add energy commodities by pressing the 'New' button. A window opens where the user can search energy commodities using their code (short name) or their description (long name). It is possible to add only one new commodity at a time. Clicking on 'Done' closes the window and creates the trade matrix for this commodity with exporters as rows and importers as columns. The user can check the intersections to create a trade link between two regions and click the 'SAVE' button. Clicking on

letters (or number) above the importers (or beside the exporters) creates links with all the other regions. Clicking a second time removes these links. Double-clicking in cells above the importers (or beside the exporters) opens a window where the user can search for commodity. This functionality is useful when a commodity does not have the same name for the exporters and the importers (for example, when an OPEC region exports to a Non-OPEC region). It is important to save the links for a commodity before opening the matrix of another commodity or closing the window (they will not be stored otherwise).

On the top-right part of the window, the user can add emission commodity by pressing the 'New' button. A window opens where the user can name the commodity, the permit that will be traded (e.g. CO2PMT for CO2 emission permit) and select the associate emission commodity (e.g. TOTCO2 or GHG). In the matrix, the same functionalities apply as for the energy commodities.

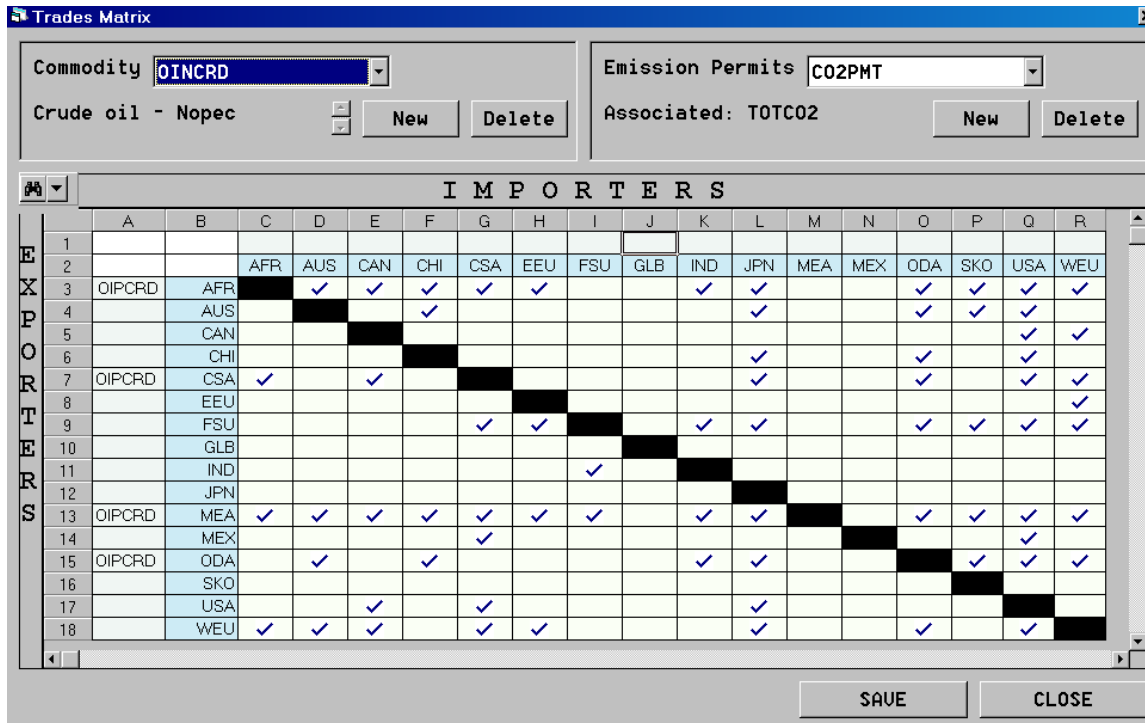
Question XVI. How to declare energy commodity trade links?

You want to declare crude oil trade links (see Figure 19).

Menu: Module-2, Trades, Trade links Region matrix.

- a) Click the left-side 'New' button to declare the energy commodity to trade: From the search form, include elements whose short name is starting with OINCRD (crude oil from non-OPEC region).
- b) Declare the trade links in the region matrix by checking manually all appropriate boxes or by pasting an excel file matrix (non-zero values are interpreted as check marks). It is possible to select (or unselect) all regions in rows or in columns by clicking on letters above the importers (or on numbers beside the exporters). At least one link should be declared first to be able to specify parameter values later on.
- c) Declare the commodity to be exported if it is not the same as the commodity to be imported (or vice-versa) by double-clicking in cells above the importers (or beside the exporters). For example, when a commodity is exported from OPEC region to non-OPEC region: It is possible to use the search form to include element where short name is starting with OIPCRD (crude oil from OPEC region) for OPEC exporters: AFR, CSA, MEA and ODA.
- d) Click the 'Save' button. To specify trade parameters see Question XVIII and Question XIX.

Figure 19. How to declare energy commodity trade links?



Question XVII. How to declare emission permit trading?

Menu: Module-2, Trades, Trade links Region matrix.

- Click the right-side 'New' button to declare the emission permit trade.
- Give a name to the traded commodity: CO2PMT for CO₂ emission permit.
- Select the associate emission commodity: TOTCO2 for the total CO₂ emissions.
- Declare the trade links in the region matrix by manually checking all appropriate boxes or by pasting an excel file matrix (values will be interpreted as check marks). It is possible to select (or unselect) all regions in rows or in columns by clicking on letters above the importers (or on numbers beside the exporters): All importers from GLB and all exporters to GLB.
- Click the 'SAVE' button.

6.3.2. Trade parameters (R matrix)

This function is to define parameters for the links declared in the first step (section 6.3.1 and Figure 20). For the active commodity (selected in the top-left combo), the same region-region matrix appears with colored cells indicating the active links. These colored cells indicate that it is possible to enter values for various parameters, which are available in the top-right combo: BOUND(BD)OR, COST, CUM, ENV_SEP and START. Below, the user can also specify the period for which these values are valid, whether they apply to the importers or the exporters, and the type of bounds (LO, FX, UP). For all the options, it is possible to select only one element at the same time. It is important to save the values entered for a commodity before opening the matrix of another commodity or closing the window (they will not be stored otherwise). *Note*

that is possible to copy and paste an Excel matrix at this level, but also at the previous level (section 6.3.1) where non-zero values are interpreted as check marks.

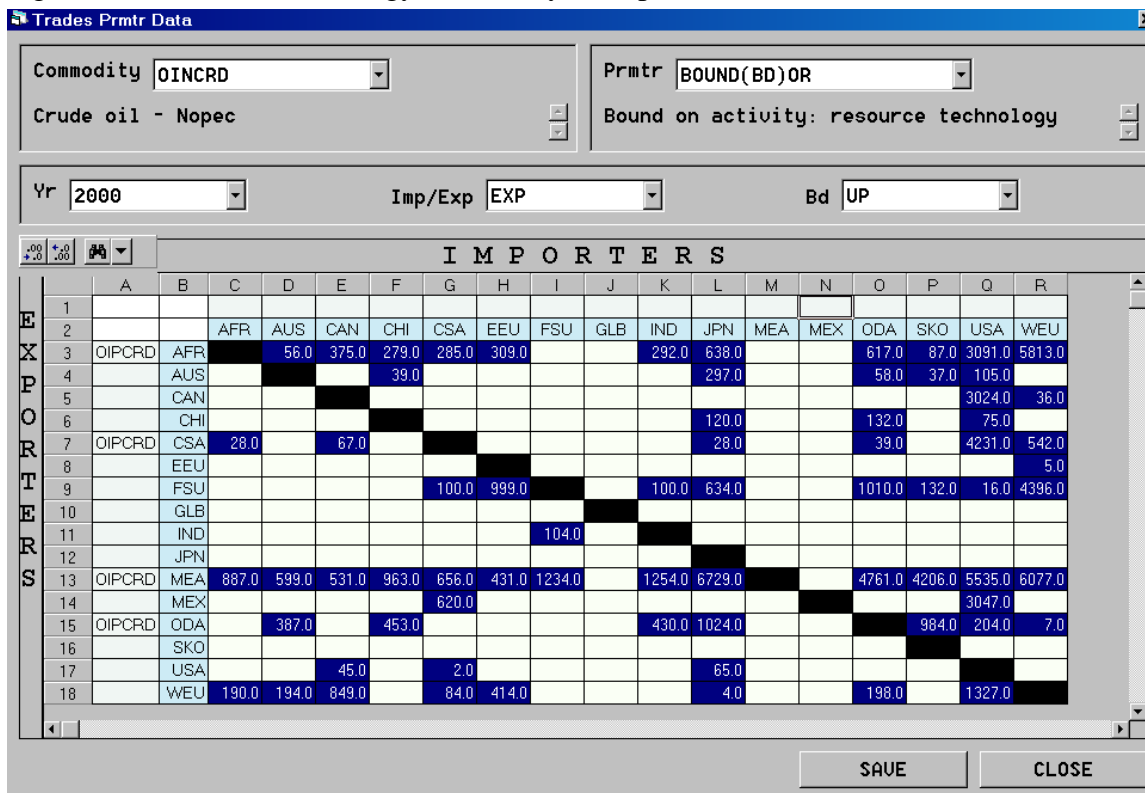
Question XVIII. How to declare energy commodity trade parameters (matrix)?

You want to declare upper bounds on crude oil exports using the region matrix (see Figure 20).

Menu: Module-2, Trades, Trade parameters (R Matrix).

- Select a commodity from the left-side combo: OINCRD. The commodities need to be declared at the first step (see Question XVI).
- Select a parameter from the right-side combo: BOUND(BD)OR for bound on activity.
- Select the period: 2000.
- Select the importers or the exporters to which to apply the parameter values: EXP for exporters.
- Select the bound type if necessary: UP for upper bound.
- Enter parameter values in the colored cells of the matrix, manually or by pasting an excel file matrix. It is also possible to enter values in non-colored cells; the links will be created automatically.
- Click the 'SAVE' button.

Figure 20. How to declare energy commodity trade parameters (matrix)?



6.3.3. Trade parameters (Time series)

This offers the same functionality as the second option, but the data is organized as a time-series rather than as a matrix (see Figure 21). The user can either visualize the parameter values entered at the previous step (section 6.3.2) or enter new values. For a particular parameter (one parameter has to be active), it is possible to view the values declared for all the commodities, the importers and the exporters, by clicking the search button. The user can also select a specific commodity, importer or exporter in the appropriate combos. In the table, the ‘**New Year**’ button as columns and the ‘**New Record**’ button as rows, allow the user to add periods and regions in the table. As in the previous steps, it is important to save the values before changing the selection or closing the window (they will not be stored otherwise).

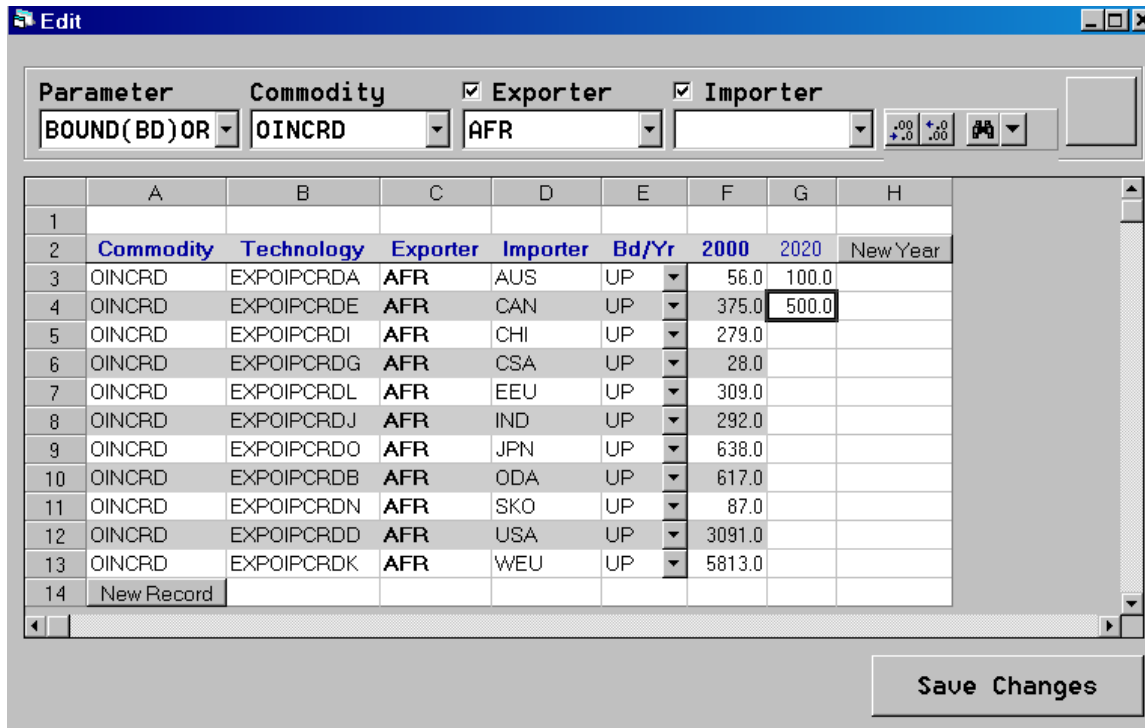
Question XIX. How to view and declare energy commodity trade parameters (time series)?

You want to view existing bounds on crude oil exports and declare new bounds by time series (see Figure 21).

Menu: Module-2, Trades, Trade parameters (Time series).

- a) Select a parameter from the first combo: BOUND(BD)OR for bound on activity.
- b) Select a commodity from the second combo: OINCRD. If no selection is made, all commodities will appear in the table. The commodities need to be declared the first step (see Question XVI).
- c) Select the importers or the exporters: AFR as an exporter. If no selection is done, all importers and exporters will appear in the table.
- d) Click the search button.
- e) Declare new parameter values if needed. It is possible to declare new parameter values for a commodity and an exporter/importer link, which has already been declared in the first step (see Question XVI), by clicking the ‘**New Record**’ button. Search forms allow to select the commodity, the exporter and the importer. However, if a commodity is already selected from the combo above, search forms will open only to select the exporter and the importer. Same comment if an exporter or an importer is selected in the combos. It is also possible to declare new parameter values for the next period by clicking the ‘**New Year**’ button. In this example, new upper bounds are declared on crude oil exports from AFR to AUS and CAN in 2020.
- f) Click the ‘**Save Changes**’ button.

Figure 21. How to view and declare energy commodity trade parameters (time series)?



6.4. User constraints

The user constraints module is divided into two main sections. The first section (related to all constraints) includes six main functions: User constraints definitions (section 6.4.1), User constraints coefficients (section 6.4.2), Quality Check (section 6.4.3), Delete (section 6.4.4), Copy (section 6.4.5) and Add Default Values (section 6.4.6). The second section (related to single constraints) includes two main functions: Add (section 6.4.7) and Edit (section 0). The main window of this module contains buttons to access the eight main functions. For a better understanding of the organization of the files and the nature of the modifications (temporary or permanent), as regard to the import process, see section 3.1 and section 3.3 respectively.

All constraints

6.4.1. User constraints definitions

This function is to view and edit definitions of existing user constraints (see Figure 22). By default, the table contains the entire list of user constraints (for all regions and sectors). The first columns contain the regions, the sectors, the names and the descriptions of the user constraints. The other columns contain more sophisticated user constraints definition parameters (see the box below for the definition of user constraint parameters):

- if it is a 'Share' or 'Absolute' user constraint,
- if the user constraints are treated as a market share (MktShr) or not (Ignore),
- if it is based on capacity (CAP), investment (INV) or flow (FLO),
- the type of normalization (IN or OUT),
- what is the limit type (FX, LO, UP, NON) and

- if it is enabled (true, and check marks) or not (false, and no check marks).

The user can modify the description of the user constraints and all the other parameters by double clicking in the appropriate cell of the table. A combo appears with all the available options. It is also possible to select the same parameter for all user constraints of the table (filtered or not) using the combo above each column.

User constraint definitions

A) Name and description

Name: By convention, the absolute user constraints are named starting with 'A_' while the share user constraint are named starting with 'S_'. The complete name should not exceed 10 characters.

Description: The description should ideally be as precise as possible and should not exceed 50 characters (including spaces).

B) Declaration

Absolute: To control the investment, capacity or operation of a set of processes (bigset) in absolute terms. Examples:

- Electricity generation should consume at least 400 PJ of gas in each period.
- Geothermal should produce at least 3 TWh per year by 2020, and 10 by 2050.
- The total nuclear capacity should be at most 4 GW by year 2020, and at most 10 by year 2050.

Share: To control the investment, capacity or operation of a set of processes (subset) as the share of a larger set (bigset). Examples:

- At least 5% of electricity generation should be wind based by 2020.
- At least 10% of the residential space heating should be based on natural gas.
- Small cars may take at most 30% of the automobile travel demand.
- At least 60% of residential lighting will use the conventional incandescent bulbs.

Absolute user constraints require the specification of a bigset of technologies only, while the share user constraints require the specification of a bigset and a subset of technologies. See below.

C) Market Share

MktShr: To convert existing user constraints to market share constraints. The user can identify a set of user constraints that operate on the same bigset of technologies, choose 'MktShr' for any user constraint of the group and 'Ignore' for the others (see Question XXI).

Ignore: To keep them as user constraints.

D) Basis (to identify the attribute of the processes to control)

CAP: Refers to the capacity of processes.

INV: Refers to investment in processes.

FLO: Refers to the sum of all input or output of the processes.

E) Normalization (only when basis is FLO)

IN: Refers to the input flows (consumption).

OUT: Refers to the output flows (production).

F) Lim Type (the way to constrain, to bound)

FX: Fix bound (equal)

LO: Lower bound (at least, minimum).

UP: Upper bound (at most, maximum).

NON: No bound (deactivate).

G) Enabled

True: User constraints are active.

False: User constraints are deactivated.

H) BigSet (to identify the bigset of technologies)

CodeLike: Identify technologies with their code (short name).

DescLike: Identify technologies with their description (long name).

InCommLike*: Identify technologies with the fuels consumed.

OutCommLike*: Identify technologies with the fuels produced.

I) SubSet (to identify the subset of technologies, only for share user constraints)

CodeLike: Identify technologies with their code (short name).

DescLike: Identify technologies with their description (long name).

InCommLike*: Identify technologies with the fuels consumed.

OutCommLike*: Identify technologies with the fuels produced.

* This is independent of the normalization (IN/OUT) specification. One can identify a set based on commodity inputs (BigSet and SubSet) and still control the input or output (Normalization).

Right clicking in any cell of a particular user constraint (any column on a particular row) allows to view the name and the description of technologies included in the bigset and the subset definitions.

For that purpose, there are some filter facilities on the right side of the window. For example, clicking at the top of a column (on the letter column) sorts the elements of that column (in alphabetical order for words, ascendant/descendant order for number, check/uncheck order, etc). On the right side of the window, the user can filter user constraints by region, sector, short name (code) and long name (description). Clicking the '**Filter**' button updates the table with only the

user constraints that have been filtered. Below, a combo allows to view market shares rather than user constraints.

Question XX. How to view or edit user constraints definition?

You want to know which technologies are included in light truck user constraints in Africa (see Figure 22).

Menu: Module-2, User constraints, User constraints definitions.

- Select the region: AFR
- Select the sector: TRA or ignore if a filter is needed (next step).
- Select the user constraints using the 'Filter' button: It is possible to filter all user constraints whose short name starts with S_TRL.
- Activate any cell of a particular user constraint row and right-click to see the list of technologies included in the bigset and the subset: in this example, right-click is done from the S_TRLNGA row.
- It is also possible to modify the description of the user constraints and all the other parameters by double clicking in the appropriate cell of the table. A combo appears with all the available options (like for the lim type of the user constraint S_TRLDCB in this example). It is also possible to select the same parameter for all user constraints of the table (filtered or not) using the combo above each column. However, the list of technologies included in the bigset or the subset of user constraints may not be modified at this step (for this purpose, see Question XXVI).

Figure 22. How to view or edit user constraints definition?

Region	Sector	Name	Description	Decla	Market	Basis	Normal	LimType	Enabled
AFR	TRA	S_TRL_AFV	Min Share of AFV LIGHT TRUCK in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_CFV	Min Share of CFV LIGHT TRUCK in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_DCA	Min Share of CFV LIGHT TRUCK-DST-Standard in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_DCB	Min Share of CFV LIGHT TRUCK-DST-Cafe2mpg in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_DCC	Min Share of CFV LIGHT TRUCK-DST-Cafe4mpg in TRL	Share	ignore	FLO	OUT	FX	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_DEG	Min Share of AFV LIGHT TRUCK-DEG in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_DMG	Min Share of AFV LIGHT TRUCK-DMG in TRL	Share	ignore	FLO	OUT	UP	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_DST	Min Share of CFV LIGHT TRUCK-DST in TRL	Share	ignore	FLO	OUT	NON	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_ELC	Min Share of AFV LIGHT TRUCK-ELC in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_ETH	Min Share of AFV LIGHT TRUCK-ETH in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_FUE	Min Share of AFV LIGHT TRUCK-FUE in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_GCA	Min Share of CFV LIGHT TRUCK-GAS-Standard in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_GCB	Min Share of CFV LIGHT TRUCK-GAS-Cafe2mpg in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_GCC	Min Share of CFV LIGHT TRUCK-GAS-Cafe4mpg in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_GSL	Min Share of CFV LIGHT TRUCK-GAS in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_HYB	Min Share of AFV LIGHT TRUCK-HYB in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_LPG	Min Share of AFV LIGHT TRUCK-LPG in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_MET	Min Share of AFV LIGHT TRUCK-MET in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>
AFR	TRA	S_TRL_NGA	Min Share of AFV LIGHT TRUCK-NGA in TRL	Share	ignore	FLO	OUT	LO	<input checked="" type="checkbox"/>

The '**User constraints coefficients**' button allows the user to view and edit the coefficients of the filtered set of user constraints (or all user constraints if no filter is applied) at each period. Then, it is possible to sort user constraints by bigset definition by clicking the '**Group By Bigset**' button. The user can edit values by entering numbers directly in the cells. It is possible to apply a single number to all rows by using the first row of the table (ADRTDATA) in the appropriate column (period) and clicking the '**Apply To All**' button above the 'Description' column. The same possibility exists for the relaxation factor (see definition in the relaxation factor paragraph) by using the second row of the table (RLXNFACT), if the 'Relaxation factor visible' box is checked at the bottom-right side of the window. The user can use the sign '-' to delete all relaxation factors. The user can '**Reset**' the original values', '**Save**' the changes, '**Close**' the window or '**Cancel**' the changes. When saving changes, a message will appear for each user constraint that is disabled: No values specified. Click '**Yes**' to delete this user constraint. Click '**No**' to disabled this user constraint.

The '**Market share coefficients**' button allows to view and to edit the coefficients of the filtered set of market shares (or all market shares if no filter is applied) at each period. The use can edit coefficients for three parameters:

- MKT_CE: The 'close enough value' test below which, a technology falls into the 'close enough' competing technologies (20% or 0.2 by default).
- MKT_GAMA: Degree to optimize the choices (2 by default).
- MKT_REAL: Fraction of market size to be reallocated by group (20% or 0.2 by default).

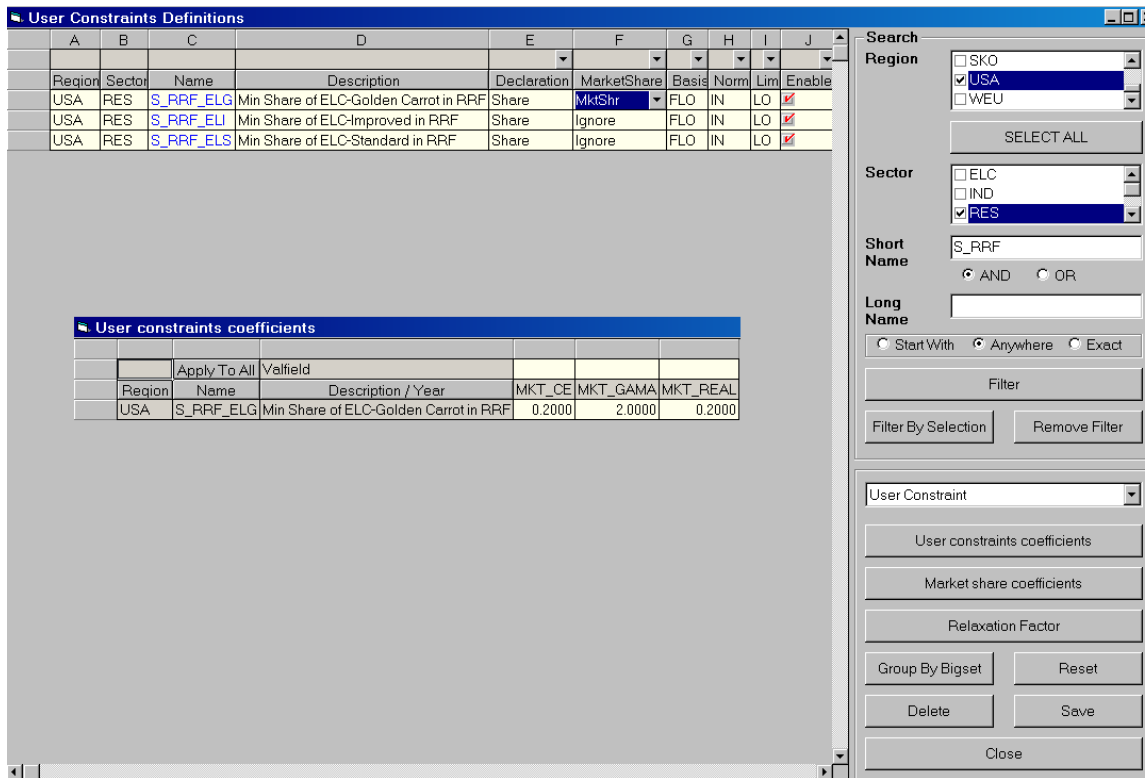
Question XXI. How to convert existing user constraints to market shares?

You want to convert user constraints related to residential refrigeration technologies into market shares for the United States (see Figure 23).

Menu: Module-2, User constraints, User constraints definitions.

- a) Select the region: USA
- b) Select the sector: RES or ignore if a filter is needed (next step).
- c) Select a group of user constraints (based on the same bigset of technologies), using the '**Filter**' button: It is possible to filter all user constraints whose short name starts with S_RRF.
- d) For one of the user constraints, double-click in the Market Share column and select MktShr in the combo. For the other user constraints of the group, select Ignore. In this example, the user constraint S_RRFELG is converted to market share.
- e) Click the '**Save**' button.
- f) Click the '**Market share coefficients**' button to view or edit the coefficients that are specified by default.
- g) Click the '**Save**' button.

Figure 23. How to convert existing user constraints to market shares?



The **'Relaxation Factor'** button allows to view and to edit the relaxation factor of the filtered set of user constraints (or all user constraints if no filter is applied) at each period. The relaxation factors are coefficients used to release user constraints by a certain percentage at each period. As in the case of the user constraint coefficients, it is possible to sort user constraints by bigset by clicking the **'Group By Bigset'** button, to edit values by entering number directly in the cells or to apply a single number to all rows by using the first row (RLXNFACT) and clicking the **'Apply To All'** button. The user can **'Reset'** the original values, **'Save'** the changes, **'Close'** the window or **'Cancel'** the changes.

The **'Filter by Selection'** button allows to filter user constraints based on contents of the active cell (e.g. if the cursor is in the normalization column, which has 'IN', this will display all user constraints that have 'IN' in the normalization column). It may be used to isolate user constraints for the same region, name, description or any other parameter.

The **'Reset'** button allows the user to reinstate the last saved definitions of user constraints.

The **'Delete'** button allows the user to delete the filtered set of user constraints.

The **'Save'** button allows the user to save the changes made in user constraints definitions (description or parameters).

The **'Group By Bigset'** button allows the user to sort user constraints by bigset definition.

6.4.2. User constraints coefficients

This function has the same functionalities than the **'User constraints coefficients'** button in the **'User constraints definitions'** window (section 6.4.1). It allows the user to view and to edit the

coefficients of the filtered set of user constraints (or all user constraints if no filter is applied) at each period (see Figure 24). For that purpose, there are some filter facilities on the right side of the window, where the user can filter user constraints by region, sector, short name (code) and long name (description). Clicking the **'Filter'** button updates the table with only the user constraints that have been filtered. *Note that only user constraints with non-zero coefficients will appear in the table. It is not the case when one uses the 'User constraints coefficients' button from the 'User constraints definitions' window.*

Then, it is possible to sort user constraints by bigset definition by clicking the **'Group By Bigset'** button. The user can edit values by entering number directly in the cells. It is possible to apply a single number to all rows by using the first row of the table (ADRTDATA) in the appropriate column (period) and clicking the **'Apply To All'** button. The same possibility exists for the relaxation factor in the second row of the table (RLXNFACT), if the 'Relaxation factor visible' box is checked at the bottom-right side of the window. The user can use the sign '-' to delete all relaxation factor. The user can **'Reset'** the original values, **'Save'** the changes, **'Close'** the window or **'Cancel'** the changes.

Question XXII. How to view or edit user constraints coefficients?

You want to increase the share of CAFE gasoline light trucks to the detriment of standard gasoline light trucks on the long term in Africa (see Figure 24).

Menu: Module-2, User constraints, User constraints coefficients. *It is also possible to view and edit user constraint coefficients using the following path: Module-2, User constraints, User constraints definitions, 'User constraints coefficients' button. With the first path, only user constraints with non-zero coefficients appear in the table, while all user constraints appear with the second path.*

- a) Select the region: AFR.
- b) Select the sector: TRA or ignore if a filter is needed (next step).
- c) Select the user constraints using the **'Filter'** button: It is possible to filter all user constraints whose short name starts with S_TRL.
- d) Edit the coefficients by manually entering values in cells of the table: in this example, the coefficients of S_TRLGCB and S_TRLGCC are increased at 5% each in 2020, while the coefficients of S_TRLGCA is decreased at 70%.
- e) Click the **'Save'** button.

Figure 24. How to view or edit user constraints coefficients?

Region	Name	Description	Attribute / Year	2000	2005	2010	2015	2020	2025
		Apply To All	RLXNFACT						
AFR	S_TRL_AFV	Min Share of AFV LIGHT TRUCK in TRL	ADRTDATA	0.0017				0.0017	
AFR	S_TRL_CFV	Min Share of CFV LIGHT TRUCK in TRL	ADRTDATA	0.9933				0.9437	
AFR	S_TRL_DCA	Min Share of CFV LIGHT TRUCK-DST-Standard	ADRTDATA	0.9453				0.8980	
AFR	S_TRL_DCB	Min Share of CFV LIGHT TRUCK-DST-Cafe2mpg	ADRTDATA		0.0200				
AFR	S_TRL_DCC	Min Share of CFV LIGHT TRUCK-DST-Cafe4mpg	ADRTDATA		0.0100	0.0100		0.0100	
AFR	S_TRL_DST	Min Share of CFV LIGHT TRUCK-DST in TRL	ADRTDATA	0.3223				0.3062	
AFR	S_TRL_GCA	Min Share of CFV LIGHT TRUCK-GAS-Standard	ADRTDATA	0.9453				0.7000	
AFR	S_TRL_GCB	Min Share of CFV LIGHT TRUCK-GAS-Cafe2mpg	ADRTDATA		0.0200			0.0500	
AFR	S_TRL_GCC	Min Share of CFV LIGHT TRUCK-GAS-Cafe4mpg	ADRTDATA		0.0100			0.0500	
AFR	S_TRL_GSL	Min Share of CFV LIGHT TRUCK-GAS in TRL	ADRTDATA	0.6727				0.6391	
AFR	S_TRL_LPG	Min Share of AFV LIGHT TRUCK-LPG in TRL	ADRTDATA	0.9950				0.7699	

Question XXIII. How to view or edit relaxation factors for user constraints?

You want to add a relaxation factor of 70% in 2020 and 50% in 2050 for all car user constraints in China (see Figure 25).

Menu: Module-2, User constraints, User constraints coefficients. *It is also possible to view and edit user constraint relaxation factors using the following path: Module-2, User constraints, User constraints definitions, 'User constraints coefficients' button. These two paths allow to view or edit user constraint coefficients and relaxation factors. A third path allows to view or edit only relaxation factors: Module-2, User constraints, User constraints definitions, 'Relaxation factor' button.*

- a) Select the region: AFR.
- b) Select the sector: TRA or ignore if a filter is needed (next step).
- c) Select the user constraints using the 'Filter' button: It is possible to filter all user constraints whose short name starts with S_TRT.
- d) Check the 'Relaxation factor visible' box.
- e) Enter the relaxation factor values in the second row of the table (RLXNFACT) and click the 'Apply to All' button: for example, 0.7 for 70% in 2020 and 0.5 for 50% in 2050.
- f) Click the 'Save' button.

Figure 25. How to view or edit relaxation factors for user constraints?

The screenshot shows a software window titled "User constraints coefficients". The main area contains a table with columns for Region, Name, Description, Attribute / Year, and years from 2000 to 2050. The table lists various user constraints such as "Min Share of AFV CAR in TRT" and "Min Share of CFV CAR-DST-Standard in TRT". The right side of the window features a search panel with the following sections:

- Region:** Radio buttons for AFR, AUS, CAN.
- Sector:** Radio buttons for ELC, IND, RES.
- Short Name:** Text input field containing "S_TRT".
- Long Name:** Text input field.
- Filtering:** Radio buttons for "Start With", "Anywhere", and "Exact".
- Buttons:** "SELECT ALL", "Filter", "Group By Bigset", "Reset", "Save", "Close", "Cancel".
- Checkbox:** "Relaxation factor visible" (checked).

6.4.3. Quality Check

This function is to help the user identify inconsistent constraint definitions, for example, a group of user constraints adding up to more than 100%. A window opens where the user can select the scenarios, the regions and the user constraints to verify, and click the **'Proceed'** button. **This is work-in-progress.**

6.4.4. Delete

This function deletes the filtered set of user constraints (or all user constraints if no filter is applied) (see Figure 26). For that purpose, the same filter facilities exist on the right side of the window, where the user can filter user constraints by region, sector, short name (code) and long name (description). Clicking the **'Filter'** button updates the table with only the user constraints that have been filtered. By default, all the user constraints are checked. The user can modify the selection of user constraints to delete, manually or using the buttons **'Select All'** and **'Unselect All'** and click the **'Delete'** button.

6.4.5. Copy

This function is to copy user constraints across regions (see Figure 27). The user can select (with check marks) the user constraints to copy, manually or with the filter facility using their short name (code) and/or their long name (description). Then, it is possible to select the region (only one) from where to copy and the regions (may be more than one) to where to copy. Clicking the **'Copy'** button process the operation, the status of which is shown in the **'FeedBack'** box. Below, a combo allows to view and to copy market shares rather than user constraints. *Note that if the user constraints have identical definition across regions, it is recommended to use this facility*

while adding new user constraints. The user can create user constraints for one region first, and then copy them to the other regions.

Figure 26. Delete User Constraints

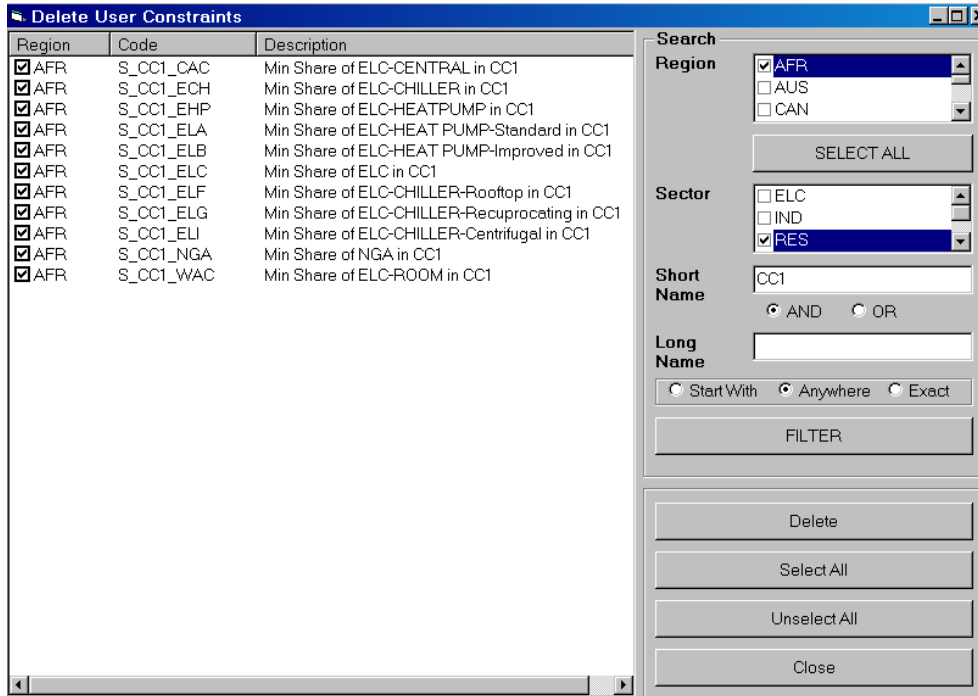
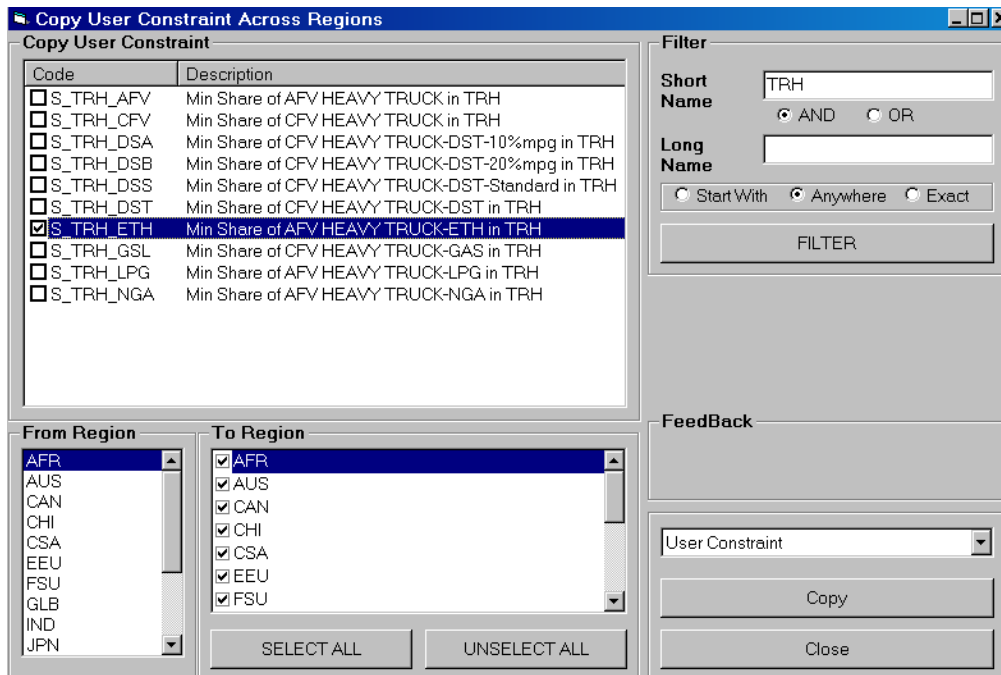


Figure 27. Copy User Constraint Across Regions



6.4.6. Add Default Values

This function is to declare the default values by sector for the three main market share parameters: MKT_CE (0.2 for 20%), MKT_GAMA (2) and MKT_REAL (0.2 for 20%). See section 6.4.1 for the definition of these parameters.

Single constraints

6.4.7. Add

This function is to create new user constraints or market shares. It is possible to add only one user constraint or market share at a time (see Figure 28). A first window opens (Add User Constraint) where the user can give a name and a description, selects the regions and the sector where it should be applied and chooses the definition parameters (by default parameters are in italic):

- if it is a 'Share' or 'Absolute' user constraint,
- if the user constraint is treated as a market share (MktShr) or not (*Ignore*),
- if it is based on capacity (CAP), investment (INV) or flow (*FLO*),
- what is the normalization (IN or *OUT*),
- what is the time type (FX, *LO*, UP, NON).

The user does not have to specify these definition parameters to create a market share.

Clicking the '**Proceed**' button opens a second window (BigSet Declaration) where the user can select the bigset of technologies to include in the user constraint. For that purpose, some filter facilities exist to select technologies to 'Include' (on the left side) or to 'Exclude' (on the right side). The user can filter technologies by checking sets (Exists in Sets or Not in Sets) or by specifying the Code, the Description, the Input commodity and/or the Output commodity (Is like or Not like). *Note that '*' may be used as a wild card in the filter facilities and comma may be used as 'Or'. For example, *HEAT PUMP*, *BURNER* in 'Description is Like' would isolate the technologies that have either of these expressions in their description.* The user constraint definition and parameters specified on the first window are also listed in the upper box. Clicking the '**Shortlist**' button lists all the technologies that satisfy the characteristics specified by the user at the bottom of the window.

Clicking the '**Proceed**' button opens a third window (SubSet Declaration), beside the second one, where the user can select the subset of technologies to use in the user constraint. The same filter facilities exist to select technologies to 'Include' (on the left side) or to 'Exclude' (on the right side). This step is not required for absolute user constraints and market shares.

Finally, clicking the '**Proceed**' button opens a fourth window (User constraints coefficients), where the user can enter values for each period. *Note that when there is no value for one or more periods, they are linearly interpolated and the last specified value is held constant for the modeling horizon. Furthermore, it is strongly recommended to avoid putting values in the first period (2000), because the model has few options in this period and this may easily lead to infeasibilities. Finally, user constraints with shares less than 1% (on an average over the horizon) are not generated as an anti-infeasibility measure.* It is possible to apply a single

number to all rows (all regions) by using the first row of the table (ADRTDATA) and clicking the **'Apply To All'** button. It is also possible to apply the same relaxation factor by using the second row (RLXNFACT), if the 'Relaxation factor visible' box is checked at the bottom-right side of the window. The user can sort the user constraints by bigset definition by clicking the **'Group By Bigset'** button. The user can also **'Reset'** the original values, **'Save'** the changes, **'Close'** the window or **'Cancel'** the changes. *Note that the logic is exactly what it used to be in the templates, but the process of choosing options is friendlier, and there are more possibilities to define bigsets and subsets.*

Question XXIV. How to create a new user constraint?

You want to create a user constraint to limit the total share of coal consumption in the residential sector of Africa (see Figure 28).

Menu: Module-2, User constraints, Add.

- a) Give a name to the user constraint: S_RESCOA.
- b) Give a description to the user constraint: Maximum consumption of coal in residential.
- c) Select the region: AFR.
- d) Select the sector: RES.
- e) Define the user constraint parameters using the various combos.
 - o Type: Share
 - o ADRMKT: Ignore
 - o Normalization: IN
 - o Basis: FLO
 - o Lim Type: UP
- f) Click the **'Proceed'** button.
- g) Determine the technologies to include in the bigset using the code, the description, the input or the output of technologies to include (or to exclude): It is possible to include all consumption technologies of the residential sector, i.e. those which belong to the DMD set and which short name is like R* (the star is used as a wild card).
- h) Click the **'Shortlist'** button.
- i) Modify the selection or click the **'Proceed'** button to continue.
- j) Determine the technologies to include in the subset using the procedure than for the bigset: It is possible to include all technologies which input commodity is like RESCOA.
- k) Click the **'Shortlist'** button.
- l) Modify the selection or click the **'Proceed'** button to continue.
- m) Enter the user constraint coefficients: like 0.8 for 80% in 2005 and 0.5 for 50% in 2025.
- n) Click the **'Save'** button. To create the same user constraint for all the other regions (copy), see section 6.4.5.

Figure 28. How to create a new user constraint?

Add User Constraint

Name: S_RESCOA
Description: Maximum consumption of coal in residential

Region: AFR, AUS, CAN, CHI, CSA, EEU

Sector: ELC, IND, RES, TRA, UPS

Select All | Unselect All

User Constraint | Market Share

Type: Share

ADRMKT: Ignore

Normalization: IN

Basis: FLO

LimType: UP

Proceed | Cancel

Figure 28. How to create a new user constraint?

BigSet Declaration

Scenario: BASE
Region: AFR
Sector: RES
Name: S_RESCOA

Include - Exists In Sets: DCN, DMD, ELE

Exclude - Not In Sets: BAS, CEN, CON

Code Is Like: R*

Description Is Like: []

Input Commodity Is Like: []

Output Commodity Is Like: []

Process	Region	Description
RC1CAE000	AFR	RES.COOLR1: .00.ELC.INS-REG.CENTRAL.STD
RC1EHP000	AFR	RES.COOLR1: .00.ELC.INS-REG.HEAT.PUMP.A
RC1ELA005	AFR	RES.COOLR1: .05.ELC.INS-REG.HEAT.PUMP.A
RC1ELB005	AFR	RES.COOLR1: .05.ELC.INS-REG.HEAT.PUMP.A
RC1ELC005	AFR	RES.COOLR1: .05.ELC.INS-REG.CENTRAL.STD
RC1ELD005	AFR	RES.COOLR1: .05.ELC.INS-REG.ROOM.STD
RC1ELE005	AFR	RES.COOLR1: .05.ELC.INS-REG.HEAT.PUMP.A
RC1ELF005	AFR	RES.COOLR1: .05.GEO.INS-REG.HEAT.PUMP.A
RC1ELG005	AFR	RES.COOLR1: .05.ELC.INS-REG.ROOM.NEW
RC1GEO000	AFR	RES.COOLR1: .00.GEO.INS-REG.HEAT.PUMP.A
RC1GEO005	AFR	RES.COOLR1: .05.GEO.INS-REG.HEAT.PUMP.A
RC1INGA005	AFR	RES.COOLR1: .05.NGA.INS-REG.HEAT.PUMP.A

Shortlist

Proceed | Cancel

SubSet Declaration

Scenario: BASE
Region: AFR
Sector: RES
Name: S_RESCOA

Include - Exists In Sets: BAS, RESCOA, CON

Exclude - Not In Sets: BAS, CEN, CON

Code Is Like: []

Description Is Like: []

Input Commodity Is Like: RESCOA

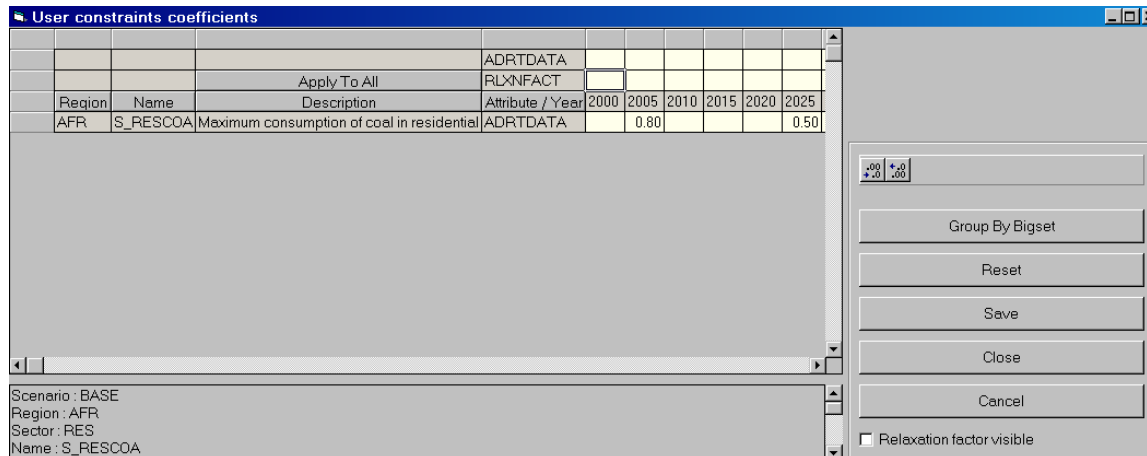
Output Commodity Is Like: []

Process	Region	Description
RH1COA000	AFR	RES.HEAT.R1: .00.CO.A.INS-REG.BURNER.
RH1COA005	AFR	RES.HEAT.R1: .05.CO.A.INS-REG.BURNER.
RH2COA005	AFR	RES.HEAT.R2: .05.CO.A.INS-REG.BURNER.
RH3COA005	AFR	RES.HEAT.R3: .05.CO.A.INS-REG.BURNER.
RH4COA005	AFR	RES.HEAT.R4: .05.CO.A.INS-REG.BURNER.
RHWCOA000	AFR	RES: .00.CO.A.WATER.HEATER.STD.
RHWCOA005	AFR	RES: .05.CO.A.WATER.HEATER.STD.
RK1COA000	AFR	RES.COOK.R1: .00.CO.A.
RK1COA005	AFR	RES.COOK.R1: .05.CO.A.
RK2COA005	AFR	RES.COOK.R2: .05.CO.A.
RK3COA005	AFR	RES.COOK.R3: .05.CO.A.
RK4COA005	AFR	RES.COOK.R4: .05.CO.A.

Shortlist

Proceed | Cancel

Figure 28. How to create a new user constraint?



Question XXV. How to create a new set of market shares?

You want to create a new set of market shares for all electricity production technologies using biomass in Africa (see Figure 29).

Menu: Module-2, User constraints, Add.

- Give a name to the set of market shares: M_ELCBIO.
- Give a description to the set of market shares: MS for electricity technologies using biomass.
- Select the region: AFR.
- Select the sector: ELC.
- Use the radio button to declare it as 'Market Share' rather than 'User constraint' (by default).
- Click the '**Proceed**' button.
- Determine the technologies to include in the bigset using the code, the description, the input or the output of technologies to include (or to exclude): It is possible to include all electricity production technologies using biomass, i.e. those which short name is like EBIO* (the star is used as a wild card).
- Click the '**Shortlist**' button.
- Modify the selection or click the '**Proceed**' button to continue.
- Edit the market share coefficients by default if needed.
- Click the '**Save**' button. To create the same set of market shares for all the other regions (copy), see section 6.4.5.

Figure 29. How to create a new set of market shares?

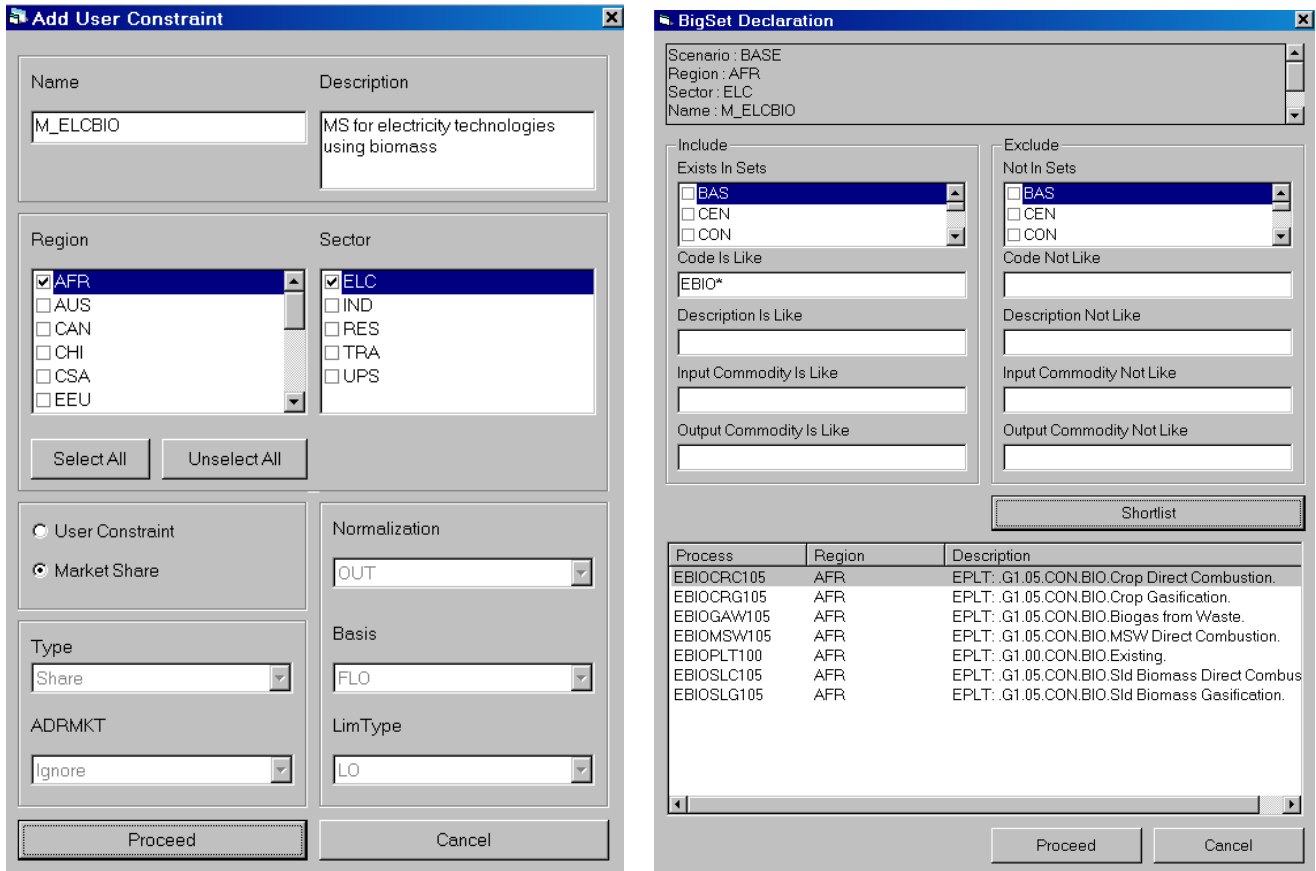
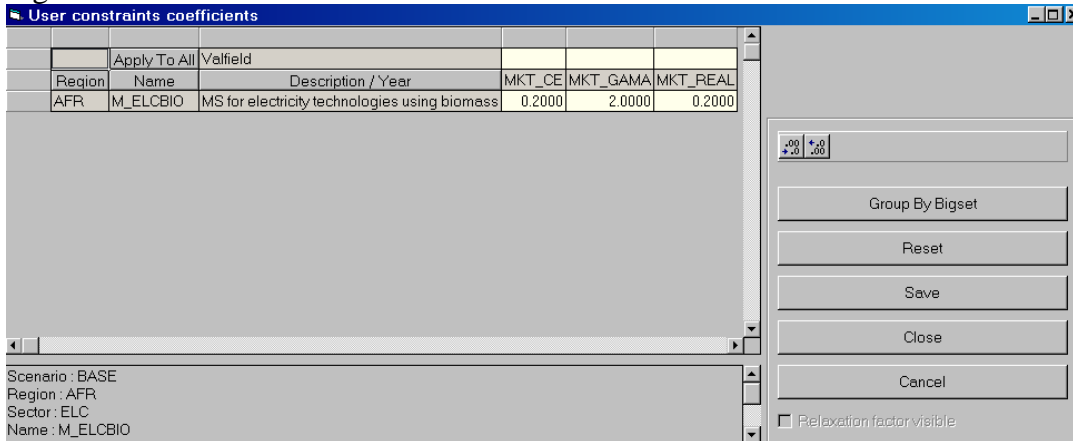


Figure 29. How to create a new set of market shares?



6.4.8. Edit

This function is to edit any existing user constraint or market share. A first window opens (Edit User Constraint), where the user has to select the name of the user constraint to edit. For that purpose, there is a filter option allows searching for elements using their short names (codes) or their long names (description). It is possible to select the regions where the user constraint has to be modified, while the appropriate sector is selected automatically. Then, the user can edit the

description and all the parameters of any existing user constraint from the first window (Edit User Constraint), to the second (BigSet Declaration), the third (SubSet Declaration) and the fourth (User constraints coefficients). For market shares, the third window does not exist. *Note that this may be done through the 'User constraints definitions' window (section 6.4.1) as well. However, using the edit at single constraint level could be useful if the user wants to review the contents of bigset and subset.*

Question XXVI. How to edit the bigset or the subset of a user constraint?

You want to modify the user constraint created earlier to limit the total share of coal consumption in the residential sector of Africa (Question XXIV) to include also the commercial sector (see Figure 30).

Menu: Module-2, User constraints, Edit.

- a) Select the user constraint from the first combo: S_RESCOA.
- b) Modify the description if needed: In this example, the previous description 'Maximum consumption of coal in residential' becomes 'Maximum consumption of coal in RES and COM'.
- c) The regions and the sectors involved are selected automatically.
- d) Modify the user constraint parameters using the different combos if needed; the appropriate parameters are also selected automatically when you select the user constraint to edit from the first combo. In this example, there are no changes at this level.
- e) Click the '**Proceed**' button.
- f) Modify the technologies to include in the bigset using the code, the description, the input or the output of technologies to include (or to exclude): the original user constraint included all consumption technologies of the residential sector, i.e. those which belong to the DMD set and which short name is like R*. It is possible to add those which short name is like C* (both are separated by a comma and the star is used as a wild card).
- g) Click the '**Shortlist**' button.
- h) Modify the selection or click the '**Proceed**' button to continue.
- i) Modify the technologies to include in the subset using the procedure than for the bigset: the original user constraint included all technologies which input commodity is like RESCOA. It is possible to add those which input commodity is like COMCOA (both are separated by a comma).
- j) Click the '**Shortlist**' button.
- k) Modify the selection or click the '**Proceed**' button to continue.
- l) Modify the user constraint coefficients if needed. In this example, there are no changes at this level.
- m) Click the '**Save**' button.

Figure 30. How to edit the bigset or the subset of a user constraint?

Edit User Constraint

Name: S_RESCOA | Description: Maximum consumption of coal in RES and COM

Region: AFR | Sector: RES

Type: Share | ADRMKT: Ignore

Normalization: IN | Basis: FLO | LimType: UP

Buttons: Proceed, Cancel

Figure 30. How to edit the bigset or the subset of a user constraint?

BigSet Declaration

Scenario: BASE | Region: AFR | Sector: RES | Name: S_RESCOA

Include: DMD | Exclude: BAS

Process	Region	Description
CC1CAE000	AFR	COM.COOLR1: .00 ELC.CENTRAL
CC1DST000	AFR	COM.COOLR1: .00 DST.CHILLER
CC1DST005	AFR	COM.COOLR1: .05 DST.CHILLER
CC1DST015	AFR	COM.COOLR1: .15 DST.CHILLER
CC1ECE000	AFR	COM.COOLR1: .00 ELC.CHILLER.ROOFTOP.ST
CC1EHP000	AFR	COM.COOLR1: .00 ELC.HEAT PUMP.AIR.STD.
CC1ELA005	AFR	COM.COOLR1: .05 ELC.HEAT PUMP.AIR.STD.
CC1ELB005	AFR	COM.COOLR1: .05 ELC.HEAT PUMP.AIR.IMP.
CC1ELC005	AFR	COM.COOLR1: .05 ELC.CHILLER.ROOFTOP.ST
CC1ELD005	AFR	COM.COOLR1: .05 GEO.HEAT PUMP.GROUNDC
CC1ELE010	AFR	COM.COOLR1: .10 GEO.HEAT PUMP.GROUNDC
CC1ELF005	AFR	COM.COOLR1: .05 ELC.CHILLER.ROOFTOP.NF

SubSet Declaration

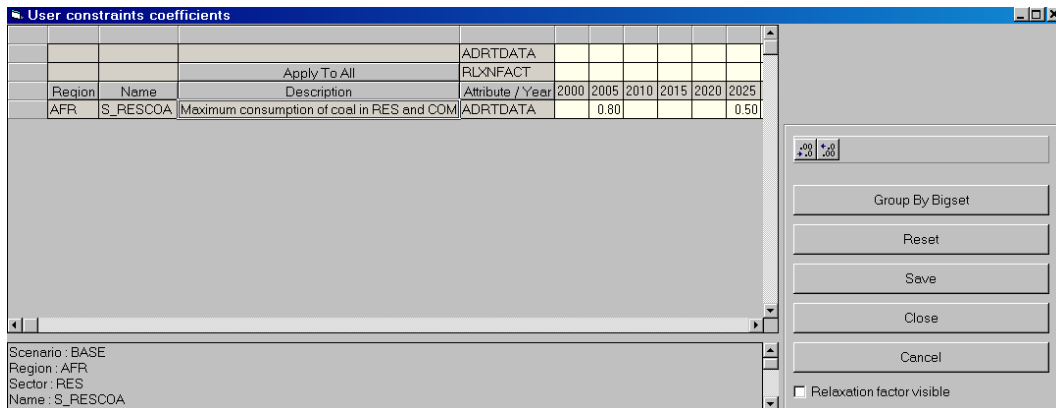
Scenario: BASE | Region: AFR | Sector: RES | Name: S_RESCOA

Include: BAS | Exclude: LNK, NBN, PRC

Process	Region	Description
CCKCOA000	AFR	COM: .00 COA COOKING
CCKCOA005	AFR	COM: .05 COA COOKING
CH1COA000	AFR	COM.HEAT.R1: .00 COA.BURNER
CH1COA005	AFR	COM.HEAT.R1: .05 COA.BURNER
CH2COA005	AFR	COM.HEAT.R2: .05 COA.BURNER
CH3COA005	AFR	COM.HEAT.R3: .05 COA.BURNER
CH4COA005	AFR	COM.HEAT.R4: .05 COA.BURNER
CHWCOA000	AFR	COM: .00 COA WATER HEATER.STD.
CHWCOA005	AFR	COM: .05 COA WATER HEATER.STD.
RH1COA000	AFR	RES.HEAT.R1: .00 COA.INS-REG.BURNER
RH1COA005	AFR	RES.HEAT.R1: .05 COA.INS-REG.BURNER
RH2COA005	AFR	RES.HEAT.R2: .05 COA.INS-REG.BURNER

Buttons: Proceed, Cancel

Figure 30. How to edit the bigset or the subset of a user constraint?



6.5. Scenario data

6.5.1. Import

An important feature of the interface is the possibility to easily construct various scenarios (for example, with a constraint on the global CO₂ emissions, with a set of bounds on energy trading or with a different set of drivers for economic projections). For this purpose, the user can compile the information related to a new scenario in an Excel file and import it in VEDA-SAGE. A window opens where the user can locate the file and click ‘**Open**’. The scenario data will load (this may take a few minutes). The user has complete freedom to name this new Excel file; this is the name of the scenario, as declared in the Excel file, which will be retained. The new scenario will appear in the scenario box of the solve form (see section 5.4). The user can check the appropriate boxes to run a particular scenario. *Note that the Base scenario should appear first in the list (for that purpose, the user can move the scenario using the arrows).*

Question XXVII. How to create and solve a new scenario?

You want to create and solve a new scenario with different time slice fractions for the commercial and the residential water heating demands.

First in Excel:

- Prepare a file containing the new time slice data (see an example in Figure 31 for the format and the special declarations needed for the import process).
- Name the scenario using the declaration ‘^scenario’: In this case, the scenario is called ‘ZDMFR’. This is the name that will be retained in VEDA-SAGE and not the name of the Excel file, which may be different. The declaration ‘^TFM_INS’ is used to indicate that these are parameter values to insert in the database. As for the rest of the table, the format is flexible. The user can define several columns using the appropriate identifiers.

Menu: Module-2, Scenario Data, Import.

- Locate and open the Excel file. The import process may take a few minutes.

d) To solve a new scenario, select the ZDMFR scenario with the BASE scenario (should always be selected) in the Solve Form (see Figure 10).

Figure 31. How to create and solve a new scenario?

^Scenario:ZDMFR																			
^TFM_INS																			
TS	Prmtr	Yr	AFR	AUS	CAN	CHI	CSA	EEU	FSU	IND	JPN	MEA	MEX	ODA	SKO	USA	WEU	Comm_Name	
ID	FR(Z)(Y)	TID	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	CHW
IN	FR(Z)(Y)	TID	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	CHW
SD	FR(Z)(Y)	TID	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	CHW
SN	FR(Z)(Y)	TID	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	CHW
WD	FR(Z)(Y)	TID	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	CHW
WN	FR(Z)(Y)	TID	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	CHW
ID	FR(Z)(Y)	TID	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	RWH
IN	FR(Z)(Y)	TID	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	RWH
SD	FR(Z)(Y)	TID	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	RWH
SN	FR(Z)(Y)	TID	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	RWH
WD	FR(Z)(Y)	TID	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	RWH
WN	FR(Z)(Y)	TID	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	RWH

Question XXVIII. How to solve a scenario with a global constraint on emissions?

You want to create and solve a reduction scenario, i.e. with a global constraint on the total CO₂ emissions.

First in Excel:

- Prepare a file containing the global constraint on emissions (see an example in Figure 32 for the format and the special declarations needed for the import process).
- Name the scenario using the declaration ^scenario: In this case, the scenario is called 'EmiRed'. This is the name that will be retained in VEDA-SAGE and not the name of the Excel file, which may be different.

Menu: Module-2, Scenario Data, Import.

- Locate and open the Excel file. The import process may take a few minutes.
- To solve a new scenario, select the EMIRED scenario with the BASE scenario (should always be selected) in the Solve Form (see Figure 10).

Figure 32. How to solve a scenario with a global constraint on emissions?

^Scenario: EmiRed																			
^TFM_INS																			
BD	Prmtr	Yr	A	A	C	C	C	E	F		I	J	M	M	O	S	U	W	Comm_Name
			F	U	A	H	S	E	S	GLB	N	P	E	E	D	K	S	E	
			R	S	N	I	A	U	U		D	N	A	X	A	O	A	U	
UP	ENV_BOUND(BD)	2005	0	0	0	0	0	0	0	20957117	0	0	0	0	0	0	0	0	TOTCO2
UP	ENV_BOUND(BD)	2010	0	0	0	0	0	0	0	21309642	0	0	0	0	0	0	0	0	TOTCO2
UP	ENV_BOUND(BD)	2015	0	0	0	0	0	0	0	22979576	0	0	0	0	0	0	0	0	TOTCO2
UP	ENV_BOUND(BD)	2020	0	0	0	0	0	0	0	25111029	0	0	0	0	0	0	0	0	TOTCO2

UP	ENV_BOUND(BD)	2025	0	0	0	0	0	0	0	0	25229746	0	0	0	0	0	0	0	TOTCO2
UP	ENV_BOUND(BD)	2030	0	0	0	0	0	0	0	0	25638051	0	0	0	0	0	0	0	TOTCO2
UP	ENV_BOUND(BD)	2035	0	0	0	0	0	0	0	0	29003932	0	0	0	0	0	0	0	TOTCO2
UP	ENV_BOUND(BD)	2040	0	0	0	0	0	0	0	0	32281592	0	0	0	0	0	0	0	TOTCO2
UP	ENV_BOUND(BD)	2045	0	0	0	0	0	0	0	0	35350716	0	0	0	0	0	0	0	TOTCO2
UP	ENV_BOUND(BD)	2050	0	0	0	0	0	0	0	0	37663976	0	0	0	0	0	0	0	TOTCO2

6.5.2. Delete

This function is to delete scenarios that have been imported at the previous step (section 6.5.1). A window opens where the user can select the scenarios to delete and click '**DELETE**'. The Base scenario may not be deleted.

6.6. Synchronize

This is work-in-progress.

7. Tools menu

7.1. Views

This function is to view the layouts saved in the browser (see section 5.2). These layouts are saved from the right-click menu ('Save Layout') in the browser table.

7.2. Set RES Colors

This function is to define colors for the various commodity and process categories in the RES. The user can select a commodity (e.g. RES or TRA) or a process (e.g. DMD or ELE) category in the combo and click on the first box to change the fore color or on the second box to change the back color. A large choice of basic colors or custom colors is available. By default, the fore color is black and the back color is white. Back color changes are not possible for commodities.

7.3. Units

This function is to add, edit or delete units for activity, capacity or commodity. A window opens where the user can select a defined unit in the combo to edit the name or the description or delete it. The user can also add a new unit by typing a name and a description and click the '**Update**' button.

7.4. Comments

This function is to add new comments and to view, edit or delete existing comments (see also the right-click menu in the browse section 5.2). A window opens with all the existing comments and their color legend. The user can edit the color or the text of comments. It is also possible to create new comments.

7.5. User Options

This function is to define general options and cube default layout options (which dimensions should appear in rows and in columns, and in what nesting order). It is possible to pre-define the table layout that is created in the browser by dragging and dropping the dimensions (attributes) in rows or in columns. The user specifies the layout of the table by deciding if a dimension should appear in rows or in columns, and in what nesting order, i.e. from the outermost to the innermost position. While dropping, a green bar will indicate valid drop positions on the window (see section 5.2).

8. Window menu

8.1. Cascade

This function is to display windows in cascade.

8.2. Tile Horizontally

This function is to display windows horizontally.

8.3. Tile Vertically

This function is to display windows vertically.

9. Help menu

9.1. About

This function is to view VEDA-SAGE information system.

9.2. Contents

This function is to: **This is work-in-progress.**

9.3. Search

This function is to: **This is work-in-progress.**

9.4. Contact Us

This function is to: **This is work-in-progress.**

10. Reference guide

This section introduces the various commands of the menu and may be used as a quick reference guide.

10.1. File Menu

New Database [Ctrl N]: To create a new active VEDA-SAGE database.

Open Database [Ctrl O]: To open an existing VEDA-SAGE database.

Close Database: To automatically close the VEDA-SAGE database that is already opened.

Delete Database [Ctrl T]: To delete existing VEDA-SAGE databases.

Compact Database [F12]: To compact the VEDA-SAGE database that is already opened, i.e. to reduce the size of the Access files.

10.2. Modules – 1

10.2.1. Import [F6]

Template manager and color legend: To import data from the templates, and from the new technology and the user constraint modules, along with a transformation process (the SAGE_QDATA.xls file) into a VEDA-SAGE database. A color legend allows the user to follow the status of the import process.

- File not found (off white): Some templates are missing from the storage folder.
- IEA Update (yellow): Updates the base-year energy numbers in the templates from the Base Year Data files located in the template folder.
- Template Import (red): Imports the SAGE templates into the Access databases.
- Technology Repository (orange): Imports the new technologies from the repository (TechRep.mdb) located in the application folder.
- User Constraints (pink): Generates the user constraints from the ADratios.mdb file located in the application folder.
- Transformation (green): Compiles all above information, along with transformations indicated in the SAGE_QDATA.XLS file, into a VEDA-SAGE database.
- Complete (blue): Import and processing is completed.

The user may de-activate some templates by removing check marks; these templates will be ignored during the import process.

There are four buttons in the Import mode, as follows:

- CHANGE PATH: To view or specify an alternate templates folder.
- SELECT OPERATIONS (combo): To start the import process at a particular level for some regions/sectors, those for which the user put check marks.
 - o Update IEA Data: To update the base-year energy numbers (yellow) and import the templates.
 - o Template Import: To import the templates (red).
 - o UConstraint: To generate the user constraints (pink).
 - o Transformation: To start the import process at the transformation level with the SAGE_QDATA.xls file (green).

- Edit: To open and edit templates. This will take you directly to the SAGE templates, which you may modify and save.
- IMPORT DATA: To start the import processing. This brings all the cells (templates) to 'blue' from whichever state (color) they are in.
- VIEW LOG: To see the pre and post-transformation data values.

10.2.2. Browse/Edit [F7]

Browse: To browse the entire active database and edit data if wanted. The user can create views (tables) of the database by setting filters on the various dimensions: scenario, region, technology, commodity, parameter and others (bound, sector, time-slice, year). Right clicking on attribute boxes gives a menu with three functions to help selecting or un-selecting: Reset list, Select all and Search. For technologies and commodities, this menu has three additional functions: Show Code/Show Description, Process information/Commodity Information and Goto RES.

Layout. It is possible to reconfigure the table created by dragging and dropping the dimensions (attributes) in rows, in columns or at the top of the table (the values for these dimensions will be summed up). It is possible to view 'Time Series' and/or 'TID' (Time Independent Data) by checking appropriate boxes.

Other functions. Right-clicking in each dimension of the table created gives a menu with various functions, linked to that particular dimensions or valid for the whole table:

- Apply Filter: To specify a smaller set of elements in dimensions.
- Copy Selected Data: To copy selected data (and paste them somewhere else).
- Export To: To export the table to an Excel, Word, Html or Text file.
- Show Code/Show Description: To switch between short names (Code) and long names (Description) of elements.
- Change Totals: To show the sum or the average of elements.
- Goto RES: To go to the RES section of the selected technology or commodity.
- Save Layout: To save the table layout for future use on other tables.
- Apply Layout: To apply a previously saved layout to a table.
- Cube Preferences: To set the user preferences by default as regards to the table layout.
- Comments: To apply comments on selected values.
- Full Screen/Undo Full Screen: To maximize the size of the table or un-do.

Other functions. Finally, other functions are available on the right side of the table.

- Edit: To edit data.
- Edit in Excel: To temporarily export the table in Excel and to edit the values.
- Copy: To copy existing elements of a dimension; arithmetic operations (+,-,/,*) are possible.
- Delete: To delete the records which are selected in the browser.
- Export to Excel: To export and save the table in Excel.
- Show Graph: To visualize a graphical representation of the data selected. Standards graph options are available as well as editing functions.

10.2.3. RES [F8]

RES: To see a graphical representation of the RES (Reference Energy System) of the regions, or more specially, to view portions of the RES centered at a particular process or commodity and the various flows of energy and materials in and out of a process. It is possible to navigate downstream or upstream of the current RES view by clicking on any element of the diagram or to search for a commodity or a process to bring at the center of the shown RES portion. Other functions exist such as: show central item information, switch between the code and the description of elements, set commodity and process color, export diagram to Power Point and view the description/name of elements.

10.2.4. Solve [F9]

Solve form: To submit runs. The user can select scenarios, regions and the time horizon to include for the run, and declare the run details (name and description). The user can also set various options like model variants (time stepped or dynamic; elastic demands; market shares) and solver options for XPRESS or CPLEX (scaling, solution Algorithm and infeasibilities).

There are other functions such as:

- Template Files: To edit run control files for the current run.
- View log files: To view the log files created by GAMS for the last run.
- Clean work folder: To delete files related to the previous runs.
- View LST files: To view LST files for previous runs.

10.3. Modules – 2

10.3.1. Demands

There are six buttons.

Demands Manager: To view and edit the selection of driver, calibration series and sensitivity series used to project demands. Filter facilities exist for regions and demands.

Edit/view single demands: To view and edit the selection of drivers, calibration and sensitivity series used to project single demands. The user can select other drivers and series from the existing lists or create new series (but not new drivers). A graph allows the user to compare the new projections (calculated after editing) to the original projections.

View multiple demands: To compare one or more demands for one or more regions and for one or more scenarios. The user can view absolute or relative values on a graph. It is possible to directly go to the Edit/View single demands window for the active demand. Few more options are available for the active demand (show markers, show statistics).

Manage driver data: To compare one or more drivers for one or more regions and for one or more scenarios. Selected drivers are shown in a table and a graph. Few options are available for the active driver (show markers, show statistics). It is also possible to import new drivers and to delete existing ones. The base scenario may not be deleted.

Manage calibration/sensitivity series: To view, add, edit or delete series. Series that are currently being used may not be deleted.

Demand projection: To project the base year values for the future time-periods, using the selected driver and sensitivity/calibration series, for all demands. This should not be needed, but any irregularities in demand projection calculation may be corrected using this function.

10.3.2. Technology Repository

There are three buttons.

Select and view technologies: To select or unselect technologies in various regions and sectors. This facility applies only with the new technologies (not the existing technology stock). There are selection and filter facilities for scenarios, sectors, regions and new technologies.

- Technology Viewer: To view the parameters of the technologies that are selected. Editing technology parameters is not permitted at this level (the only way is to modify the Excel input file and re-import the technology scenario. It is possible to re-configure the table created by dragging and dropping the dimensions (attributes) in rows or in columns.
- Apply Selections: To apply a technology selection from an existing scenario to a new one. This handles only those technologies that are common to both scenarios.

Import technologies: To import new technologies into the repository, from the main file located in the application folder (TechRep.xls) or any other files. Data is expected to be in the format of the main file (TechRep.xls). Technologies for each sector are expected to be on a separate sheet, and each sheet is expected to have a scenario identifier. *Note that 'scenario' here refers to an alternate set and selection of technologies. Consequently, the scenarios are defined at the sector level.* The user can name the new scenario by sector.

Delete scenarios: To delete new scenario that have been created. The base scenario may not be deleted.

10.3.3. Trades

There are three buttons.

Trade links Region matrix: To declare energy and permit trading links by commodity on a full region-region matrix. The user can check the intersections to create a trade link between two regions. To declare emission permit trading, the user can name the commodity that will be traded (e.g. CO2PMT for CO2 emission permit) and select the associate emission commodity (e.g. TOTCO2 or GHG). *It is possible to copy and paste an Excel matrix, where non-zero values are interpreted as check marks.*

Trade parameters (R matrix): To define parameters for the links declared in the first step. For the active commodity, the same region-to-region matrix appears with colored cells indicating the

active links. It is possible to enter values for various parameters (BOUND(BD)OR, COST, CUM, ENV_SEP and START) on importers or exporters for specific period. *It is possible to copy and paste an Excel matrix.*

Trade parameters (Time series): This offers the same functionality as the second option, but the data is organized as a time-series rather than as a matrix. The user can either visualize the parameter values entered at the previous step or enter new values. For a particular parameter, it is possible to view the values declared for the different commodities, importers and exporters.

10.3.4. User constraints

There are eight buttons, six for ‘all constraints’ and two for ‘single constraints’.

All constraints

User constraints definitions: To view and edit definitions of existing user constraints. Selection and filter facilities exist for regions, sectors and user constraints. The user can modify the description of the user constraints and all the other parameters (Share/Absolute, MktShr/Ignore, CAP/INV/FLO, normalization IN/OUT, lime type FX/LO/UP/NON, Enabled/Disabled). Right-clicking in any cell of a particular user constraint (any column on a particular row) allows to view the name and the description of technologies included in the bigset and the subset definitions. It is also possible to view market shares rather than user constraints.

- **User constraints coefficients**: To view and to edit the coefficients of the filtered set of user constraints at each period. The user can edit values by entering numbers directly in the cells. A single number may be applied to all rows by using the first row.
- **Market share coefficients**: To view and to edit the coefficients of the filtered set of market shares (or all market shares if no filter is applied) at each period.
- **Relaxation Factor**: To view and to edit the relaxation factor of the filtered set of user constraints (or all user constraints if no filter is applied) at each period. A single number may be applied to all rows by using the first row.
- **Filter by selection**: To filter user constraints based on contents of the active cell.
- **Group By Bigset**: To sort user constraints by bigset definition.

User constraints coefficients: To view and to edit the coefficients of the filtered set of user constraints (or all user constraints if no filter is applied) at each period. It leads to the same functionalities than the ‘**User constraints coefficients**’ button in the ‘User constraints definitions’ window. Selection and filter facilities exist for regions, sectors and user constraints. *Only user constraints with non-zero coefficients will appear in the table; it is not the case from the ‘User constraints definitions’ window.* The user can edit values by entering numbers directly in the cells. A single number may be applied to all rows by using the first row.

Quality Check: To help the user identify inconsistent constraint definitions, for example, a group of user constraints adding up to more than 100%. **This is work-in-progress.**

Delete: To delete the filtered set of user constraints (or all user constraints if no filter is applied). Selection and filter facilities exist.

Copy: To copy user constraints across regions. It is also possible to copy market shares. Selection and filter facilities exist.

Add default values: This function is to declare the default values for the three main market share parameters: MKT_CE, MKT_GAMA and MKT_REAL.

Single constraints

Add: To create new user constraints or market shares (one at a time). A series of windows open where the user can construct a user constraint:

- First window (Add User Constraint): To give a name and a description, select the regions and the sector and choose the definition parameters (Share/Absolute, MktShr/Ignore, CAP/INV/FLO, IN/OUT, FX/LO/UP/NON). Some parameters are not required for market shares.
- Second window (BigSet Declaration): To select the bigset of technologies to include. Some filter facilities exist and a shortlist allows to view the technologies that satisfy the characteristics specified by the user.
- Third window (SubSet Declaration): To select the subset of technologies to include. Some filter facilities exist and a shortlist allows to view the technologies that satisfy the characteristics specified by the user. This step is not required for absolute user constraints and market shares.
- Fourth window (User constraints coefficients): To enter values for each period (except 2000). A single number may be applied to all rows by using the first row.

Edit: To edit any existing user constraint or market share. The same series of windows (used to add user constraints) open where the user can edit a user constraint:

- First window (Edit User Constraint): To select the name of the user constraint to edit and the region (the sector is selected automatically). Some filter facilities exist. It is possible to edit the description and all the parameters of the user constraint.
- Second window (BigSet Declaration): To edit the bigset of technologies.
- Third window (SubSet Declaration): To edit the subset of technologies. This step is not required for absolute user constraints and market shares.
- Forth window (User constraints coefficients): To edit coefficient values for each period. A single number may be applied to all rows by using the first row.

10.3.5. Scenario data

Import: To import new scenario data in the database. The user can compile the information related to a new scenario in any Excel file and import it. The user has complete freedom to name this new Excel file. The new scenario will appear in the scenario box of the solve form.

Delete: To delete scenarios that have been imported at the previous step (Import). The Base scenario may not be deleted.

10.3.6. Synchronize

This is work-in-progress.

10.4. Tools menu

Views: To view the layouts saved in the browser.

Set RES Colors: To define colors for the various commodity and process categories in the RES.

Units: To add, edit or delete units for activity, capacity or commodity.

Comments: To apply comments to selected values.

User Options: To define general options and cube default layout options (which dimensions should appear in rows and in columns, and in what nesting order).

10.5. Window menu

Cascade: To display windows in cascade.

Tile Horizontally: To display windows horizontally.

Tile Vertically: To display windows vertically.

10.6. Help menu

About: To view the characteristics of the installed VEDA-SAGE system.

Contents: This is work-in-progress.

Search: This is work-in-progress.

Contact Us: This is work-in-progress.