

ANSWERv6-MARKAL

User Manual

**ANSWER MARKAL,
an Energy Policy Optimization Tool**

Noble-Soft Systems Pty Ltd

Foreword

This manual provides users of the ANSWER software with a detailed guide to the use of the software. The ANSWER software was developed to provide a modern Windows based interface for the MARKAL (MARKet ALlocation) model.

The MARKAL model is an integrated energy system least cost optimization model that determines the least cost means of satisfying the demand for energy services. The original MARKAL model was developed in the early 1980's by the International Energy Agency's (IEA) Energy Technology Systems Analysis Programme (ETSAP); since then ETSAP has developed a number of MARKAL model variants which extend the original MARKAL modelling framework. MARKAL is used by a wide range of agencies and institutions, in both developed and developing countries, which have energy sector planning and policy analysis functions. MARKAL modellers can also access a world-wide users support network established under the auspices of the IEA Energy Technology and Systems Analysis Project (ETSAP). For further details, refer to the ETSAP website (<http://www.etsap.org/>).

Background

The ANSWER software was originally developed and marketed over the period 1996 to late 2003 by the Australian Bureau of Agricultural and Resource Economics (ABARE) – an independent economic and policy research agency of the Government of Australia. During this period, primary system design, programming and support and maintenance were undertaken by then ABARE staff member, Dr Ken Noble. Important contributions were made by other ABARE staff members Dr Ray Hinde (system design and programming), Brett Jacobs (the ANSWER User Manual), Barry Naughten and Brian Dawson.

In late 2003 Ken Noble retired from ABARE, established Noble-Soft Systems Pty Ltd and purchased the ANSWER software from ABARE, thereby ensuring continuing development and support for the software.

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There is a special version of ANSWER that incorporates a Library Database facility (relying on a special Library Region) and that was developed to meet the needs of the International Energy Agency's Energy Technology Perspectives model (IEA-ETP model).

Comprehensive documentation of the Library Database facility is not currently available.

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 - 14.2.3 Creating a new Season-Time of Day Time Slice (Member of Z-Y)
 - 14.2.4 Additional special considerations applying to the TimeSlice tab
- 14.3 Setting the Peak Time Slices**
- 14.4 Multi-region Considerations for Flexible Time Slicing**
- 14.5 Run Model Considerations for Flexible Time Slicing**
- 14.6 Other Considerations for Flexible Time Slicing**

Section Fifteen: Handling Bilateral Trade in ANSWER

- 15.1 Items Listview on BiTrade Tab Populated with Bilateral Trade Links**
- 15.2 Operation of buttons in Item Management frame on the BiTrade Tab**
- 15.3 Data displayed in TS and TID data spreads on BiTrade Tab**
- 15.4 Results handling on BiTrade Tab**
- 15.5 Specifying Global Trade Data and Viewing Global Trade Results**
 - 15.5.1 Specifying Global Trade Data Parameters
 - 15.5.2 Viewing Global Trade Results Parameters
 - 15.5.3 Accessing Global Trade Data Parameters on Alternative Tabs

Appendix One: MARKAL Data Parameters

A1.1 MARKAL Data Parameters by Component, Subset Parameter Setting

MARKAL Data Parameters: Global (system wide)
MARKAL Data Parameters: Energy Carrier, Specific
MARKAL Data Parameters: Energy Carrier, Related Technologies
MARKAL Data Parameters: Energy Carrier, Related Taxes/Subsidies
MARKAL Data Parameters: Energy Carrier, Related Trade
MARKAL Data Parameters: Material, Specific
MARKAL Data Parameters: Material, Related Technologies
MARKAL Data Parameters: Material, Related Taxes/Subsidies
MARKAL Data Parameters: Material, Related Trade
MARKAL Data Parameters: End-Use Demand, Specific
MARKAL Data Parameters: End-Use Demand, Related Technologies
MARKAL Data Parameters: End-Use Demand, Related Stochastics
MARKAL Data Parameters: Emission, Specific
MARKAL Data Parameters: Emission, Related Technologies
MARKAL Data Parameters: Emission, Related Stochastics
MARKAL Data Parameters: Emission, Related Trade
MARKAL Data Parameters: Technology, Specific
MARKAL Data Parameters: Technology, Related User-Defined Constraints
MARKAL Data Parameters: Technology, Related Taxes/Subsidies
MARKAL Data Parameters: Technology, Related Stochastics
MARKAL Data Parameters: Technology, Related Trade
MARKAL Data Parameters: User-Defined Constraint
MARKAL Data Parameters: Tax/Subsidy
MARKAL Data Parameters: State of World (Stochastic)

A1.2 MARKAL Data Parameters, Parameter Tab, Bilateral Trade and Global Trade

MARKAL Data Parameters: Parameter Tab, BiTrade Data Parameters Sets Filter Setting
MARKAL Data Parameters: Parameter Tab, Global Data Parameters Sets Filter Setting

Appendix Two: MARKAL Results Tables and Results Parameters

A2.1 MARKAL Results Tables

A2.2 MARKAL Results Parameters by Table

MARKAL Results Table T01: Scenario Indicators
MARKAL Results Table T02: Summary
MARKAL Results Table T03: Primary Energy Supply
MARKAL Results Table T04: Output of Energy by Technology
MARKAL Results Table T05: Fuel Consumption by Demand Sector
MARKAL Results Table T06: Useful Energy by Demand Device
MARKAL Results Table T08: Use of Energy Carriers by Technology
MARKAL Results Table T09: Shadow Prices of Energy Carriers and Emissions
MARKAL Results Table T11: Reduced Costs of Technologies, End-Use Demands, Emissions, etc.

MARKAL Results Table T25: Annualised Resource and Technology Costs
MARKAL Results Table T27ENV: Annual Environmental Effects
MARKAL Results Table T30: Adjustments to Demand for MARKALED
MARKAL Results Table ACT: Activity of Processes - Solution Values
MARKAL Results Table CAP: Capacity Utilisation of Technologies
MARKAL Results Table COSTBEN: Cost/Benefit Ratios
MARKAL Results Table DEMAND: Demand Levels - Solution Values
MARKAL Results Table GDP: Key MACRO Indicators
MARKAL Results Table INV: Investment in Technologies - Quantity and Cost
MARKAL Results Table MC: Demand Marginals and PREF Differences
MARKAL Results Table SUPPLY: Resource Supply Levels - Solution Values
MARKAL Results Table TRADE: Bilateral Trade
MARKAL Results Table TRADE: Global Trade

Section One: What is ANSWER MARKAL - an overview

This Section introduces the user to MARKAL and its user interface, ANSWER. It also discusses the user's PC hardware/software requirements and how to install ANSWER MARKAL.

1.1 MARKAL

1.1.1 What is MARKAL

MARKAL (MARKet ALlocation model) is a highly flexible, multi-time period, linear programming model of a generalised energy system. The original MARKAL model was developed in the early 1980's by the International Energy Agency's (IEA) Energy Technology Systems Analysis Programme (ETSAP); since then ETSAP has developed a number of MARKAL model variants which extend the original MARKAL modelling framework.

The original (standard) MARKAL is 'demand driven', in that feasible solutions are obtained only if all the specified end-use demands for energy services are satisfied for every time period. (The MARKAL-MACRO and the Elastic Demand MARKAL model variants allow end-use demands to be responsive to price.) It allows for the specification of energy supply, demand for energy services, transformation and demand technologies, and any constraints or policy assumptions that may be set on the energy system. Such constraints may take the form of limited capital for investment, restricted petroleum imports, or limits on CO₂ emissions.

With these parameters specified, MARKAL then determines the configuration of technologies and fuels that represent the least cost means of satisfying the demand for energy services over the forecast time period. Because MARKAL models a generalised energy system, it is capable of analysing energy systems at a local, regional or national level.

1.1.2 MARKAL's policy analysis role

MARKAL depicts a perfectly competitive market. It assists policy analysts and decision makers to track the complex interactions and feedback systems in their energy system, and assists them to quantify the effects of policy changes. Examples of policy applications of MARKAL include:

- . least cost strategies to limit greenhouse gas emissions and other waste emissions from the energy sector
- . assessing the impact of demand side management programs
- . assessing the economic merits of inter-connecting national and international gas pipelines and electricity grids
- . identifying the potential impacts of the introduction or removal of taxes and subsidies on energy production, energy consumption, and energy using technologies
- . identifying the potential role of improved technologies, such as clean coal technologies, renewable technologies, and more energy efficient technologies.

1.1.3 MARKAL input requirements

To determine the least cost configuration of the energy system, the user must detail in MARKAL both the items that constitute the energy system and the technical and cost data that are necessary to adequately characterise each item. The user must also detail all possible constraints on the system, such as availability of fuels, emission limits, and load constraints.

MARKAL, like other optimisation models, requires comprehensive and detailed data on the energy system in order to deliver useful results. To be an effective analytical tool, users must be aware that considerable time and effort is required to develop a comprehensive database of the energy system to be modelled.

However, once the database is adequately populated with the data necessary for the modelling tasks, it is then available for ongoing policy analysis with only limited update and maintenance.

1.2 ANSWER

1.2.1 What is ANSWER

ANSWER is a Windows interface to the MARKAL family of energy system models, developed using:

- Microsoft Visual Basic
- Microsoft Access
- Microsoft Excel

and requiring the GAMS mathematical modelling language software.

It is mouse driven, visual, intuitive, and interactive. It provides the energy analyst with:

- data entry/edit/browse
- model run
- results handling
- and charting.

1.2.2 Why was ANSWER developed

ANSWER was developed to provide a modern Windows-based interface for MARKAL modellers.

ANSWER represents another step forward from the original and technically complex main frame version of the model, through the significant enhancement achieved by the PC based MARKAL Users Support System (MUSS), to this modern Windows-based PC version. ANSWER has enabled the MARKAL model to become more readily accessible to and usable by the energy policy and systems analyst.

ANSWER continues to be enhanced to enable it to address extended versions of MARKAL and to increase its usability.

1.2.3 Major enhancements in version 5 of ANSWER, the version prior to version 6

Version 5 of ANSWER contained major enhancements as compared with the then previous production version, version 3.5.x. These enhancements included:

The extension of the ANSWER database structure and code to allow a single ANSWER database to contain data and results from multiple regions.

The introduction of a new Trade tab on the Data/Results screen to allow the user to specify bilateral and global trade data on a scenario-by-scenario basis, and likewise to display bilateral and global trade results on a case-by-case basis.

The extension of the "Run Model" facility to allow the user to generate all relevant files and carry out a multi-region run (nearly) as simply as for a single-region run.

An improved "Model Variant Specification" facility for use with "Run Model".

The extension of all Export/Import facilities to cater for the possibility of multiple regions in an ANSWER database.

The incorporation of a Technology Library Database feature. (This feature has now been superseded by a special Library Region feature that is used by the International Energy Agency for their multi-region Energy Technology Perspectives (ETP) model, but that is not currently available to other ANSWER clients.)

The extension of Set Membership filtering facilities via the "Enhance Subset Items" facility, that provides a graphical mechanism for specifying a Set Membership filter.

Allowing full multi-select in the Items display on the Data/Results screen.

The extension of TS and TID spread filtering facilities via the "TS and TID Filter Form" facility that provides powerful filtering facilities with a wide range of filtering criteria available, and the ability to save filters by name for subsequent re-use.

The incorporation of a new _DELETED scenario to allow the deletion of an Item from data without requiring the deletion of on-line results involving that Item.

The development of a new improved "Batch Run" facility allowing the user to initiate a batch of model runs.

Allowing RES graphics to be invoked for Results as well as for Data.

The extension of ANSWER to allow the handling of cross-region emission constraints and cross-region user-defined constraints.

The introduction for Delete Case of a 'Remember Case Definition' option, so that the Case definition is retained online (the Scenarios involved and the run settings), while all the actual results for the Case are deleted. And the introduction of a "Delete All Cases" facility.

The creation of a Batch Management facility, allowing the user to create, copy, delete and edit named Batches of Cases inside an ANSWER Database, and hence to easily recall a Batch of Cases to be re-run via the "Batch Run" facility.

The enhancing of the "Import GAMS DD" facility to permit the import of BASE and non-BASE SAGE GAMS DDs (generated by VEDA-SAGE) into ANSWER.

Significant strengthening of the "Import Model Data from Excel" facility by the development of new ANSWER "smart" load templates and allowing import from these templates. Very briefly, the "smart" load templates comprise an ANSWER-MARKAL aware Excel workbook whose worksheets have a very flexible and user-friendly format, along with associated "smart" buttons enabling the user to do such things as linking to an ANSWER database to facilitate correct data entry.

Details of these enhancements are provided later in this manual.

1.2.4 Major enhancements in version 6 of ANSWER

Version 6 of ANSWER contains major enhancements as compared with the previous production version, version 5.x.x. These enhancements include:

The addition of flexible time-slicing to MARKAL and to ANSWER. Thus instead of the Seasons being restricted to Summer, Winter, Intermediate and the Diurnal divisions being restricted to Day and Night, both the Seasons and Diurnal divisions are now under user control. Flexible time-slicing is the most important enhancement made to MARKAL in the past several years.

The introduction into ANSWER of a powerful facility for filtering the items that are displayed in the Technology Items listview. This facility allows the user to create Named Technology Item Filters based upon technology name, description and set memberships, and input/output commodity masks.

The incorporation into ANSWER of "Rule-based Constraints (ADRATIOs)" that employ the new Technology Item Filters. The new "Rule-based Constraints" facility allows the user to

specify a Constraint such as "renewable electricity production must be at least 5% of total electricity production" much more simply than previously and also with the benefit that the "rule" will automatically update the Constraint when new technologies are added.

The improvement of ANSWER's handling of bilateral trade. This is relevant for multi-region MARKAL models.

Enhancing the ANSWER "smart" load templates to handle the needs of multi-region models with common naming conventions across regions, and to allow the specification of bilateral trade data, with the "Import Model Data from Excel" facility being correspondingly enhanced.

Details of these enhancements are provided later in this manual.

1.2.5 **MARKAL model variants supported by ANSWER**

Since the creation of the original (standard) MARKAL model in the early 1980s, ETSAP has developed a number of MARKAL model variants which extend the standard MARKAL modelling framework. These extended variants include:

- MARKAL-MACRO
- MARKAL-MICRO
- Elastic Demand MARKAL
- Elastic Demand MARKAL with Income Elasticity
- Stochastic MARKAL
- MARKAL with Endogenous Technology Learning (ETL)
- MARKAL with Environmental Damages
- Multi-Region MARKAL with Bilateral and Global Trade
- SAGE variant of MARKAL (Time-stepped solve)
- Enhanced Refinery Blending variant of MARKAL
- Lumpy Investment variant of MARKAL
- Goal Programming variant of MARKAL
- MAC-GHG Global Multi-region MARKAL formulation
- SAGE Market Share (MKTSHR) formulation

with various combinations of the above extended variants also possible.

ANSWER version 6 supports all MARKAL model variants with the exception of the enhanced Refinery Blending variant and the SAGE Market Share formulation.

1.3 Operating ANSWER MARKAL

1.3.1 What level of user skill is required to operate ANSWER MARKAL

Users must be competent in the Windows environment, have a good understanding of how energy systems function, and understand the physical and energy units of measurement.

1.3.2 What backup is available to ANSWER MARKAL users

The user should first consult this User Manual, but if still unable to resolve any aspect of the operation of the ANSWER software, should contact Noble-Soft Systems (noblesoft@netspeed.com.au). Note that this email backup service is for enquiries regarding the operation of the ANSWER software, as distinct from enquiries related to the MARKAL modelling framework itself (including data requirements and modelling techniques). Enquiries regarding the latter may be addressed, but at the discretion of Noble-Soft Systems.

1.3.3 What are the hardware/software requirements of ANSWER MARKAL

ANSWER MARKAL is PC based and is installed as an executable file with associated DLLs and OCXs. The initial ANSWER installation files and subsequent ANSWER software update files are downloaded from the web. The following minimum hardware and software requirements apply:

- 1.8 GHz Pentium processor (or equivalent), for large multi-region models at least 3 GHz Pentium processor
- 256 MB RAM, but preferably at least 512 MB RAM, and for large multi-region models at least 1 GB RAM
- 200 MB free HDD space, for large multi-region models at least 2 GB free HDD space
- SVGA monitor, set at 800 x 600 or greater, **preferably 1024 x 768 or higher**
- Microsoft Windows 2000 or higher, preferably Microsoft Windows XP
- Microsoft Excel 2000 or higher
- A recent version of PC GAMS, preferably version 21.7 or higher.

There is one particular point that should be noted, and this is that **it is strongly preferable when working with ANSWER to have a monitor whose resolution is 1024 x 768, or higher.**

1.4 Installing and testing ANSWER MARKAL

1.4.1 Installing ANSWER MARKAL on your PC

To carry out a new ANSWER installation, first download from the web the files that are needed by following the instructions in the Word document "AnswerV6 Download.doc" that will be emailed to you by Noble-Soft. Included amongst the files that you will download is the Word doc "AnswerV6 New Installation.doc". Read this doc to get an overview of the installation process, and then carry out the installation.

Be sure that you carry out step 9 of the installation instructions, namely that you place the licence file `answerv6.lic` that Noble-Soft sends to you by separate email into folder `C:\AnswerV6`. Note that if the `answerv6.lic` file is missing, ANSWER will only function in demonstration mode: it will not allow you to carry out model runs, or import results.

At this stage, the initial ANSWERv6 installation is complete. You will be able to run ANSWER in full production mode for the next 60 days. **(But see section 1.4.2 'AnswerV6 License File System' for details of what you need to do to fully register your ANSWER system.)**

The installation process will have added ANSWERv6 (and its associated icon) to the Programs menu, and (assuming that you have used `C:\AnswerV6` as your ANSWER home directory) it will have added the following directories to your machine, as indicated below.

C:\AnswerV6

The home directory for ANSWERv6 (the Flexible TimeSlice, Technology Items Filter and Rule-based Constraint – aware version of ANSWER), containing:

- ANSWERv6.exe (the latest ANSWERv6.exe)
- ANSWERver6.1.xls (or a similarly named xls file – the latest version of the ANSWER "smart" load templates)
- TemplateV6FlexTS.mdb
- TemplateV6FlexTSRatRule.mdb
- One or more UpdateAnsSysTables_*.xls files – used to update system tables in existing ANSWER databases to incorporate new features, and
- Excel9.olb, SPR32X30.ocx

along with the following 7 subdirectories:

C:\AnswerV6\Ans_WrkPRD

This subdirectory is used to contain ANSWER-generated work files. Initially it contains a number of demonstration ANSWER Load Templates (Excel workbooks) that indicate the format required for the Import Model Data from Excel facility.

C:\AnswerV6\Answer_Databases

This subdirectory is used to contain your ANSWER databases. Initially it contains a number of demonstration ANSWER databases.

C:\AnswerV6\Doc

This subdirectory contains assorted ANSWER and ETSAP documentation. In particular it contains the only currently available documentation of some of the advanced MARKAL variants. It is a good idea to browse the most recent documentation for information about new MARKAL and ANSWER features.

C:\AnswerV6\Doc\UserManualUpdates

This subfolder contains documentation for recent ANSWER enhancements that may not yet have been incorporated into the ANSWER User Manual. Again it is a good idea to browse the most recent documentation for information about new ANSWER features.

C:\AnswerV6\Gams_SrcPRD

This subdirectory contains the most recent ANSWER-specific GAMS MARKAL source code.

C:\AnswerV6\Gams_WrkPRD

This subdirectory is used to contain ANSWER-generated files (*.DD, *.DDS and *.GEN, *.RPT, *.SLV) associated with GAMS model runs, and also the *.LST, *.ANT, *.OUT files that are created by the GAMS run. Initially this subdirectory contains just the file CONVERT.OPT (needed if using the COSTBEN facility) and the subfolder gamssave, where the GAMS save/restart .G0* files will be stored.

C:\AnswerV6\UserManuals

This subdirectory is used to contain ANSWER User Manuals, specifically *ANSWERv6-MARKAL User Manual.pdf* (this manual) and *ANSWERv6-MARKAL Load Templates Manual.pdf* (the manual that documents the ANSWER “smart” load templates). Initially this subdirectory contains only the second of these Manuals, because to incorporate the ANSWERv6-MARKAL User Manual as part of the ANSWERv6 installation would mean that a very large installation file would need to be downloaded from the web. The ANSWERv6-MARKAL User Manual may be separately downloaded from the web, and should be placed in the subdirectory C:\AnswerV6\UserManuals.

1.4.2 AnswerV6 License File System

The license file system for AnswerV6, like that for ANSWER version 5, is specific to an individual PC. That is, an AnswerV6 license file (answerv6.lic) from one PC will not work on another PC. Also, an AnswerV6 license file for a PC is specific to the user logon for that PC.

The AnswerV6 license file system works as follows:

1. Noble-Soft emails you an initial license file, answerv6.lic, that contains your Owner Details (and an Unlock Key). You should put this file in your AnswerV6 home folder (default is C:\AnswerV6) before attempting to run AnswerV6, as explained in section 1.4.1 above.
2. **Before you first run AnswerV6.exe, ensure that you are logged on with the same user logon as the person who will be using this PC for ANSWER-MARKAL work.**
3. When you first run AnswerV6, it changes the license file, answerv6.lic, in your AnswerV6 home folder so that it now also contains a Product ID that is specific to your PC. This new license file lets you run in production mode for 60 days. Each time that you run ANSWER, you will be advised how many days remain during which ANSWER will run in production mode.
4. As soon as possible after you first run AnswerV6, you should email back to Noble-Soft the new license file, answerv6.lic, that is in your AnswerV6 home folder. As noted at 3 above, this license file contains a Product ID that is specific to your PC, as well as Unlock Key and your Owner Details.
5. Once Noble-Soft has received payment, we will email back to you a **fully registered** license file, answerv6.lic, that is specific to your Product ID, and that allows you to run in production mode indefinitely on your PC. You should put this file in your AnswerV6 home folder, overwriting the previous answerv6.lic.

1.4.3 Installation of GAMS

Before a complete test of the ANSWER installation can be undertaken, GAMS and a GAMS-compatible optimiser (e.g. CPLEX or MINOS) must be installed. If you do not already have GAMS installed, follow the GAMS software installation instructions.

Note that ANSWER runs GAMS from an MS-DOS Window. **It is essential when you open an MS-DOS Window and type PATH, that you find that the PATH includes the GAMS installation directory.**

If the PATH does not include the GAMS installation directory...

On a PC running Windows XP, choose Start, Control Panel, System. On a PC running Windows 2000, choose Start, Settings, Control Panel, System. Once at the System dialogue box, click on the Advanced tab and click on Environment Variables. Scroll down in the System variables list until you find Path, select Path and then click on the Edit button to bring up the Edit System Variable form. (If you find that the Edit button is disabled, ask your system administrator to change the Path for you.) Then if your GAMS installation directory is say C:\Program Files\GAMS21.7, add the following to the end of what is currently displayed as the Value of Path:

```
;C:\"Program Files\GAMS21.7"
```

and click on the OK button to confirm. It is not necessary to reboot the PC.

On PCs running older operating systems, edit the AUTOEXEC.BAT file (in directory C:\) to include the GAMS installation directory in the path, and reboot the PC.

Before attempting Run Model from ANSWER, be sure to test your GAMS installation by opening an MS-DOS Window, changing to some directory (such as C:\TEMP) other than the GAMS installation directory, and typing:

- i. gamslib trnsport
- ii. gams trnsport. You should get an optimal solution value of 153.675.

Note that you cannot properly test your GAMS installation unless you carry out the gamslib trnsport and gams trnsport commands in a directory which differs from the GAMS installation directory.

1.4.4 Testing the ANSWER installation

To test that ANSWER has been correctly installed:

1. From the Start button, choose Programs and then choose ANSWERv6. This should bring up the ANSWER Home Screen, including empty Data Management and Results Management regions.
2. Click on the 'Open Database' toolbar button, or choose 'File, Open Database...' from the menu bar. This will take you into the Answer_Databases folder.
3. Click on one of the demonstration ANSWER databases (mdb's) to highlight it, and then click on Open to load this database into ANSWER.
4. Click on the BASE icon in the Selected Scenarios display, and then click on the 'Run Model' button.
5. Change the Case Name to BASETEST, ensure that the 'Import Results Automatically' checkbox is checked, and then click on the [OK] button.
6. The Run Model form will remain displayed while ANSWER creates the GAMS data dictionary and will then close and a DOS Window running GAMS will appear. The GAMS run should obtain an optimal solution and on its termination, you should see an 'ANSWER Show Progress' form displayed as the run results are imported, followed by a message box indicating:

"Finished GAMS run BASETEST"

"Model status: Optimal"

along with an indication of the number of records imported.

7. Move off ANSWER's Home Screen, either by clicking on the 'Browse Data'/'Edit Data' buttons to examine Scenario data, or by clicking on the 'Results' button to examine Case results.
8. If each of the above steps goes smoothly, ANSWER has been installed correctly on your computer.

1.4.5 Uninstalling ANSWERv6

To uninstall ANSWERv6:

1. Choose Settings/Control Panel from the Start menu and then double-click on Add/Remove Programs.
2. Highlight ANSWERv6 and then click on the Add/Remove button.
3. You may get messages indicating that the various directories associated with ANSWERv6 cannot be removed, but ANSWERv6 itself will have been uninstalled.

To remove ANSWERv6 directories:

1. Choose Programs/Windows Explorer from the Start menu.
2. Highlight C:\AnswerV6 directory and delete the ANSWERv6 home directory and all its subdirectories.


Section Two: Starting ANSWER and the ANSWER Home Screen

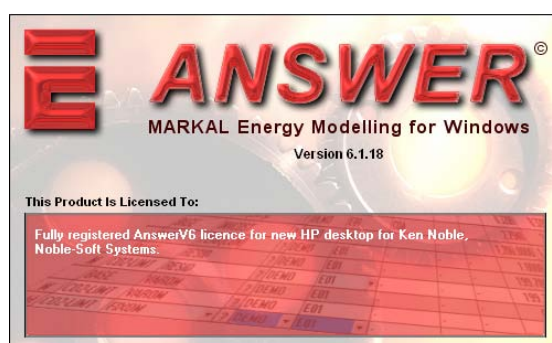
This Section shows the user how to start and exit ANSWER. It introduces the ANSWER Home Screen and takes the user through the Home Screen facilities.

2.1 Starting/exiting ANSWER

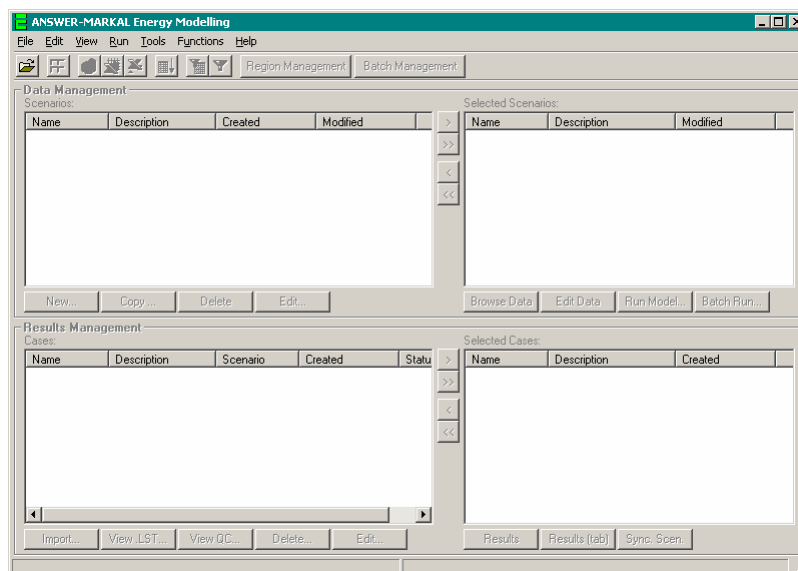
2.1.1 Starting ANSWER

To start ANSWER

1. Click on the **[Start]** button in the Windows taskbar, and point to **Programs**.
2. Click on the **ANSWER** icon . Alternatively, a desktop shortcut using usual Windows procedures may be created.
3. ANSWER will start and the ANSWER Title Screen (shown below) will appear momentarily.




4. The ANSWER Home Screen (shown below) will then appear. At this stage, the Home Screen will be empty as you have not yet loaded a MARKAL Database.



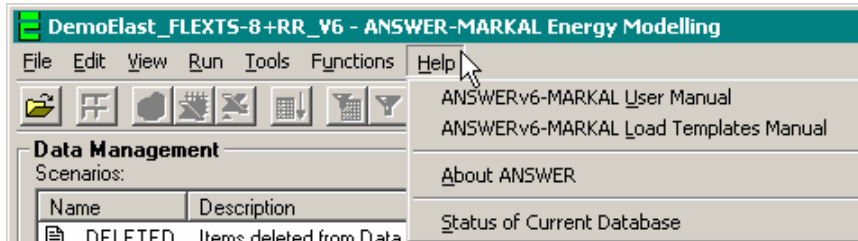
2.1.2 Exiting ANSWER

To exit ANSWER

1. Double click on the ANSWER icon  in the top left corner of the Home Screen, or click on **File** in the menu bar and choose **Exit** in the drop menu.

2.2 ANSWER menu bar Help facilities

In ANSWER version 6.2.15 (and higher) if you click on **H**elp in the menu bar the following drop-down menu of Help facilities will be displayed:

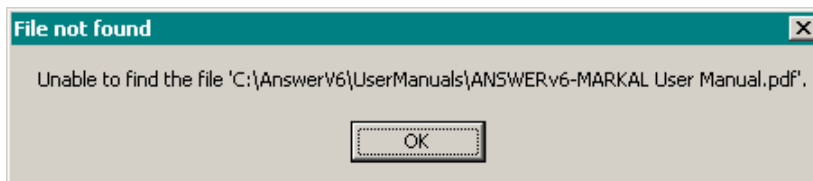


Each of these facilities is now described.

2.2.1 Help, ANSWERv6-MARKAL User Manual

This facility allows you to bring up PDF of the ANSWERv6-MARKAL User Manual, using the default PDF reader such as Adobe Reader that is on your PC.

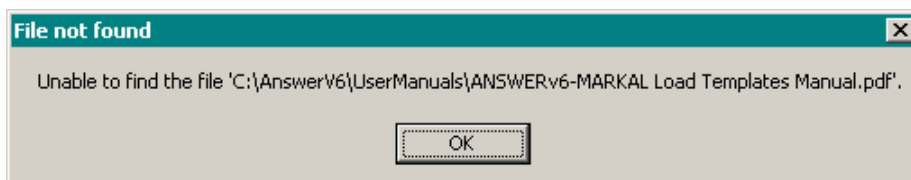
The operation of this facility is based on the assumption that the ANSWERv6-MARKAL User Manual exists as a file *ANSWERv6-MARKAL User Manual.pdf* in the UserManuals subfolder of the ANSWERv6 home directory. If this file does not exist, the following message is displayed:



2.2.2 Help, ANSWERv6-MARKAL Load Templates Manual

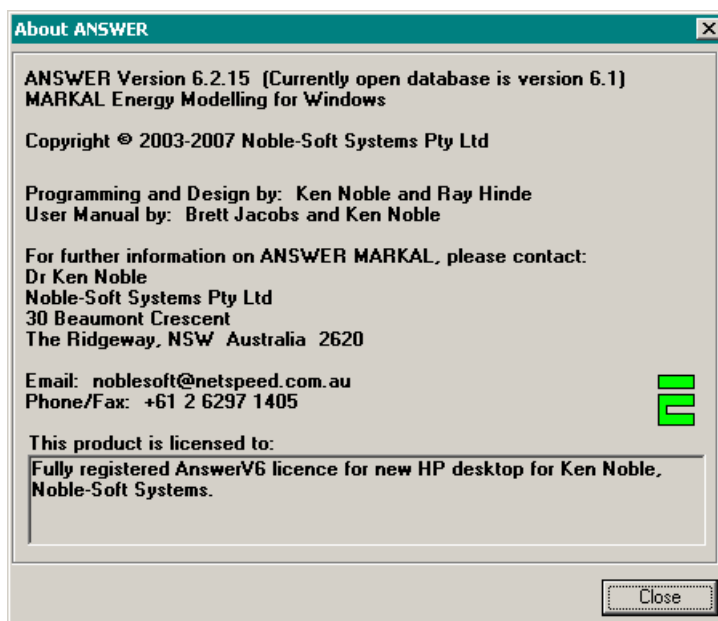
This facility allows you to bring up PDF of the ANSWERv6-MARKAL Load Templates Manual, using the default PDF reader such as Adobe Reader that is on your PC.

The operation of this facility is based on the assumption that the ANSWERv6-MARKAL Load Templates Manual exists as a file *ANSWERv6-MARKAL Load Templates Manual.pdf* in the UserManuals subfolder of the ANSWERv6 home directory. If this file does not exist, the following message is displayed:



2.2.3 Help, About ANSWER

This facility allows you to determine the ANSWER Version that you are currently running – see the top line of the screen snapshot below. It also provides contact information for Noble-Soft Systems, the owner/developer of the ANSWER software.

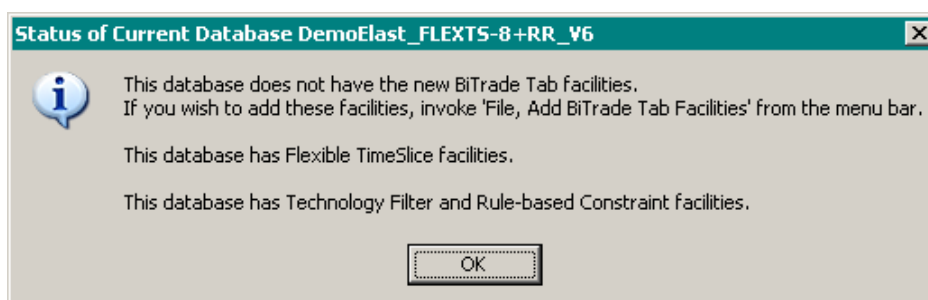


2.2.4 Help, Status of Current Database

This facility allows you to determine the status of the currently open ANSWER database, namely which of the following new ANSWERV6 facilities the currently open ANSWER database is aware of:

- New BiTrade Tab facilities
- Flexible TimeSlice facilities
- Technology Filter and Rule-based Constraint facilities

So for example, for the database DemoElast_FLEXTS-8+RR_V6.mdb that is one of the demonstration ANSWER databases provided with the ANSWERV6 installation, the status is as follows:



(Since this is a single-region database, we would not expect it to have BiTrade Tab facilities.)

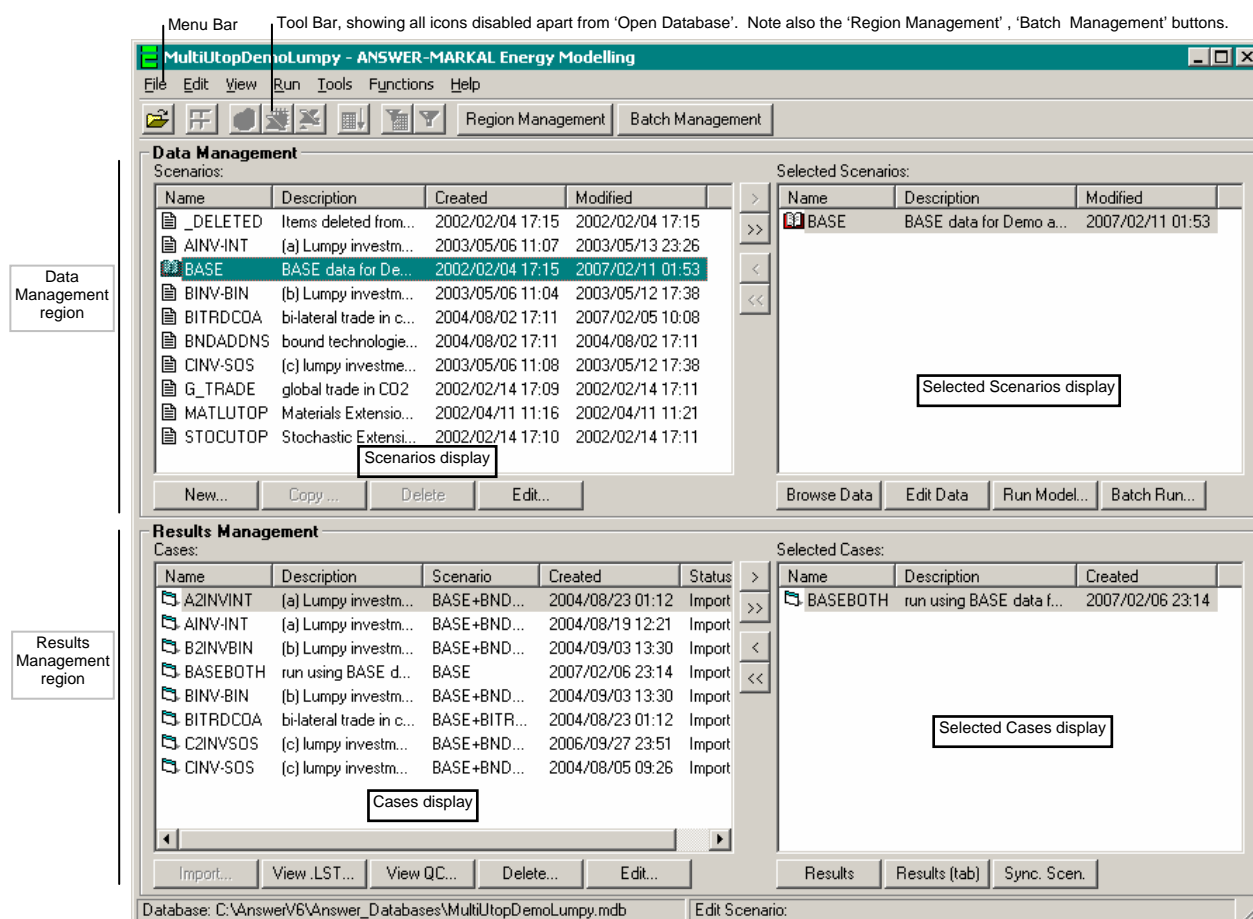
Note also that ANSWERV6 may be used to open an ANSWERV5 database, in which case this facility would indicate that the ANSWERV5 database was not aware of any of the above ANSWERV6 facilities.

2.3 The ANSWER Home Screen

The ANSWER Home Screen provides the user with various facilities, including facilities to:

- create a new Database or open an existing Database
- create/delete/edit Regions in the on-line Database (the 'Region Management' facility)
- create/delete/edit Batches of Runs in the on-line Database (the 'Batch Management' facility)
- view the current on-line Scenarios, including their date created and date last modified
- create/copy/delete/edit a Scenario
- access on-line editing/browsing of Scenario data
- run the model, either a single run ('Run Model') or a batch of runs ('Batch Run')
- view the current on-line Cases, including their date created
- manually import a Case (if automatic import of Cases is de-activated)
- view the List (*.LST) file of a Case
- view the quality assurance log for the most recent run ('View QC')
- delete/edit a Case
- access on-line viewing of the Case results.

2.3.1 Features of the Home Screen



The Home Screen is made up of 4 primary regions:

1. The Menu Bar
2. The Tool Bar, including the 'Region Management' and 'Batch Management' buttons
3. The Data Management region
4. The Results Management region.

2.3.2 The Menu Bar

The Menu Bar provides operational access to all the Home Screen's facilities. The 'exit ANSWER' facility was discussed in Section 2.1.2 'Exiting ANSWER'. The operation of other facilities is detailed in subsequent Sections.

2.3.3 The Tool Bar, including the 'Region Management' and 'Batch Management' buttons

On the Home Screen, the Tool Bar provides a one step icon for opening an existing Database. This is detailed in Section 2.4.2 'Opening an existing Database'. The Tool Bar plays a greater role on the Data/Results Screen.

The 'Region Management' button in the Tool Bar row allows the user to create / delete / edit Regions in the on-line Database. This is detailed in section 2.5 'Region Management' below.

The 'Batch Management' button in the Tool Bar row allows the user to create / delete / edit Batches of Runs in the on-line Database. Since Batch Management is related to running the model, the operation of this facility is detailed in section 6 'Running the Model', see in particular section 6.4 'Batch Management facility'.

2.3.4 The Data Management region and the Results Management region

The facilities of the Data Management and the Results Management regions are detailed in Sections 2.6 'The Data Management region' and 2.7 'The Results Management region'.

2.3.5 Home Screen terminology: what is a Database, a Scenario, and a Case

A Database is the specified Microsoft Access mdb file comprising a BASE Scenario and its associated non-BASE Scenario(s). If the Scenarios have been run under MARKAL, the Database will also contain a BASE Case and non-BASE Case(s).

A Scenario is the data set that depicts an energy system under specified conditions. This includes the BASE Scenario, which is the data set that depicts the energy system under expected conditions. It is the reference energy system against which the non-BASE Scenarios are run.

Generally, the term non-BASE Scenario is used to refer to the data set that tests the BASE Scenario under varying conditions (e.g., CO₂ emission limits). While there can be only one BASE Scenario for an energy system, there can be any number of non-BASE Scenarios. It is the deviation of the non-BASE Scenario results from the BASE Scenario results that is of interest to energy analysts.

When a Scenario is run under MARKAL, the result of the model run is called a Case. The modelled BASE Scenario is termed the BASE Case and the modelled non-BASE Scenarios are termed the non-BASE Cases.

2.3.6 An example multi-region MARKAL Database

From this point, the Manual will illustrate the ANSWER screens using a hypothetical multi-region MARKAL Database, called 'MultiUtopDemoLumpy'. This database comprises 'Utopia' and 'Demo', two highly simplified single-region MARKAL models that have been loaded into a multi-region ANSWER database. (The 'Lumpy' in the database name stems from the fact that this database contains some non-BASE Scenarios that specify data for lumpy investment.)

2.4 Creating, Opening, and Closing a Database in ANSWER

2.4.1 Creating a New ANSWER Database

To create a New ANSWER Database:

1. Use the keyboard shortcut **Ctrl+N**, or click on **File** in the menu bar and choose **New Database...** in the drop menu.
2. The New Database dialogue box (shown below) will appear. Note that the default settings for the Starting Year, Number of years in a period, Number of Periods and the 'Create Standard Markal TimeSlices' and 'Create Initial Region' checkboxes are taken from the previous use of the New Database facility.
3. **It is recommended that the (default) Template Version of 'FLEXTS MARKAL, Rule-based Constraints' be used.** Choosing this Version results in the creation of a new ANSWER database that it is aware of both Flexible TimeSlice facilities and Rule-based Constraint facilities.
4. Fill in the Description. The Description will be used as the Description for the BASE scenario, and also as the default filename for the ANSWER database that is created. See further discussion at step 11 below.
5. Fill in the Starting Year, Number of years in a period and Number of Periods fields on the New Database dialogue box.
6. The **[OK]** button will become enabled when data has been entered into the Description, Starting Year, Number of years in a period and Number of Periods fields.
7. The 'Create Standard Markal TimeSlices' checkbox affords the user the convenience of being able to create a new ANSWER database that contains the standard MARKAL TimeSlices (D, N, I, S, W, I-D, I-N, S-D, S-N, W-D, W-N) if this checkbox is checked. If this checkbox is unchecked, the new ANSWER database will not contain any TimeSlices.
8. Leave the 'Create Initial Region' checkbox checked to create an initial region (named REGION1) in the new database. Users who prefer that the new database is created without an initial region should uncheck this checkbox.
9. The New Database dialogue box now appears as follows:

New Database

Template Version

Version: FLEXTS MARKAL
FLEXTS MARKAL, Rule-based Constraints
Other...

Base Scenario Details

Name: BASE

Description: MultiUtopDemoLumpy

Spacing of Time Periods

☒ Equal spacing ☐ Unequal spacing

Time Periods

Starting Year: 1990

Number of years in a period: 10

Number of Periods: 4

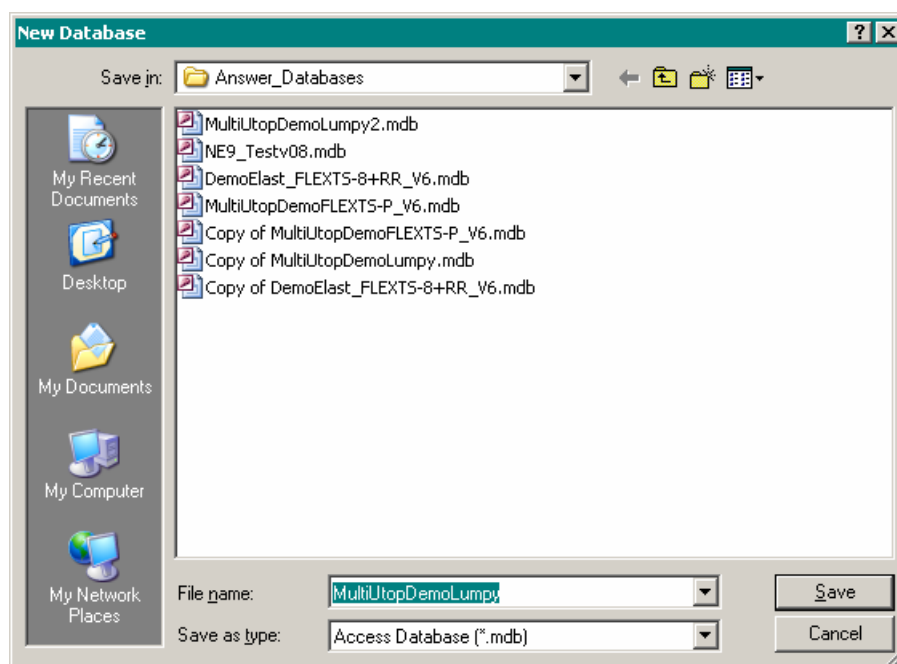
Ending Year: 2020

☒ Create Standard Markal TimeSlices

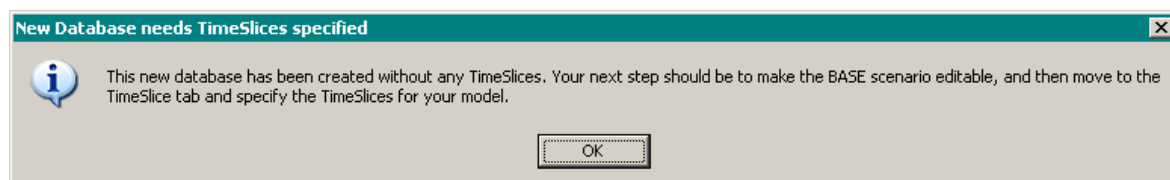
☒ Create Initial Region

OK Cancel

10. Click on **[OK]** and the New Database dialogue box will appear.



11. By default, the **File name** field is set to the Description entered at step 4 above. Either proceed using this filename, or change it to whatever filename you wish.
12. The **Save as type** field must remain as Access Database (*.mdb).
13. Click on **[Save]**. This will both save the Database and create an empty BASE Scenario within it.
14. If the 'Create Standard Markal TimeSlices' checkbox was unchecked above, the following message reminds the user that the new database does not contain any Time Slices:




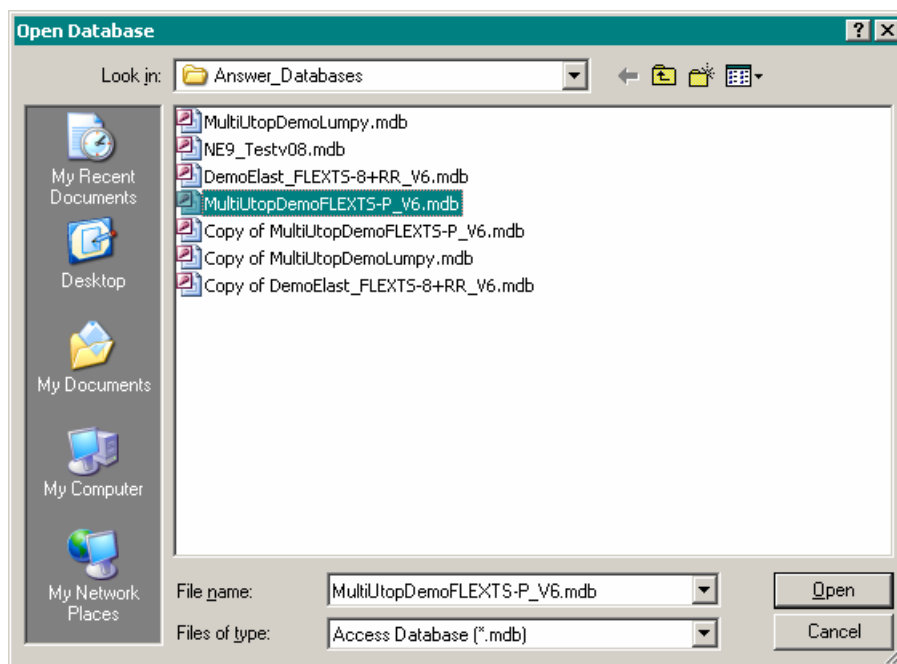
For details regarding flexible timeslicing in version 6 of ANSWER, see section 14 'Handling Flexible Time Slices in ANSWER'.

15. The settings for the Starting Year, Number of years in a period, Number of Periods and the 'Create Standard Markal TimeSlices' and 'Create Initial Region' checkboxes are saved to the registry and will be used as the default settings the next time that the New Database facility is invoked.

2.4.2 Opening an existing Database

To open an existing Database:

1. Click on **File** in the menu bar and then choose **1** or **2** or **3** or **4** near the bottom of the drop-down menu to open the most recently opened, second-most recently opened etc. ANSWER Database. Go to step 3. *Alternatively*, click on the Open Database icon , or click on **File** in the menu bar and then choose **Open Database...** in the drop menu. Go to step 2.
2. The Open Database dialogue box (shown below) will appear.



Double click on the required Database file name, or click on the required Database file name and click on the **[Open]** button.

3. The Database and its Scenarios and Cases will be loaded into ANSWER.
4. The library of Scenarios and Cases in the Database will be displayed respectively in the Scenarios display and the Cases display on the Home Screen. The BASE Scenario will also be displayed in the Selected Scenarios display.

2.4.3 Closing a Database

To close a Database:

1. Click on **File** in the menu bar and choose **Close Database** in the drop menu.
2. The Database will then close and be removed from the Home Screen.

2.5 Region Management

By default, the Database created by use of the New Database facility contains a single initial Region with Name REGION1, and Description 'Initial Region'. Alternatively, the user may choose to create a new Database that does not contain an initial Region.

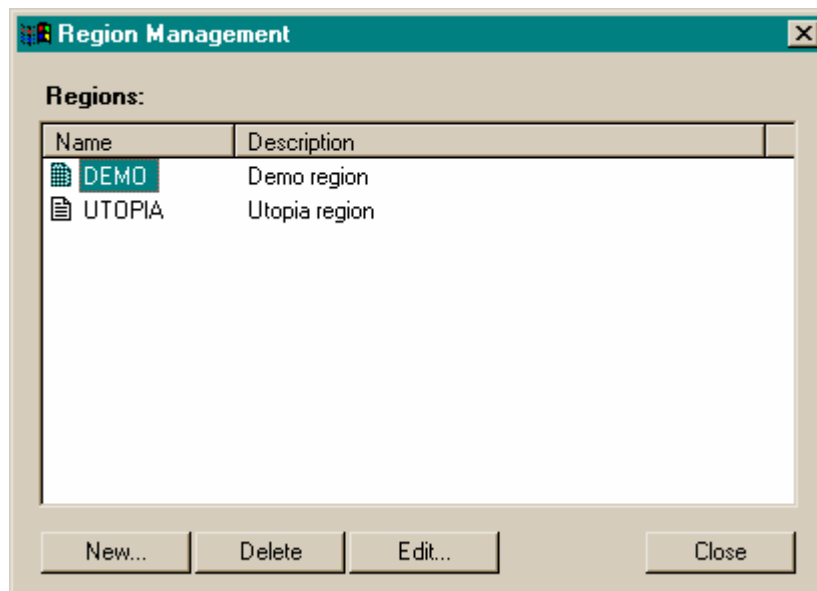
The Region Management facility allows the user to:

1. View the Names and descriptions of existing Regions.
2. Create a new Region.
3. Delete an existing Region.
4. Edit the Name and/or Description of an existing Region.

2.5.1 Invoking the Region Management facility and viewing existing Regions

To invoke the Region Management facility:

1. Click on the **[Region Management]** button in the Tool Bar row on the Home Screen, or click on **Edit** in the menu bar and choose **Region Management...** in the drop menu. The Region Management dialogue box will appear, displaying the Names and Descriptions of existing Regions:

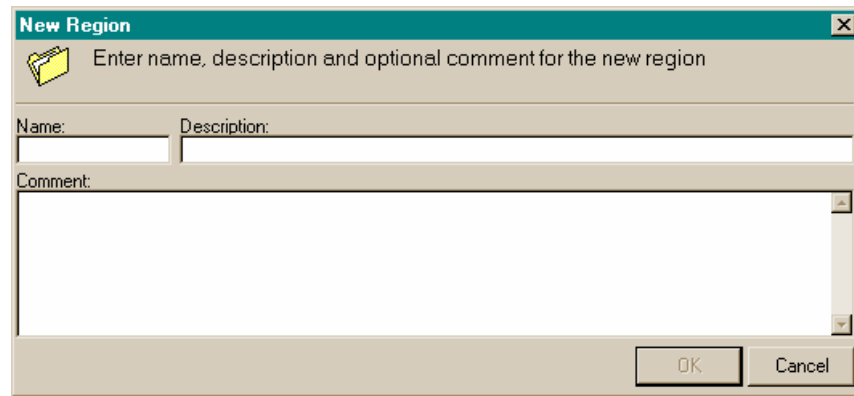


2. The **[New...]**, **[Delete]** and **[Edit...]** buttons below the Regions display allow the user to create new Regions, and to delete and edit existing Regions. These facilities are detailed below.

2.5.2 Creating a new Region

To create a new Region:

1. Invoke the Region Management facility to bring up the Region Management dialogue box.
2. Click on the **[New...]** button below the Regions display.
3. A New Region dialogue box (shown below) will appear.
4. Enter the Name and Description for the new Region. The **[OK]** button will then become enabled. A Comment can also be added.



The 'New Region' dialog box has a title bar with a close button. Below the title bar is a folder icon and the text 'Enter name, description and optional comment for the new region'. There are three input fields: 'Name:', 'Description:', and 'Comment:'. The 'Comment:' field is a larger text area. At the bottom right are 'OK' and 'Cancel' buttons.

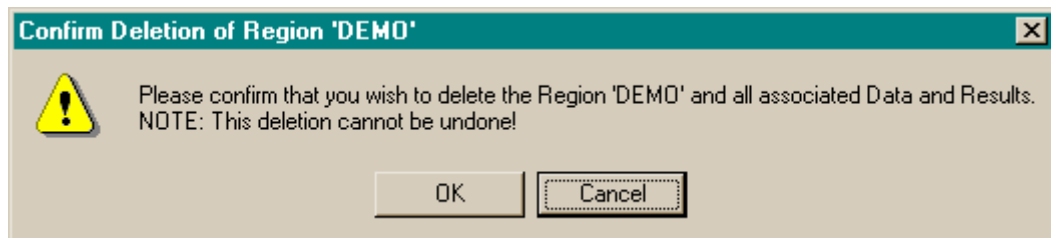
5. Click on **[OK]** and the newly created Region will be saved to the Database. It will also be displayed in the Regions display of the Region Management dialogue box.

2.5.3 Deleting a Region

WARNING: Deleting a Region from a multi-region Database is a serious step. When a Region is deleted, all Data and Results involving this Region are deleted permanently from the Database.

To delete a Region:

1. Invoke the Region Management facility to bring up the Region Management dialogue box.
2. In the Regions display, highlight the Region that is to be deleted.
3. Click on the **[Delete]** button below the Regions display.
4. A Confirm Deletion of Region information box will be displayed:



The 'Confirm Deletion of Region 'DEMO'' dialog box has a title bar with a close button. Below the title bar is a yellow warning triangle icon and the text 'Please confirm that you wish to delete the Region 'DEMO' and all associated Data and Results. NOTE: This deletion cannot be undone!'. At the bottom are 'OK' and 'Cancel' buttons.

5. Click on **[OK]** and the Region will be deleted from the Database, along with its associated Data and Results. The Region will also be deleted from the Regions display of the Region Management dialogue box.

2.5.4 Editing a Region

To edit a Region's Name and/or Description and/or Comment:

1. Invoke the Region Management facility to bring up the Region Management dialogue box.
2. In the Regions display, highlight the Region that is to be edited.
3. Click on the **[Edit...]** button below the Regions display.
4. An Edit Region dialogue box (similar to the New Region dialogue box above) will appear.
5. Change the Name and/or Description and/or Comment for the Region. The **[OK]** button will be enabled.
6. Click on **[OK]** and the edited Region information will be saved to the Database, and displayed in the Regions display of the Region Management dialogue box.
7. Note that where the Region Name is changed, this change of Name must cascade through the entire Database, and the Data/Results Screen must be refreshed. So change of Region Name may take some time.

2.6 The Data Management region

2.6.1 Features of the Data Management region of the Home Screen

The Scenarios display on the left side of the Data Management region shows the current on-line Scenarios. For each Scenario, the Name, Description, Date Created and Date last Modified are shown.

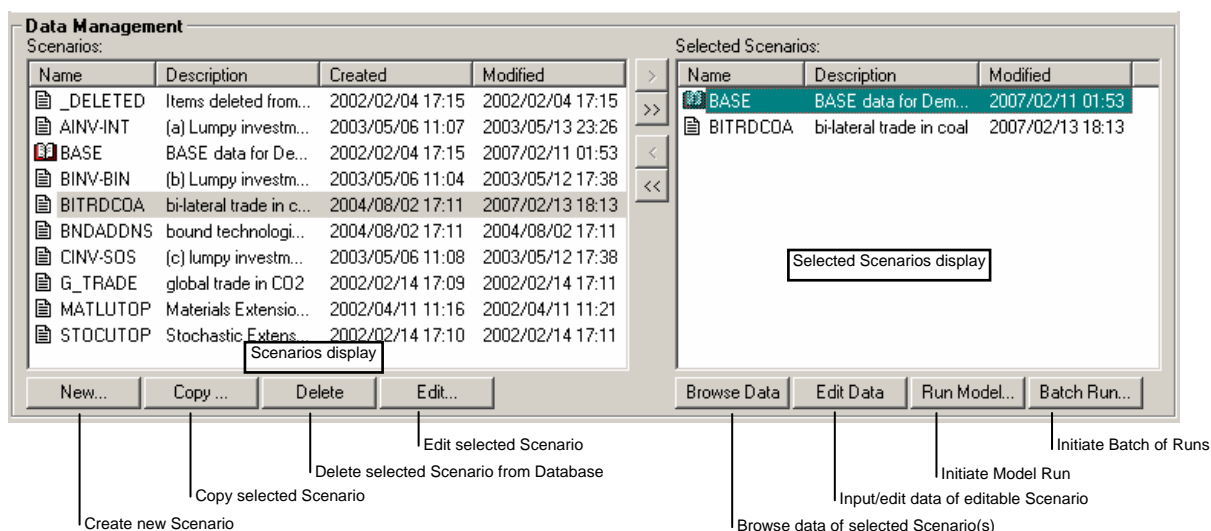
The Scenarios display always contains at least two special scenarios, the **BASE scenario** and the **_DELETED scenario**. Usually it will also contain a number of **non-BASE scenarios**, as shown below where there are non-BASE scenarios AINV-INT, BINV-BIN, BITRDCOA, BNDADDNS, CINV-SOS, G_TRADE, MATLUTOP and STOCUTOP.

The BASE scenario contains a complete depiction of the energy system under 'business as usual' conditions. The role of the _DELETED scenario is to retain information about Items that occur in on-line Results, but that have been deleted from the BASE or non-BASE scenarios.

The **[New...]**, **[Copy...]**, **[Delete]** and **[Edit...]** buttons below the Scenarios display allow the user to create new scenarios, and to copy, delete and edit existing scenarios. These facilities are detailed below in sections 2.6.2 to 2.6.5.

The Selected Scenarios display on the right side of the Data Management region shows the Scenarios that the user has selected for browsing/editing. The Selected Scenarios display always contains the BASE scenario. Often, it will also contain a number of non-BASE scenarios, as shown below where it also contains non-BASE scenario BITRDCOA.

The **[Browse Data]** and **[Edit Data]** buttons below the Selected Scenarios display allow the user to move off the Home Screen to the Data/Results Screen to browse or edit data respectively. These facilities are detailed below in sections 2.6.7 and 2.6.8. The **[Run Model...]** button allows the user to bring up a dialogue box to initiate a model run, and the **[Batch Run...]** button allows the user to bring up a dialogue box to batch up a succession of model runs to be carried out one after the other. These facilities are briefly described in section 2.6.9, and explained in detail in section 6 'Running the Model'.



2.6.2 Creating a new non-BASE Scenario

To create a new non-BASE Scenario:

1. Click on the **[New...]** button below the Scenarios display, or click on **E**dit in the menu bar and choose **New Scenario...** in the drop menu.

2. A New Scenario dialogue box (shown below) will appear.

3. Enter the Name (e.g. CO2LIMIT) and Description for the new Scenario. The **[OK]** button will then become enabled. A Comment can also be added.
4. Click on **[OK]** and the newly created non-BASE Scenario will be displayed in the Scenarios display on the Home Screen. It will also be saved to the Database.

2.6.3 Copying a Scenario

This facility allows the creation of a new Scenario by the direct copying of an existing non-BASE Scenario. Copying the BASE Scenario is not permitted.

To copy a Scenario:

1. In the Scenarios display, highlight the non-BASE Scenario that is to be copied.
2. Click on the **[Copy...]** button below the Scenarios display, or click on **Edit** in the menu bar and choose **Copy Scenario...** in the drop menu.
3. A Copy Scenario dialogue box (similar to the New Scenario dialogue box above) will appear.
4. Enter the new Scenario's Name and Description. The **[OK]** button will then be enabled. A Comment can also be added.
5. Click on **[OK]** and the copied non-BASE Scenario will be displayed in the Scenarios display on the Home Screen. It will also be saved to the Database.

2.6.4 Deleting a Scenario and the role of the _DELETED Scenario

The Delete Scenario facility allows the deletion of a non-BASE Scenario. It is not possible to delete the BASE Scenario, or the _DELETED scenario.

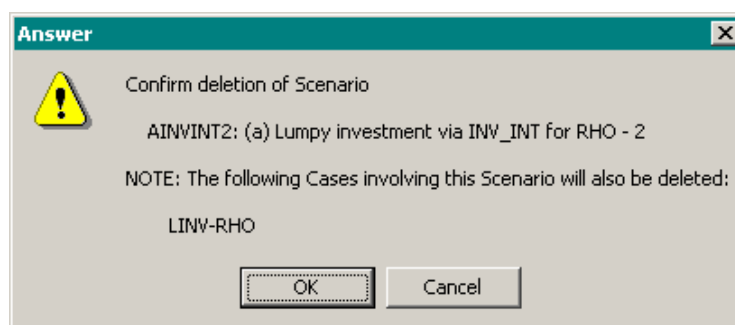
When a Scenario is deleted:

1. All on-line Results (Cases) that involve this Scenario are deleted.
2. Each Item in the about to be deleted Scenario that does not occur in the remaining on-line Results is permanently deleted from the database.
3. Each Item in the about to be deleted Scenario that does occur in the remaining on-line Results is moved to the _DELETED scenario. (As already noted, the _DELETED scenario is a special scenario whose role is to retain information about Items that occur in on-line Results, but that have been deleted from Data.)
4. The Item information that is moved to the _DELETED scenario comprises the Name, Description, Units, Set Memberships and the 'specific' TS and TID Data associated with the Item. So for a Technology, the 'specific' TS and TID Data comprises those TS and TID Data parameters that are displayed on the Subset Parameters 'Technology, Specific' setting.
5. ANSWER automatically ensures that the _DELETED scenario is updated to contain only those Items that occur in on-line Results, but that have been deleted from Data.

To delete a Scenario:

1. In the Scenarios display, highlight the non-BASE Scenario that is to be deleted.

2. Click on the **[Delete]** button below the Scenarios display, or click on **E**dit in the menu bar and choose **Delete Scenario** in the drop menu.
3. A Confirm Deletion of Scenario information box (shown below) will appear.



4. Click on **[OK]** and the non-BASE Scenario will be deleted, along with its associated Cases.

2.6.5 Editing a Scenario

This facility allows the editing of a non-BASE Scenario's Name and/or Description, and any associated Comment. It also allows the changing of the BASE (or _DELETED) Scenario's Description and Comment. It is not possible to change the Name of the BASE Scenario or the _DELETED Scenario.

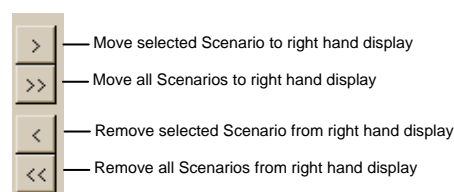
To edit a Scenario's Name and/or Description and/or Comment:

1. In the Scenarios display, highlight the Scenario that is to be edited.
2. Click on the **[Edit...]** button below the Scenarios display, or click on **E**dit in the menu bar and choose **Edit Scenario...** in the drop menu.
3. An Edit Scenario dialogue box (similar to the New Scenario dialogue box above) will appear.
4. Change the Name and/or Description and/or Comment for the Scenario. The **[OK]** button will be enabled.
5. Click on **[OK]** and the edited Scenario will be displayed in the Scenarios display on the Home Screen.

2.6.6 Moving a Scenario(s) between the Scenarios display and the Selected Scenarios display

The Data Management region is split into two displays, being the Scenarios display and the Selected Scenarios display. The Scenarios display shows all the on-line Scenarios in the current Database. The Selected Scenarios display shows the Scenarios that are currently being edited or browsed.

To move individual or all Scenarios from the left hand display to/from the right hand display, use the selection buttons as shown.



2.6.7 Browsing a Scenario's data

This facility takes the user into the Data/Results Screen to allow browsing of the selected Scenario(s) data. It is not possible to edit the selected Scenario(s) data using this facility.

To browse a Scenario's data:

1. Use the Scenario selection buttons so that the Selected Scenarios display contains the Scenario(s) to be browsed.

2. Click on the **[Browse Data]** button below the Selected Scenarios display, or click on **View** in the menu bar and choose **Browse data** in the drop menu.
3. The Data/Results Screen will appear with the data displayed for all selected Scenarios.

2.6.7.1 Browsing the _DELETED Scenario


To see which Items are in the _DELETED Scenario, use the Browse Data facility with the _DELETED Scenario as the only Selected Scenario apart from the BASE Scenario, as follows:

1. On the Home Screen, move the _DELETED scenario to the Selected Scenarios listview. The BASE scenario should be the only other scenario in the Selected Scenarios listview.
2. Click on the **[Browse Data]** button to move to the Data Screen, and move to the component tab (e.g. Technology) that is of interest.
3. Change the setting of the 'Items: All' combobox in the toolbar row (next to the 'Regions...' button) to 'Items: Modified'.
4. Items that occur in the Items listview with Status of 'SM' or 'S' are Items that are in the _DELETED scenario.

2.6.8 Editing a Scenario's data

This facility takes the user into the Data/Results Screen to allow editing of the data associated with the editable Scenario (Edit Scenario). The editable Scenario is one of the Selected Scenarios that has been specially designated as editable (see step 2 below).

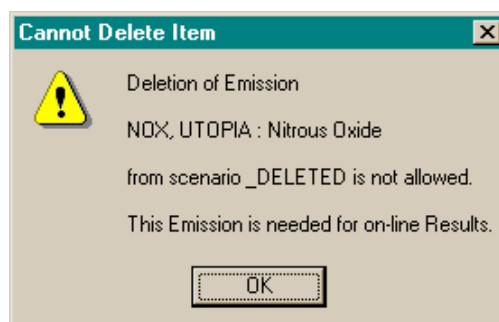
To designate a Scenario as the editable Scenario and to edit that Scenario's data:

1. Use the Scenario selection buttons so that the Selected Scenarios display contains the Scenario to be edited. (The Selected Scenarios display may also contain other Scenarios whose data will be browsable but not editable.)
2. Double click on the Scenario in the Selected Scenarios display that is to be edited; a pen icon  will appear beside the highlighted Scenario. The edit facility cannot be invoked unless a Scenario is double clicked. Only one Scenario can be selected for editing at a time.
3. Click on the **[Edit Data]** button below the Selected Scenarios display, or click on **View** in the menu bar and choose **Edit Data** in the drop menu.
4. The Data/Results Screen will appear with the editable Scenario's data displayed for editing (and data for other Selected Scenarios displayed for browsing).

2.6.8.1 Editing the _DELETED Scenario

Although unusual, it is permissible to make the _DELETED Scenario the editable Scenario, by carrying out steps 1,2 and 3 above and at step 2 double clicking on the _DELETED Scenario in the Selected Scenarios display. Once on the Data/Results Screen the standard Item Management facilities are available, although it is difficult to imagine why the user would wish to use such facilities as New Item or Copy Item in respect of the _DELETED Scenario.

1. **Edit Item allows the user to change the Name and/or Description of an Item in the _DELETED Scenario, and in on-line Results.**
2. Delete Item for an Item in the _DELETED Scenario will produce the following information message:



2.6.9 Carrying out a MARKAL Model Run, or a Batch of Model Runs

As already noted in section 2.6.1, the **[Run Model...]** button on the Home Screen allows the user to bring up a dialogue box to initiate a model run, and the **[Batch Run...]** button allows the user to bring up a dialogue box to batch up a succession of model runs to be carried out one after the other.

To bring up a dialogue box to initiate a model run:

1. Click on the **[Run Model...]** button below the Selected Scenarios display, or click on **Run** in the menu bar and choose **Run Model...** in the drop menu.
2. A Run Model dialogue box will appear. Complete the information required in the dialogue box (see Section 6.1 'Running the Model' for details), and click on the **[OK]** button to initiate the MARKAL model run in GAMS.
3. The name and description of the model run (or Case) will be displayed in the Cases listview in the Results Management region of the Home Screen, and the results from the model run imported into the Database for viewing (see Section 2.7 'The Results Management region').

To bring up a dialogue box to batch up a succession of model runs to be carried out one after the other:

1. Click on the **[Batch Run...]** button below the Selected Scenarios display, or click on **Run** in the menu bar and choose **Batch Run...** in the drop menu.
2. A Batch Run dialogue box will appear. Complete the information required in the dialogue box (see Section 6.3 'Batch Run facility for Multiple Model Runs' for details), and click on the **[Run Batch]** button to initiate a succession of model runs to be carried out one after the other.
3. The names and descriptions of the model runs (or Cases) will be displayed in the Cases listview in the Results Management region of the Home Screen, and the results from the model runs imported into the Database for viewing (see Section 2.7 'The Results Management region').

2.6.10 The 'Regions with data in this scenario' facility

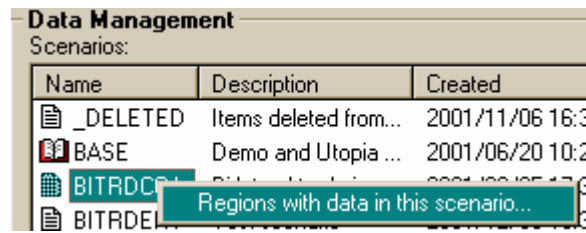
This facility allows the user to select a Scenario and via a right-mouse click, bring up a pop-up menu item 'Regions with data in this scenario' to determine which Regions have data in the selected Scenario. This facility is particularly useful when working with a multi-region database and when the selected Scenario is a non-BASE Scenario. (The BASE scenario will normally contain data for every Region, whereas non-BASE Scenarios may only contain data for a subset of the Regions in the database, and it can be useful to know what this subset is.)

The Scenario that is selected may be any Scenario in:

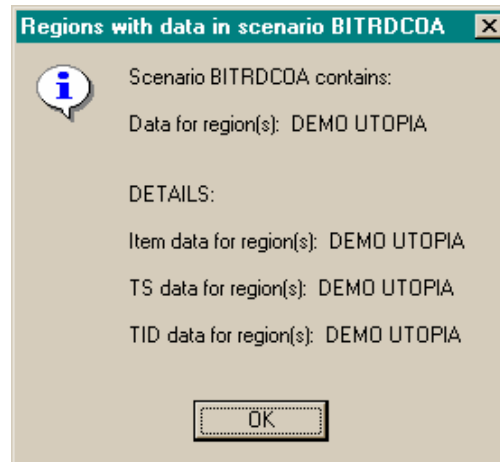
- the Scenarios display
- the Selected Scenarios display
- the 'Scenarios comprising this run' frame on the Run Model form
- the 'Scenario Selection' form that appears after clicking the **[Add...]** button on the Run Model form
- the 'Scenarios comprising this case' frame on the Edit Case form (To bring up the Edit Case form, select a Case in the Cases display and click on the **[Edit...]** button.)

To invoke the 'Regions with data in this scenario' facility:

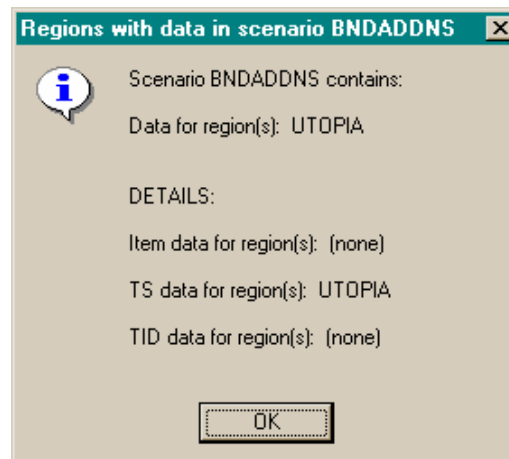
1. Select the Scenario to which this facility is to be applied by clicking on its icon.
2. Right-mouse click to bring up the pop-up menu item **Regions with data in this scenario...** as indicated below.



3. Select this menu item by highlighting it and left-clicking the mouse. The following form displays information about the Regions that have data in the selected Scenario.



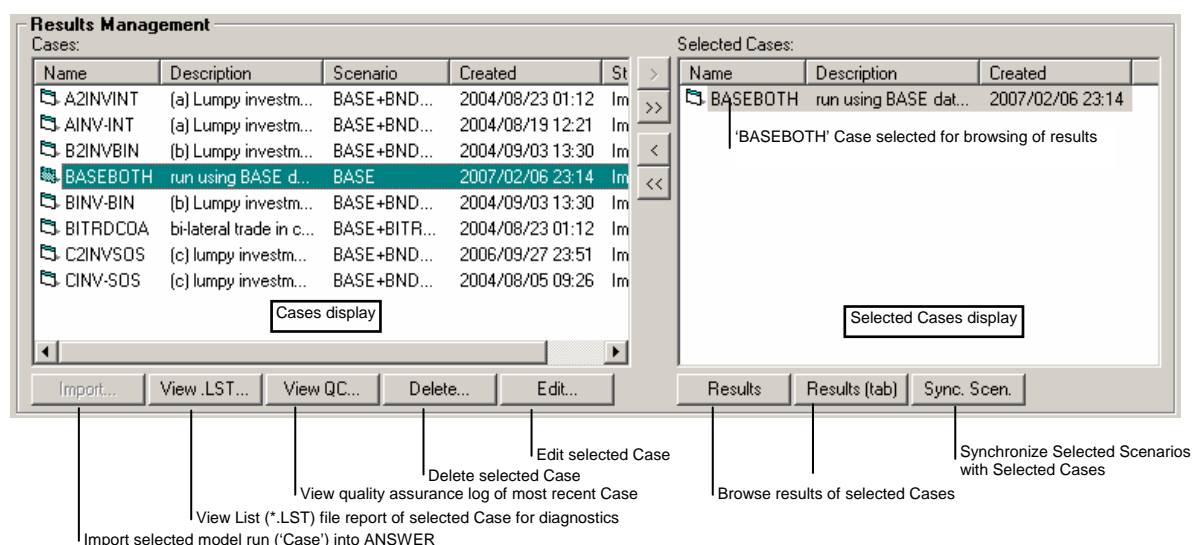
4. In the above example, Scenario BITRDCOA contains data for regions DEMO and UTOPIA. Looking at the details, this Scenario contains Item data and TS data and TID data for each of these two regions.
5. In comparison, if we apply this facility to Scenario BNDADDNS, we get the following:



This indicates that Scenario BNDADDNS contains data for region UTOPIA only. Looking at the details, this Scenario contains TS data only. Nor does it contain any TID data for UTOPIA.

2.7 The Results Management region

2.7.1 Features of the Results Management region of the Home Screen

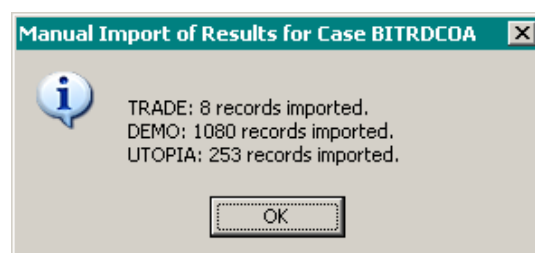


2.7.2 Importing a Case

On the Run Model dialogue box there is an 'Import Results Automatically' checkbox whose default setting is checked. So by default, ANSWER automatically imports the results for a MARKAL model run (Case) and the Status of the run as displayed in the Cases listview will be 'Imported'. If this checkbox is unchecked, then after undertaking a MARKAL model run, the run (Case) will be displayed in the Cases listview with a status of 'Not Imported'.

To import a Case into the Database (where its Status is 'Not Imported'):

1. In the Cases display, highlight the Case that is to be imported.
2. Click on the **[Import...]** button, or click on **File** in the menu bar and choose **Import** then choose **Case** in the drop menu.
3. The Case will be imported into your Database, and the following message summarising the import process will appear:



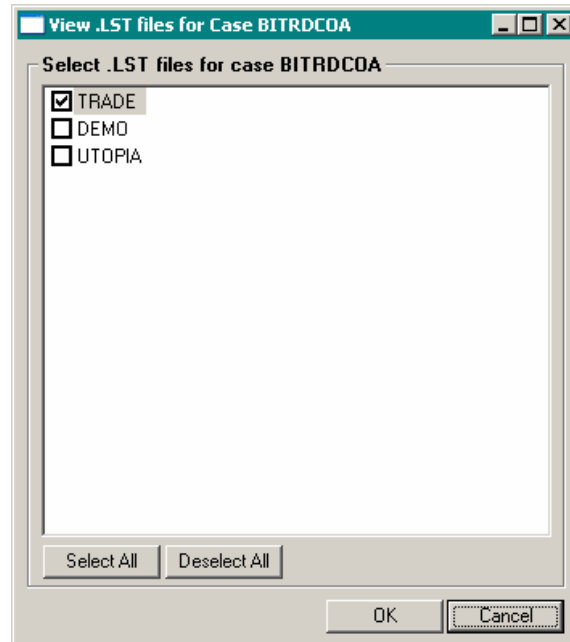
5. Results for the Case may now be browsed on-line (see Section 2.7.8 'Browsing a Case's Results').

2.7.3 Viewing the GAMS Listing files (.LST files) associated with a Case

For a multi-region run, a separate GAMS listing file (.LST file) is created for each Region that comprised the run, as well as the GAMS listing file related to the multi-region run. For convenience, the latter is designated as the TRADE .LST file.

To view the .LST files associated with a Case:

1. In the Cases display, highlight the Case that is to be viewed.
2. Click on the **[View .LST...]** button, or click on **View** in the menu bar and choose **GAMS Listing File...** in the drop menu. The following 'View .LST files' form will appear to allow you to choose which .LST files you wish to view:

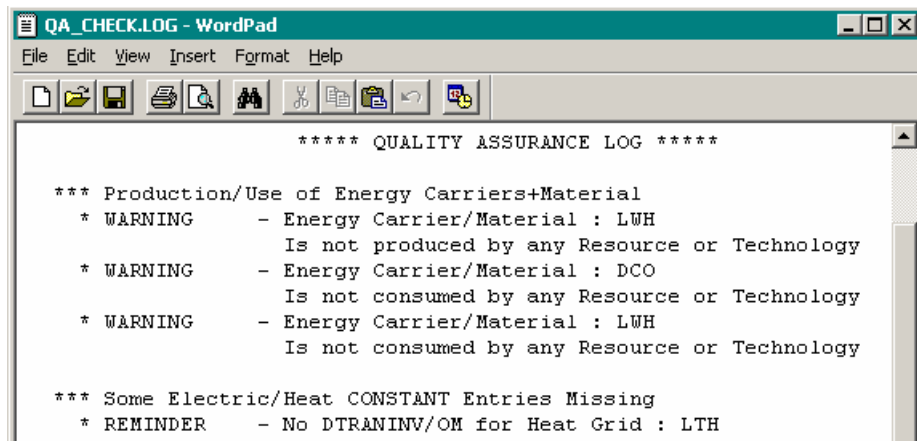


3. Select one or more Regions, and click on the **[OK]** button. The .LST file for each Region that is selected will appear as a WordPad file, along with the TRADE .LST file if TRADE is selected.
4. Each .LST file can then be edited and printed using standard WordPad facilities.

2.7.4 Viewing the quality assurance log (QA_CHECK.LOG) associated with the most recent Case

Each MARKAL run, whether single-region or multi-region, creates a quality assurance log (a file named QA_CHECK.LOG in the GAMS Work folder). This file may indicate problems with your MARKAL model and particularly when developing a model you should check it regularly. The QA_CHECK.LOG file for the most recent run overwrites the QA_CHECK.LOG file for the preceding run. To view the quality assurance log associated with the most recent run (Case):

1. Click on the **[View QC...]** button, or click on **View** in the menu bar and choose **Quality Assurance Checking (QA_CHECK.LOG)** in the drop menu.
2. The QA_CHECK.LOG file will appear as a WordPad file and can be browsed and if necessary printed using standard WordPad facilities.



2.7.5 Deleting a Case and the role of the _DELETED Scenario

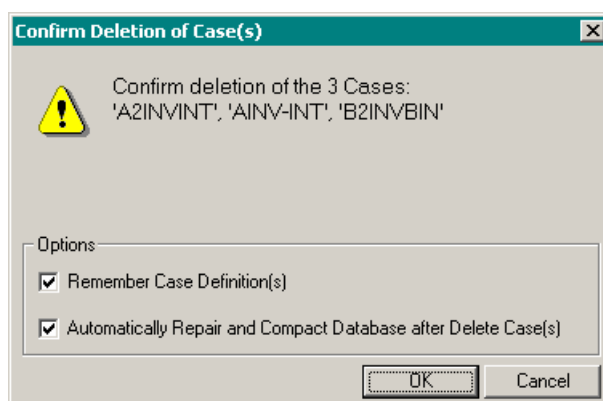
The Delete Case facility allows the deletion of a Case. All Cases, including the BASE Case, can be deleted using this facility.

In ANSWER version 6.2.8 (and higher) the Cases listview allows multi-select for Delete of Cases, so that in a single operation the user can delete several Cases, normally followed by Repair and Compact Database after the Cases have been deleted. See below for details.


When a Case is deleted, ANSWER automatically ensures that the _DELETED scenario is updated to contain only those Items that occur in on-line Results, but that have been deleted from Data. This updating involves the deletion from the _DELETED scenario of Items that occur in the about to be deleted Case, but that do not occur in any other Cases.

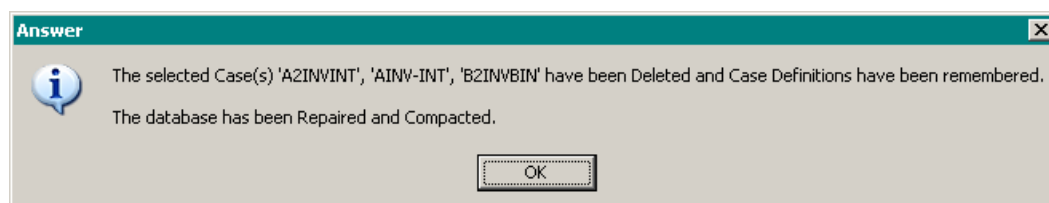
To delete one or more Cases:

1. In the Cases listview, select the Case or Cases that is/are to be deleted.
2. Click on the **[Delete...]** button below the Cases listview, or click on **E**dit in the menu bar and choose **Delete Case...** in the drop menu.
3. A Confirm Deletion of Case(s) dialogue box will appear, show below for the situation where several Cases were multi-selected for deletion:



The checkbox options where more than one Case has been selected for deletion are always set as above, but can of course be altered by the user.

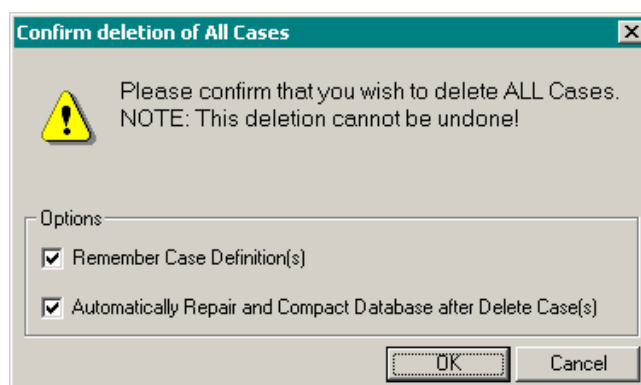
4. Where the 'Remember Case Definition(s)' checkbox is checked, the Case(s) will be retained on-line and so the Scenarios that comprise the Case(s) and other details of the Case(s) will be remembered, but the TS and TID results for the Case(s) will be deleted. After the delete a special  icon in the Cases listview will serve as a visual indicator to the user that just the Case definition has been remembered, and that this Case no longer has actual results online.
5. To delete the selected Case(s), while remembering the Case definitions, and Repair and Compact the database, click on the **[OK]** button. The following message box will appear:



2.7.5.1 The 'Edit, Delete All Cases' facility

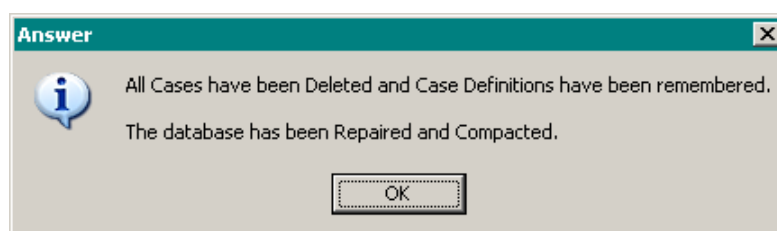
The 'Edit, Delete All Cases' facility provides a very efficient way of deleting all on-line Cases from an ANSWER database. To delete all on-line Cases:

1. Either multi-select all Cases in the Cases listview and click on the **[Delete...]** button below the Cases listview, or click on Edit in the menu bar and choose **Delete All Cases...** in the drop menu.
2. A Confirm Deletion of All Cases dialogue box will appear:



The checkbox options for 'Edit, Delete All Cases' are always set as above, but can of course be altered by the user.

3. To delete all Cases while remembering the Case definitions, and then to repair and compact the database, simply click on the **[OK]** button. The following message box will appear to confirm that all Cases have been deleted, while remembering the Case Definitions, and that the database has been Repaired and Compacted:



4. The 'Delete All Cases' part of this facility runs very quickly, even for a large ANSWER database that has many Cases loaded.
5. The 'Repair and Compact' part of this facility also runs very quickly in this situation where results have been deleted for all Cases. (By comparison, 'Repair and Compact' where results have been deleted for only some Cases may be quite slow.)
6. After use of the 'Edit, Delete All Cases' facility, the Cases listview (bottom LHS of ANSWER's Home Screen) appears as follows:

Name	Description	Scenario	Created	Status
A2INVINT	(a) Lumpy investme...	BASE+BND...	2004/08/18 23:39	Remem...
AINV-INT	(a) Lumpy investme...	BASE+BND...	2004/08/05 10:24	Remem...
B2INVBIN	(b) Lumpy investme...	BASE+BND...	2004/08/18 23:39	Remem...
BASEBOTH	run using BASE dat...	BASE	2004/10/06 07:24	Remem...
BASEDEMO	run using BASE dat...	BASE	2004/08/18 14:18	Remem...
BASEUTOP	run using BASE dat...	BASE	2004/10/11 16:09	Remem...
BINV-BIN	(b) Lumpy investme...	BASE+BND...	2004/08/05 10:24	Remem...
BITRDCOA	bi-lateral trade in coal	BASE+BITR...	2004/08/12 11:52	Remem...
C2INVSOS	(c) lumpy investment...	BASE+BND...	2004/08/18 23:39	Remem...

7. Each Case now has an icon associated with it, serving as a visual indicator that just the Case definition has been reMembered. This is reinforced by the Status column displaying "Remembered Case Defn".

2.7.6 Editing a Case

This facility allows the viewing of details associated with a Case, and the editing of a Case's Name and/or Description, and any associated Comment. A BASE Case's Name and/or Description can be changed using this facility

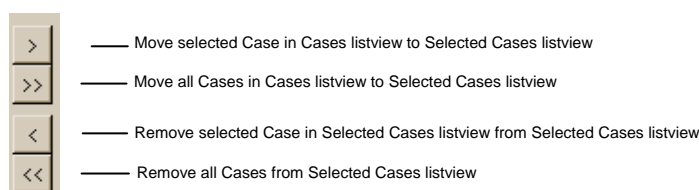
1. In the Cases listview, select the Case that is to be edited.
2. Click on the **[Edit...]** button below the Cases display, or choose **Edit** in the menu bar and choose **Edit Case...** in the drop menu.
3. An Edit Case dialogue box will appear:

4. To see the Regions that comprised the model run for this Case, click on the **[Regions...]** button near the bottom right of the form.
5. Optionally, change the Name and/or Description and/or Comments for the Case. The **[OK]** button will be enabled.
6. Click on the **[OK]** button and the edited Case will be displayed in the Cases listview on the Home Screen.

2.7.7 Moving a Case(s) between the Cases listview and the Selected Cases listview

The Results Management region is split into two displays, being the Cases listview and the Selected Cases listview. The Cases listview shows all the on-line Cases in the current Database. The Selected Cases listview shows the Cases that the user has selected for browsing of results.

To move individual or all Cases from the Cases listview to/from the Selected Cases listview, and back again, use the selection buttons as shown below.



2.7.8 Browsing a Case's results

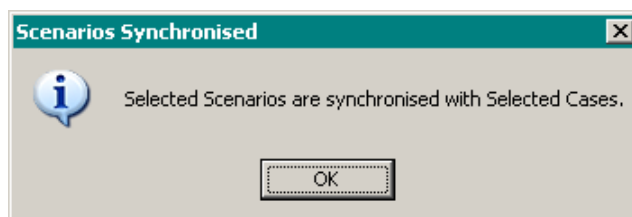
This facility takes the user into the Data/Results Screen to allow browsing of the results for the selected Case(s). As these results are determined by the Database model runs, ANSWER does not permit editing of Case(s) results.

To browse the results for the selected Case(s):

1. Use the Case selection buttons so that the Selected Cases listview contains the Case(s) whose results are to be browsed.
- 2a. Click on the **[Results]** button below the Selected Cases display, or click on **View** in the menu bar and choose **Results** in the drop menu. The Data/Results Screen will appear, always on the Parameter tab, with the results displayed for all selected Cases; alternatively
- 2b. Click on the **[Results (tab)]** button below the Selected Cases display, or click on **View** in the menu bar and choose **Results (tab)** in the drop menu. The Data/Results Screen will appear on the tab that was last visited for Data or Results (with the results displayed for all selected Cases). For example if you are looking at Results on the Technology tab and then return to the Home Screen, clicking on the **[Results (tab)]** button will take you back to Results on the Technology tab. (Whereas clicking on the **[Results]** button will take you back to Results on the Parameter tab.)

2.7.9 Synchronizing Selected Scenarios with Selected Cases

The **[Sync. Scen.]** button allows the user to synchronize the Selected Scenarios with the Selected Cases. If the user clicks on this button, the Scenarios in the Selected Scenarios are changed to comprise all (and only) the Scenarios involved in any of the Cases in the Selected Cases listview, and the following message box appears:



Suppose for example that the Selected Cases are AINV-INT (involving the BASE, BNDADDNS and AINV-INT Scenarios) and BITRDCOA (involving the BASE and BITRDCOA Scenarios). Then after clicking on the **[Sync. Scen.]** button, the Selected Scenarios listview will contain the AINV-INT, BASE, BNDADDNS and BITRDCOA Scenarios.

Synchronizing the Selected Scenarios with the Selected Cases is useful if while browsing Results, the user wants to switch to view the Data that gave rise to those Results.

2.8 Exporting and Importing a Database's Units Settings

ANSWER incorporates two facilities which together enable copying of a Database's Units Settings from one Database to another. The origin Database and the target Database may or may not be on the same computer. Units Settings comprises information about Units and Units Defaults in the Database, but not information about the Units associated with individual Items.

To copy a Database's Units Settings from one Database to another requires two stages:

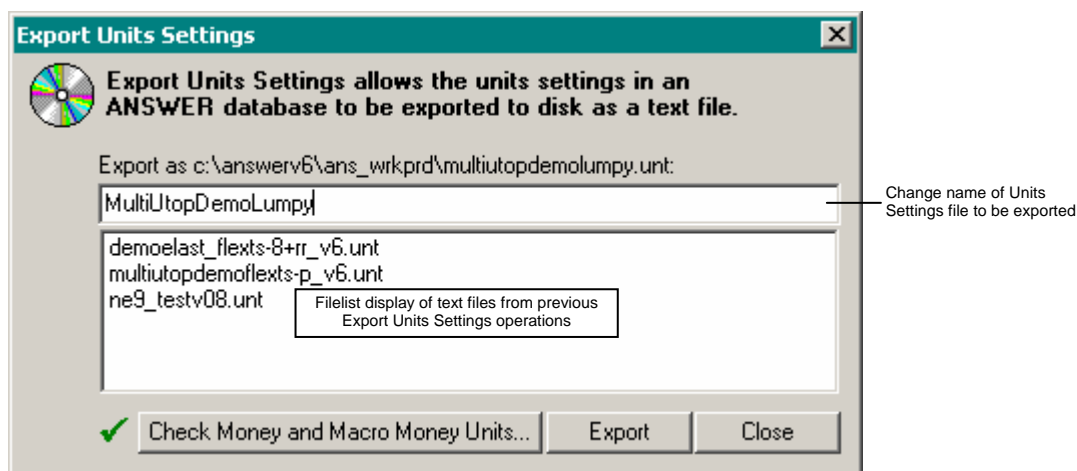
- i. Exporting the Units Settings from the origin Database into the ANSWER Work folder, C:\AnswerV6\Ans_WrkPRD, as a text file; and
- ii. Importing the Units Settings from the text file in C:\AnswerV6\Ans_WrkPRD into the target Database.





In ANSWER version 5.3.0 (and higher), the Export Units Settings facility has been enhanced to allow you to ensure that the Units Settings text file will contain just a single Money unit and a single Macro Money unit. And likewise the Import Units Settings facility has been enhanced to ensure so far as possible that after the import of a Units Settings text file, the target database will contain just a single Money unit and a single Macro Money unit. For additional details regarding the desirability of an ANSWER Database containing just a single Money unit and a single Macro Money unit, see section 4.2.5 'Money Units and Macro Money Units'.


2.8.1 Exporting a Database's Units Settings

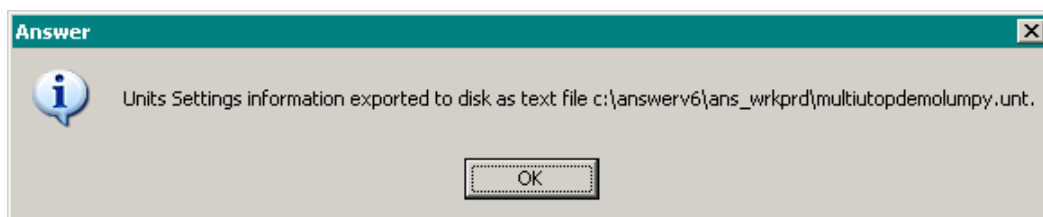
To export a Database's Units Settings:


1. Open the origin Database.
2. Click on **File** in the menu bar and choose **Export** then choose **Units Settings...** in the drop menu.
3. An Export Units Settings dialogue box (shown below) will appear.

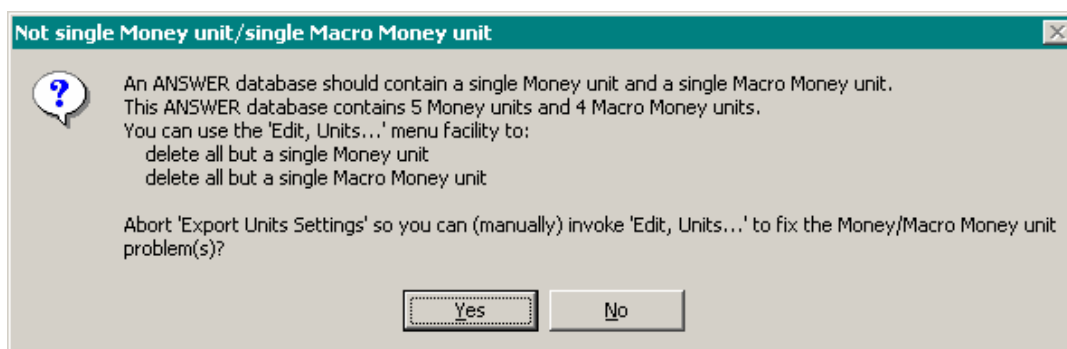


4. The name given to the Units Settings file defaults to the Database name, and always has a file type of '.unt'. To vary the name given to the Units Settings file, either change the name in the 'Export as c:\answerv6\ans_wrkprd\<name>.unt:' text box, or choose an existing name from the file list display.
5. In ANSWER version 5.3.0 (and higher) the Export Units Settings dialogue box incorporates a **Check Money and Macro Money Units...** button at the bottom LHS, along with a  or  indicator to the left of this button as a visual cue that either the current database does contain a single Money unit and a single Macro Money unit (in which case the  indicator will be displayed) or that it contains multiple Money units and/or multiple Macro Money units (in which case the  indicator will be displayed).

- 6a. Where the  indicator is displayed, the origin Database contains a single Money unit and a single Macro Money unit (as it should). Click on the **[Export]** button and a message box will appear to advise that the Units Settings information for the origin Database has been exported to C:\AnswerV6\Ans_WrkPRD as text file <name>.unt:

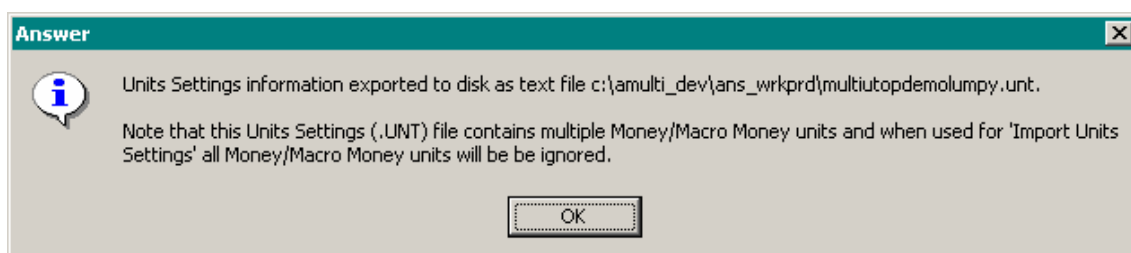


- 6b. Where the  indicator is displayed, the origin Database contains multiple Money units and/or multiple Macro Money units. If you click on the **[Export]** button, a message box will appear to suggest that you abort Export Units Settings and manually invoke 'Edit, Units...' (see section 4.2.5) to fix the Money/Macro Money unit problems:



If you click on the **[Yes]** button, you will exit the 'File, Export Units Settings' facility, and should then invoke 'Edit, Units...' to delete all but a single Money and single Macro Money unit.

However if you click on the **[No]** button, a message box will appear to advise that the Units Settings information for the origin Database has been exported to C:\AnswerV6\Ans_WrkPRD as text file <name>.unt, and that the resultant Units Settings text file contains multiple Money/Macro Money units (and when used for 'Import Units Settings' all Money/Macro Money units will be ignored):

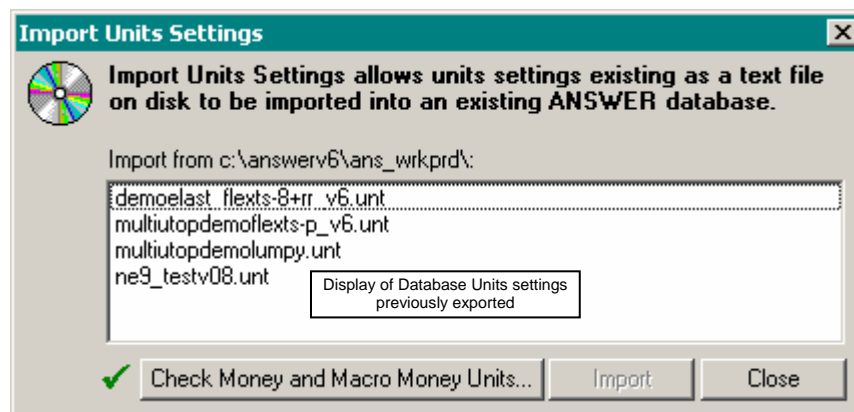







2.8.2 Importing a Database's Units Settings

If the Units Settings information in text file <name>.unt is to be copied to a Database on a separate computer, the user will need to copy/move the file via USB stick or network to the C:\AnswerV6\Ans_WrkPRD folder in the target computer.

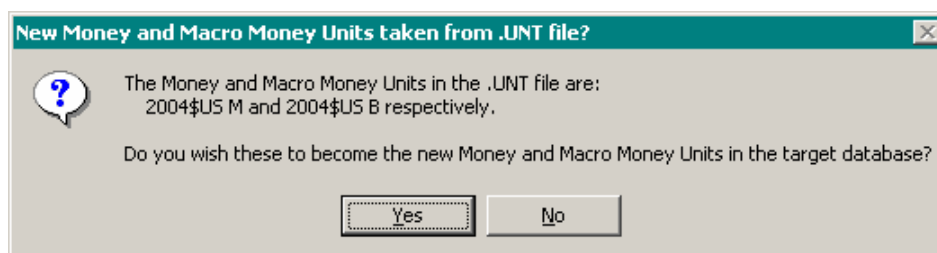
To import a Database's Units Settings:

1. Open the target Database.
2. Click on **File** in the menu bar and choose **Import** then choose **Units Settings...** in the drop menu.
3. An Import Units Settings dialogue box (shown below) will appear, in which all the Units text files (*.unt) produced by previous Export Units operations and held in the C:\AnswerV6\Ans_WrkPRD folder will be displayed.



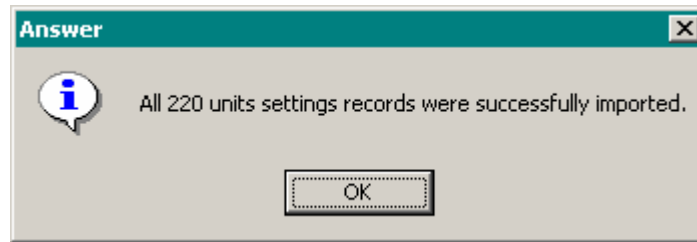
4. Click on the required Units Settings file <name>.unt in the filelist display. The **[Import]** button will then become enabled.
5. In ANSWER version 5.3.0 (and higher) the Import Units Settings dialogue box incorporates a **Check Money and Macro Money Units...** button at the bottom LHS, along with a  or  indicator to the left of this button as a visual cue that either the current – target – database does contain a single Money unit and a single Macro Money unit (in which case the  indicator will be displayed) or that it contains multiple Money units and/or multiple Macro Money units (in which case the  indicator will be displayed).
- 6a. Where the  indicator is displayed, the target Database contains a single Money unit and a single Macro Money unit (as it should). Click on the **[Import]** button.


If the Units Setting file that is being imported also contains a single Money unit and a single Macro Money unit, and if either of these units differs from the respective unit in the target Database, the following message box will appear asking you whether you wish the Money and Macro Money units in the Units Setting file to become the new Money and Macro Money units in the target Database:

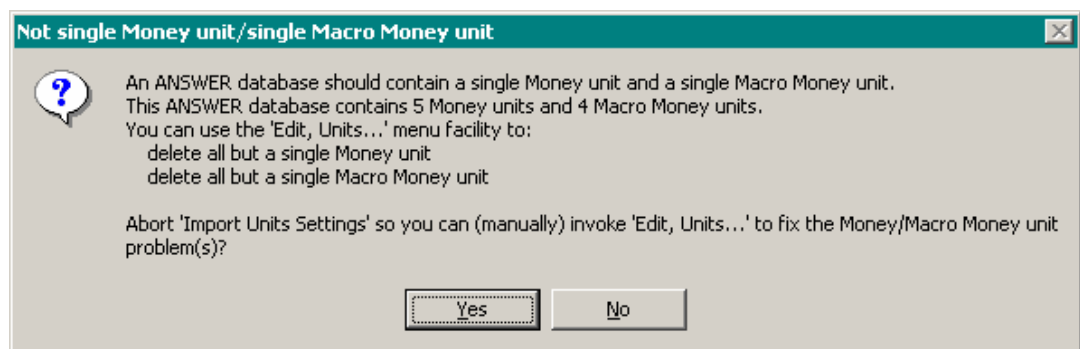


Note that the above message box always appears if it is possible for Money and Macro Money units in the .unt file to become the new Money and Macro Money units in the target Database. If it does not appear, this is an indication that the Import Units Settings process has not altered the Money and Macro Money units in the target Database, either because the Units Setting file that is being imported contains multiple Money/Macro Money units, or because it contains the same Money and Macro Money units as those in the target Database.

After you click on either **[Yes]** or **[No]**, the following message will appear to advise that the Units Settings records have been successfully imported:

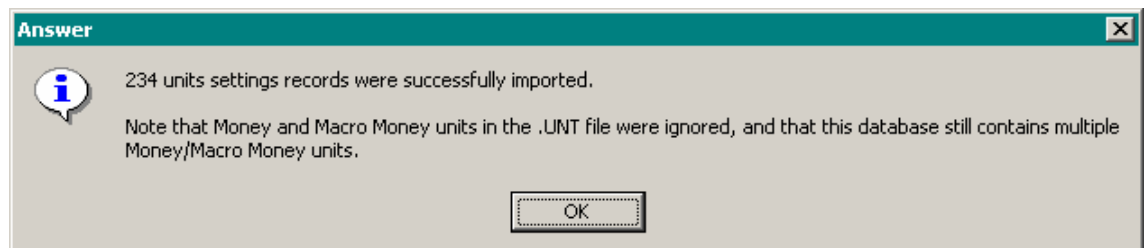


- 6b. Where the  indicator is displayed, the target Database contains multiple Money units and/or multiple Macro Money units. If you click on the **[Import]** button, a message box will appear to suggest that you abort Import Units Settings and manually invoke 'Edit, Units...' (see section 4.2.5) to fix the Money/Macro Money unit problems:



If you click on the **[Yes]** button, you will exit the 'File, Import Units Settings' facility, and should then invoke 'Edit, Units...' to delete all but a single Money and single Macro Money unit.

However if you click on the **[No]** button, a message box will appear to advise that the Units Settings records have been imported into the target Database, with Money and Macro Money units in the .UNT file ignored, and to remind you that the target Database still contains multiple Money/Macro Money units:



2.9 Exporting and Importing a Scenario

ANSWER incorporates two facilities which together enable copying of a Scenario from one Database to another. The origin Database and the target Database may or may not be on the same computer. A Scenario comprises all information associated with a Scenario in the Database: Items, Set Memberships, Units, Time Series and Time Independent data, and Comments.

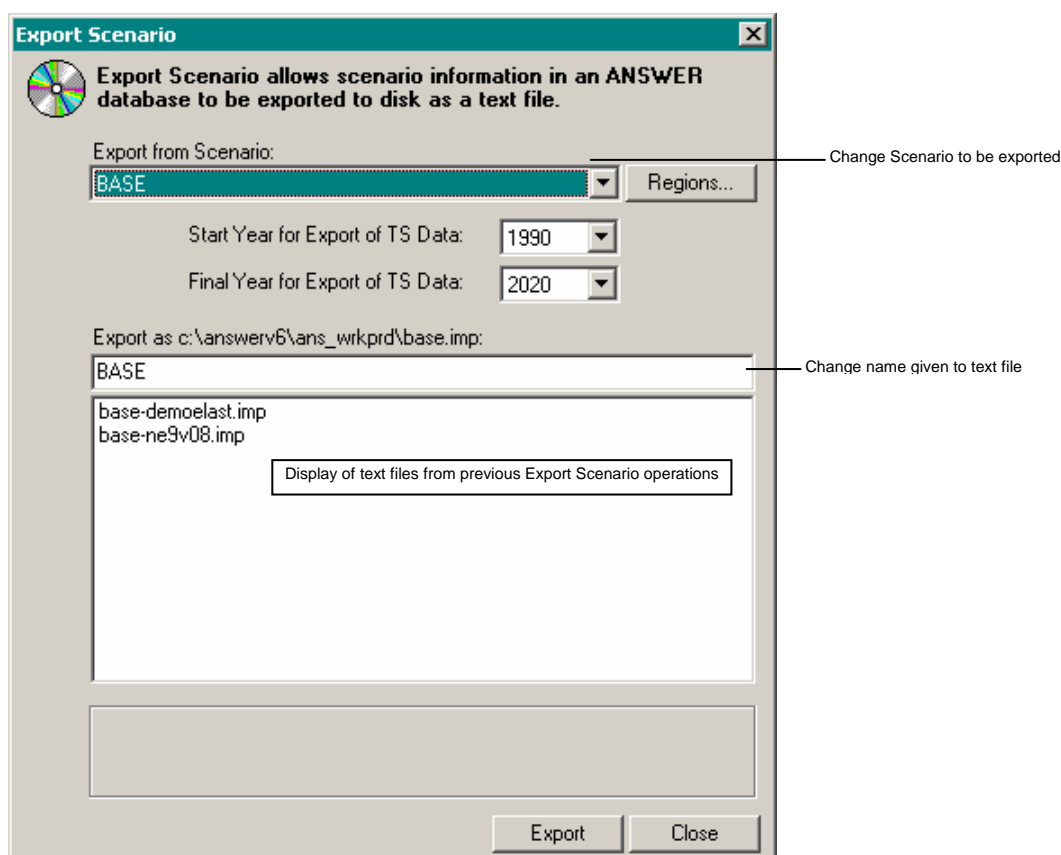
To copy a Scenario from one Database to another requires two stages:

- i. Exporting the Scenario from the origin Database into the ANSWER Work folder, C:\AnswerV6\Ans_WrkPRD, as a text file; and
- ii. Importing the Scenario from the text file in C:\AnswerV6\Ans_WrkPRD into the target Database.

2.9.1 Exporting a Scenario

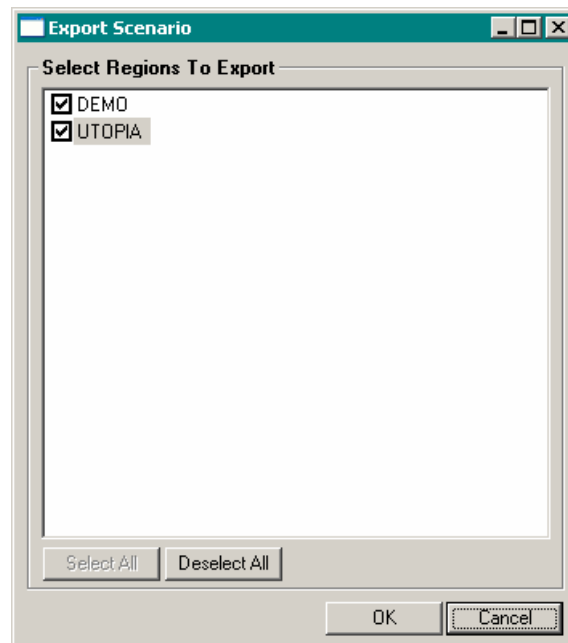
To export a Scenario:

1. Open the origin Database.
2. Click on the Scenario to be exported.
3. Click on **File** in the menu bar and choose **Export** then choose **Scenario...** in the drop menu.
4. An Export Scenario dialogue box (shown below) will appear, in which the Scenario to be exported will default to the Scenario chosen at Step 2.

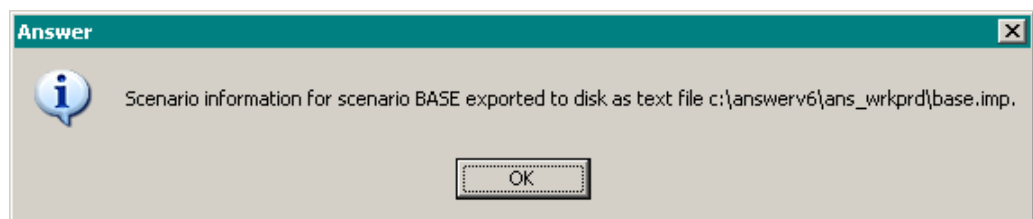


5. To vary the Scenario to be exported, choose a different Scenario from the 'Export from Scenario:' combobox. The name given to the Export Scenario text file defaults to the Scenario name, with a file type of '.imp'. To vary the name given to the text file, either change the name in the 'Export as c:\answerv6\ans_wrkprd\<name>.imp:' textbox, or choose an existing name from the display.
6. By default, the data for all Regions that comprise the scenario will be exported to the .imp file.

To export data for a subset of Regions, click on the **[Regions...]** button. This brings up the Export Scenario Select Regions to Export dialogue box on the following page. Select the subset of Regions whose data you wish to export, and click on the **[OK]** button. This returns you to the Export Scenario dialogue box.



7. By default, the data for all periods in the database will be exported to the .imp file. That is, the default setting for the 'Start Year for Export of TS Data' combobox will be the year corresponding to the first period in the database, and the default setting for the 'Final Year for Export of TS Data' combobox will be the year corresponding to the final period in the database. To export data for fewer periods, change the default settings of either or both of these comboboxes to correspond to the Start and Final Years for which you want TS data to be exported.
8. Click on the **[Export]** button of the Export Scenario dialogue box to invoke the Export Scenario facility. A message box (shown below) will appear to advise that the Scenario has been exported to C:\AnswerV6\Ans_WrkPRD as text file <name>.imp.



Also the frame immediately above the **[Export]** and **[Close]** buttons displays a message reminding the user of the scenario that has just been exported.

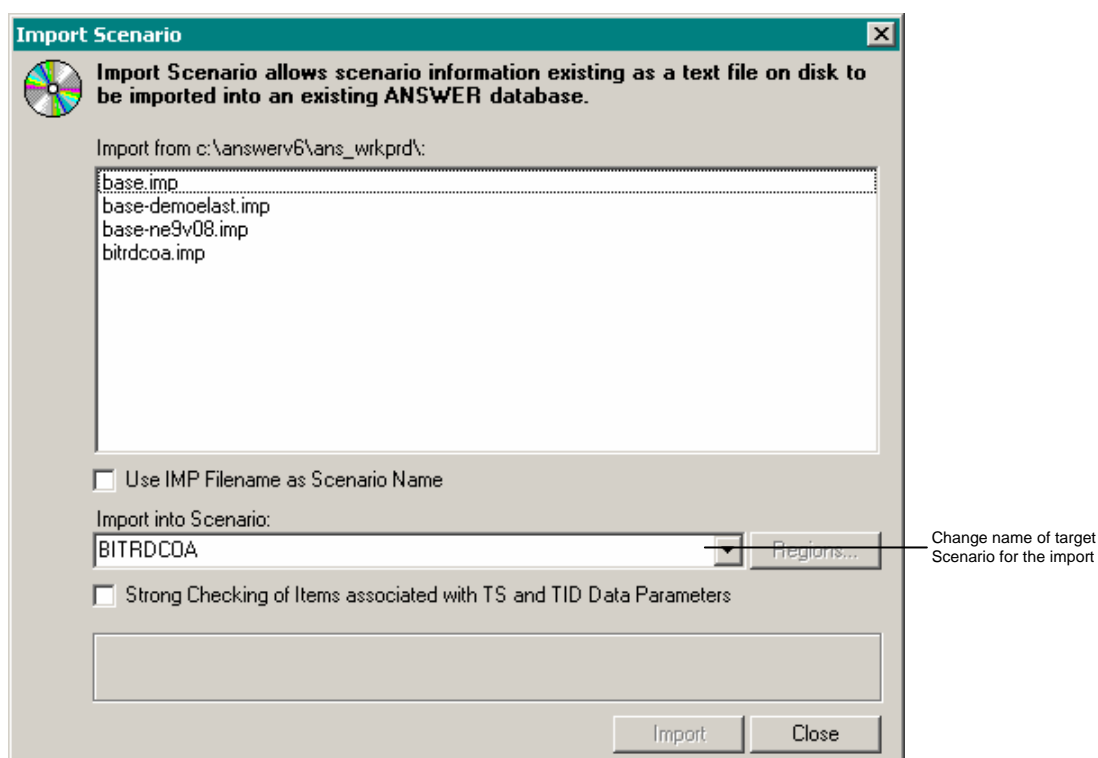
9. The Export Scenario dialogue box remains open, so that the user can select another Scenario to export (by choosing the Scenario from the 'Export from Scenario:' combobox) and again clicking the **[Export]** button.
10. Click on the **[Close]** button to close the Export Scenario dialogue box.

2.9.2 Importing Scenario data contained in an .imp file

If the Scenario information in text file <name>.imp is to be imported into a Database on a separate computer, the user will need to copy/move the .imp file via USB stick or network to the C:\AnswerV6\Ans_WrkPRD folder in the target computer.

To import Scenario data contained in an .imp file:

1. Open the target Database.
2. Click on **F**ile in the menu bar and choose **I**mport then choose **S**cenario... in the drop menu.
3. An Import Scenario dialogue box will appear, in which all the Scenario text files (*.imp) produced by previous Export Scenario operations and held in the C:\AnswerV6\Ans_WrkPRD folder will be displayed:

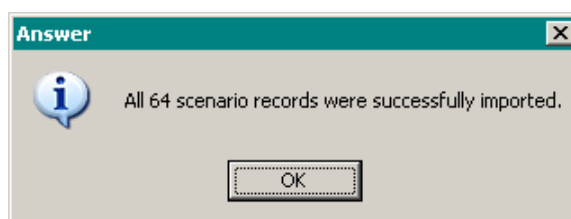


4. Click on the .imp file to be imported. The **[Regions...]** button and the **[Import]** button will become enabled.
5. To simplify the explanation, we first assume that the 'Use IMP Filename as Scenario Name' checkbox is unchecked. See section 2.9.2.1 below for an explanation of how Import Scenario functions when this checkbox is checked.
6. The setting for the 'Import into Scenario:' combobox will default to the Scenario that is currently selected in the Scenarios display.
To vary the target Scenario, either choose a different existing Scenario from the 'Import into Scenario:' combobox, or key the name for a *n*ew Scenario into the combobox.
7. By default, the data for all Regions in the .imp file will be imported.
To import data for a subset of Regions, click on the **[Regions...]** button. This brings up the Import Scenario Select Regions to Import dialogue box. Select the subset of Regions whose data you wish to import, and click on the **[OK]** button. This returns you to the Import Scenario dialogue box.
8. Before clicking on the **[Import]** button of the Import Scenario dialogue box, it is recommended that you check the 'Strong Checking of Items associated with TS and TID Data Parameters' checkbox. This activates more thorough checking of the TS and TID Data Parameters. (See section 2.10 'Importing Model Data from Excel' for an example that

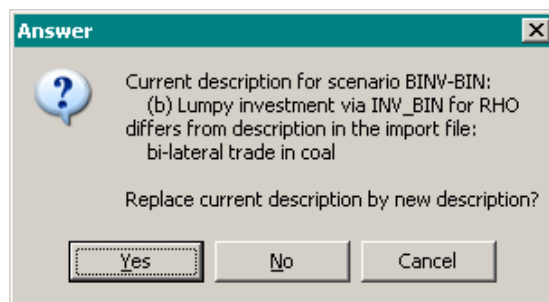
demonstrates the nature of the additional checking that is carried out.) The import process will be a little more time-consuming with Strong Checking activated than if it is not.

9. Click on the **[Import]** button of the Import Scenario dialogue box.
- 9a. If the Name specified in the 'Import into Scenario:' combobox is an existing Scenario in the target Database, and if the Description for this Scenario matches that in the .imp file, the Import Scenario process will immediately be carried out: data in the .imp file will be **merged** with the already existing data for that Scenario. That is, the data in the .imp file will be imported into the existing Scenario according to the following rules:
 - i. If an Item in the .imp file has both the same Name and the same Data Parameters as an Item in the existing Scenario, then the imported Item and its Data Parameters will overwrite the existing Item and its Data Parameters.
 - ii. If an Item in the .imp file has the same Name but some different Data Parameters to an Item in the existing Scenario, then those Data Parameters that are additional will be appended to the existing Item and its Data Parameters.
 - iii. If an Item in the .imp file does not exist in the existing Scenario, then the Item and its Data Parameters will be copied into the existing Scenario.
 - iv. Those Items in the existing Scenario that do not exist in the .imp file, and their Data Parameters, will remain unchanged in the existing Scenario.

On completion of the Import Scenario process, a message box will be displayed to advise that the records in the .imp file were successfully imported:



- 9b. If the Name specified in the 'Import into Scenario:' combobox is an existing Scenario in the target Database, but the Description for this Scenario differs from the Description in the .imp file, a message box is displayed asking the user whether the Description in the .imp file should replace the current Scenario Description:

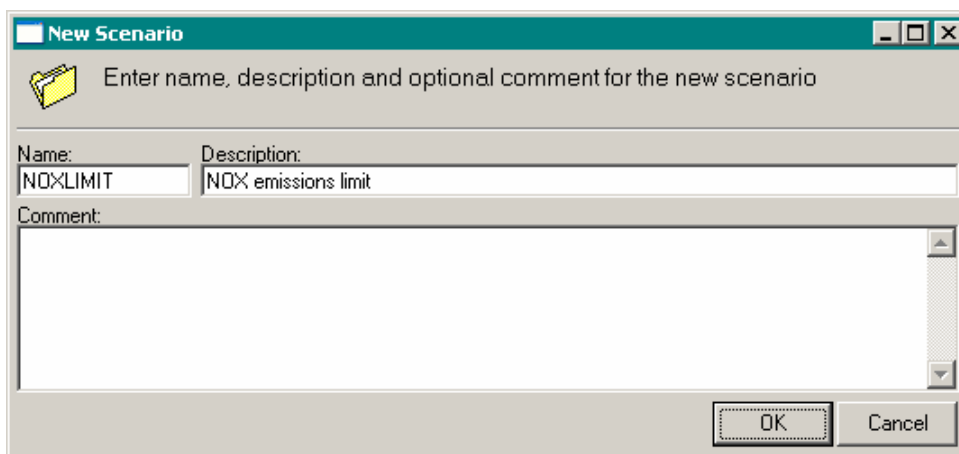


If you click on the **[Yes]** button then the Scenario Description will be changed to match that in the .imp file, and if you click on the **[No]** button the Scenario Description will be left unchanged. In either case (**[Yes]** or **[No]**) the Import Scenario process will proceed and data in the .imp file will be **merged** with the already existing data for that Scenario, as detailed in step 9a above.

*Note that this message box also allows you the option of **Canceling** the Import Scenario process if you realize that you are attempting to import into the wrong Scenario.*

- The message box displayed above indicates that the user is attempting Import Scenario from an .imp file with Description "bi-lateral trade in coal" into an existing Scenario BINV-BIN whose Description is "(b) Lumpy investment via INV_BIN for RHO". Almost certainly the user has made an error in selecting BINV-BIN as the 'Import into Scenario', and can simply click on the **[Cancel]** button to cancel the import.

- 9c. If the Name specified in the 'Import into Scenario:' combobox is not a Scenario in the target Database, a New Scenario dialogue box (shown below) will appear with Name matching that in the 'Import into Scenario:' combobox, and with Description taken from the .imp file, so that the user need only click on the **[OK]** button to create the new scenario and initiate Import Scenario:

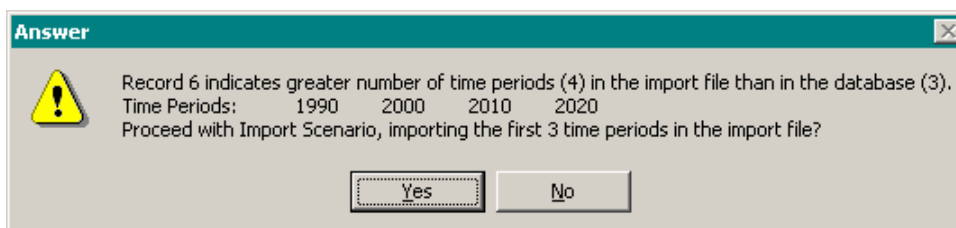


The 'New Scenario' dialog box has a title bar with a green gradient and standard window controls. Below the title bar is a folder icon and the text 'Enter name, description and optional comment for the new scenario'. There are three input fields: 'Name:' with the text 'NOXLIMIT', 'Description:' with the text 'NOX emissions limit', and a large 'Comment:' text area. At the bottom right are 'OK' and 'Cancel' buttons.

Click on the **[OK]** button, and a new Scenario will be created and then data in the .imp file will be imported into this new Scenario.

As for Step 9a above, a message box will be displayed to advise that the records in the .imp file were successfully imported.

10. If at Step 9a or 9b or 9c above the situation is encountered where the .imp file has more time periods than the target database, a message box similar to the one below is displayed, warning that there are more time periods in the .imp file than in the target database (N), and advising that if Import Scenario proceeds, the first N time periods of TS data in the .imp file will be imported:



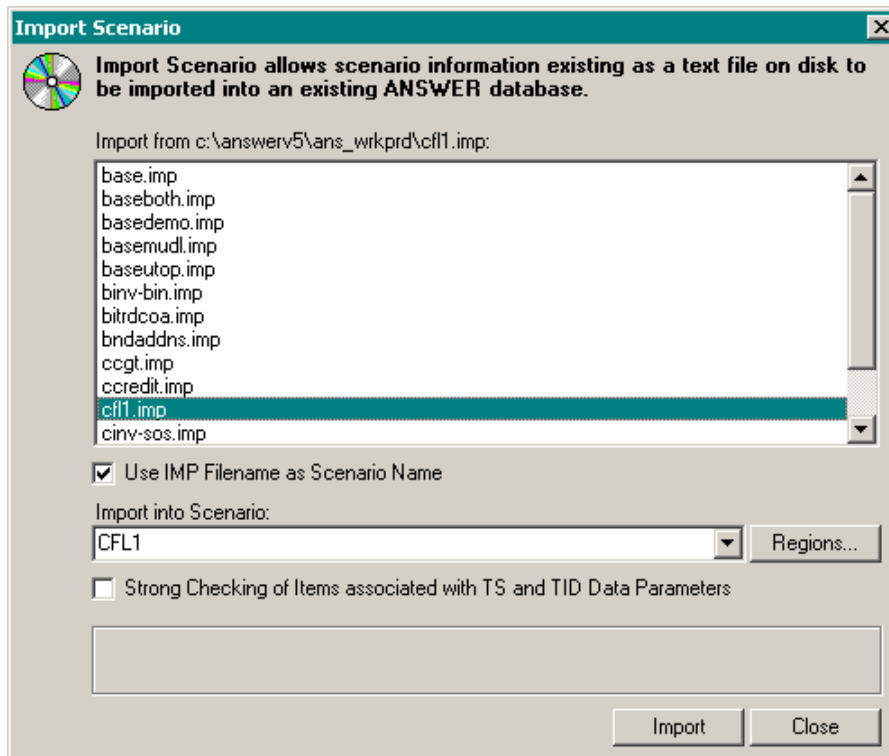
The 'Answer' dialog box has a title bar with a green gradient and a close button. It features a yellow warning triangle icon. The text inside reads: 'Record 6 indicates greater number of time periods (4) in the import file than in the database (3). Time Periods: 1990 2000 2010 2020 Proceed with Import Scenario, importing the first 3 time periods in the import file?'. At the bottom are 'Yes' and 'No' buttons.

Click on the **[Yes]** button to proceed with Import Scenario, and on the **[No]** button to cancel Import Scenario.

11. The Import Scenario dialogue box remains open, so that the user can select another .imp file to import (see step 4 above), specify another 'Import into Scenario:' (see step 6 above) and again click the **[Import]** button.
12. Click on the **[Close]** button to close the Import Scenario dialogue box.

2.9.2.1 When the 'Use IMP Filename as Scenario Name' checkbox is checked

When the 'Use IMP Filename as Scenario Name' checkbox is checked, and the user then selects an .imp file in the 'Import from' file listbox, the .imp filename is automatically assigned as the Scenario Name in the 'Import into Scenario' combobox:



So in the screen snapshot above, if the user checks the 'Use IMP Filename as Scenario Name' checkbox and then selects cfl1.imp as the .imp file to be imported, the 'Import into Scenario:' combobox will automatically be assigned CFL1.

Under some circumstances, checking the 'Use IMP Filename as Scenario Name' checkbox allows the rapid import of a series of .imp files, since all that is required is for the user to select an .imp file to be imported and click on the **[Import]** button, then select the next .imp file to be imported and click on the **[Import]** button, etc. with no need to adjust the setting of the 'Import into Scenario:' combobox. One such set of circumstances might be where Export Scenario has been used to create a series of .imp files with names corresponding to the Scenarios in the database being exported from, and where these .imp files are to be imported into a target database with the same Scenario names as in the origin database.

2.10 Importing Model Data from Excel

ANSWER's Import Model Data from Excel facility allows the user to import Item information (Name, Description, Units, Set Memberships) and Time Series and Time Independent data contained in worksheets of an Excel file into a Scenario of an ANSWER database.

The Import Model Data from Excel facility provides a very useful means of bulk-loading Model Data into an ANSWER database.

This facility accepts Excel files in two quite different formats:

- The newer ANSWER "smart" load template format in which the 6 types of Excel worksheets have a very flexible and user-friendly format.
- The original ANSWER load template format in which the 5 types of Excel worksheets have a rather rigid format, and in which one type of worksheet (** ITEMS **) in particular has a rather user-unfriendly format. The original ANSWER format will be described in this section as "old format".

For most purposes the user is strongly encouraged to use the ANSWER "smart" load templates, rather than ANSWER's "old format" load templates.

The "smart" load templates allow the specification of model data for Commodities (Energy Carriers, Materials, End-Use Demands, Emissions), Technologies and User-Defined Constraints (ADRATIOS), and Taxes and Subsidies, and so allow nearly all model data to be specified in a very flexible and user-friendly format. However the "smart" load templates do not allow the specification of Global Tab data (DISCOUNT, STARTYRS etc) or model data for Stochastics: in order to specify this data in an Excel worksheet, the user will need to use the "old format" load templates.

Additional details regarding the ANSWER "smart" load templates and the "old format" load templates are provided in sections 2.10.1 and 2.10.2 below.

2.10.1 Importing Model Data from ANSWER "smart" load templates

As already noted above, the ANSWER "smart" load templates involve 6 types of Excel worksheets. Cell A1 of each worksheet contains a header record indicating the type of data in the sheet, as follows:

Declaration information for Commodites	Commodities
Declaration information for Technologies	Technologies
Declaration information for Constraints	Constraints
Data associated with Commodities	CommData
Data associated with Technologies	TechData
Data associated with Constraints	ConstrData

with each type of worksheet having a very flexible and user-friendly format. (By declaration information, we mean Name, Description, Units and Set Memberships information.)

Briefly, the new ANSWER "smart" load templates comprise an Excel workbook with associated macros enabling the workbook to link to the user's ANSWER database, and where each of the 6 types of worksheets has associated "smart" buttons enabling the user to do such things as selecting an Item's Set Memberships or allowable MARKAL parameter names from the ANSWER database.

- One of the important "smart" buttons on each worksheet is a **[Check Sheet]** button that when clicked on by the user initiates a series of thorough checks of all of the information on that sheet and so detects any inadvertent user errors that would otherwise not be detected until Import Model Data from Excel was used to try to load the information into an ANSWER database.

The **ANSWerv6-MARKAL Load Templates Manual.pdf** contains detailed information about the operation of the ANSWER "smart" load templates, including the required format of each of the 6 types of worksheets. This is a separate manual from the ANSWerv6-MARKAL User Manual and can be downloaded from the Noble-Soft website. See also sections 2.10.3, 2.10.4 and 2.10.6 below re various aspects of the operation of the Import Model Data from Excel facility.

2.10.2 Importing Model Data from ANSWER “old format” load templates

As already noted above, the ANSWER “old format” load templates involve 5 types of Excel worksheets. Cell A1 of each worksheet contains a header record indicating the type of data in the sheet, as follows:

Item data	*** ITEMS ***
Time Series data	*** TS DATA ***
Time Independent data	*** TID DATA ***
Time Series Trade data	*** TS TRADE ***
Time Independent Trade data	*** TID TRADE ***

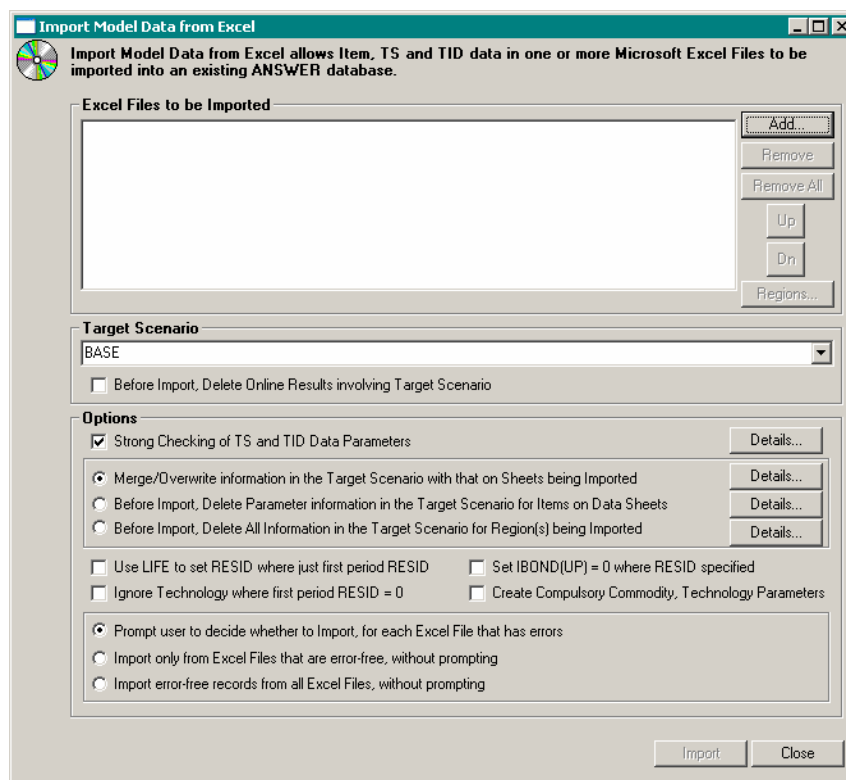
with each type of worksheet having a rather rigid format. The *** ITEMS *** worksheet has a format that requires several lines for each Item and so is rather user-unfriendly in the context of spreadsheet operations.

For details of the required format of each of the 5 types of worksheets that can comprise an ANSWER “old format” load template, see section 2.10.5 ‘Required Format for Import Model Data from Excel if using “Old Format”’ below. See also sections 2.10.3, 2.10.4 and 2.10.6 below re various aspects of the operation of the Import Model Data from Excel facility.

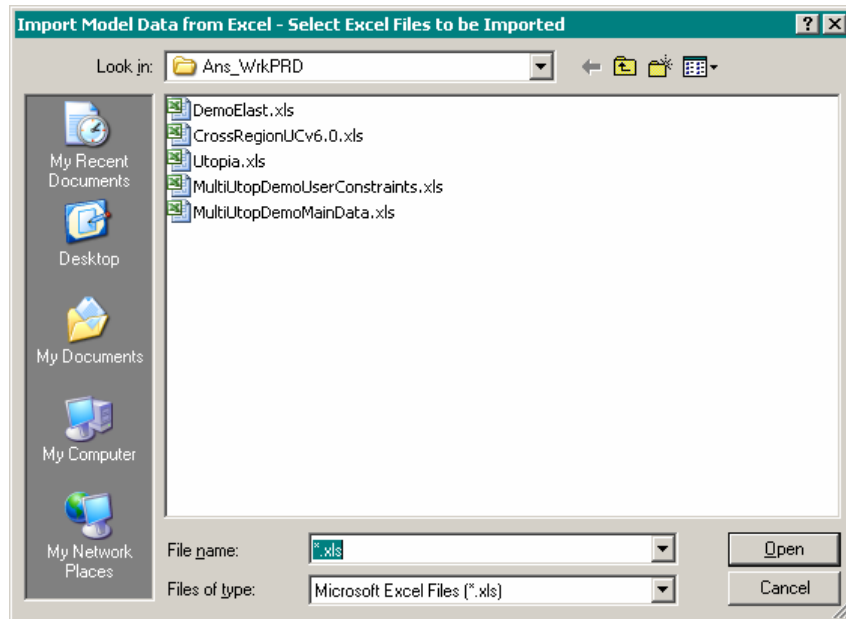
2.10.3 Operation of the Import Model Data from Excel facility

The operation of the Import Model Data from Excel facility is the same regardless of whether the Excel files that you want to import are in the ANSWER “smart” template format or in the ANSWER “old format”. Once you have prepared one or more Excel files containing Model Data in whichever format you prefer, you need to carry out the following steps to import the data in these Excel files into an ANSWER Database:

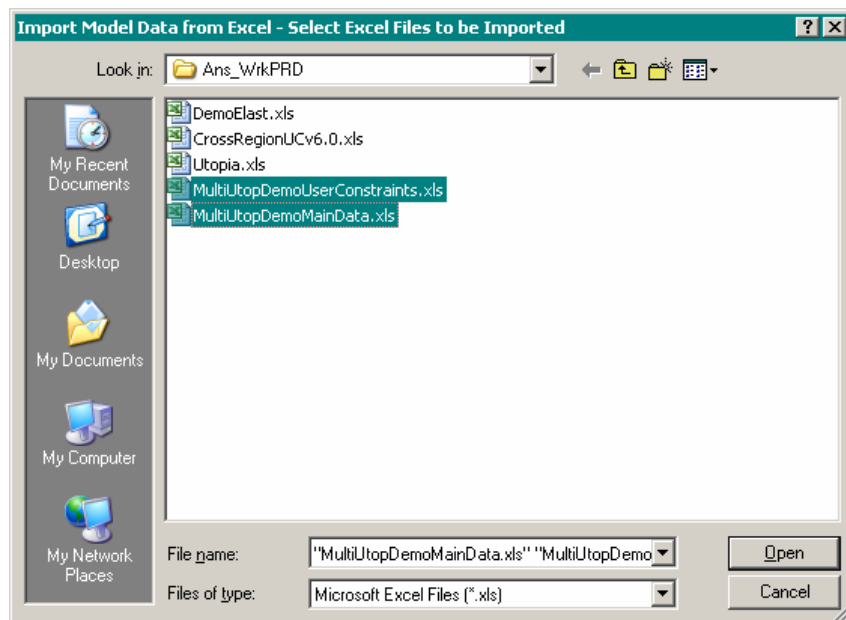
1. Open the target Database.
2. Invoke the Import Model Data from Excel facility by clicking on **File** in the menu bar and choosing **Import** then **Model Data from Excel...** in the drop menu (or alternatively by using the keyboard shortcut **Ctrl+I**).
3. An ‘Import Model Data from Excel’ dialogue box will appear:



4. Click on the **[Add...]** button. An 'Import Model Data from Excel – Select Excel Files to be Imported' dialogue box will appear, initially positioning you at the ANSWER Work Folder (C:\AnswerV6\Ans_WrkPRD) to begin the selection process:

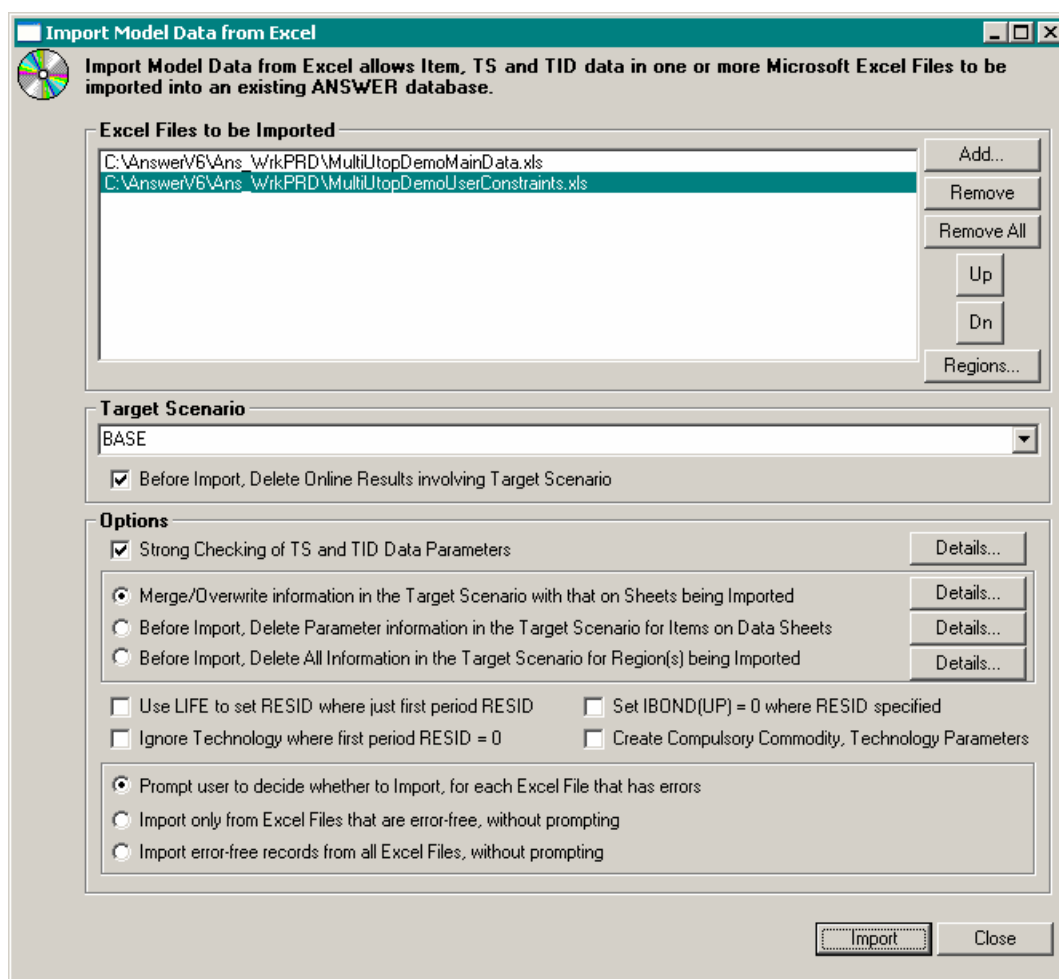


5. If necessary, use the 'Look in' combobox (at the top of the above dialogue box) to change to a different folder that contains the Excel files that you want to select. Then either select a single Excel file to be imported, and click on the **[Open]** button, or multi-select several Excel files to be imported (by clicking on each file's icon while holding down the **Ctrl** key), and click on the **[Open]** button.



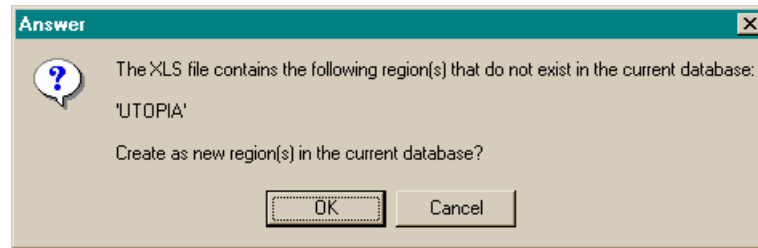
Note that the last folder you use to select Excel files from is remembered (it is stored in the ANSWER database), and the next time you use the **[Add...]** button you will be positioned there to begin the selection process.

6. The 'Excel Files to be Imported' listbox of the 'Import Model Data from Excel' dialogue box will display the Excel file(s) that have been selected at step 5 above, and all of the buttons including the **[Regions...]** button and the **[Import]** button will now be enabled:

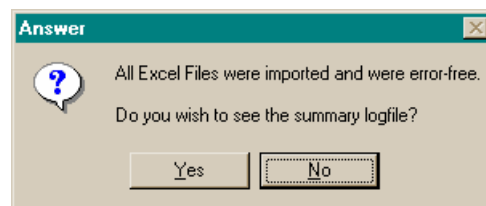


7. If necessary, use the **[Add...]** button to bring up the 'Select Excel Files' dialogue box (step 4) and then repeat step 5 to specify additional Excel files to be imported. If you make a mistake in selecting an Excel File(s) use the **[Remove]** (**[Remove All]**) button to remove the currently selected file (all files) from the listbox. If the order in which files are imported is important, use the **[Up]** and **[Dn]** buttons to change the order. (The file at the top of the listbox will be the first file to be imported.)
8. By default, the data for all Regions in each of the Excel files will be imported.
To import data for a subset of Regions, click on the **[Regions...]** button. This brings up the 'Select Regions to Import' dialogue box that will display the Regions that occur in the Excel files to be imported. Select the subset of Regions whose data you wish to import, and click on the **[OK]** button. This returns you to the 'Import Model Data from Excel' dialogue box. *If a subset of Regions is specified, this common subset applies to all of the Excel files to be imported.*
9. The setting for the 'Target Scenario' combobox will default to the Scenario that is currently selected in the Scenarios display. *Note that the Target Scenario is common to all of the Excel files to be imported.*
To vary the Target Scenario, either choose a different existing Scenario from the Target Scenario combobox, or key the name for a new Scenario into the combobox.
10. Before clicking on the **[Import]** button, ensure that appropriate user options are selected to control the import process. These options are detailed below in section 2.10.4 'Import Model Data from Excel User Options'. Note that your user option settings are saved to the registry and will be used as the default settings the next time that the Import Model Data from Excel facility is invoked.
11. Click on the **[Import]** button.

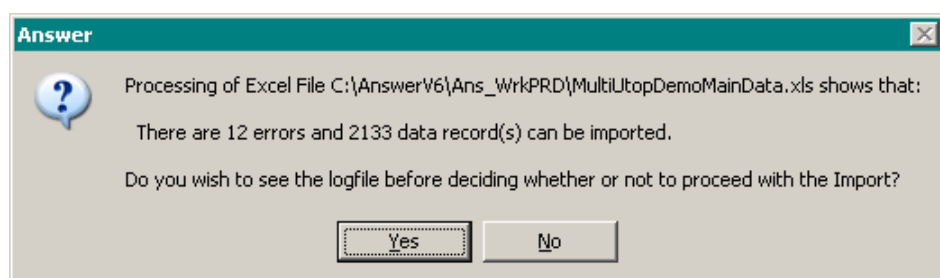
- 11a. If the Excel file contains a Region(s) that is not currently in the database, and that is selected as one of the Regions to be imported, a message similar to the following is displayed to allow you to **[OK]** the automatic creation of this(these) new region(s):



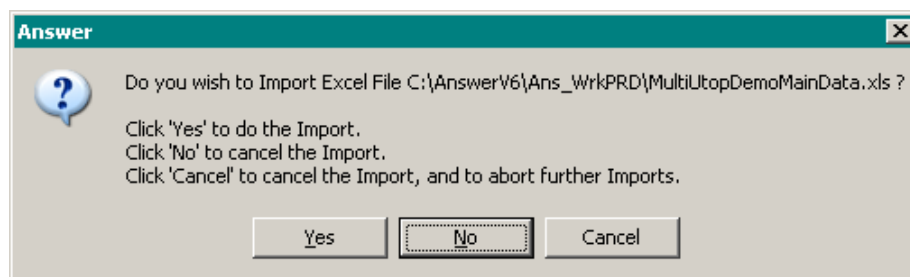
- 11b. If all of the Regions selected to be imported are currently in the database, no message is displayed at this point.
12. Starting with the Excel file at the top of the listbox, each Excel file is processed in turn. When multiple Excel files are imported, log files ImportDataExcelSummary.log and ImportDataExcel-1.log, ImportDataExcel-2.log, ImportDataExcel-3.log, ... are created in the ANSWER Work Folder. ImportDataExcelSummary.log contains summary information regarding the entire import process, while the remaining log files contain more detailed information regarding the import of the first, second, third, ... Excel files respectively in the list.
- 12a. If each of the Excel files being imported is error-free, each of them is imported in turn with no prompting of the user until the following message is displayed to indicate that all of the relevant data in all of the Excel files has been successfully imported into the database:



- 12b. If errors are detected, and if the 'Prompt user to decide whether to Import, for each Excel File that has errors' user option was selected, a message similar to the following is displayed:



Click on the **[Yes]** button to examine in Wordpad the error messages that appear in the file ImportDataExcel-n.log, n = 1, 2, 3, ... in the ANSWER Work folder. After examining these messages, whether you respond **[Yes]** or **[No]** or **[Cancel]** to the following prompt:

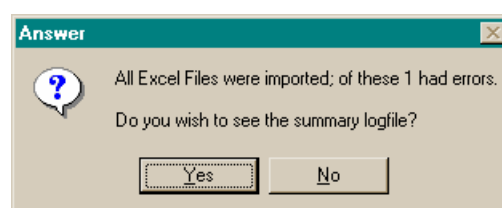


will depend upon the nature and number of the errors.

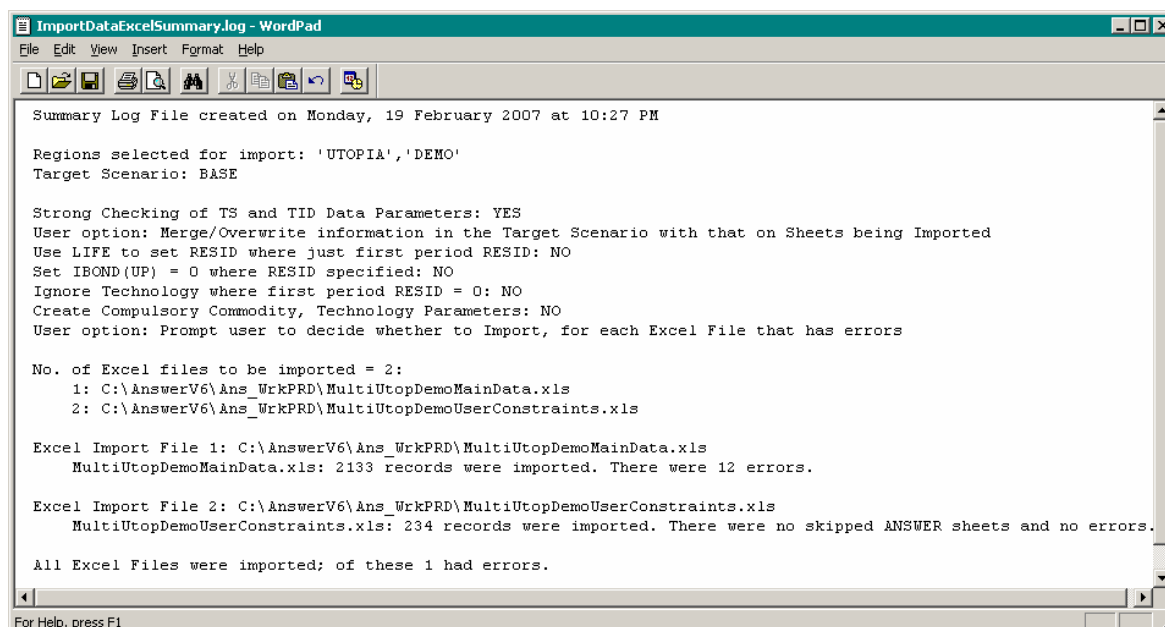
- Responding **[Yes]** results in error-free records in the current Excel file being imported, and allows the import of subsequent Excel files to proceed.
- Responding **[No]** cancels the import of the current Excel file, and allows the import of subsequent Excel files to proceed.
- Responding **[Cancel]** cancels the import of the current Excel file and also aborts the import of subsequent Excel files.

For a detailed discussion of the checks that are carried out on data in the Excel import file, and of the error messages that may be encountered, see section 2.10.6 'Checking of Data in the Excel Import File and Log File Errors'.

13. At the end of the Import Model Data from Excel process, where multiple Excel files have been imported and where some of these had errors, a message similar to the following is displayed:



Click on the **[Yes]** button to display the summary log file ImportDataExcelSummary.log in the ANSWER Work folder:



2.10.4 Import Model Data from Excel User Options

A number of user options are available on the dialogue box to control the Import Model Data from Excel process, as can be seen from the screen snapshot on the following page that displays the bottom part of the 'Import Model Data from Excel' dialogue box.

This screen snapshot displays the default settings for the user options, as they will appear the first time that you run AnswerV6.exe on your computer. As already noted above, your user option settings are saved to the registry and will be used as the default settings the next time that the Import Model Data from Excel facility is invoked. (The only exception to this rule is that the 'Strong Checking of TS and TID Data Parameters' checkbox will always be checked.)

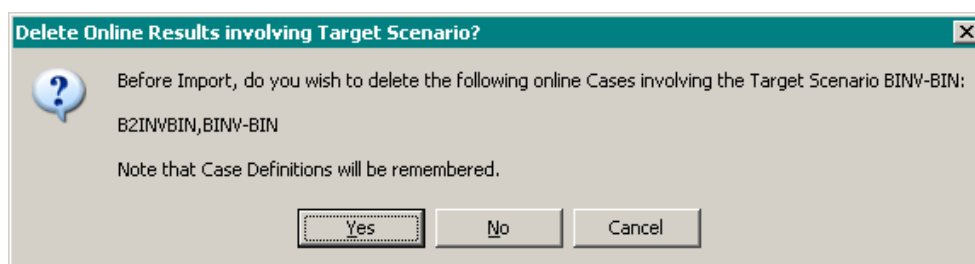
These user options can be summarised as follows:

- A checkbox option allows you, before the import, the option of deleting online Results for Cases involving the Target Scenario.
- A checkbox option allows you to carry out thorough checking of TS and TID Data Parameters in the Excel File(s) being imported.
- The first set of radio buttons allows you control over the way that information is imported into the Target Scenario.
- There are four checkbox options that allow you special control of the data that is being imported, including the generation of additional data in the Target Scenario beyond that in the Excel File(s) being imported.
- The second set of radio buttons allows you to control whether your intervention will be asked for if ANSWER detects errors in any of the Excel Files being imported.

Each of these user options is now explained in more detail.

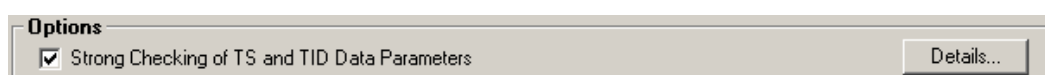
2.10.4.1 'Before Import, Delete Online Results involving Target Scenario' checkbox

If you check this checkbox, then a check is made as to whether there are any online results (Cases) that involve the Target Scenario. If there are, the following message appears asking you to confirm their deletion:



- If you click on the **[Yes]** button, then all online results (Cases) that involve the Target Scenario are deleted from the ANSWER database, and the Import proceeds.
- If you click on the **[No]** button, then a message appears asking you to confirm that you wish to proceed with the Import without deleting any online results.
- And if you click on the **[Cancel]** button, the Import is cancelled and you are returned to the 'Import Model Data from Excel' dialogue box.

2.10.4.2 'Strong Checking of TS and TID Data Parameters' checkbox



This checkbox is always checked when the Import Model Data from Excel dialogue box is displayed and it is recommended that you leave it checked.

As you would expect, when the 'Strong Checking ...' checkbox is checked, there will be more thorough checking of the TS and TID Data Parameters than if it is unchecked. In particular, this more thorough checking means that ANSWER will check that the Set Memberships for each component Item of the Parameter are appropriate for the Parameter. The difference in the checking that is carried out is best explained with an example.

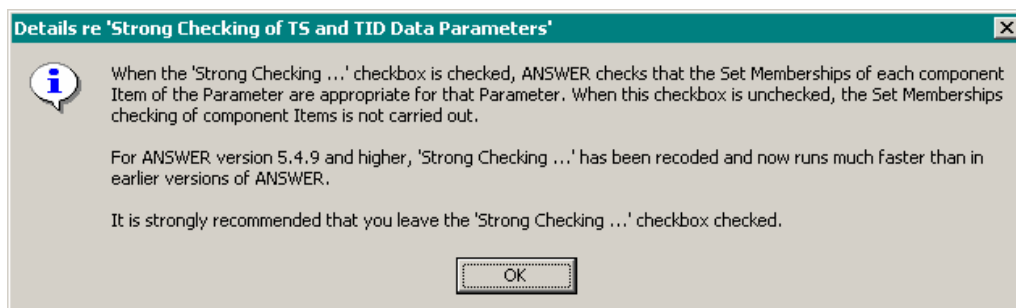
Suppose that there is a TS Data Parameter BOUND(BD) record in one of the Excel Files that is being imported. For the BOUND(BD) Parameter, the Item in the Item1 position (column B) should be a Technology Item and the Item in the Item3 position (column D) should be a Bound Item. Additionally, the Technology Item should be either a Conversion or Demand or Process Technology, and should not be a Resource Technology. Suppose also that the user has mistakenly specified a Resource Technology in the Item1 position.

- When the 'Strong Checking ...' checkbox is unchecked, ANSWER checks that the Item in the Item1 position (column B) is a Technology Item and that the Item in the Item3 position (column D) is a Bound Item but does not check the Set Memberships of the Technology Item and so does not detect the mistake. The BOUND(BD) record will be imported into the Database.
- When the 'Strong Checking ...' checkbox is checked, ANSWER additionally checks that the Set Memberships of the Technology Item are appropriate for the BOUND(BD) Parameter and so detects the mistake. An error message similar to that below will be generated in the ImportDataExcel-n.log file:

```
Record 100 has error: Technology Item EXPCOAC in Item1 position does not have
appropriate Set Memberships for Parameter 'BOUND(BD)'.
BOUND(BD)  EXPCOAC      -      LO      -      10      15      20      20
```

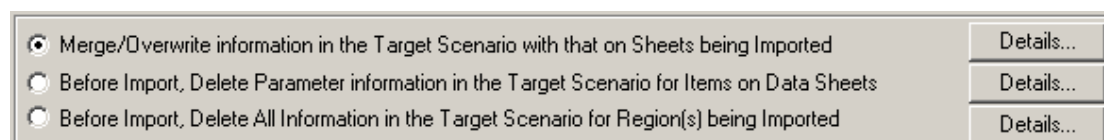
and this BOUND(BD) record will not be imported.

If you click on the **[Details...]** button to the right of the 'Strong Checking of TS and TID Data Parameters' checkbox, you will get the following message, explaining that 'Strong Checking ...' has been recoded to run much faster than previously, and concluding with the recommendation that you leave this checkbox checked.



2.10.4.3 Alternative options to control the way that information is imported into the Target Scenario

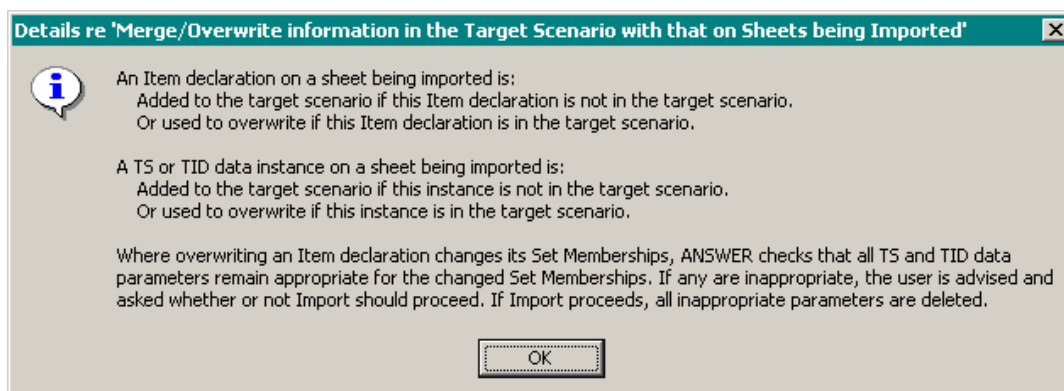
Three alternative user options are available to control the way that information is imported into the Target Scenario:



The way that each of these options functions is now detailed.

2.10.4.3.1 'Merge/Overwrite information in the Target Scenario with that on Sheets being Imported' radio button

If you select the 'Merge/Overwrite information ...' radio button, the way that information is imported into the Target Scenario is the same as in earlier versions of the Import Model Data from Excel facility. If you click on the **[Details...]** button to the right of this radio button, you will get the following message that summarises the way Merge/Overwrite works:

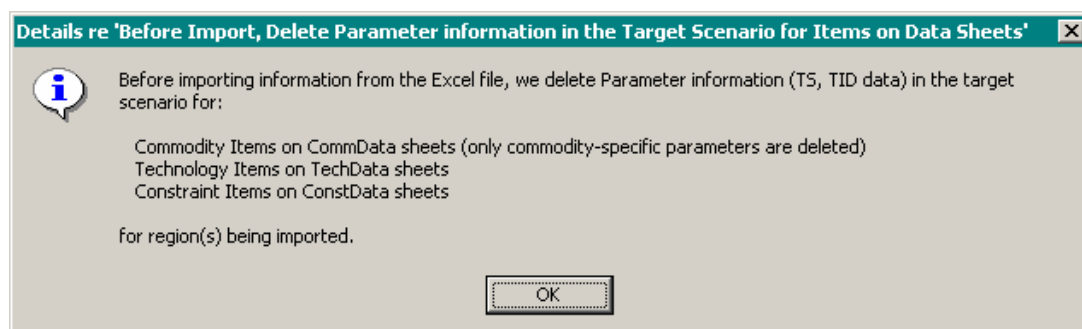


As stated in the above message, where overwriting an Item declaration changes its Set Memberships, ANSWER checks that all TS and TID data parameters remain appropriate for the changed Set Memberships. For example, if the effect of overwriting a Technology declaration is to change that technology's Set Memberships from say a Conversion technology to a Process technology, then a parameter such as PEAK(CON) that was associated with the Technology would no longer be appropriate, since this parameter is only meaningful for Conversion technologies. On the other hand, parameters such as FIXOM, INVCOST, RESID, VAROM would remain appropriate since these parameters apply to Conversion and to Process technologies.

2.10.4.3.2 'Before Import, Delete Parameter information in the Target Scenario for Items on Data Sheets' radio button

If the 'Before Import, Delete Parameter information in the Target Scenario for Items on Data Sheets' radio button is selected, then before importing from the Excel file, TS and TID parameter information in the target scenario is deleted for Items on the (new) CommData, TechData and ConstrData sheets for region(s) being imported. Note that for Commodity Items on CommData sheets, only commodity-specific parameter information is deleted. So for example commodity-specific parameters such as TE(ENT) are deleted, but I/O parameters such as INP(ENT)c that involve both commodities and technologies are not deleted.

If you click on the **[Details...]** button to the right of this radio button, you will get the following message, that summarises the way this option works:

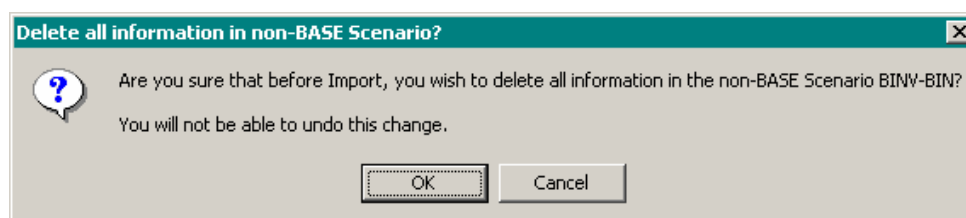


Note that at present, this option applies only to Items on the new CommData, TechData and ConstrData sheets. If this option is selected and the Excel File being imported contains *** TS DATA *** or *** TID DATA *** sheets, then TS and TID parameter information for Items on these sheets is not deleted prior to importing information from the Excel file, and consequently for these Items a Merge/Overwrite of information occurs.

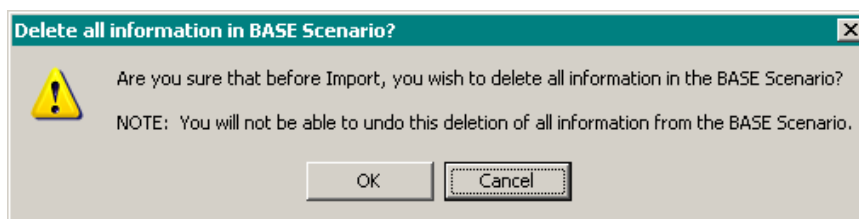
2.10.4.3.3 'Before Import, Delete All Information in the Target Scenario for Region(s) being Imported' radio button

If the 'Before Import, Delete All Information in the Target Scenario ...' radio button is selected, then after the user clicks on the **[Import]** button to initiate Import Model Data from Excel, one of the following two messages appears asking the user to confirm the deletion of all information in the target scenario.

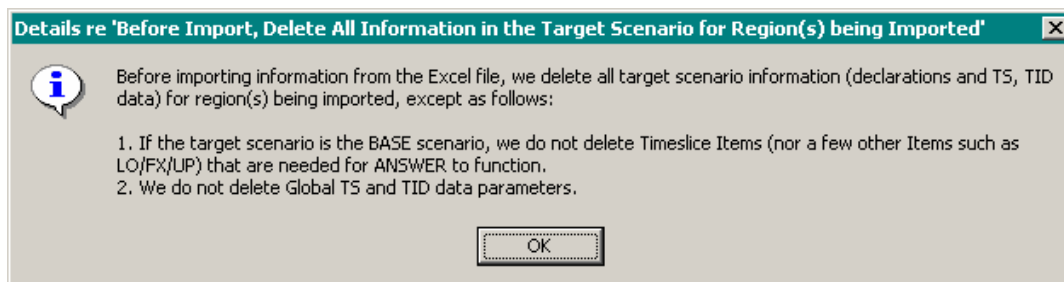
Where the target scenario is a non-BASE scenario:



Where the target scenario is the BASE scenario:



If the user clicks on the **[OK]** button to confirm the deletion of all information in the target scenario then before importing from the Excel file, all information in the target scenario is deleted for region(s) being imported, with a few exceptions that are summarised in the message that you get if you click on the **[Details...]** button to the right of this radio button:



2.10.4.4 'Use LIFE to set RESID where just first period RESID' checkbox

If the 'Use LIFE to set RESID where just first period RESID' checkbox is checked, the user can specify the LIFE of a technology and just the first period value for the RESID parameter, and an automatic calculation will be done that sets RESID = 0 in the appropriate period.

For example, suppose that the periods in a model are 2000, 2005, 2010, 2015, ..., 2050. If for some technology LIFE = 15 and just the first period value for RESID is specified, this calculation would set RESID = 0 in 2015.

Note that for the 'Use LIFE to set RESID...' facility to work, it is essential that on the TechData sheets, LIFE is specified in a column to the left of the RESID column(s). This is because parameters on a TechData sheet are imported into the ANSWER database working from left to right, and we need to have the value of LIFE already in the database at the time that we calculate the appropriate period in which to set RESID = 0.

Note also that at present, for this option to work for a technology where LIFE is specified on a *** TID DATA *** sheet, and RESID is specified on a *** TS DATA *** sheet, it is essential that the *** TID DATA *** sheet precedes the *** TS DATA *** sheet.

2.10.4.5 'Set IBOND(UP) = 0 where RESID specified' checkbox

If the 'Set IBOND(UP) = 0 where RESID specified' checkbox is checked, then where a RESID data parameter instance is encountered in the Excel file, there will be automatic generation for the associated technology of an IBOND(UP) parameter instance, whose values are 0 in all periods.

2.10.4.6 'Ignore Technology where first period RESID = 0' checkbox

The 'Ignore Technology where first period RESID = 0' checkbox option is useful in the context of importing an Excel file as part of the initial calibration process. If this checkbox is checked, then any technologies in the Excel file for which the first period value for the RESID parameter is 0 are effectively ignored and are not imported into the target scenario. In practice the way that this is achieved is that declaration data and TS and TID data for such technologies are initially imported, while building up a list of such technologies, and at the end of the import process these technologies are deleted from the target scenario.

2.10.4.7 'Create Compulsory Commodity, Technology Parameters' checkbox

If the 'Create Compulsory Commodity, Technology Parameters' checkbox is checked, then commodities and technologies in the Excel file will automatically have associated "compulsory" TS and TID parameter instances created, provided that these instances do not already exist.

As commodity compulsories are currently set in TemplateV6.mdb:

- for an ELC commodity we will create (E)DISTINV, (E)DISTOM, (E)LCFEQ, (E)RESERV, (E)TRANINV, (E)TRANOM, BAS(E)LOAD and TE(ENT);
- for an LTH commodity we will create DHDE(Z) x 3, DTRANINV, DTRANOM, HRESERV;
- for a DMD commodity we will create DEMAND, ELF [and FR(Z)(Y) x 6 if Set Memberships indicate non-default distribution of demand];
- for an ENV commodity we will create nothing.

As technology compulsories are currently set in TemplateV6.mdb:

- for CON, DMD, PRC we will create CAPUNIT, LIFE, START (START will have default of first time-period);
- for CON we will also create AF, PEAK(CON), AF_TID (generate CF(Z)(Y) rather than AF if fixed-capacity utilization);
- for CON that is CPD we will also create TRNEFF(Z)(Y) x 6;
- for DMD we will also create CF, EFF;
- for PRC we will also create AF;
- for SRCENCP we will create START and COST.

To change the Compulsory setting for a Parameter in an ANSWER database, with the BASE scenario editable go to the Parameter tab and select the Parameter, then choose "Edit..." and check/uncheck the "Compulsory Parameter" checkbox. At the same time as this change is made, consider whether the current Default Value setting is appropriate.

2.10.4.8 Alternative options to control level of user intervention if ANSWER detects errors in any of the Excel Files being imported

Three alternative user options are available to control whether user intervention will be asked for if ANSWER detects errors in any of the Excel Files being imported:

- ☒ Prompt user to decide whether to Import, for each Excel File that has errors
- ☐ Import only from Excel Files that are error-free, without prompting
- ☐ Import error-free records from all Excel Files, without prompting

Under each of these user options, an Excel file that is error-free is imported with no prompting of the user. Where the options differ is in the way that Excel files that do contain errors are handled.

2.10.4.8.1 'Prompt user to decide whether to Import, for each Excel File that has errors' radio button

For each Excel file that has errors, the user will be prompted to view a log file that details the nature of the errors that have been detected, before then being prompted to decide whether or not to proceed with the import.

This user option provides control of the import process at the individual Excel file level, but may require considerable user intervention and hence may negate some of the benefits of importing multiple Excel files, as compared with importing Excel files one at a time.

When importing a single Excel file, this is the recommended option, since it provides the user with maximum control of the import process.

2.10.4.8.2 'Import only from Excel Files that are error-free, without prompting' radio button

Only Excel files that are completely error-free are imported. If an Excel file contains any errors, then none of the records in that file is imported. This user option does not require any user intervention.

2.10.4.8.3 'Import error-free records from all Excel Files, without prompting' radio button

All of the error-free records in every Excel file are imported. This user option imports as much as possible and does not require any user intervention.

2.10.5 Required Format for Import Model Data from Excel if using “Old Format”

For a concrete example of the required format for Import Model Data from Excel, see the Excel file UtopDemo.xls in the C:\AnswerV6\Ans_WrkPRD folder. This Excel file completely specifies the Item data, Time Series data and Time Independent data for the BASE Scenario for the multi-region Utopia and Demo MARKAL model, including the specification of bilateral trade in electricity between DEMO and UTOPIA. If you use ANSWER to create a New Database with start year 1990, 10 years per period and 4 periods, and then carry out Import Model Data from Excel using UtopDemo.xls as the source of Model Data, you will load the multi-region Utopia and Demo MARKAL model into this New Database. (When you create the New Database, check the 'Create Standard Markal TimeSlices' checkbox and uncheck the 'Create Initial Region' checkbox.)

2.10.5.1 Main Points about “Old Format” for Import Model Data from Excel

The main points about “old format” for Import Model Data from Excel are:

- Each of Item data, Time Series data and Time Independent data must be in a separate worksheet (or worksheets) within the Excel file. It is not allowable to have a single worksheet that contains, say, both Item data and Time Series data. On the other hand, it is allowable to have, say, Time Series data spread over several worksheets within the Excel file.
- Cell A1 of each worksheet must contain a header record indicating the type of data, as follows:

Item data	*** ITEMS ***
Time Series data	*** TS DATA ***
Time Independent data	*** TID DATA ***
Time Series Trade data	*** TS TRADE ***
Time Independent Trade data	*** TID TRADE ***

These are the same headers as occur in the Export Scenario facility, and the required format for the model data within the Excel worksheets corresponds closely to that produced by the Export Scenario facility.

- Worksheets that do not contain one of the above types of header records in cell A1 are ignored by the Import Model Data from Excel facility.
- Cell B1 of each worksheet that has a header record of *** ITEMS *** or *** TS DATA *** or *** TID DATA *** must contain a Region name that indicates the Region associated with the Item or Time Series or Time Independent data in that worksheet.
- Cells B1, C1, ... of each worksheet that has a header record of *** TS TRADE *** or *** TID TRADE *** must contain Region names that indicates the Regions associated with the Time Series Trade data or Time Independent Trade data in that worksheet. (For example, if there are just 2 regions DEMO and UTOPIA, then cells B1, C1 should contain DEMO, UTOPIA respectively, and cell D1 should be empty.)
- Note that the *** TID TRADE *** sheet must be used to specify Bilateral Trade (region x region) data parameters. (Currently there are no TS Bilateral Trade data parameters.) TS Trade parameters that are not Bilateral Trade parameters (e.g. TRD_COST(ENT)) may be specified on a *** TS TRADE *** sheet, or may be specified on a *** TS DATA *** sheet, at the user's discretion. Likewise TID Trade parameters that are not Bilateral Trade parameters (e.g. TRD_FROM(ENT)) may be specified on a *** TID TRADE *** sheet, or may be specified on a *** TID DATA *** sheet, at the user's discretion.
- Data records are contained in rows 2, 3, 4 ... of the worksheet. *The first completely empty row after row 1, and the first completely empty column after column A, are taken as defining the data of interest on that particular worksheet.* Any row that contains a string beginning with an * in column A is ignored by the Import process. Such rows may thus be used for comments, or otherwise to improve readability of the worksheet.
- Worksheets in the Excel file that contain Item data are processed before worksheets containing Time Series or Time Independent data.

2.10.5.2 Item Data Format (** ITEMS **)

A worksheet that contains *** ITEMS *** in cell A1 is assumed to contain Item data; there may be several such worksheets in the Excel file.

Cell B1 of each *** ITEMS *** worksheet must contain a (single) Region name.

Item Data for Import Model Data from Excel must obey the following rules:

For each Item there must be 3 rows (in the format produced by ANSWER's Export Scenario facility) as follows:

A	B	C	D	E	F
Item:	T	E01	Coal Steam Electric		
Sets:	TCH	CON	ELE	CEN	BAS
Units:	TACT=	PJ	TCAP=	GW	

'Item:' row

This row must contain 'Item:' in column A, a single character indicating the Component (e.g. T for technology) in column B, the Item Name in column C, and the Item Description in column D.

The following character codes apply to the various ANSWER Components:

Component	Code
Technology	T
Emission	M
End-Use Demand	D
Energy Carrier	E
Material	L
State of World	S
Tax/Subsidy	A
User-Defined Constraint	C

The Item Description should not exceed 100 characters in length, and must not contain either a single quote (') or a double quote (").

'Sets:' row

This row must contain 'Sets:' in column A, followed by the Set Memberships for this Item in columns B, C, etc. You can most easily see what ANSWER requires by way of individual Sets for say Technologies if you use ANSWER to create a Scenario containing various sorts of Technologies that you wish to specify in the worksheet, carry out Export Scenario, and then look at the 'Sets:' rows in the *** ITEMS *** section of the .IMP file created by Export Scenario.

'Units:' row

This row must contain 'Units:' in column A. The remaining cells in the row may be empty, in which case ANSWER will assign default units according to the Item's Set Memberships. If the remaining cells in the row are not empty, then the type of unit and the unit must be specified in pairs in columns B and C, D and E (and possibly in columns F and G). The type of unit being specified must be one of the following:

- 'TACT=' technology activity unit
- 'TCAP=' technology capacity unit
- 'COMM=' commodity unit

The unit must be a unit that already exists in the ANSWER database into which the data is being imported.

2.10.5.3 Time Series Data Format (** TS DATA **)

A worksheet that contains **TS DATA** in cell A1 is assumed to contain Time Series data; there may be several such worksheets in the Excel file.

Cell B1 of each **TS DATA** worksheet must contain a (single) Region name.

Time Series Data for Import Model Data from Excel must obey the following rules:

For each instance of a Time Series Data Parameter, the corresponding row must contain Parameter, Item1, Item2, Item3, Item4 in columns A to E respectively followed by the time series values in columns F, G, etc, (in the format produced by ANSWER's Export Scenario facility) for example:

A (Parameter)	B (Item1)	C (Item2)	D (Item3)	E (Item4)	F (1990)	G (2000)	H (2010)
BOUND(BD)	E31	-	UP	-	0.13	0.17	null

Note that it is necessary to use - (minus) as a placeholder so that Item1, Item2, Item3, Item4 correspond exactly to what ANSWER expects for a given Parameter. In the above example for the BOUND(BD) parameter, ANSWER expects Technology in Item1 position and Bound in Item3 position, with - as a placeholder in the Item2 and Item4 positions.

For nearly all ANSWER-MARKAL parameters, the Item positions are as follows:

- Item1 Technology
- Item2 End-Use Demand, Energy Carrier, Material, Emission, Constraint, Tax/Subsidy
- Item3 Bound
- Item4 TimeSlice, Stochastic

Note the use of 'null' in the cell in column H to indicate a null value. As an alternative to putting 'null' in a cell, the cell may simply be left empty.

Note also that Global Time Series parameters (e.g. MM_GROWV) are a special case. They may have _ (underscore) as a placeholder in the Item2 position, or - (minus).

Any Item referenced in the Item1-Item4 positions must either already exist in the ANSWER database into which the data is being imported, or must be specified in one of the Item Data worksheets of the Excel file. That is, the combination of the Item name in the Item1-Item4 position and the Region name for this worksheet as specified in cell B1 must either already exist in the ANSWER database, or must be specified in one of the Item Data worksheets of the Excel file.

2.10.5.4 Time Independent Data Format (** TID DATA **)

A worksheet that contains **TID DATA** in cell A1 is assumed to contain Time Independent data; there may be several such worksheets in the Excel file.

Cell B1 of each **TID DATA** worksheet must contain a (single) Region name.

Time Independent Data for Import Model Data from Excel must obey the following rules:

For each instance of a Time Independent Data Parameter, the corresponding row must contain Parameter, Item1, Item2, Item3, Item4 in columns A to E respectively followed by the data value in column F, (in the format produced by ANSWER's Export Scenario facility) for example:

A (Parameter)	B (Item1)	C (Item2)	D (Item3)	E (Item4)	F (Value)
---------------	-----------	-----------	-----------	-----------	-----------

FR(Z)(Y)	-	RH	-	I-D	0.12
----------	---	----	---	-----	------

Note that it is necessary to use - (minus) as a placeholder so that Item1, Item2, Item3, Item4 correspond exactly to what ANSWER expects for a given Parameter. In the above example for the FR(Z)(Y) parameter, ANSWER expects End-Use Demand in Item2 position and TimeSlice in Item4 position, with - as a placeholder in the Item1 and Item3 positions.

For nearly all ANSWER-MARKAL parameters, the Item positions are as follows:

Item1 Technology
 Item2 End-Use Demand, Energy Carrier, Material, Emission, Constraint, Tax/Subsidy
 Item3 Bound
 Item4 TimeSlice, Stochastic

Note also that Global TID parameters (e.g. DISCOUNT, QHR(Z)(Y)) are a special case. They may have _ (underscore) as a placeholder in the Item2 position, or - (minus).

Any Item referenced in the Item1-Item4 positions must either already exist in the ANSWER database into which the data is being imported, or must be specified in the Item Data worksheet(s) of the Excel file. (That is, the combination of the Item name in the Item1-Item4 position and the Region name for this worksheet as specified in cell B1 must either already exist in the ANSWER database, or must be specified in one of the Item Data worksheets of the Excel file.)

2.10.5.5 Time Series Trade Data Format (** TS TRADE **)

Currently there are no Time Series Bilateral Trade data parameters (all Bilateral Trade data parameters are Time Independent) so a ** TS TRADE ** worksheet is not needed for specifying bilateral trade data. If in the future Time Series Bilateral Trade parameters are needed, then the existence of the ** TS TRADE ** worksheet means that such parameters will be able to be imported.

Most of the information in section 2.10.5.6 below would be applicable to a ** TS TRADE ** sheet that contained Time Series Bilateral Trade parameters, if in the future such parameters are needed.

2.10.5.6 Time Independent Trade Data Format (** TID TRADE **)

A worksheet that contains ** TID TRADE ** in cell A1 is assumed to contain Time Independent Trade data; there may be several such worksheets in the Excel file.

Cells B1, C1, ... of each ** TS DATA ** worksheet must contain Region names. (A single Region name in each of cells B1, C1, ...)

Time Independent Trade Data for Import Model Data from Excel must obey the following rules:

For each instance of a Time Independent Trade Data Parameter, the corresponding row must contain Parameter, Region, Region2, Item1, Item2, Item3, Item4, Item5, Item6 in columns A to I respectively followed by the data value in column J (in the format produced by ANSWER's Export Scenario facility) for example:

A (Parameter)	B (Region)	C (Region2)	D (Item1)	E (Item2)	F (Item3)	G (Item4)	H (Item5)	I (Item6)	J (Value)
BI_TRD(ENT)	DEMO	UTOPIA	EXPHCO1	HCO	-	-	IMPHCO1	HCO	1

Note that it is necessary to use - (minus) as a placeholder so that Item1, Item2, Item3, Item4, Item5, Item6 correspond exactly to what ANSWER expects for a given Parameter. In the above example for the BI_TRD(ENT) parameter, ANSWER expects Exporting Region in the Region position, Importing Region in the Region2 position, Export Technology and Commodity in Item1 and Item2 positions, and Import Technology and Commodity in Item5 and Item6 positions, with - (minus) as a placeholder in the Item3 and Item4 positions.

For the Time Independent Trade Data Parameter, the Item positions are as follows:

- Item1 Technology in Export Region
- Item2 Energy Carrier, Material, Emission in Export Region
- Item3 not used
- Item4 TimeSlice
- Item5 Technology in Import Region
- Item6 Energy Carrier, Material in Import Region

Any Item referenced in the Item1-Item6 positions must either already exist in the ANSWER database into which the data is being imported, or must be specified in the Item Data worksheet(s) of the Excel file. That is, the combination of the Item name in the Item1-Item4 position and the Region name as specified in the Region column (column B) must either already exist in the ANSWER database, or must be specified in one of the Item Data worksheets of the Excel file. Likewise for the combination of the Item name in the Item5-Item6 position and the Region2 name as specified in the Region2 column (column C).

2.10.6 Checking of Data in the Excel Import File and Log File Errors

The Import Model Data from Excel facility carries out similar checking for the Import of both the ANSWER “smart” load templates and the “old format” load templates, as follows:

- i. Checking of each Item’s Name, Description, Set Memberships and Units information;
- ii. Checking of each TS and TID Data Parameter to ensure that valid values are specified for the Parameter and each of its arguments; and
- iii. Checking of each TS and TID Trade Data Parameter to ensure that valid values are specified for the Parameter and each of its arguments.

As noted above, if errors are detected then explanatory messages are written to the file ImportDataExcel-n.log in the ANSWER Work folder. These are examined in more detail in sections 2.10.6.1 and 2.10.6.2 below.

Note that the error messages that are put out for TS and TID Data Parameters are easier to understand if importing data from the “old format” load templates than the ANSWER “smart” load templates. Where a TS or TID Data Parameters is imported from the ANSWER “smart” load template, this Parameter is first transformed into the Item1-Item4 (or if a Bilateral Trade Data Parameter into the Item1-Item6) format used to store parameters inside an ANSWER database, and then subjected to the same testing as if it had been imported from an “old format” load template. This should be only a minimal disadvantage, since use of the **[Check Sheet]** button on each “smart” worksheet prior to invoking Import Model Data from Excel should ensure that the worksheet will be largely free of the sorts of errors that are detected by the Import Model Data from Excel checking.

2.10.6.1 Checking Item Data for Valid Set Memberships and Units

Set Memberships checking

ANSWER checks that the Sets specified for an Item define a leaf node in the Set Membership tree. Where the Additional Characterization Sets for this leaf node involve a radio button choice, such as CEN / DCN (or LIQ / SLD / GAZ), ANSWER checks that exactly one of these Sets has been specified.

Examples of Possible Error Messages from Set Memberships checking

Suppose that the user specifies Set Memberships of ENT and ENC for Energy Carrier CSV. These fail to define a leaf node in the Energy Carrier Set Membership tree (since one of ECV / EFS / EHC / ENU / ERN / ESY is also required). The following error message is produced:

```
Record 30 for Item CSV in Region UTOPIA has Set Membership problems as follows:
The set(s) ENT+ENC do not define a leaf node in the Energy Carrier Set
Membership tree.
Sets:      ENT      ENC
```

Suppose that the user specifies Set Memberships of ENT, ENC and EFS for Energy Carrier DSL, but fails to specify one of the Sets LIQ / SLD / GAZ. The Sets ENT, ENC and EFS define a leaf node in the Energy Carrier Set Membership tree, but this leaf node requires one of the Additional Characterization Sets LIQ / SLD / GAZ to be specified. The following error message is produced:

```
Record 34 for Item DSL in Region UTOPIA has Set Membership problems as follows:
  Exactly one of the sets LIQ,SLD,GAZ must be specified for the leaf node
  ENT+ENC+EFS in the Energy Carrier Set Membership tree.
  But none of these sets is specified.
Sets:      ENT    ENC    EFS
```

Units checking

As already noted in section 2.10.5.2, the Units row may contain just 'Units:' in column A, with empty cells in the remainder of the row, in which case ANSWER will assign default units according to the Item's Set Memberships. Where the cells in the remainder of the row are not empty, the units that are specified must be units that already exist in the ANSWER database into which the data is being imported.

Examples of Possible Error Messages from Units checking

Suppose that the user enters the TCAP unit for Technology RHE as PJ/a, when PJ/a was intended. The following error message is produced:

```
Record 118 has illegal UnitID
Units:      COMM= PJ      TACT= PJ      TCAP= PJ/a
```

```
Group of records (for Item RHE in Region UTOPIA) ending near record 120 skipped
over because of errors.
```

2.10.6.2 Checking TS and TID Data Parameters for Valid Parameter and Item Values

Checking for Valid Parameter

ANSWER checks that each Parameter Name is the Name of a valid Data Parameter.

Also ANSWER checks that each Parameter that is specified as being TS (TID) is a valid TS (TID) Data Parameter.

Examples of Possible Error Messages from Checking for Valid Parameter

Suppose that the user mis-spells SECURITY as SECURTY. The following error message is produced:

```
Record 2 has error: 'SECURTY' is not a valid Data Parameter.
SECURTY IMPDSL1      -      -      -      1      1      1
```

Suppose that the user attempts to add SECURITY (TS Data Parameter) from an (old format) *** TID DATA *** sheet (else specifies it as being a TID parameter on a TechData "smart" sheet). The following error message is produced:

```
Record 2 has error: 'SECURITY' is a TS Data Parameter. You cannot add it in from a
*** TID DATA *** sheet.
SECURITY IMPDSL1      -      -      -      1      1      1
```

Suppose that the user attempts to add CUM (TID Data Parameter) from an (old format) *** TS DATA *** sheet (else specifies it as being a TS parameter on a TechData "smart" sheet). The following error message is produced:

```
Record 2 has error: 'CUM' is a TID Data Parameter. You cannot add it in from a ***
TS DATA *** sheet.
CUM      IMPDSL1      -      -      -      0
```

Checking for Valid Item1-Item4 Values in columns B-E of *** TS DATA *** or *** TID DATA *** sheets

ANSWER checks that each of the Items specified in the Item1-Item4 positions (columns B-E) is an Item that already exists in the ANSWER database, or is specified in the *** ITEMS *** worksheet(s) of the Excel file (else is specified on either a Commodities / Technologies / Constraints “smart” sheet, whichever is appropriate). That is, ANSWER checks that the combination of the Item name in the Item1-Item4 position and the Region name for this worksheet as specified in cell B1 either already exists in the ANSWER database, or is specified in one of the Item Data/Declaration worksheets of the Excel file.

ANSWER also checks that each of the Items specified in the Item1-Item4 positions is of the correct Component type for the TS/TID Data Parameter instance being specified.

Checking for Valid Item1-Item6 Values in columns D-I of *** TS TRADE *** or *** TID TRADE *** sheets

Likewise ANSWER checks that each of the Items specified in the Item1-Item6 positions (columns D-I) is an Item that already exists in the ANSWER database, or is specified in the *** ITEMS *** worksheet(s) of the Excel file, having regard to the associated Region for Item1-4 and the associated Region2 for Item5-6 (else is specified on either a Commodities / Technologies / Constraints “smart” sheet, whichever is appropriate).

ANSWER also checks that each of the Items specified in the Item1-Item6 positions is of the correct Component type for the TS or TID Trade Data Parameter instance being specified.

Examples of Possible Error Messages from Checking for Valid Item1-Item4 Values

Suppose that the user mis-spells HCO as BCO when specifying an INP(ENT)c Parameter instance (where BCO is not in the ANSWER database, and is not specified in the *** ITEMS *** worksheet(s) of the Excel file). The following error message is produced:

```
Record 70 has error: 'BCO' is not a valid Item Name for Region UTOPIA.
INP(ENT)c      E01  BCO  -    -    3.125 3.125 3.125
```

Suppose that the user mistakenly enters CO2 in the Item2 position (column C) when specifying an INP(ENT)c Parameter instance. The following error message is produced:

```
Record 70 has error: Parameter 'INP(ENT)c' requires Energy Item in Item2 position
whereas 'CO2' is Emission Item.
INP(ENT)c      E01  CO2  -    -    1      1      1
```

2.11 Importing GAMS Data Dictionary generated by VEDA-SAGE or MUSS

ANSWER's Import GAMS Data Dictionary facility allows the user to import into an ANSWER database the data contained in GAMS Data Dictionary (GAMS *.DD) files generated by VEDA-SAGE or MUSS. Thus this facility provides a very useful means of transferring data from VEDA-SAGE or MUSS into the BASE Scenario and non-BASE Scenarios of an ANSWER database.

Note that you must be running ANSWER version 5.4.1 (or higher) and GAMS-MARKAL code version 5.4b (or higher) to import VEDA-SAGE GAMS DDs, and to import non-BASE MUSS GAMS DDs. (Earlier versions of ANSWER and the GAMS-MARKAL code only permit the import of BASE MUSS GAMS DDs.)

The steps required to Import a GAMS Data Dictionary into an ANSWER database are rather similar regardless of whether the GAMS DD was generated by VEDA-SAGE or by MUSS. However there are sufficient differences that the mechanics of the Import process are presented in separate self-contained sections that follow.

This facility is unchanged since it was created in version 5.4.1 of ANSWER and the documentation and the screen snapshots throughout section 2.11 refer to **AnswerV5**, and have not been updated to **AnswerV6**. If using version 6 of ANSWER, simply read **AnswerV6** everywhere that **AnswerV5** occurs in the text and screen snapshots below.

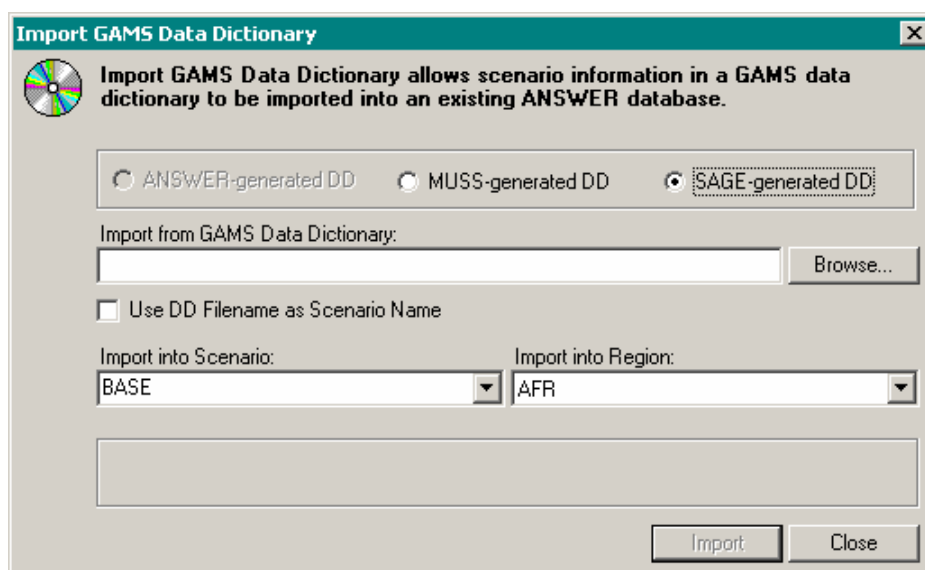
2.11.1 Importing GAMS Data Dictionaries (GAMS DDs) generated by VEDA-SAGE

It is strongly recommended that the user reads through this entire section, and section 2.11.1.1 "Special Considerations where a SAGE GAMS DD file contains Bilateral Trade Data", to obtain an overview of the Import process.

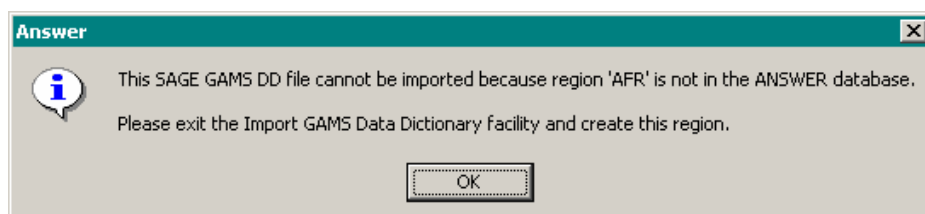
SAGE is a multi-region model, but most VEDA-SAGE GAMS DD files contain data for a single region. The VEDA-SAGE naming convention for a file containing data for a single region is that such a file has a name of the form <scenario>_<region>.DD. For example BASE_AUS.DD contains BASE Scenario data for region AUS (Australia). The VEDA-SAGE naming convention for a file containing bilateral trade data, which is data specifying the bilateral trade possibilities between regions, is that such a file has a name of the form <scenario>_TRADE.DD.

When importing VEDA-SAGE GAMS DD files into a multi-region ANSWER database, ANSWER makes use of the VEDA-SAGE naming convention to detect whether it is a single region or bilateral trade DD file that is being imported, and automatically chooses either the (single) region into which the data will be transferred, or recognises that bilateral trade data must be transferred into multiple regions.

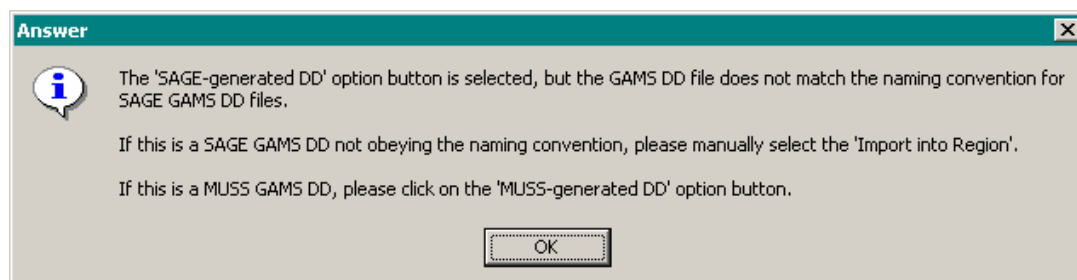
1. The full SAGE model comprises 15 regions (AFR, AUS, CAN, CHI, CSA, EEU, FSU, IND, JPN, MEA, MEX, ODA, SKO, USA, WEU) plus a special global region (GLB). To import BASE scenario data for the full SAGE model into ANSWER requires the import of 15 BASE_<region>.DD files, and the BASE_GLB.DD file, as well as import of the BASE_TRADE.DD file that specifies bilateral trade data. To simplify the mechanics of the Import operation, place all of the SAGE GAMS DD files in the Answer Work folder (default C:\AnswerV5\Ans_WrkPRD).
2. Use **File, New Database...** with the 'Create Initial Region' checkbox unchecked, and with Starting Year 2000, Years per period 5, and Number of Periods 11 to create an empty ANSWER database.
3. A file SAGEregions.IMP has been provided to expedite the creation of the 15 SAGE regions along with the special global region. Place this file in the Answer Work folder (default C:\AnswerV5\Ans_WrkPRD) and then invoke **File, Import, Scenario...** and import this IMP file into the BASE scenario.
Or, if wanting to import just a single SAGE GAMS DD, use the **[Region Management]** button to create a single new Region whose Name corresponds to the <region> part of the SAGE GAMS DD, e.g. create new Region USA if wanting to import just BASE_USA.DD and other <scenario>_USA.DD files.
4. Click on **File** in the menu bar, choose **Import** and then choose **GAMS DD...** in the drop menu. An Import GAMS Data Dictionary dialogue box (shown below) will appear.



5. Use the **[Browse...]** button to select the first SAGE-generated GAMS DD to be imported. *Note that the SAGE-generated BASE GAMS DD file for a region (this file is named BASE_<region>.DD) must be imported into the ANSWER BASE scenario before attempting the import of any of the non-BASE SAGE-generated GAMS DDs for that region into non-BASE scenarios. **Before attempting the import of the special <scenario>_TRADE.DD files that specify bilateral trade data, see section 2.11.1.1 “Special Considerations where a SAGE GAMS DD file contains Bilateral Trade Data”.***
- 6a. As noted above, the VEDA-SAGE naming convention for GAMS DD files is that names are of the form <scenario>_<region>.DD or <scenario>_TRADE.DD. If the filename of the GAMS DD selected at step 5 matches this convention, ANSWER automatically selects the appropriate Region in the ‘Import into Region’ combobox. But there is a possible exception: the < region> part of the filename may refer to a Region that is not in the ANSWER database, in which case the following message box appears:



- 6b. If the filename of the GAMS DD selected at step 5 does not match the convention, the following message box appears alerting the user to the fact that automatic selection of the ‘Import into Region’ is not possible, and suggesting possible alternative courses of action.



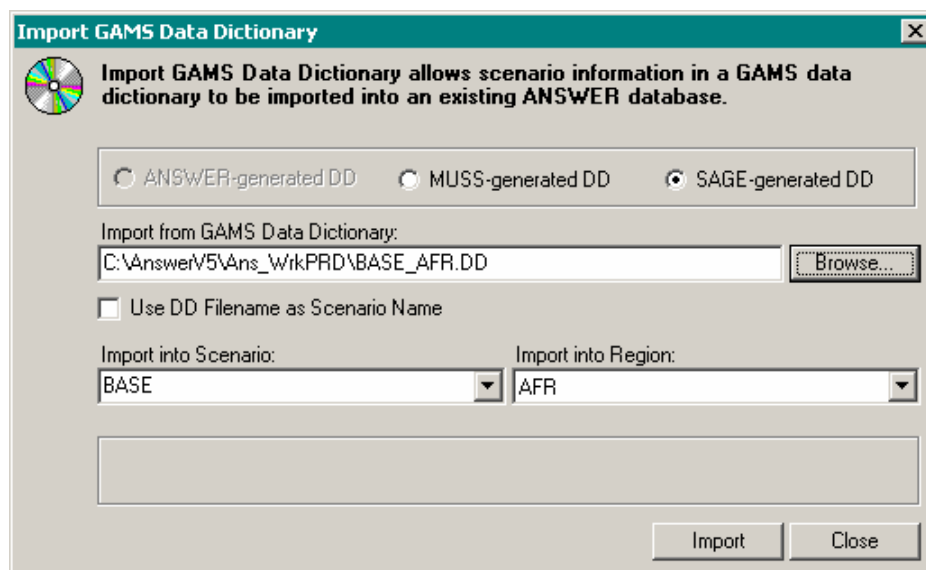
7. If the ‘Use DD Filename as Scenario Name’ checkbox is checked, and provided that the GAMS DD matches the VEDA-SAGE naming convention, the ‘Import into Scenario’ combobox will be automatically set to the first 8 characters of the <scenario> part of the DD

Filename. (So set to REF04_AU if the DD Filename is REF04_AUG_CSA.DD.) Alternatively, use the 'Import into Scenario' combobox to select the Scenario that the data will be imported into, either by choosing an existing Scenario from the combobox, or by keying the name for a new Scenario into the combobox.

8. If at step 6 above, a message box advised that automatic selection of the 'Import into Region' is not possible, use the 'Import into Region' combobox to manually select the appropriate Region in the ANSWER database that the data will be imported into.

Reminder: Special Considerations apply at steps 9, 10, 11a, 11b when importing a SAGE TRADE GAMS DD file containing Bilateral Trade Data, see section 2.11.1.1.

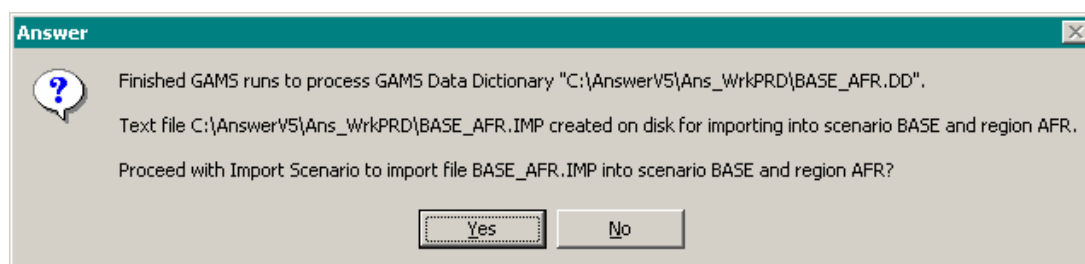
9. The Import GAMS Data Dictionary dialogue box now appears as follows:



Click on the **[Import]** button. This opens a Command Prompt window and initiates two special GAMS runs whose combined effect is to process the GAMS Data Dictionary to create an IMP file that is suitably formatted for ANSWER's Import Scenario facility. (See section 2.9.2 "Importing a Scenario".) The filename assigned to the IMP file is the same as that of the DD file, so in the above case the IMP file created will be BASE_AFR.IMP.

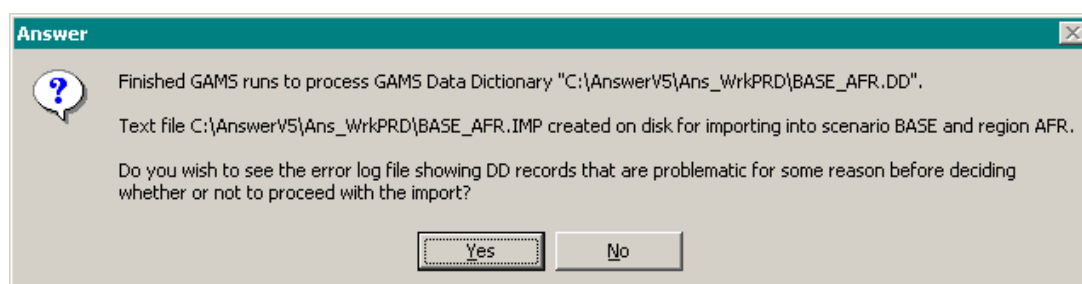
10. Do not be unduly concerned if the two special GAMS runs (RUN_SEP.GMS and RITEMDAT.GMS) produce \$170 warnings, so long as at their completion a message box appears indicating that an IMP file has been created for import – see step 11a below. Alternatively, it may happen that GAMS errors occur in either or both of the GAMS runs in which case no IMP file will be created – see step 11b below.
- 11a. If no GAMS errors (as distinct from warnings) are detected in the special GAMS runs, an IMP file has been created for import, and there are two possibilities:
 - i. RITEMDAT.GMS has not detected any problematic DD records; or
 - ii. RITEMDAT.GMS has detected some DD records that are problematic for some reason, such as inconsistent SET memberships.

In situation i. a message box invites the user to proceed with import of the IMP file.



Go to step 12 below.

In situation ii. a message box invites the user to examine the error log file (in this case BASE_AFR.LOG) produced by RITEMDAT.GMS before deciding whether or not to proceed with import of the IMP file.



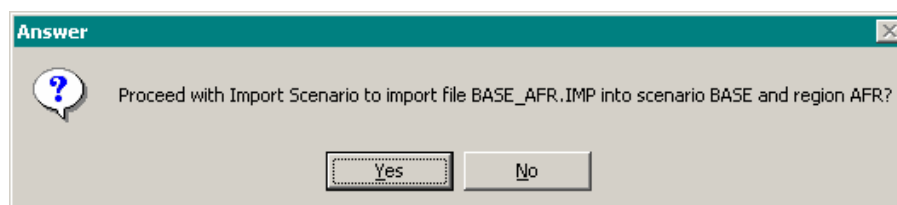
This log file shows records in the DD file that are problematic for some reason. For example the October 2004 SAGE GAMS DDs (incorrectly) list resources (members of SET SRCENCP) as members of SET TCH. The first resource listed in SET TCH for the October 2004 BASE_AFR.DD is IMPELCBGSZ. In the error log file there is a corresponding line:

```
set TCH: item IMPELCBGSZ not in exactly 1 of {CON/DMD/PRC}
```

This admittedly somewhat cryptic message arises because code in RITEMDAT.GMS checks that each member of SET TCH is also in exactly one of the primary TCH subsets CON/DMD/PRC. This code finds that the SRCENCPs incorrectly listed in SET TCH do not occur in exactly one of CON/DMD/PRC (they occur in none of CON/DMD/PRC). As it happens, there are no further consequences for the remainder of the Import process from resources being listed (incorrectly) as members of SET TCH.

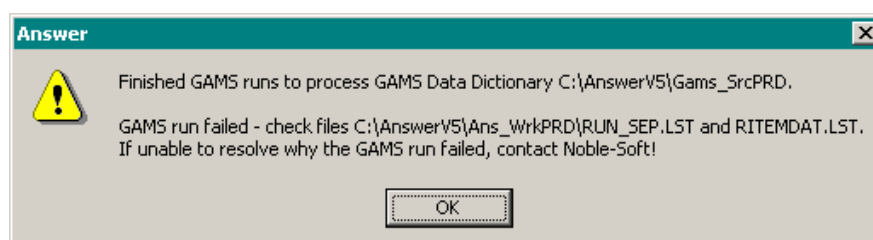
Click on the **[Yes]** button to examine the error log file.

After the user has examined the error log file (or otherwise), the following message box appears inviting the user to proceed with import of the IMP file.



Go to step 12 below.

- 11b. If GAMS errors (as distinct from warnings) are detected in the special GAMS run, a message box appears advising the user that the GAMS run has failed, and to check the GAMS listing files RUN_SEP.LST and RITEMDAT.LST for the reason for failure. These files are located in the Answer Work folder (default C:\AnswerV5\Ans_WrkPRD).



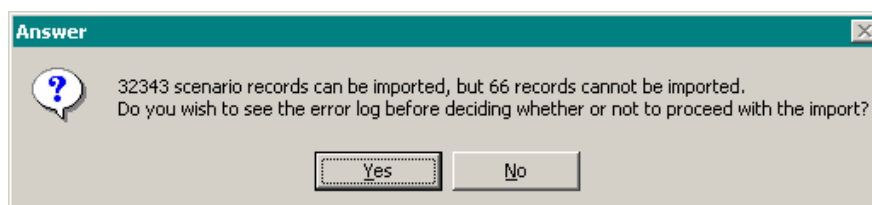
The user is advised that checking the GAMS listing files RUN_SEP.LST and RITEMDAT.LST to determine the reason for failure requires some knowledge of the

fundamentals of the GAMS modelling language. If unable to determine why the GAMS run(s) has(have) failed, please contact Noble-Soft for assistance.

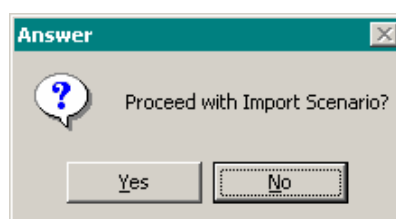
Go to step 13 or 14 below.

12. In situation i. or ii. above, click on the **[Yes]** button to proceed with Import Scenario. Note that when the IMP file corresponding to a BASE SAGE GAMS DD file is being imported, Import Scenario may take several minutes. The frame immediately above the **[Import]** and **[Close]** buttons is updated after 100, 200, 300, ... records have been imported so that the user can see the progress of the Import.

It may happen that not all of the records in the IMP file can be imported into the ANSWER database. For example when importing an October 2004 SAGE BASE GAMS DD file for region AFR, instead of getting a message box confirming successful import of all scenario records, the following message box was obtained indicating that some records could not be imported:



In this particular case, examination of the error log (ImportScenario.log) indicates that for nearly all of the records that cannot be imported, the problem is that "Technology Items do not have appropriate Set Memberships for Parameters". For example there are a number of records in the SAGE BASE GAMS DD file for region AFR that involve the ARAF and SRAF(Z) parameters, but for which the associated Technology Items are not members of the SET HDE. ANSWER knows and insists that the ARAF and SRAF(Z) parameters can only be associated with Technology Items that are members of the SET HDE.



Click on the **[Yes]** button to proceed with the Import.

13. After the import of the first GAMS DD file has been completed, the Import GAMS Data Dictionary dialogue box remains open to allow the import of further GAMS DD files. Simply repeat steps 5-12 above, starting by clicking on the **[Browse...]** button to select the next SAGE GAMS DD to be imported. It is of course important to take care to ensure that the Scenario specification in the 'Import into Scenario' combobox is correct before clicking on the **[Import]** button to initiate the import of the GAMS DD. As noted at steps 6 and 8 above, ANSWER automatically adjusts the selected Region in the 'Import into Region' combobox.
14. Click on the **[Close]** button to exit the Import GAMS Data Dictionary facility.

2.11.1.1 Special Considerations where a SAGE GAMS DD file contains Bilateral Trade Data

Special considerations apply to the import of a SAGE GAMS DD file that contains bilateral trade data, as noted below.

1. As already mentioned, the convention is that SAGE GAMS DD files containing bilateral trade data files are named <scenario>_TRADE.DD.
2. Before attempting the import of a SAGE TRADE GAMS DD file, the SAGE BASE GAMS DD files for all regions (including the special global region GLB) must be imported.
3. When the 'SAGE-generated DD' option button is selected, ANSWER inserts TRADE as the last entry in the 'Import into Region' combobox. This is an indicator to invoke special mechanics for Importing the Trade information. (TRADE is not the name of a Region in the

ANSWER database, indeed TRADE must never be used as a Region name in a multi-region ANSWER database.)

4. Provided that the SAGE GAMS DD being imported adheres to the VEDA-SAGE file naming convention and has a name of the form <scenario>_TRADE.DD, ANSWER automatically selects the TRADE entry in the 'Import into Region' combobox.
5. Otherwise the mechanics of the Import process are the same as for a single-region SAGE GAMS DD, except that special considerations apply at steps 9, 10, 11a and 11b:

At step 9, after the user clicks on the **[Import]** button a single special GAMS run (**RBITRADE.GMS**) is initiated in the Command Prompt window to create an IMP file that is suitably formatted for ANSWER's Import Scenario facility.

At step 10, the special RBITRADE.GMS GAMS run will always produce \$170 warnings. Again do not be unduly concerned, so long as at the completion of this run, a message box appears indicating that an IMP file has been created for import.

At step 11a, if no GAMS errors (as distinct from warnings) are detected in the special GAMS run, an IMP file has been created for import, and there are two possibilities:

- i. RBITRADE.GMS has not detected any problematic DD records; or
- ii. RBITRADE.GMS has detected some DD records that are problematic for some reason.

In situation ii. the user is strongly advised to examine the error log file (<scenario>_TRADE.LOG) produced by RBITRADE.GMS before deciding whether or not to proceed with import of the IMP file.

This error log file shows records in the TRADE DD file that cannot be imported for some reason. Consider whether the reason might be that import of the TRADE DD file has been attempted before the SAGE BASE GAMS DD files for all regions (including the special global region GLB) have been imported.

If the user decides to proceed with the Import, it is most likely that all of the records in the IMP file will be able to be imported. If this is not the case, examine the error log file (ImportScenario.log) before deciding whether or not to proceed with the Import.

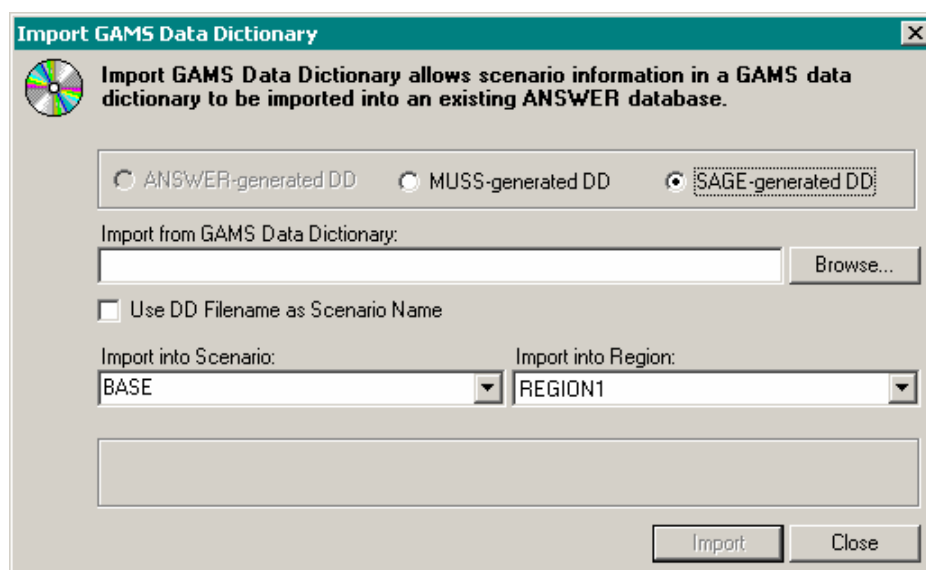
At step 11b, if errors are detected in the special GAMS run, the message box that appears advising the user that the GAMS run has failed, says to check the GAMS listing file **RBITRADE.LST** (rather than the files RUN_SEP.LST and RITEMDAT.LST) for the reason for failure.

2.11.2 Importing GAMS Data Dictionaries (GAMS DDs) generated by MUSS

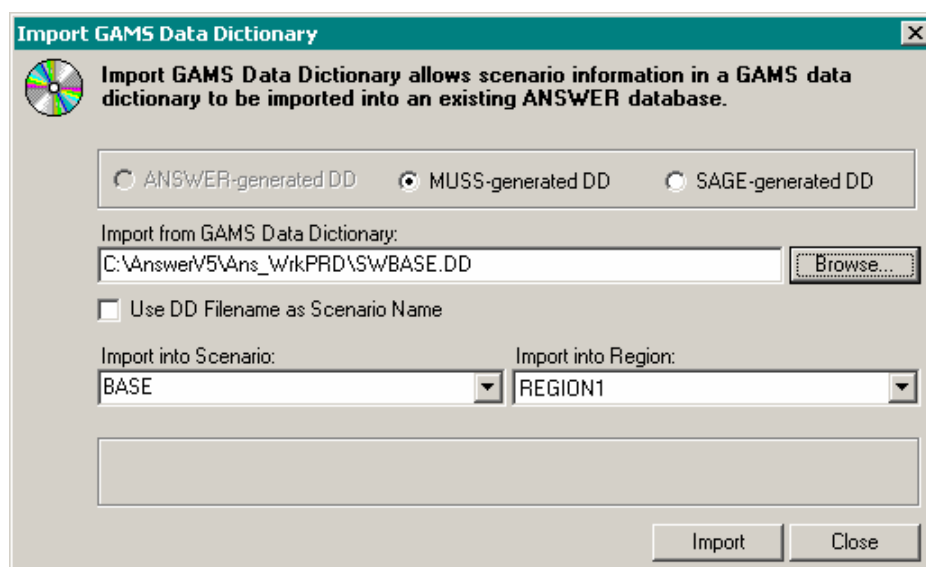
MUSS GAMS DD files always contain data for a single Region. When importing MUSS GAMS DD files into a multi-region ANSWER database, the user must manually choose the Region into which the data will be transferred.

1. Check that the GAMS DDs to be imported are in RMARKAL format, and not in an older MARKAL format. To do this, use an editor such as WordPad to open one of the GAMS DDs and search for the string DM_DEM. If the line contains TABLE DM_DEMAND, then the format is not RMARKAL and the file cannot be imported. But if the line begins TABLE DM_DEM(then the format is RMARKAL and the file is suitable for import. (Contact Gary Goldstein (ggoldstein@irqltd.com), the ETSAP Primary Systems Coordinator, if you require assistance with creating an RMARKAL MUSS DD from an older version of MARKAL.)
2. Place the MUSS-generated BASE and non-BASE GAMS DD files in the Answer Work folder (default C:\AnswerV5\Ans_WrkPRD).
3. First create a New ANSWER Database whose Template Version is 'Production MARKAL', and whose Starting Year, Number of years per Period and Number of Periods correspond to those in the BASE-case GAMS DD to be imported (see section 2.4.1 'Creating a New ANSWER Database');
Or if importing other regions into the same database, create a new Region for the other BASE-case GAMS DD to be imported (see section 2.5.2 'Creating a new Region').
4. Click on **File** in the menu bar, choose **Import** and then choose **GAMS DD...** in the drop menu.

An Import GAMS Data Dictionary dialogue box (shown below) will appear.



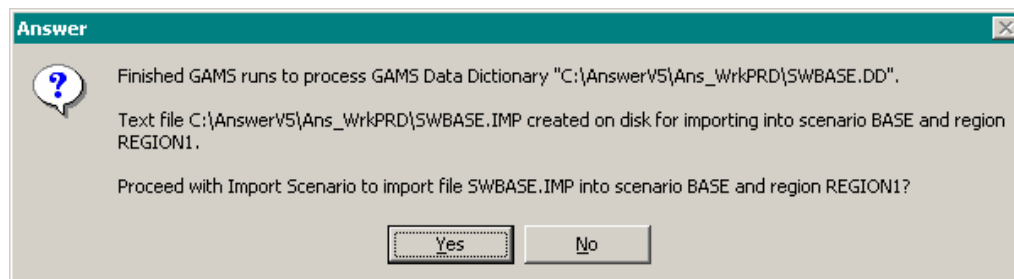
5. Click on the 'MUSS-generated DD' option button.
6. Use the **[Browse...]** button to select the first MUSS-generated GAMS DD to be imported. *Note that the MUSS-generated BASE scenario GAMS DD must be imported into the ANSWER BASE scenario before the import of non-BASE GAMS DDs into ANSWER non-BASE scenarios is attempted.*
7. If the 'Use DD Filename as Scenario Name' checkbox is checked, the 'Import into Scenario' combobox will be automatically set to the first 8 characters of the DD Filename. (So set to HIEFF if the DD Filename is HIEFF.DD.) Alternatively, use the 'Import into Scenario' combobox to select the Scenario that the data will be imported into, either by choosing an existing Scenario from the combobox, or by keying the name for a new Scenario into the combobox.
8. Use the 'Import into Region' combobox to select an existing Region in the ANSWER database that the data will be imported into.
9. The Import GAMS Data Dictionary dialogue box now appears as follows:



Click on the **[Import]** button. This opens a Command Prompt window and initiates two special GAMS runs whose combined effect is to process the GAMS Data Dictionary to create a *.IMP file suitably formatted for ANSWER's Import Scenario facility. (See section 2.9.2 "Importing a Scenario".) The filestem assigned to the IMP file is the same as that of the DD file, so in the above case the IMP file created will be SWBASE.IMP.

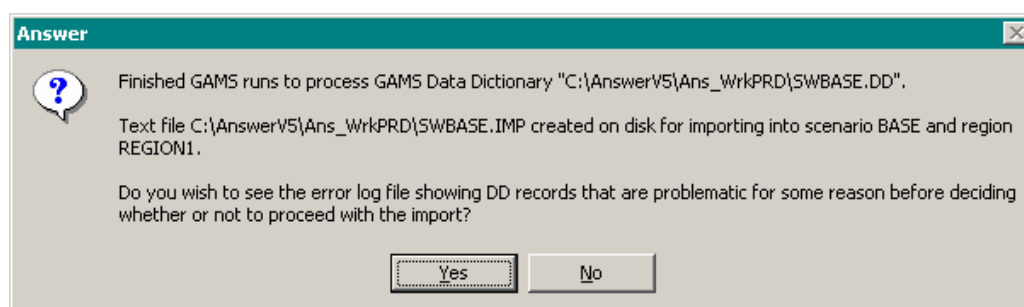
- 10a. If no GAMS errors are detected in the special GAMS runs, an IMP file has been created for import, and there are two possibilities:
- RITEMDAT.GMS has not detected any problematic DD records; or
 - RITEMDAT.GMS has detected some DD records that are problematic for some reason, such as inconsistent SET memberships.

In situation i. a message box invites the user to proceed with import of the IMP file.



Go to step 11 below.

In situation ii. a message box invites the user to examine the error log file (in this case SWBASE.LOG) produced by RITEMDAT.GMS before deciding whether or not to proceed with import of the IMP file.



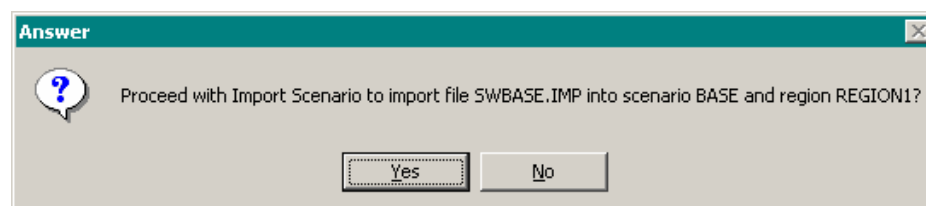
This log file shows records in the DD file that have Set Membership problems. ANSWER attempts to resolve these problems where it can. For example where an energy carrier Item occurs in SET EFS/ESY, but is not in one of the SETs GAZ/LIQ/SLD, ANSWER assumes that the energy carrier is in SET LIQ. In the error log file there is a corresponding pair of lines:

```
set ENC: EFS/ESY item BCO          not in exactly 1 of {GAZ/LIQ/SLD}
*** we will assume that BCO          is in set LIQ ***
```

If this assumption is incorrect, then when the Import process is complete the user should go to the Energy tab and edit energy carrier BCO to change its Set Memberships so that it is in SET GAZ or SET SLD rather than in SET LIQ.

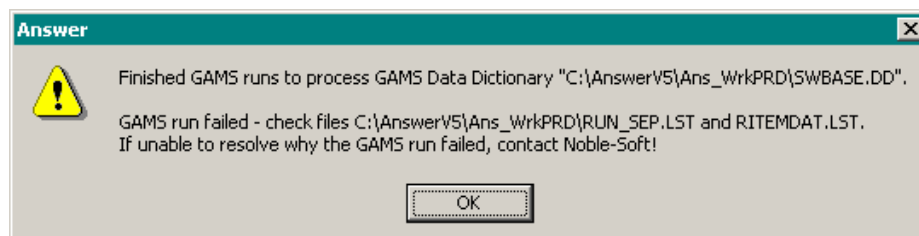
Click on the **[Yes]** button to examine the error log file.

After the user has examined the error log file (or otherwise), the following message box appears inviting the user to proceed with import of the IMP file.



Go to step 11 below.

- 10b. If errors are detected in the special GAMS run, a message box appears advising the user that the GAMS run has failed, and to check the GAMS listing files RUN_SEP.LST and RITEMDAT.LST for the reason for failure. These files are located in the Answer Work folder (default C:\AnswerV5\Ans_WrkPRD).

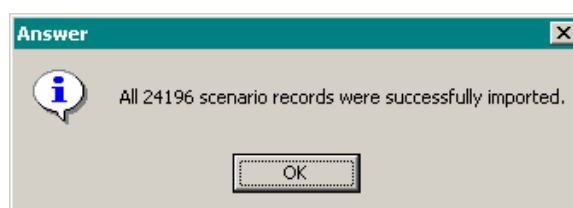


The user is advised that checking the GAMS listing files RUN_SEP.LST and RITEMDAT.LST to determine the reason for failure requires some knowledge of the fundamentals of the GAMS modelling language. If unable to determine why the GAMS run has failed, please contact Noble-Soft for assistance.

Go to step 12 or 13 below.

11. In situation i. or ii. above, click on the **[Yes]** button to proceed with Import Scenario. Note that when the IMP file corresponding to a **BASE** MUSS GAMS DD file is being imported, Import Scenario may take several minutes. The frame immediately above the **[Import]** and **[Close]** buttons is updated after 100, 200, 300, ... records have been imported so that the user can see the progress of the Import.

Once the Import Scenario process is complete, a message box appears confirming successful completion (assuming that all records in the IMP file can be imported into the ANSWER database).



If not all records in the IMP file can be imported, a message box appears indicating the number of records that can and cannot be imported, and suggesting that the user examine the error log (ImportScenario.log) before deciding whether or not to proceed with the Import.

12. After the import of the first GAMS DD file has been completed, the Import GAMS Data Dictionary dialogue box remains open to allow the import of further GAMS DD files. Simply repeat steps 6-11 above, starting by clicking on the **[Browse...]** button to select the next MUSS GAMS DD to be imported. It is of course important to take care to ensure that the Scenario specification in the 'Import into Scenario' combobox and the Region specification in the 'Import into Region' combobox are correct before clicking on the **[Import]** button to initiate the import of the GAMS DD.
13. Click on the **[Close]** button to exit the Import GAMS Data Dictionary facility.

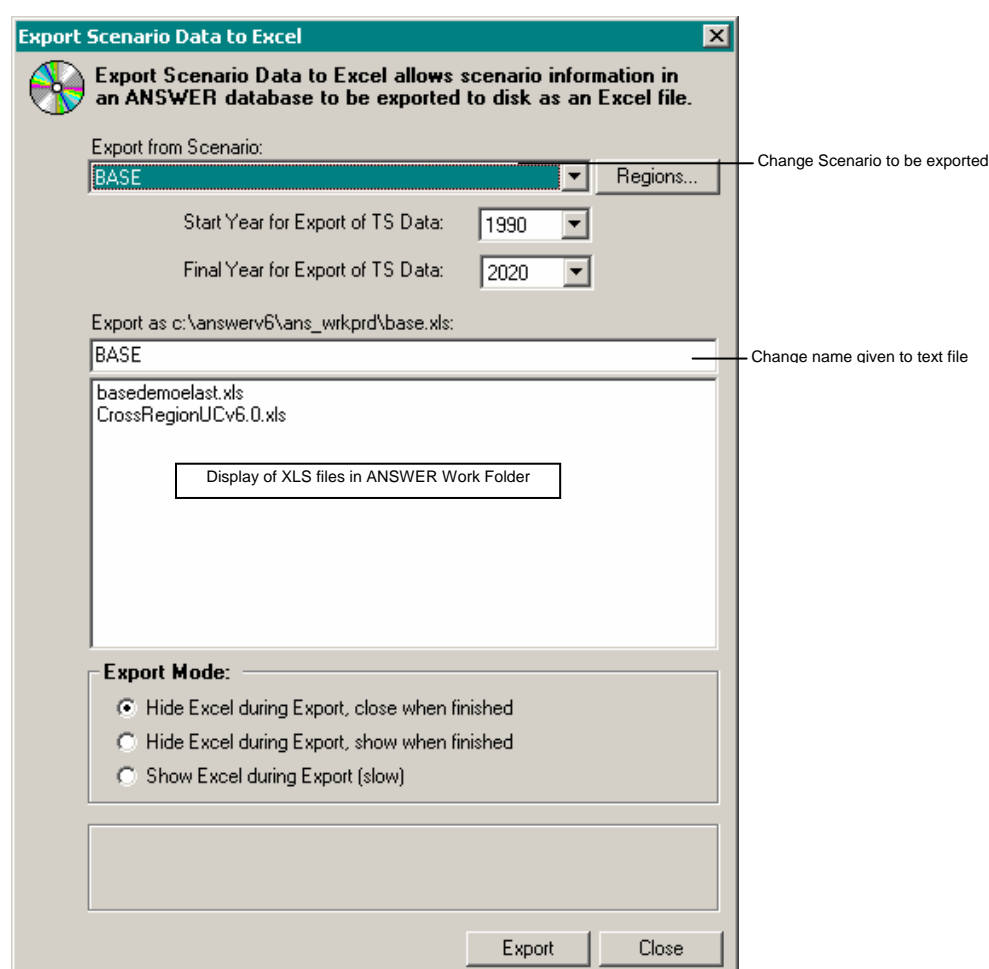
2.12 Exporting Scenario Data to Excel

The 'Export Scenario Data to Excel' facility exports Scenario data to Excel in an identical format to the older *** ITEMS ***, *** TS DATA ***, *** TID DATA *** format that can be used with ANSWER's 'File, Import Model Data from Excel' facility.

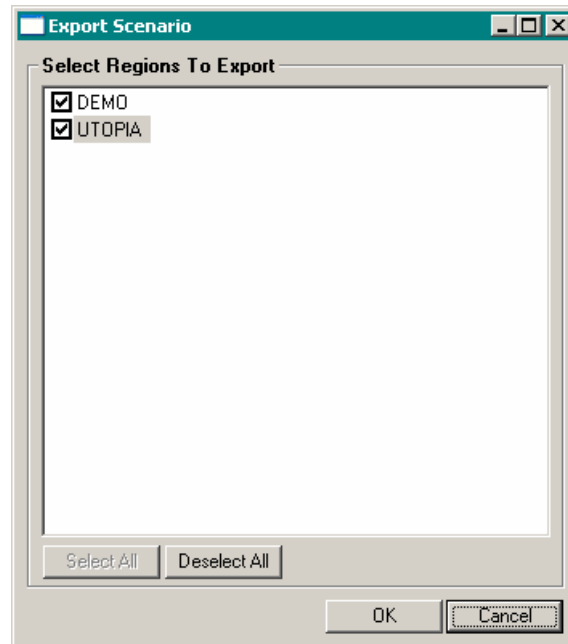
The operation of this facility is similar to the operation of the 'File, Export Scenario' facility.

To export Scenario Data to Excel:

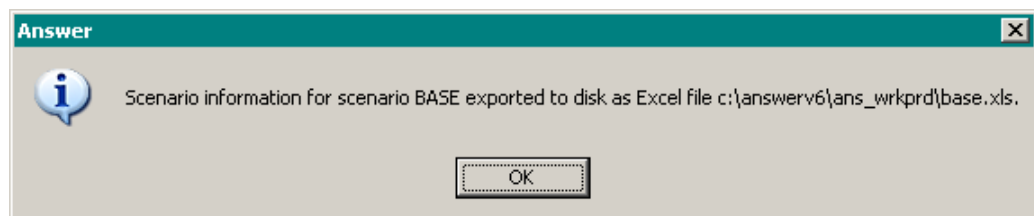
1. Open the origin Database.
2. Click on the Scenario to be exported.
3. Click on **File** in the menu bar and choose **E**xport then choose **S**cenario **D**ata to **E**xcel... in the drop menu.
4. An Export Scenario Data to Excel dialogue box (shown below) will appear, in which the Scenario to be exported will default to the Scenario chosen at Step 2.



5. To vary the Scenario to be exported, choose a different Scenario from the 'Export from Scenario:' combobox. The name given to the Export Scenario Data to Excel XLS file defaults to the Scenario name, with a file type of '.xls'. To vary the name given to the XLS file, either change the name in the 'Export as c:\answerv6\ans_wrkprd\<name>.xls:' textbox, or choose an existing name from the display.
6. By default, the data for all Regions that comprise the scenario will be exported to the .xls file. To export data for a subset of Regions, click on the **[Regions...]** button. This brings up the Export Scenario Select Regions to Export dialogue box on the following page. Select the subset of Regions whose data you wish to export, and click on the **[OK]** button. This returns you to the Export Scenario Data to Excel dialogue box.



7. By default, the data for all periods in the database will be exported to the xls file. That is, the default setting for the 'Start Year for Export of TS Data' combobox will be the year corresponding to the first period in the database, and the default setting for the 'Final Year for Export of TS Data' combobox will be the year corresponding to the final period in the database. To export data for fewer periods, change the default settings of either or both of these comboboxes to correspond to the Start and Final Years for which you want TS data to be exported.
8. Click on the **[Export]** button of the Export Scenario Data to Excel dialogue box to invoke the Export Scenario facility. A message box (shown below) will appear to advise that the Scenario has been exported to C:\AnswerV6\Ans_WrkPRD as XLS file <name>.xls:



Also the frame immediately above the **[Export]** and **[Close]** buttons displays a message reminding the user of the scenario that has just been exported.

9. The Export Scenario Data to Excel dialogue box remains open, so that the user can select another Scenario to export (by choosing the Scenario from the 'Export from Scenario:' combobox) and again click the **[Export]** button.
10. Click on the **[Close]** button to close the Export Scenario Data to Excel dialogue box.

2.13 Repairing and Compacting a Database

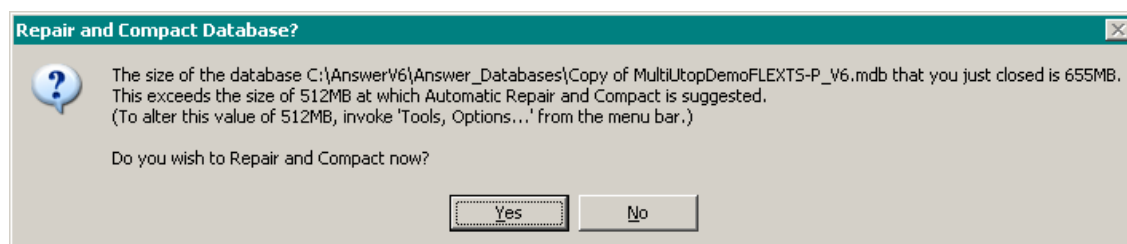
Over a period of time, a Database can become fragmented and use disk space inefficiently, with the result that certain parts of ANSWER slow down very considerably. ANSWER incorporates a Repair and Compact Database facility to remove this fragmentation of space within the Database. This procedure first makes a copy of the Database (named *.bak) in the same folder as the original Database, and then repairs any damage and compacts the Database file on disk. Provided that no errors are encountered during the Repair and Compact process, the *.bak copy of the original Database is deleted.

As a matter of course, repairing and compacting a Database should be carried out at least once a week.

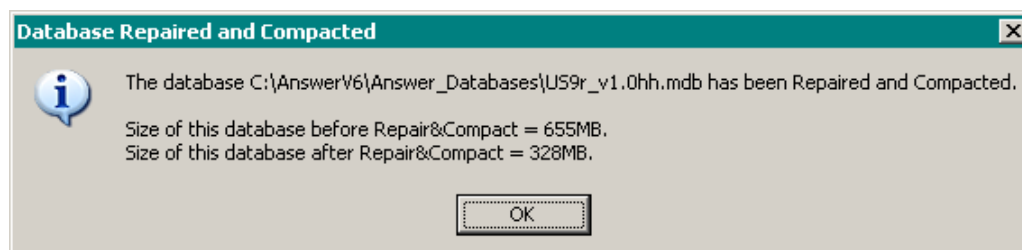
By default, ANSWER version 6.2.11 (and higher) automatically invokes the Repair and Compact Database facility at Close Database time if the database that is being closed has grown “too big”. See section 2.13.1 below. The user may also invoke the facility from **T**ools in the menu bar. See sections 2.13.2 and 2.13.3 below for details.

2.13.1 ANSWER-initiated Automatic Repair and Compact of a Database

By default, ANSWER version 6.2.11 (and higher) automatically invokes the Repair and Compact Database facility at Close Database time if the database that is being closed has grown “too big”, where the default value of “too big” is the database size exceeding 512MB. When you close a database that has grown “too big” either via ‘File, Close Database’ or simply by exiting ANSWER via ‘File, Exit’, the following prompt will appear:



inviting you to Repair and Compact the database. Click on the **[Yes]** button to invoke the Repair and Compact Database facility. If you do this, a message will appear to indicate that repair and compact is complete:



Note that both the automatic invoking of Repair and Compact, and the Database Size at which automatic invoking occurs, may be controlled by the user through the **T**ools, **O**ptions... menu bar facility. See section 3.9 ‘Tools, Options’ with particular reference to sub-section 3.9.5 ‘Repair and Compact Current Database’.

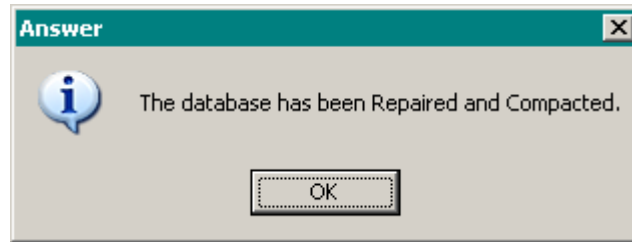
2.13.2 User-initiated Repair and Compact of a Currently Open Database

ANSWER version 5.3.0 (and higher) allows the user to invoke the Repair and Compact Database facility for the *currently open* ANSWER database.

To repair and compact the currently open Database:

1. Click on **T**ools in the menu bar.
2. Click on **R**epair and Compact Current Database in the drop menu.

3. With no further user intervention, the currently open database will be closed, and the Repair and Compact Database operation will be initiated. A message will appear to indicate that repair and compact is complete:

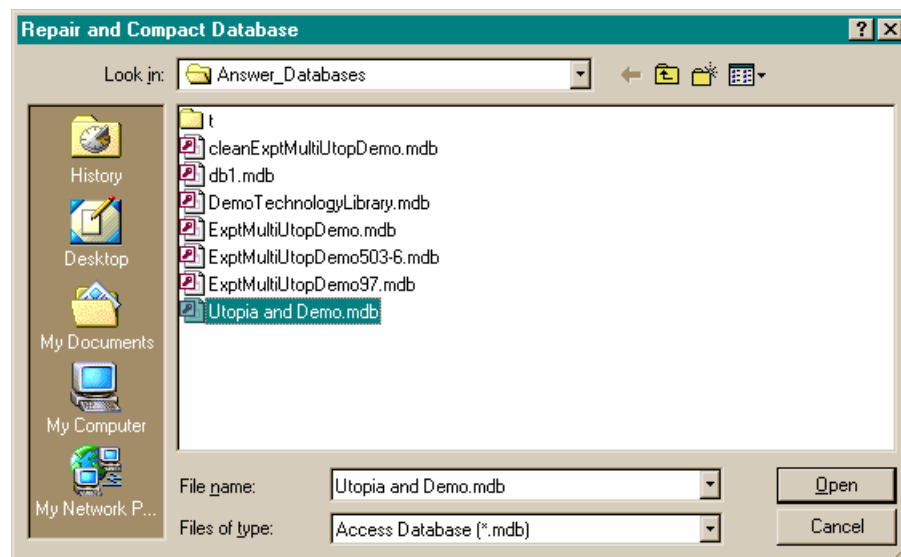


4. Click on the **[OK]** button, and the repaired and compacted database will be reopened.

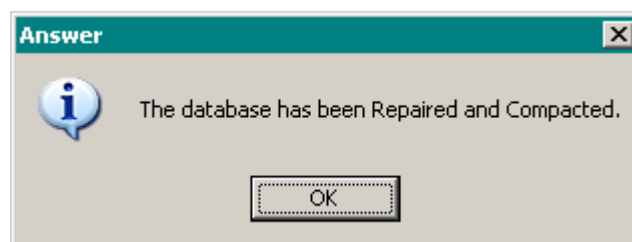
2.13.3 User-initiated Repair and Compact of a Database that is not Currently Open

To repair and compact a Database that is not currently open in ANSWER:

1. Close any currently open database (see Section 2.4.3 'Closing a Database').
2. Click on **T**ools in the menu bar.
3. Click on **R**epair and **C**ompact Database... in the drop menu.
4. A Repair and Compact Database dialogue box will appear (shown below).



5. Click on the Database to be repaired and compacted, and click **[Open]** to initiate the operation.
6. When the operation has completed, an information box will appear (shown below).



7. Click on the **[OK]** button. The repaired and compacted Database can subsequently be operated in the usual manner.

2.14 Tools, Default File Locations and Tools, File Locations

In ANSWER versions 5 and 6, the default folder names for the GAMS Source, GAMS Work, ANSWER Work and ANSWER Databases folders are Gams_SrcPRD, Gams_WrkPRD, Ans_WrkPRD and Answer_Databases respectively. These default folder names are perfectly adequate for most users, but some users may wish to have greater flexibility.

The **Tools, Default File Locations...** menu bar facility allows the user to display the folder names that will be associated with any ANSWER database that is created by use of the **File, New Database...** facility, and to change these folder names as desired. In other words, the current folder names as displayed by this facility will be associated with each ANSWER database that is created by future use of the **File, New Database...** facility. Use of this facility to change folder names has no effect on the folder names that are associated with ANSWER databases that already exist.

The **Tools, File Locations...** menu bar facility allows the user to display the folder names that are associated with the currently open ANSWER database, and to change these folder names as desired. Use of this facility affects only the folder names that are associated with the currently open ANSWER database. It has no effect on the folder names that are associated with any other ANSWER databases that already exist, or on the folder names that will be associated with any ANSWER database that is created by future use of the **File, New Database...** facility.

Either of these facilities also allows the user to choose a favourite text editor to be used for all ANSWER text file editing operations, in place of ANSWER's default of WordPad. The choice of text editor is not associated with an individual ANSWER database, but is a global ANSWER setting.

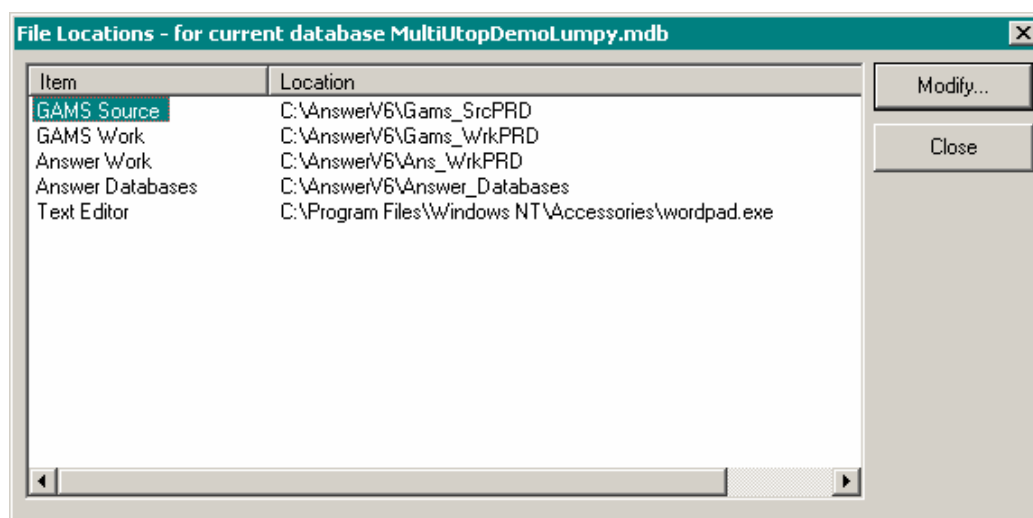
The steps required to use the **Tools, Default File Locations...** facility or the **Tools, File Locations...** facility to display and to change folder names, or to choose a favourite text editor, are exactly similar, and will now be detailed.

2.14.1 User Control of Folder Names for GAMS Source, GAMS Work, ANSWER Work folders

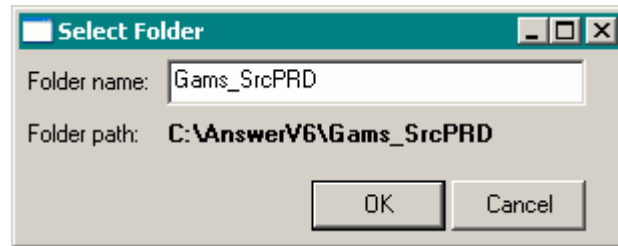
See above for a discussion of the respective roles of the **Tools, Default File Locations...** and the **Tools, File Locations...** facilities in respect of the folder names used for the GAMS Source or GAMS Work or ANSWER Work folders.

To use either of these facilities to modify the folder name used for the GAMS Source or GAMS Work or ANSWER Work folder:

1. Click on **T**ools in the menu bar and choose either , **Default File Locations...** or **File Locations...** from the drop menu, as appropriate. Then click on the appropriate item, e.g. GAMS Source, to highlight it (see below).



2. Click on the **[Modify...]** button. This brings up the Select Folder dialogue box (see below).



3. Modify the Folder Name, and then click on the **[OK]** button.
4. Click on the **[Close]** button to close the File Locations dialogue box.
5. The most useful aspect of this facility is probably that it allows the advanced user who has a number of different ANSWER databases to have different Gams Work folders corresponding to each database. It also allows very advanced users to have different Gams Source folders so that they can experiment with different versions of the GAMS code.
6. Note that while the user has control of the folder names, the folders still have to be subdirectories of the ANSWER home directory.

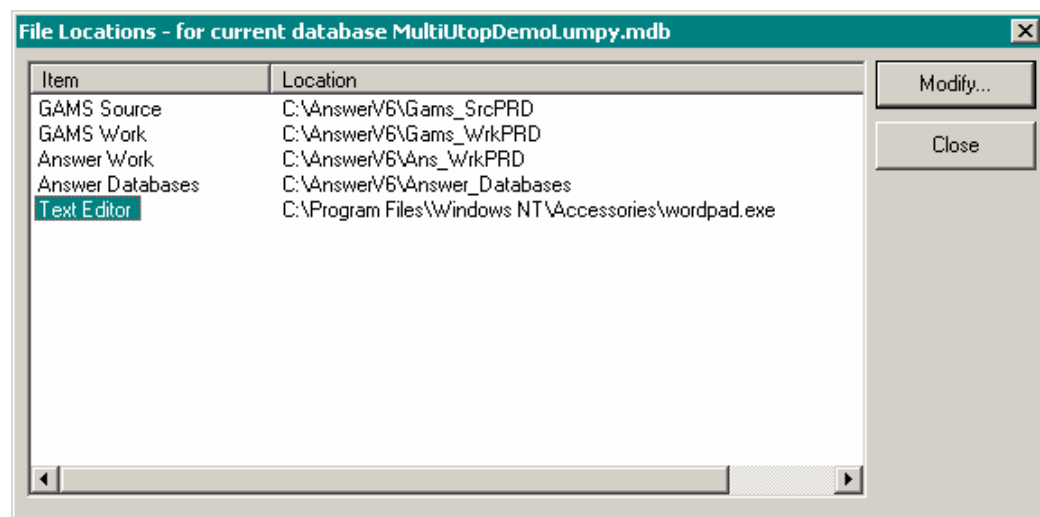
2.14.2 User Choice of Text Editor

ANSWER's default is to use WordPad (Wordpad.exe) as its default text editor.

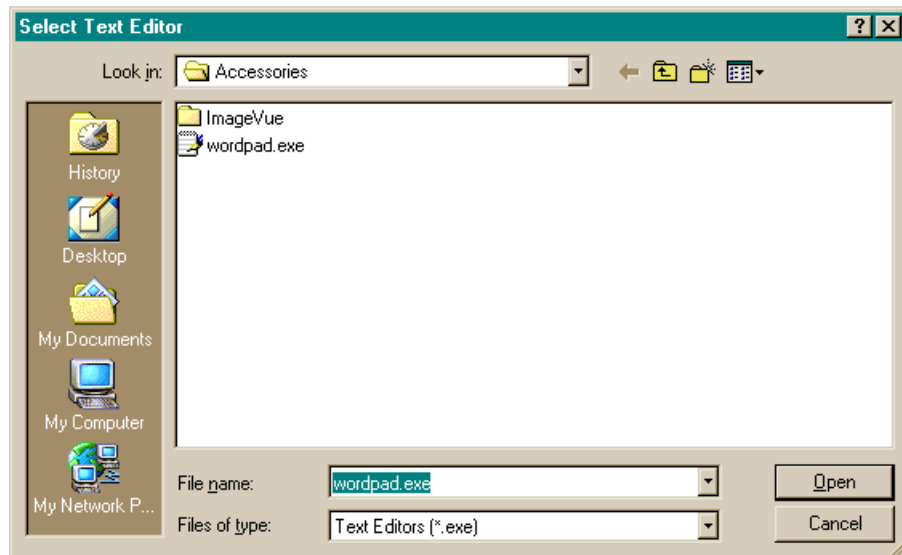
To switch from Wordpad.exe to your favourite text editor:

1. Click on **T**ools in the menu bar and choose either **Default File Locations...** or **File Locations...** from the drop menu. Then click on the Text Editor item to highlight it.

Note that the form that appears below was brought up by choosing **T**ools, **F**ile **L**ocations... since the caption is "File Locations – for current database MultiUtopDemoLumpy.mdb". In the current context of changing to your favourite text editor, this caption is a little misleading. Any change that you make in respect of the Text Editor will apply globally to any currently open ANSWER database.



2. Click on the **[Modify...]** button. This brings up the Select Text Editor dialogue box (see below).



3. Locate your favourite text editor, and then click on the **[Open]** button.
4. Click on the **[Close]** button to close the File Locations dialogue box.

2.15 Password protection facilities

ANSWER has two password protection facilities, namely a Database Logon password and a BASE Scenario Edit password. Use of these facilities is optional. *Most ANSWER users do not password protect either logon to their Database, or the editing of the BASE Scenario.*

2.15.1 Database Logon password facility

The Database Logon password facility is available to prevent unauthorised access to each individual Database within ANSWER. The password protection does not prevent unauthorised access to ANSWER or to non-protected Databases within ANSWER.

As part of general software security and database integrity, users should recognise that all data and software on a personal computer (PC) remains accessible to unauthorised access, loss, or corruption by other routes, such as MS Explorer.

It remains the responsibility of the user to determine the level of risk of loss or corruption of their ANSWER MARKAL software and database(s), and to institute appropriate precautions.

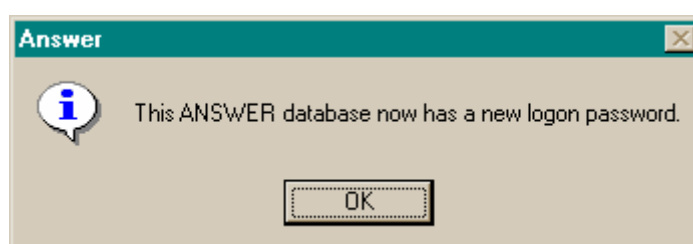
2.15.1.1 Applying the Database Logon password protection

To apply Database Logon password protection to a Database:

1. Open the Database.
2. Click on **Tools** in the menu bar and choose **Change Logon Password...** in the drop menu.
3. A Change Logon Password dialogue box (shown below) will appear.



4. Leave the Old Password field blank, but enter the password in both the New Password and Verify fields. The password facility is case sensitive and must have a minimum of four alpha numeric characters. The **[OK]** button will then become enabled.
5. Click on **[OK]** and an ANSWER dialogue box (shown below) will confirm that the Database has a new logon password.



2.15.1.2 Using the Database Logon password protection

To open a Database that has password protection:

1. Initiate the 'Open Database' procedure.
2. A Logon Password dialogue box (shown below) will appear.



3. Enter the password. The [OK] button will then become enabled.
4. Click on [OK] and the Database will open.

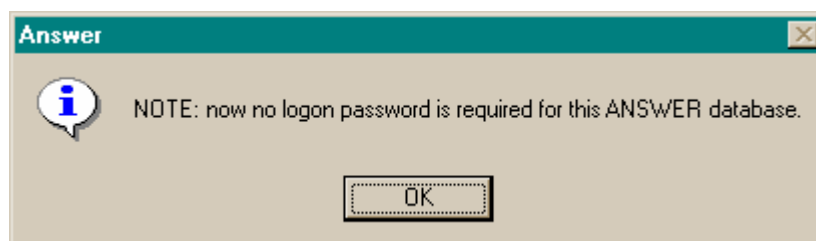
2.15.1.3 Removing the Database Logon password protection

To remove password protection from a Database:

1. Open the Database.
2. Click on **Tools** in the menu bar and choose **Change Logon Password...** in the drop menu.
3. A Change Password dialogue box (shown below) will appear.



4. Enter the Old Password (the [OK] button will then become enabled), but leave the New Password and Verify fields empty.
5. Click on [OK] and an ANSWER dialogue box (shown below) will confirm that the Database does not require a logon password.



2.15.2 BASE Scenario Edit password facility

The BASE Scenario Edit password facility is available to prevent unauthorised editing of the BASE Scenario within each individual Database within ANSWER. The password protection does not prevent browsing of a BASE Scenario or unauthorised access to non-BASE Scenarios within a Database.

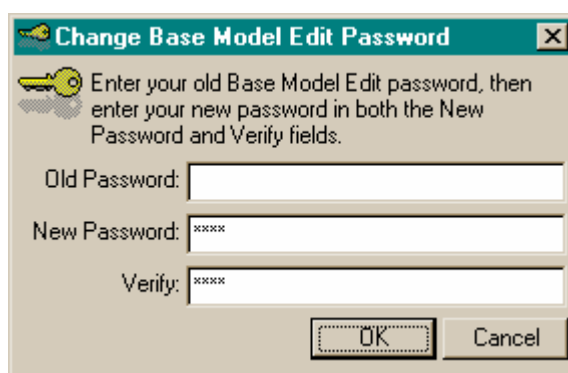
As part of general software security and database integrity, users should recognise that all data and software on a personal computer (PC) remains accessible to unauthorised access, loss, or corruption by other routes, such as MS Explorer.

It remains the responsibility of the user to determine the level of risk of loss or corruption of their ANSWER MARKAL software and database(s), and to institute appropriate precautions.

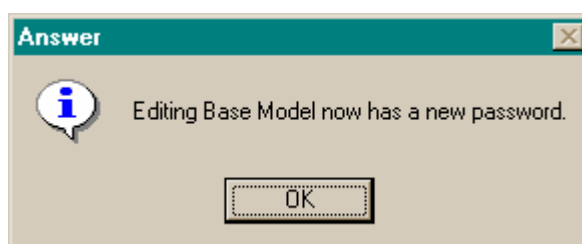
2.15.2.1 Applying the BASE Scenario Edit password protection

To apply password protection to editing of a BASE Scenario:

1. Open the Database.
2. Click on **T**ools in the menu bar and choose **C**hange Base Model **E**dit Password... in the drop menu.
3. A Change Password dialogue box (shown below) will appear.



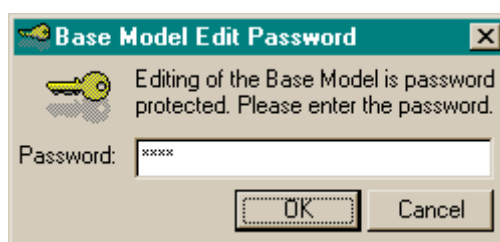
4. Leave the Old Password field blank, but enter the password in both the New Password and Verify fields. The password facility is case sensitive and must have a minimum of four alpha numeric characters. The **[OK]** button will then become enabled.
5. Click on **[OK]** and an ANSWER dialogue box (shown below) will confirm that the BASE Scenario has a new edit password.



2.15.2.2 Using the BASE Scenario Edit password protection

To edit a BASE Scenario that has password protection:

1. Double-click on the BASE Scenario icon in the Selected Scenarios display.
2. A Base Model Edit Password dialogue box (shown below) will appear.

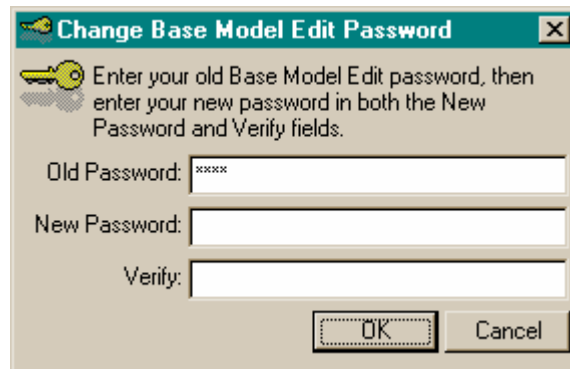


3. Enter the password. The **[OK]** button will then become enabled.
4. Click on **[OK]** and the BASE Scenario will now be editable.

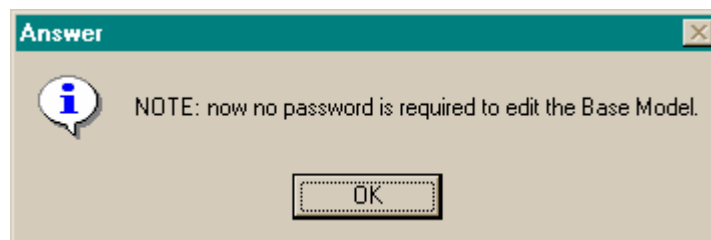
2.15.2.3 Removing the BASE Scenario Edit password protection

To remove the edit password protection from a BASE Scenario:

1. Open the Database.
2. Click on **Tools** in the menu bar and choose **Change Base Model Edit Password...** in the drop menu.
3. A Change Base Model Edit Password dialogue box (shown below) will appear.



4. Enter the Old Password (the **[OK]** button will then become enabled), but leave the New Password and Verify fields empty.
5. Click on **[OK]** and an ANSWER dialogue box (shown below) will confirm that the BASE Scenario does not require an edit password.

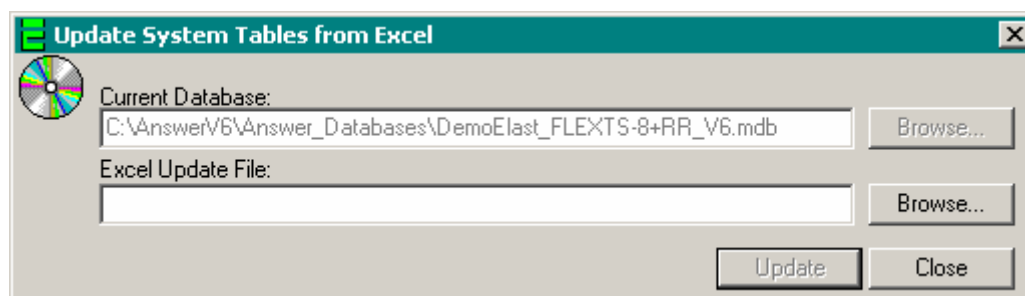


2.16 Updating System Tables from Excel

ANSWER's Update System Tables from Excel facility simplifies the process of updating ANSWER System Tables **in an existing ANSWER database** to incorporate new features, or to rectify errors and omissions that may be detected from time to time. This feature permits Noble-Soft to email to ANSWER clients an Excel Update File containing the information needed to update System Tables in their existing databases, so that the client can apply the update via a simple menu procedure.

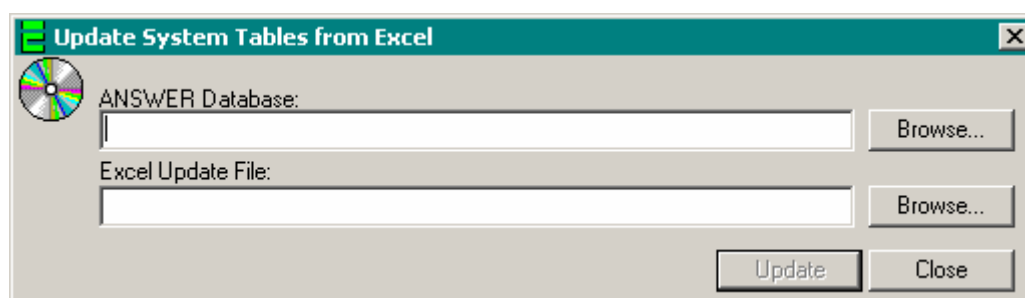
To update System Tables in an existing ANSWER database:

1. Ensure that you have updated your ANSWER system to the most recent version. (For example, if the most recent version is 6.2.15 by following the instructions in "AnswerV6.2.15 Update Download.doc". This means that your ANSWERv6.exe will be version 6.2.15, and that the Excel Update File "UpdateAnsSysTables_V6215.xls" (or some similarly named xls file) will reside in your ANSWERv6 home directory (default C:\AnswerV6)).
- 2a. If the ANSWER database that you wish to update is open inside ANSWER, then choose the **File, Update System Tables from Excel for Current Database...** menu item. This brings up the following dialogue box in which the Current Database textbox contains the name of the currently open database:



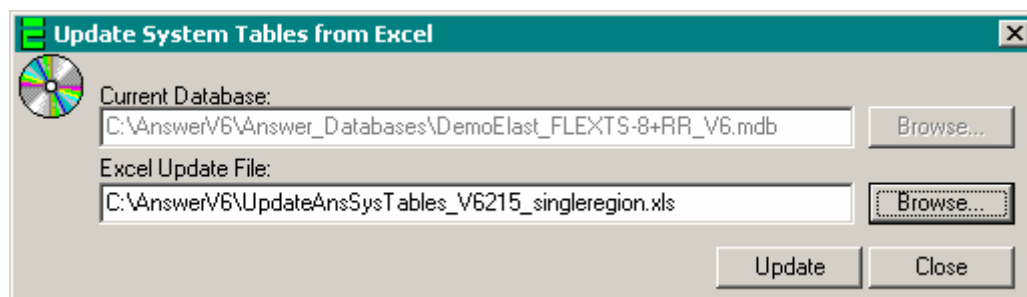
Carry out steps 4 to 7, and step 9 below.

- 2b. Alternatively, if you have several ANSWER databases that you wish to update, with ANSWER open but no database open inside ANSWER, choose **File, Update System Tables from Excel...** from the menu bar. This brings up the following dialogue box:

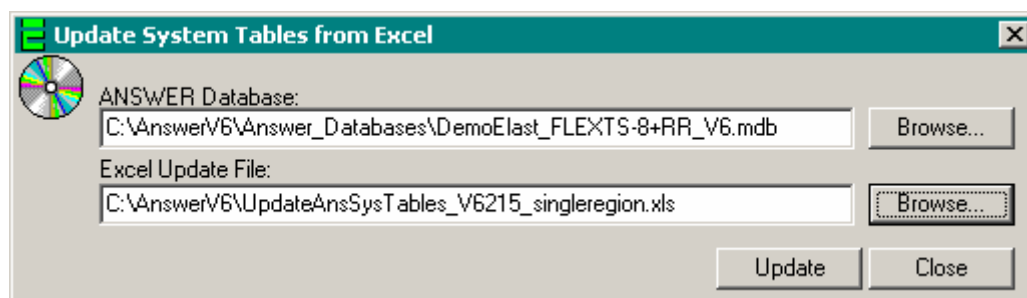


Carry out steps 3 to 9 below.

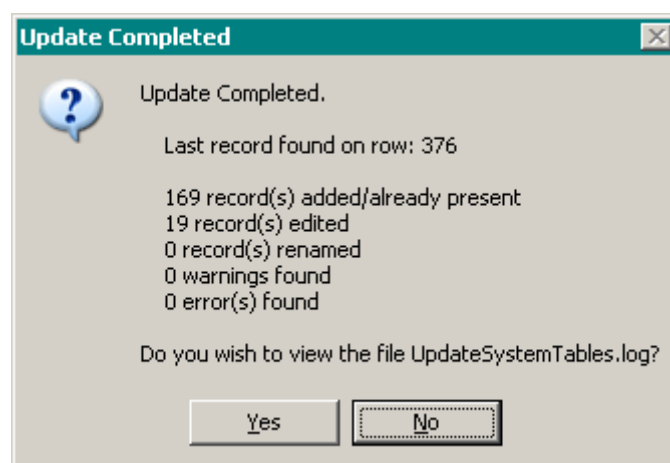
3. Use the **[Browse...]** button alongside the 'ANSWER Database' textbox to select the ANSWER database that you wish to update.
4. Use the **[Browse...]** button alongside the 'Excel Update File' textbox to select the Excel Update File to be used for the update. For example, for the ANSWER version 6.2.15 update, select the file "UpdateAnsSysTables_V6215_singleregion.xls" in your ANSWER home directory.
5. Now the dialogue box appears as follows if your starting point was step 2a:



or as follows if your starting point was step 2b:



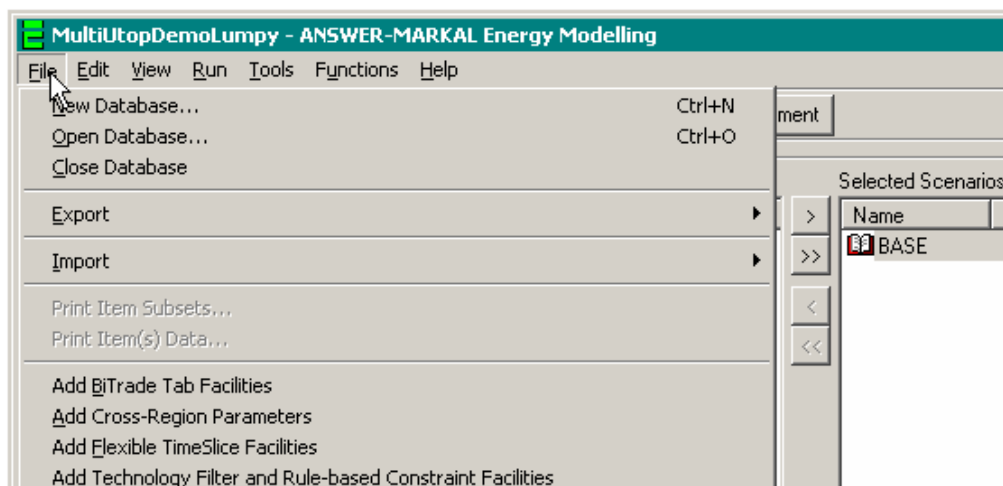
6. Click on the **[Update]** button. A message box appears confirming that the update has been completed, and summarising the number of records added/edited/renamed:



7. In the unusual event that warnings or errors are generated as part of the update process, you can examine them in the file UpdateSystemTables.log (in the C:\AnswerV6\Ans_WrkPRD folder) by clicking on the **[Yes]** button. Email Noble-Soft the UpdateSystemTables.log file if you are concerned about any warnings or errors in the log file. Otherwise, click on the **[No]** button.
8. If your starting point was step 2b and you have other ANSWER databases that you wish to update (with the same Excel Update File), simply use the **[Browse...]** button alongside the 'ANSWER Database' textbox to select another ANSWER database to be updated, and click on the **[Update]** button to initiate the update. Then repeat for each other ANSWER database that you wish to update.
9. Click on the **[Close]** button to close the Update System Tables from Excel dialogue box.

2.17 Updating an ANSWER Database to be aware of New Facilities

Some new ANSWER facilities require not only a new ANSWER EXE (e.g. a new AnswerV6.exe) but also for some of the tables within an existing ANSWER database to be updated (or for new tables to be created). A number of **File** menu options are available that allow an existing ANSWER database to be updated to be aware of new facilities:



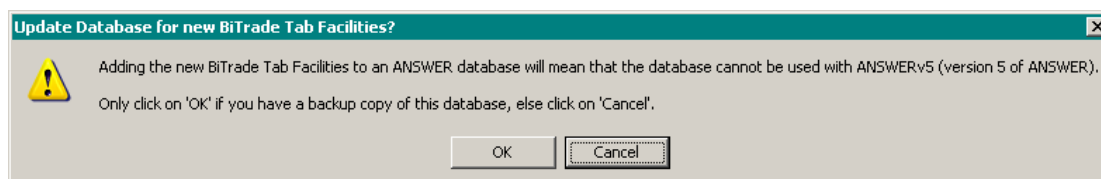
Each of these facilities is discussed below.

2.17.1 Add BiTrade Tab Facilities

The **File** menu option **Add BiTrade Tab Facilities** allows the user to make an ANSWER version 6 (or an ANSWER version 5) database aware of the new ANSWER version 6 BiTrade Tab facilities. For details of the new ANSWER version 6 BiTrade Tab facilities, see section 15 'Handling Bilateral Trade in ANSWER'.

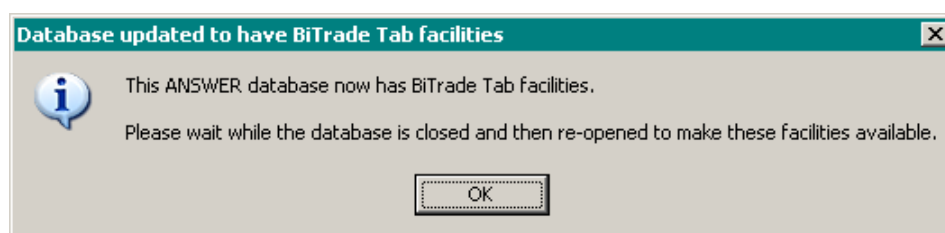
To make an ANSWER version 6 (or version 5) database aware of the new ANSWER version 6 BiTrade Tab facilities:

1. Open the database with the AnswerV6.exe in folder C:\AnswerV6 and from the menu bar immediately invoke **File, Add BiTrade Tab Facilities**. (You must invoke immediately after opening the database, if you move to the Data/Results screen, this menu item becomes disabled, and you will need to close the database and then reopen it in order for the menu item to be available.) The following message box appears:



(If the database has already been updated for either or both of Flexible TimeSlice facilities and Technology Items Filter and Rule-based Constraint facilities, and hence is already an ANSWER version 6 database, you will not be able to use it with ANSWERV5 in any case.)

2. Assuming that you have a backup copy of the database, click on the **[OK]** button. After a couple of seconds, a message box confirms that the database has been updated to have these facilities:



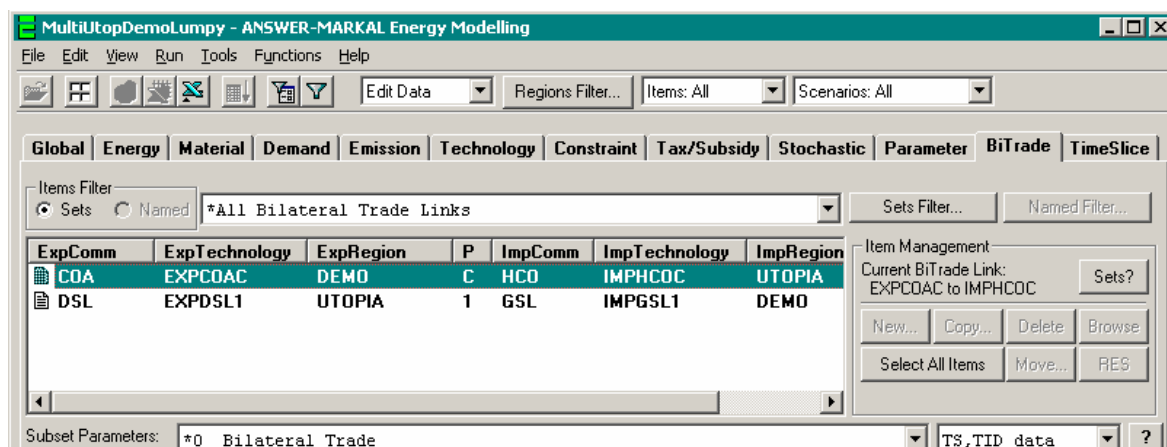
3. As indicated by the message, simply click on the **[OK]** button, and wait while the database is closed and then re-opened with these facilities now available.
4. If the database already has these facilities, the following message box appears:



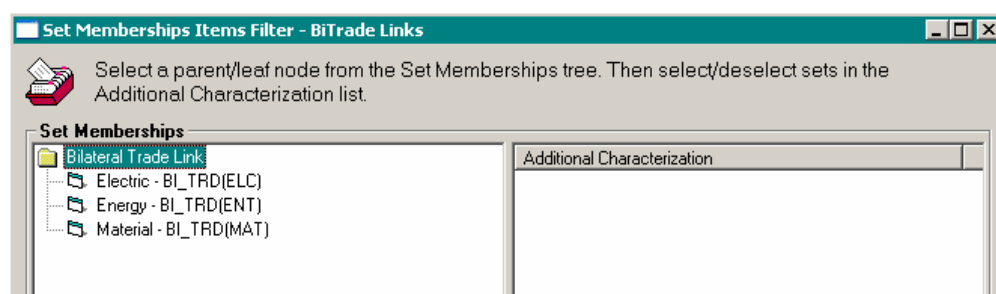
2.17.1.1 Indications that an ANSWER Database is aware of BiTrade Tab Facilities

What are the indications that an ANSWER Database is aware of BiTrade Tab facilities?

1. On moving to the Data/Results screen, you will see that the Trade tab has been renamed to **BiTrade**, and if you click on the BiTrade tab you will see that Bilateral Trade data is presented in a completely new format in which the Items listview is populated with Bilateral Trade Links:



2. On the BiTrade tab, if you click on the **[Sets Filter...]** button (immediately to the right of the large combobox), you will see the BiTrade subsets that are available, as follows:



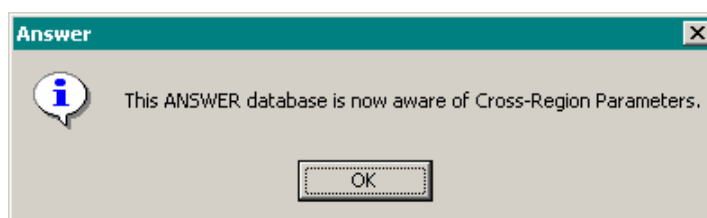
3. It should be noted that further enhancement of the bilateral trade facilities is on-going.

2.17.2 Add Cross-Region Parameters

The **File** menu option **Add Cross-Region Parameters** allows the user to make a multi-region ANSWER database aware of cross-region data parameters that are needed if the user wishes to be able to model cross-region emission constraints and cross-region user-defined constraints. For details, see section 11 'Cross-Region Constraints in ANSWER'.

To make an ANSWER database aware of cross-region data parameters:

1. Open the database and from the menu bar immediately invoke **File, Add Cross-Region Parameters**. (You must invoke immediately after opening the database, if you move to the Data/Results screen, this menu item becomes disabled, and you will need to close the database and then reopen it in order for the menu item to be available.)
2. A message box will appear to confirm that cross-region parameters have been added to the database. See below.



3. Click on the **[OK]** button.

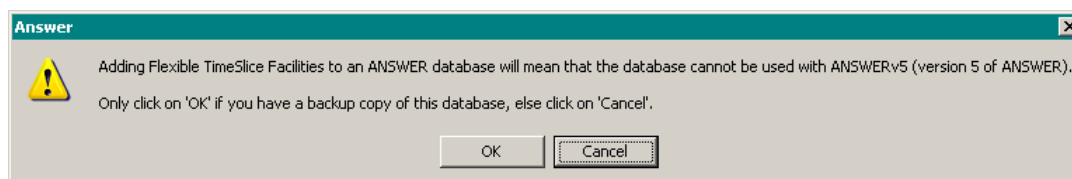
2.17.3 Add Flexible TimeSlice Facilities

The **File** menu option **Add Flexible TimeSlice Facilities** allows the user to make an ANSWER version 5 database aware of the new ANSWER version 6 Flexible Time Slice facilities.

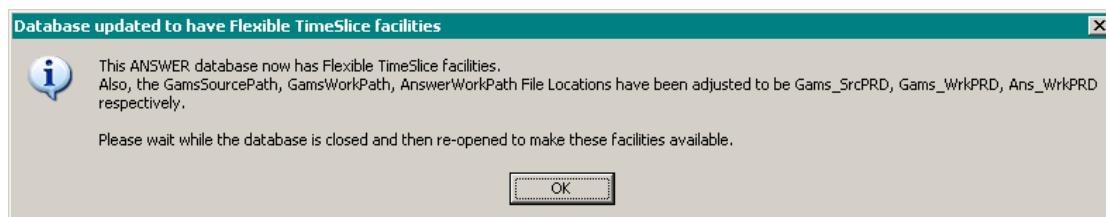
For details of the new ANSWER version 6 Flexible Time Slice facilities, see section 14 'Handling Flexible Time Slices in ANSWER'.

To make an ANSWER version 5 database aware of the new ANSWER version 6 Flexible Time Slice facilities:

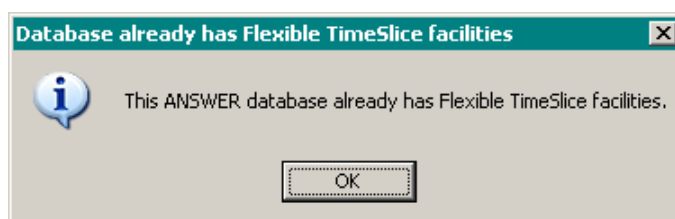
1. If you have not previously done so, use AnswerV5.exe and the "File, Update System Tables from Excel" facility (specifying UpdateAnsSysTables_V550.xls as the Excel Update File) to ensure that the ANSWER version 5 database that you wish to update is aware of data and results parameters associated with recently added MARKAL model variants. Then ensure that you have a backup copy of this database.
2. Open the database with the AnswerV6.exe in folder C:\AnswerV6 and from the menu bar immediately invoke **File, Add Flexible TimeSlice Facilities**. (You must invoke immediately after opening the database, if you move to the Data/Results screen, this menu item becomes disabled, and you will need to close the database and then reopen it in order for the menu item to be available.) The following message box appears:



3. Assuming that you have a backup copy of the database, click on the **[OK]** button. After a couple of seconds, a message box confirms that the database has been updated to have these facilities:



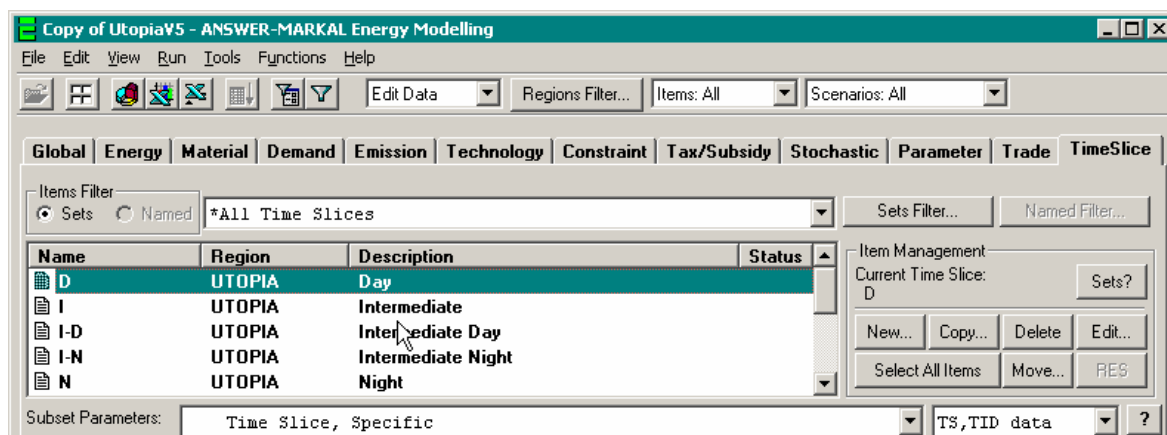
4. As indicated by the message, simply click on the **[OK]** button, and wait while the database is closed and then re-opened with these facilities now available.
5. If the database already has these facilities, the following message box appears:



2.17.3.1 Indications that an ANSWER Database is aware of Flexible TimeSlice Facilities

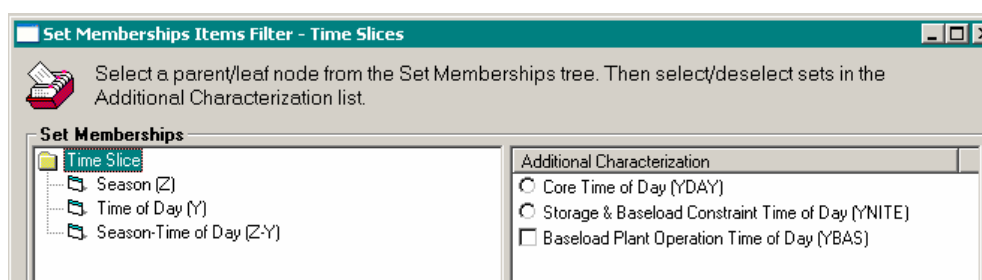
What are the indications that a version 5 ANSWER Database has been updated to be aware of Flexible TimeSlice facilities?

1. On moving to the Data/Results screen, you will see that there is a new TimeSlice tab, to the right of the Trade tab:



Note: When an existing ANSWER database with the standard MARKAL Time Slices of Season = {I, S, W}, Time of Day = {D, N} and Season-Time of Day = {I-D, I-N, S-D, S-N, W-D, W-N} is updated to be aware of flexible Time Slice facilities, the TimeSlice tab will appear similar to the screen snapshot above. Of course there are many issues to be considered if wishing to use the flexible Time Slice facilities to modify the standard MARKAL Time Slices – for example, the values for every data parameter defined over Season (Z) or Season-Time of Day (Z-Y) will need to be appropriately adjusted.

2. On the TimeSlice tab, if you click on the **[Sets Filter...]** button (immediately to the right of the large combobox), you will see the Time Slice subsets that are available, as follows:



3. On the TimeSlice tab, if you select a Season-Time of Day Time Slice, then when you drop down the Parameter combobox in the AddRow of the TID spread, you will find that a new PEAK(Z)(Y) parameter ('Indicator that peaking applies for season, time-of-day timeslice') is available. Likewise on the Parameter tab, you will find that this new PEAK(Z)(Y) parameter is available.

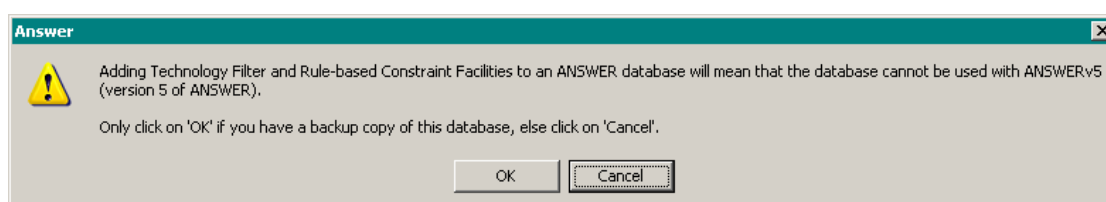
2.17.4 Add Technology Filter and Rule-based Constraint Facilities

The **File** menu option **Add Technology Filter and Rule-based Constraint Facilities** allows the user to make an ANSWER version 5 database aware of the new ANSWER version 6 Technology Filter and Rule-based Constraint facilities.

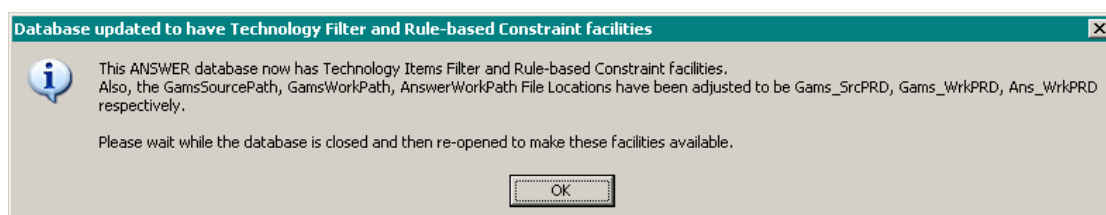
For details of the new ANSWER version 6 Technology Filter and Rule-based Constraint facilities, see section 12 'Technology Items Filters in ANSWER' and section 13 'Defining a "Rule-based" Constraint in ANSWER'.

To make an ANSWER version 5 database aware of the new ANSWER version 6 Technology Filter and Rule-based Constraint facilities:

1. If you have not previously done so, use AnswerV5.exe and the "File, Update System Tables from Excel" facility (specifying UpdateAnsSysTables_V550.xls as the Excel Update File) to ensure that the ANSWER version 5 database that you wish to update is aware of data and results parameters associated with recently added MARKAL model variants. Then ensure that you have a backup copy of this database.
2. Open the database with the AnswerV6.exe in folder C:\AnswerV6 and from the menu bar immediately invoke **File, Add Technology Filter and Rule-based Constraint Facilities**. (You must invoke immediately after opening the database, if you move to the Data/Results screen, this menu item becomes disabled, and you will need to close the database and then reopen it in order for the menu item to be available.) The following message box appears:



3. Assuming that you have a backup copy of the database, click on the **[OK]** button. After a couple of seconds, a message box confirms that the database has been updated to have these facilities:



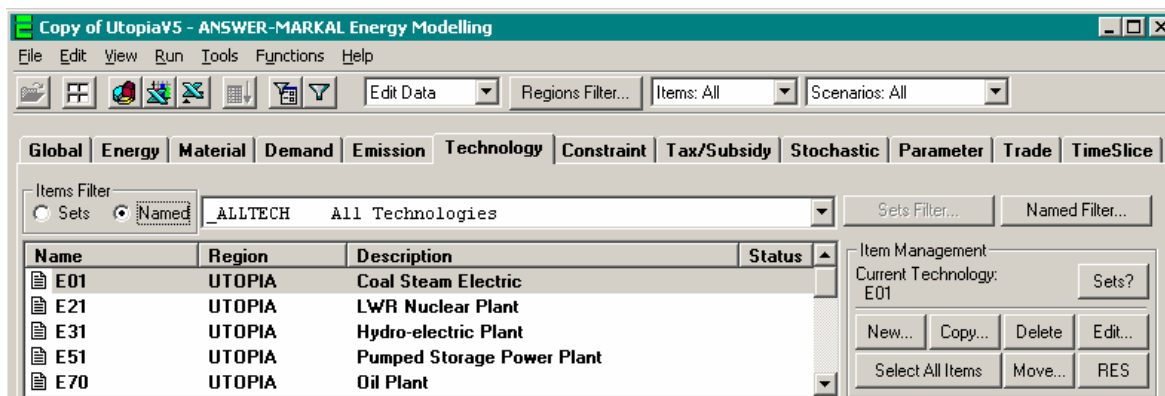
4. As indicated by the message, simply click on the **[OK]** button, and wait while the database is closed and then re-opened with these facilities now available.
5. If the database already has these facilities, the following message box appears:



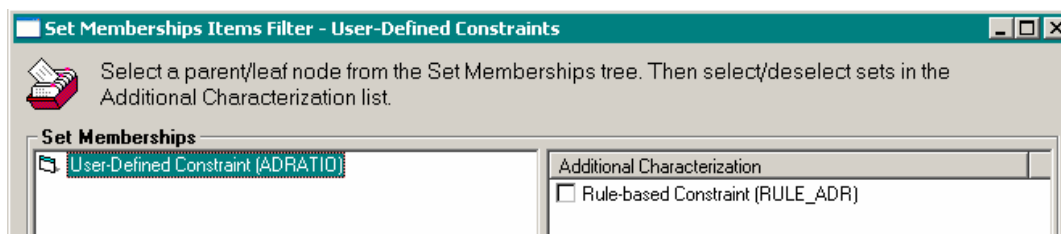
2.17.4.1 Indications that an ANSWER Database is aware of Technology Filter and “Rule-based” Constraint Facilities

What are the indications that a version 5 ANSWER Database has been updated to be aware of Technology Filter and Rule-based Constraint facilities?

1. On the Technology tab, the **Named** option button within the Items Filter frame will be *enabled* but not selected (when you first move to the Technology tab the **Sets** option button is selected). If you click on the **Named** option button, the top part of the form will appear as follows:



2. The large combobox will be populated with “_ALLTECH All Technologies” (the name and description of the default Technology Items Filter) and the **[Named Filter...]** button will become enabled. Click on the **[Named Filter...]** button to bring up the Technology Items Filter Management form that allows you to define new Technology Items Filters, and copy/delete/edit existing Technology Items Filters. (See section 12 for details.)
3. On the Constraint tab, if you click on the **[Sets Filter...]** button (immediately to the right of the large combobox), under Additional Characterization you will see a new ‘Rule-based Constraint’ checkbox, as follows:



4. On the Constraint tab, if you create a new constraint with the ‘Rule-based Constraint’ checkbox checked, then when you drop down the Parameter combobox in the AddRow, you will find that 6 new RATRULE_* parameters are available. Likewise on the Parameter tab, you will find that these 6 new RATRULE_* parameters are available. (See section 13 for details.)

Section Three: ANSWER's Data/Results Screen

This Section introduces the user to ANSWER's Data/Results Screen and its facilities. It focuses on the selection and display facilities of the Data/Results Screen. Data entry and editing facilities are detailed in Section 5 'Data Entry and Editing'.

Multi-region

The text and the screen snapshots that follow have been updated to correspond to what the user sees when working with a multi-region database.

3.1 Opening/exiting ANSWER's Data/Results Screen

3.1.1 Opening the Data/Results Screen

Section 2 'Starting ANSWER and the ANSWER Home Screen' illustrated how a user can enter the Data/Results Screen from the Home Screen in three different modes:

1. Browse Data - to browse data for the selected Scenario(s)
2. Edit Data - to edit data for the selected Scenario
3. Results - to browse results for the selected Case(s).

Once inside the Data/Results Screen and provided that there is at least one selected Case, the user can swap between Browse Data mode and Results mode without needing to return to the Home Screen. If a Scenario has also been selected for editing, the user can also swap to Edit Data mode for that Scenario without having to return to the Home Screen. To change the currently editable scenario, it is necessary to return to the Home Screen.

3.1.1.1 Browsing Scenario(s) data

This facility takes the user from the Home Screen into the Data/Results Screen to allow browsing of all the selected Scenarios data. It is not possible to edit Scenario data using this facility.


To browse a Scenario(s) data:

1. Use the Scenario selection buttons so that the Selected Scenarios display contains the Scenario(s) to be browsed.
2. Click on the **[Browse Data]** button below the Selected Scenarios display.
3. The Data/Results Screen will appear in Browse Data mode with the data displayed for the selected Scenario(s).

3.1.1.2 Editing a Scenario's data

This facility takes the user from the Home Screen into the Data/Results Screen to allow editing of a selected Scenario's data. Only one Scenario can be edited at a time. The remaining selected Scenarios will be displayed as browseable data in the Data/Results Screen.

To edit a Scenario's data

1. Use the Scenario selection buttons so that the Selected Scenarios display contains the Scenario to be edited.
2. To view other Scenarios' data alongside the data of the Scenario to be edited, use the Scenario selection buttons so that the Selected Scenarios display also contains the Scenario(s) to be browsed.
3. Double click on the Scenario in the Selected Scenarios display that is to be edited; a pen icon  will appear beside the highlighted Scenario. The edit facility cannot be invoked unless a Scenario is double clicked. Only one Scenario can be selected for editing at a time.
4. Click on the **[Edit Data]** button below the Selected Scenarios display.

5. The Data/Results Screen will appear in Edit Data mode with the Scenario's data displayed for editing. All the remaining selected Scenarios will be displayed as browseable data in the Data/Results Screen.

3.1.1.3 Browsing Case(s) results

This facility takes the user from the Home Screen into the Data/Results Screen to allow browsing of the selected Case(s) results. As these results are determined by the database model runs, ANSWER does not permit editing of Case(s) results.

To browse a Case(s) results in ANSWER:

1. Use the Case selection buttons so that the Selected Cases display contains the Case(s) to be browsed.
2. Click on the **[Results]** or **[Results (tab)]** button below the Selected Cases display.
3. The Data/Results Screen will appear in Results mode with the results displayed for all selected Cases.

3.1.2 Effect of the screen mode on the appearance and facilities of the Data/Results Screen

The screen appearance of the Data/Results Screen will not greatly vary with the entry mode; only the visible data and some facilities will vary with the mode. Note that while the user can switch between the various modes, only one mode is active at any one time.

The Data/Results Screen below has been entered in the Browse Data mode.

MultiUtopDemoLumpy - ANSWER-MARKAL Energy Modelling

File Edit View Run Tools Functions Help

Browse Data Regions Filter... Items: All Scenarios: All

Global Energy Material Demand Emission Technology Constraint Tax/Subsidy Stochastic Parameter BiTrade TimeSlice

Items Filter: ☒ Sets ☐ Named *All Technologies (TCH+SRCECNP) Sets Filter... Named Filter...

Name	Region	Description	Status
E01	DEMO	COAL STEAM ELECTRIC	
E01	UTOPIA	Coal Steam Electric	
E10	DEMO	DST CONDENSING STEAM TURBINE +IN...	
E14	DEMO	DST+NGA GAS TURBINE	
E21	DEMO	LWR	

Item Management: Current Technology: E01 Sets? New... Copy... Delete Browse Select All Items Move... RES


Subset Parameters: *C Technology, Specific TS data ?

Scenario	Parameter	Region	Technology	Energy	Bound	1990	2000	2010	2020
BASE	AF	? DEMO	E01	-	-	0.7000	0.7167	0.7333	0.7500
BASE	BOUND(BD)	? DEMO	E01	-	LO	290.0000			
BASE	BOUND(BD)	? DEMO	E01	-	UP	310.0000			
BASE	DELIV(ENT)	C DEMO	E01	COA	-	0.4160	0.4160	0.4160	0.4160
BASE	FIXOM	? DEMO	E01	-	-	10.0000	16.6667	23.3333	30.0000
BASE	INP(ENT)c	? DEMO	E01	COA	-	2.7940	2.7940	2.7940	2.7940
BASE	INVCOST	? DEMO	E01	-	-	1,200.0000	1,166.6667	1,133.3333	1,100.0000
BASE	PEAK(CON)	? DEMO	E01	-	-	1.0000	1.0000	1.0000	1.0000
BASE	RESID	? DEMO	E01	-	-	199.7000	99.8500	0.0000	0.0000
BASE	VAROM	? DEMO	E01	-	-	0.9400	0.9400	0.9400	0.9400

Database: C:\Answer\6\Answer_Databases\MultiUtopDemoLumpy.mdb Edit Scenario:

3.1.3 Exiting the Data/Results Screen to the Home Screen

To close the Data/Results Screen and return to the Home Screen:

1. Click on the **[Home Screen]** icon  in the tool bar, or click on **View** in the menu bar and click on **Home** in the drop menu.

3.2 The ANSWER Data/Results Screen

The Data/Results Screen provides the user with an extensive range of on-line facilities, principally:

- create/edit Scenarios' data
- browse/compare Scenarios' data
- Reference Energy System graphics
- browse/compare Cases' results
- filter data and results
- chart (MS Excel) data and results
- export data and results to Excel
- specify and edit the default units for the Database data.

3.2.1 General features of the Data/Results Screen

The Data/Results Screen is made up of five primary regions:

1. the Menu bar
2. the Tool bar
3. the Component tabs
4. the Items region
5. the Parameters region.

Home Screen

Chart

Chart with Excel

Analyze with Excel

Specify screen mode

Specify Items to be displayed

Specify Parameters to be displayed

Menu bar

Tool bar

Component tabs

Items region

Parameters region

Parameters spread

Sort Parameters by column header

Scenario	Parameter	Region	Technology	Energy	Bound	1990	2000	2010	2020
BASE	AF	? DEMO	E01	-	-	0.7000	0.7167	0.7333	
BASE	BOUND(BD)	? DEMO	E01	-	LO	290.0000			
BASE	BOUND(BD)	? DEMO	E01	-	UP	310.0000			
BASE	DELIV(ENT)	? DEMO	E01	COA	-	0.4160	0.4160	0.4160	0.4160
BASE	FIXOM	? DEMO	E01	-	-	10.0000	16.6667	23.3333	30.0000
BASE	INPI(ENT)	? DEMO	E01	-	-	2.7940	2.7940	2.7940	2.7940
BASE	INVCOST	? DEMO	E01	-	-	1,200.0000	1,166.6667	1,133.3333	1,100.0000
BASE	PEAK(CON)	? DEMO	E01	-	-	1.0000	1.0000	1.0000	1.0000
BAS		? DEMO	E01	-	-	199.7000	99.8500	0.0000	0.0000
BAS		? DEMO	E01	-	-	0.9400	0.9400	0.9400	0.9400

Database: C:\Answer\6\Answer_Databases\MultiUtopDemoLumpy.mdb

Edit Scenario:

3.2.2 Data/Results Screen terminology: Components, Items, Set Memberships, and Parameters

3.2.2.1 Components

In ANSWER, the elements of an energy system that have a common nature are grouped together. In ANSWER version 5 there are nine broad categories or **Components**, namely:

1. **Global** Component comprises those data parameters that describe some aspect of the global energy system, such as the discount rate.
2. **Energy** Component encompasses all the energy forms in the energy system, such as petroleum products, solid fuels, nuclear fuels, renewable energy, electricity, and heat.
3. **Material** Component is relevant for the material extension of MARKAL.
4. **Demand** Component comprises the end-use demands for energy services in the system, such as residential lighting, automobile passenger transportation, commercial air conditioning.
5. **Emission** Component encompasses the environmental impacts of the energy system, such as tonnes of CO₂ emissions from the electricity generation technologies, tonnes of NOX emissions from the road transport technologies.
6. **Technology** Component encompasses four broad groups of energy conversion, processing, utilisation, and supply technologies
 - i. **Conversion technologies** refers to technologies that convert an energy carrier(s) to electricity, or district heat, or both, such as coal fired steam turbines, and combined cycle gas turbines
 - ii. **Process technologies** refers to technologies that convert one energy carrier into another, excluding electricity and/or district heat. Process technologies include oil refineries, town gas facilities, coke ovens, and uranium enrichment plant
 - iii. **Demand technologies** refers to technologies that consume an energy carrier(s) to meet energy end-use demands, such as electric motors, refrigerators, and air conditioners
 - iv. **Resource technologies** refers to the means by which energy enters or leaves the energy system, other than by end-use consumption. They include mining/extraction, renewables production, and exports and imports. It also includes stockpiling.
7. **Constraint** Component comprises user-defined constraints that are additional to the standard constraints of a MARKAL model.
8. **Tax/Subsidy** Component is relevant for the tax/subsidy extension of MARKAL.
9. **Stochastic** Component is relevant for the stochastic extension of MARKAL.

These Components correspond to the first nine tabs on ANSWER's Data/Results Screen. The Global, Energy, Demand, Emission, Technology and Constraint Components are necessary to specify what is commonly referred to as the Standard MARKAL model. The Material, Tax/Subsidy and Stochastic Components are relevant for extended versions of MARKAL.

The tenth tab on ANSWER's Data/Results Screen, the **Parameter** tab, comprises all the Parameters listed in alphabetical order. The user may wish to think of this as the Parameter Component, but should realise that it is different in its nature to the first nine Components.

In ANSWER version 5 the eleventh and last tab on ANSWER's Data/Results Screen is the **Trade** tab. It is used in multi-region MARKAL to display data/results related to global and bi-lateral trade between regions. If an ANSWER version 5 database is opened with ANSWER version 6, it can be made aware of the new version 6 BiTrade tab facilities, in which case the eleventh tab is renamed **BiTrade**.

Normally an ANSWER version 6 database will have a twelfth tab, the **TimeSlice** tab, that displays TimeSlice components associated with the energy system, namely the seasonal divisions and time of day (diurnal) divisions along with season – time of day divisions. (In ANSWER version 6, TimeSlices are *flexible*, that is, they are under user control.) If an ANSWER version 5 database is opened with ANSWER version 6, it can be made aware of the new version 6 Flexible TimeSlice facilities, in which case a twelfth tab, the **TimeSlice** tab, will be added.

3.2.2.2 An Item and its Set Memberships

An **Item** is a unique, user defined element of the energy system. In standard MARKAL, the user defines Items representing Energy Carriers, Demands, Emissions, Technologies, and Constraints. The Energy Component then comprises all the Energy Carrier Items and their associated Parameters, the Demand Component comprises all the Demand Items and their associated Parameters, and so on.

Each Item is defined by the user by its Name and Region (the combination of Name and Region must be unique), its Description, its MARKAL **Set Memberships**, and its Units. The Set Memberships of an Item determine the Data Parameters that will be associated with the Item.

For example, to create an Item to represent a coal fired electric generator which is centralised and base loaded, the user will need to indicate that this Item's Set Memberships include

- . Conversion Technology
- . Centralised
- . Base Loaded.

ANSWER provides facilities for ensuring that the user makes logically consistent choices when selecting an Item's Set Memberships (see Section 5.2.2 'Creating a new Item').

3.2.2.3 Parameters

MARKAL has two types of Parameters, namely **Data Parameters** for Scenarios and **Results Parameters** for Cases.

Data Parameters specify the economic and technical characteristics of the user defined Items of the energy system. The data for the Data Parameters is determined by the user and will measure such characteristics as:

1. pre-existing installed capacity
2. fixed and variable operation and maintenance costs
3. investment costs for additional capacity
4. the efficiency, availability and emissions coefficients associated with the use of energy producing or using technologies
5. the levels of use of energy services.

Standard MARKAL provides about 80 different Data Parameters for describing the characteristics of the energy system and the Items within it. When Data Parameters associated with extended versions of MARKAL are included, this number grows to over 200.

The model is extremely flexible, and, depending on the complexity and diversity of the energy system being modelled, many of the Data Parameters may simply assume their default values or be omitted if not relevant.

A comprehensive listing of the Standard MARKAL Data Parameters is attached at Appendix A1. Users of this manual are expected to be familiar with MARKAL's Data Parameters.

The **Results Parameters** typically determined by a MARKAL model run include:

1. the activity and capacity level for each conversion technology in each time period
2. the capacity level for each demand technology in each time period
3. the level of additional capacity for each conversion, process and demand technology developed in each time period
4. the activity level for each resource technology in each time period
5. a full range of prices, such as
 - . the total system cost
 - . the price of electricity, by season and time of day
 - . the price of gas

- . the price of energy provided by renewable technologies
- 6. the unit cost of reduction in emission levels and emission levels for each technology and the total energy system in each time period.

Standard MARKAL provides some 220 different Results Parameters in its reporting of the results of a model run. When Results Parameters associated with extended versions of MARKAL are included, this number grows to over 300.

A comprehensive listing of the Standard MARKAL Results Parameters is attached at Appendix A2. Users of this manual are expected to be familiar with MARKAL's Results Parameters.

3.3 The Menu bar and the Tool bar

3.3.1 The Menu bar

The menu bar provides operational access to all the Data/Results Screen's facilities. The operation of its facilities will be detailed in subsequent Sections.

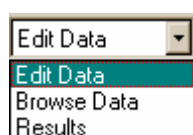
3.3.2 The Tool bar

The tool bar provides the main operational facilities as one step icons. The operation of its facilities will be detailed in subsequent Sections.

The tool bar also provides comboboxes that determine the screen mode, the Items to be displayed, and the Parameters to be displayed.

In addition, the **[Regions Filter...]** button in the tool bar allows the user to select a subset of Regions for which data or results is displayed, and so provides a Region filtering facility that applies across all Component tabs.

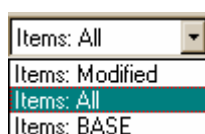
3.3.2.1 Screen mode combobox



If Edit Data mode, Browse Data mode, and Results mode have been enabled, the user can switch between modes within the Data/Results Screen by clicking on the required mode in the Screen mode combobox.

Alternatively, the user can click on **V**iew in the menu bar and click on **E**dit Data, **B**rowse Data or **R**esults in the drop menu.

3.3.2.2 Items display combobox (disabled in Results mode)



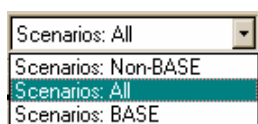
The Items display combobox determines which Items are displayed:

BASE = display Base Scenario Items only

Modified = display Items which occur only in the selected non-Base Scenario(s) and Base Scenario Items whose Parameters have been modified in non-Base Scenario(s)

All = display both BASE and non-Base Scenario(s) Items.

3.3.2.3 Parameters spread combobox



The Parameters spread combobox determines which Parameters are displayed:

BASE = display Base Scenario and Base Case Parameters

Non-BASE = display non-Base Scenario(s) and non-Base Case(s) Parameters

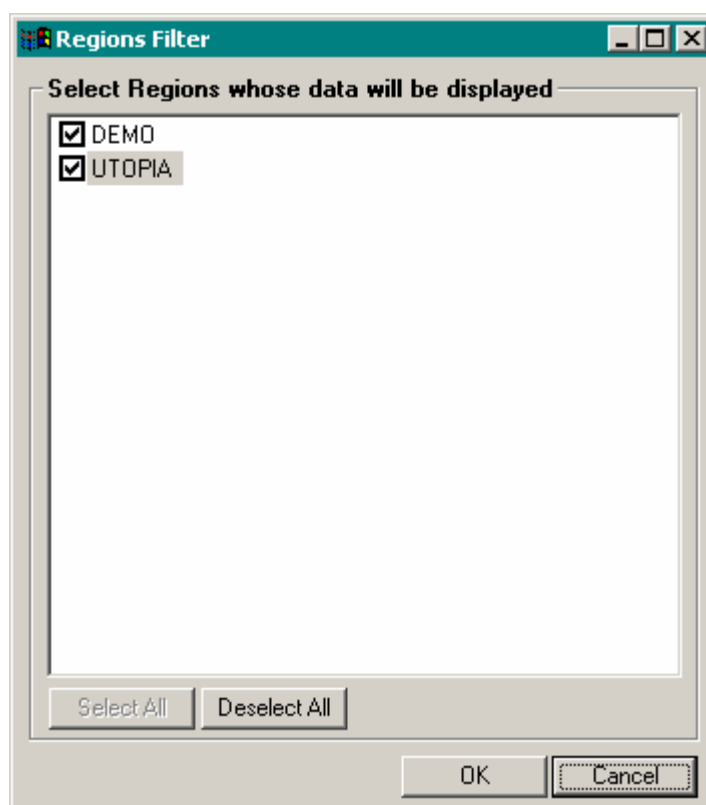
All = display both BASE and non-Base Scenarios and Cases Parameters.

3.3.2.4 [Regions Filter...] button to select subset of Regions for Data/Results display

By default, the Data/Results Screen displays data/results for every Region.

The **[Regions Filter...]** button in the Tool Bar allows the user to select a subset of Regions for which Data or Results is displayed:

1. Click on the **[Regions Filter...]** button.
2. The 'Select Regions whose data will be displayed' dialogue box will appear (see below).



3. Use the checkboxes to specify the desired subset of Regions, and click on **[OK]**.
4. The Items region display (and the Parameters region display) will be refreshed to display only those Items for which the Region is in the subset specified at step 3.
5. Where the Region subset specified at step 3 is a strict subset of the set of all Regions, the Items display background color is set to yellow (rather than the normal white), as a visual cue to the user that a subset of Regions is being displayed. That is, as a visual cue that a Region filter is applied.
6. The Regions subset specified at step 3 applies across all Component tabs. That is, if Regions are subsetting to just DEMO, say, on the Technology tab, then on switching to the Demand tab, only End-Use Demands for Region DEMO will be displayed.

3.4 The Component tabs

In ANSWER, the elements of an energy system that have a common nature are grouped together, as already noted in section 3.2.2.1. There are nine broad categories or **Components**, namely Global, Energy, Material, Demand, Emission, Technology, Constraint, Tax/Subsidy and Stochastic. In addition, the Parameter Component provides an alphabetical listing of all Parameters, and the Trade/BiTrade Component displays Data/Results Parameters related to global and bi-lateral trade between regions. Finally, in ANSWER version 6, there is a TimeSlice Component.

To select the Component that is to be displayed in the Data/Results Screen

1. Click on the required Component tab, or click on **View** in the menu bar and click on the required Component in the drop menu.
2. Repeat step 1. to display a different Component.

Below, the Technology Component tab has been selected for a version 5 ANSWER database.



Below, the TimeSlice Component tab has been selected for a version 6 ANSWER database.



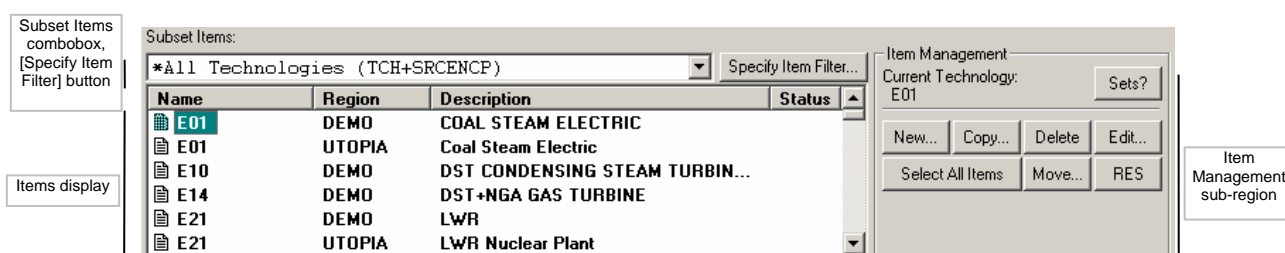
3.5 The Items region

The Items region (shown below) provides a list view display of the Items in the selected Component. When in Edit Data mode, the Items region provides the facilities for adding new Items, and for copying, deleting, editing and moving existing Items.

An exception is the Parameter Component, where the Items display shows all the Data/Results Parameters. In Edit Data mode for the Parameter Component, the Items region provides the facility to edit the properties of Data Parameters (see Section 3.6.3.2 'Changing the Status and Properties of a Data Parameter').

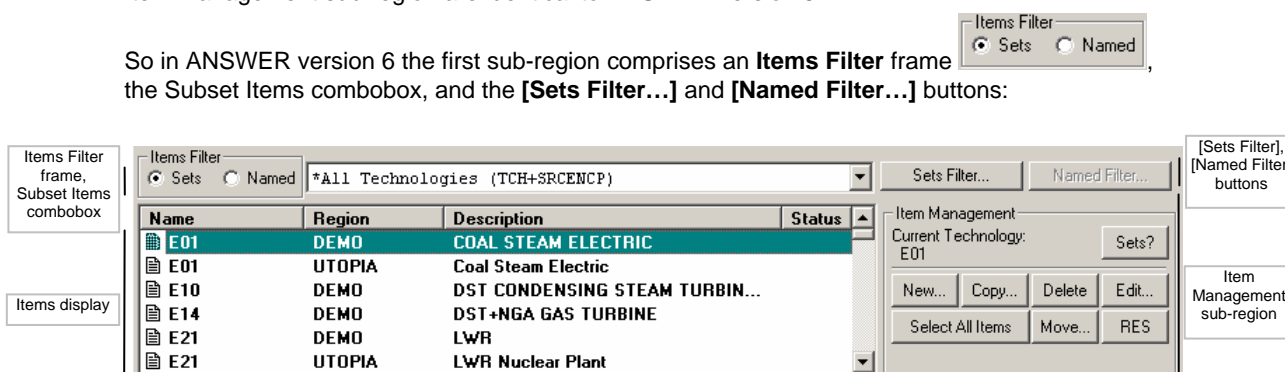
In ANSWER version 5, the Items region is made up of three sub-regions:

1. The Subset Items combobox and [Specify Item Filter...] button
2. The Items display
3. The Item Management sub-region.



In ANSWER version 6, the first of the above sub-regions differs from ANSWER version 5 on account of the new Technology Items Filters (Named Filter) facility, while the Items display and the Item Management sub-region are identical to ANSWER version 5.

So in ANSWER version 6 the first sub-region comprises an **Items Filter** frame, the Subset Items combobox, and the [Sets Filter...] and [Named Filter...] buttons:



When the **Sets** option button is selected (the default), the Subset Items combobox is populated in the same fashion as for ANSWER version 5, the [Sets Filter...] button plays the same role as the [Specify Items Filter...] button in ANSWER version 5, the [Named Filter...] button is disabled, and the documentation in section 3.5.1 below is applicable.

NOTE: When the **Named** option button is selected on the Technology tab, the [Named Filter...] button is enabled, and the **Technology Items Filters facility** becomes available. This facility allows the user to create very powerful Filters for the Technology Items listview that allow filtering by a Technology's Name and/or Description and/or Set Memberships and/or Input/Output Commodities. **For details, see section 12, 'Technology Items Filters in ANSWER'.**

3.5.1 The 'Sets Filter' facility and the Subset Items combobox

On initial entry to a Component tab, the Subset Items combobox is set to display all the Items for that Component. For example, on initial entry to the Technology tab, the Subset Items combobox is set to '*All Technologies (TCH+SRCENCP)'. With this setting, the Technology Items display would list hundreds of Technologies for a large MARKAL model.

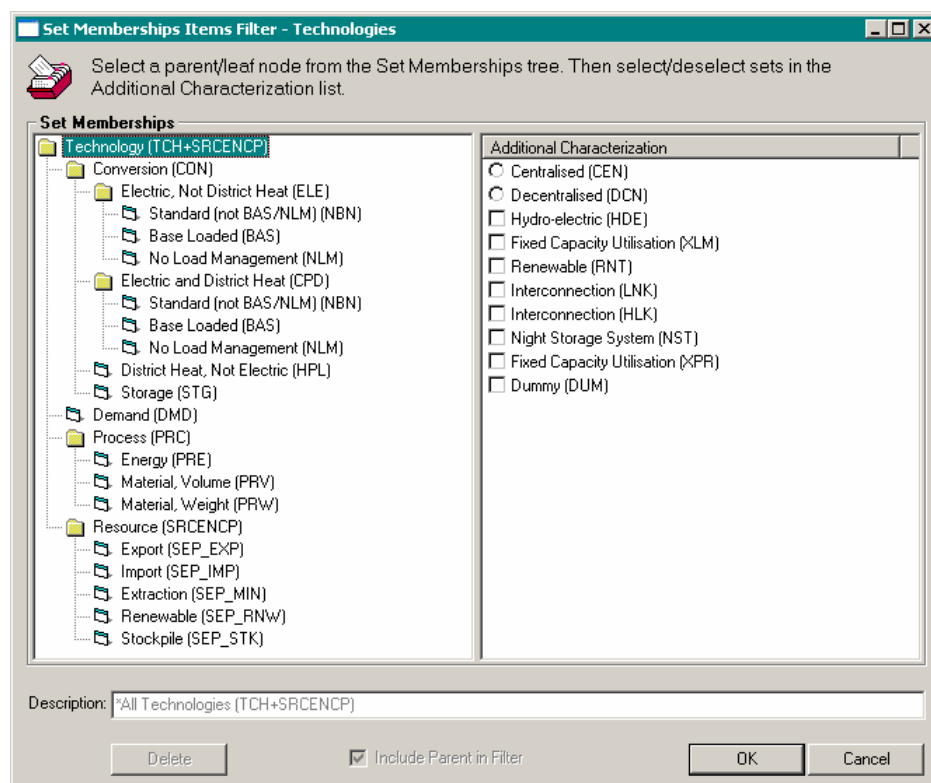
The 'Sets Filter' facility and the Subset Items combobox are used in conjunction to provide the user with powerful Set Membership filtering capabilities for the Items display, to limit the Items that are displayed to those currently of interest to the user. For example, on the Technology tab, the user can limit the Technologies that are displayed to 'BAS – Base Loaded Conversion Technologies'. And by use of the Sets Filter facility, the user can create user-defined Set Membership filters that involve several MARKAL subsets, for example to limit the Technologies that are displayed to those that have Set Memberships of BAS (Base loaded) and CEN (Centralised) and HDE (Hydro-electric). The use of these facilities is now detailed.

3.5.1.1 Using the 'Sets Filter' facility to specify a Set Membership Filter

The easiest, most visual, and most powerful way to specify a Set Membership Filter is to use the Sets Filter facility. This facility enables the user to create user-defined Set Membership filters that are added to the Subset Items combobox (and stored permanently in the database).

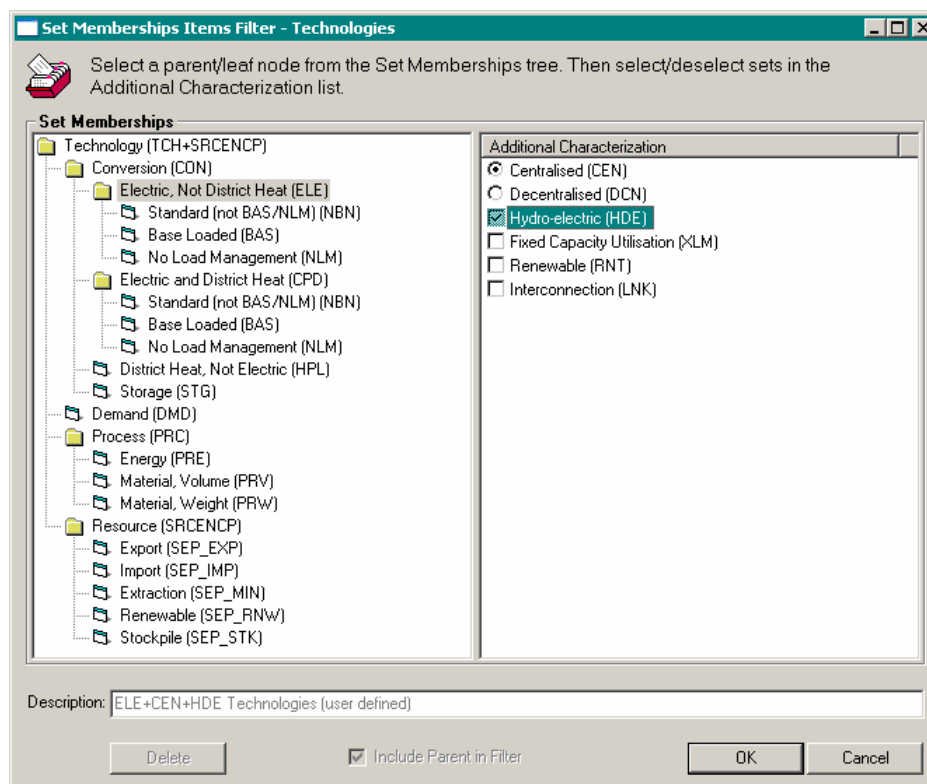
For example, to display just those Technologies that are members of the ELE and CEN and HDE Technology subsets:

1. Activate the 'Set Memberships Items Filter' dialogue box by clicking on the **[Sets Filter...]** button to the right of the Subset Items combobox. The dialogue box will be displayed with Set Memberships (in the treeview and in the 'Additional Characterization' listview) corresponding to the current setting of the Subset Items combobox. (The Set Membership display uses the same treeview-listview mechanism that is used to specify Set Memberships when the user carries out the New/Edit Item functions.)

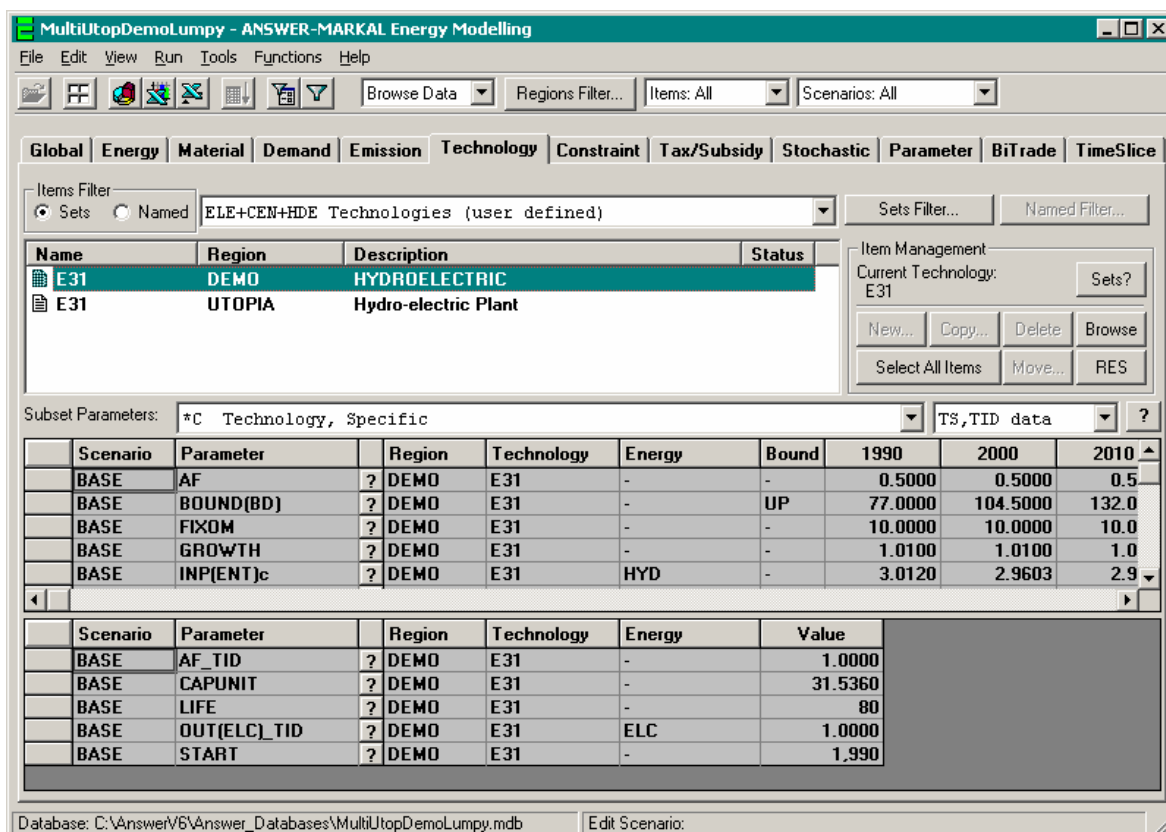


2. Click on the ELE node in the treeview, then click on the CEN radio button and ensure that HDE is the only checked checkbox in the 'Additional Characterization' listview. The Description field will be automatically updated to contain:

"ELE+CEN+HDE Technologies (user-defined)"



3. Click on the **[OK]** button.
4. If it did not previously exist, a new entry with the above Description will be added to the Technology Subset Items combobox (the combobox entries are sorted by Description), and the Technology Items display will be re-populated to display just those Technologies that are members of the ELE and CEN and HDE Technology subsets.

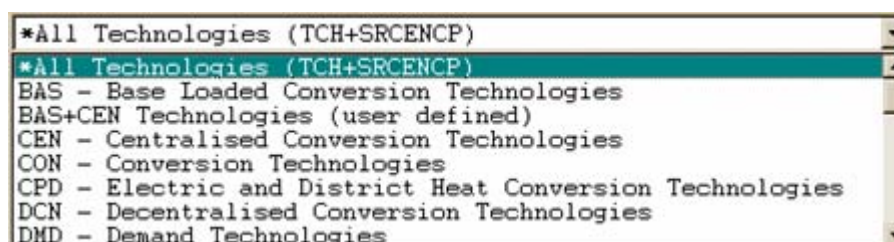


3.5.1.2 Using the Subset Items combobox to select a Set Membership Filter

The Subset Items combobox provides an alternative mechanism that allows the user to select either pre-defined or existing user-defined Set Membership filters.

To select a Set Membership filter from the Subset Items combobox:

1. Click anywhere in the Subset Items combobox. This will drop down the combobox, as follows:



2. Choose the required Set Membership filter from the dropdown list.
3. The Items display will be re-populated to display just those Items that match the selected Set Membership filter.

Alternatively:

1. Ensure that the combobox has focus.
2. 'Quick-key' the first few characters of the filter Description to position at (or near) the desired filter in the combobox list. For example, quickly keying BAS while on the Technology tab will position at (or near) the "BAS – Base-loaded Conversion Technologies" entry. If this process arrives near but not at the desired filter, use the down-arrow key or up-arrow key to position at the desired filter in the Subset Items combobox.
3. The Items display will be re-populated to display just those Items that match the selected Set Membership filter.

3.5.1.3 Additional Notes regarding the 'Sets Filter' facility

1. ANSWER automatically generates the Description field, based on the particular subsets selected by the user. No mechanism is provided by which the user can alter the Description.
2. The mechanism is available on all Component tabs including for Data and Results Parameters. The mechanism is superfluous for Component tabs such as Global, Tax/Subsidy and Stochastic where there are no subsets.
3. The user is not required to select a leaf node from the treeview, as is the case when carrying out the New/Edit Item functions. It is perfectly acceptable to select a non-leaf (parent) node. The contents of the 'Additional Characterization' listview automatically adjust to contain just those subsets that are appropriate according to the parent node selected.
4. 'Quick-key' in the treeview to quickly select the Set Membership of interest. For example, in the case of Results Parameters, quickly key in T08 to select 'T08 – Use of Energy Carriers by Technology' in the treeview.
5. It is not possible to select more than one node in the treeview.
6. Clicking on a radio button that is already selected causes it to become de-selected. (By comparison, in New/Edit Item clicking on an already selected radio button has no effect.) Clicking on a de-selected radio button when an alternate radio button is selected behaves in the same fashion as in New/Edit Item. (So for example, clicking on a de-selected CEN radio button when the DCN radio button is selected has the effect of selecting CEN and de-selecting DCN.)
7. Initially, the 'Subset Items' combobox contains pre-defined filters, that for a particular Component tab comprise all of the possible single MARKAL subsets for that Component. If on the 'Set Memberships Items Filter' form the user chooses just a single subset and clicks on the [OK] button, then the appropriate pre-defined filter will be selected in the 'Subset Items' combobox, and the Items display will be re-populated accordingly.

8. The **[Delete]** button allows a user-defined Set Membership filter to be deleted from the 'Subset Items' combobox. Following such a deletion, the 'Set Memberships Items Filter' form is re-set to correspond to All Items. Of course the user has the option of specifying an alternative Set Memberships setting prior to clicking on the **[OK]** button. Pre-defined filters cannot be deleted: the **[Delete]** button is disabled when a pre-defined filter is selected.
9. When ANSWER generates the Description of the user-defined Set Membership filter, it uses the short names of the sets selected by the user, for example BAS. In general, these short names are very familiar to MARKAL users, and so the filter Description displayed in the 'Subset Items' combobox clearly conveys the meaning of the filter. However there are two subsets used in ANSWER that are not standard MARKAL subsets. These are: NDFTDIS_DM (non-default distribution of demand) on the Demand tab, and NBN (not BAS/NLM) on the Technology tab. Users will need to learn that these two non-standard MARKAL subsets may occur in Set Membership filters that they create.
10. Technology Sets NBN, BAS, NLM are special cases because they occur in the treeview as subsets of both ELE and CPD. The **Include Parent in Filter** checkbox allows the user additional control if any of these subsets is selected in the treeview. For example:
 - (i) To display Technologies that are members of BAS and ELE and CEN, simply click on the occurrence of BAS that has ELE as parent node in the treeview, click on the CEN radio button, ensure that there are no checked checkboxes in the 'Additional Characterization' listview, and ensure that the **Include Parent in Filter** checkbox is checked (checked is the default).
 - (ii) To display Technologies that are members of BAS and CEN (regardless of whether they are members of ELE or CPD), simply click on either occurrence of BAS in the treeview, click on the CEN radio button, ensure that there are no checked checkboxes in the 'Additional Characterization' listview, and ensure that the **Include Parent in Filter** checkbox is unchecked (since checked is the default, most likely the user will need to click on the checkbox to uncheck it).
11. It is only possible to construct user-defined filters to display those Items that are members of each of several subsets, e.g. to display Technologies that are members of CON and ELE and BAS and CEN. Neither Oring nor negations are possible.

3.5.2 The Items display

The Items display shows those Items whose Set Memberships correspond to those of the Subset Items combobox, with the caveat that the Items display may be further restricted by the setting of the Items display combobox (see section 3.3.2.2) or by the Region subset (see section 3.3.2.4). The display has a number of features to assist the user to view, search for, and select an Item(s), namely:

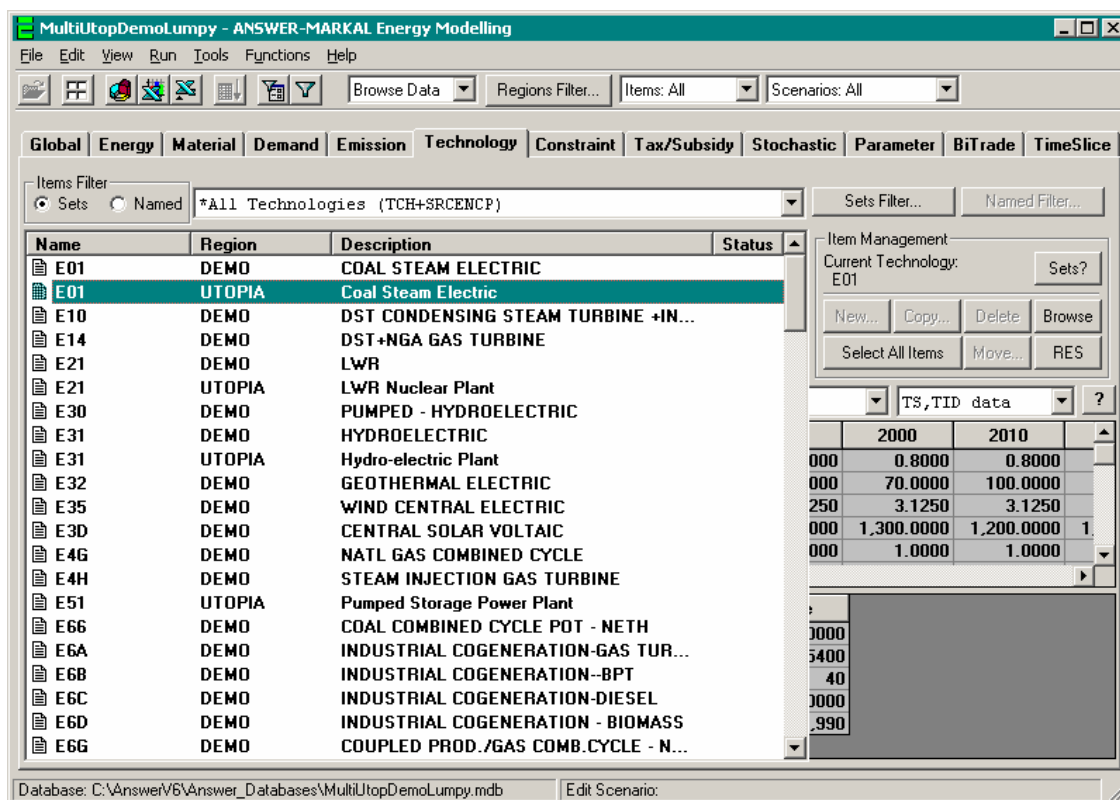
1. Expansion of the Items display
2. Item search
3. Item Multi-select and Select All Items.
4. Sort Items display by Name or by Region
5. Refresh Items display

3.5.2.1 Expansion of the Items display

Due to screen size limitations, the Items display normally shows only nine Items at a time (at 1024 x 768 resolution). However, the display incorporates a Toggle Size button that expands the display to about 32 Items (at 1024 x 768 resolution).

To activate the Toggle Size button:

1. Right mouse click anywhere on the Items display and choose **[Toggle Size]** from the pop-up menu.
2. The display will expand as shown below.



- Repeat the procedure to return the display to normal size.

3.5.2.2 Item search

ANSWER's built in Item search facility enables the user to quickly find a specific Item within a Component.

To find an Item:

1. Click on the required Component tab.
2. Click on the Name code of any Item in the Items display.
3. Type, at normal speed, the Name code (up to 10 characters) of the Item being sought.
4. The search facility will then take you to the specified Item.
5. Repeat step 2. for subsequent searches.

The Item search facility operates in the same manner for the Parameter Component. It enables the user to quickly find a specific Parameter from the list of all Data or Results Parameters.

3.5.2.3 Item Multi-select and Select All Items

By default, a single Item is selected in the Items display, and the TS and TID spreads display the Parameter data for that Item. If multiple Items are selected in the Items display, then the TS and TID spreads will display the Parameter data for every selected Item. Multiple Items may be selected using the Item multi-select facility, or the Select All Items facility.

3.5.2.3.1 Item Multi-select

Multi-selection of the Items in the Items display is performed in the standard fashion using the Name field in the Items display. So for example to multi-select contiguous Items from E01 in region DEMO to E21 in region DEMO, first select E01 in region DEMO by clicking in its Name field. Then holding down the Shift key, click in the Name field for E21 in region DEMO. See the following page.

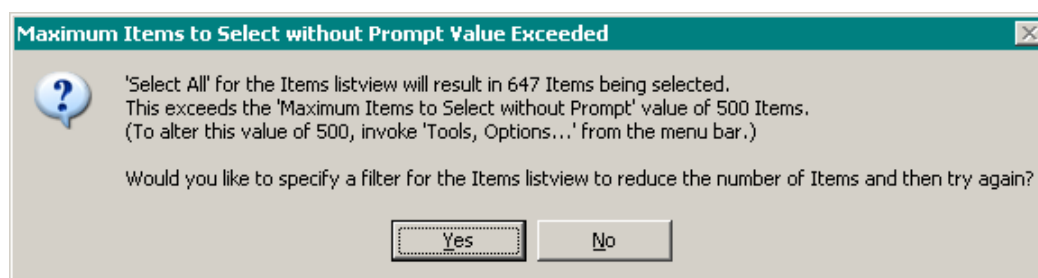
The Items that are selected do not have to be contiguous. Additional Items may be added to the selection by holding down the Ctrl key and clicking in their Name fields.

It is possible to de-select an already selected Item by holding down the Ctrl key and clicking in its Name field.

3.5.2.3.2 Select All Items

To select all Items in the Items display, click on the **[Select All Items]** button in the Item Management sub-region, or right mouse click on the Items display and choose **[Select All]**.

Where selecting all Items would result in a large number of Items being selected, the following prompt will appear inviting the user to specify a filter for the Items display to reduce the number of Items that will be selected:

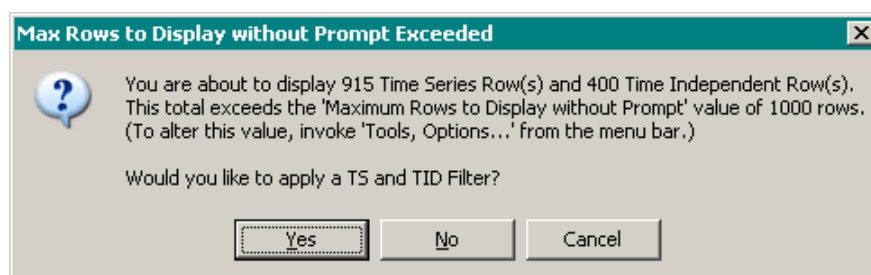


If the user clicks on **[Yes]** Select All Items will not occur: the user will be returned to the Data/Results screen in order to specify a filter for the Items display (or to change to a different filter) to reduce the number of Items.

If the user clicks on **[No]** Select All Items will proceed, notwithstanding that the 'Maximum Items to Select without Prompt' value has been exceeded.

To adjust the default 'Maximum Items to Select without Prompt' value of 500, choose **Tools, Options...** from the menu bar to bring up the Options form, enter a new 'Maximum Items to Select without Prompt' value, and click on **[OK]**.

Even where 'Select All Items' results in a more modest number of Items being selected, such that the above prompt is not displayed, it is possible that this more modest number of Items would produce a large number of rows in the TS and TID spreads, in which case the following prompt will appear inviting the user to apply a Filter to reduce the number of rows that will be displayed:



Click on **[Yes]** to invoke the TS and TID Filter form, click on **[No]** to display TS and TID parameters with no Filter, and click on **[Cancel]** if you decide not to proceed with Select All Items. For details of the TS and TID Filter Form facility, see section 3.7.

To adjust the default 'Maximum Rows to Display without Prompt' value of 1000, choose **Tools, Options...** from the menu bar to bring up the Options form, enter a new 'Maximum Rows to Display without Prompt' value, and click on **[OK]**.

Click on a single Item in the Items display to undo Select All Items.

3.5.2.4 Sort Items display by Name or by Region

By default, the Items display is sorted by Name, and then by Region.

To sort the Items display by Region, and then by Name, click on the Region header in the Items display.

To re-sort the Items display by Name, and then by Region, click on the Name header in the Items display.

3.5.2.5 Refresh Items display

To refresh the Items display, right-mouse click in the Items display and choose **Refresh** from the pop-up menu, or click on **V**iew in the menu bar and choose **Refresh** in the drop menu.

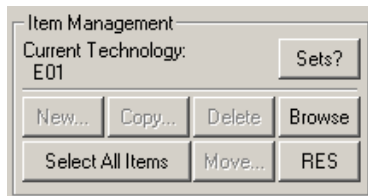
In the main, ANSWER automatically refreshes the Items display. But there is one feature of the Items display, namely the Status indicator to provide information about Items that are modified in non-BASE scenarios (see section 3.5.4) that may not always correctly reflect the current state of the database, particularly when the Items display combobox setting is 'Items: Modified' (see section 3.3.2.2). To be sure that the Status indicators are correct, Refresh the Items display.

3.5.3 The Item Management sub-region

The Item Management sub-region provides the user with the facilities to create, manage, and view information about the Items. The available facilities depend on the screen mode. The full operation of the Item Management sub-region facilities is detailed in Section 5.2 'Data entry and editing for Items'.

3.5.3.1 Browse Data and Results screen mode

Click on:



[Sets?] button to display the Set Memberships information for the selected Item. Alternatively, click on **T**ools in the menu bar and choose **S**et **I**nformation in the drop menu.

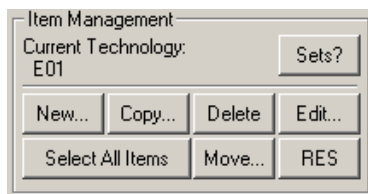
[Browse] button to browse an existing Item, and its specifications.

[Select All Items] button to select and highlight all Items in the Items display (see Section 3.5.2.3 'Select All Items'). Alternatively, click on **E**dit in the menu bar and choose **S**elect **A**ll **I**tems in the drop menu.

[RES] button to display the Reference Energy System diagram for the selected Item (see Section 9 'Reference Energy System Graphics'). Alternatively, click on **V**iew in the menu bar and choose **R**ES **G**raphics in the drop menu.

3.5.3.2 Edit Data screen mode

Click on:



[Sets?] button to display the Set Memberships information for the selected Item.

[New...] button to create a new Item, including defining its Set Memberships and establishing its Units. Alternatively, click on **E**dit in the menu bar and choose **N**ew **I**tem... in the drop menu.

[Copy...] button to copy an existing Item, with its specifications, Parameters and data. Alternatively, click on **E**dit in the menu bar and choose **C**opy **I**tem... in the drop menu.

[Delete] button to delete an existing Item. Alternatively, click on **E**dit in the menu bar and choose **D**ele~~t~~e **I**tem in the drop menu.

[Edit...] button to edit an existing Item, including its Set Memberships and Units. Alternatively, click on **E**dit in the menu bar and choose **E**dit **I**tem... in the drop menu.

This button will appear as **[Browse]** if the selected Item is not in the editable scenario.

[Select All Items] button to select and highlight all Items in the Items display (see Section 3.5.2.3 'Select All Items').

[Move...] button to move an existing Item, with its specifications, Parameters and data. Alternatively, click on **E**dit in the menu bar and choose **M**ove **I**tem... in the drop menu.






[RES] button to display the Reference Energy System diagram for the selected Item (see Section 9 'Reference Energy System Graphics').

3.5.4 Status of an Item

As shown below, the status of an Item is displayed as blank, M or SM.

1. A blank status indicates that the Item is to be found only in the Base Scenario.
2. An M indicates that the Item is a Base Scenario Item which has had at least one of its Data Parameters modified in one of the selected non-Base Scenario(s).
3. An SM indicates that the Item is fully defined (i.e., its Name, Description, Set Memberships, and Units are specified) in one of the selected non-Base Scenarios.

Items Filter
☒ Sets ☐ Named *All Technologies (TCH+SRCENCP)

Name	Region	Description	Status
 IMPELC1	DEMO	Import Electricity	
 IMPELC1	UTOPIA	import of electricity added to Utopia	M
 IMPELC2	DEMO	Import Electricity - Seasonal	
 IMPELC2	UTOPIA	import of electricity 2 added to Utopia	SM
 IMPELC3	UTOPIA	import of electricity 3 added to Utopia	SM

3.6 The Parameters region

The Parameters region provides a Spread display of the Data/Results Parameters and their data for the Items that have been selected. It also provides a number of data management facilities.

The Parameters region has four main features:

1. The Subset Parameters combobox
2. The TS/TID (Time Series and Time Independent) Data combobox
3. The Data/Results Parameter query button
4. The Parameters spreads, i.e., the Time Series and Time Independent Parameters spreads.

When in **Browse Data** screen mode (shown below) and in **Results** screen mode, the Parameters region provides the facilities for viewing the Time Series (TS) and Time Independent (TID) Parameters and data/results of the selected Item(s).

Subset Parameters: *C Technology, Specific TS, TID data ?

Scenario	Parameter	Region	Technology	Energy	1990	2000	2010	2020
BASE	AF	? UTOPIA	E01	-	0.8000	0.8000	0.8000	0.8000
BASE	FIXOM	? UTOPIA	E01	-	40.0000	70.0000	100.0000	130.0000
BASE	INP(ENT)c	? UTOPIA	E01	HCO	3.1250	3.1250	3.1250	3.1250
BASE	INVCOST	? UTOPIA	E01	-	1,400.0000	1,300.0000	1,200.0000	1,200.0000
BASE	PEAK(CON)	? UTOPIA	E01	-	1.0000	1.0000	1.0000	1.0000
BASE	RESID	? UTOPIA	E01	-	0.5000	0.3250	0.1500	0.1500
BASE	VAROM	? UTOPIA	E01	-	0.3000	0.3000	0.3000	0.3000

Time Series Parameters spread

Time Series (TS) / Time Independent Data (TID) combobox

Data/Results Parameter query button

Scenario	Parameter	Region	Technology	Energy	Value
BASE	AF_TID	? UTOPIA	E01	-	1.0000
BASE	CAPUNIT	? UTOPIA	E01	-	31.5400
BASE	LIFE	? UTOPIA	E01	-	40
BASE	OUT(ELC)_TID	? UTOPIA	E01	ELC	1.0000
BASE	START	? UTOPIA	E01	-	1,990

Time Independent Parameters spread

Initially both the Time Series data spread and the Time Independent data spread are displayed. By adjusting the setting of the TS, TID Data combobox, the user may display just the Time Series data spread, or just the Time Independent data spread.

In **Edit Data** screen mode (shown below), the Parameters region also provides facilities for:

1. Adding a new Data Parameter and its data (see Add row, shown in blue)
2. Editing a Data Parameter's data (shown in white)
3. Direct cell editing of a Data Parameter argument
4. Deleting an existing Data Parameter and its data.

Subset Parameters: *C Technology, Specific TS, TID data ?

Scenario	Parameter	Region	Technology	Commo	Boun	TimeSeries	1990	2000	2010	2020
BASE	INP(ENT)c	? UTOPIA	E01	HCO	-	-	250	3.1250	3.1250	3.1250
BASE	INVCOST	? UTOPIA	E01	CSV	-	-	1,400.0000	1,300.0000	1,200.0000	1,200.0000
BASE	PEAK(CON)	? UTOPIA	E01	DSL	-	-	1.0000	1.0000	1.0000	1.0000
BASE	RESID	? UTOPIA	E01	ELC	-	-	0.5000	0.3250	0.1500	0.1500
BASE	VAROM	? UTOPIA	E01	FSL	-	-	0.3000	0.3000	0.3000	0.3000
Add	BASE	?		HCO						

'Add' row

Scenario	Parameter	Region	Technology	Item2	Value
BASE	AF_TID	? UTOPIA	E01	-	1.0000
BASE	CAPUNIT	? UTOPIA	E01	-	31.5400
BASE	LIFE	? UTOPIA	E01	-	40
BASE	OUT(ELC)_TID	? UTOPIA	E01	ELC	1.0000
BASE	START	? UTOPIA	E01	-	1,990
Add	BASE	?			

'Add' row

Direct cell editing of Parameter argument

Direct cell editing of Parameter argument

These edit facilities are detailed in Section 5, 'Data Entry and Editing'.

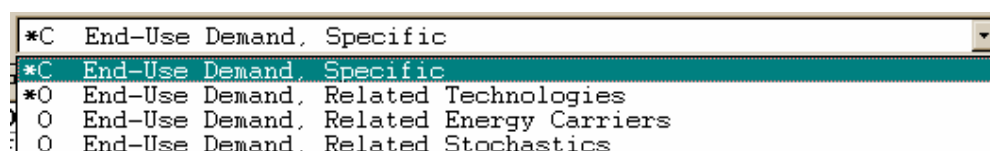
3.6.1 The Subset Parameters combobox

A Parameter may be specific to a single Component or related to two (or more) Components. A Parameter that is specific to a single Component will not appear under any other Component (apart from the Parameter Component, which lists all Parameters). For example, the Data Parameter DEMAND is specific to the End-Use Demand Component, and, consequently, browsing/editing of the DEMAND Parameter can only be done on the Demand tab (or on the Parameter tab).

A Parameter that is related to two (or more) Components will generally be a Technology Parameter. It will appear under both the Technology Component and its second Component. For example, OUT(DM) is a Demand technology Data Parameter and appears under the Technology Component and, through its relationship with Demand, will also appear under the Demand Component.

To display in the Parameters spread those Parameters that are specific to a Component or those that are related to a Component:

1. Click anywhere in the Subset Parameters combobox and choose the required selection (shown below), or click on **View** in the menu bar, click on **Subset Parameters** in the drop menu, and choose the selection.



3.6.1.1 Compulsory versus Optional Data Parameters

Data Parameters are either compulsory or optional depending on the Set Memberships of an Item, and beside each selection option in the Subset Parameters combobox are a series of indicators showing the overall status of the data for the selected Item.

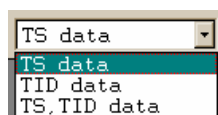
The indicators are as follows:

- * = One or more Data Parameters exist.
- C = All compulsory Data Parameters exist.
- O = All the relevant Data Parameters are optional.
- I = One or more illegal Data Parameters exist.
- X = Missing one or more compulsory Data Parameters.

For example, in the Subset Parameters combobox shown above, ***C** indicates that all the compulsory Data Parameters have been created, although their data may yet to be entered. An **X** in place of a **C** would indicate that one or more compulsory Parameters have not been entered.

In the case of Results parameters, * indicates that results data exists.

3.6.2 The Time Series Data (TS)/Time Independent Data (TID) combobox



Data Parameters are either Time Series (TS) or Time Independent (TID). To display either or both in the spread, click on the TS/TID Data combobox and select either TS data, TID data, or TS, TID data.


3.6.3 The Data/Results Parameter query button

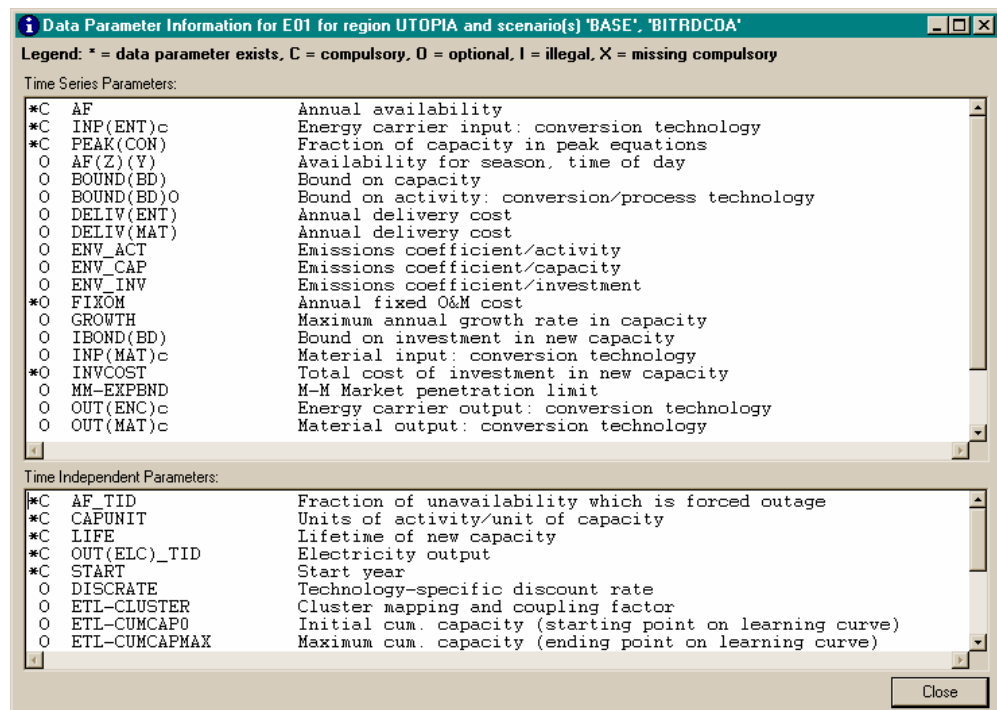
When the user clicks on the Parameter query button, ANSWER will display a complete listing of the Data/Results Parameters which are relevant for the selected Item. This listing is determined by ANSWER based on the Item's Set Memberships as specified by the user.

This display will also indicate the compulsory/optional/illegal status of each Data Parameter and whether the Parameter currently exists for the specified Item. For example, when the Set Memberships of a coal fired electric generator specify it to be a Centralised, Base Loaded, Conversion Technology, ANSWER will ascribe to it all the Data Parameters that are necessary to adequately specify such a technology. Each of the Data Parameters may be either compulsory or optional to providing a sensible MARKAL specification.

In the situation of an Item in a non-Base Scenario that has been modified from the Base Scenario, the Data Parameters listing for this Item will display the status of both the Data Parameters in the non-Base Scenario and any residual Data Parameters of the Base Scenario.

To display the Data Parameters listing:

1. Click on the required Item in the Items display.
2. Click on the **[Data/Results Parameter query]** button , or click on **T**ools in the menu bar and choose **Parameter Information** in the drop menu.
3. A Data Parameter Information display will appear if you are viewing data (shown below). A Results Parameter Information display will appear if you are viewing results.




3.6.3.1 Status of a Parameter

The Data Parameter Information display also shows the compulsory/optional/illegal status of each Data Parameter and whether the Parameter currently exists for the specified Item.

The indicators are as follows

- * = Data Parameter exists.
- C = Existing compulsory Data Parameter.
- O = Optional Data Parameter.
- I = Existing illegal Data Parameter.
- X = Missing compulsory Data Parameter.

For example, *C indicates that this compulsory Parameter has been created for the Item (the data itself may not be entered). An X indicates that this compulsory Parameter has not been created. An I indicates that the Parameter is illegal for the Item under its current Set specification.

If more than one Item is selected in the Items display, the **[Data/Results Parameter query]** button is disabled .

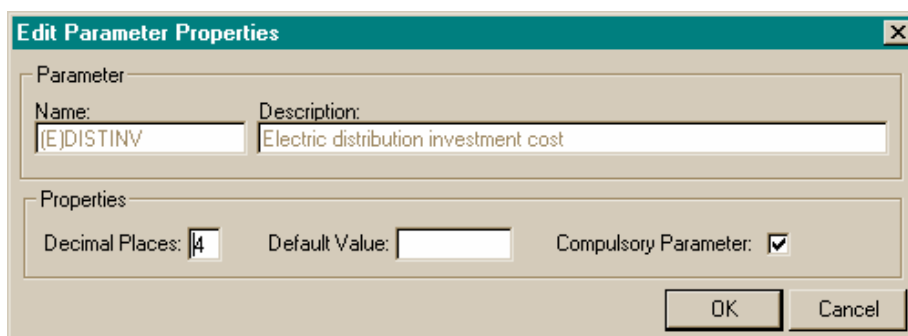
Results Parameters are created by the ANSWER MARKAL report generator. Consequently, the Results Parameter Information display status of * indicates that the Results Parameter and its results exists.

3.6.3.2 Changing the Status and Properties of a Data Parameter and a Results Parameter

A Data Parameter has a number of properties, namely the number of decimal places, its default value, and its compulsory/optional status. Although these properties are pre-set in ANSWER, a user may choose to change them at a later stage.

To edit the properties of a Data Parameter:

1. Ensure the screen is in Edit Data mode. If the user wishes to edit the number of decimal places only, the screen can be in Browse Data mode.
2. Click on the Parameter Component tab.
3. In the Items display, click on the Data Parameter to be edited.
4. Click on the **[Edit...]** button in the Item Management sub-region and the Edit Parameter Properties dialogue box (shown below) will appear with the current properties for that Data Parameter displayed.



The dialog box titled "Edit Parameter Properties" contains two main sections. The "Parameter" section has two text fields: "Name:" with the value "(E)DISTINV" and "Description:" with the value "Electric distribution investment cost". The "Properties" section contains three controls: "Decimal Places:" with a spinner box set to 4, "Default Value:" with an empty text box, and "Compulsory Parameter:" with a checked checkbox. At the bottom right are "OK" and "Cancel" buttons.

5. Edit the necessary fields.
6. Click on **[OK]** and the new properties for the Data Parameter will be saved to the Database and displayed.

Note that if the status of a Data Parameter is changed to compulsory, the user is responsible for adding the Parameter where relevant to an existing Item.

For a Results Parameter, only the Description and Decimal Places can be changed. The operation is the same as for Data Parameters, except that the screen must be in Results mode

3.6.4 The Parameters spread

The Parameters spread displays the Time Series data spread and the Time Independent data spread corresponding to the currently selected Item(s), the settings of the Subset Parameters combobox, and the settings of the Time Series Data/Time Independent Data combobox.

However, particularly when selecting multiple Items (see Section 3.5.2.3 'Item Multi-select and Select All Items'), the number of Parameters contained in the spread will quickly overflow the screen. Consequently, the spread has a number of features to assist the user to view and sort Parameter(s), namely:

1. Adjustable spread column widths
2. Sort spread by Column Header

3. Expansion of the Parameters spread

To assist the user in understanding the status and details of a particular Data or Results Parameter, the spread also incorporates:

1. A Data Parameter status field
2. A Data Parameter ? Indicator for Null Data Row or Row containing -none-
3. A Data/Results Parameter Details query button.

Also, the 'TS and TID Filter Form' facility provides the user with a powerful filtering mechanism to limit the Data or Results Parameters that are displayed in the spreads to those of particular interest. This filtering facility is particularly valuable when multiple Items are selected in the Items display. For details of the 'TS and TID Filter Form' facility, see section 3.7.

Sort spread by column header

Expand/contract Parameters spread

Data Parameter status fields

'Add' row

Direct cell editing of Parameter argument

Data/results Parameter details query button

Scenario	Parameter	Region	Technology	Commo	Bound	TimeSlice	1990	2000	2010	2020
BASE	AF	?	UTOPIA	E01	-	-	0.8000	0.8000	0.8000	0.8000
BASE	FIXOM	?	UTOPIA	E01	-	-	0.0000	70.0000	100.0000	100.0000
BASE	INP(ENT)c	?	UTOPIA	E01	HCO	-	1.250	3.1250	3.1250	3.1250
BASE	INVCOST	?	UTOPIA	E01	CSV	-	1,300.0000	1,300.0000	1,200.0000	1,200.0000
BASE	PEAK(CON)	?	UTOPIA	E01	DSL	-	1.0000	1.0000	1.0000	1.0000
BASE	RESID	?	UTOPIA	E01	ELC	-	0.5000	0.3250	0.1500	0.1500
BASE	VAROM	?	UTOPIA	E01	FEQ	-	0.3000	0.3000	0.3000	0.3000
Add	BASE				GSL	-				

The spread also has a number of features that are specific to the Edit Data mode (shown above) to enable the user to:

1. Add a new Data Parameter and its data (see Add row, shown in blue)
2. Edit a Data Parameter's data (shown in white)
3. Direct cell edit of a Data Parameter argument
4. Delete an existing Data Parameter and its data.

The edit facilities are detailed in Section 5, 'Data Entry and Editing'.

3.6.4.1 Adjustable spread column widths

To ensure that the maximum number of periods are displayed (subject to the limitations imposed by the width and resolution of the monitor being used), the user can change and set the Parameters spread column widths.

3.6.4.1.1 Changing spread column widths

The user may change the widths of columns in the Time Series (TS) and Time Independent data (TID) spreads, and the new column widths will be retained until changed again. The user may choose to reduce the widths of any or all the Scenario, Parameter, Region, Technology, Commodity, Bound, and Time Slice columns in order to display more Time Series values on the screen without the need for horizontal scrolling.

If the user changes the width of any of the Scenario, Parameter, etc, columns in the TS spread, then the width of the corresponding column in the TID spread is automatically adjusted to match. The converse also applies.

If the user changes the width of any numeric data column in the TS spread (e.g., the 1990 column), then all the numeric data column widths in the TS spread are automatically adjusted to match. The width of the Value column in the TID spread is not affected.

If the user changes the width of the Value column of the TID spread, the width of the numeric data columns in the TS spread are not affected.

The same column widths will then apply for each Component. For example, the Scenario column will have the same width regardless of which Component is selected.

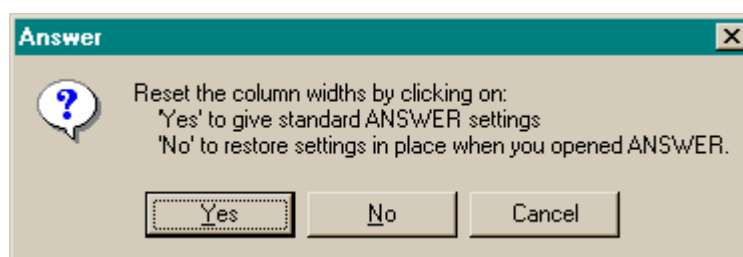
Column widths which are in effect when ANSWER is exited are saved to the registry, and become the default column widths when ANSWER is next opened.

3.6.4.1.2 Resetting spread column widths

ANSWER has a facility which allows the user to reset spread column widths to either standard ANSWER settings, or to the settings which were in effect when ANSWER was opened, i.e., to the settings which are currently saved in the registry.

To reset the spread column widths

- 1a. Click on **Tools** in the menu bar and click on **Reset Column Widths...** in the drop menu, or
- 1b. Right click over either data spread and click on **Reset Column Widths...** in the pop-up menu.
2. A dialogue box (shown below) will appear.



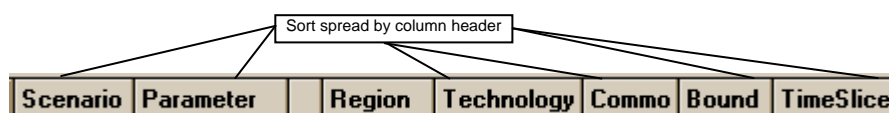
3. Select **[Yes]** to reset to standard ANSWER settings, or **[No]** to reset to settings which were in effect when ANSWER was opened.

3.6.4.2 Sort spread by Column Header

When the spread first appears, the Parameters are ordered alphabetically (in descending order) by Region, then by Parameter, then by Region, then by Technology, then by Commodity, Bound, TimeSlice and Scenario (or Case). When viewing the Parameters, it is often useful to sort by a name other than the Parameter name, such as the Scenario or Technology name.

To sort the Parameters by something other than the Parameter name:

1. Click on the required column header (shown below).



2. The Parameters will then be ordered alphabetically (in descending order) for that header. For example, clicking on the Technology header will cause the Parameters to be ordered alphabetically by Technology, then by Parameter, Region, Commodity, Bound, TimeSlice and Scenario (or Case).
3. To return to the original Parameter order, simply click on the Parameter column header.

3.6.4.3 Expansion of the Parameters spread


Due to screen size limitations, the Parameters spread displays about 20 Parameters and their data (at 1024 x 768 resolution). However, the spread incorporates an Expand/Contract Parameters spread button that enables the user to expand the display to about 36 Parameters (at 1024 x 768 resolution).

To expand the spread:

1. Click anywhere on the spread using the right hand mouse button and a pop-up menu will appear.
2. Click on **Toggle Size** in the pop-up menu, and the spread will expand as shown below to about 36 Parameters (at 1024 x 768 resolution).
3. Repeat the procedure to return the spread to normal size.

Expand/contract Parameters spread

Scenario	Parameter	Region	Technology	Commo	Bound	1990	2000	2010	2020
BASE	AF	? UTOPIA	E01	-	-	0.8000	0.8000	0.8000	0.8000
BASE	AF	? UTOPIA	E21	-	-	0.8000	0.8000	0.8000	0.8000
BASE	AF	? UTOPIA	E31	-	-	0.2750	0.2753	0.2756	0.2756
BASE	AF	? UTOPIA	E51	-	-	0.1700	0.1700	0.1700	0.1700
BASE	AF	? UTOPIA	E70	-	-	0.8000	0.8000	0.8000	0.8000
BASE	AF	? UTOPIA	SRE	-	-	1.0000	1.0000	1.0000	1.0000
BASE	BOUND(BD)	? UTOPIA	E31	-	LO	0.1300	0.1300	0.1300	0.1300
BASE	BOUND(BD)	? UTOPIA	E31	-	UP	0.1300	0.1700	0.2100	0.2100
BASE	BOUND(BD)	? UTOPIA	E51	-	UP	3.0000	3.0000	3.0000	3.0000
BASE	BOUND(BD)	? UTOPIA	RHE	-	UP	0.0000			
BASE	BOUND(BD)	? UTOPIA	SRE	-	LO	0.1000			
BASE	BOUND(BD)	? UTOPIA	TXE	-	UP	0.0000	4.0000	10.0000	10.0000
BASE	CF	? UTOPIA	RHE	-	-	1.0000	1.0000	1.0000	1.0000
BASE	CF	? UTOPIA	RHO	-	-	1.0000	1.0000	1.0000	1.0000
BASE	CF	? UTOPIA	RL1	-	-	1.0000	1.0000	1.0000	1.0000
BASE	CF	? UTOPIA	TXD	-	-	1.0000	1.0000	1.0000	1.0000
BASE	CF	? UTOPIA	TXE	-	-	1.0000	1.0000	1.0000	1.0000
BASE	CF	? UTOPIA	TXG	-	-	1.0000	1.0000	1.0000	1.0000
? BASE	COST	? UTOPIA	EXPDSL1	-	-				
BASE	COST	? UTOPIA	IMPDSL1	-	-	10.0000	10.0000	10.0000	10.0000
? BASE	COST	? UTOPIA	IMPELC1	-	-				
M? BITRDCO	COST	? UTOPIA	IMPELC1	-	-				
BASE	COST	? UTOPIA	IMPGSL1	-	-	15.0000	15.0000	15.0000	15.0000
BASE	COST	? UTOPIA	IMPHC01	-	-	2.0000	2.0000	2.0000	2.0000
M BITRDCO	COST	? UTOPIA	IMPHC0C	-	-	0.1000	0.1000	0.1000	0.1000
BASE	COST	? UTOPIA	IMPOIL1	-	-	8.0000	8.0000	8.0000	8.0000
BASE	COST	? UTOPIA	IMPUBN1	-	-	2.0000	2.0000	2.0000	2.0000

Alternatively, click on the **[Expand/Contract Parameters spread]** button  at the top left-hand corner of the spread, and the spread will expand as shown above.

3.6.4.4 Data Parameter status field

The Data Parameter status field (shown below) indicates whether the adjacent Parameter is a Base Scenario Parameter (i.e., displayed as a null field) or a non-Base Scenario Parameter (i.e., displayed as an 'M').

The distinction between a Base Scenario Parameter and its non-Base Scenario Parameter pair is important. When modelling the non-Base Scenario, the data in the non-Base Scenario Parameter will override the data in the Base Scenario Parameter for the purpose of the model run.

For example, when modeling the BITRDCOA Scenario, the data of the BITRDCOA COST Parameter for IMPELC1 in region UTOPIA (shown below) will override the data of the BASE COST Parameter.

Scenario	Parameter	Region	Technology	Energy	1990	2000	2010	2020
BASE	COST	? UTOPIA	IMPELC1	-	0.5000	0.5000	0.5000	0.5000
M BITRDCOA	COST	? UTOPIA	IMPELC1	-	3.0000	3.0000	3.0000	3.0000
BASE	OUT(ENT)r	? UTOPIA	IMPELC1	ELC	1.0000	1.0000	1.0000	1.0000

3.6.4.5 Data Parameter ? Indicator for Null Data Row or Row containing -none-

A row of all null values for a Time Series Data Parameter (or a null value for a Time Independent Data Parameter) nearly always means that the user has failed to specify data where data is required.

And a row containing the -none- placeholder means (usually) that the user, after creating a new technology, has failed to specify a commodity as input to or output from the technology.

As a visual indicator to the user that a Data Parameter row has all null values, or that the row contains -none-, ANSWER inserts a ? indicator in the first column of the data spread in each such row. (Note the ? indicator in the first column of the data spread below for the INP(ENT)c and VAROM Parameter Rows.)

	Scenario	Parameter		Region	Technology	Commo	Bound	TimeSlice	1990	2000	2010	2020
	BASE	AF	?	UTOPIA	E41	-	-	-	1.0000	1.0000	1.0000	1.0000
?	BASE	INP(ENT)c	?	UTOPIA	E41	-none-	-	-	3.2000	3.2000	3.2000	3.2000
	BASE	PEAK(CON)	?	UTOPIA	E41	-	-	-	1.0000	1.0000	1.0000	1.0000
?	BASE	VAROM	?	UTOPIA	E41	-	-	-				
Add	BASE		?									

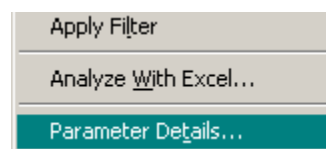
3.6.4.6 Data/Results Parameter Details query button

To assist the user in understanding the details of a specific Data or Results Parameter, the spread incorporates a Parameter Details query button, which when clicked brings up a Parameter Details form. This form displays all pertinent definitional details for a Parameter, including its Scenario/Case, its domain of definition and its units. Importantly, it also includes a facility for User Comments.

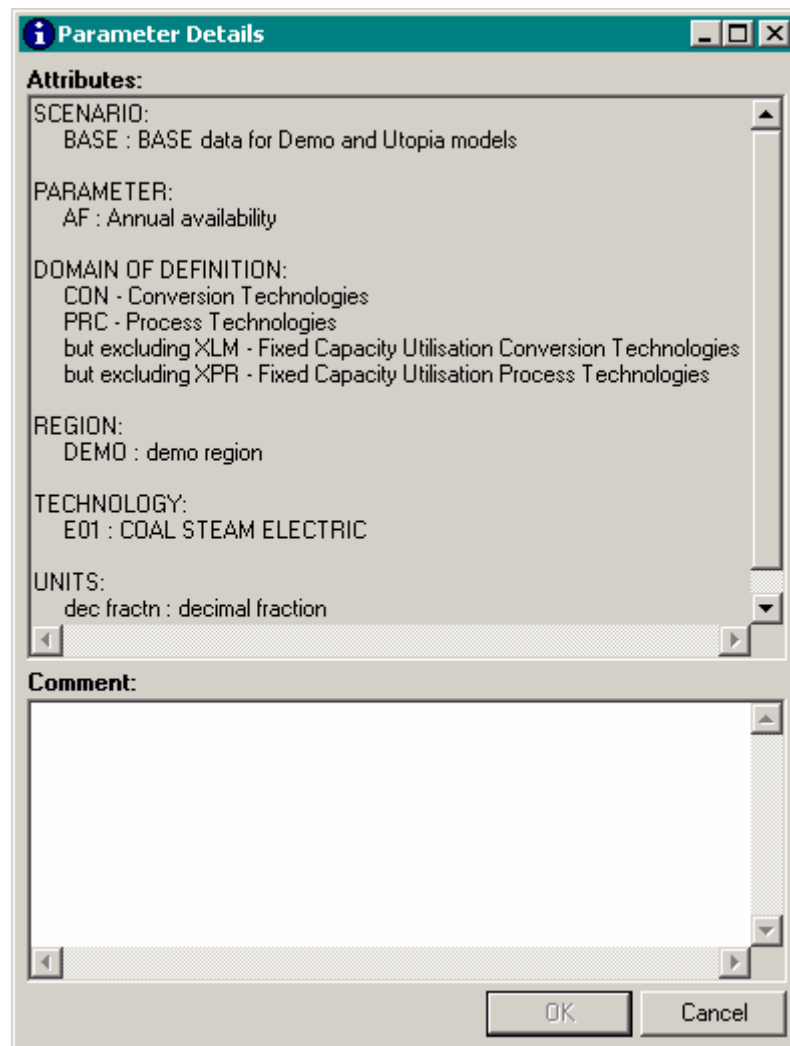
To display the Parameter Details form

1. Click on the **[Parameter Details query]** button  in the Parameter row in question.

Alternatively, click anywhere in the Parameter row using the right hand mouse button and a pop-up menu will appear (shown below). Then click on **Parameter Details....**



2. A Parameter Details form will appear (shown below), displaying definitional details and User Comments (if any).
3. If in Edit Data mode and the Parameter is for the currently editable Scenario, User Comments can be added. (See section 5.4.2.4 'Associating a User Comment with a Data Parameter'.)



The image shows a 'Parameter Details' dialog box with a teal title bar. It contains two main sections: 'Attributes' and 'Comment'. The 'Attributes' section lists several parameters with their values: SCENARIO (BASE), PARAMETER (AF), DOMAIN OF DEFINITION (CON, PRC, and exclusions), REGION (DEMO), TECHNOLOGY (E01), and UNITS (dec fractn). The 'Comment' section is an empty text area. At the bottom are 'OK' and 'Cancel' buttons.

Parameter Details

Attributes:

SCENARIO:
BASE : BASE data for Demo and Utopia models

PARAMETER:
AF : Annual availability

DOMAIN OF DEFINITION:
CON - Conversion Technologies
PRC - Process Technologies
but excluding XLM - Fixed Capacity Utilisation Conversion Technologies
but excluding XPR - Fixed Capacity Utilisation Process Technologies

REGION:
DEMO : demo region

TECHNOLOGY:
E01 : COAL STEAM ELECTRIC

UNITS:
dec fractn : decimal fraction

Comment:

OK Cancel

3.7 TS and TID Filter Form facility


By default, ANSWER's Time Series and Time Independent spreads display all Data/Results Parameters corresponding to the currently selected Item(s) in the Items listview, and the setting of the 'Subset Parameters' combo. Where there are many selected Items, this may lead to many rows of TS and TID data being displayed and associated slow response times. Thus it is extremely useful to be able to define and apply TS and TID Filters to limit the rows of TS and TID data being displayed to that which is of particular interest.

The TS and TID Filter facility provides filtering facilities with the following general characteristics:

- (i) A wide range of filtering criteria may be entered in individual cells on the TS and TID Filter form.
- (ii) Multiple composite row criteria may be specified for each of TS and TID data. These criteria are obtained by ORing the individual composite row criteria.
- (iii) Filters are saved by Name (all Filters are Named). The work of creating frequently used Filters needs to be done only once. After that, the user can simply select the Filter by Name. Thus via a Named Filter, the user is able to create a useful "user view of the data" and then subsequently select this view by Name.

The term **Specified Filter** is used in the following documentation, and in ANSWER, to denote the Filter that is currently associated with a Component tab and data mode (Data or Results). The Specified Filter is the Filter that will be applied when the user clicks on the 'Apply Filter' button. If no Filter is associated with a Component tab and data mode, the Specified Filter will appear on the TS and TID Filter form set to <New Filter>.

3.7.1 To Create and Apply a New Filter

1. Bring up the TS and TID Filter form by clicking on the **[TS and TD Filter Form...]** icon , or by clicking on **T**ools in the menu bar and choosing **TS and TID Filter Form...** in the drop menu, or by right-mouse clicking on the TS or TID spread and choosing **TS and TID Filter Form...** in the pop-up menu.
2. The TS and TID Filter form (see below) will appear.

TS and TID Filter

Specified Filter: <New Filter>

Name: <New Filter> Delete

Description:

Row Comparison Filter: Show All Rows

Time Series Filter:

	Scenario	Parameter	Region	Technology	Commodity	Bound	TimeSlice
Look for:							
or:							
or:							
or:							
or:							

Time Independent Filter:

	Scenario	Parameter	Region	Technology	Item2	Item3	TimeSlice
Look for:							
or:							
or:							
or:							
or:							

Clear TS Clear TID Copy TS -> TID Save Save & Apply Save & Apply with Select All Cancel

3. If the Filter in the 'Name' combobox is not <New Filter>, select <New Filter> in the combobox (it is the top entry). This will clear all existing Filter specifications from the form, and place the focus on the 'Row Comparison Filter' combobox.
4. Choose whichever setting for the Row Comparison Filter combobox is appropriate. The default setting is 'Show All Rows', with 'Hide Identical Rows' as the alternate setting. Further details regarding the meaning of 'Hide Identical Rows' are given in section 3.7.10 below. The Row Comparison Filter setting applies to both the Time Series and Time Independent spreads.
5. Enter appropriate filtering criteria for the Time Series Filter and Time Independent Filter. Details regarding allowable filtering criteria are given in section 3.7.11 below. (Note that if the Time Series and Time Independent criteria are rather similar, it will be advantageous to first enter the Time Series Filter filtering criteria, and then use the **[Copy TS -> TID]** button to copy the Time Series criteria to the Time Independent Filter. All criteria except Parameter criteria will be copied from the Time Series to the Time Independent Filter.) The form might now look as follows:

TS and TID Filter

Specified Filter: <New Filter>

Name: <New Filter> Delete

Description:

Row Comparison Filter: Show All Rows

Time Series Filter:

	Scenario	Parameter	Region	Technology	Energy	Bound	Item4
Look for:		= "INP(ENT)C"		Like "E*"			
or:		= "DELIV(ENT)"		Like "E*"			
or:							
or:							
or:							

Time Independent Filter:

	Scenario	Parameter	Region	Technology	Energy	Item3	Item4
Look for:		= "START"		Like "E*"			
or:							
or:							
or:							
or:							

Clear TS Clear TID Copy TS -> TID Save Save & Apply Save & Apply with Select All Cancel

- Click on the **[Save & Apply]** button (or possibly on the **[Save & Apply with Select All]** button). This brings up a 'Save & Apply Filter' form (or a 'Save & Apply Filter with Select All' form), initially with the Name field set to <New Filter> and the Description field empty.

Save & Apply Filter

Name: <New Filter>

Description:

Apply As Temp Save & Apply Cancel

- Enter a Name for the Filter, and optionally enter a Description. Now the form might look as follows:

Save & Apply Filter

Name: Technologies like E*

Description: Technologies like E*: INP(ENT)c, DELIV(ENT) and START parameters

Apply As Temp Save & Apply Cancel

- Click on the **[Save & Apply]** button. This saves the Filter to the database, and applies the Filter to restrict the information that is displayed in the Time Series and Time Independent spreads for the selected Items. If the selected Items at the time the Filter is applied are E01 in DEMO and UTOPIA regions, and E10 in DEMO region, this might result in the display shown below.

MultiUtopDemoLumpy - ANSWER-MARKAL Energy Modelling

File Edit View Run Tools Functions Help

Browse Data Regions Filter... Items: All Scenarios: All

Global Energy Material Demand Emission Technology Constraint Tax/Subsidy Stochastic Parameter BiTrade TimeSlice

Items Filter: Sets Named *All Technologies (TCH+SRCENCP) Sets Filter... Named Filter...

Name Region Description Status

E01	DEMO	COAL STEAM ELECTRIC	
E01	UTOPIA	Coal Steam Electric	
E10	DEMO	DST CONDENSING STEAM TURBINE +IN...	
E14	DEMO	DST+NGA GAS TURBINE	
E21	DEMO	LWR	


Item Management: 3 items selected. New... Copy... Delete Browse Select All Items Move... RES

Subset Parameters: * Technology, Specific TS, TID data ?


Scenario	Parameter	Region	Technology	Energy	1990	2000	2010	2020
BASE	DELIV(ENT)	?	DEMO	E01	COA	0.4160	0.4160	0.4160
BASE	DELIV(ENT)	?	DEMO	E10	DST	0.4000	0.4000	0.4000
BASE	INP(ENT)c	?	DEMO	E01	COA	2.7940	2.7940	2.7940
BASE	INP(ENT)c	?	DEMO	E10	DST	3.0300	2.8967	2.7633
BASE	INP(ENT)c	?	UTOPIA	E01	HCO	3.1250	3.1250	3.1250

Scenario	Parameter	Region	Technology	Value	
BASE	START	?	DEMO	E01	1,990
BASE	START	?	DEMO	E10	1,990
BASE	START	?	UTOPIA	E01	1,990

Database: C:\Answer\6\Answer_Databases\MultiUtopDemoLumpy.mdb Edit Scenario: BASE

- When the Filter is applied, the **[Apply/Remove Filter]** icon  in the tool bar is backlit and recessed (as shown). The backgrounds of the TS and TID spreads are coloured yellow, and, in Browse Data and Results mode, the TS and TID data rows are coloured dark yellow (shown above).
- The TS and TID Filter facility also allows *temporary* Filters to be used. Using such Filters reduces the keystrokes needed when experimenting with Filters. For example when the 'Save & Apply Filter' form is displayed at step 6, instead of carrying out steps 7 and 8, an alternative course of action is simply to click on the **[Apply As Temp]** button. When this is done, a special pre-defined Name is assigned to the temporary Filter, and the Filter is applied. (A temporary Filter applied to Data on the Technology tab is always assigned the special Name <Temp_Technology_Data>, while a temporary Filter applied to Results on the Energy tab is always assigned the special Name <Temp_Energy_Results>, etc.)

3.7.2 To Remove a Filter that is Applied

- Click on the **[Remove Filter]** icon  in the tool bar, or click on **Tools** in the menu bar and choose **Remove Filter** in the drop menu, or right-mouse click on the TS or TID spread and choose **Remove Filter** in the pop-up menu.
- Note that there is an important distinction between removing a Filter that is applied, and deleting a Filter. Removing a Filter that is applied simply has the effect that the Time Series and Time Independent information that is displayed is no longer filtered. If immediately after choosing **Remove Filter** the user then chooses **Apply Filter**, the same Filter that has just been removed will be re-applied to the Time Series and Time Independent spreads.

3.7.3 To Apply an existing Filter

- Bring up the TS and TID Filter form (as per step 1 in section 3.7.1 above).
- When the TS and TID Filter form appears, drop-down the Name combobox and select the existing Filter that you wish to apply, as shown below.

TS and TID Filter

Specified Filter:

Name:

Description:

Row Comparison Filter:

Time Series Filter:

	Scenario	Parameter	Region	Technology	Energy	Bound	Item4
Look for:		= "INP(ENT)c"		Like "E*"			
or:		= "DELIV(ENT)"		Like "E*"			
or:							
or:							
or:							
or:							

Time Independent Filter:

	Scenario	Parameter	Region	Technology	Energy	Item3	Item4
Look for:		= "START"		Like "E*"			
or:							
or:							
or:							
or:							
or:							

- Click on the **[Save & Apply]** button. Provided that no changes have been made to the Filter, the Filter is immediately applied to the Time Series and Time Independent spreads.
- If changes are made to the Filter after its initial selection at step 2, the 'Save and Apply Filter' form will be displayed, with the Name and Description fields set to match those of the Filter that was chosen at step 2. To save these changes with the same Filter Name and Description, simply click on the **[Save & Apply]** button.

3.7.4 To Create a New Filter (but not Apply it)

- Follow the steps detailed in section 3.7.1 ('To Create and Apply a New Filter'), but at step 6, instead of clicking on the **[Save & Apply]** button, click on the **[Save]** button. This brings up a 'Save Filter' form, as shown below.

Save Filter

Name:

Description:

- Enter a Name for the Filter, and optionally enter a Description.

Save Filter

Name:

Description:

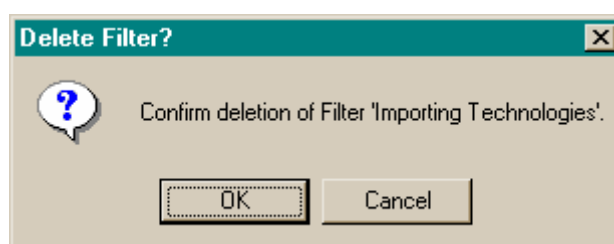
3. Click on the **[Save]** button. This saves the Filter to the database, and redisplay the TS and TID Filter form. It does not apply the Filter, and so does not change the currently Specified Filter for the current Component tab and current data mode.

3.7.5 To Create a New Filter by Copying an Existing Filter

1. Bring up the TS and TID Filter form (as per step 1 in section 3.7.1 above).
2. When the TS and TID Filter form appears, drop-down the Name combobox and select the existing Filter that you wish to **copy**.
3. Modify any/all of Row Comparison Filter setting, Time Series and Time Independent Filter criteria.
4. Click on the **[Save]** button. This brings up a 'Save Filter' form, initially with the Name and Description fields set to match those of the Filter chosen at step 2 above. Enter a new Name for the Filter, and optionally enter a new Description.
5. Click on the **[Save]** button. This saves the Filter to the database, and redisplay the TS and TID Filter form.

3.7.6 To Delete an Existing Filter

1. Bring up the TS and TID Filter form (as per step 1 in section 3.7.1 above).
2. When the TS and TID Filter form appears, drop-down the Name combobox and select the Filter that you wish to **delete**.
3. Click on the **[Delete]** button to the right of the Name combobox. A 'Delete Filter?' message box (shown below) will appear.



4. Click on the **[OK]** button to confirm the deletion of the Filter.

3.7.7 To Edit the Name of an Existing Filter

It is not currently possible to simply edit the Name of an existing Filter. To change the Name of an existing Filter, copy the Filter (as detailed in section 3.7.5) to create a new Filter with the desired Name. Then delete the original Filter (as detailed in section 3.7.6).

3.7.8 Three Categories of Filters

There are three broad categories of Filters:

- | | |
|-----------------------|---|
| <i>'Data Only'</i> | Filters that are useful for Data only.
They were created for data mode of Data and have filtering criteria in the Parameter column, or in the Scenario column. |
| <i>'Results Only'</i> | Filters that are useful for Results only.
They were created for data mode of Results and have filtering criteria in the Parameter column, or in the Case column. |
| <i>'Data+Results'</i> | Filters that are potentially useful for both Data and Results.
They do <u>not</u> have filtering criteria in the Parameter column, or in the Scenario/Case column. |

When the user is browsing/editing Data, and brings up the TS and TID Filter form, the Name combobox is populated with all TS and TID Filters that are in the 'Data Only' and 'Data+Results' categories.

Likewise when the user is browsing Results, the Name combobox is populated with all TS and TID Filters that are in the 'Results Only' and 'Data+Results' categories.

This applies regardless of which Component tab the user is on. So if the user is say browsing Results, the combobox will contain the same list of Filters regardless of whether the user is on the Technology tab, or the Parameter tab, or some other tab such as Energy.

3.7.9 Applying the Same Filter more than once

The user may apply the same Filter in more than one place.

For example, if a Filter is in the 'Data+Results' category (applicable to both Data and Results), the user may apply this Filter to say Data on the Technology tab, and then switch to Results and apply the same Filter there.

Another example: the user may apply a Filter to Results on the Parameter tab, and then switch to the Energy tab (still for Results) and apply the same Filter there.

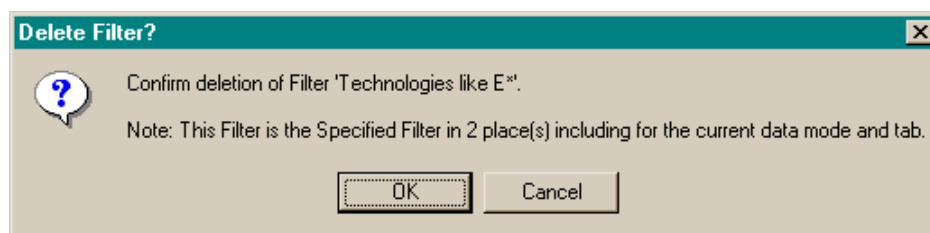
3.7.9.1 Changing a Filter that is in use more than once

When the same Filter is the Specified Filter in more than one place, and the user **changes** (and saves) the settings associated with this Filter (while retaining the same Name), the updated settings apply to all places where this Filter is the Specified Filter.

Thus having changed the Filter settings, on switching back to other places where this Filter is applied, the user may see different information displayed in the Time Series and Time Independent spreads from what was previously there, when this Specified Filter had different criteria associated with it.

3.7.9.2 Deleting a Filter that is in use more than once

When the same Filter is the Specified Filter in more than one place, and the user **deletes** this Filter, then the following 'Delete Filter?' message appears:



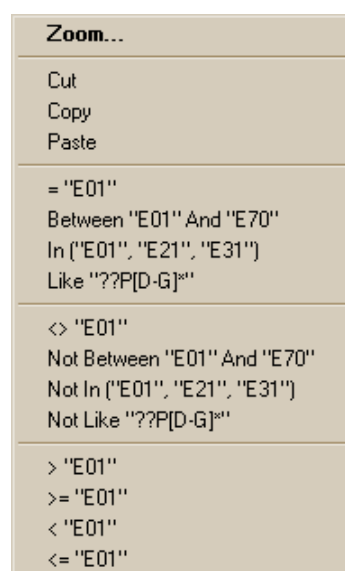
If the user clicks on the [OK] button, then in all places where this Filter was the Specified Filter, the special Name '<Filter Deleted>' temporarily becomes the Specified Filter Name, and the settings associated with the Filter that has just been deleted are retained. If the user brings up the TS and TID Filter form, it will appear as below — note the special Name '<Filter Deleted>' in the Specified Filter textbox.

Thus having deleted the Filter, on switching back to other places where this Filter was applied, the user will see the same information displayed in the Time Series and Time Independent spreads as previously, before this Filter was deleted.

1. As already noted above, the Row Comparison Filter combobox has two alternate settings: 'Show All Rows' (the default) and 'Hide Identical Rows'. Whichever setting is selected applies to both the Time Series and Time Independent spreads.
2. With the 'Show All Rows' setting, what is displayed in the Time Series and Time Independent spreads is determined solely by the Time Series and Time Independent Filters, respectively.
3. The 'Hide Identical Rows' setting can only be used when browsing Results. If a Filter with the 'Hide Identical Rows' setting is applied when browsing/editing Data, ANSWER displays a message indicating that the 'Hide Identical Rows' option is not available for Data, and the spreads will be displayed as though 'Show All Rows' had been selected.
4. With the 'Hide Identical Rows' setting, what is displayed in the Time Series and Time Independent spreads is what would be displayed with the 'Show All Rows' setting, but with the additional filtering out of rows that are the same in all respects (except for Case) for each Case. For example, suppose that the selected Cases are "AAA", "BBB" and "CCC". Further suppose that any other filtering criteria that may be in place permit Results Parameter "CAPACITY.L" for Technology "E01" to appear in the Time Series spread. If the time series of "CAPACITY.L" values for Technology "E01" is the same for each of the selected Cases "AAA", "BBB" and "CCC", then these three rows are deemed to be 'identical', and would be hidden with 'Hide Identical Rows' as the setting for the Row Comparison Filter.

3.7.11 Filtering Criteria for individual cells in the TS and TID Filters

1. A wide range of filtering criteria may be entered in individual cells of the Time Series and Time Independent Filters. By right mouse clicking over any cell in the Time Series or Time Independent Filter, the user can consult the pop-up menu (see below) as a reminder of the allowable filtering criteria.



2. Note that in order to specify within an individual cell filtering criterion involving **or**, it is necessary to use the **In()** construct. Thus the filtering criterion to say that Technology is either "E01" **or** "E21" **or** "E31" is handled via the criterion **In ("E01", "E21", "E31")**.
3. The **Like** and **Not Like** constructs provide for the use of:
 - * (asterisk) as a wild character representing 0 or more of any character
 - ? (question mark) as a wild character representing any single character
 - [D-G] to represent a single character in the range D to G

Thus the example **Like "??P[D-G]*"** on the pop-up menu matches any name whose first and second characters are arbitrary, whose third character is P, whose fourth character is in the range D to G, and where any remaining characters are arbitrary.
4. For most of the filtering criteria, the user may enter shortened forms and ANSWER will expand these to match the formats displayed on the pop-up menu. For example, the shortened form **E01** entered by the user will be expanded to **= "E01"**. Likewise the shortened form **E01**, **E21**, **E31** entered by the user will be expanded to **In ("E01", "E21", "E31")** and any expression involving *, ?, [or] such as **??P[D-G]*** will be expanded to **Like "??P[D-G]*"**. In general the quotation marks surrounding names need not be entered by the user.
5. The pop-up menu also provides a simple means of entering into a cell a proforma for the particular filtering criterion that is desired.
6. Where a filtering criterion exceeds the width of the cell, the **Zoom...** right mouse click pop-up menu facility provides a convenient means of editing the cell contents:

Time Series Filter:						
	Scenario	Parameter	Region	Technology	Commodity	Bound
Look for:				In ("E01", "E21", "E31")		
or:						
or:						
or:						
or:						
or:						

After invoking **Zoom...**, the following form appears to allow easy editing of the cell contents:

The Zoom dialog box has a title bar with 'Zoom' and a close button. It contains a large text input field with the text 'In ("E01", "E21", "E31")'. To the right of the input field are two buttons: 'OK' and 'Cancel'.

3.7.12 How Filtering Criteria for individual cells combine

In each row, the criteria for individual cells are **AND**ed to form a composite row criteria, and then these composite row criteria are **OR**ed. For example, suppose that the Time Series Filter contains filtering criteria in the 'Look for:' row, and in the following 'or:' row, as follows:

The 'TS and TID Filter' dialog box has a title bar with a dropdown arrow and the text 'TS and TID Filter'. It contains several fields and buttons:

- Specified Filter: <Filter Deleted>
- Name: <New Filter> (with a dropdown arrow)
- Description: Technologies like E*: INP(ENT)c, DELIV(ENT) and START parameters
- Row Comparison Filter: Show All Rows (with a dropdown arrow)
- Time Series Filter:**

	Scenario	Parameter	Region	Technology	Energy	Item3	Item4
Look for:		Like "INP(ENT)*"		Between "E00" And "E99"			
or:		= "DELIV(ENT)"		Like "E??"			
or:							
or:							
or:							
- Time Independent Filter:**

	Scenario	Parameter	Region	Technology	Item2	Item3	Item4
Look for:							
or:							
or:							
or:							
or:							
or:							
- Buttons at the bottom: Clear TS, Clear TID, Copy TS -> TID, Save, Save & Apply, Save & Apply with Select All, Cancel.

The composite row criteria for the 'Look for:' row, obtained by **AND**ing the criteria for individual cells, becomes:

((Parameter Like "INP(ENT)*") **AND** (Technology Between "E00" And "E99"))

while the composite row criteria for the 'or:' row, also obtained by **AND**ing the criteria for individual cells, becomes:

((Parameter = "DELIV(ENT)") **AND** (Technology Like "E?"))

Any Time Series Parameter instance that satisfies **either** the 'Look for:' composite row criteria **OR** the 'or:' composite row criteria will be displayed in the Time Series spread.

3.8 The Trade Tab (applies only to ANSWER version 5)

NOTE: In version 6 of ANSWER, the *Trade* tab is replaced by a *BiTrade* tab that provides improved facilities for defining new bilateral trade links and for browsing, deleting and editing existing bilateral trade links. For details of the operation of the *BiTrade* tab, see section 14 'The BiTrade Tab in ANSWER'.



Thus the documentation in the remainder of this section 3.8 is applicable only to version 5 of ANSWER.

The Trade tab allows the display of Data/Results Parameters related to global and bilateral trade between regions. The Trade tab is only used when working with a multi-region MARKAL model, and is not needed when working with a single-region MARKAL model.

While the general operation of ANSWER facilities on the Trade tab is the same as on other tabs, there are a few areas of difference. These are detailed below.

3.8.1 The Items Region of the Trade Tab

On the Trade tab, the Items region displays the names of Regions that are in the database, and the Description field contains 'Bilateral and Global Trade', for example:

Subset Items:	
*All Bilateral and Global Trade Parameters	
Region	Description
 DEMO	Bilateral and Global Trade
 UTOPIA	Bilateral and Global Trade

The Data/Results Parameters that are displayed in the Parameters region are determined by the Region(s) that is(are) selected in the Items display. In the example above, both the DEMO and UTOPIA Regions have been selected.

3.8.2 The Parameters Region of the Trade Tab

The Data/Results Parameters that are displayed on the Trade tab relate to global and bilateral trade between regions. For a comprehensive listing of Data Parameters that can appear on the Trade tab, see the section of Appendix One titled 'MARKAL Data Parameters: Bilateral and Global Trade'. For a comprehensive listing of Results Parameters that can appear on the Trade tab, see the sections of Appendix Two titled 'MARKAL Results Table TRADE: Bilateral Trade' and 'MARKAL Results Table TRADE: Global Trade'.

Currently, all of the Trade Results Parameters are TS. There are no TID Trade Results Parameters.

As compared with the Parameters display on other tabs, on the Trade tab the Spreads contain additional Region2, Technology2, Commodity2 columns. These additional columns permit the display of the bilateral trade Data/Results Parameters such as BI_TRD(ENT), BI_TRD(MAT) and BI_TRDEL(C)(Z)(Y). (Note: In ANSWER version 6 Data Parameter BI_TRDEL(C)(Z)(Y) is renamed to the shorter BI_TRD(ELC).) That is, they permit the display of Parameters that are defined over two regions, as shown below:

Subset Parameters:		* Bi-lateral and Global Trade							TID data		
	Scenario	Parameter		Region	Region2	Technology	Commodity	TimeSlice	Technology2	Commodity2	Value
M	BITRDCOA	BI_TRD(ENT)	?	DEMO	UTOPIA	EXPCOAC	COA	-	IMPHCOC	HCO	1
M	BITRDCOA	BI_TRD(ENT)	?	UTOPIA	DEMO	EXPDSL1	DSL	-	IMPGSL1	GSL	1

The first row in the Spread above indicates that bilateral trade from the DEMO region to the UTOPIA region is possible, with export technology EXPCOAC (that exports COA) in region DEMO linked to import technology IMPHCOC (that imports HCO) in region UTOPIA. The numeric value of 1 is simply an indicator that this bilateral trade possibility exists.

Those trade Data/Results Parameters that are defined over a single region (such as G_TRADE(ENT), REG_XCVT(ENT) etc) are displayed in the Spreads with the region contained in the Region column, and with the placeholder '-' in the Region2 column.

NOTE: If a single region is selected in the Items display, then the Spreads display all those Trade Data/Results Parameters that have this region in either the Region column, or the Region2 column. For example, if just the DEMO region is selected in the Items display, then the Spreads display all those Trade Data/Results Parameters that have DEMO in the Region column, or have DEMO in the Region2 column. This enables the user to see all of those regions that are involved in bilateral trade with the DEMO region. Those bilateral trade possibilities that involve export from region DEMO will have DEMO in the Region column, while those that involve import into region DEMO will have DEMO in the Region2 column.

(Where multiple regions are selected in the Items display, then what the Spreads display is the union of what would be displayed if each region were selected singly.)

For a general discussion of edit facilities for the Parameters region for any tab, see section five. In particular note that sections 5.4.2.2.1 and 5.4.2.2.2 detail the use of the Add Row facility to add a bilateral Trade Data Parameter.

3.8.3 TS and TID Filter on the Trade Tab

The overall operation of the TS and TID Filter is the same on Trade tab as for other tabs. But when the TS and TID Filter Form is invoked from the Trade tab, it contains additional Region2, Technology2, Commodity2 columns that are not present when the TS and TID Filter Form is invoked from other tabs. See below.

TS and TID Filter

Specified Filter: <New Filter>

Name: <New Filter> Delete

Description:

Row Comparison Filter: Show All Rows

Time Series Filter:

	Scenario	Parameter	Region	Region2	Item1	Item2	Item3	Item4	Item5	Item6
Look for:										
or:										
or:										
or:										
or:										
or:										

Time Independent Filter:

	Scenario	Parameter	Region	Region2	Technology	Commodity	Item3	TimeSlice	Technology2	Commodity2
Look for:										
or:										
or:										
or:										
or:										
or:										

Clear TS
Clear TID
Copy TS -> TID
Save
Save & Apply
Save & Apply with Select All
Cancel

The user may enter filtering criteria in any of these columns to limit the amount of information that is displayed in the Spreads on the Trade tab to that which is of particular interest.

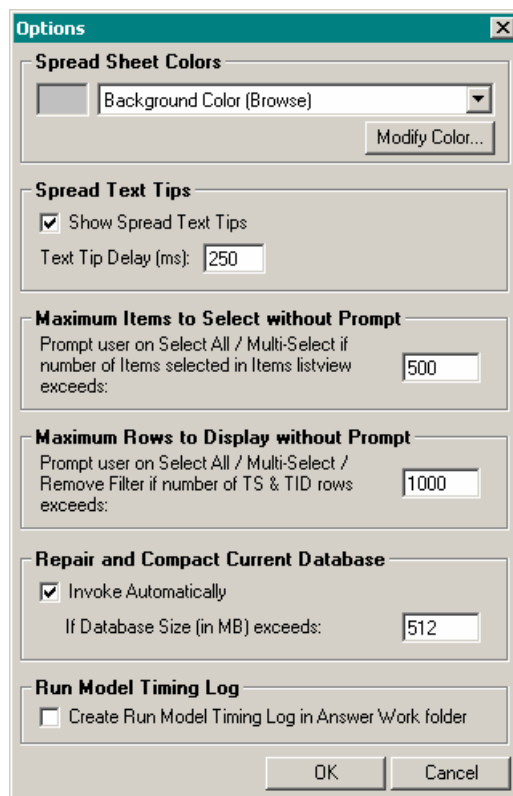
3.9 Tools, Options

The **Tools, Options...** menu bar facility allows the user to control:

- **Spread Sheet Colors** - the colors used in the TS and TID spreads on the Data/Results screen
- **Spread Text Tips** - whether or not Spread Text Tips are displayed, and if so the delay before they are displayed
- **Maximum Items to Select without Prompt** - the maximum number of Items that the user can select either via 'Select All Items' / via multi-select without being prompted to specify a Filter for the Items listview / to multi-select a smaller number of Items.
- **Maximum Rows to Display without Prompt** - the maximum number of TS and TID rows to display without prompting the user to apply a Filter when the user chooses 'Select All Items'. This maximum is also used when multi-select of Items is in place, and the user chooses 'Remove Filter'.
- **Repair and Compact Current Database** - whether or not the Repair and Compact Database facility is invoked automatically, and if so the Database Size at which this facility is invoked when the currently open database is closed.
- **Run Model Timing Log** - whether or not timing information for the Run Model cycle is written to a log file in the Answer Work folder for each model run.

To invoke the **Tools, Options...** menu bar facility:

1. Click on **Tools** in the menu bar and choose **Options...** in the drop menu.
2. The Options dialogue box (shown below) will appear.



3. Modify any of the above settings (see below for details regarding each setting) and click on the **[OK]** button.
4. The new settings are saved to the registry and will apply to any ANSWER database that is opened while they are in effect, with two exceptions: the Database Size specified for 'Repair and Compact Current Database' and the 'Run Model Timing Log' checkbox setting apply only to the currently open ANSWER database, and are saved to that database only.

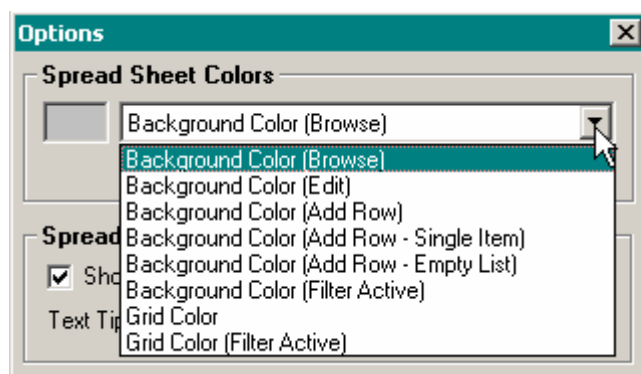
5. All new settings are applied immediately, with one exception: any new Spread Sheet Color settings are applied on the next occasion that the spreads are refreshed.

3.9.1 Spread Sheet Colors

The TS and TID spreads on the Data/Results screen employ a variety of colors to indicate:

- . whether cells are editable or browsable
- . whether or not a Filter is currently applied
- . whether comoboxes in the Add Row offer exactly one choice, several choices, or are empty.

See below where the combobox in the 'Spread Sheet Colors' frame is dropped down to indicate the variety of color indicators that is available.



Background Color (Browse) – default is light grey

The color given to all cells when browsing Data/Results. The color given to cells that are not in the editable scenario when editing Data. This color is an indicator that the values in such cells may not be edited.

Background Color (Edit) – default is white

The color given to cells that are in the editable scenario when editing Data. This color is an indicator that the values in such cells may be edited (see section 5.4.2.1).

Background Color (Add Row) – default is light blue

The color given to all cells in the Add Row, except those that are comboboxes and contain either a single Item, or an empty Item list.

Background Color (Add Row – Single Item) – default is dark blue

The color given to all cells in the Add Row that are comboboxes, and that contain a single Item. This color is an indicator to the user that there is no point in dropping down the combobox, since it contains just a single Item.

Background Color (Add Row – Empty List) – default is light red

The color given to a cell in the Add Row that is a combobox, and where the combobox Item list is empty. That is, given the choices already made in comboboxes to the left of this one, together with any Filter that may be applied, it is not possible to proceed further. This color is an indicator to the user that there is no point in dropping down the combobox, since its Item list is empty.

Background Color (Filter Active) – default is bright yellow

The color given to all cells when browsing Data/Results, and when a Filter is active (applied). The color given to cells that are not in the editable scenario when editing Data, and when a Filter is active (applied). This color is an indicator to the user that a Filter is applied.

Grid Color – default is dark grey

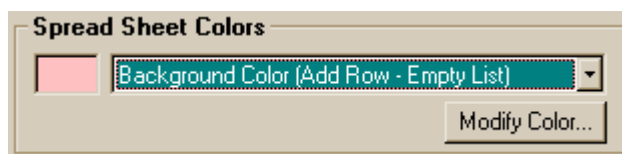
The 'backcolor' of the Spread when no Filter is active (applied). The backcolor of the Spread is that part to the right of, and below, those cells that contain data.

Grid Color (Filter Active) – default is light yellow

The 'backcolor' of the Spread when a Filter is active (applied). The backcolor of the Spread is that part to the right of, and below, those cells that contain data. This backcolor is an indicator to the user that a Filter is applied.

To alter the Spread color associated with one of the above color indicators:

1. Drop down the combobox in the 'Spread Sheet Colors' frame, and select the color indicator that you wish to change. For example, you might select Background Color (Add Row – Empty List), where the default color is a light red, as indicated below:



2. Click on the **[Modify Color...]** button to bring up the Color dialogue box, as below:



3. Select the color that you wish to be associated with 'Background Color (Add Row – Empty List)' in the Spreads, and click on the **[OK]** button. For example, click on the bright red color that is at the far left of the second row of Basic colors, and then click on the **[OK]** button. The 'Spread Sheet Colors' frame now appears as follows:



4. Repeat steps 1-3 above for as many color indicators as you wish to change.
5. Click on the **[OK]** button at the bottom of the Options form to save the new settings for the Spread color indicators to the registry. The new settings will be applied on the next occasion that the Spreads are refreshed.

3.9.2 Spread Text Tips

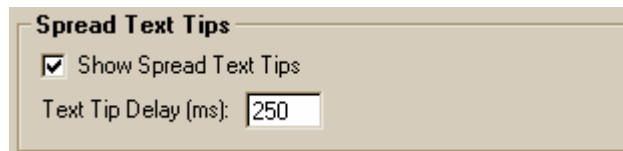
The TS and TID Spreads display Names for Scenarios and Cases, Parameters and Items. The Spread Text Tip facility allows for the momentary display of the corresponding Description when the mouse is held stationary over a Name in the Spread.

For example, suppose that the mouse is held stationary over the Technology Name T4X (for region DEMO). Then the Text Tip will momentarily display the Description 'AUTOMOBILE, IMPROVED OTTO CYCLE' as shown below:

?	DEMO	T4X	60.0000	60.0000
?	DEMO	T4Y	49.3300	47.6000
		AUTOMOBILE, IMPROVED OTTO CYCLE		38.9100
?	UTOPIA	E21	5,000.0000	5,000.0000

To alter the settings associated with Spread Text Tips:

1. Bring up the Options dialogue box by clicking on **Tools** in the menu bar and choosing **Options...** in the drop menu. Initially the 'Show Spread Text Tips' checkbox will be checked, and the 'Text Tip Delay (ms)' value will be 250, as indicated below:



2. **To turn Spread Text Tips off**, simply uncheck the 'Show Spread Text Tips' checkbox, and then click on the **[OK]** button. (To subsequently turn Spread Text Tips on, bring up the Options dialogue box and check the 'Show Spread Text Tips' checkbox.)
3. **To change the Text Tip Delay**, simply alter the value for 'Text Tip Delay (ms)', and then click on the **[OK]** button. With a value for Text Tip Delay of say 1000 (ms), the Text Tip will only be displayed when the mouse is held stationary over the Name for one second. The user may wish to experiment with different values for Text Tip Delay to see which he/she finds most suitable.

3.9.3 Maximum Items to Select without Prompt

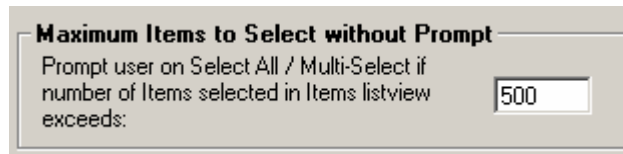
The 'Maximum Items to Select without Prompt' value (default 500) comes into play in two contexts:

- **Select All Items** where this would multi-select a large number of Items, hence in turn requiring the display of a large number of rows in the TS and TID spreads and most likely leading to a long response time, and the display of far more data than the user is really interested in. The user is prompted to specify a Filter for the Items listview.
- **Multi-select of Items by the user** (other than by use of 'Select All Items') where this would result in a large number of Items being multi-selected in the Items display, again most likely leading to a long response time, and the display of far more data than the user is really interested in. The user is prompted to consider reducing the number of multi-selected Items.

In each of these contexts, the 'Maximum Items to Select without Prompt' value determines how many Items is considered to be 'a large number'. If the number of selected Items would exceed this value, then a prompt will be displayed, and otherwise it will not. For further details concerning the operation of 'Maximum Items to Select without Prompt' in the context of 'Select All Items' and 'Multi-select of Items', see sections 3.9.3.1 and 3.9.3.2 below.

To alter the 'Maximum Items to Select without Prompt' value:

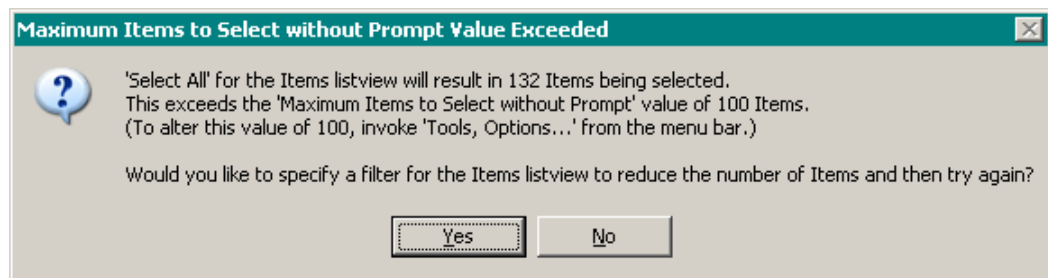
1. Bring up the Options dialogue box by clicking on **Tools** in the menu bar and choosing **Options...** in the drop menu. Initially the Maximum Items to Select without Prompt value will be 500, as indicated below:



2. Enter the new value in the 'Prompt user on Select All / Multi-Select if number of Items selected in Items listview exceeds:' textbox, and then click on the **[OK]** button.

3.9.3.1 Maximum Items to Select without Prompt, for 'Select All Items'

When carrying out 'Select All Items' and where this would result in a large number of Items being selected in the Items display, a prompt is displayed inviting the user to specify a filter for the Items listview to reduce the number of Items (see section 3.5.2.3.2):



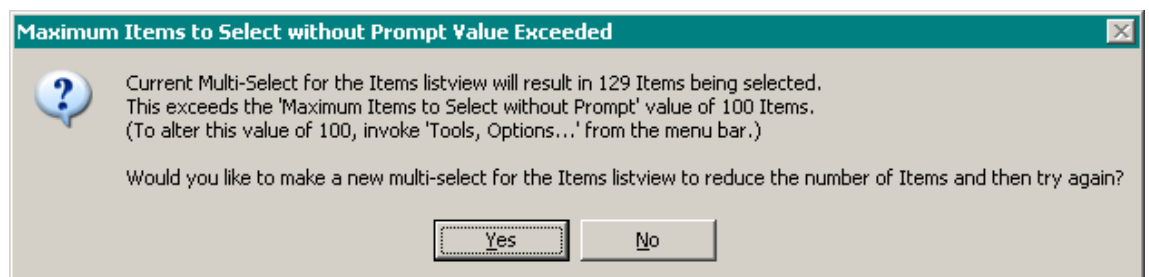
In the above example, 'Select All Items' would result in 132 Items being selected, and the 'Maximum Items to Select without Prompt' value has been set at 100 (down from the default value of 500), so the prompt is displayed. If the 'Maximum Items to Select without Prompt' value had been ≥ 132 , then the prompt would not have been displayed.

When the above prompt appears:

1. To specify a filter for the Items listview (or change the filter that is currently specified), click on the **[Yes]** button. The Items listview will be displayed as it was before you clicked on the **[Select All Items]** button, allowing you the opportunity to specify a filter for the Items listview, for example by using the **[Sets Filter...]** button.
2. To carry out 'Select All Items' with no filter specified for the Items listview (or with no change to the filter that is currently specified), click on the **[No]** button. In the above example, all 132 Items in the Items listview will be selected.

3.9.3.2 Maximum Items to Select without Prompt, for Multi-select of Items by the user

When multi-select of Items by the user (other than by use of 'Select All Items') would result in a large number of Items being selected in the Items display, a prompt is displayed inviting the user to make a new multi-select to reduce the number of selected Items:



In the above example, your current multi-select would result in 129 Items being selected, and the 'Maximum Items to Select without Prompt' value has been set at 100 (down from the default value of 500), so the prompt is displayed. If the 'Maximum Items to Select without Prompt' value had been ≥ 129 , then the prompt would not have been displayed.

When the above prompt appears:

1. To change your current multi-select, click on the **[Yes]** button, and make a different multi-select involving a reduced number of Items.
2. To proceed with your current multi-select, click on the **[No]** button. In the above example, 129 Items will be multi-selected in the Items listview.

3.9.4 Maximum Rows to Display without Prompt

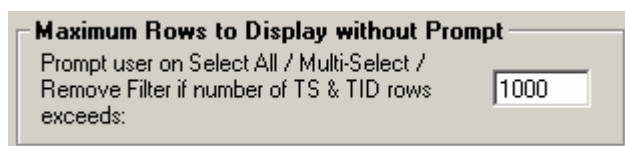
The 'Maximum Rows to Display without Prompt' value (default 1000) comes into play in two contexts:

- **Select All Items / Multi-Select of Items** when no TS and TID Filter is applied, and where this would produce a large number of rows in the TS and TID spreads. The user is prompted to apply a Filter.
- **Remove TS and TID Filter** where multiple Items are selected in the Items display, and where this would produce a large number of rows in the TS and TID spreads. The user is prompted to consider reducing the number of selected Items before removing the TS and TID Filter.

In each of these contexts, the 'Maximum Rows to Display without Prompt' value determines how many rows is considered to be 'a large number'. If the total number of TS and TID rows would exceed this value, then a prompt will be displayed, and otherwise it will not. For further details concerning the operation of 'Maximum Rows to Display without Prompt' in the context of 'Select All Items' and 'Remove TS and TID Filter', see sections 3.9.4.1 and 3.9.4.2 below.

To alter the 'Maximum Rows to Display without Prompt' value:

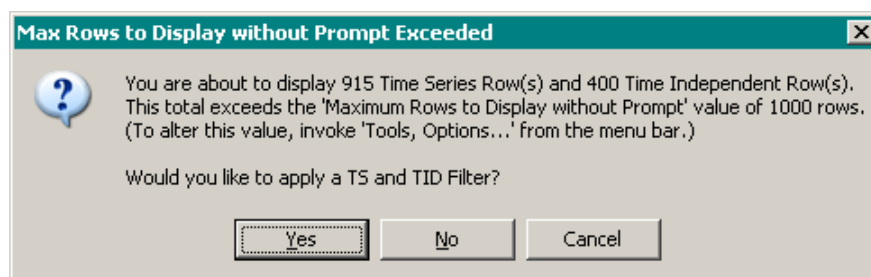
1. Bring up the Options dialogue box by clicking on **Tools** in the menu bar and choosing **Options...** in the drop menu. Initially the Maximum Rows to Display without Prompt value will be 1000, as indicated below:



2. Enter the new value in the 'Prompt user on Select All / Multi-Select / Remove Filter if total number of TS & TID rows exceeds:' textbox, and then click on the **[OK]** button.

3.9.4.1 Maximum Rows to Display without Prompt, for 'Select All Items' / Multi-Select of Items

When carrying out 'Select All Items' / multi-select of Items when no TS and TID Filter is applied, and where this would produce a large number of rows in the TS and TID spreads, a prompt is displayed inviting the user to apply a TS and TID Filter to reduce the number of rows (see section 3.5.2.3.2):



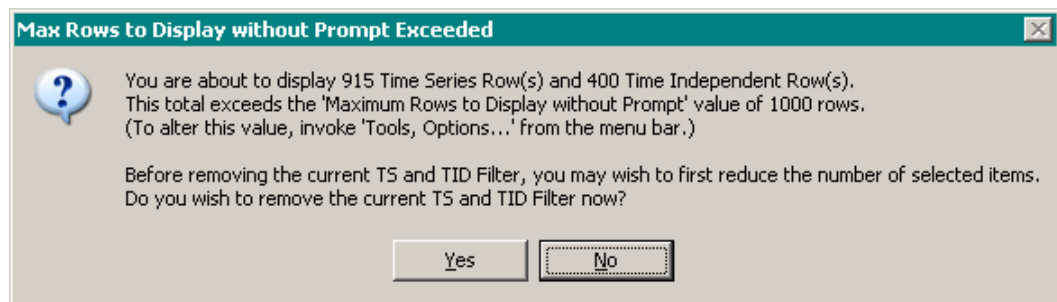
In the above example, a total of 1315 (= 915+400) TS and TID rows would be displayed in the absence of a TS and TID Filter, and the 'Maximum Rows to Display without Prompt' value is 1000, so the prompt is displayed. If the 'Maximum Rows to Display without Prompt' value had been ≥ 1315 , then the prompt would not have been displayed, and the 'Select All Items' operation would have proceeded with no Filter applied.

When the above prompt appears:

1. To apply a TS and TID Filter, click on the **[Yes]** button. This will bring up the TS and TID Filter Form facility. (For details, see section 3.7.)
2. To carry out 'Select All Items' with no TS and TID Filter applied, click on the **[No]** button. In the above example, the TS and TID spreads will contain 915 and 400 rows respectively.
3. To cancel the 'Select All Items' operation, click on the **[Cancel]** button.

3.9.4.2 Maximum Rows to Display without Prompt, for 'Remove TS and TID Filter'

When multiple Items are selected in the Items display, and where 'Remove Filter' (that is Remove TS and TID Filter) would produce a large number of rows in the TS and TID spreads, the user is prompted to consider reducing the number of selected Items before removing the TS and TID Filter:



In the above example, a total of 1315 (= 915+400) TS and TID rows would be displayed if the current TS and TID Filter is removed, and the 'Maximum Rows to Display without Prompt' value is 1000, so the prompt is displayed. If the 'Maximum Rows to Display without Prompt' value had been ≥ 1315 , then the prompt would not have been displayed, and the 'Remove Filter' operation would have proceeded to display all TS and TID data associated with the currently selected Items.

When the above prompt appears:

1. To carry out the 'Remove Filter' and display all TS and TID data associated with the currently selected Items, click on the **[Yes]** button. In the above example, the TS and TID spreads will contain 915 and 400 rows respectively.
2. To cancel the 'Remove Filter' operation, click on the **[No]** button (and reduce the number of selected Items before again invoking the 'Remove Filter' operation).

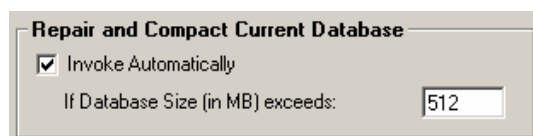
3.9.5 Repair and Compact Current Database

As noted in section 2.13 'Repairing and Compacting a Database', ANSWER version 6.2.11 (and higher) automatically invokes the Repair and Compact Database facility at Close Database time if the database that is being closed has grown "too big", where the default value of "too big" is the Database Size exceeding 512MB. (Previously at Close Database time ANSWER checked the number of days that had elapsed since the database was last Repaired and Compacted, and if 7 days had elapsed, recommended that the user Repair and Compact.)

The reason for automatically invoking the Repair and Compact facility when the Database Size exceeds 512MB is that certain parts of ANSWER slow down very considerably if you allow the size of the ANSWER database to grow much larger than that.

To alter the default settings associated with Repair and Compact Current Database:

1. Bring up the Options dialogue box by clicking on **Tools** in the menu bar and choosing **Options...** in the drop menu. Initially the 'Invoke Automatically' checkbox will be checked, and the '... Database Size (in MB) ...' value will be 512, as indicated below:



2. **To turn Automatic Invoking of Repair and Compact Current Database off**, simply uncheck the 'Invoke Automatically' checkbox, and then click on the **[OK]** button. *Note that it is recommended that you retain the default setting of checked.* (To subsequently turn Automatic Invoking on, bring up the Options dialogue box and check the 'Invoke Automatically' checkbox.)
3. **To change the Database Size for Invoking Repair and Compact Current Database**, simply alter the value in the 'If Database Size (in MB) exceeds' textbox, and then click on the **[OK]** button. Note that a change to the default Database Size of 512 MB applies only to the currently open ANSWER database. (Note also that since an ANSWER database is a Microsoft Access database, and there is an absolute limit of 2048MB to the size of a Microsoft Access database, it is strongly recommended that you do not use a number larger than 1024. In any case, as already noted above, certain parts of ANSWER slow down very considerably if you allow the size of the ANSWER database to grow much larger than 512MB.)

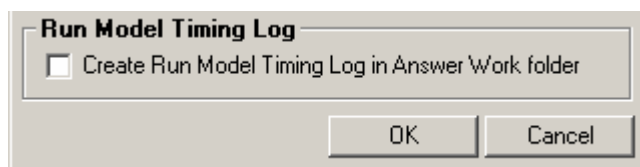
3.9.6 Run Model Timing Log

ANSWER version 6.2.13 (and higher) incorporates some additional code that records (in memory) how long assorted components of the Run Model cycle are taking. The "Tools, Options" Run Model Timing Log facility allows the user to control whether or not this Run Model cycle timing information is written to a log file in the Answer Work folder for each model run. This control is provided at the individual database level.

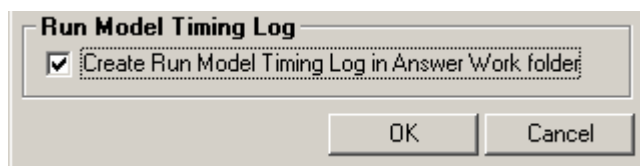
The reason for providing this facility is to allow users with large multi-region databases to collect timing information that has already proven invaluable in deciding which parts of the Run Model cycle to focus on in attempting to speed up Run Model.

By default when a database is first opened, Run Model cycle timing information will not be written. To cause Run Model cycle timing information to be written to the Answer Work folder for a particular ANSWER database, open this database and:

1. Bring up the Options dialogue box by clicking on **T**ools in the menu bar and choosing **O**ptions... in the drop menu. Initially the 'Create Run Model Timing Log...' checkbox will be unchecked (and timing information will not be written), as indicated below:



2. Check the 'Create Run Model Timing Log...' checkbox:

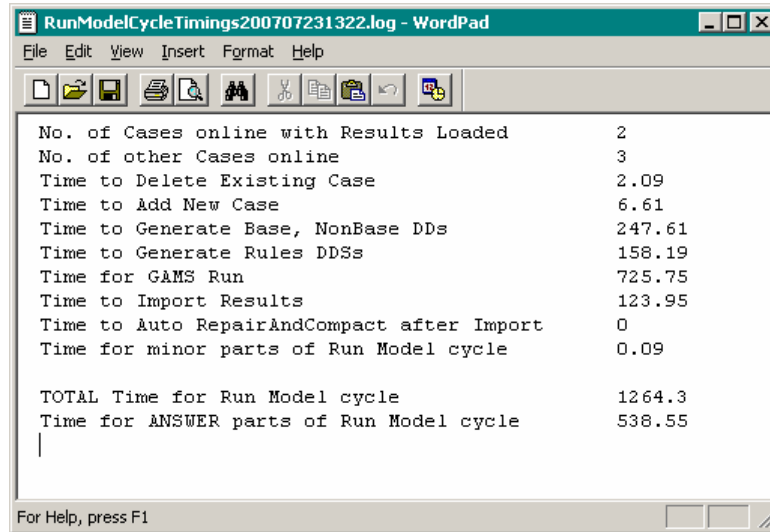


and then click on the **[OK]** button. Timing information will be written to files RunModelCycleTimings*.log in the Answer Work folder each time a model run is carried out using that particular ANSWER database until such time as the user again invokes **T**ools, **O**ptions... for that database and unchecks the 'Create Run Model Timing Log...' checkbox. (Run Model cycle timing information will not be written for other ANSWER databases.)

3. While 'Create Run Model Timing Log ...' is activated, each time the user carries out Run Model for that particular ANSWER database a new file RunModelCycleTimingsyyyymmddhhmm.log will be created in the Answer Work folder, where yyyymmddhhmm is the date and time that the Run Model cycle completed. Thus if the user continues to leave 'Create Run Model Timing Log ...' activated, over time

RunModelCycleTimings*.log files will accumulate in the Answer Work folder. It is the user's responsibility to manage the log files that accumulate. But for example an easy way to retain just the most recent log files is to use Windows Explorer to sort the files in the Answer Work folder by Date Modified, and then delete all but the most recent log files.

4. The timing information is written with a tab separating the textual label and the numeric values, to facilitate pasting into a spreadsheet. An example RunModelCycleTimings*.log for a large multi-region model follows:



No. of Cases online with Results Loaded	2
No. of other Cases online	3
Time to Delete Existing Case	2.09
Time to Add New Case	6.61
Time to Generate Base, NonBase DDS	247.61
Time to Generate Rules DDSs	158.19
Time for GAMS Run	725.75
Time to Import Results	123.95
Time to Auto RepairAndCompact after Import	0
Time for minor parts of Run Model cycle	0.09
 TOTAL Time for Run Model cycle	 1264.3
Time for ANSWER parts of Run Model cycle	538.55

For Help, press F1

Section Four: Setting up Units in ANSWER

This Section shows the user how to set up units in ANSWER. A distinction is made between

1. allowable units for the Database
2. default units for each Component
3. units for individual Items (which are generally the default units of the relevant Component).

Before entering data into the Database, the user must ensure that the units that will be allowed in the Database have been correctly entered. The user must also ensure that the default units for each Component in the Database have been correctly entered. ANSWER is distributed with a common set of default units.

Each Component will have a general set of default units. Where the units for individual Items in the Database vary from the default Component units, they can be specified at the data entry and editing stage. This is detailed in Section 5 'Data Entry and Editing'.

Multi-region

Units and Default Units in the multi-region case are region-independent. That is, the same Units and Default Units apply in every region.

4.1 What allowable Units should we use

In MARKAL, it is at the discretion of the user to choose the units to be used in the Database for costs, flows and levels of energy carriers, levels of end-use demands, levels of emissions, and activity and capacity levels of technologies.

However, given the volume and variety (e.g., economic, cost, technical, energy) of data in a MARKAL Database, it is important that the user approach the specification of units in a disciplined and consistent manner.

Similarly, to ensure model results are not meaningless and to encourage national and regional comparability, the units must be consistent and common for all Database Items occurring in a particular relation.

In practice, only a handful of different units is necessary to cover all Items of an energy system. The following set of units for Standard MARKAL should be used where possible.

Item	Description	Abbreviation
Currency	e.g., constant 2000 million US dollars	e.g., 2000\$USm
Energy Carrier	petajoules	PJ
End-use Demand (except Transport)	petajoules	PJ
Passenger Transport End-use Demand	billion-passenger-kilometres	bn-pass-km
Freight Transport End-use Demand	billion-tonne-kilometres	bn-t-km
Emissions	million tonnes contained Carbon	mt C
Technology activity (except Transport)	petajoules	PJ
Passenger Transport Demand Technology activity	billion-passenger-kilometres	bn-pass-km
Freight Transport Demand Technology activity	billion-tonne-kilometres	bn-t-km
Conversion Technology capacity	gigawatts	GW
Process Technology capacity	petajoules/annum	PJ/a
Demand Technology capacity (except Transport)	petajoules/annum	PJ/a
Passenger Transport Demand Technology capacity	billion-passenger-kilometres/annum	bn-pass-km/a
Freight Transport Demand Technology capacity	billion-tonne-kilometres/annum	bn-t-km/a

4.2 Specifying allowable Units for the Database

Before entering or editing data in the ANSWER Database, the user must ensure that the allowable units have been specified in the Database.

ANSWER divides units into six groups, namely:

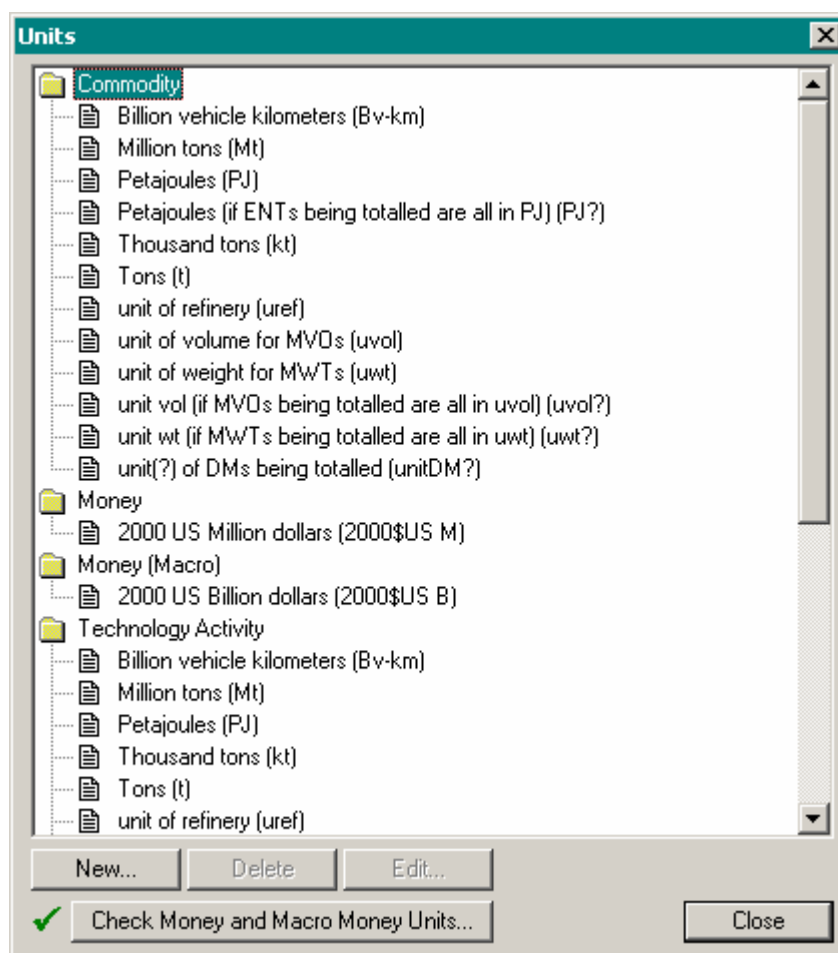
1. Commodity units, i.e., for energy carriers, demands, and emissions
2. Money units
3. Money (Macro) units
4. Technology activity units, i.e., the operation of the technology
5. Technology capacity units, i.e., the installed capacity of the technology.
6. User-Defined Constraint units.

Some special considerations apply to Money units and Macro Money units. For details, see section 4.2.5 'Money Units and Macro Money Units'.

4.2.1 Viewing allowable Units

Virtually all necessary units are pre-set in ANSWER. To view allowable units that have been entered into the Database (either pre-set or entered later):

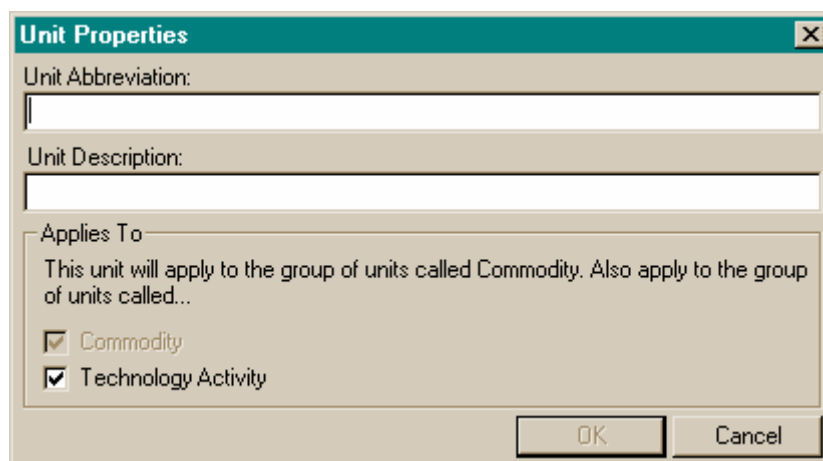
1. Ensure that you are editing the BASE scenario. You may be on the Home Screen or the Data/Results Screen.
2. Click on **Edit** in the menu bar, and click on **Units...** in the drop menu.
3. The Units tree view (shown below) will appear.



4.2.2 Specifying a new allowable Unit

To specify a new allowable unit:

1. Ensure that you are editing the BASE scenario. You may be on the Home Screen or the Data/Results Screen.
2. Click on **Edit** in the menu bar, and click on **Units...** in the drop menu.
3. The Units tree view (shown above) will appear.
4. Highlight the group for which the new unit is intended (Commodity, Technology Activity, or Technology Capacity), and click on the **[New...]** button.
5. The Unit Properties dialogue box (shown below) will appear.



The 'Unit Properties' dialog box has a title bar with a close button. It contains two text input fields: 'Unit Abbreviation:' and 'Unit Description:'. Below these is a section titled 'Applies To' with a text description: 'This unit will apply to the group of units called Commodity. Also apply to the group of units called...'. Under this section are two checked checkboxes: 'Commodity' and 'Technology Activity'. At the bottom right are 'OK' and 'Cancel' buttons.

6. Fill in the Unit Abbreviation (maximum of 15 characters) and Unit Description (maximum of 50 characters), and the **[OK]** button will become enabled.
7. In MARKAL, the activity of a technology is measured in terms of the amount of commodity produced. Consequently, the same unit is normally required for both the Commodity variables and the Technology Activity variables. Indicate this by ticking in the relevant check



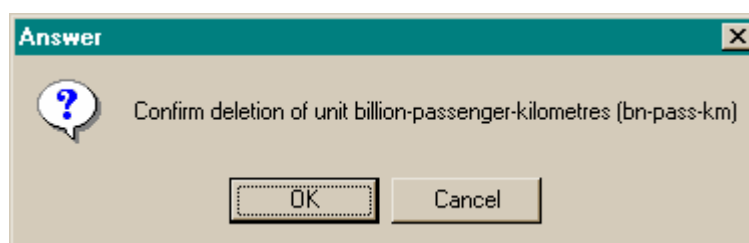
box ☒ Commodity
☒ Technology Activity

8. Click on **[OK]**, and the unit will then appear in the Units tree view. Where the same unit has been required as both a Commodity and a Technology Activity unit, it will appear in both locations.

4.2.3 Deleting an allowable Unit

To delete a unit:

1. Ensure that you are editing the BASE scenario. You may be on the Home Screen or the Data/Results Screen.
2. Click on **Edit** in the menu bar, and click on **Units...** in the drop menu.
3. The Units tree view will appear.
4. Highlight the unit to be deleted and click on the **[Delete]** button.
5. A Confirm deletion of Unit information box (shown below) will appear.



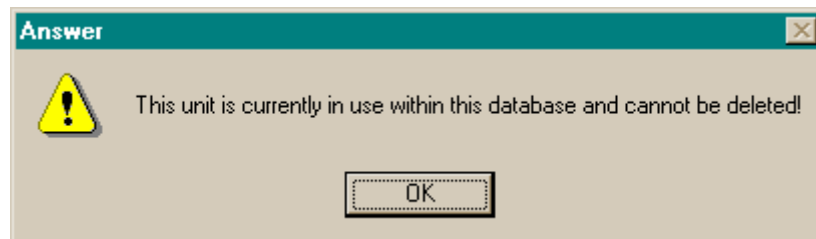
The 'Answer' dialog box has a title bar with a close button. It features a question mark icon in a speech bubble on the left. The text reads: 'Confirm deletion of unit billion-passenger-kilometres (bn-pass-km)'. At the bottom are 'OK' and 'Cancel' buttons.

6. Click on **[OK]**, and the unit will be deleted from the Database.

Note that where the same unit appears as say both a Commodity and a Technology Activity unit, deleting this unit from one group (say the Commodity group) does not delete it from the other group (in this case, the Technology Activity group). The user must ensure the unit is fully deleted.

4.2.3.1 Deletion of a unit currently in use

Note that ANSWER will not allow the deletion of any unit that is currently in use in the Database. ANSWER will prompt the user (shown below).

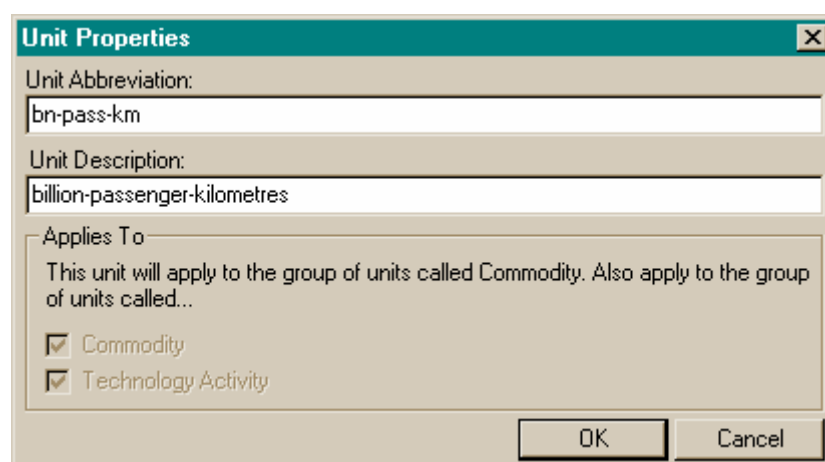


Also note that in ANSWER version 5.3.0 (and higher), where there are multiple Money (Macro Money) units you will always be able to delete a Money (Macro Money) unit. For further details, see section 4.2.5 'Money Units and Macro Money Units'. (In earlier versions of ANSWER, it could happen that ANSWER would disallow the deletion of a Money (Macro Money) unit because it considered the unit to be currently in use within the database.)

4.2.4 Editing an allowable Unit

To edit a unit's abbreviation and/or description:

1. Ensure that you are editing the BASE scenario. You may be on the Home Screen or the Data/Results Screen.
2. Click on **Edit** in the menu bar, and click on **Units...** in the drop menu.
3. The Units tree view will appear.
4. Highlight the unit to be edited and click on the **[Edit...]** button.
5. The Unit Properties dialogue box (shown below) will appear.



6. Edit the Unit Abbreviation (maximum of 15 characters) and/or Unit Description (maximum of 50 characters).
7. Click on the **[OK]** button and the revised abbreviation and/or description will appear in the Units tree view.



8. If the unit is both a Commodity unit and a Technology Activity unit, it will be revised in both locations.

4.2.5 Money Units and Macro Money Units


Some special considerations apply to Money units and Macro Money units. In a MARKAL model, there needs to be a single consistent Money unit and a single Macro Money unit, and so *in a properly setup ANSWER database, there should be a single Money unit and a single Macro Money unit.*


In ANSWER version 5.3.0 (and higher) the Units dialogue box incorporates a

Check Money and Macro Money Units...

button at the bottom LHS, along with a  or 


indicator to the left of this button as a visual cue that either the current database does contain a

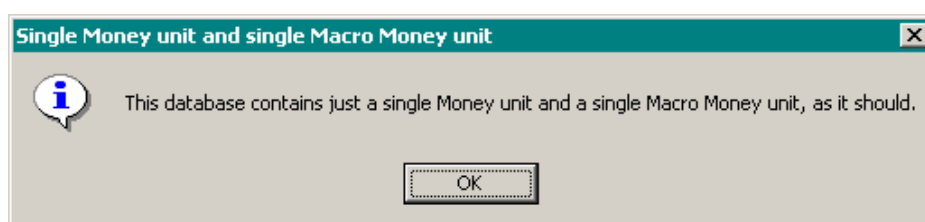
single Money unit and a single Macro Money unit (in which case the  indicator will be displayed)

or that it contains multiple Money units and/or multiple Macro Money units (in which case the  indicator will be displayed).

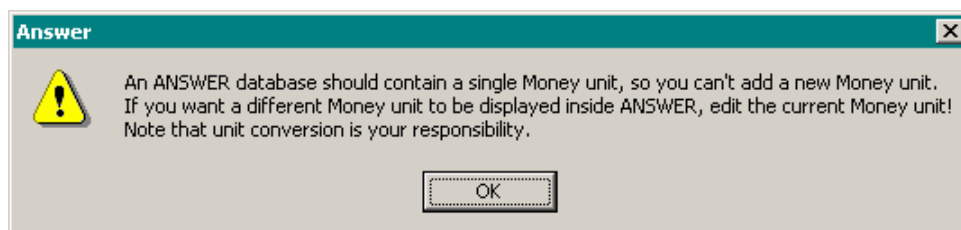
You should understand that the only way in which ANSWER uses the Money (Macro Money) unit that you specify is to display the units associated with data or results parameters that involve the Money (Macro Money) unit. For example the data parameter INVCOST (cost of investment in new capacity) has units that are Money unit / Technology Capacity unit. To display the units associated with INVCOST, ANSWER uses a table lookup to determine the Money unit (e.g. 2000\$US M) and the Technology Capacity unit for the selected technology (e.g. GW) and hence determines the INVCOST unit as 2000\$US M / GW. If an ANSWER database contains more than a single Money (Macro Money) unit, the Money (Macro Money) unit determined by the table lookup will be ambiguous.

4.2.5.1 Where an ANSWER database contains a single Money Unit and a single Macro Money Unit

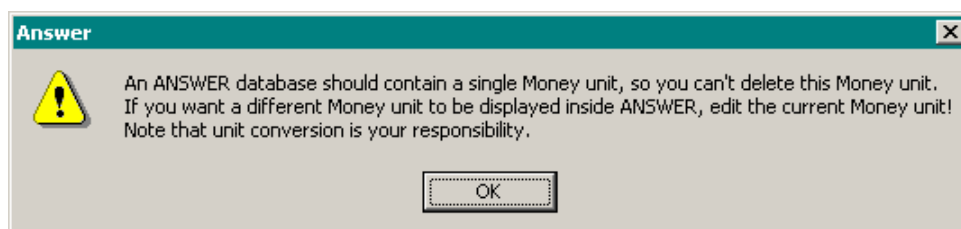
1. The indicator associated with the **Check Money and Macro Money Units...** button will be a .
2. If you click on the **[Check Money and Macro Money Units...]** button, you will get the following message:





3. To maintain the existence of just a single Money (Macro Money) unit, ANSWER will only allow you to **[Edit...]** the existing Money (Macro Money) unit. See section 4.2.4 'Editing an allowable unit' above.
4. If you attempt to add a **[New...]** Money (Macro Money) unit, you will get the following message:

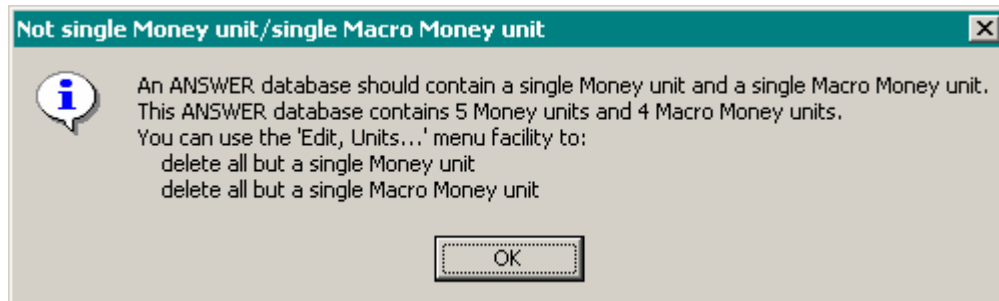


5. If you attempt to **[Delete]** the single existing Money (Macro Money) unit, you will get the following message:



4.2.5.2 Where an ANSWER database contains multiple Money Units and/or multiple Macro Money Units

1. The indicator associated with the  button will be a .
2. If you click on the **[Check Money and Macro Money Units...]** button, you will get a message similar to the following:



- 3a. If the Money (Macro Money) unit that is appropriate for your database is one of the Money (Macro Money) units that is displayed on the Units dialogue box under the Money (or Money (Macro)) group, make repeated use of **[Delete]** to delete all Money (Macro Money) units except the one that is appropriate for your database.

As already noted at section 4.2.3.1 'Deletion of a unit currently in use' above, in ANSWER version 5.3.0 (and higher), where there are multiple Money (Macro Money) units you will always be able to delete a Money (Macro Money) unit.

- 3b. If the Money (Macro Money) unit that is appropriate for your database is not one of the Money (Macro Money) units that is displayed on the Units dialogue box under the Money (or Money (Macro)) group, make repeated use of **[Delete]** to delete all but a single Money (Macro Money) unit, and then use **[Edit...]** to change the single Money (Macro Money) unit to what is appropriate for your database.

4.3 Reviewing and editing default Units for each Database Component

Before entering data into the Database, the user should review the default units that ANSWER has pre-specified for each Component in the Database.

If these default units are to be changed, care must be taken by the user to ensure that the consistency and standardisation of units throughout the Database is retained. ANSWER organises units according to the Component type.

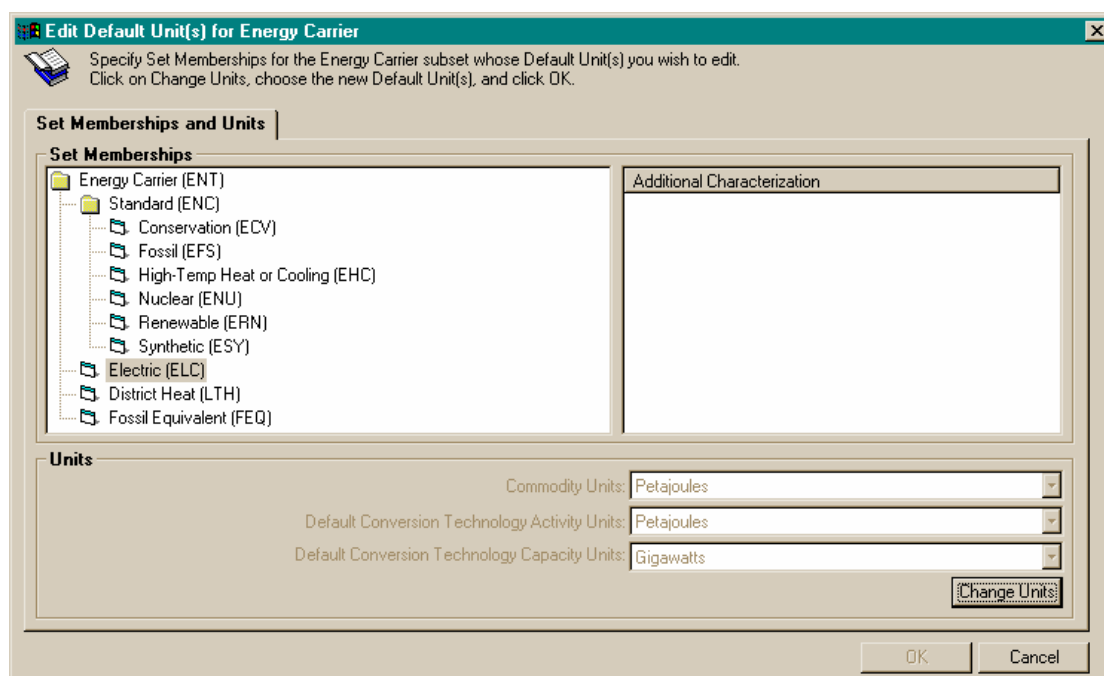
Note that default units are not relevant for the Global, Parameter and Trade Components.


4.3.1 Reviewing and editing default Units for each Component

Note that a change to the Component's default unit(s) will only be applied to new data having the same Set Membership, i.e., no existing data unit specification will be changed. This must be done individually by the user (see Section 4.4 'Specifying and editing Units for the individual Database Items').

To review or edit the default units for each Component:

1. Ensure that you are editing the BASE scenario. You may be on the Home Screen or the Data/Results Screen.
2. If you are on the Data/Results Screen, choose the required Component tab (e.g., the Energy tab was selected below).
3. If you are on the Home Screen, click on **Edit** in the menu bar, click on **Unit Defaults**, and choose the required Component (e.g. Energy) in the drop menu. If you are on the Data/Results Screen, click on **Edit** in the menu bar and choose **Unit Defaults...** in the drop menu.
4. The Edit Default Unit(s) for Energy Carrier dialogue box (shown below) will appear.



5. Click on a leaf node in the Set Membership tree view to display the current default units associated with an Energy Carrier that has this Set Membership. For example, above the current default units associated with Electric (ELC) Energy Carriers are displayed.
6. To change the current default units, click on the **[Change Units]** button  and the default units comboboxes will become enabled.

7. Click on the required combo box and choose an appropriate allowable unit. If the appropriate allowable unit is not listed, exit this facility and re-specify allowable units as shown in Section 4.2.2 'Specifying a new allowable Unit'.
8. Having clicked on the appropriate allowable unit, click on the **[OK]** button (now enabled) and the new default unit(s) will be written to the Database.

While each 'Edit default Unit(s) for' dialogue box will vary marginally with the Component concerned (shown below), their operation is identical.

Edit Default Unit(s) for End-Use Demand

Specify Set Memberships for the End-Use Demand subset whose Default Unit(s) you wish to edit. Click on Change Units, choose the new Default Unit(s), and click OK.

Set Memberships and Units

Set Memberships

- End-Use Demand (DM)
 - Agricultural (DM_AGR)
 - Commercial (DM_CDM)**
 - Industrial (DM_IND)
 - Non-Energy (DM_NDN)
 - Residential (DM_RES)
 - Transport (DM_TRN)

Additional Characterization

Units

Commodity Units: Petajoules

Change Units

OK Cancel

'Edit Default Unit(s) for End-Use Demand' - Commercial

Edit Default Unit(s) for Emission

Specify Set Memberships for the Emission subset whose Default Unit(s) you wish to edit. Click on Change Units, choose the new Default Unit(s), and click OK.

Set Memberships and Units

Set Memberships

- Emission (ENV)

Additional Characterization

Units

Commodity Units: Thousand tons

Change Units

OK Cancel

'Edit Default Unit(s) for Emission'

Edit Default Unit(s) for Technology

Specify Set Memberships for the Technology subset whose Default Unit(s) you wish to edit. Click on Change Units, choose the new Default Unit(s), and click OK.

Set Memberships and Units

Set Memberships

- Technology (TCH+SRCECP)
 - Conversion (CON)**
 - Demand (DMD)
 - Process (PRC)
 - Energy (PRE)
 - Material, Volume (PRV)
 - Material, Weight (PRW)
 - Resource (SRCECP)

Additional Characterization

Units

Default Input(DMD)/Output(PRC) Commodity Units: Petajoules

Default Technology Activity Units: Gigawatts

Default Technology Capacity Units: Gigawatts

Default CAPUNIT Value: 31.536

Change Units

OK Cancel

'Edit Default Unit(s) for Technology' - Conversion

4.4 Specifying and editing Units for the individual Database Items

Care must be taken by the user to ensure that the consistency and standardisation of units throughout the Database is retained.

In Section 4.2 'Specifying allowable Units for the Database', the units that are allowable in the Database were reviewed and edited.

In Section 4.3 'Reviewing and editing default Units for each Database Component', the default units for each Component in the Database were reviewed and edited.

However, as mentioned, a change to the Component's default unit(s) will only be applied to new data having the same Set Membership when it is entered into the Database. In other words, the units of data already in the Database with the identical Set Membership will not be changed using this default facility.

Additionally, some individual Items within a Component are likely to have units that do not conform to the default units of the Component, notably Transport Demand in the Demand Component, and the corresponding Transport Technology Items in the Technology Component.

For either of the above reasons, where the units for the individual Items vary from the default Component units, they will have to be edited at the individual Items level. This will be discussed in detail under Section 5 'Data Entry and Editing'.

Section Five: Data entry and editing

This Section takes the user through the data entry and editing process for a MARKAL Scenario. As mentioned in the Introduction, users of this manual are expected to be familiar with MARKAL, particularly its Set Memberships and Data Parameters.

Multi-region

In the text that follows, 'Item' means the combination of the Name and Region that uniquely defines an entity in the database. For example, a Technology Item might be E01 in region DEMO. The same database might also contain another Technology Item also with Name E01 but in a different region, say in region UTOPIA.

The text and the screen snapshots that follow have been updated to correspond to what the user sees when working with a multi-region database.

5.1 Starting your data entry

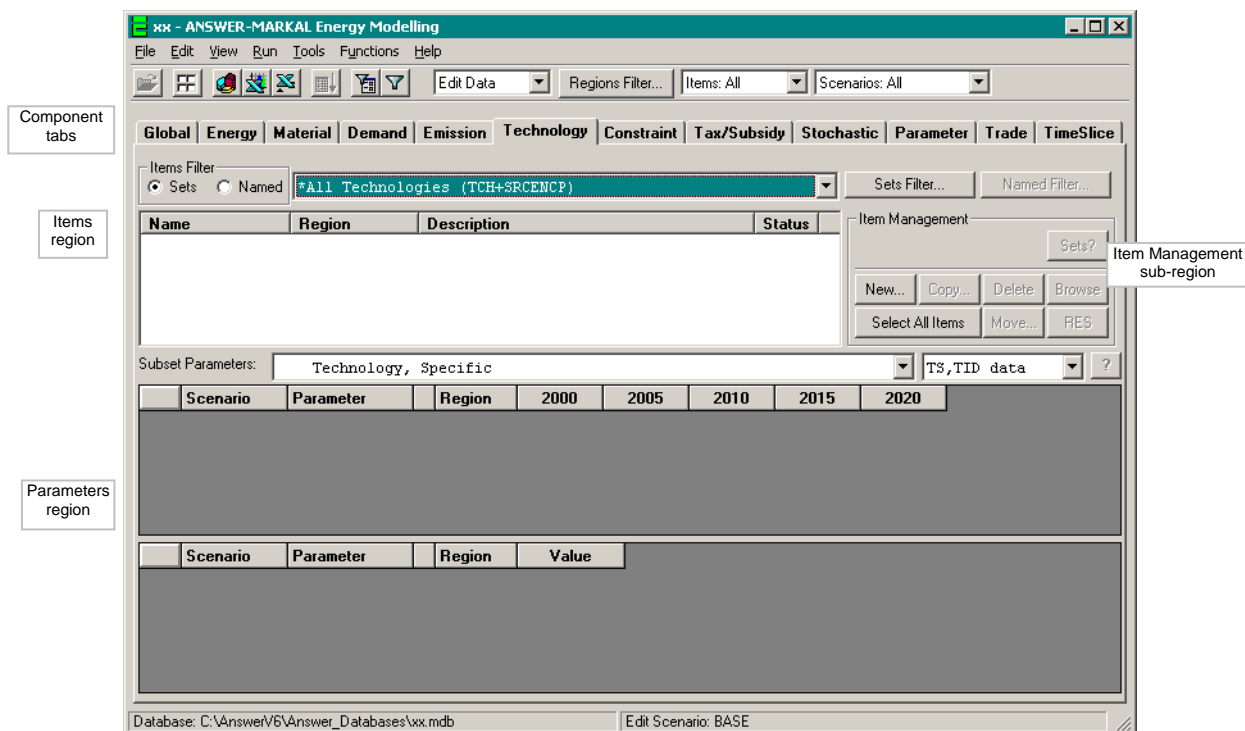
To enter or edit data for a particular Scenario, enter the Data/Results Screen from the Home Screen in Edit Data mode after double clicking on the required Scenario.

The user should note that ANSWER's data entry and editing process operates in a consistent manner

1. for both new and existing Scenarios
2. for each Component (apart from the Global, Parameter and Trade Components)
3. for each Item and its Data Parameters.

5.1.1 What does a new Database data entry screen look like?

A new Database contains a Base Scenario only, which is devoid of data. Consequently, in the Data/Results screen, the Items region is empty, and, until an Item has been created, the Parameters region is empty.



5.1.2 Rules for entry of data

5.1.2.1 Units

As detailed in Section 4 'Setting up Units in ANSWER', before entering data into the Database, the user must ensure that:

1. The units that are to be allowed in the Database have been correctly entered, and
2. The default units that are to be allowed for each Component in the Database have been correctly entered.

Where the units for individual Items in the Database are to be varied from the default Component units already entered, they must be explicitly adjusted at the data entry and editing stage. Otherwise, the default units will be assigned by ANSWER to the Items concerned.

However, given the volume and variety (e.g., economic, cost, technical, energy) of data in a MARKAL Database, it is important that the user approach the specification of units in a disciplined and consistent manner.

Similarly, to ensure model results are sensible and to encourage national and regional comparability, the units must be consistent and standardised for all Database Items occurring in a particular relation.

5.1.2.2 Time Slices

If using version 6 of ANSWER to work with a database that has flexible time slice facilities, go to the TimeSlice tab and check that the Time Slices that are specified are appropriate. If not, specify any additional Time Slices that are needed. Do this before entering data on any of the other tabs. For details regarding flexible timeslicing in version 6 of ANSWER, see section 14 'Handling Flexible Time Slices in ANSWER'.

If using version 5 of ANSWER (or if using version 6 of ANSWER to work with a version 5 database that does not have flexible time slice facilities) the Time Slices will be the standard MARKAL Time Slices, there will be no TimeSlice tab, and there is no need check that the Time Slices are appropriate.

5.1.2.3 Work from left to right

After ensuring that appropriate Units and Time Slices are specified as per sections 5.1.2.1 and 5.1.2.2 above, when entering data into a newly created Scenario or when creating a major new entry, it is strongly recommended that the user start with the left hand Component (i.e., Global) and work to the right through each Component in turn.

This ensures that any necessary precursor data has been entered into the Scenario before it is required for successive data entries. For example, if a coal fired steam turbine is to be created under the Technology Component, the user should first enter its energy carrier (i.e., coal) under the Energy Carrier Component. Otherwise, the coal fired steam turbine Technology data entry will not be able to be completed. (Of course in such a situation, the user can go to the Energy tab and enter coal, and then return to the Technology tab to complete the specification of Data Parameters for the coal fired steam turbine technology.)

5.1.2.4 Define your Item first

The specification of an Item's Set Memberships determines which compulsory Data Parameters are automatically ascribed to the Item by ANSWER (see Section 5.2.2 'Creating a new Item'). Consequently, ANSWER requires that an Item be created and fully defined before any Parameter data can be entered.

5.1.2.5 Item naming

ANSWER does not enforce any Item naming conventions on the user (as was the case in earlier MARKAL interfaces). There are just some broad limitations:

1. The combination of the Name and Region of an Item must be unique to that Item in the Database. So there may be an Item with Name E01 in Region DEMO, and another Item with Name E01 in a different Region, say UTOPIA. But Region DEMO cannot contain two Items each with Name E01.
2. The Name of an Item can comprise up to 10 characters, being comprised of A-Z, 0-9, - (hyphen), _ (underscore), & (ampersand), . (period). ANSWER automatically converts lower case alpha characters entered by the user to upper case.
3. Likewise, the Region of an Item can comprise up to 10 characters, being comprised of A-Z, 0-9, - (hyphen), _ (underscore). ANSWER automatically converts lower case alpha characters entered by the user to upper case.
4. The first character of a Name and the first character of a Region must be alphabetic (A-Z).

However, the ANSWER MARKAL user is strongly encouraged to adopt naming conventions that ease management of their MARKAL model. For example, one MARKAL convention is that Electric conversion technology names always start with the letter E, and that no other technology names start with an E.

The MARKAL naming conventions which are presently used by most MARKAL modellers are detailed in Section 5.3 'Item Naming Conventions'. In addition, there are comments indicating where the user may wish to vary these conventions to provide transparency for users as to the broad nature of each Item and to provide a link between associated Items in a Database, such as an End-Use Demand Item and the Demand Technology Items servicing that Demand.

5.1.2.6 Number of decimal places

In ANSWER, the number of decimal places displayed is preset at the individual parameter level, with most data being displayed to 4 decimal places. Users should note that the number of decimal places for which data is displayed will determine the number of decimal places before data entry is truncated. Hence, if data is to be entered to 6 decimal places, the user must first ensure that the data is displayed to 6 decimal places.

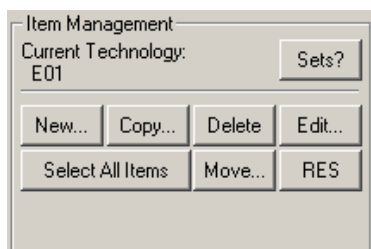
The number of decimal places displayed for an individual parameter is easily changed by the user (see Section 3.6.3.2 'Changing the Status and Properties of a Data Parameter and a Results Parameter'). There is no mechanism in ANSWER by which the user can multi-select a number of parameters and change the number of decimal places displayed to a common value in a single operation.

5.2 Data entry and editing for Items

An Item must be created and specified before its data can be entered. Naming conventions should be applied when creating an Item (see Section 5.3 'Item Naming Conventions').

5.2.1 The Item Management sub-region

In Edit Data mode, the Item Management sub-region of the Items region has a number of editing buttons (shown below). If the Items display is empty, only the **[New...]** button will be enabled.



For editing purposes, click on:

[New...] button to create a new Item, including specifying its Set Memberships and its Units.

[Copy...] button to copy an existing Item, including its specifications, and Data Parameters.

[Delete] button to delete an existing Item.

[Edit...] button to edit an existing Item, and its specifications.

This button will appear as **[Browse]** if the selected Item is not in the editable scenario.



[Move...] button to move an existing Item, including its specifications, and Data Parameters.

5.2.2 Creating a new Item

This facility allows the user to create a new Item in the specified Scenario, to define its Set Memberships, and, if necessary, to change its Units from the Component's default units.

To create a new Item:

1. Click on the required Component tab. In the following example, the Demand tab has been selected.
2. Click on the **[New...]** button in the Item Management sub-region, or click on **Edit** in the menu bar and choose **New Item...** in the drop menu.
3. A New End-Use Demand dialogue box (shown below) will appear.

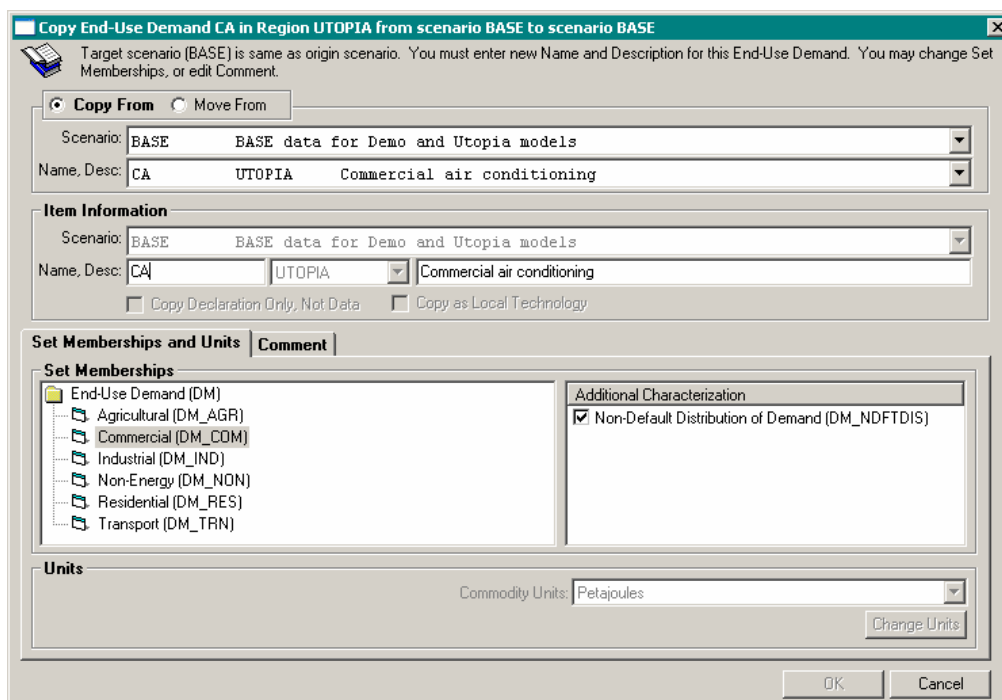
4. Fill in the Name, select the appropriate Region from the combobox, and fill in the Description of the new End-Use Demand.
5. Specify the Set Memberships of the new Item by clicking on the appropriate leaf node (leaf nodes have icon ) in the tree view, and clicking in the appropriate check box(s) under Additional Characterization as required. Above, the Commercial leaf node has been selected, along with the 'Non-Default Distribution of Demand' checkbox.
6. When the Name, Description and Set Memberships have been fully specified, the **[OK]** button will be enabled.
7. If the default units require changing, click on the **[Change Units]** button , to enable the Units combobox(es). Then select the appropriate allowable unit from the relevant combobox. If the appropriate unit is not listed, cancel out of the New Item facility and specify the allowable unit (see Section 4.2.2 'Specifying a new allowable Unit').
8. Optionally, click on the Comment tab and enter a Comment for the Item. Note that if you wish to enter a multi-line Comment, and you are using ANSWER version 6.1.18 or earlier, you must hold down the Shift key while hitting the Enter key (otherwise hitting the Enter key while entering a Comment will cause a click on the **[OK]** button.)
9. Click on the **[OK]** button and the Item will be created in the Scenario and will become the current Item in the Items display. The Item's associated compulsory Parameters will also be displayed in the Parameters spread for data entry/editing.

5.2.3 Copying an Item

This facility allows the copying of a single existing Item and its specifications and associated data from a BASE or non-BASE Scenario (referred to as the origin Scenario) to the currently editable Scenario (referred to as the target Scenario). Also note that there is a facility that allows the bulk copying of multi-selected Items from one Scenario to another Scenario. See section 5.2.8 'Copy Item(s) across Scenarios'.

To copy an Item:

1. Click on the required Component tab, for example the Demand tab.
2. Select the Item that is to be copied by clicking on the Item's Name in the Items display.
3. Click on the **[Copy...]** button in the Item Management sub-region, or click on **E**dit in the menu bar and choose **C**opy Item... in the drop menu.
4. A Copy End-Use Demand dialogue box (shown below) will appear.



Copy End-Use Demand CA in Region UTOPIA from scenario BASE to scenario BASE

Target scenario (BASE) is same as origin scenario. You must enter new Name and Description for this End-Use Demand. You may change Set Memberships, or edit Comment.

☒ Copy From ☐ Move From

Scenario: BASE BASE data for Demo and Utopia models

Name, Desc: CA UTOPIA Commercial air conditioning

Item Information

Scenario: BASE BASE data for Demo and Utopia models

Name, Desc: CA UTOPIA Commercial air conditioning

☐ Copy Declaration Only, Not Data ☐ Copy as Local Technology

Set Memberships and Units **Comment**

Set Memberships

- End-Use Demand (DM)
 - Agricultural (DM_AGR)
 - Commercial (DM_COM)
 - Industrial (DM_IND)
 - Non-Energy (DM_NON)
 - Residential (DM_RES)
 - Transport (DM_TRN)

Additional Characterization

☒ Non-Default Distribution of Demand (DM_NDFTDIS)

Units

Commodity Units: Petajoules

Change Units

OK Cancel

The Region combobox is set to match the Region of the Item being copied, and disabled. This is because copying an Item in one Region to a different Region is not permitted.

5. The 'Copy From' frame initially displays the origin Scenario, and the Name, Region and Description of the Item selected at Step 2.
 - i. The Scenario combobox is populated with every Scenario in the Database. Its setting determines the origin Scenario.
 - ii. The 'Name, Desc' combobox is populated with those Items (in the example shown above, End-Use Demand Items) which are fully defined in the Scenario currently selected at Step i. above, and whose Set Memberships match the current 'Subset Items' setting for the current Component Tab, and whose Region(s) match the region(s) currently selected for data display via the 'Regions...' button.
 - iii. The user may change the settings of either/both of the Scenario and 'Name, Desc' comboboxes.

Where the target Scenario is the same as the origin Scenario:

- 6a. Enter a new Name and (presumably) a new Description. (The Region combobox is set to the same Region as for the origin Item selected at Step 5.ii. above, and is disabled since copy with change of Region is not permitted.) The **[OK]** button will only become enabled when a new Name has been entered.

Where the target Scenario differs from the origin Scenario:

- 6b. The **[OK]** button will be immediately enabled. The Name and Description for the new Item in the target Scenario are allowed to be the same as in the origin Scenario. (Region is required to be the same.) Or the user may proceed as in Step 6a. above and enter a new Name and a new Description for the copied Item in the target Scenario.

The user should note that retaining the existing Name and Description for the Item in the target Scenario creates data redundancy (and the potential for confusion). The user should carefully consider whether such a copy is appropriate.

7. If there is a Comment associated with the Item being copied, then this Comment is copied across to the copied Item, and the original Comment is prefixed by the following line:
(Copy of comment for End-Use Demand CA in region UTOPIA in scenario BASE follows)
Click on the Comment tab to display and change any Comment that may be present, or to enter a Comment.
(Note that if you wish to enter a multi-line Comment, and you are using ANSWER version 6.1.18 or earlier, you must hold down the Shift key while hitting the Enter key (otherwise hitting the Enter key while entering a Comment will cause a click on the **[OK]** button).)
8. Click on **[OK]**. The copied Item will then become the current Item in the Items display, ready for any necessary respecification (see Section 5.2.5 'Editing an Item'). The Item's Data Parameters will be displayed in the Parameters spread, ready for data entry and/or editing.

5.2.4 Deleting an Item (or Items) and the role of the _DELETED Scenario

The Delete Item facility is used to delete an existing Item (or existing Items) and its (their) associated specifications and data from the currently editable Scenario.

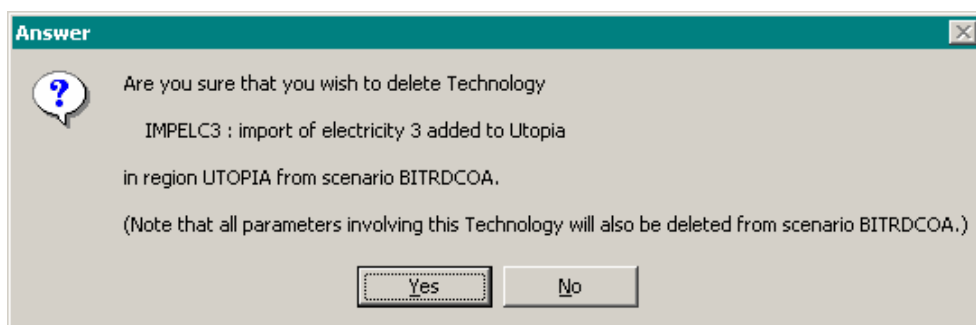
When an Item that does not occur in on-line Results is deleted, information for this Item in the currently editable scenario is permanently deleted from the database.

When an Item that does occur in on-line Results is deleted, information for this Item in the currently editable scenario is moved to the _DELETED scenario. The _DELETED scenario is a special scenario whose role is to retain information about Items that occur in on-line Results, but that have been deleted from Data.

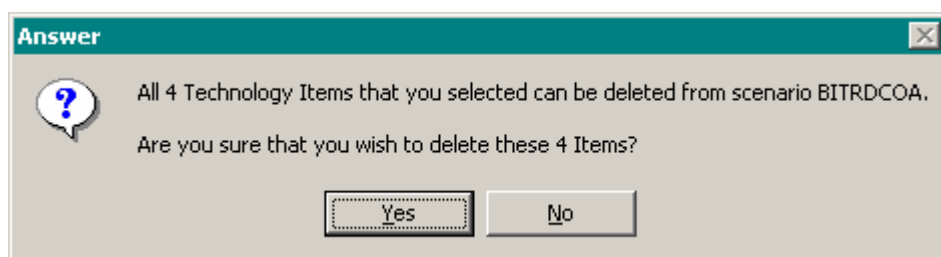
The Item information that is moved comprises the Name, Description, Units, Set Memberships and the 'specific' TS and TID Data associated with the Item. So for a Technology, the 'specific' TS and TID Data comprises those TS and TID Data parameters that are displayed on the Subset Parameters 'Technology, Specific' setting.

To delete an Item (or Items):

1. Click on the required Component tab. In the following example, the Technology tab has been selected.
2. In the Items display, select the Item that is to be deleted, or multi-select the Items that are to be deleted.
3. Click on the **[Delete]** button in the Item Management sub-region, or click on **E**dit in the menu bar and choose **Delete Item** in the drop menu.
- 4a. If at step 2 you selected a single Item, and if that Item is able to be deleted, then the following message box will appear, asking you to confirm the Item deletion:



- 4b. If at step 2 you selected several Items, and if all of those Items are able to be deleted, then the following message box will appear, asking you to confirm the multiple Item deletion:



Note that in the multi-select case, it can happen that only some of the selected Items are able to be deleted. For example, this would be the case where the user has selected as one of the Items an Item that is not in the currently editable scenario. Then the information box will advise how many of the selected Items are able to be deleted.

5. Click on **[Yes]**, and the Item(s) and any associated data will be deleted from the Items display and the specified Scenario.

Note that an Item cannot be deleted from the BASE Scenario if that Item is referenced in a non-BASE Scenario(s). This will occur when one or more Data Parameters for the Item have been added into a non-BASE Scenario(s). Consequently, to delete the Item from the BASE Scenario, the Data Parameter(s) for that Item first have to be deleted from the non-BASE Scenario(s).

5.2.5 Editing an Item

This facility allows the user to change an Item's Name, Description, Set Memberships, any Comments, and its Units.

Note that changing an Item's Set Memberships may mean that the user will need to change some of the Data Parameters ascribed to the Item. If radical changes to an Item's Set Memberships are required, consider deleting the Item and creating a new Item with the required Set Memberships.

When an Item's Set Memberships are changed, ANSWER automatically creates any new associated compulsory Data Parameters that are now required for the Item (see Section 5.4.1 'Automated Data Parameter creation and entry'). The user will need to populate the Item's new compulsory Data Parameters with the required data if the default entries are not appropriate or the fields are null. The user will also have to add and populate any non-compulsory Data Parameters that are required for the Item.

In addition, when an Item's Set Memberships are changed, ANSWER automatically deletes any Data Parameters that were associated with the Item, but that would now be illegal for the Item's new Set Memberships.


The user should be also aware that changing an Item's Units may have significant ramifications through the entire Database. ANSWER automatically detects and advises the user where a change in units will create a units conflict; ANSWER prompts the user for any necessary input, and then automatically undertakes the changes.

Although changing an Item's Set Memberships and an Item's Units can be made simultaneously in ANSWER, for ease of understanding, they are dealt with below as separate operations.

5.2.5.1 Editing an Item's Name, Description, Set Memberships, or Comment

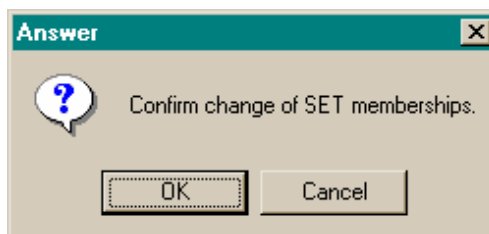
To edit an Item's Name, Description, Set Memberships, or Comment:

1. Click on the required Component tab. In the following example, the Demand tab has been selected.
2. Select the Item that is to be edited by clicking on the Item's name in the Items display.
3. Click on the **[Edit...]** button in the Item Management sub-region, or click on **Edit** in the menu bar and choose **Edit Item...** in the drop menu.
4. An Edit End-Use Demand dialogue box (shown below) will appear.

5. If changes are required to the Item's Name and/or Description, enter the new Name and/or Description.
6. If changes are required to the Set Memberships of the Item, click on the appropriate leaf node (icon ) in the tree view, and click on/off the appropriate check box(s) under Additional Characterization.
7. If changes are required to the Comment associated with the Item, click on the Comment tab and make the required changes.

8. The **[OK]** button will become enabled when the Name or Description or Set Memberships or Comment have been changed.
9. If a Set Memberships change has been made, the user will be prompted to confirm the change (shown below).

Note that if a Set Memberships change has been made, then subsequent entry/editing of the Item's Data Parameters may be required (see Sections 5.4.1 'Automated Data Parameter creation and entry', 3.6.1 'The Subset Parameters combobox', and 3.6.3 'The Data/Results Parameter query button').

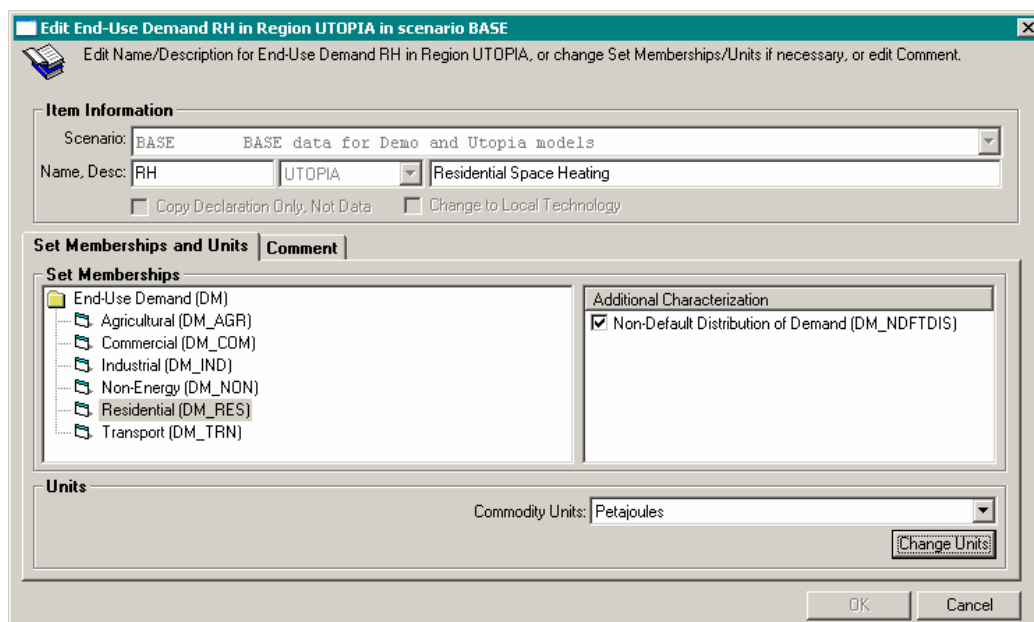


10. Click on **[OK]**, and the edited Item will become the current Item in the Items display and will exhibit any changes made. The Item's Data Parameters will be displayed in the Parameters spread, ready for data editing/deleting.

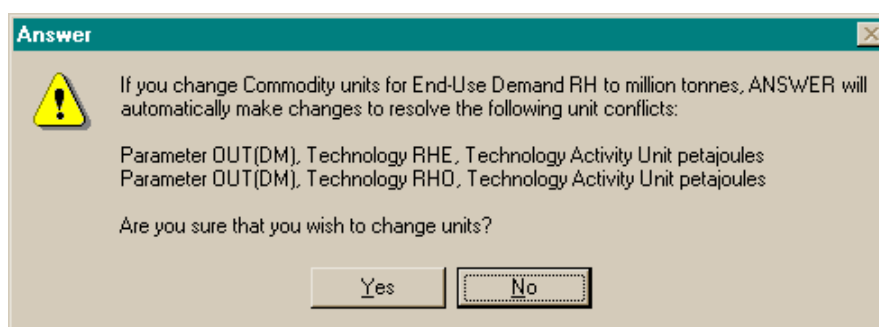
5.2.5.2 Editing an Item's Units

To edit an Item's Units:

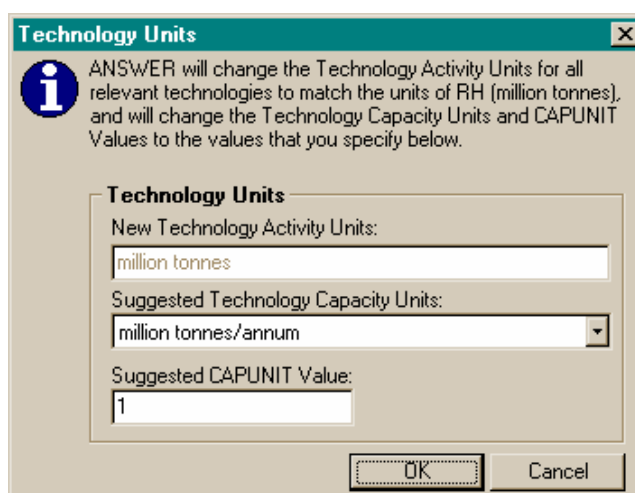
1. Click on the required Component tab, for example the Demand tab.
2. Select the Item that is to be edited by clicking on the Item's name in the Items display.
3. Click on the **[Edit...]** button in the Item Management sub-region, or click on **E**dit in the menu bar and choose **Edit Item...** in the drop menu.
4. An Edit End-Use Demand dialogue box (shown below) will appear.
5. Click on the **[Change Units]** button and the Units combobox(s) will become enabled.



6. Choose the appropriate unit(s) in the combobox(s).
7. If a units conflict arises, the user will be prompted to confirm the change (shown below).



8. If the user confirms the change, and ANSWER detects further unit conflicts in an associated Component (generally the associated Technology), the user will be prompted to confirm the change to the Technology's activity and capacity units and the CAPUNIT value (shown below).



9. Check that the suggested Technology Capacity unit and CAPUNIT value are correct, and alter them if they are not. Click on the **[OK]** button and ANSWER will undertake the required units changes.

5.2.6 Moving an Item

This facility allows the moving of an existing Item and its specifications and associated data from a BASE or non-BASE Scenario (referred to as the origin Scenario) to the currently editable Scenario (referred to as the target Scenario). Also note that there is a facility that allows the bulk moving of multi-selected Technology Items from one Scenario to another Scenario. See section 5.2.9 'Move Item(s) across Scenarios'.

It is useful to know that the way that ANSWER internally handles moving an Item is by first copying the Item from the origin Scenario to the target Scenario (the currently editable Scenario), and then deleting the Item from the target Scenario. Note that this deletion occurs, even though the target Scenario may not be the currently editable Scenario.

Note also that where the target Scenario is the same as the origin Scenario, there is a distinction between moving an Item and editing an Item. If an Item's Name is edited, this change cascades through the entire database, including to any on-line Results that involve this Item. In contrast, if an Item is moved with change of Name, this has the effect of creating a new Item with this Name in the target Scenario only. Any occurrences of this Item with its previous Name in other Scenarios, or in Results, are unaffected. So in particular, if the Item does not occur in any other Scenarios, but does occur in on-line Results, the specific Item details for the previous name will be moved to the _DELETED Scenario. This is consistent with the fact that ANSWER internally treats an Item move as an Item copy from the origin Scenario to the target Scenario, followed by an Item deletion from the target Scenario.

To move an Item:

1. Click on the required Component tab, for example the Technology tab.
2. Select the Item that is to be moved by clicking on the Item's Name in the Items display. (In the example below, the selected Item is E01 in Region UTOPIA.)
3. Click on the **[Move...]** button in the Item Management sub-region, or click on **Edit** in the menu bar and choose **Move Item...** in the drop menu.
4. A Move Technology dialogue box (shown below) will appear.

The Region combobox is set to match the Region of the Item being moved, and disabled. This is because moving an Item in one Region to a different Region is not permitted.

5. The 'Move From' frame initially displays the origin Scenario (in this case BASE), and the Name, Region and Description of the Item selected at Step 2.
 - i. The Scenario combobox is populated with every Scenario in the Database. Its setting determines the origin Scenario.
 - ii. The 'Name, Desc' combobox is populated with those Items (in the example shown above, Technology Items) which are fully defined in the Scenario currently selected at Step i. above, and whose Set Memberships match the current 'Subset Items' setting for the current Component Tab, and whose Region(s) match the region(s) currently selected for data display via the 'Regions...' button.
 - iii. The user may change the settings of either/both of the Scenario and 'Name, Desc' comboboxes.

Where the target Scenario is the same as the origin Scenario:

- 6a. Enter a new Name and (optionally) a new Description. (The Region combobox is set to the same Region as for the origin Item selected at Step 5.ii. above, and is disabled since move with change of Region is not permitted.) The **[OK]** button will only become enabled when a new Name has been entered.

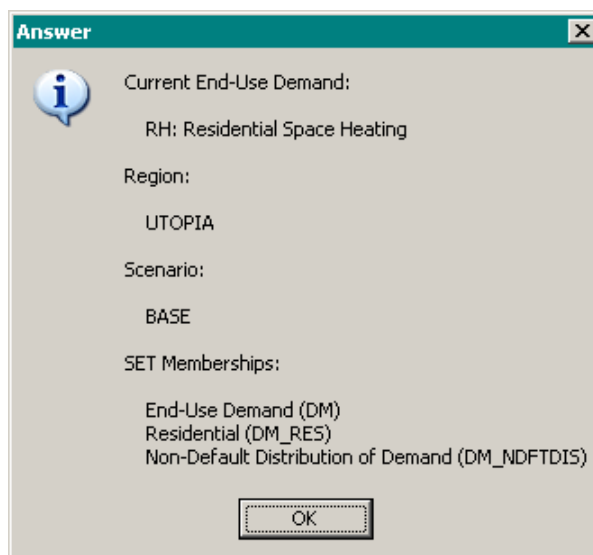
Where the target Scenario differs from the origin Scenario:

- 6b. The **[OK]** button will be immediately enabled. (This is the case above, where the target Scenario HI-EFF differs from the origin Scenario BASE.) The Name and Description in the target Scenario for the Item that is being moved are allowed to be the same as in the origin Scenario. (Region is required to be the same.) Or the user may proceed as in Step 6a. above and enter a new Name and a new Description for the moved Item in the target Scenario.
The user should note that Move is most commonly used to move an Item across Scenarios with no change of Name or Description.
7. If there is a Comment associated with the Item being moved, then this Comment is moved across with the moved Item, and the original Comment is prefixed by the following line:
(Copy of comment for Technology E01 in region UTOPIA in scenario BASE follows)
Click on the Comment tab to display and change any Comment that may be present, or to enter a Comment.
(Note that if you wish to enter a multi-line Comment, and you are using ANSWER version 6.1.18 or earlier, you must hold down the Shift key while hitting the Enter key (otherwise hitting the Enter key while entering a Comment will cause a click on the **[OK]** button).)
8. Click on **[OK]**. The moved Item will then become the current Item in the Items display, ready for any necessary respecification (see Section 5.2.5 'Editing an Item'). The Item's Data Parameters will be displayed in the Parameters spread, ready for data entry and/or editing.

5.2.7 Displaying an Item's Set Memberships

To display just the Set Memberships information for an Item, clicking on the **[Sets?]** button in the Item Management frame is an alternative to clicking on the **[Edit...]** / **[Browse]** button.

1. Click on the required Component tab. In the following example, the Demand tab has been selected.
2. Select the Item that is to have its Set Memberships displayed by clicking on the Item's Name in the Items display.
3. Click on the **[Sets?]** button (visible in both Edit and Browse mode) and the Current End-Use Demand Set Memberships message box will appear:

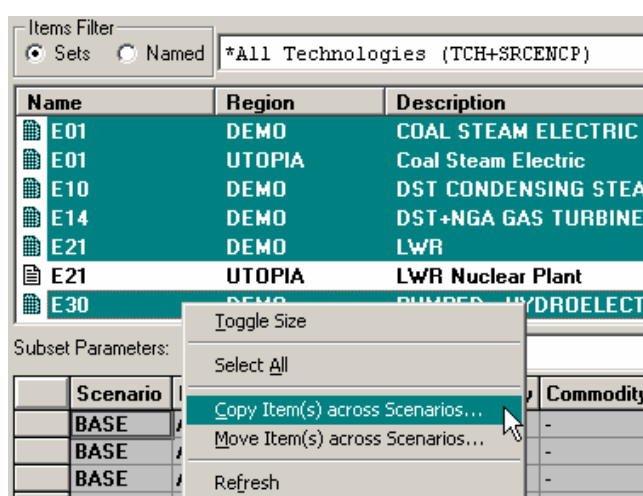


5.2.8 'Copy Item(s) across Scenarios' facility

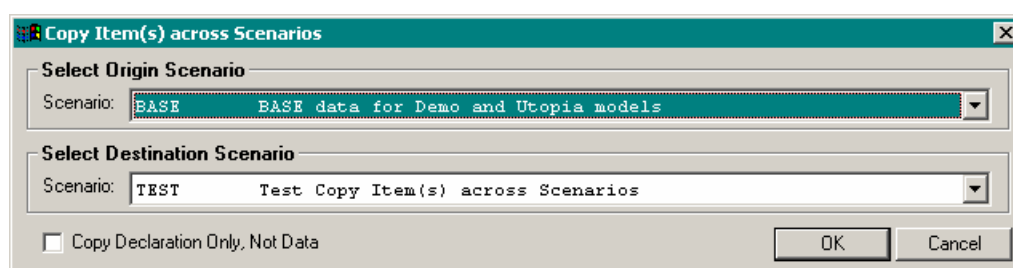
The 'Copy Item(s) across Scenarios' facility is a bulk-copying facility that allows the user to multi-select Items in the Items listview, and in a single operation to copy these Items (and their associated parameters) from one Scenario to another. This facility is available on the Energy, Material, Demand, Emission, Technology and Constraint tabs. The mechanics of the facility are explained assuming that the user wishes to bulk-copy Technology Items across Scenarios, and are identical when bulk-copying Items on other tabs.

To bulk-copy a number of Items in the Items listview (and their associated parameters) from one Scenario to another:

1. Click on the required Component tab. In the following example, the Technology tab has been selected.
2. Multi-select the Item(s) in the Items listview that are to be copied, right-mouse click, and select "Copy Item(s) across Scenarios..." from the popup menu:



3. This brings up the 'Copy Item(s) across Scenarios' form, with the Origin Scenario initially set to BASE, and the Destination Scenario initially set to be the currently editable scenario (in this example TEST):



4. Use the Origin Scenario and Destination Scenario comboboxes to adjust the Origin and Destination Scenarios for the bulk-copy as appropriate, and then click on the [OK] button to initiate a bulk-copy of all selected Items from the Origin Scenario to the Destination Scenario.

The screen snapshot below shows the result of copying the selected Technology Items from the BASE Scenario to Scenario TEST:

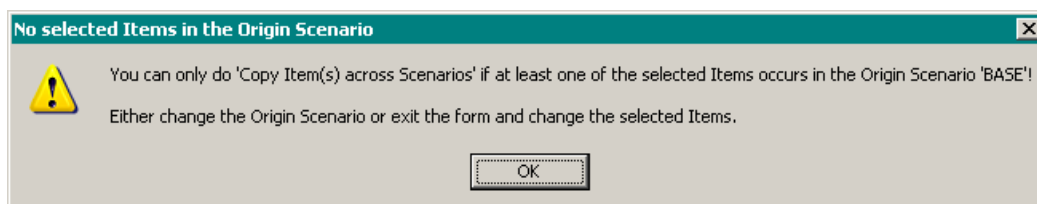
Items Filter: ☒ Sets ☐ Named *All Technologies (TCH+SRCENCP) Sets F

Name	Region	Description	Status
E01	DEMO	COAL STEAM ELECTRIC	M
E01	UTOPIA	Coal Steam Electric	M
E10	DEMO	DST CONDENSING STEAM TURBINE +...	M
E14	DEMO	DST+NGA GAS TURBINE	M
E21	DEMO	LWR	M
E21	UTOPIA	LWR Nuclear Plant	M
E30	DEMO	PUMPED - HYDROELECTRIC	M

Subset Parameters: * Technology, Specific

Scenario	Parameter	Region	Techn	Commo	Bound	Ti	1990	2000	2010
BASE	AF	? DEMO	E01	-	-	-	0.7000	0.7167	0.7333
M TEST	AF	? DEMO	E01	-	-	-	0.7000	0.7167	0.7333
BASE	AF	? DEMO	E10	-	-	-	0.7000	0.8000	0.8500
M TEST	AF	? DEMO	E10	-	-	-	0.7000	0.8000	0.8500
BASE	AF	? DEMO	E21	-	-	-	0.6400	0.7000	0.7000
M TEST	AF	? DEMO	E21	-	-	-	0.6400	0.7000	0.7000
BASE	AF	? DEMO	E30	-	-	-	0.9900	0.9900	0.9900
M TEST	AF	? DEMO	E30	-	-	-	0.9900	0.9900	0.9900
BASE	AF	? UTOPIA	E01	-	-	-	0.8000	0.8000	0.8000
M TEST	AF	? UTOPIA	E01	-	-	-	0.8000	0.8000	0.8000
BASE	BOUND(BD)	? DEMO	E01	-	LO	-	290.0000		
M TEST	BOUND(BD)	? DEMO	E01	-	LO	-	290.0000		

- Note that from among the multi-selected Items, only those that occur in the Origin Scenario will be copied: any selected Items that do not occur in the Origin Scenario will be ignored. If none of the multi-selected Items occurs in the Origin Scenario, the following message box will be displayed:



- Where an Item being copied already occurs in the Destination Scenario, the effect of the copy is that data parameter instances associated with the Item in the Origin Scenario are merged with data parameter instances already existing in the Destination Scenario for the Item. In other words, the values for data parameter instances in the Destination Scenario are overwritten by the values for corresponding parameter instances in the Origin Scenario, with other data parameter instances in the Destination Scenario remaining intact. (The overwriting of parameter values occurs with no warning given to the user.)
- On the Technology tab only, the 'Copy Declaration Only, Not Data' checkbox may be used so that just declaration information (Set Memberships and Units) will be copied to the Destination Scenario, while TS and TID data for the Technologies in the Origin Scenario will not be copied. See section 5.2.10 'Copy Declaration Only, Not Data' checkbox facility' for further details regarding the circumstances under which using this checkbox option is beneficial.

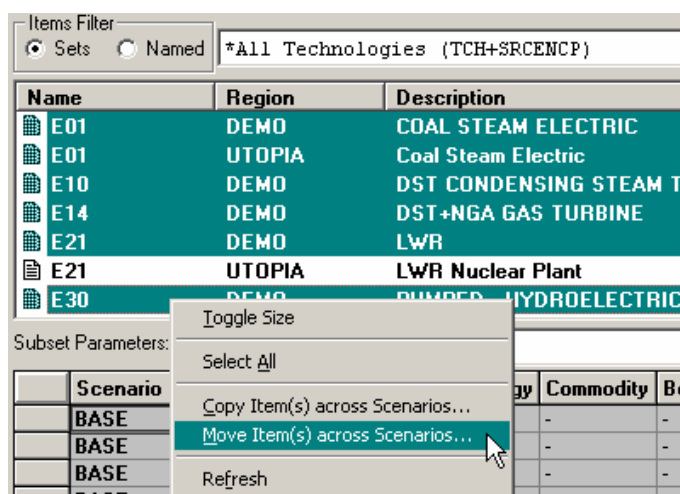
5.2.9 'Move Item(s) across Scenarios' facility

The 'Move Item(s) across Scenarios' facility is a bulk-moving facility that allows the user to multi-select Items in the Items listview, and in a single operation to move these Items (and their associated parameters) from one Scenario to another. This facility is available on the Technology tab only.

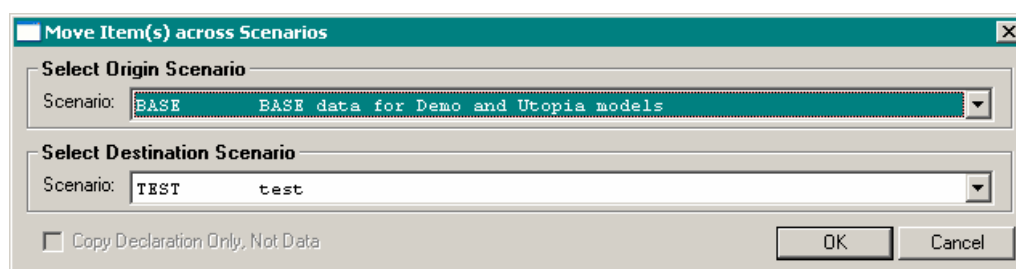
To bulk-move a number of Items in the Technology Items listview (and their associated parameters) from one Scenario to another:

- Click on the Technology tab.

- Multi-select the Item(s) in the Technology Items listview that are to be moved, right-mouse click, and select "Move Item(s) across Scenarios..." from the popup menu:



- This brings up the 'Move Item(s) across Scenarios' form, with the Origin Scenario initially set to BASE, and the Destination Scenario initially set to be the currently editable scenario (in this example TEST):



- Use the Origin Scenario and Destination Scenario comboboxes to adjust the Origin and Destination Scenarios for the bulk-move as appropriate, and then click on the [OK] button to initiate a bulk-move of all selected Items from the Origin Scenario to the Destination Scenario.

The screen snapshot below shows the result of moving the selected Technology Items from the BASE Scenario to Scenario TEST:

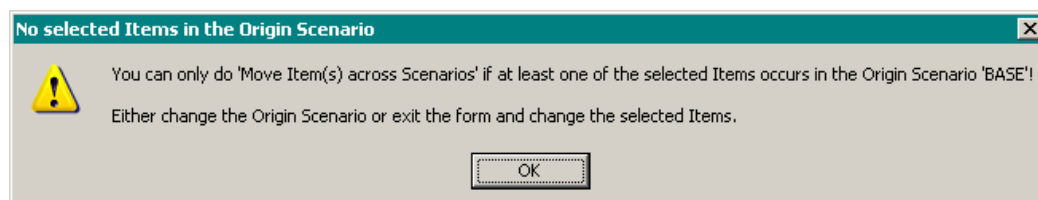
The screenshot shows the 'Items Filter' window with the 'Sets' radio button selected and the filter set to '*All Technologies (TCH+SRCEMCP)'. The listview displays several technology items. A right-click context menu is open over the list, showing options: 'Toggle Size', 'Select All', 'Copy Item(s) across Scenarios...', 'Move Item(s) across Scenarios...' (highlighted by the mouse), and 'Refresh'.

Name	Region	Description	Status
E01	DEMO	COAL STEAM ELECTRIC	
E01	UTOPIA	Coal Steam Electric	
E10	DEMO	DST CONDENSING STEAM TURBINE +...	
E14	DEMO	DST+NGA GAS TURBINE	
E21	DEMO	LWR	
E21	UTOPIA	LWR Nuclear Plant	
E30	DEMO	PUMPED - HYDROELECTRIC	

Scenario	Parameter	Region	Techn	Commo	Bound	Ti	1990	2000	2010
M TEST	AF	? DEMO	E01	-	-	-	0.7000	0.7167	0.7333
M TEST	AF	? DEMO	E10	-	-	-	0.7000	0.8000	0.8500
M TEST	AF	? DEMO	E21	-	-	-	0.6400	0.7000	0.7000
M TEST	AF	? DEMO	E30	-	-	-	0.9900	0.9900	0.9900
M TEST	AF	? UTOPIA	E01	-	-	-	0.8000	0.8000	0.8000
M TEST	BOUND(BD)	? DEMO	E01	-	LO	-	290.0000		
M TEST	BOUND(BD)	? DEMO	E01	-	UP	-	310.0000		

In particular note that after the move, there are TS (and TID) parameter instances for Scenario TEST, but not for the BASE Scenario, because the latter have been deleted as a result of the move. The screen snapshot below should be contrasted with the earlier screen snapshot that shows the result of *copying* the selected technologies from the BASE Scenario to Scenario TEST, and in which there are TS (and TID) parameter instances for both Scenario TEST and the BASE Scenario.

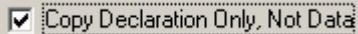
5. Note that from among the multi-selected Items, only those that occur in the Origin Scenario will be moved: any selected Items that do not occur in the Origin Scenario will be ignored. If none of the multi-selected Items occurs in the Origin Scenario, the following message box will be displayed:



6. Where an Item being moved already occurs in the Destination Scenario, the effect of the move is that data parameter instances associated with the Item in the Origin Scenario are merged with data parameter instances already existing in the Destination Scenario for the Item. In other words, the values for data parameter instances in the Destination Scenario are overwritten by the values for corresponding parameter instances in the Origin Scenario, with other data parameter instances in the Destination Scenario remaining intact. (The overwriting of parameter values occurs with no warning given to the user.)

5.2.10 'Copy Declaration Only, Not Data' checkbox facility

In ANSWER version 5.5.0 (and higher), a 'Copy Declaration Only, Not Data' checkbox is available to the user who is copying a single Technology Item (see section 5.2.3 'Copying an Item'), or who is bulk-copying Technology Items (see section 5.2.8 'Copy Item(s) across Scenarios' facility').

If the user checks this checkbox  then when the copy or bulk-copy occurs, just Set Memberships information for the selected Technology Item(s) in the Origin Scenario will be copied to the Destination Scenario, while TS and TID data will not be copied.

The purpose of the 'Copy Declaration Only, Not Data' checkbox is to make it easier for the user to construct non-BASE scenarios that contain Technology parameter instances, some of which may be for Technologies that occur in other non-BASE scenarios. This statement is elaborated on below.

For example, suppose that the user's currently editable non-BASE scenario is TEST, and that the user wishes to place into TEST a Technology parameter instance (say a bound) for Technology RL2 that occurs in another non-BASE scenario CF1. The user who selects Technology RL2 in the Technology listview will find that both the TS and TID AddRow Parameter combobox lists are empty: ANSWER does not allow parameter instances to be added into a non-BASE scenario when the selected Item is in a different non-BASE scenario! While there are some good reasons for this restriction, it creates considerable user inconvenience. The 'Copy Declaration Only, Not Data' checkbox has been introduced to reduce this inconvenience.

In the situation described above, the user should select Technology RL2 in the Technology listview, click on the **[Copy...]** button in the Item Management frame to bring up the Copy Technology form, check the 'Copy Declaration Only, Not Data' checkbox, and then click on the **[OK]** button. Following on this copy, the user will be able to use the AddRow to place Technology parameter instances for technology RL2 into scenario TEST. (Doing the above copy but with the checkbox *unchecked* would result in all TS and TID parameter instances for Technology RL2 in scenario CF1 being copied to scenario TEST, thereby creating the undesirable situation of having redundant data.)

5.3 Item Naming Conventions

ANSWER does not enforce Item naming conventions on the user; there are just some broad limitations:

1. The combination of the Name and Region of an Item must be unique to that Item.
2. The Name of an Item can comprise up to 10 characters, being comprised of A-Z, 0-9, - (hyphen), _ (underscore), & (ampersand), . (period).
3. The Region of an Item can comprise up to 10 characters, being comprised of A-Z, 0-9, - (hyphen), _ (underscore).
4. The first character of a Name and the first character of a Region must be alphabetic (A-Z).
5. The Item Description cannot contain single/double quotes.

This Section introduces the user to the naming conventions generally used by MARKAL modellers for the Name and Description of Items. In addition, a suggested expansion and variance to the traditional conventions is introduced.

Traditional MARKAL users will notice the slight changes in the suggested naming convention, such as an End-Use Demand Item having a three character Name instead of a two character Name. These suggestions provide for the development of hierarchical classifications for larger and more detailed Scenarios, while retaining the transparency of the traditional MARKAL conventions.

5.3.1 Name Code

COMPONENT	Traditional MARKAL NAME code	Suggested NAME code
ENERGY CARRIERS	3 alpha numeric characters, in upper case. NAME reflects ENERGY CARRIER type, e.g. HCO = Hard coal.	No suggested change.
DEMANDS	2 alpha numeric characters, in upper case. First character reflects the END-USE DEMAND sector, i.e. A = Agriculture C = Commercial I = Industrial N = Non-energy R = Residential T = Transport. Second character (0 to 9, A to Z) provides a unique identifier.	3 alpha numeric characters, in upper case. First character reflects the END-USE DEMAND sector, i.e. A = Agriculture C = Commercial I = Industrial N = Non-energy R = Residential T = Transport. Second character reflects the END-USE DEMAND sub-sector, e.g. CO = Commercial/Office. Third character (0 to 9, A to Z) provides a unique identifier, e.g. COH = Commercial/Office/High Rise.
DEMAND TECHNOLOGIES	3 alpha numeric characters, in upper case. First two characters are the NAME of the END-USE DEMAND sector which the TECHNOLOGY primarily services, e.g. CO = Commercial/Office. Third character (0 to 9, A to Z) is the unique identifier of the TECHNOLOGY, e.g. CO1 = Commercial/Office/Lift.	5 alpha numeric characters, in upper case. First three characters are the NAME of the END-USE DEMAND sector which the TECHNOLOGY primarily services, e.g. COH = Commercial/Office/High Rise. Fourth and fifth characters identify the TECHNOLOGY. Fourth character reflects the TECHNOLOGY type, e.g. V = Vertical Transport. Fifth character (0 to 9, A to Z) provides a unique identifier of the TECHNOLOGY, e.g. V1 = Vertical Transport/Lifts.
CONVERSION TECHNOLOGIES	3 alpha numeric characters, in upper case. First character is E, this being traditionally unique in MARKAL to the CONVERSION TECHNOLOGIES. Second and third characters (0 to 9, A to Z) provide unique identifiers.	5 alpha numeric characters, in upper case. First character is E, this being traditionally unique in MARKAL to the CONVERSION TECHNOLOGIES. Second to fifth characters (0 to 9, A to Z) provide unique identifiers.

COMPONENT	Traditional MARKAL NAME code	Suggested NAME code
PROCESS TECHNOLOGIES	3 alpha numeric characters, in upper case. First character is S, this being traditionally unique in MARKAL to the PROCESS TECHNOLOGIES. Second and third characters (0 to 9, A to Z) provide unique identifiers.	5 alpha numeric characters, in upper case. First character is P, this being more transparent to users as referring to the PROCESS TECHNOLOGIES. Second to fifth characters (0 to 9, A to Z) provide unique identifiers.
RESOURCE TECHNOLOGIES	7 alpha numeric characters, in upper case. First three characters reflects the RESOURCE type, i.e. EXP = Export IMP = Import STK = Stocks MIN = Mining/Extraction RNW = Renewable. Second three characters are the NAME code of the ENERGY CARRIER. Seventh character (0 to 9, A to Z) provides a unique identifier.	No suggested change.
EMISSIONS	3 alpha numeric characters, in upper case. NAME reflects EMISSIONS type.	No suggested change.

5.3.2 Description Convention

For all Components, the Description

1. must be unique
2. may comprise up to 50 characters (up to 100 characters for ANSWER version 5.4.0 or higher)
2. should use upper and lower case, as this is easier to read and more space efficient
4. cannot contain single/double quotes.

It is suggested that the Name code closely reflect the Description, as in the following examples.

COMPONENT	Example NAME	Suggested DESCRIPTION convention
ENERGY CARRIERS	HCO	Hard coal
DEMANDS	COH	Commercial/Office/High Rise
DEMAND TECHNOLOGIES	COHV1	Commercial/Office/High Rise/Vertical Transport/Lifts
CONVERSION TECHNOLOGIES	EEHCO	Electricity Generation/Coal fired steam boiler
PROCESS TECHNOLOGIES	PPRF1	Petroleum Refinery #1
RESOURCE TECHNOLOGIES	IMPHCOW	Imported Hard Coal/Washed
EMISSIONS	CO2	Carbon Dioxide

5.4 Data entry and editing for Data Parameters

Having created and correctly specified the required Items in the Scenario, the Data Parameters and their data can now be entered for each Item. ANSWER automates much of this process.

5.4.1 Automated Data Parameter creation and entry

Based on the user's specification of an Item's Set Memberships, ANSWER will automatically:

1. Create each of the compulsory Data Parameters for the Item in the Parameters spreads;
2. Enter default data for each compulsory Data Parameter where default data is specified;
3. Ensure that only appropriate Data Parameters can be associated with the Item.

5.4.1.1 An example of ANSWER's automated Data Parameter creation and entry

Suppose an End-Use Demand Item, labelled 'CH - Commercial Space Heating', is created in region UTOPIA and its Set Memberships specified as 'Commercial/Non-Default Distribution of Demand'. As illustrated below, ANSWER will then automatically create the appropriate Data Parameters for the Item, namely DEMAND, ELF, and FR(Z)(Y). Default data for the ELF Data Parameter will also be written to the data fields in the ELF row, while the data fields in the DEMAND and FR(Z)(Y) Data Parameters remain blank pending manual data entry.

Item highlighted in Items display

DEMAND Data Parameter awaiting data entry

ELF Data Parameter showing default data

FR(Z)(Y) Data Parameter awaiting data entry

Name	Region	Description	Status
CH	UTOPIA	Commercial space heating	
I1	DEMO	IRON + STEEL METALLURGY	
ID	DEMO	INDUSTRIAL PROCESS HEAT	
IE	DEMO	INDUSTRIAL ELECTRICITY	
IH	DEMO	HYDROCARBONS FOR NON-ENERGY USE	
R1	DEMO	RESIDENTIAL SPACE HEAT	

Subset Parameters: *C End-Use Demand, Specific

Scenario	Parameter	Region	Deman	Bound	1990	2000	2010	2020
? BASE	DEMAND	? UTOPIA	CH	-				
? BASE	ELF	? UTOPIA	CH	-	1.0000	1.0000	1.0000	1.0000
Add	BASE							

Scenario	Parameter	Region	Deman	Bound	TimeSlice	Value
? BASE	FR(Z)(Y)	? UTOPIA	CH	-	I-D	
? BASE	FR(Z)(Y)	? UTOPIA	CH	-	I-N	
? BASE	FR(Z)(Y)	? UTOPIA	CH	-	S-D	
? BASE	FR(Z)(Y)	? UTOPIA	CH	-	S-N	
? BASE	FR(Z)(Y)	? UTOPIA	CH	-	W-D	
? BASE	FR(Z)(Y)	? UTOPIA	CH	-	W-N	
Add	BASE					

Database: C:\Answer\6\Answer_Databases\MultiUtopDemoLumpy.mdb Edit Scenario: BASE

With the automated Data Parameter creation and default data entry complete, it is necessary to now manually complete the data entry and editing.

5.4.2 Manual Data Parameter entry and editing

Manual Data Parameter entry and editing covers three operations:

1. Adding a Data Parameter
2. Entering and/or editing a Data Parameter's arguments and data

3. Deleting a Data Parameter.


Suppose that the user creates a new Demand Technology Item 'CHE - Commercial Electric Boiler'. The Data/Results screen appears as follows:

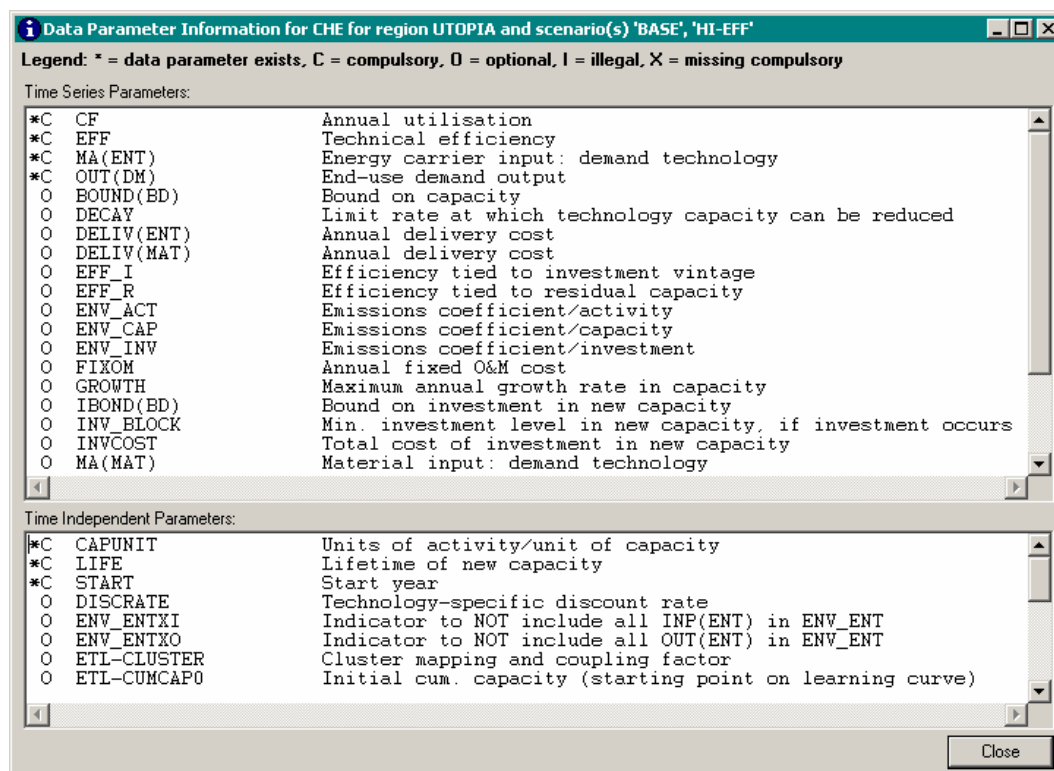
The screenshot displays the 'MultiUtopDemoLumpy - ANSWER-MARKAL Energy Modelling' application. The 'Technology' tab is active, showing a list of technologies. The 'CHE' technology is highlighted. Below the list, the 'Subset Parameters' table is shown, with columns for Scenario, Parameter, Region, Technology, Commodity, Bound, and years 1990, 2000, 2010, 2020. The 'TID Data Parameters' table is also visible, with columns for Scenario, Parameter, Region, Technology, Item2, and Value. Annotations point to various elements: 'Item highlighted in Items display' points to the 'CHE' row in the technology list; 'TS Data Parameters showing default data' points to the 'BASE' row in the subset parameters table; 'TS Data Parameters awaiting data entry' points to the 'BASE' row in the subset parameters table; 'TID Data Parameters showing default data' points to the 'BASE' row in the TID data parameters table; 'Parameter fields combobox' points to the 'Parameter' column in the subset parameters table; 'Argument fields' points to the 'Commodity' column in the subset parameters table; and 'Data fields' points to the year columns in the subset parameters table.

To enable the automatic creation of a compulsory Data Parameter for which its argument is indeterminate (i.e. has to be specified by the user), ANSWER creates the placeholder '-none-' in place of the argument name (shown above).

The minimum actions that the user should now take to complete the specification for the example Technology 'CHE' above are to:

1. Specify appropriate Commodity arguments for the Data Parameters MA(ENT) and OUT(DM), currently showing the placeholder '-none-'.
2. Review whether the default data values for Parameters CF, EFF, MA(ENT), OUT(DM), CAPUNIT and START are satisfactory.
3. Enter an appropriate data value for the LIFE Parameter.

Note that the Data Parameters that have been automatically created by ANSWER are those Parameters that are listed as C = compulsory if the user clicks on the **[Data/Results Parameter query]** button  to bring up the Data Parameter Information form (see below).



5.4.2.1 Entering, editing and deleting a Data Parameter's argument and data

Entering and/or editing a Data Parameter's arguments and data can be done at the time of creating the Data Parameter or subsequently.

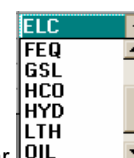
It is preferable to ensure that all '-none-' placeholders are replaced with the appropriate argument at the time of creating the Data Parameter. If this is not done, and '-none-' placeholders remain in scenario data, this will be detected when the user attempts a model run involving any such scenario.

5.4.2.1.1 Direct cell editing of a Data Parameter's argument

To direct cell edit a Data Parameter's argument:

1. Click on the argument field. The argument field will display as a combobox and be backlit,

e.g., 



2. Either type the first letter of the required Item or use the scroll bar to move to and click on the required Item. The Items displayed in the combobox will be the only legal options available for this argument.
3. The change of Item argument is immediately saved to the Database and displayed in the Data Parameter row.

5.4.2.1.2 Entering and editing a Data Parameter's data

To enter and/or edit a Data Parameter's numeric data:

1. Click on the required data field.
2. Enter the data.
3. Using the arrow keys/Tab key/pointer, move to the next required data field and enter data.

- The data is immediately saved to the Database and displayed in the Data Parameter row with each move.

5.4.2.1.3 Deleting data from a Data Parameter

To delete numeric data from a Data Parameter:

- Click on the required numeric data field or click on the left mouse key and highlight a series of consecutive numeric data fields whose data requires deletion.
- Press the delete key to delete the data.
- The deletion is immediately saved to the Database and displayed in the Parameter spread.
- Using the arrow keys/Tab key/pointer, move to the next required numeric data field and repeat data deletion.

5.4.2.2 Adding a Data Parameter

When in Edit Data mode, each of the Parameters spreads includes an Add row (shown in blue) for adding Data Parameters and their data to an Item.

Listed in the Parameter field combobox in the Add row are those Data Parameters that can be associated with the Item (these are determined from the Item's Set Memberships) but that have not yet been added to the Item, i.e. the optional Data Parameters.

To add a Data Parameter to an Item:

- Ensure that you are in Edit Data mode for the appropriate scenario and with the desired Item selected in the Items display. (In the example below, this is Technology E01 in Region UTOPIA.)
- Click on the Parameter field combobox in the Add row.
- Either type the first letter of the required Data Parameter or use the scroll bar to move to and click on the required Data Parameter, e.g., ENV_CAP (shown below).

	Scenario	Parameter	Region	Technology	Commodity	Bound	TimeSlice	1990	2000	2010	2020
	BASE	AF	? UTOPIA	E01	-	-	-	0.8000	0.8000	0.8000	0.8000
	BASE	FIXOM	? UTOPIA	E01	-	-	-	40.0000	70.0000	100.0000	100.0000
	BASE	INP[ENT]c	? UTOPIA	E01	HCO	-	-	3.1250	3.1250	3.1250	3.1250
	BASE	INVCOST	? UTOPIA	E01	-	-	-	1,400.0000	1,300.0000	1,200.0000	1,200.0000
	BASE	PEAK(CON)	? UTOPIA	E01	-	-	-	1.0000	1.0000	1.0000	1.0000
	BASE	RESID	? UTOPIA	E01	-	-	-	0.5000	0.3250	0.1500	0.1500
	BASE	VAROM	? UTOPIA	E01	-	-	-	0.3000	0.3000	0.3000	0.3000
Add	BASE	ENV_CAP	? UTOPIA	E01	-	-	-				
		BOUND(BD)									
		BOUND(BD)D									
		DELIV[ENT]									
		DELIV[MAT]									
		ENV_ACT									
		ENV_CAP									

- Having clicked on the required Data Parameter, ANSWER will automatically fill the Region and Technology comboboxes with UTOPIA and E01 respectively, and will move the active field to the next field in the Add row that requires argument or data specification. For the ENV_CAP Parameter, this is the Commodity argument that requires specification of the emission. Either type the first letter of the required Commodity or drop down the combobox and choose the required Commodity, as shown below.

	Scenario	Parameter	Region	Technology	Commodity	Bound	TimeSlice	1990	2000	2010	2020
	BASE	AF	? UTOPIA	E01	-	-	-	0.8000	0.8000	0.8000	0.8000
	BASE	FIXOM	? UTOPIA	E01	-	-	-	40.0000	70.0000	100.0000	100.0000
	BASE	INP[ENT]c	? UTOPIA	E01	HCO	-	-	3.1250	3.1250	3.1250	3.1250
	BASE	INVCOST	? UTOPIA	E01	-	-	-	1,400.0000	1,300.0000	1,200.0000	1,200.0000
	BASE	PEAK(CON)	? UTOPIA	E01	-	-	-	1.0000	1.0000	1.0000	1.0000
	BASE	RESID	? UTOPIA	E01	-	-	-	0.5000	0.3250	0.1500	0.1500
	BASE	VAROM	? UTOPIA	E01	-	-	-	0.3000	0.3000	0.3000	0.3000
Add	BASE	ENV_CAP	UTOPIA	E01	CO2	-	-				
					NOX						

5. Having chosen the required Commodity, ANSWER will move the active field to the next field in the Add row that requires argument or data specification. For the ENV_CAP Parameter, this is the first numeric data field (1990). Enter numeric data in each data field. Note the availability of mathematical functions to expedite the entry of data in such cases as each Time Series entry having the same value. See section 5.4.4.

	Scenario	Parameter	Region	Technology	Commodity	Bound	TimeSlice	1990	2000	2010	2020
	BASE	AF	? UTOPIA	E01	-	-	-	0.8000	0.8000	0.8000	0.8000
	BASE	FIXOM	? UTOPIA	E01	-	-	-	40.0000	70.0000	100.0000	100.0000
	BASE	INP(ENT)c	? UTOPIA	E01	HCO	-	-	3.1250	3.1250	3.1250	3.1250
	BASE	INVCOST	? UTOPIA	E01	-	-	-	1,400.0000	1,300.0000	1,200.0000	1,200.0000
	BASE	PEAK(CON)	? UTOPIA	E01	-	-	-	1.0000	1.0000	1.0000	1.0000
	BASE	RESID	? UTOPIA	E01	-	-	-	0.5000	0.3250	0.1500	0.1500
	BASE	VAROM	? UTOPIA	E01	-	-	-	0.3000	0.3000	0.3000	0.3000
Add	BASE	ENV_CAP	? UTOPIA	E01	C02	-	-				

6. Having entered the required data:
- Press the ↓ key (or the **Insert** key) when the cursor is in any numeric field in the Add row.

The contents of the Add row will be saved to the Database and displayed in the Item's Parameter spread. The Add row will return to its initial state and the same process may be used to add subsequent Data Parameters.

If the user attempts to use the ↓ key (or the **Insert** key) before all the comboboxes in the Add row have been specified, a message box will be displayed advising that the Add row is not yet complete.

5.4.2.2.1 Adding a Bilateral Trade Data Parameter

Special Add row treatment is given to the three bilateral trade data parameters BI_TRD(ENT), BI_TRD(MAT) and BI_TRD(ELC). These parameters differ from other parameters in that each of them is defined over:

Region x Region2 x Technology x Commodity x Technology2 x Commodity2

where Region is export region, Technology is an Export technology in the export region and Commodity is the commodity exported, and Region2 is import region, Technology2 is an Import technology in the import region and Commodity2 is the commodity imported.

(The BI_TRD(ELC) parameter is also defined over TimeSlice.)

NOTE: In version 5 of ANSWER, bilateral trade data parameters can be added from either the Trade tab or the Parameter tab. **In version 6.1.20 (and higher) of ANSWER, bilateral trade data parameters can be added only from the Parameter tab (most conveniently from the "BiTrade Data Parameters" setting of the Subset Items combobox).**

The special Add row treatment for bilateral trade data parameters is as follows:

- Once the user selects the desired bilateral trade data parameter (e.g. BI_TRD(ENT)), the Region combobox is populated in the standard fashion. In version 5 of ANSWER on the Trade tab, this means populated with all regions that are currently selected in the Items display. In version 6 of ANSWER on the Parameter tab, this means populated with all regions.
- Once the user selects an export region in the Region combobox, the Region2 combobox is populated with all regions except the selected export region.
- Once the user selects an import region in the Region2 combobox, the Technology combobox is populated with all Export technologies from the selected export region that export either energy carriers / materials / electric energy carriers according to whether the selected bilateral trade data parameter is BI_TRD(ENT) / BI_TRD(MAT) / BI_TRD(ELC).
- Once the user selects an Export technology, the Commodity combobox is filled with the commodity that is exported by the selected export technology, and the Technology2 combobox is populated with all Import technologies from the selected import region that import either energy carriers / materials / electric energy carriers according to whether the selected bilateral trade data parameter is BI_TRD(ENT) / BI_TRD(MAT) / BI_TRD(ELC), but with an additional caveat: if the selected Export technology has P as its final character,

then only Import technologies that have P as final character appear in the Technology2 combobox.

5. Once the user selects an Import technology, the Commodity2 combobox is filled with the commodity that is imported by the selected import technology.

5.4.2.2.2 Example of use of the Add row to add Bilateral Trade Parameter BI_TRD(ENT)

Suppose that for the MultiUtopDemoLumpy database, we are on the Parameter tab. We wish to add an instance of the BI_TRD(ENT) parameter into a scenario that we have created called BITRDENT.

1. Select the desired bilateral trade data parameter, say BI_TRD(ENT). The Add row now appears as follows, with the Region combobox populated to contain both DEMO and UTOPIA.

										TID data
	Scenario	Parameter		Region	Region2	Technology	Energy	Technology2	Energy2	Value
Add	BITRDENT	BI_TRD(ENT)	?							1

2. Select the export region in the Region combobox, say DEMO. The Region2 combobox is populated with all regions except DEMO. For the MultiUtopDemoLumpy database, this means that the Region2 combobox contains just the single region UTOPIA.
3. Since the Region2 combobox contains just the single region UTOPIA, it is automatically selected as the import region. The Add row now appears as follows, with the Technology combobox populated with all Export technologies from the DEMO region that export energy carriers.

										TID data
	Scenario	Parameter		Region	Region2	Technology	Energy	Technology2	Energy2	Value
Add	BITRDENT	BI_TRD(ENT)	?	DEMO	UTOPIA					1

4. Select the Export technology in the Technology combobox, say EXPJTF1. The Commodity combobox is filled with JTF, the commodity that is exported by EXPJTF1. The Add row now appears as follows, with the Technology2 combobox populated with all Import technologies from the UTOPIA region that import energy carriers, and **that have 1 as their final character**.

										TID data
	Scenario	Parameter		Region	Region2	Technology	Energy	Technology2	Energy2	Value
Add	BITRDENT	BI_TRD(ENT)	?	DEMO	UTOPIA	EXPJTF1	JTF			1

5. Select the Import technology in the Technology2 combobox, say IMPDSL1. The Commodity2 combobox is filled with DSL, the commodity that is imported by IMPDSL1. The Add row now appears as follows, ready for insertion into the database by pressing the ↓ key, or the **Insert** key.

										TID data
	Scenario	Parameter		Region	Region2	Technology	Energy	Technology2	Energy2	Value
Add	BITRDENT	BI_TRD(ENT)	?	DEMO	UTOPIA	EXPJTF1	JTF	IMPDSL1	DSL	1

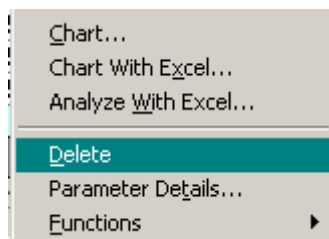
5.4.2.3 Deleting a non-required Data Parameter

To delete a Data Parameter(s):

- 1a. To delete a single Data Parameter, select the Data Parameter by clicking on its status field, and then press the Delete key.
- 1b. To delete multiple Data Parameters, multi-select the Data Parameters by clicking on their status fields, and then press the Delete key.

	Scenario	Parameter		Region	Technology	Commodity	Bound	TimeSlice	1990	2000	2010	2020
	BASE	AF	?	UTOPIA	E01	-	-	-	0.8000	0.8000	0.8000	0.8000
	BASE	ENV_CAP	?	UTOPIA	E01	CO2	-	-	0.0030	0.0030	0.0030	0.0030
	BASE	FIXOM	?	UTOPIA	E01	-	-	-	40.0000	70.0000	100.0000	100.0000
Status fields	BASE	INP(ENT)c	?	UTOPIA	E01	HCO	-	-	3.1250	3.1250	3.1250	3.1250
	BASE	INVCOST	?	UTOPIA	E01	-	-	-	1,400.0000	1,300.0000	1,200.0000	1,200.0000
	BASE	PEAK(CON)	?	UTOPIA	E01	-	-	-	1.0000	1.0000	1.0000	1.0000
	BASE	RESID	?	UTOPIA	E01	-	-	-	0.5000	0.3250	0.1500	0.1500
	BASE	VAROM	?	UTOPIA	E01	-	-	-	0.3000	0.3000	0.3000	0.3000
Add	BASE		?									

Alternatively, after selecting or multi-selecting the Data Parameter(s) to be deleted, right-mouse click on the spread and choose **Delete** in the pop-up menu (shown below).



Multi-selection of Data Parameters in the Spread

Multi-selection of the Data Parameters to be deleted is performed in the standard fashion using the status field in the spread. So for example to multi-select contiguous rows from ENV_CAP to RESID, as above, first select the ENV_CAP row by clicking in its status field. Then holding down the Shift key, click in the status field for the RESID row.

Or alternatively, simply hold down the Shift key and with the mouse swipe the status fields of the rows from ENV_CAP to RESID.

The rows that are selected do not have to be contiguous. Additional rows may be added to the selection by holding down the Ctrl key and clicking, or mouse swiping, their status fields.


There is one restriction: it is not possible to de-select an already selected row by holding down the Ctrl key and clicking in that row.

2. Confirm the deletion of the Data Parameter(s).
3. The deletion is immediately applied to the Database and the Parameter spread is re-displayed (minus the Data Parameter(s) that have just been deleted).
4. Repeat the operation as required.

5.4.2.4 Associating a User Comment with a Data Parameter

ANSWER allows the user to associate a Comment with each instance of a Data Parameter in the currently editable Scenario.

To associate a User Comment with a Data Parameter in the currently editable Scenario:

1. Click on the  button next to the Parameter in the TS/TID data spread.
2. The Parameter Details dialogue box (shown below) will appear.

Parameter Details

Attributes:

SCENARIO:
BASE : BASE data for Demo and Utopia models

PARAMETER:
DEMAND : End-use demand

DOMAIN OF DEFINITION:
All End-Use Demands (DM)

REGION:
UTOPIA : UTOPIA region

END-USE DEMAND:
CH : Commercial air conditioning

UNITS:
PJ : Petajoules

Comment:

OK Cancel

3. Enter the User Comment in the Comment field. The **[OK]** button will become enabled. If you wish to enter a multi-line Comment, and you are using ANSWER version 6.1.18 or earlier, you must hold down the Shift key while hitting the Enter key (otherwise hitting the Enter key while entering a Comment will cause a click on the **[OK]** button.)
4. Click on the **[OK]** button. The Comment will be stored in the Database and the button will change to . The enables the user to tell at a glance that this Parameter now has a Comment associated with it.
5. To edit an existing User Comment associated with a Data Parameter, repeat the procedure in steps 1-4 above, and edit the text in the Comment field of the Parameter Details dialogue box. Note that if the existing Comment is deleted entirely, then after clicking on the **[OK]** button, the button will change from back to , that is the button will revert to what it was before the User Comment was associated with this Parameter.

5.4.3 Entry of Data Parameters which are Bounds

In ANSWER, there are a number of Data Parameters available to the user for imposing lower/fixed/upper Bounds on model variables such as those representing the capacity or activity of a technology in a period, the level of investment in new capacity for a technology in a period, and the level of an emission in a period.

5.4.3.1 Bounds in ANSWER

The TS Bound Data Parameters are:

BOUND(BD)	Bound on technology <u>capacity</u>
BOUND(BD)O	Bound on technology <u>activity</u> : conversion/process technology
BOUND(BD)Or	Bound on technology <u>activity</u> : resource technology
ENV_BOUND(BD)	Bound on <u>emissions</u>

ENV_MAXEM	Bound on <u>emission</u> (an upper bound)
IBOND(BD)	Bound on <u>investment</u> in new capacity
MED-ELAST(BD)	MED Elasticity of demand
MED-VAR(BD)	MED Variation of demand
MM-EXPBND	M-M Market <u>penetration</u> limit (an upper bound)
S_BOUND(BD)	Stochastic bound on <u>capacity</u>
S_BOUND(BD)O	Stochastic bound on <u>activity</u> : conversion/process technology
S_BOUND(BD)Or	Stochastic bound on <u>activity</u> : resource technology
S_ENV_BND(BD)	Stochastic bound on <u>emissions</u>
S_ENV_MAXEM	Stochastic bound on <u>emissions</u> (an upper bound)
S_IBOND(BD)	Stochastic bound on <u>investment</u> in new capacity
TSUB_BND(BD)	Bound on total <u>tax/subsidy</u> revenues

The TID Bound Data Parameters are:

CUM	Bound on total <u>resource availability</u> (an upper bound)
ENV_CUMMAX	Bound on cumulative <u>emission</u> (an upper bound)
MED-STEP(BD)	MED Number of demand growth/reduction steps
S_ENV_CUM	Stochastic cumulative <u>emissions</u> limit (an upper bound)

Where the name of the Data Parameter contains (BD), the user may impose a lower (LO) and/or upper (UP) bound, or a fixed (FX) bound.

5.4.3.1.1 Handling of Bounds in ANSWER

Note the following points in regard to Data Parameters that are Bounds:

1. For a fixed bound or an upper bound, specifying an explicit zero in a data field has a very different effect from leaving the data field blank: specifying an explicit zero sets the bound to zero, whereas leaving a blank imposes no bound. So for example, specifying an explicit zero for an IBOND(BD) fixed or upper bound in a period constrains investment in new capacity in that period to be zero, whereas leaving a blank in a period places no constraint. See also the discussion at points 4 and 5 below.
2. For a lower bound, specifying an explicit zero in a data field, or leaving the data field blank, have the same effect: the lower bound in that period is taken to be zero. See also the discussion at points 4 and 5 below.
3. By default, each model variable that may be bounded by using a Bound Data Parameter has a lower bound of zero, and no upper bound (an upper bound of $+\infty$). The user may vary this by specifying a lower bound, or an upper bound, or both. Also, the user may specify a fixed bound, possibly in conjunction with a lower bound and/or an upper bound.
 - i. If the user specifies a fixed bound and there is no upper bound specified for the same parameter instance, the resultant effect is that the variable's lower bound is set to the data value(s) specified in the fixed bound, and the variable's upper bound is also set to the data value(s) specified in the fixed bound. (Any lower bound data value(s) that may be specified for the same parameter instance is(are) overwritten.)
 - ii. If the user specifies a fixed bound and also an upper bound for the same parameter instance, the *default* behaviour of the GAMS MARKAL code is that the variable's upper bound is set to the data value(s) specified in the upper bound. That is, the upper bound data value(s) is(are) preferred to the fixed bound data value(s). But see point iii below.
 - iii. It is possible to change the default behaviour of the GAMS MARKAL code so that when both a fixed bound and an upper bound are specified for the same parameter instance, the variable's upper bound is set to the data value(s) specified in the fixed bound. That is, it is possible to change the default behaviour so that the fixed bound data value(s) is(are) preferred to the upper bound data value(s). To do this, invoke "Run, Edit GEN File Template..." (or for a multi-region model invoke "Run, Edit Multi-Region GEN File Template...") and then ensure that the lines \$SET BD1 'UP' and \$SET BD2 'FX' both appear as below (unasterisked):


```

* Unasterisk the following line to set START period bound = GROWTH_TID, if bound not provided
*$SET BNDGRTID 'YES'

* Uncomment each of the next 2 lines to generate special EPS&P fixed bounds override upper bounds
$SET BD1 'UP';
$SET BD2 'FX';

```

To simplify the handling of Data Parameters that are Bounds, it is recommended that the user observes the following “rules” when specifying the data value for a TID Bound Data Parameter instance, or the time series of data values for a TS Bound Data Parameter instance:

4. For a TID Bound Data Parameter, always enter an explicit (non-negative) numeric value in the data field. That is, do not leave the data field blank.
5. For a TS Bound Data Parameter, do not have blank data fields interspersed between data fields that contain explicit (non-negative) numeric values. So for example, do not specify a BOUND(BD) parameter instance as follows:

Scenario	Parameter	Region	Technology	Commodity	Bound	1990	2000	2010	2020
BASE	BOUND(BD)	? UTOPIA	CHE	-	UP	100.0000		200.0000	

Here the blank data field for period 2000 falls between the data fields for periods 1990 and 2010 that contain explicit numeric values of 100 and 200 respectively. Instead of leaving a blank data field for period 2000, specify an explicit numeric value for the bound in this period – e.g. specify 150 if linear interpolation is appropriate. (The blank data field for the final period 2020 is OK because it does not fall between two data fields that contain explicit numeric values.)

Scenario	Parameter	Region	Technology	Commodity	Bound	1990	2000	2010	2020
BASE	BOUND(BD)	? UTOPIA	CHE	-	UP	100.0000	150.0000	200.0000	

Note: The GAMS MARKAL code version 5.7c (and lower) does not interpolate TS Bound Data Parameters. This means that in the example above where the data field for period 2000 is left blank, the BOUND(BD) parameter instance in the model generated by the GAMS MARKAL code will have an upper bound of 100 in 1990, no upper bound (an upper bound of $+\infty$) in 2000, an upper bound of 200 in 2010, and no upper bound (an upper bound of $+\infty$) in 2020.

For a TS Bound Data Parameter, the recommended “rule” may alternatively be stated as follows: the specified time series of data fields should comprise 0 or more consecutive blank data fields, followed by 1 or more consecutive data fields that contain explicit numeric values, followed by 0 or more consecutive blank data fields. (In the screen snapshot immediately above, there are 0 blank data fields followed by 3 consecutive data fields that contain explicit numeric values, followed by 1 blank data field.)

5.4.3.1.2 Bound type of NON

Apart from the standard bound types of LO, FX and UP, ANSWER also provides a bound type of NON. This bound type provides a mechanism for switching off a Bound Data Parameter instance while retaining it in the database. (When the GAMS MARKAL model run occurs, any Bound Data Parameter instances with a bound type of NON that occur in the DD or DDS files that ANSWER’s Run Model facility generates will be ignored.)

Switching a Bound Data Parameter from LO or FX or UP to NON is most easily done by using direct cell editing. To subsequently reactivate the Bound, simply use direct cell editing to change the bound type from NON back to whichever of LO or FX or UP is desired.

It is important to note that specifying a bound type of NON for a Bound Data Parameter instance switches off only that particular Bound Data Parameter instance, and does not

switch off other LO/FX/UP Bound Data Parameter instances that may be specified for the same Bound Data Parameter.

5.4.3.2 RAT__RHS Parameter in ANSWER

In ANSWER, there are similarities and important differences between the treatment of the RAT__RHS Data Parameter (used to specify the type and right hand side (RHS) for a User-Defined Constraint) and the treatment of bounds for Time Series (TS) Data Parameters:

A bound of LO for the RAT__RHS Data Parameter specifies a \geq User-Defined Constraint.

A bound of FX for the RAT__RHS Data Parameter specifies an $=$ User-Defined Constraint.

A bound of UP for the RAT__RHS Data Parameter specifies a \leq User-Defined Constraint.

A bound of NON for the RAT__RHS Data Parameter specifies a non-binding User-Defined Constraint. (A GAMS MARKAL model run that involves a non-binding User-Defined Constraint returns the level of the constraint in each time period and this information may be valuable to the user.)

5.4.3.2.1 Handling of RAT__RHS Parameter in ANSWER

1. A difference between the handling of the RAT__RHS Data Parameter and a TS Bound Data Parameter that it is important to be aware of, is that only a single RAT__RHS Data Parameter instance should be associated with each User-Defined Constraint. That is, a given User-Defined Constraint should have just a single RAT__RHS Data Parameter instance associated with it: either a LO, or an FX, or an UP, or a NON. (Ideally ANSWER would prevent the user from associating several RAT__RHS Data Parameter instances with a User-Defined Constraint, but it does not.)
2. To simplify the handling of the RAT__RHS Data Parameter, it is recommended that the user always enters an explicit numeric value in every data field. That is, it is recommended that the user enters an explicit numeric value in every time period, and does not leave a blank in any time period.
3. If, contrary to the recommendation in point 2 above, a RAT__RHS Data Parameter with a bound type of FX or UP does contain a blank data field, then what happens in the GAMS MARKAL model run depends on the "Run, Mapping of Nulls to GAMS DD..." settings for Fixed Bounds and Upper Bounds:
 - i. If ANSWER's default "Mapping of Nulls to GAMS DD..." settings are in effect (namely mapping blanks (nulls) to +INF), no constraint is generated in the corresponding period in the model that the GAMS MARKAL code generates.
 - ii. If the common alternative to ANSWER's default "Mapping of Nulls to GAMS DD..." settings are in effect (namely mapping blanks (nulls) to spaces), the situation is a little more complicated: the RAT__RHS Data Parameter is interpolated by the GAMS MARKAL code, and so this interpolation will cause any blank data fields that are interspersed between data fields that contain explicit numeric values to themselves be assigned a numeric value. But any blank data field that is not interspersed between data fields that contain explicit numeric values will remain blank, and interpreted by the GAMS MARKAL code as zero.
4. Where explicit numeric data values are specified for a RAT__RHS Data Parameter, it is allowable (although unusual) to specify negative values.

5.4.3.2.2 Bound type of NON

As has already been noted above, ANSWER and the GAMS MARKAL code provide for a bound type of NON to be associated with a RAT__RHS Data Parameter, and a non-binding equation is generated in the MARKAL model formulation for each time period. Since the user specifying a non-binding User-Defined Constraint is usually interested in the level of the constraint in each time period, it is customary where the bound type is NON that the RAT__RHS Data Parameter will have data values that are all zeroes.

5.4.4 Mathematical functions for data entry

ANSWER incorporates a number of mathematical functions to speed the data entry and edit operation in the time series data and to reduce errors in data transfer. These functions are:

Functions	Help
Extend Constant	F2
Linear Interpolate	F3
Linear Extrapolate	F4
Geometric Interpolate	F5
Geometric Extrapolate	F6
Geometric Extrapolate...	F7
Multiply by Constant...	F8
Divide by Constant...	F9
Add Constant...	F11

Two different modes of operation are available to the user for invoking a mathematical function:

- Mode 1. the user enters the necessary data, highlights the adjacent data fields in a row (or rows) of the Time Series data spread, and then invokes the desired mathematical function. These fields may be anywhere within the time horizon
- Mode 2. the user enters the necessary data, and then immediately invokes the desired mathematical function. There is no need to highlight the data fields that are going to be affected. In this mode, only the active row is affected, and the general rule is that all data fields from the currently active field to the end of the time horizon will be affected.

In general, the second mode of operation is more efficient (fewer keystrokes) for data entry in a single row (e.g. the Add row) than the first mode.

For the purpose of describing how the mathematical functions work, we will assume that we are dealing with just a single Data Parameter row

- Mode 1. assume that the highlighted fields are numbered 1, 2, ..., N
- Mode 2. the general rule is that the currently active field is numbered 1 and that the last field in the time horizon is numbered N, although there are some exceptions which will be dealt with as we consider each function in turn.

Assume that the values in these fields before the mathematical function is applied are $a(1)$, $a(2)$, ..., $a(N)$.

Let $anew(1)$, $anew(2)$, ..., $anew(N)$ denote the values in these fields after a mathematical function has been applied. (Note that what we call field 1 is the first field highlighted by the user (Mode 1) or the currently active field (Mode 2). It is not necessarily the field corresponding to the first time period.)

5.4.4.1 Extend Constant (F2)

The value $a(1)$ in field 1 is extended to each of field 2, ..., N, overwriting any values that may already be present in fields 2, ..., N. Thus we have:

$$\begin{aligned} anew(1) &= a(1), \\ anew(n) &= a(1) \text{ for } n=2, \dots, N \end{aligned}$$

Mode 1

To invoke the Extend Constant function

1. Enter the data into the first data field in the series.
2. Click on the left mouse key and highlight the required consecutive data fields (shown below).

BASE	DEMAND	? UTOPIA	CH	5.0000		
------	--------	----------	----	--------	--	--

3. Press the **F2** key, or click on **Functions** in the menu bar and choose **Extend Constant** in the drop menu.
4. The calculated data (in this example, 5.0000|5.0000) is immediately saved to the Database and displayed in the Parameter spread.

Mode 2

The currently active field is numbered 1 and that the last field in the time horizon is numbered N.

To invoke the Extend Constant function

1. Enter the data (in this example, 5.0000) into the first data field in the series, but do not press the **Tab** or **Enter** key.

	BASE	DEMAND	?	UTOPIA	CH	5.0000		
--	------	--------	---	--------	----	--------	--	--

2. Press the **F2** key.
3. The calculated data (in this example, 5.0000|5.0000) is immediately saved to the Database and displayed in the Parameter spread.

5.4.4.2 Linear Interpolate (F3)

Linear interpolation is carried out between the value $a(1)$ in field 1 and the value $a(N)$ in field N, overwriting any values that may already be present in fields 2, ..., N-1. Thus the common increment I between values in adjacent fields is given by:

$$I = [a(N) - a(1) / (N - 1)]$$

and we have:

$$anew(1) = a(1), anew(N) = a(N),$$

$$anew(n) = a(1) + (n-1)I \text{ for } n=2, \dots, N-1$$

Mode 1

To invoke the Linear Interpolate function

1. Enter the data into the first and last data field in the series.
2. Click on the left mouse key and highlight the required consecutive data fields (shown below)

	BASE	DEMAND	?	UTOPIA	CH	5.0000		7.0000
--	------	--------	---	--------	----	--------	--	--------

3. Press the **F3** key, or click on **Functions** in the menu bar and choose **Linear Interpolate** in the drop menu.
4. The calculated data (in this example, 6.0000) is immediately saved to the Database and displayed in the Parameter spread.

Mode 2

The linear interpolate function works somewhat differently in Mode 2 from the other functions. For the interpolate functions, assume that the currently active field is numbered N (this field is not necessarily at the end of the time horizon). Also, assume that the first non-null field preceding the currently active field is numbered 1. Then linear interpolate is carried out according to the formula above.

To invoke the Linear Interpolate function

1. Enter the data (in this example, 5.0000) into the first data field in the series, tab over intervening null fields, and enter data (in this example, 7.0000) into the last data field. Do not press the **Tab** or **Enter** key.

	BASE	DEMAND	?	UTOPIA	CH	5.0000		7.0000
--	------	--------	---	--------	----	--------	--	--------

2. Press the **F3** key.
3. The calculated data (in this example, 6.0000) is immediately saved to the Database and displayed in the Parameter spread.

5.4.4.3 Linear Extrapolate (F4)

Linear extrapolation is carried out from the value $a(1)$ in field 1 and the value $a(2)$ in field 2, overwriting any values that may already be present in fields 3, ..., N. Thus the common increment I between values in adjacent fields is given by:

$$I = [a(2) - a(1)]$$

and we have:

$$anew(1) = a(1), anew(2) = a(2),$$

$$anew(n) = a(1) + (n-1)I \text{ for } n=3, \dots, N$$

Mode 1

To invoke the Linear Extrapolate function

1. Enter the data into the first and second data field in the series.
2. Click on the left mouse key and highlight the required consecutive data fields (shown below).

	BASE	DEMAND	?	UTOPIA	CH	5.0000	7.0000	
--	------	--------	---	--------	----	--------	--------	--

3. Press the **F4** key, or click on **F**unctions in the menu bar and choose **L**inear **E**xtrapolate in the drop menu.
4. The calculated data (in this example, 9.0000) is immediately saved to the Database and displayed in the Parameter spread.

Mode 2

The linear extrapolate function assumes that the currently active field is numbered 2, with the immediately preceding field numbered 1. Then linear extrapolate is carried out according to the formula above.

To invoke the Linear Extrapolate function

1. Enter the data (in this example, 5.0000) into the first data field in the series and then (in this example, 7.0000) into the second data field. Do not press the **Tab** or **Enter** key.

	BASE	DEMAND	?	UTOPIA	CH	5.0000	7.0000	
--	------	--------	---	--------	----	--------	--------	--

2. Press the **F4** key.
3. The calculated data (in this example, 9.0000) is immediately saved to the Database and displayed in the Parameter spread.

5.4.4.4 Geometric Interpolate (F5)

Geometric interpolation is carried out between the value $a(1)$ in field 1 and the value $a(N)$ in field N, overwriting any values that may already be present in fields 2, ..., N-1. Geometric interpolation means the determination of values $anew(2)$, ..., $anew(N-1)$ such that the numbers $a(1)$, $anew(2)$, ..., $anew(N-1)$, $a(N)$ form a geometric progression. Thus the common ratio R between values in adjacent fields is given by:

$$R = [a(N)/a(1)]^{1/(N-1)}$$

and we have:

$$anew(1) = a(1), anew(N) = a(N),$$

$$anew(n) = a(1) R^{n-1} \text{ for } n=2, \dots, N-1$$

Mode 1

To invoke the Geometric Interpolate function

1. Enter the data into the first and last data field in the series.
2. Click on the left mouse key and highlight the required consecutive data fields (shown below).

	BASE	DEMAND	?	UTOPIA	CH	5.0000		7.0000
--	------	--------	---	--------	----	--------	--	--------

3. Press the **F5** key, or click on **Functions** in the menu bar and choose **Geometric Interpolate** in the drop menu.
4. The calculated data (in this example, 5.9161) is immediately saved to the Database and displayed in the Parameter spread.

Mode 2

The geometric interpolate function works somewhat differently in Mode 2 from the other functions. For the interpolate functions, assume that the currently active field is numbered N (this field is not necessarily at the end of the time horizon). Also, assume that the first non-null field preceding the currently active field is numbered 1. Then geometric interpolate is carried out according to the formula above.

To invoke the Geometric Interpolate function

1. Enter the data (in this example, 5.0000) into the first data field in the series, tab over intervening null fields, and enter data (in this example, 7.0000) into the last data field. Do not press the **Tab** or **Enter** key.

	BASE	DEMAND	?	UTOPIA	CH	5.0000		7.0000
--	------	--------	---	--------	----	--------	--	--------

2. Press the **F5** key.
3. The calculated data (in this example, 5.9161) is immediately saved to the Database and displayed in the Parameter spread.

5.4.4.5 Geometric Extrapolate (F6)

Geometric extrapolation is carried out from the value $a(1)$ in field 1 and the value $a(2)$ in field 2, overwriting any values that may already be present in fields 3, ..., N. Geometric extrapolation means the determination of values $anew(3)$, ..., $anew(N)$ such that the numbers $a(1)$, $a(2)$, $anew(3)$, ..., $anew(N)$ form a geometric progression. Thus the common ratio R between values in adjacent fields is given by:

$$R = [a(2)/a(1)]$$

and we have:

$$anew(1) = a(1), anew(2) = a(2),$$

$$anew(n) = a(1) R^{n-1} \text{ for } n=3, \dots, N$$

Mode 1

To invoke the Geometric Extrapolate function

1. Enter the data into the first and second data field in the series.
2. Click on the left mouse key and highlight the required consecutive data fields (shown below).

	BASE	DEMAND	?	UTOPIA	CH	5.0000	7.0000	
--	------	--------	---	--------	----	--------	--------	--

3. Press the **F6** key, or click on **Functions** in the menu bar and choose **Geometric Extrapolate** in the drop menu.
4. The calculated data (in this example, 9.8000) is immediately saved to the Database and displayed in the Parameter spread.

Mode 2

The geometric extrapolate function assumes that the currently active field is numbered 2, with the immediately preceding field numbered 1. Then geometric extrapolate is carried out according to the formula above.

To invoke the Geometric Extrapolate function

1. Enter the data (in this example, 5.0000) into the first data field in the series and then (in this example, 7.0000) into the second data field. Do not press the **Tab** or **Enter** key.

	BASE	DEMAND	?	UTOPIA	CH	5.0000	7.0000	
--	------	--------	---	--------	----	--------	--------	--

2. Press the **F6** key.
3. The calculated data (in this example, 9.8000) is immediately saved to the Database and displayed in the Parameter spread.

5.4.4.6 Geometric Extrapolate with user supplied annual percentage increase (F7)

In this variant of geometric extrapolation, the user supplied annual percentage increase S is used to determine the common ratio between values in adjacent columns, and values $anew(2)$, ..., $anew(N)$ are determined such that the numbers $a(1)$, $anew(2)$, ..., $anew(N)$ form a geometric progression. The common ratio R between values in adjacent columns is determined as:

$$R = [1 + S/100]^{NYRSPER}, \text{ where } NYRSPER \text{ is the number of years in each time period}$$

and we have:

$$anew(1) = a(1),$$

$$anew(n) = a(1) R^{n-1} \text{ for } n=2, \dots, N$$

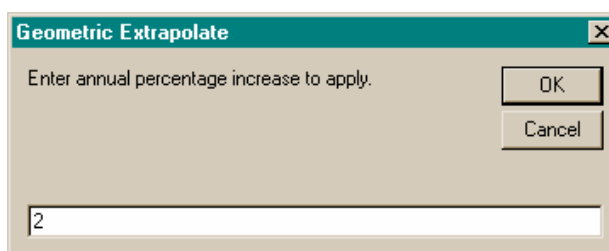
Mode 1

To invoke the Geometric Extrapolate... function

1. Enter the data into the first data field in the series.
2. Click on the left mouse key and highlight the required consecutive data fields (shown below).

	BASE	DEMAND	?	UTOPIA	CH	5.0000		
--	------	--------	---	--------	----	--------	--	--

3. Press the **F7** key, or click on **Functions** in the menu bar and choose **Geometric Extrapolate...** in the drop menu.
4. Enter the required annual percentage increase in the Geometric Extrapolate dialogue box (shown below), and click **[OK]**.



The dialog box titled "Geometric Extrapolate" has a close button (X) in the top right corner. It contains the text "Enter annual percentage increase to apply." followed by two buttons: "OK" and "Cancel". Below this text is a text input field containing the number "2".

5. The calculated data (being 6.0950/7.4297, based on an annual percentage increase of 2%) is immediately saved to the Database and displayed in the Parameter spread.

Mode 2

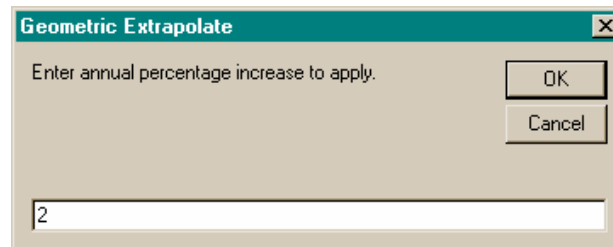
The currently active field is numbered 1 and the last field in the time horizon is numbered N .

To invoke the Geometric Extrapolate... function

1. Enter the data (in this example, 5.0000) into the first data field in the series. Do not press the **Tab** or **Enter** key.

	BASE	DEMAND	?	UTOPIA	CH	5.0000		
--	------	--------	---	--------	----	--------	--	--

- Press the **F7** key.
- Enter the required annual percentage increase in the Geometric Extrapolate dialogue box (shown below), and click **[OK]**.



Geometric Extrapolate

Enter annual percentage increase to apply.

OK

Cancel

2

- The calculated data (being 6.0950|7.4297, based on an annual percentage increase of 2%) is immediately saved to the Database and displayed in the Parameter spread.

5.4.4.7 Multiply by a Constant (F8)

The values in each of columns 1, 2, ..., N are multiplied by the user specified constant C, and we have:

$$a_{\text{new}}(n) = a(n) * C \text{ for } n=1, 2, \dots, N$$

In the instance of a null field, this function will not create a data entry.

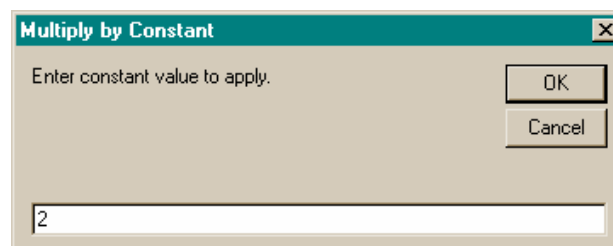
Mode 1

To invoke the Multiply by a Constant... function

- Click on the left mouse key and highlight the required consecutive data fields (shown below) containing existing data.

	BASE	DEMAND	?	UTOPIA	CH	5.0000	6.0000	7.0000
--	------	--------	---	--------	----	--------	--------	--------

- Press the **F8** key, or click on **Functions** in the menu bar and choose **Multiply by a Constant...** in the drop menu.
- Enter the required constant number in the Multiply by a Constant dialogue box (shown below), and click **[OK]**.



Multiply by Constant

Enter constant value to apply.

OK

Cancel

2

- The calculated data (being 10.0000|12.0000|14.0000, based on a multiplication by 2) is immediately saved to the Database and displayed in the Parameter spread.

Mode 2

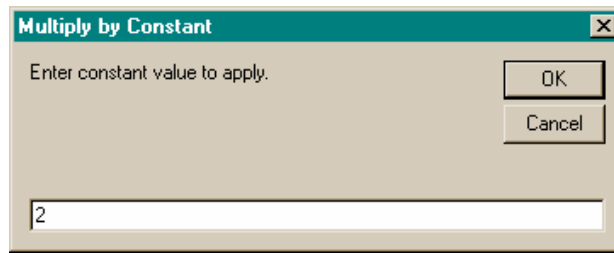
The currently active field is numbered 1 and the last field in the time horizon is numbered N.

To invoke the Multiply by a Constant... function

1. Select the active data field containing existing data (in this example, 5.0000).

	BASE	DEMAND	?	UTOPIA	CH	5.0000	6.0000	7.0000
--	------	--------	---	--------	----	--------	--------	--------

2. Press the **F8** key.
3. Enter the required constant number in the Multiply by a Constant dialogue box (shown below), and click **[OK]**.



A dialog box titled "Multiply by Constant" with a close button (X). It contains the text "Enter constant value to apply." and two buttons: "OK" and "Cancel". Below the text is a text input field containing the number "2".

4. The calculated data (being 10.0000|12.000|14.0000, based on a multiplication by 2) is immediately saved to the Database and displayed in the Parameter spread.

5.4.4.8 Divide by a Constant (F9)

The values in each of columns 1, 2, ..., N are divided by the user specified constant C, and we have:

$$anew(n) = a(n) / C \text{ for } n=1, 2, \dots, N$$

In the instance of a null field, this function will not create a data entry.

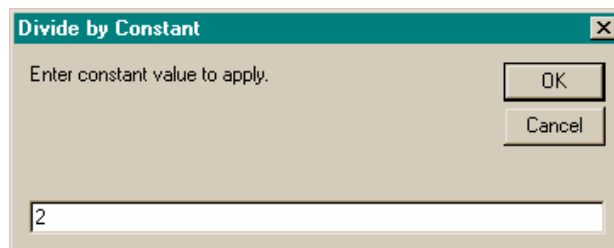
Mode 1

To invoke the Divide by a Constant... function

1. Click on the left mouse key and highlight the required consecutive data fields (shown below) containing existing data.

	BASE	DEMAND	?	UTOPIA	CH	5.0000	6.0000	7.0000
--	------	--------	---	--------	----	--------	--------	--------

2. Press the **F9** key, or click on **Functions** in the menu bar and choose **Divide by a Constant...** in the drop menu.
3. Enter the required constant number in the Divide by a Constant dialogue box (shown below), and click **[OK]**.



A dialog box titled "Divide by Constant" with a close button (X). It contains the text "Enter constant value to apply." and two buttons: "OK" and "Cancel". Below the text is a text input field containing the number "2".

4. The calculated data (being 2.5000|3.0000|3.5000, based on a division by 2) is immediately saved to the Database and displayed in the Parameter spread.

Mode 2

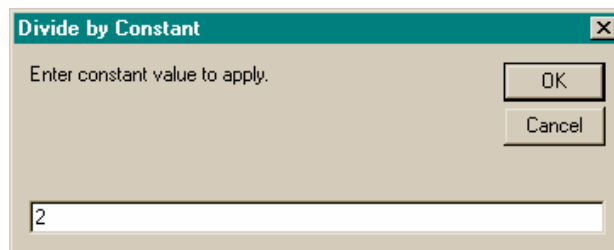
The currently active field is numbered 1 and the last field in the time horizon is numbered N.

To invoke the Divide by a Constant... function

1. Select the active data field containing existing data (in this example, 5.0000).

	BASE	DEMAND	?	UTOPIA	CH	5.0000	6.0000	7.0000
--	------	--------	---	--------	----	--------	--------	--------

2. Press the **F9** key.
3. Enter the required constant number in the Divide by a Constant dialogue box (shown below), and click **[OK]**.



A dialog box titled "Divide by Constant" with a close button (X) in the top right corner. It contains the text "Enter constant value to apply." followed by two buttons: "OK" and "Cancel". Below the text is a text input field containing the number "2".

4. The calculated data (being 2.5000|3.0000|3.5000, based on a division by 2) is immediately saved to the Database and displayed in the Parameter spread.

5.4.4.9 Add a Constant (F11)

The values in each of columns 1, 2, ..., N are increased by the user specified constant C, and we have:

$$a_{new}(n) = a(n) + C \text{ for } n=1, 2, \dots, N$$

In the instance of a null field, this function will not create a data entry.

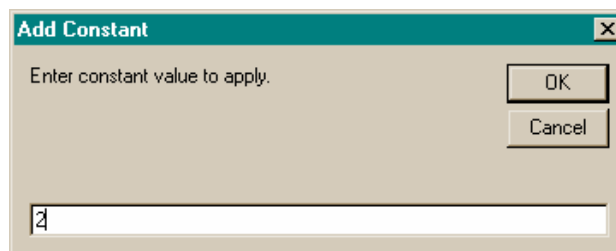
Mode 1

To invoke the Add Constant... function

1. Click on the left mouse key and highlight the required consecutive data fields (shown below) containing existing data.

	BASE	DEMAND	?	UTOPIA	CH	5.0000	6.0000	7.0000
--	------	--------	---	--------	----	--------	--------	--------

2. Press the **F11** key, or click on **F**unctions in the menu bar and choose **A**dd Constant... in the drop menu.
3. Enter the required constant number in the Add Constant dialogue box (shown below), and click **[OK]**.



A dialog box titled "Add Constant" with a close button (X) in the top right corner. It contains the text "Enter constant value to apply." followed by two buttons: "OK" and "Cancel". Below the text is a text input field containing the number "2".

4. The calculated data (being 7.0000|8.0000|9.0000, based on an addition of 2) is immediately saved to the Database and displayed in the Parameter spread.

Mode 2

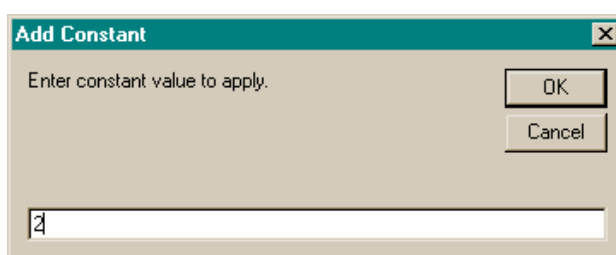
The currently active field is numbered 1 and the last field in the time horizon is numbered N.

To invoke the Add Constant... function

1. Select the active data field containing existing data (in this example, 5.0000).

	BASE	DEMAND	?	UTOPIA	CH	5.0000	6.0000	7.0000
--	------	--------	---	--------	----	--------	--------	--------

2. Press the **F11** key.
3. Enter the required constant number in the Add Constant dialogue box (shown below), and click **[OK]**.



4. The calculated data (being 7.0000|8.0000|9.0000, based on an addition of 2) is immediately saved to the Database and displayed in the Parameter spread.

5.5 Printing Item details and data

ANSWER provides facilities for producing text files of the Items' details and their data for each Component or for a subset of a Component. These ANSWER generated text files are exported to WordPad for viewing/editing on-line and printing by the user as required.

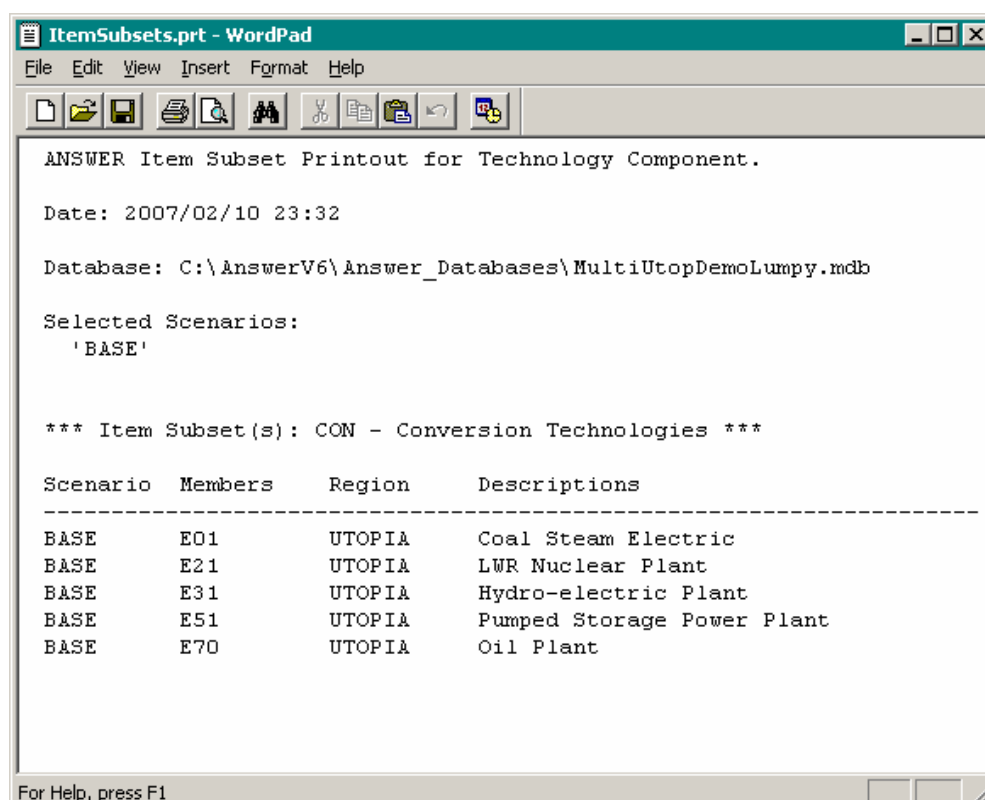
5.5.1 Print Item Subsets

This facility produces a WordPad report listing the Name, Region and Description for every Item that appears in the Items listview for the current Component tab. The WordPad report is created as a text file named 'ItemSubsets.prt' in the C:\AnswerV6\Ans_WrkPRD folder.

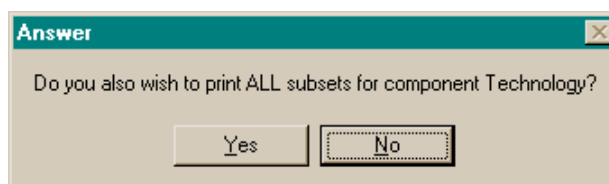
To create this WordPad report:

1. Click on the required Component tab. In the following examples, the Technology Component has been selected.
2. Use the Subset Items facility to limit the Items that appear in the Items listview to the subset that you wish to appear in the report. For example, you may wish to limit to 'CON - Conversion Technologies'.
3. Use the 'Regions...' button to further limit the Items that appear in the Items listview to particular region(s) that you wish to appear in the report. For example, you may wish to limit to just the UTOPIA region.
3. Click on **File** in the menu bar and choose **Print Item Subsets...** in the drop menu.
- 4a. If you elected to display for a subset of a Component, ANSWER will immediately display the report in WordPad for editing and/or printing.

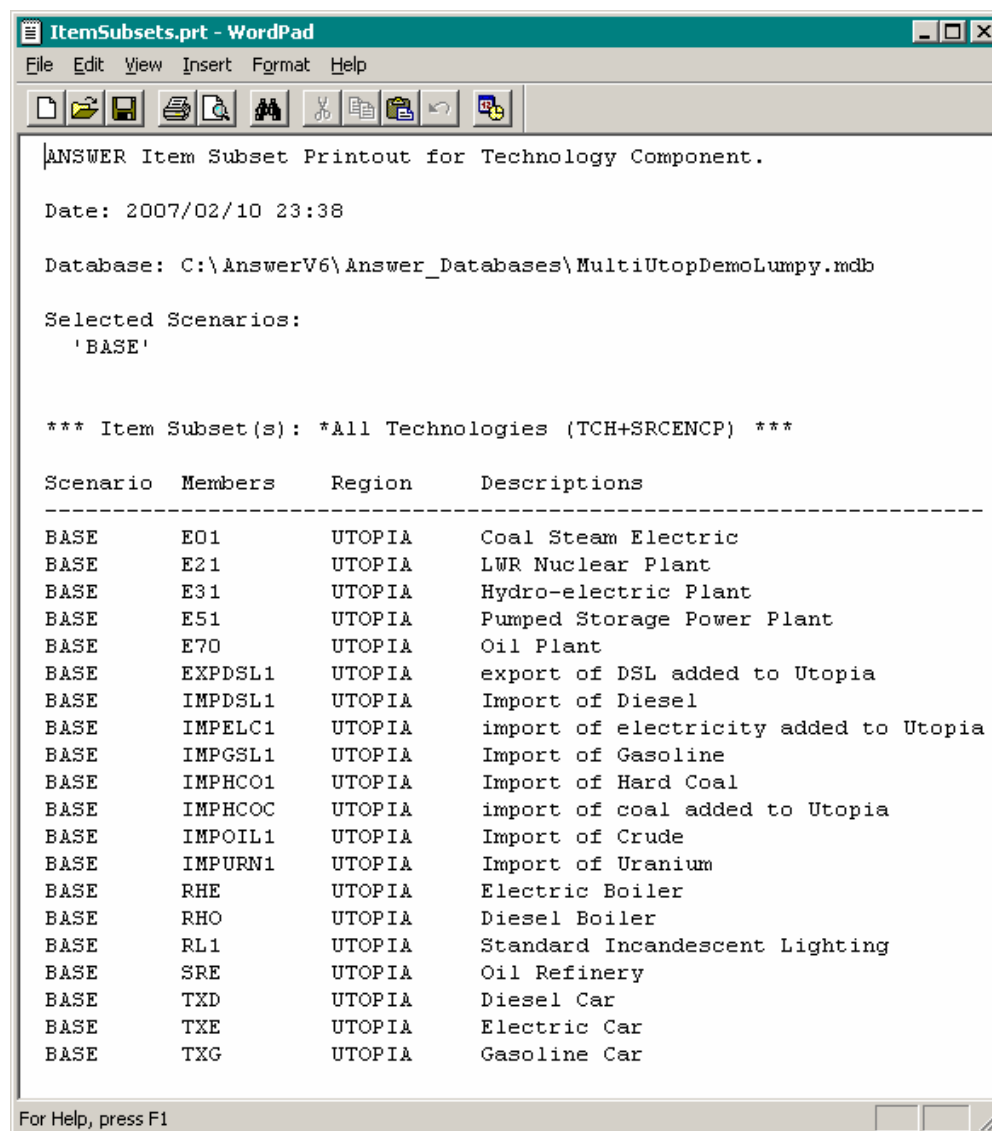
In the example below, the 'CON - Conversion Technologies' subset of the Technology Component was selected, and region was limited to just UTOPIA.



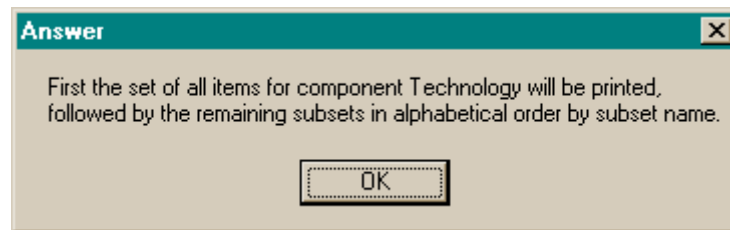
- 5b. If you elected to display all Items of a Component, you will be prompted with the option of also viewing/printing not just all Items, but also printing Items by their subset groups as an addition to the report.



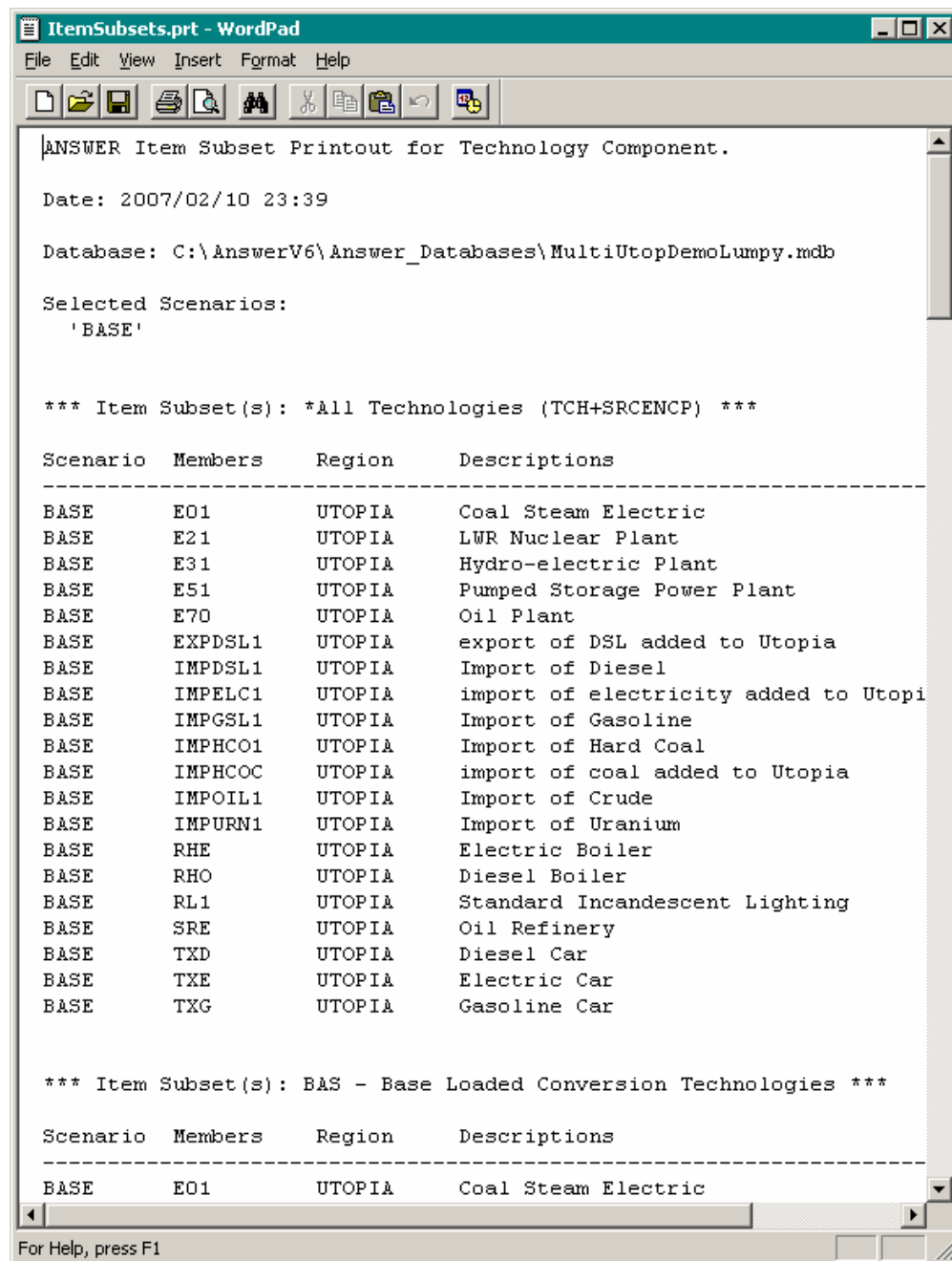
- 5b.i If you choose **[No]**, the following WordPad report will appear for viewing/printing:



5b.ii. If you choose **[Yes]**, the following information message will be displayed:



When you click on **[OK]** the WordPad report will appear for viewing/printing:




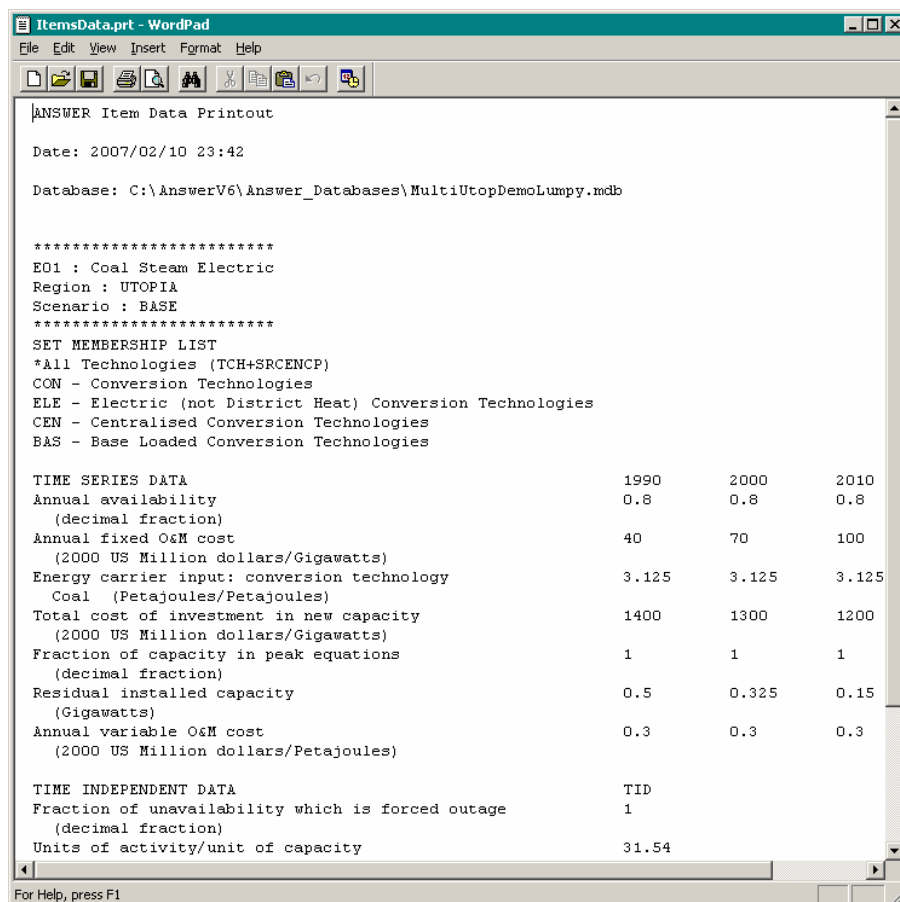
This can be a lengthy report, since it lists the Items in every Technology subset, of which 'BAS – Base Loaded Conversion Technologies' is just the first.

5.5.2 Print Item(s) Data

This facility produces a WordPad report listing the Scenario, Name, Region, Description, Set Memberships, Time Series Data, Time Independent Data, Units and Comment (if any) for every selected Item that appears in the Items listview for the current Component tab. The WordPad report is created as a text file named 'ItemsData.prt' in the C:\AnswerV6\Ans_WrkPRD folder.

To create this WordPad report:

1. Click on the required Component tab. In the following example, the Technology Component has been selected.
2. Use the Subset Items facility to limit the Items that appear in the Items listview to the subset that you wish to appear in the report. For example, you may wish to limit to 'CON - Conversion Technologies'.
3. Use the 'Regions...' button to further limit the Items that appear in the Items listview to particular region(s) that you wish to appear in the report. For example, you may wish to limit to just the UTOPIA region.
4. Select the required Item or Items. To select more than a single Item, multi-select Items in the Items listview, or use the **[Select All Items]** button  in the Item Management sub-region to select all Items. In the following example, just the single Technology Item E01 has been selected.
5. Click on **File** in the menu bar and choose **Print Item(s) Data ...** in the drop menu.
6. ANSWER will immediately display the report in WordPad for editing and/or printing.



Section Six: Running the Model

This Section discusses various aspects of running the model including:

- . The 'Run Model' facility for initiating a single model run.
- . The detection and correction of inconsistencies and errors that may arise during a model run, including using the QA_CHECK.LOG file to detect data inconsistencies and the <Casename>.LST file to investigate GAMS compilation/execution errors and Run Model status of Infeasible or Unbounded.
- . The 'Batch Run' facility for batching up a number of model runs to be carried out one after the other.
- . The 'Batch Management' facility for storing Batches of Runs inside an ANSWER Database.

Before attempting to carry out a model run, ensure that you have installed GAMS, and in particular ensure that the PATH includes your GAMS installation directory. (See section 1.4.3 'Installation of GAMS'.)

By default ANSWERv6 assumes that you are running a fairly recent version of GAMS – GAMS version 20.6 or higher. If this is the case, then the GAMS runs that are initiated by ANSWER will be carried out using assorted CMD files that are contained in the GAMS Source folder, and you can skip the following paragraph.

If you are running an older version of GAMS (GAMS version 20.5 or earlier) then you need to inform ANSWER that the GAMS runs should be carried out using assorted BAT files in the GAMS Source folder. To do this, open ANSWERv6, choose 'Run, Mode (BAT or CMD)' from the menu bar, and select 'BAT' from the submenu. This needs to be done once only, since on exiting ANSWER, the choice of BAT mode is written to the registry and used as the default the next time ANSWERv6 is opened.


If you subsequently upgrade your GAMS to a more recent version (version 20.6 or higher), then choose 'Run, Mode (BAT or CMD)' from the menu bar and select 'CMD' from the submenu.

Also, you should read section 6.1.16 'What happens when the same parameter instance is specified in several scenarios? – the effect of 'Run, Mapping of Nulls to GAMS DD' settings for bound parameters', and ensure that you have appropriate mappings specified for the 'Run, Mapping of Nulls to GAMS DD' facility.

6.1 The Run Model Facility

ANSWER's Run Model facility allows the user considerable flexibility in carrying out model runs. In particular, the run model facility allows the user to carry out model runs in which the BASE Scenario is varied by not just one, but several non-BASE Scenarios. The user also has control over the Name and Description of the model run, the MARKAL Model Variant to be used, the End year, and for a multi-region model the Regions that are to comprise the model run.

To start a model run:

1. If on the Data/Results Screen, return to the Home Screen by clicking on the **[Home Screen]** icon .
2. In the Selected Scenarios display, click on the Scenario that is to be modelled.
3. Click on the **[Run Model...]** button below the Selected Scenarios display, or click on **Run** in the menu bar and choose **Run Model...** in the drop menu.
4. A Run Model dialogue box (shown below) will appear, in which the Model Run details will default to the most recent model run involving the Scenario selected at Step 2. In this case, where a model run is being repeated, and none of the run details require changing, simply click on the **[OK]** button at the bottom right of the form to initiate the model run. See Step 15 below.

Run Model (mode is CMD)

Model Run Details

Name: Edit default name and description of model run (Case), if required Change Run...

Description:

Comment:

Model Variant: Specify Model Variant...

☐ Collapse ☐ Lumpy Investment

Scenarios comprising this run:

Name	Description	Modified
BASE	BASE data for Demo and Utopia models	2004/08/06 12:20
BITRDCOA	bi-lateral trade in coal	2004/08/02 17:11

Display of Scenarios (Base + one or more non-Base Scenarios) comprising the model run

Add... Remove Up Dn Regions...

File Locations

Base Case DD File: Modify...

☒ Solve from scratch ☐ Solve using GAMS Restart

GAMS Restart Files: Modify...

GAMS Save Files: Modify...

Progress

☐ Edit GAMS Control File ☐ Generate Files, Do Not Run ☒ Create Results For Import into ANSWER

☐ Edit Report Directives File ☒ Regenerate Base DD File ☒ Import Results Automatically

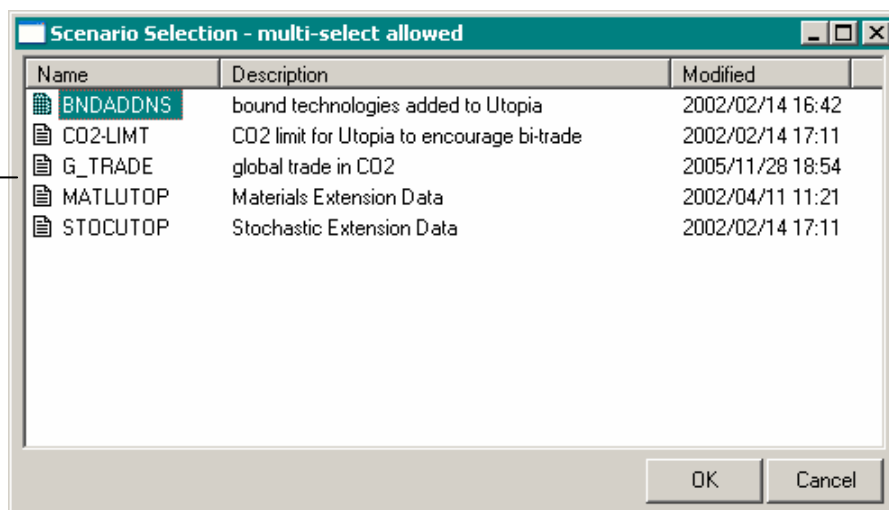
☒ Regenerate Non-Base DD Files ☐ Automatic Repair & Compact after Import

☒ Regenerate Rule-based DDSs OK Cancel

Steps 5-14 discuss each aspect of model run details which may be changed. In particular, steps 9-11 discuss how to specify the non-Base Scenarios which comprise a model run.

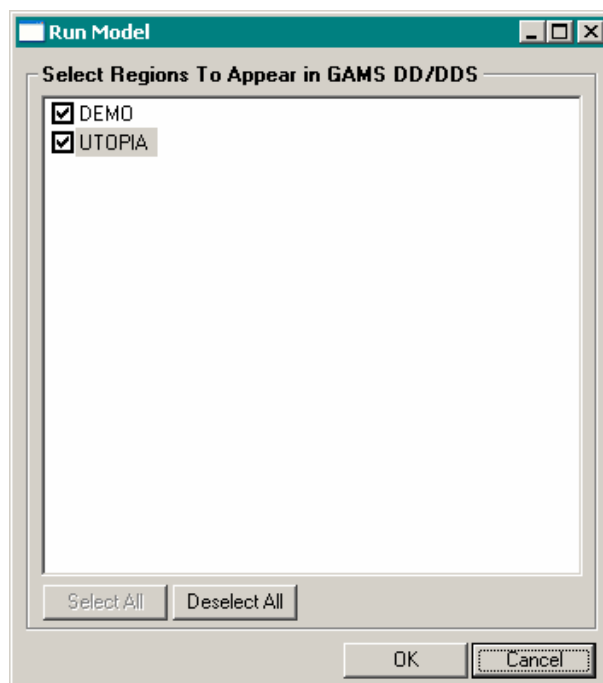
5. To change to a different model run, click on the **[Change Run...]** button, and choose from among the model runs that are currently on-line.
6. Alternatively if desired, edit the Name, Description and Comment associated with the model run.
If you edit the Name, a new Case with this Name will be created when you run the model and the previously existing Case will remain unaltered in the Database. Thus to Copy an existing Case to create a new Case with similar attributes, simply bring up the Case to be copied, and then edit the Name (and Description) and modify other attributes as required.
7. If desired, change the Model Variant. This is most conveniently done by clicking on the **[Specify Model Variant...]** button at the right of the Model Variant combo box. For details, see section 6.1.1 'Model Variant Specification' below. Other settings such as that of the 'Collapse' checkbox, the 'Diff. DMD Costing' combobox and the 'Lumpy Investment' checkbox may also be changed. See sections 6.1.2, 6.1.3 and 6.1.4 below.
8. If desired, change the End year by clicking on the End year combo box and selecting the required year. (The default End year is the Database's last time period.)
9. To select additional Scenarios to comprise the model run (ANSWER allows Base Scenario plus zero or more non-Base Scenarios), click on the **[Add...]** button. The Scenario Selection display (shown below) will show all non-Base Scenarios that can be included in the model run.

Scenario Selection display



Multi-select the required non-Base Scenarios and click on the **[OK]** button. This returns you to the Run Model dialogue box and adds the multi-selected Scenarios to the 'Scenarios comprising this run' listview.

10. To remove a non-Base Scenario which is no longer required for the model run, click on the appropriate non-Base Scenario and click on the **[Remove]** button. Repeat as required.
11. To reorder the selected non-Base Scenarios to determine precedence for overlapping Scenario data during the model run, click on the appropriate non-Base Scenario and click on the **[Up]** or **[Dn]** buttons as required. The non-Base Scenario which is lowest in the order has precedence. See also the discussion in section 6.1.16 'What happens when the same parameter instance is specified in several scenarios?'
12. If desired, change the subset of Regions that will be used for the model run, by clicking on the **[Regions...]** button. This brings up the 'Select Regions To Appear in GAMS DD/DDS' form:



Select the Regions that you wish to be used for the model run, and click on the **[OK]** button.

Note that the initial default for a new Case is all Regions. Note also that if re-running an existing Case, the selected Regions will default to those for the most recent model run of this Case.

- | | | |
|--|---|---|
| <input type="checkbox"/> Edit GAMS Control File | <input type="checkbox"/> Generate Files, Do Not Run | <input checked="" type="checkbox"/> Create Results For Import into ANSWER |
| <input type="checkbox"/> Edit Report Directives File | <input checked="" type="checkbox"/> Regenerate Base DD File | <input checked="" type="checkbox"/> Import Results Automatically |
| | <input checked="" type="checkbox"/> Regenerate Non-Base DDS Files | <input type="checkbox"/> Automatic Repair & Compact after Import |
| | <input checked="" type="checkbox"/> Regenerate Rule-based DDSs | |
| | | <input type="button" value="OK"/> <input type="button" value="Cancel"/> |

Note that the settings of the 'Create Results For Import into ANSWER', 'Import Results Automatically' and 'Automatic Repair & Compact after Import' checkboxes for the Run Model facility are independent of the settings of the checkboxes of the same name in the Batch Run facility.

- Note: Do not close the DOS Window while the GAMS run is occurring!!

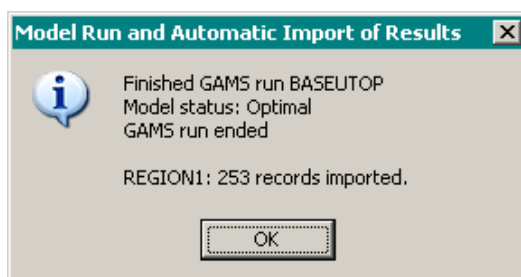
```
C:\WINDOWS\system32\cmd.exe
Optimal solution found.
Objective :      36820.825029


--- Restarting execution
--- Reading solution for model MRK


+++ Run: BASEUTOP Model Status = Optimal +++

--- Putfile ANT C:\AnswerU6\Gams_WrkPRD\TEMP.ANT
--- Putfile OUT C:\AnswerU6\Gams_WrkPRD\TEMP.OUT
--- Putfile END_GAMS C:\AnswerU6\Gams_WrkPRD\END_GAMS.STA
--- Putfile SR C:\AnswerU6\Gams_WrkPRD\STOPRUN.ERR
--- Putfile TRPERR C:\AnswerU6\Gams_WrkPRD\TRPERR.CMD
--- Putfile screen C:\AnswerU6\Gams_WrkPRD\con
--- Putfile UDE C:\AnswerU6\Gams_WrkPRD\solsete.txt
--- Putfile UDS C:\AnswerU6\Gams_WrkPRD\solsets.txt
--- Putfile UD C:\AnswerU6\Gams_WrkPRD\solveda.txt
--- Putfile CLOG C:\AnswerU6\Gams_WrkPRD\CONVERT.LOG
--- Putfile QLOG C:\AnswerU6\Gams_WrkPRD\QA_CHECK.LOG
--- GD\X File C:\AnswerU6\Gams_WrkPRD\Gamssave\BASEUTOP.gdx
*** Status: Normal completion
***
Model status: Optimal
GAMS run ended
***
*
*****
*
*
*
*
*****
*
*
*
*
*****
```

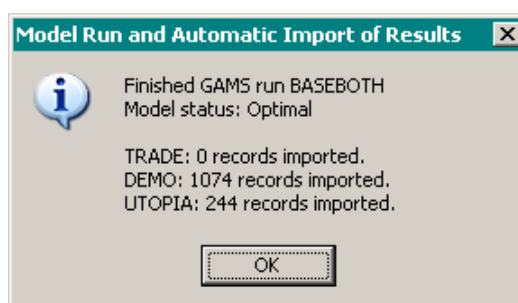
- 17a. When a single region run is completed that reaches an optimal solution, and if the 'Import Results Automatically' checkbox was checked ☒ **Import Results Automatically**, a message box will appear indicating the Name of the run, 'Model status: Optimal', and indicating the number of results records imported into the Database. Click on **[OK]** to close the box.



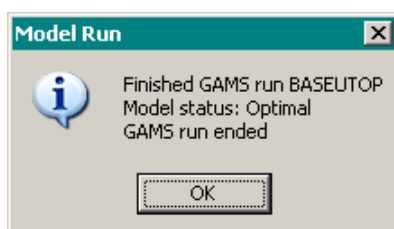
In the Cases display, the Case BASEUTOP will have the following icon  and its Status will be 'Imported...':


Results Management				
Cases:				
Name	Description	Scenario	Created	Status
 BASEUTOP	Utopia Base Model	BASE	2007/02/21 17:45	Imported...


For a multi-region run that reaches an optimal solution (with the 'Import Results Automatically' checkbox checked) there is similar behaviour, with the message box that appears indicating the Name of the run, 'Model status: Optimal', and the number of results records imported for each region:



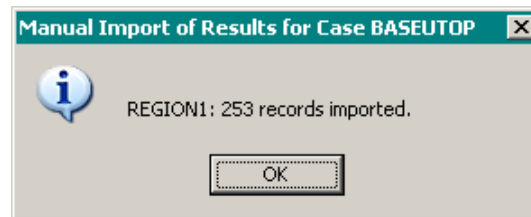
- 17b. When a single region run is completed that reaches an optimal solution, and if the 'Import Results Automatically' checkbox was unchecked ☐ **Import Results Automatically**, a message box will appear indicating the Name of the run and 'Model status: Optimal'. Click on **[OK]** to close the box.



In the Cases display, the Case BASEUTOP will have the following icon  and its Status will be 'Not Imported...':

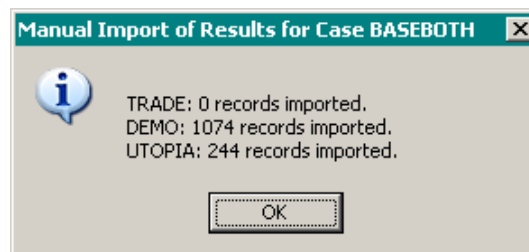
Results Management					
Cases:					
Name	Description	Scenario	Created	Status	
 BASEUTOP	Utopia Base Model	BASE	2007/02/21 18:08	Not Imported...	

To import the results for Case BASEUTOP, ensure that BASEUTOP is the selected Case and click on the **[Import...]** button at the bottom of the Cases listview (or click on **File** in the menu bar and choose **Import** then choose **Case** in the drop menu). A message box will indicate the number of results records imported into the Database. Click on **[OK]** to close the box.



In the Cases display, the Case BASEUTOP will now have the following icon  and its Status will now be 'Imported...'.

For a multi-region run that reaches an optimal solution (with the 'Import Results Automatically' checkbox unchecked) there is similar behaviour to that for a single region run. When the results for the Case are imported the message box that appears indicates the number of results records imported for each region:




18. It is possible that a model run might not terminate with 'Model status: Optimal'. Instead a run might terminate with a GAMS execution error (or much less commonly with a GAMS compilation error) or with a Model Status of Infeasible or Unbounded. Any of these errors is an indication of a data omission or error, whose source will need to be investigated – see Section 6.2 'Run Model Detection and Correction of Inconsistencies and Errors'.

6.1.1 Model Variant Specification

Since the creation of the original (standard) MARKAL model in the early 1980s, ETSAP has developed a number of MARKAL model variants that extend the standard MARKAL modelling framework. Various combinations of the extended variants are possible, such that there are now over 180 possible combinations of variants.

To specify which particular combination of variants, or **Model Variant**, is to be used:

1. Click on the  button at the right of the Model Variant combo box, to bring up the 'Model Variant Specification' form, as follows:

Model Variant Specification

To specify the Model Variant, first select the Primary Variant. Then select Additions to the Primary Variant. Note that the permitted Additions will change dynamically depending upon the Primary Variant that is selected. Also, some combinations of Additions are not permitted.

Primary Variant

☒ **MARKAL**

☐ ELASTIC DEMAND

☐ MARKAL-MACRO

☐ MARKAL-MICRO

Additions to Primary Variant

☒ (None) ☐ Damage LP ☐ Damage NLP

☒ (None) ☐ Elastic Demand - Income

☒ (None) ☐ Endogenous Technology Learning

☐ (None) ☒ **Multi-Region**

☒ (None) ☐ SAGE (Time-stepped solve)

☒ (None) ☐ Stochastic ☐ Stochastic - Risk

☒ (None) ☐ Goal Programming

Optimizer

LP

Model Variant Description

MARKAL + MultiRegion

OK Cancel

- First, select which Primary Variant you wish to use by clicking on the appropriate radio button in the 'Primary Variant' frame.
- Note that the permitted Additions to the Primary Variant will change dynamically depending upon the Primary Variant that you select. For example, if MARKAL is the selected Primary Variant, then all other Additions to the Primary Variant except Elastic Demand-Income are permitted. Whereas if MARKAL-MACRO is the selected Primary Variant, then Damage LP and Multi-Region are the only permitted Additions.
- Then select which Additions to the Primary Variant you wish to use by clicking on the appropriate radio button(s) in the 'Additions to the Primary Variant' frame. Above, Multi-Region has been selected as the single addition to the Primary Variant of MARKAL.
- Note that the 'Model Variant Description' textbox adjusts automatically as you change the Primary Variant or Additions to Primary Variant that are selected, as does the 'Optimizer' textbox that indicates the type of optimizer (LP or NLP or MIP) that is needed for the selected Model Variant.
- Click on the **[OK]** button once you have selected the Additions to the Primary Variant that you require.
- Finally, note that some combinations of Additions to the Primary Variant are not permitted. For example, suppose that MARKAL is the selected Primary Variant, that Endogenous Technology Learning and Multi-Region have already been selected as Additions, and that SAGE (Time-stepped solve) is then selected as a further Addition. The 'Model Variant Specification' form will now appear as follows:

Model Variant Specification

To specify the Model Variant, first select the Primary Variant. Then select Additions to the Primary Variant. Note that the permitted Additions will change dynamically depending upon the Primary Variant that is selected. Also, some combinations of Additions are not permitted.

Primary Variant

- ☒ MARKAL
- ☐ ELASTIC DEMAND
- ☐ MARKAL-MACRO
- ☐ MARKAL-MICRO

Additions to Primary Variant

- ☒ (None) ☐ Damage LP ☐ Damage NLP
- ☒ (None) ☐ Elastic Demand - Income
- ☐ (None) ☒ Endogenous Technology Learning
- ☐ (None) ☒ Multi-Region
- ☐ (None) ☒ SAGE (Time-stepped solver)
- ☒ (None) ☐ Stochastic ☐ Stochastic - Risk
- ☒ (None) ☐ Goal Programming

Optimizer

LP + MIP

Model Variant Description

This combination of Additions is not permitted for the selected Primary Variant.

OK Cancel

Note that the 'Model Variant Description' textbox is colored red, and displays the message "This combination of Additions is not permitted for the selected Primary Variant". The [OK] button is also disabled. In the above situation, the choice of the (None) radio button for any of Endogenous Technology Learning or Multi-Region or SAGE will result in a combination of Additions that is permitted.

Note also that an alternative, but much less convenient way of specifying the **Model Variant**, is to drop down the Model Variant combobox, as shown below, and scroll through the approximately 180 permitted Model Variants until the desired Model Variant is located.

Model Variant: MARKAL + MultiRegion

Specify Model Variant...

End year: 2020

Add...

Remove

Up


22:32

Scenarios combobox:

- MARKAL + MultiRegion
- MARKAL-MACRO + MultiRegion
- Elastic Demand + MultiRegion
- ElastDM-Income + MultiRegion
- MARKAL + ETL + MultiRegion
- Elastic Demand + ETL + MultiRegion
- ElastDM-Income + ETL + MultiRegion
- MARKAL + DamageLP

6.1.1.1 Default Model Variant Specification

To allow the user to readily specify the particular combination of MARKAL model variants that is to be used as the Default Model Variant for any new model run, a Home Screen menu bar option **Run, Default Model Variant...** is provided. (When invoked, this menu bar option also displays the current Default Model Variant.)

1. If on the Data/Results Screen, return to the Home Screen by clicking on the [Home Screen] icon .
2. Click on **Run** in the menu bar and choose **Default Model Variant...** in the drop menu.

3. This brings up the 'Default Model Variant Specification' form, as follows:

4. The form displays the current Default Model Variant of MARKAL + Multi-Region.
5. To specify a different Default Model Variant, first specify the Primary Variant and then specify the Additions to the Primary Variant that together will constitute the combination of model variants that you wish to become the new Default Model Variant. For additional details regarding this form, see section 6.1.1 'Model Variant Specification'.

6.1.2 Run Model 'Collapse' option

When working with very large models, it may be desirable to Collapse the model, e.g. rather than running a 9 period model from 2000 to 2040 at 5 year intervals, to instead invoke the Collapse feature and run a 5 period model from 2000 to 2040 at 10 year intervals, and obtain model results for the years 2000, 2010, 2020, 2030, 2040.

To invoke the Collapse feature when carrying out a model run, simply click in the 'Collapse'

checkbox ☒ Collapse on the Run Model form. ANSWER will automatically make the necessary adjustments in the GAMS GEN file in regard to SET TP(YEAR), and setting COLLAPSE=1.

When the results for a run where Collapse was invoked have been imported, every alternate time period for Time Series data will contain nulls. So in the example above, Time Series results will contain nulls in 2005, 2015, 2025 and 2035.

6.1.3 Run Model 'Differential DMD Costing' option

Diff. DMD Costing:	No (DIFFDMDS=0)
rising this run:	No (DIFFDMDS=0)
	All DM (DIFFDMDS=1)
Description	By DM (DIFFDMDS=2)

The 'Diff. DMD Costing' combobox allows the user to select from three different Differential DMD Costing options, as appropriate, to be used in connection with the MARKAL-MACRO model variant.

6.1.4 Run Model 'Lumpy Investment' option

<input checked="" type="checkbox"/> Lumpy Investment
--

The 'Lumpy Investment' MARKAL model variant allows sophisticated modeling in respect of lumpy investments (such as the construction of gas pipelines) via the use of Mixed Integer Programming (MIP) techniques. In ANSWER, there is no 'Lumpy Investment' model variant on the 'Model Variant Specification' form, but instead there is a 'Lumpy Investment' checkbox on the 'Run Model' form.

The 'Lumpy Investment' checkbox must be checked when the user wishes to carry out a model run that utilizes the 'Lumpy Investment' MARKAL model variant, possibly in conjunction with some of the other MARKAL model variants.

For additional details regarding the modeling of lumpy investments in ANSWER-MARKAL, see the Word document "Modeling Lumpy Investments in ANSWER-MARKAL.doc" in folder C:\AnswerV6\Doc.

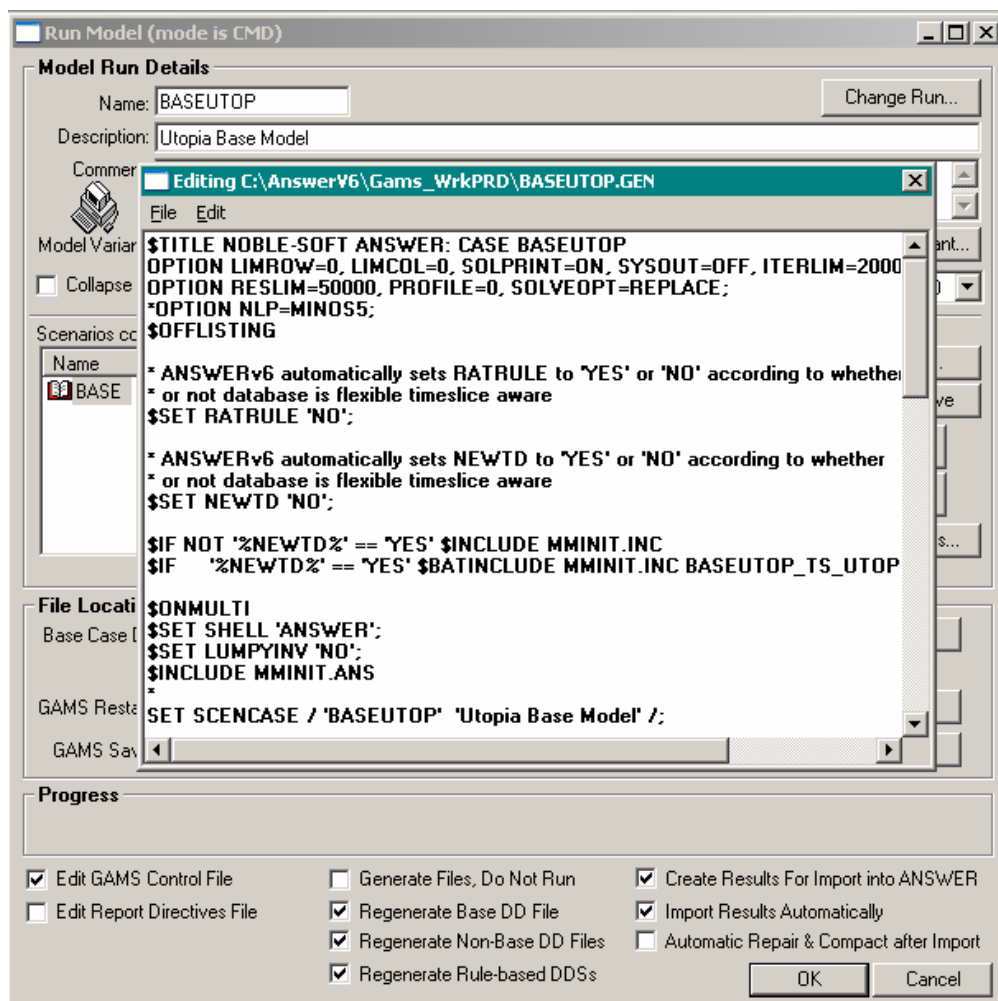
6.1.5 Run Model 'Edit GAMS Control File' checkbox option

<input checked="" type="checkbox"/> Edit GAMS Control File
--

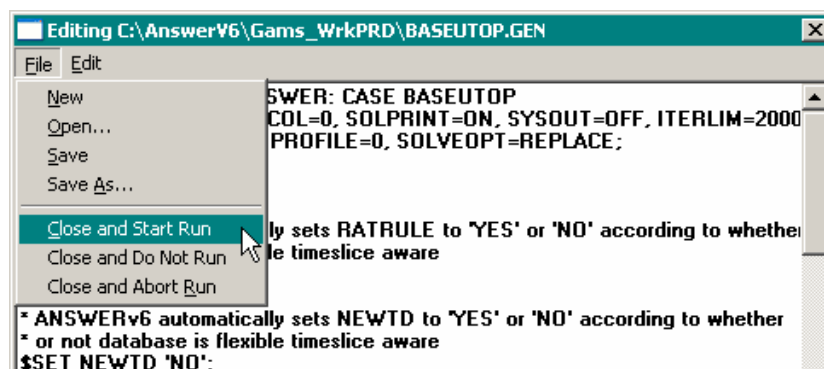
As is discussed in sections 6.1.14 and 6.1.15 below, a single region model run is controlled by a GEN file and a multi-region model run is controlled by GEN files, a SLV file and RPT files. These are small master files in GAMS format that contain the essentials of the model run as specified by the user on the Run Model form.

The default versions of these files as created by ANSWER are adequate for most users, but some advanced users may need to edit these files to suit their purposes.

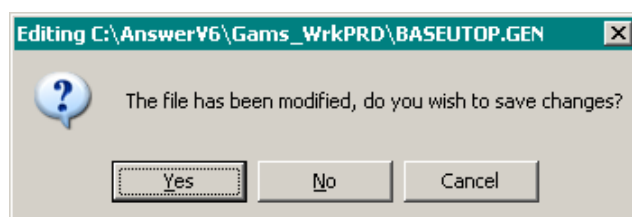
To make one-off changes to the GEN file that controls a single region run, or to make one-off changes to the SLV file that controls the optimization phase of a multi-region run, check the 'Edit GAMS Control File' checkbox prior to clicking on the **[OK]** button on the Run Model form. ANSWER will generate the BASE DD and non-BASE DDS files for the run, and then will display the GEN file for the run (SLV file if a multi-region run) in a window so that it can be edited by the user.



After making the desired editing changes, select **File**, **C**lose and **S**tart Run:



and when the following message box appears, click on the **[Yes]** button to save the GEN file changes.



The GAMS MARKAL model run will then be initiated in a Command Prompt window.

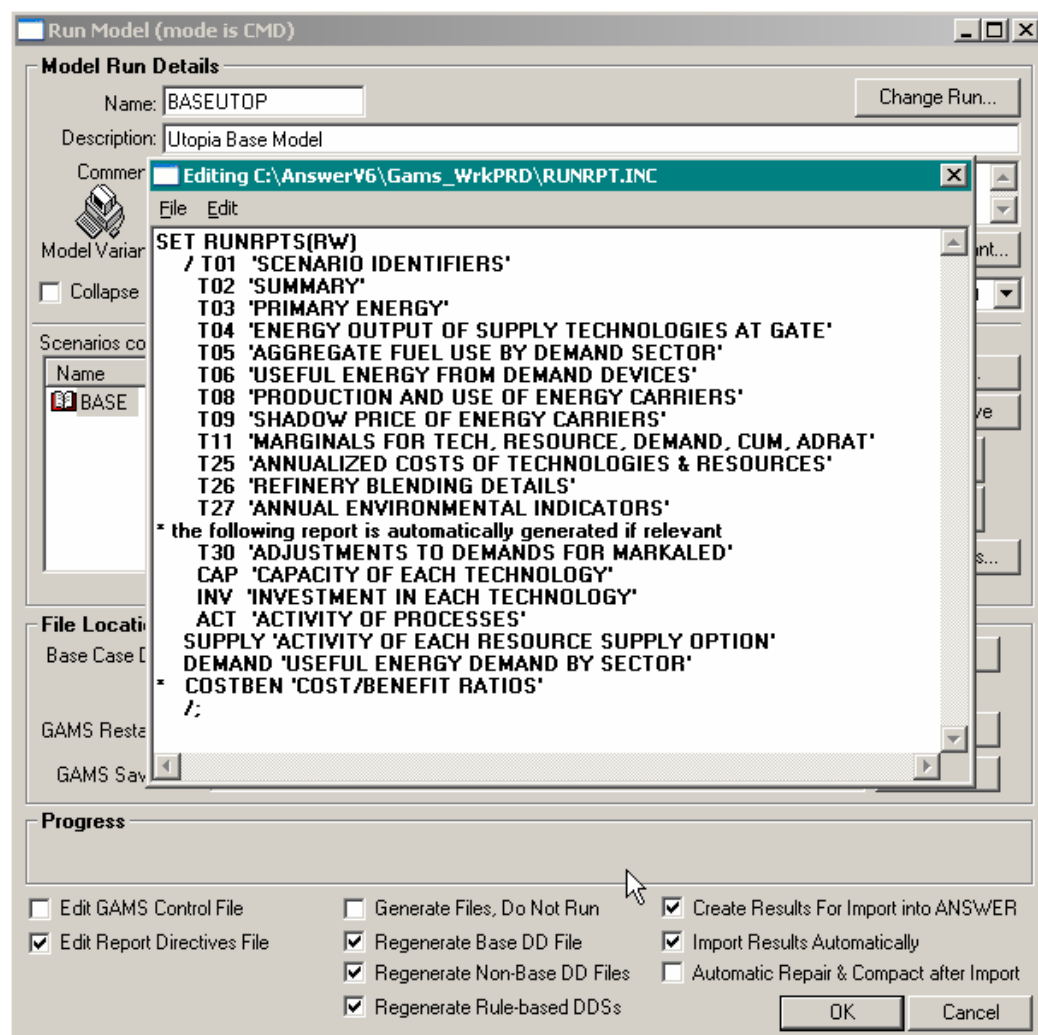
6.1.6 Run Model 'Edit Report Directives File' checkbox option

☒ Edit Report Directives File

The 'Edit Report Directives File' checkbox option allows the user to make one-off changes to the file RUNRPT.INC that controls the results tables that will be produced by a GAMS MARKAL model run.

The default RUNRPT.INC file in the GAMS Source folder (C:\AnswerV6\Gams_SrcPRD) is adequate for most purposes, and so most users need not be concerned with this checkbox option.

To make a one-off change to the file RUNRPT.INC, check the 'Edit Report Directives File' checkbox prior to clicking on the [OK] button on the Run Model form. ANSWER will generate the BASE DD and non-BASE DDS files for the run, and then will display the RUNRPT.INC file in a window so that it can be edited by the user:




After making the desired editing changes to the RUNRPT.INC file, select **File, Close and Start Run** and when a message box appears, click on the [Yes] button to save the changes. The GAMS MARKAL model run will then be initiated in a Command Prompt window.


6.1.7 Run Model 'Generate Files, Do Not Run' checkbox option

☒ Generate Files, Do Not Run

The 'Generate Files, Do Not Run' option is an important Run Model user option, since it is the only way currently available in ANSWER to define a new Case without the need to carry out a model run.

(The ability to define a new Case is useful in the context of the Batch Run and Batch Management facilities – see sections 6.3 and 6.4 respectively.)

If you run with the 'Generate Files, Do Not Run' checkbox checked, then ANSWER generates in the GAMS Work folder (C:\AnswerV6\Gams_WrkPRD) all of the files needed for a model run, but does not submit the run, so no Command Prompt window appears. More importantly in the context of defining a new Case, full details regarding the Case are written to the Database, and the Case is added to the Cases listview with the following icon  and with Status of 'Run Pending...':

Results Management				
Cases:				
Name	Description	Scenario	Created	Status
 BASEUTOP	Utopia Base Model	BASE	2007/02/22 23:26	Run Pending...

Note that having used the 'Generate Files, Do Not Run' checkbox option to cause ANSWER to generate all of the files needed for a model run, you can if you wish initiate the run in a Command Prompt window yourself. One way of doing this is to open Windows Explorer and select the file ANSRUN.CMD in folder C:\AnswerV6\Gams_WrkPRD and then to double-click on its icon. Having carried out the model run in this fashion and created the results ANT file(s), the results may be subsequently re-imported into ANSWER in the standard fashion, by clicking on the **[Import...]** button under the Cases listview.

6.1.8 Run Model 'Regenerate Base DD File' checkbox option

☒ Regenerate Base DD File

If you run with the 'Regenerate Base DD File' checkbox checked, then ANSWER will regenerate the BASE DD file(s) for each region involved in the model run from the BASE Scenario data in the Database, and consequently you can be certain that the BASE DD file(s) correspond to the current BASE Scenario data.

If you run with the 'Regenerate Base DD File' checkbox unchecked, then ANSWER will generate the BASE DD file only if it does not already exist in the GAMS Work folder, or if the Date&Time Modified for the BASE DD file is later than the Date&Time Modified for the BASE scenario. Running with this checkbox unchecked allows you to save the time it would take to generate a BASE scenario DD file whose Date&Time Modified is later than the Date&Time Modified for the BASE scenario (and so where presumably the BASE DD file already on disk is identical to what would be generated).

Note that for a multi-region run, ANSWER always regenerates the BASE TRADE DD file that contains Bilateral (and Global Trade) data for the regions involved in the model run.

6.1.9 Run Model 'Regenerate Non-Base DDS Files' checkbox option

☒ Regenerate Non-Base DDS Files

The operation of the 'Regenerate Non-Base DDS Files' checkbox is similar to the operation of the 'Regenerate Base DD File' checkbox, as described in section 6.1.8 above.

If you run with the 'Regenerate Non-Base DDS Files' checkbox checked, then ANSWER will regenerate all non-BASE scenario DDS files for each region involved in the model run from the non-BASE Scenario data in the Database, and consequently you can be certain that the non-BASE DDS file(s) correspond to the current non-BASE Scenario data. (This excludes Rule-based DDS

files, whose regeneration is determined by the setting of the 'Regenerate Rule-based DDSs' checkbox – see section 6.1.10 below.)

If you run with the 'Regenerate Non-Base DDS Files' checkbox unchecked, then ANSWER will generate a non-BASE DD file only if it does not already exist in the GAMS Work folder, or if the Date&Time Modified for the non-BASE DDS file is later than the Date&Time Modified for the associated non-BASE scenario. Running with this checkbox unchecked allows you to save the time it would take to generate a non-BASE scenario DDS file whose Date&Time Modified is later than the Date&Time Modified for the associated non-BASE scenario (and so where presumably the non-BASE DDS file already on disk is identical to what would be generated).

Note that for a multi-region run, ANSWER always regenerates the non-BASE TRADE DDS files that contain Bilateral (and Global Trade) data for the regions involved in the model run.

6.1.10 Run Model 'Regenerate Rule-based DDSs' checkbox option



If you run with the 'Regenerate Rule-based DDSs' checkbox checked, then ANSWER will regenerate the Rule-based DDS file(s) for each region involved in the model run from the data in the Database, and consequently you can be certain that the Rule-based DDS file (s) correspond to the current data in the Database.

If you run with the 'Regenerate Rule-based DDSs' checkbox unchecked, then ANSWER will only generate a Rule-based DDS file if the Rule-based DDS file does not already exist in the GAMS Work folder: where the Rule-based DDS file already exists, it will not be regenerated.

Note that running with the 'Regenerate Rule-based DDSs' checkbox unchecked is a potentially dangerous choice. If you run with this checkbox not checked you are taking full responsibility for the already existing Rule-based DDS file(s) being appropriate: ANSWER does no checking of the Modified Date&Time for the Rule-based DDS against such things as the Modified Date&Time of TechFilters and Scenarios that are involved in the Rule-based Constraints.

6.1.11 Run Model 'Create Results for Import into ANSWER' checkbox option



If you run with the 'Create Results for Import into ANSWER' checkbox checked, then the GAMS run will generate results in one or more ANT files: these are results files in a format that ANSWER has the ability to process and import into an ANSWER database. So if you want to import into ANSWER the results of a model run, then you should run with this checkbox checked.

In particular, if you want to import results automatically into ANSWER at the end of a model run, it is essential that you run with this checkbox checked, since if you uncheck it, the 'Import Results Automatically' checkbox becomes unchecked (and disabled), as shown below:

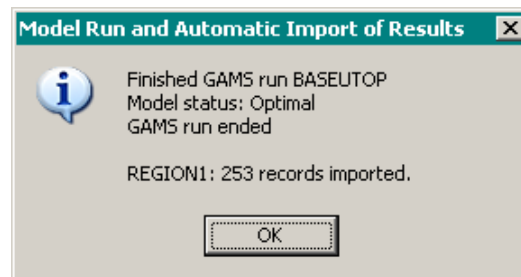



If you prefer to use VEDA-BE for your results processing, and do not wish to import results into ANSWER, run with the 'Create Results for Import into ANSWER' checkbox unchecked. As it happens, the GAMS run will still generate results in one or more ANT files, so that you can still import the results into ANSWER if you want to. (When this checkbox option was first introduced into ANSWER, the intention was to save on processing time by not creating ANT files at the end of the GAMS run if the user did not intend to import results into ANSWER, but the GAMS code has not yet been modified to achieve this.)


6.1.12 Run Model 'Import Results Automatically' checkbox option


☒ Import Results Automatically


If you run with the 'Import Results Automatically' checkbox checked (which as noted in section 6.1.11 above is only possible if the 'Create Results for Import into ANSWER' checkbox is checked), then when the GAMS run is completed, and provided that an optimal solution is obtained, automatic import of results from the ANT file(s) created by the GAMS run will be carried out. After the results have been imported into ANSWER, a message box similar to the one below will appear:



and in the Cases listview, the icon for the Case will be the 'Imported' icon  and its Status will be 'Imported...':

Results Management				
Cases:				
Name	Description	Scenario	Created	Status
 BASEUTOP	Utopia Base Model	BASE	2007/02/21 17:45	Imported...

If you run with the 'Import Results Automatically' checkbox unchecked, then when the GAMS run is completed, and an optimal solution is obtained, there will be no import of results from the ANT file(s) created by the GAMS run. A message box will indicate that the GAMS run finished with a Model status of optimal, and in the Cases listview, the icon for the Case will be the 'Not Imported' icon  and its Status will be 'Not Imported...':

Results Management				
Cases:				
Name	Description	Scenario	Created	Status
 BASEUTOP	Utopia Base Model	BASE	2007/02/21 18:08	Not Imported...

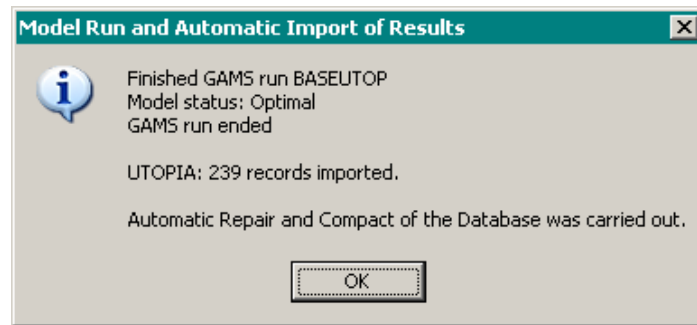
To subsequently import the results, select the Case in the Cases listview and click on the **[Import...]** button (at the bottom of the Cases listview).

6.1.13 Run Model 'Automatic Repair & Compact after Import' checkbox option

☒ Automatic Repair & Compact after Import

If you run with the 'Automatic Repair & Compact after Import' checkbox checked (which is only possible if the 'Import Results Automatically' checkbox is checked), then when the GAMS run is completed, and provided that an optimal solution is obtained so that automatic import of results occurs, then Repair and Compact of the database will be initiated.

After Repair and Compact is completed, a message appears confirming that an optimal solution has been obtained, that the import of results has occurred, and that automatic Repair and Compact has been carried out:



6.1.14 'Run, Edit GEN File Template' facility (for single region runs)

Each single region model run is controlled by a "GEN file". This is a small master file in GAMS format that contains the essentials of the model run as specified by the user on the Run Model form. ANSWER's Run Model procedure automatically creates the GEN file with name <casename>.GEN, where <casename> is the Run (Case) Name entered by the user. So for example, BASEUTOP.GEN is the GEN file created by ANSWER if the user enters BASEUTOP as the Run (Case) Name.

The default GEN file created by ANSWER is adequate for most purposes, and so most users need not be concerned with the contents of the GEN file, or the way in which it is created by ANSWER.


The details in subsection 6.1.14.1 below are directed at those advanced users who find that the default GEN file created by ANSWER is not adequate for their purposes.

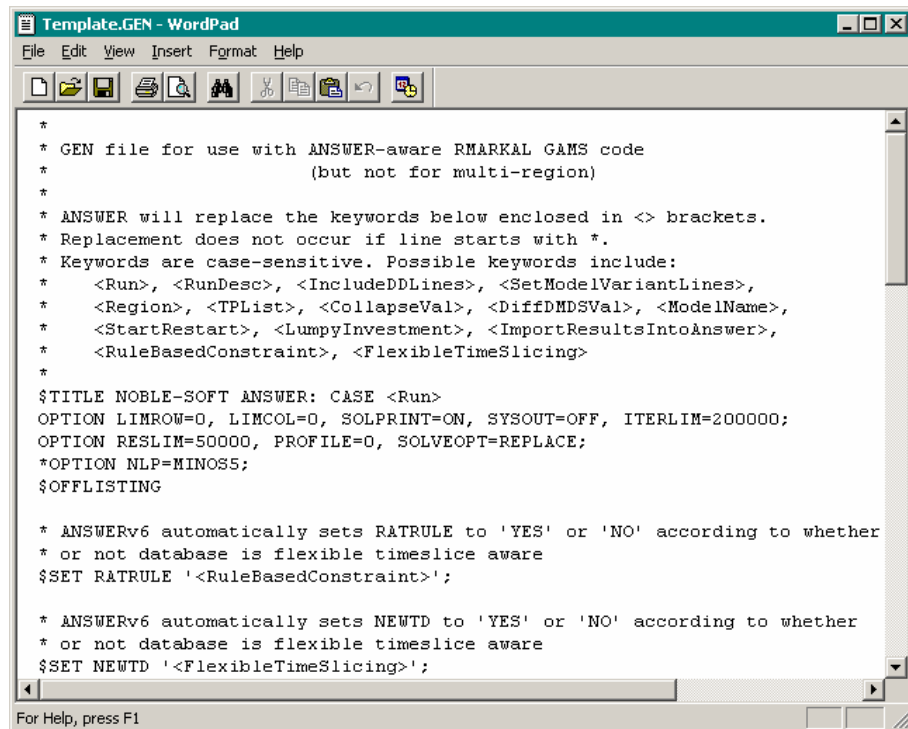
6.1.14.1 Details of the 'Run, Edit GEN File Template' facility

ANSWER creates the GEN file using a template approach, in which a special text file Template.GEN that contains keywords contained in <> brackets is copied to give the <casename>.GEN file, and then the keywords are replaced by relevant information from the Run Model form, such as Run Name and Description, Model Variant, End Year etc.

ANSWER's 'Run, Edit GEN File Template' feature is provided to allow the (advanced) user to edit the Template.GEN file. The changes made will persist in all GEN files created by the Run Model procedure until the user next edits the template.

To edit the GEN File Template:

1. If on the Data/Results Screen, return to the Home Screen by clicking on the **[Home Screen]** icon .
2. Click on **Run** in the menu bar and choose **Edit GEN File Template...** in the drop menu.
3. This brings up the Template.GEN file in the Gams Source folder inside WordPad (see below).



```

*
* GEN file for use with ANSWER-aware RMARKAL GAMS code
*           (but not for multi-region)
*
* ANSWER will replace the keywords below enclosed in <> brackets.
* Replacement does not occur if line starts with *.
* Keywords are case-sensitive. Possible keywords include:
*   <Run>, <RunDesc>, <IncludeDDLines>, <SetModelVariantLines>,
*   <Region>, <TPList>, <CollapseVal>, <DiffDMSVal>, <ModelName>,
*   <StartRestart>, <LumpyInvestment>, <ImportResultsIntoAnswer>,
*   <RuleBasedConstraint>, <FlexibleTimeSlicing>
*
$TITLE NOBLE-SOFT ANSWER: CASE <Run>
OPTION LIMROW=0, LIMCOL=0, SOLPRINT=ON, SYSOUT=OFF, ITERLIM=200000;
OPTION RESLIN=50000, PROFILE=0, SOLVEOPT=REPLACE;
*OPTION NLP=MINOS5;
$OFFLISTING

* ANSWERv6 automatically sets RATTRULE to 'YES' or 'NO' according to whether
* or not database is flexible timeslice aware
$SET RATTRULE '<RuleBasedConstraint>';

* ANSWERv6 automatically sets NEWTD to 'YES' or 'NO' according to whether
* or not database is flexible timeslice aware
$SET NEWTD '<FlexibleTimeSlicing>';

```

4. Carefully edit Template.GEN to make the desired changes, and exit WordPad.
5. If you make a mess of editing the Template.GEN file, carefully use Explorer to delete this file from the Gams Source folder (C:\AnswerV6\Gams_SrcPRD), and then copy the file DefaultTemplate.GEN and rename it to create a new Template.GEN.
6. Note that the various \$SETs associated with different model variants are automatically generated by ANSWER (using a table-driven approach), so that there is no need for the user to edit the GEN file template to provide them.
7. Note also that the Run Model ☒ **Edit GAMS Control File** checkbox (at the bottom of the Run Model form) is available for the user to make one-off changes to a particular <casename>.GEN file, prior to initiating a model run. See section 6.1.5 above.

6.1.15 'Run, Edit Multi-Region GEN/RPT/SLV File Template' facilities (for multi-region runs)

Each multi-region model run involves:

- A "GEN file" for each region that is part of the model run. This is a small master file in GAMS format that controls the generation of the matrix for that particular region.
- A single "SLV file" that controls the optimization phase for a multi-region run.
- An "RPT file" for each region that is part of the model run. This is a small master file in GAMS format that controls the generation of results for that particular region.

ANSWER's Run Model procedure automatically creates the GEN files, SLV file and RPT files that are needed for a multi-region model run, using a similar template-based approach to that used for a single region run.

The default multi-region GEN, SLV and RPT files created by ANSWER are adequate for most purposes, and so most users need not be concerned with their contents.

For those advanced users who need to adjust these files, there are three Home Screen menu options available under **Run** on the menu bar, namely **Edit Multi-Region GEN File Template...**, **Edit Multi-Region RPT File Template...** and **Edit Multi-Region SLV File Template...**

The steps involved in editing the Multi-Region Gen/RPT/SLV File Templates are exactly similar to those detailed in section 6.1.14 above.

Note also that the Run Model ☒ **Edit GAMS Control File** checkbox (at the bottom of the Run Model form) is available for the user to make one-off changes to a particular <casename>.SLV file, prior to initiating a multi-region model run. (There are no analogous facilities to make one-off changes to the GEN and RPT files associated with a particular multi-region model run.)

6.1.16 What happens when the same parameter instance is specified in several scenarios? – the effect of ‘Run, Mapping of Nulls to GAMS DD’ settings for bound parameters

Where a model run involves the BASE scenario and one or more non-BASE scenarios, this creates the possibility that the same parameter instance might be specified in several scenarios. To give a specific example, suppose that the same parameter instance (EFF for technology I1M in region DEMO) occurs in three scenarios BASE, HIEFF1 and HIEFF2 with different numeric values in each of the three scenarios, as follows:

Scenario	Parameter		Region	Technology	Commodity	Bound	1990	2000	2010	2020
BASE	EFF	?	DEMO	I1M	-	-	0.3400	0.3900	0.4050	0.4200
HIEFF1	EFF	?	DEMO	I1M	-	-	0.3570	0.4095	0.4253	0.4410
HIEFF2	EFF	?	DEMO	I1M	-	-	0.3740	0.4290	0.4455	0.4620

What will be the resultant numeric values for this parameter instance in the GAMS MARKAL model run? To answer this question, we need to know whether scenario HIEFF1 is lower down in the Run Model order than scenario HIEFF2, or whether the reverse applies. (See step 11 in section 6.1 ‘The Run Model Facility’.)

If scenario HIEFF1 is lower down in the Run Model order than scenario HIEFF2, then the resultant numeric values for this parameter instance in the GAMS MARKAL model run will be the HIEFF1 values, namely:

EFF	?	DEMO	I1M	-	-	0.3570	0.4095	0.4253	0.4410
-----	---	------	-----	---	---	--------	--------	--------	--------

and if scenario HIEFF2 is lower down in the Run Model order than scenario HIEFF1, then the resultant numeric values for this parameter instance in the GAMS MARKAL model run will be the HIEFF2 values, namely:

EFF	?	DEMO	I1M	-	-	0.3740	0.4290	0.4455	0.4620
-----	---	------	-----	---	---	--------	--------	--------	--------

Where explicit numeric data values are specified for the parameter instance in every time period in each of the scenarios in which it occurs, the following statement accurately describes what happens when the GAMS MARKAL model run occurs, both for parameters that are not bounds and for parameters that are bounds:

Where explicit numeric data values are specified for the parameter instance in every time period in each of the scenarios in which it occurs, the resultant data values for the parameter instance are taken to be those in the scenario that is lowest down in the Run Model order. That is data values for the scenario that is lowest down in the Run Model order take precedence over data values for the same parameter instance in scenarios that are higher up.

However if explicit numeric data values are not specified for the parameter instance in every time period, that is if there are blank (null) data values specified in some time periods, the situation becomes more complicated and the above statement is no longer sufficient. What happens when the GAMS MARKAL model run occurs differs depending on whether a parameter is not a bound or is a bound, as is discussed in the following sections 6.1.16.1 and 6.1.16.2.

6.1.16.1 What happens when there are blank (null) data values specified in some time periods for a parameter that is not a bound?

To explain what happens when the same parameter instance is specified in several scenarios, and there are blank (null) data values specified in some time periods, it is probably easiest to convey the general principles that are involved by means of a specific (admittedly unrealistic) example.

Suppose that the FIXOM parameter (not a bound) is specified for technology E34 in region REG1 in scenarios BASE, HIEFF1, HIEFF2 with data values as in the screen snapshot below:

Scenario	Parameter	Region	Techn	Energy	Bound	2000	2005	2010	2015	2020	2025
BASE	FIXOM	? REG1	E34	-	-	100.0000					0.0000
HIEFF1	FIXOM	? REG1	E34	-	-	110.0000		55.0000		0.0000	
HIEFF2	FIXOM	? REG1	E34	-	-	120.0000					20.0000

Further suppose that the Run Model scenario order is BASE, followed by HIEFF1 and then HIEFF2, so that scenario HIEFF2 is the lowest down in the Run Model order.

When the GAMS MARKAL model run occurs, first the BASE scenario data is processed, after which what GAMS holds in memory as the FIXOM data values for technology E34 in region REG1 are the BASE scenario values, as shown below:

Parameter	Region	Techn	Energy	Bound	2000	2005	2010	2015	2020	2025
FIXOM	? REG1	E34	-	-	100.0000					0.0000

Next the HIEFF1 scenario data is processed, and two rules apply:

An explicit numeric value in the lower down scenario (HIEFF1) overwrites an explicit numeric value or a blank (null) in the higher up scenario (BASE); and

A blank (null) in the lower down scenario (HIEFF1) does not overwrite an explicit numeric value in the higher up scenario (BASE).

After the HIEFF1 scenario is processed according to these two rules, what GAMS holds in memory as the FIXOM data values for technology E34 in region REG1 are the values shown below:

Parameter	Region	Techn	Energy	Bound	2000	2005	2010	2015	2020	2025
FIXOM	? REG1	E34	-	-	110.0000		55.0000		0.0000	0.0000

(Note in particular that the explicit numeric value of 0 in period 2025 from the BASE scenario is not overwritten.)

Finally the HIEFF2 scenario data is processed, and the two rules that apply are slight generalizations of those above:

An explicit numeric value in the scenario being processed (HIEFF2) overwrites an explicit numeric value or a blank (null) in what GAMS currently holds in memory; and

A blank (null) in the scenario being processed (HIEFF2) does not overwrite an explicit numeric value in what GAMS currently holds in memory.

After the HIEFF2 scenario is processed according to these two rules, what GAMS holds in memory as the FIXOM data values for technology E34 in region REG1 are the values shown below:

Parameter	Region	Techn	Energy	Bound	2000	2005	2010	2015	2020	2025
FIXOM	? REG1	E34	-	-	120.0000		55.0000		0.0000	20.0000

The FIXOM data values that GAMS holds in memory are then interpolated, to arrive at the following final FIXOM data values for technology E34 in region REG1:

Parameter	Region	Techn	Energy	Bound	2000	2005	2010	2015	2020	2025
FIXOM	? REG1	E34	-	-	120.0000	87.5000	55.0000	27.5000	0.0000	20.0000

6.1.16.2 What happens when there are blank (null) data values specified in some time periods for a parameter that is a bound?

Suppose that upper BOUND(BD) parameter is specified for technology E34 in region REG1 in scenarios BASE, HIEFF1, HIEFF2 with data values as in the screen snapshot below. (These are the same data values as specified for the FIXOM parameter in section 6.1.16.1.)

Scenario	Parameter		Region	Techn	Energy	Bound	2000	2005	2010	2015	2020	2025
BASE	BOUND(BD)	?	REG1	E34	-	UP	100.0000					0.0000
HIEFF1	BOUND(BD)	?	REG1	E34	-	UP	110.0000		55.0000		0.0000	
HIEFF2	BOUND(BD)	?	REG1	E34	-	UP	120.0000					20.0000

Further suppose that the Run Model scenario order is BASE, followed by HIEFF1 and then HIEFF2. (This is the same scenario order as in section 6.1.16.1.)

When the GAMS MARKAL model run occurs, the final upper BOUND(BD) data values that are determined depend on the “Run, Mapping of Nulls to GAMS DD...” settings for Upper Bounds:

- If ANSWER's default “Mapping of Nulls to GAMS DD...” settings are in effect (namely mapping blanks (nulls) to +INF), then the TS data for the scenario that is lower down in the Run Model order will completely overwrite the TS data for the same parameter instance for the scenario that is higher up in the Run Model order. (Indeed the mapping of nulls for fixed and upper bounds to +INF in the GAMS DD and DDS files is a technical device used to ensure that complete overwriting occurs.) The end result is that the upper BOUND(BD) data values for technology E34 in region REG1 will be 120, +∞, +∞, +∞, +∞, 20 in periods 2000, 2005, 2015, 2020, 2025 respectively.
- If the common alternative to ANSWER's default “Mapping of Nulls to GAMS DD...” settings are in effect (namely mapping blanks (nulls) to spaces), the situation corresponds more closely to that described for the FIXOM parameter in section 6.1.16.1. After the processing of the BASE, HIEFF1 and HIEFF2 scenarios in accordance with the rules described in section 6.1.16.1, what GAMS holds in memory as the upper BOUND(BD) data values for technology E34 in region REG1 will be the values shown below:

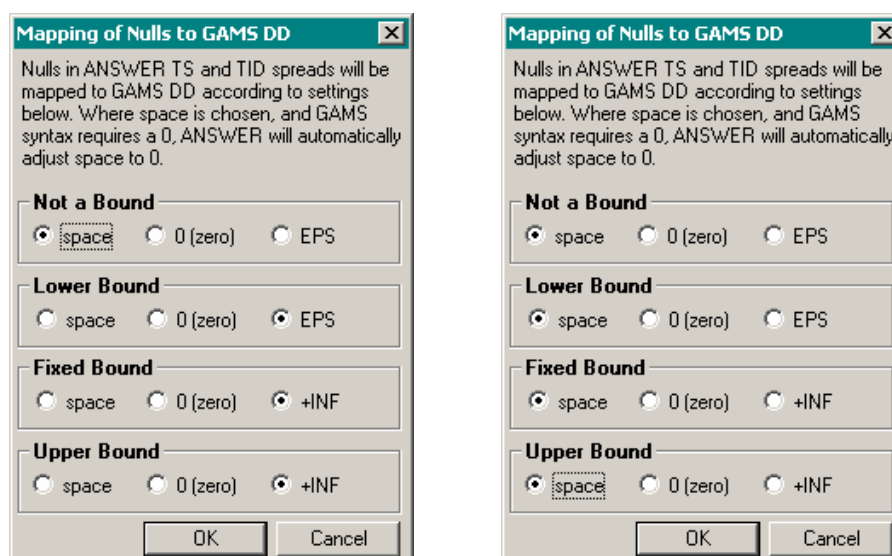
Parameter		Region	Techn	Energy	Bound	2000	2005	2010	2015	2020	2025
BOUND(BD)	?	REG1	E34	-	UP	120.0000		55.0000		0.0000	20.0000

Since the GAMS MARKAL code version 5.7c (and lower) does not interpolate TS Bound Data Parameters, the above data values are the final data values and so the upper BOUND(BD) data values for technology E34 in region REG1 will be 120, +∞, 55, +∞, 0, 20 in periods 2000, 2005, 2015, 2020, 2025 respectively.

In summary, when the same Bound parameter instance is specified in several scenarios, and there are blank (null) data values specified in some time periods, the way that this Bound parameter instance is resolved when the GAMS MARKAL model run occurs (and hence the model that is generated) may depend on the “Run, Mapping of Nulls to GAMS DD...” settings. The operation of the “Run, Mapping of Nulls to GAMS DD...” facility is now discussed.


6.1.16.3 ‘Run, Mapping of Nulls to GAMS DD’ facility

The ‘Run, Mapping of Nulls to GAMS DD’ facility allows the user to control how nulls that occur in the TS data spreads are put out to the GAMS DD and DDS files that ANSWER creates when ‘Run Model’ is invoked. This is a somewhat technical area and in practice the user simply needs to be aware that there are only two different recommended mappings: ANSWER's default mappings as shown below on the left, or alternatively the mappings shown below on the right in which nulls in the TS data spreads are always mapped to spaces:



In section 6.1.16.2 above, the user has already been made aware that when the same Bound parameter instance is specified in several scenarios, and there are blank (null) data values specified in some time periods, the way that this Bound parameter instance is resolved when the GAMS MARKAL model run occurs can depend on the 'Mapping of Nulls to GAMS DD' settings.

To invoke the 'Mapping of Nulls to GAMS DD' facility:

1. If on the Data/Results Screen, return to the Home Screen by clicking on the **[Home Screen]** icon .
2. Click on **Run** in the menu bar and choose **Mapping of Nulls to GAMS DD...** in the drop menu.
3. This brings up the Mapping of Nulls to GAMS DD form, that initially will show ANSWER's default mappings (see screen snapshot on the [left](#) above).
4. If the user wishes to change ANSWER's default mappings, then it is recommended that they change the mappings to those shown in the screen snapshot on the [right](#) above, and then click on the **[OK]** button.
5. The new mappings will apply immediately, will be stored in the registry when you exit ANSWER, and will continue to apply unless you subsequently invoke this menu option to change them.

6.1.17 File Naming Conventions for Multi-Region Runs

The following file naming conventions have been adopted in ANSWER for multi-region runs (for files in the Gams Work folder):

Input files to multi-region GAMS run

BASE scenario Data Dictionary file
 BASE scenario Trade Data file
 Non-BASE scenario Data Dictionary file
 Non-BASE scenario Trade Data file
 Matrix generation master control file
 Multi-region optimization control file
 Results generation master control file

File Naming Convention

BASE+<region>.DD
 BASE+TRADE.DD
 <scenarioname>+<region>.DDS
 <scenarioname>+TRADE.DDS
 <casename>+<region>.GEN
 <casename>.SLV
 <casename>+<region>.RPT

Output files from multi-region GAMS run

Regional Results file
 Trade Results file
 Matrix generation GAMS listing file

File Naming Convention

<casename>+<region>.ANT
 <casename>+TRADE.ANT
 <casename>+<region>.LST

Multi-region optimization GAMS listing file	<casename>+TRADE .LST
Results generation GAMS listing file	<casename>+<region>.LST

where <region> is Region Name,
 <scenarioname> is Scenario Name,
 <casename> is the Run (Case) Name.

The regional GAMS listing files for matrix generation and for results generation are assigned the same names. So if a multi-region run proceeds normally, the results generation GAMS listing files over-write the matrix generation GAMS listing files. Usually this is not a concern, since usually the multi-region optimization GAMS listing file is the only LST file that the user may need to consult.

6.1.17.1 An Example Illustrating File Naming Conventions for a Multi-Region Run

Suppose that we carry out a multi-region run involving the BASE scenario and non-BASE scenario BITRDCOA, for a database with regions DEMO and UTOPIA, and suppose that the Case Name specified for this run is BASETEST.

So we have:

<region> taking the values DEMO and UTOPIA,
 <scenarioname> taking the values BASE and BITRDCOA, and
 <casename> taking the value BASETEST.

ANSWER generates the following input files to the multi-region GAMS run:

BASE scenario Data Dictionary files	BASE+DEMO.DD, BASE+UTOPIA.DD
BASE scenario Trade Data file	BASE+TRADE.DD
Non-BASE scenario Data Dictionary file	BITRDCOA+DEMO.DDS, BITRDCOA+UTOPIA.DDS
Non-BASE scenario Trade Data file	BITRDCOA+TRADE.DDS
Matrix generation master control file	BASETEST+DEMO.GEN, BASETEST+UTOPIA.GEN
Multi-region optimization control file	BASETEST.SLV
Results generation master control file	BASETEST+DEMO.RPT, BASETEST+UTOPIA.RPT

The multi-region GAMS run will create the following output files:

Regional Results file	BASETEST+DEMO.ANT, BASETEST+UTOPIA.ANT
Trade Results file	BASETEST+TRADE.ANT
Matrix generation GAMS listing file	BASETEST+DEMO.LST, BASETEST+UTOPIA.LST
Multi-region optimization GAMS listing file	BASETEST+TRADE .LST
Results generation GAMS listing file	BASETEST+DEMO.LST, BASETEST+UTOPIA.LST

6.2 Run Model Detection and Correction of Inconsistencies and Errors

To reduce the possibility of data inconsistencies and errors and to assist with their detection and correction, it is recommended that the user adopt an incremental and documented approach to building their MARKAL database.

Such an approach would include the following practices

1. maintain documentation of data entries and their data sources
2. input/edit data in the database in small increments and, where possible, undertake frequent models runs to ensure each increment of data is error free
3. investigate and correct data inconsistencies and errors subsequent to each model run
4. maintain a log of errors, including how they were detected, investigated, and corrected
5. retain back-up copies of earlier error-free databases for retrieval as required.

A common source of error is incorrect data entry or neglecting to enter required data. ANSWER minimizes these errors at the time of data entry through facilities such as

1. specifying allowable and default units
2. preventing duplicate Items
3. creating compulsory data parameters at the time of Item creation
4. where it exists, entering default data into the newly created compulsory data parameters
5. flagging illegal data parameters for Items whose Set Membership has been edited.

Consequently, the following discussion on data errors is based on the premise that users have responded to ANSWER's data requirements flags.

ANSWER MARKAL also detects illegal data during the MARKAL model run, namely

1. GAMS compilation errors
2. GAMS execution errors
3. model optimization errors, e.g., infeasibilities, unbounded solution, processing errors
4. GAMS reporting errors
5. errors importing GAMS results into ANSWER.

The discussion and examples in the remainder of this section are for a single-region ANSWER MARKAL database (screen snapshots were obtained using ANSWER version 6.1.20 and may differ in some respects from those that would be obtained using earlier versions of ANSWER). Similar considerations apply for a multi-region database.

6.2.1 The QA_CHECK.LOG file and the <Casename>.LST file

During a MARKAL model run, two files are generated by GAMS that are the primary avenue for the user in detecting and investigating data inconsistencies and illegal data entries. These files are the QA_CHECK.LOG file and the <Casename>.LST file, with both files being created in the GAMS Work folder (C:\AnswerV6\Gams_WrkPRD).

6.2.1.1 The QA_CHECK.LOG file

The QA_CHECK.LOG file or 'quality assurance log' file is primarily a check on data inconsistencies. It is not comprehensive for all errors and, consequently, should be viewed as a one tool to be used in conjunction with other means of error detection.

Because the QA_CHECK.LOG file is re-generated with each model run, it only provides a log for the most recent model run. If a user wishes to retain the QA_CHECK.LOG file for a particular run, the user must save that file with a new name via Windows Explorer.

The QA_CHECK.LOG file is generated after the GAMS execution. Consequently, a QA_CHECK.LOG file will not be created in the case of a model run involving a GAMS compilation error.

The role of the QA_CHECK.LOG file is discussed in detail in section 6.2.2 'Detecting data inconsistencies'.

6.2.1.2 The <Casename>.LST file

The <Casename>.LST file or 'GAMS Listing File' is generated for each model run to provide the user with a log of the model run. This log will include any error conditions, which can then be followed up by the user.

The <Casename>.LST file is the primary file for detection of compilation errors, execution errors, infeasibilities, and unbounded solutions.

A separate <Casename>.LST file is generated for each Case. Consequently, the LST file will only be overwritten when the same Casename is re-modelled.

The role of the <Casename>.LST file in detecting and investigating errors is extensive and is discussed in detail in section 6.2.3 'GAMS compilation errors', section 6.2.4 'GAMS execution errors' and section 6.2.5 'Errors at the model optimization, report writing, and results importing stages'.

6.2.2 Detecting data inconsistencies

The QA_CHECK.LOG file or 'quality assurance log' file is created by a utility module of the GAMS MARKAL modeling system that does numerous quality assurance checks on the model input data. The nature of the checks are for the generally less obvious data inconsistencies, e.g., for consistency of Set Memberships relative to input Item data, range checks on the Item's data, checks on simple sums, and more.

It provides the user with a log (see example below) of 'REMINDERS' (e.g., non-fatal missing data parameters), 'WARNINGS' (e.g., non-fatal missing data items such as an energy carrier not being consumed by a technology), 'Illegal <DATA PARAMETER> Specification' (e.g., the sum of a data parameter, such as OUT(DM), not equalling 1), and some 'MAJOR ERRORS' (e.g., fatal missing data item or data parameter, such as EFF).

```
***** QUALITY ASSURANCE LOG *****

*** Production/Use of Energy Carriers+Material
* WARNING      - Energy Carrier/Material : CSV
                  Is not consumed by any Resource or Technology

*** Some Electric/Heat CONSTANT Entries Missing
* REMINDER     - No ETRANINV/OM or EDISTINV/OM for Electric Grid : ELC
* REMINDER     - No DTRANINV/OM for Heat Grid : LTH

*** No Conversion Technologies Contributing to Peak
* WARNING      - For Heat Grid : LTH

*** Illegal OUT(DM) Specification
* WARNING      - Sum of DM output fractions Not = 1 for DMD : RL1
```

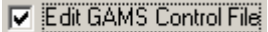
The QA_CHECK.LOG clearly attributes the error or inconsistency to an Item or its data parameter(s), which can then be followed up by the user.

The QA_CHECK.LOG file is written to the GAMS Work folder (C:\AnswerV6\Gams_WrkPRD), and is readily accessed by clicking on the **[View QC...]** button below the Cases listview to bring this file up in Wordpad. As already mentioned, the QA_CHECK.LOG file is for the most recent model run (Case), not for the currently selected Case in the Cases listview.

6.2.3 GAMS compilation errors

In ANSWER MARKAL, a GAMS compilation error is rare because of the restrictions and checks imposed on the user by ANSWER and the ANSWER database structure.

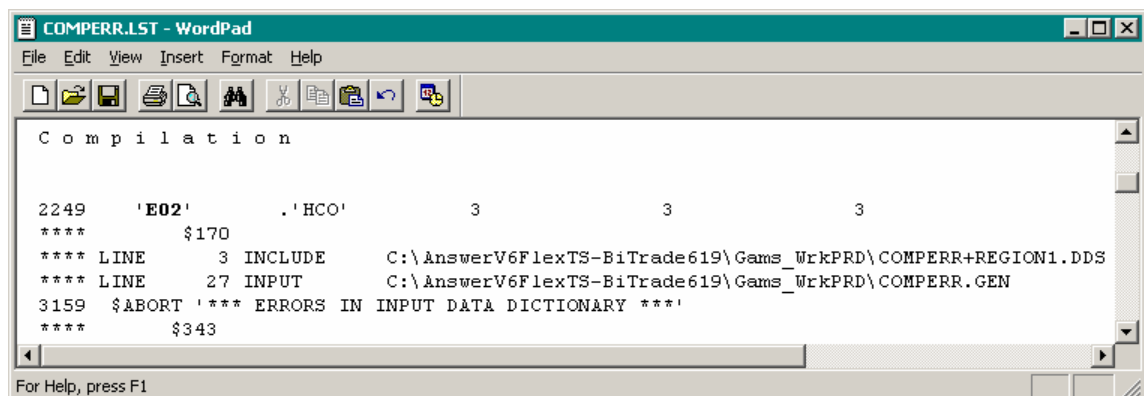
One way of deliberately generating a GAMS compilation error from an ANSWER MARKAL model run would be to proceed as follows:

1. Carry out a model run of the BASE Scenario and use Windows Explorer to save the Base Case DD file with a different name to the standard name of BASE+<region>.DD.
2. Create a new Technology Item, say E02, in the BASE Scenario.
3. Create a non-Base Scenario, called say COMPERR, and in it create a Data Parameter entry, say INP(ENT)c, for the new Technology Item E02.
4. Attempt to carry out a model run of the BASE Scenario plus the non-Base Scenario COMPERR but with the  checkbox checked, and when the GEN file (in this case COMPERR.GEN) is displayed for editing, edit the \$INCLUDE BASE+<region>.DD line to replace BASE+<region>.DD by the name of the **out-of-date** Base Case DD file saved at step 1 above.
5. This results in a compilation error, and a '*** Compilation error(s)' line will appear in the GAMS Execution Command Prompt window, but possibly too quickly for the user to see since this window then closes. ANSWER displays the following message box, which indicates that "*** DATA or COMPILE error(s)" have occurred:



To determine the Item(s) that is(are) the cause of the compilation error(s), and rectify the problem:

1. Click on the **[View .LST...]** button below the Cases listview to bring up the <Casename>.LST file in Wordpad.
2. Search the <Casename>.LST file for occurrences of '\$170' (without the single quotes). These will occur associated with the Item(s) in the non-Base Scenario DDS file that do not occur in the out-of-date Base Case DD file. In the example below, the Item 'E02' that occurs in line 3 of the COMPERR+REGION1.DDS file is tagged with a \$170.



3. Repeat the model run, ensuring that an **up-to-date** Base Case DD file is specified.

6.2.4 GAMS execution errors

A GAMS execution error is usually due to a 'division by zero' (or 'division by eps') operation, involving one or more of the data parameters CAPUNIT, DHDE(Z), DISCOUNT, EFF, ELM, LIFE, QHR(Z)(Y), or REH.

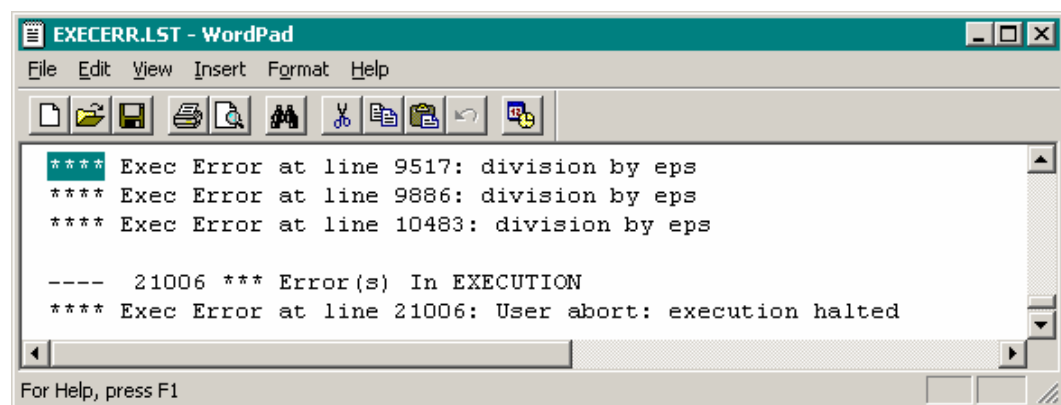
To deliberately generate a GAMS execution error from an ANSWER MARKAL model run, proceed as follows:

1. Create a non-Base Scenario, called say EXECERR, and in it create an EFF Data Parameter entry that has all zero entries (explicit zeroes) for any Demand Technology in the BASE Scenario.
2. Attempt to carry out a model run of the BASE Scenario plus the non-Base Scenario EXECERR.
3. This results in a GAMS execution error, and a '*** Execution error(s)' line will appear in the GAMS Execution Command Prompt Window, but possibly too quickly for the user to see since this window then closes. ANSWER displays the following message box, which indicates that "*** Error(s) in EXECUTION" have occurred:



To determine the cause of an execution error, and rectify the problem:

1. Click on the **[View .LST...]** button below the Cases listview to bring up the <Casename>.LST file in Wordpad, and then search for 'Exec Error' (without the single quotes) or easier, search for '****' (again without the single quotes). This might result in the following:

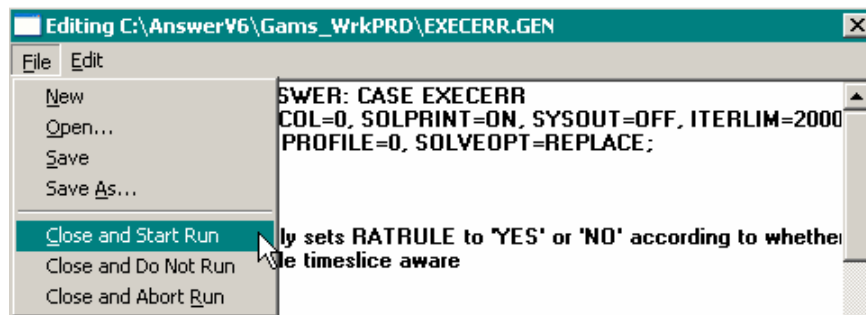


2. Thus the first execution error is occurring at line 9517 in the GAMS MARKAL code. We need to examine the GAMS code in the vicinity of line 9517 looking for a divide (/) operation so that we can determine the Data Parameter that is causing the problem. In order to do this, we need to generate a <Casename>.LST file that shows all of the lines in the GAMS MARKAL code, by carrying out steps 3, 4 and 5 below.
3. Click on the **[Run Model...]** button to re-run the model, but with the ☒ **Edit GAMS Control File** checkbox checked, and when the GEN file (in this case EXECERR.GEN) is displayed for editing, change the **\$OFFLISTING** command (on the 5th line) to **\$ONLISTING**. Changing this command means that the <Casename>.LST file will show all of the lines in the GAMS MARKAL code, along with any error conditions.

```

Editing C:\AnswerV6\Gams_WrkPRD\EXECERR.GEN
File Edit
$TITLE NOBLE-SOFT ANSWER: CASE EXECERR
OPTION LIMROW=0, LIMCOL=0, SOLPRINT=ON, SYSOUT=OFF, ITERLIM=2000
OPTION RESLIM=50000, PROFILE=0, SOLVEOPT=REPLACE;
*OPTION NLP=MINOS5;
$OFFLISTING
  
```

- After changing **\$OFFLISTING** to **\$ONLISTING**, click on **File** in the menu bar and then **Close and Start Run**.



- ANSWER will again display a message box which indicates that “*** Error(s) in EXECUTION” have occurred. Click on the **[View .LST...]** button below the Cases listview to bring up the <Casename>.LST file in Wordpad. This time the LST file will show all of the lines in the GAMS MARKAL code.
- To locate line 9517, search the <Casename>.LST file for **9517**. The <Casename>.LST file might appear as follows:

```

EXECERR.LST - WordPad
File Edit View Insert Format Help
9517  ANC_CAP(TPDMD(TP,DMD)) = (
9518      TCH_FIXOM(DMD, TP) + (
9519      * Include the variable OM too!
9520      SUM(ENT$DD_MA(DMD, ENT),
9521      *V5.1b - dont add in DELIV if DMD is vintaged
9522      (TCH_DELIV(DMD, ENT, TP) * DMD_MA(DMD, ENT, TP))
9523      / DMD_EFF(DMD, TP)) $(NOT DMD_VINT(DMD))
9524      + TCH_VAROM(DMD, TP) )
9525      * TCH_CAPU(DMD) * TCH_CF2(DMD, TP) );
  
```

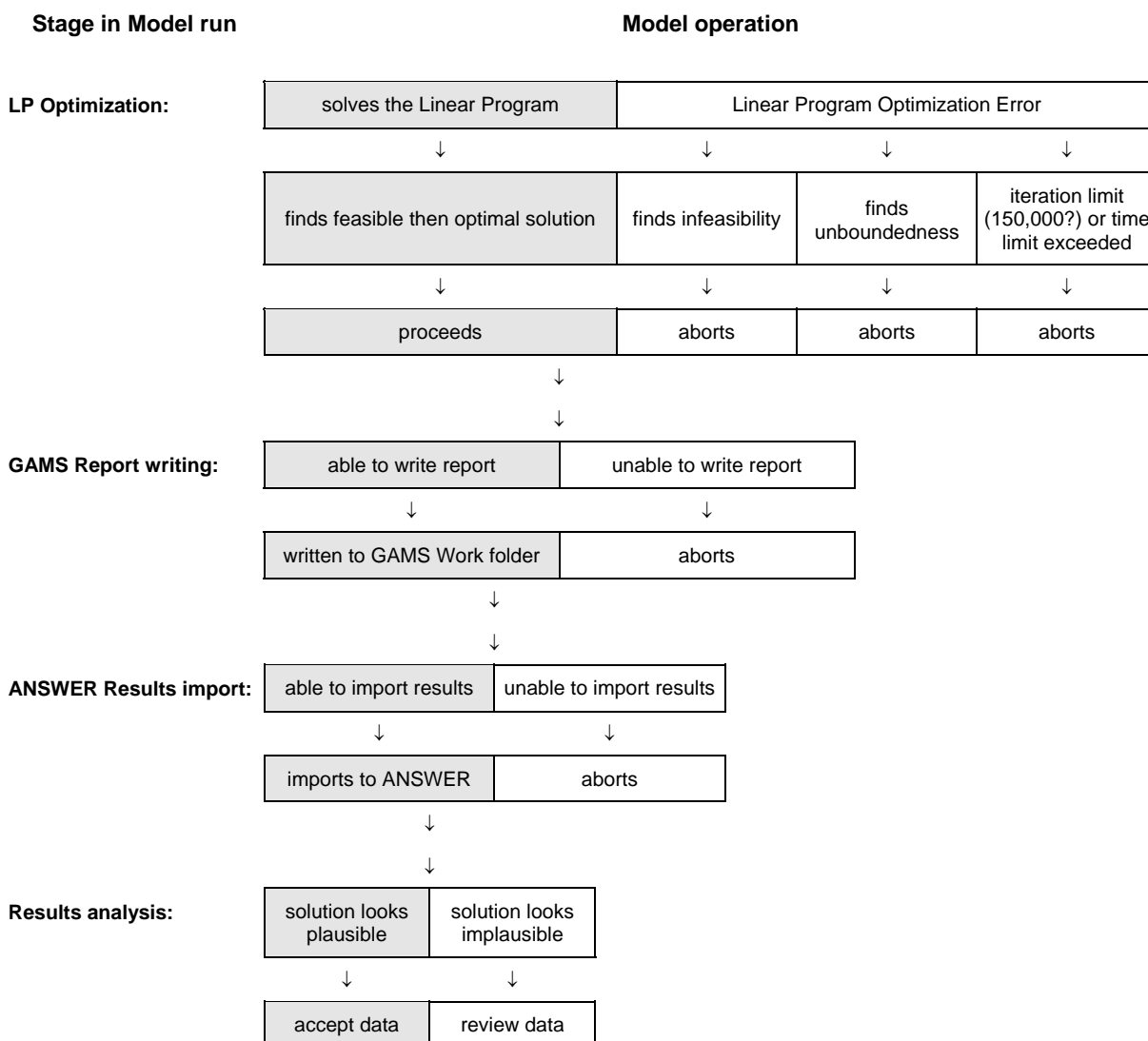
- As it happens, line 9517 is the first line in a single GAMS statement that concludes on line 9525 (this line has a semi-colon (;) that terminates the GAMS statement). We need to scan the entire statement looking for the division operand (/) and then note the Data Parameter that occurs immediately after the division operand (/). In the example above, the division operand occurs on line 9523 and the Data Parameter that occurs immediately after is **DMD_EFF**. (This is the GAMS name for the EFF Data Parameter.)
- Return to ANSWER and on the Parameter tab visually scan the EFF Data Parameters for explicit zero entries and correct them.

6.2.5 Errors at the model optimization, report writing, and results importing stages

During the model run's linear program optimization stage, a number of detectable error conditions can occur, namely infeasible solutions, unbounded solutions, and processing errors. Also, during

the subsequent results import stage when the model results are imported back into ANSWER, a detectable import error can occur.

These error conditions are represented below.



6.2.5.1 Linear Program Optimization errors

As displayed in the table above, the normal outcome from the LP Optimization phase is that the optimizer finds an optimal solution to the GAMS MARKAL Linear Program, but there are alternative outcomes where a Linear Programming Optimization error of some kind is encountered. Amongst these alternative outcomes, are the following:

- The optimizer determines that the LP has no feasible solution, i.e. is infeasible. This is the most commonly occurring type of LP Optimization error, and is examined in more detail in section 6.2.5.1.1 below.
- The optimizer determines that the LP has an unbounded solution. This is examined in more detail in section 6.2.5.1.2 below.
- The optimizer halts before being able to determine optimality/infeasibility/unboundedness due to encountering some sort of resource limit, such as an iteration limit or a time limit. This is uncommon when running standard MARKAL with modern LP solvers such as CPLEX, unless perhaps working with a huge multi-region model.

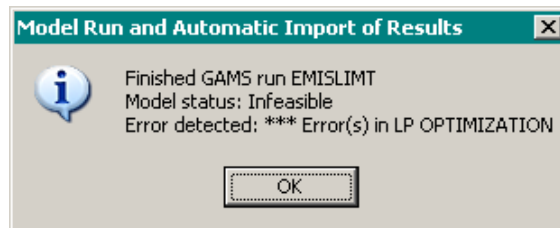
Where a Linear Programming Optimization error is encountered, the message box displayed by ANSWER at the end of the GAMS MARKAL run will contain the generic line:

Error detected: *** Error(s) in LP OPTIMIZATION

The message box may also contain a preceding 'Model status' line that might indicate 'Infeasible' or 'Unbounded' or some other Model status that is more specific about the type of LP Optimization error that has occurred.

6.2.5.1.1 Run Model status of Infeasible

If the model being solved has no feasible solution, i.e. is infeasible, then at the end of the GAMS run ANSWER will display a message box that contains the line: 'Model status: Infeasible':



The most common causes of infeasibilities are:

1. An end-use demand is specified, but a demand technology is not specified to meet this demand. Setting a demand technology's CF or OUT(DM) entry to zero will have the same effect.
2. Inconsistencies amongst user specified constraints (bounds), such as
 - an upper or fixed bound on a technology or group of technologies leads to an inability to satisfy their specified end-use demand
 - a lower bound exceeds an upper bound for a technology or group of technologies
 - inconsistency between a bound on a technology's output and its activity (only applies to conversion and process technologies)
 - inconsistency between a technology specific bound and a bound applied to a group of technologies (i.e., using an ADRATIO constraint)
 - the system wide energy requirements exceed those which can be supplied due to constraints on supply (this will be more likely in a database insufficiently rich in technology or energy carrier options)
 - tight system wide constraints on, say, emissions (this may be a symptom of a database insufficiently rich in technology or energy carrier options).

To determine the cause of an infeasibility, and rectify the problem:

1. Search the <Casename>.lst file for occurrences of **INFES**, using the Find... facility. In the following example, the 1990 OUT(DM) for Technology 'RL1' was inadvertently set to zero, and there were no other demand technologies for meeting end-use demand 'RL'. This meant that the end-use demand 'RL' had no technologies to satisfy its demand in that period, and hence created an infeasibility.

```

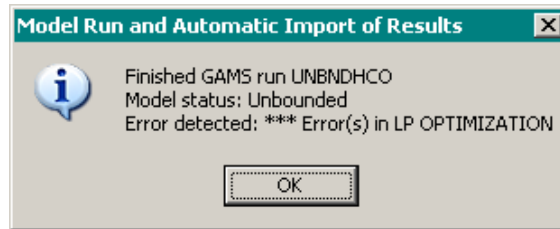
---- EQU EQ_DEM      demand relation (=G=)
          LOWER      LEVEL      UPPER      MARGINAL
1990.RL    5.600      .          +INF      .          INFES
2000.RL    8.400      8.400      +INF      132.476
2010.RL    12.600     12.600      +INF      93.090
    
```

2. Return to ANSWER and ensure that the 1990 OUT(DM) for Technology 'RL1' is non-zero, and/or ensure that other demand technologies are specified to satisfy end-use demand 'RL' in 1990.

NOTE: The cause of some infeasibilities can be very difficult to determine!!

6.2.5.1.2 Run Model status of Unbounded

If the model being solved has an unbounded solution, i.e. if there are feasible solutions which will make the objective function as *small* as we wish (remember MARKAL is a cost minimizing model), then at the end of the GAMS run ANSWER will display a message box that contains the line: 'Model status: Unbounded':



An unbounded solution is less common than an infeasibility and is generally due to:

1. The level of exports, imports and/or production of an energy carrier having not been constrained, and the unit cost of the exported carrier exceeding that of the unit cost of importing or producing that energy carrier. In this situation, MARKAL will attempt to minimise system costs by perpetually exporting all of the energy carrier.
2. A negative sign on some costs, which because MARKAL is a cost minimizing model, acts to minimize the solution. This is uncommon.

To determine the cause of an unbounded solution, and rectify the problem:

1. Search the <Casename>.lst file for occurrences of **UNBND**, using the Find... facility. In the following example, resource technology 'EXPHCOA' (export of hard coal, HCO) was unconstrained with a unit COST exceeding that of its import COST, and also the resource technology for the import of hard coal was unconstrained. This led to an unbounded solution as shown below. (GAMS is indicating that there are feasible solutions in which we can make the level of resource technology 'EXPHCOA' as large as we wish, and that when we do so we can make the objective function as *small* as we wish.)

```

---- VAR TSEP
          LOWER    LEVEL    UPPER    MARGINAL
1990 .EXP.HCO.A    .        .        +INF    -27.479 UNBND
2000 .EXP.HCO.A    .        .        +INF    -16.870
2010 .EXP.HCO.A    .        .        +INF    -10.356

```

2. Return to ANSWER and impose an appropriate constraint on resource technology 'EXPHCOA', and also consider imposing an appropriate constraint on the resource technology for the import of hard coal.

6.2.5.2 GAMS Report Writing Errors

An execution error encountered at the GAMS report writing stage is normally indicative of a GAMS programming error, rather than a user induced error. In ANSWER MARKAL, a GAMS report writing error is rare.

If encountered, such an error should be referred to Ken Noble of Noble-Soft Systems (noblesoft@netspeed.com.au) or to Gary Goldstein of DecisionWare Inc (ggoldstein@irqltd.com) for their attention.

6.2.5.3 ANSWER Results Importing Errors (Import Case Errors)

A successful GAMS MARKAL run creates a text file <Casename>.ANT (in the ANSWER Work folder) that contains the run results in a format suitable for importing into the ANSWER database. ANSWER's "File, Import Case" facility is then invoked to import the results in the <Casename>.ANT file into the ANSWER database. (If the ☒ Import Results Automatically checkbox is checked, the "File, Import Case" facility will be invoked automatically, otherwise the user may subsequently

manually invoke this facility.) Import Case errors are relatively uncommon and there are two different situations that together account for nearly all Import Case errors:

- Import Case is attempted into an ANSWER database that is not aware of newly introduced GAMS MARKAL Results Parameters. How this situation arises and how to correct it is examined in more detail in section 6.2.5.3.1 below.
- Import Case is attempted into an ANSWER database that is out of sync with the <Casename>.ANT file. How this situation might arise is examined in more detail in section 6.2.5.3.2 below.

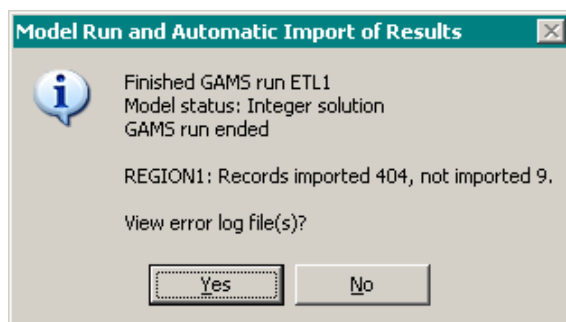
6.2.5.3.1 Import Case into an ANSWER Database that is not aware of newly introduced GAMS MARKAL Results Parameters

The situation where Import Case is attempted into an ANSWER database that is not aware of newly introduced GAMS MARKAL Results Parameters could arise as follows:

1. The user installs an enhanced version of the GAMS MARKAL code that introduces some new GAMS MARKAL Results Parameters.
2. The user forgets to apply ANSWER's "File, Update System Tables from Excel" facility to make their ANSWER database(s) aware of the new GAMS MARKAL Results Parameters. (Normally when an enhanced version of the GAMS MARKAL code is distributed to ANSWER clients, an UpdateAnsSysTables XLS will also be distributed for use with the "Update System Tables from Excel" facility, and the accompanying distribution note will remind the user to update their ANSWER databases.)
3. The user carries out a model run that creates a <Casename>.ANT file that contains references to one or more Results Parameters that are not known to the ANSWER database, and then attempts Import Case. This will result in one or more Import Case errors occurring, where some of the records in the ANT file are unable to be imported into the ANSWER database.

When an Import Case error occurs:

1. A message box will appear advising the number of records that have been imported and the number that have not been able to be imported, and giving the user the option of viewing the error log. Click on **[Yes]**.



2. The error log will appear and will list all of the results records that could not be imported, along with the reason that each record could not be imported. In the error log below, the reason that each record could not be imported is "Could not find GAMS parameter ..." (where the GAMS parameter that could not be found is either T08FEQ.TCH or T08FEQ.TOT). This generic error message indicates that the ANSWER database is not aware of some of the GAMS MARKAL Results Parameters that are being created in the <Casename>.ANT file.

Note that the GAMS parameter names that appear in the ANT file do not in general appear as Results Parameter names inside an ANSWER database. It is the generic error message "Could not find GAMS parameter ..." that signals that an ANSWER database is not aware of some GAMS MARKAL Results Parameters.

Could not find GAMS parameter TOSFEQ.TCH				
Line: TOSFEQ.TCH URN E21	25000.00	34588.62	51618.49	76826.87
Could not find GAMS parameter TOSFEQ.TCH				
Line: TOSFEQ.TCH URN E22	0.00	41.89	487.12	1212.36
Could not find GAMS parameter TOSFEQ.TOT				
Line: TOSFEQ.TOT URN	25000.00	34630.51	52105.62	78039.23
Could not find GAMS parameter TOSFEQ.TCH				
Line: TOSFEQ.TCH HYD E31	21875.00	18750.00	18750.00	23723.76
Could not find GAMS parameter TOSFEQ.TOT				
Line: TOSFEQ.TOT HYD	21875.00	18750.00	18750.00	23723.76
Could not find GAMS parameter TOSFEQ.TCH				
Line: TOSFEQ.TCH SOL E41	13.80	173.78	588.72	1664.98
Could not find GAMS parameter TOSFEQ.TOT				
Line: TOSFEQ.TOT SOL	13.80	173.78	588.72	1664.98
Could not find GAMS parameter TOSFEQ.TCH				
Line: TOSFEQ.TCH WIN E61	143.49	515.67	1481.01	3984.84
Could not find GAMS parameter TOSFEQ.TOT				
Line: TOSFEQ.TOT WIN	143.49	515.67	1481.01	3984.84

3. If you encounter such errors and are unable to resolve them by applying ANSWER's "File, Update System Tables from Excel" facility to your database(s) using the most recently distributed UpdateAnsSysTables XLS, please contact Ken Noble of Noble-Soft Systems (noblesoft@netspeed.com.au).

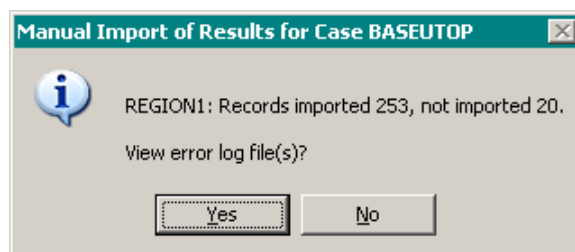
6.2.5.3.1 Import Case into a Database that is out of sync with the <Casename>.ANT file

The situation where Import Case is attempted into an ANSWER database that is out of sync with the <Casename>.ANT file could arise as follows:

1. A model run is carried out for Case <Casename> with the ☐ Import Results Automatically checkbox unchecked, and Import Case is not immediately attempted.
2. The ANSWER database is edited and one of the Items involved in the model run is renamed, but no new model run of Case <Casename> is initiated. (For example, Technology Item 'E01' might be renamed.)
3. Import Case is attempted into a database that is now out of sync with the <Casename>.ANT file created by the model run at step 1 – out of sync because the ANT file contains references to an Item that is no longer known to the ANSWER database. This will result in one or more Import Case errors occurring, where some of the records in the ANT file are unable to be imported into the ANSWER database.

When an Import Case error occurs:

1. A message box will appear advising the number of records that have been imported and the number that have not been able to be imported, and giving the user the option of viewing the error log. Click on **[Yes]**.



2. The error log will appear and will list all of the results records that could not be imported, along with the reason that each record could not be imported. In the error log below, the reason that each record could not be imported is that "a related record is required in table 'tblITEMS'". This generic error message indicates that the ANSWER database does not contain an Item in the results record. In the error log below, it is clear that it is Technology Item 'E01' that the ANSWER database does not contain.

BASEUTOP.ERR - WordPad

File Edit View Insert Format Help

You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: CAP.TCH E01 0.00 0.00 0.00
 You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: T25.F E01 20.00 22.75 72.28
 You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: T25.V E01 1.41 2.28 4.35
 You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: T25.I E01 0.00 0.00 40.06
 You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: CAP.C E01 0.50 0.33 0.72
 You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: CAP.E E01 4.70 7.59 14.48
 You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: CAP.A E01 29.82 74.06 63.53
 You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: CAP.%E E01 I-D 21.99 80.00 53.74
 You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: CAP.%E E01 I-N 21.99 80.00 53.74
 You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: CAP.%E E01 S-D 21.99 56.23 40.40
 You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: CAP.%E E01 S-N 21.99 56.23 40.40
 You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: CAP.%E E01 W-D 37.66 80.00 80.00
 You cannot add or change a record because a related record is required in table 'tblITEMS'.
 Line: CAP.%E E01 W-N 37.66 80.00 80.00

For Help, press F1


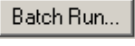
6.3 Batch Run facility for Multiple Model Runs

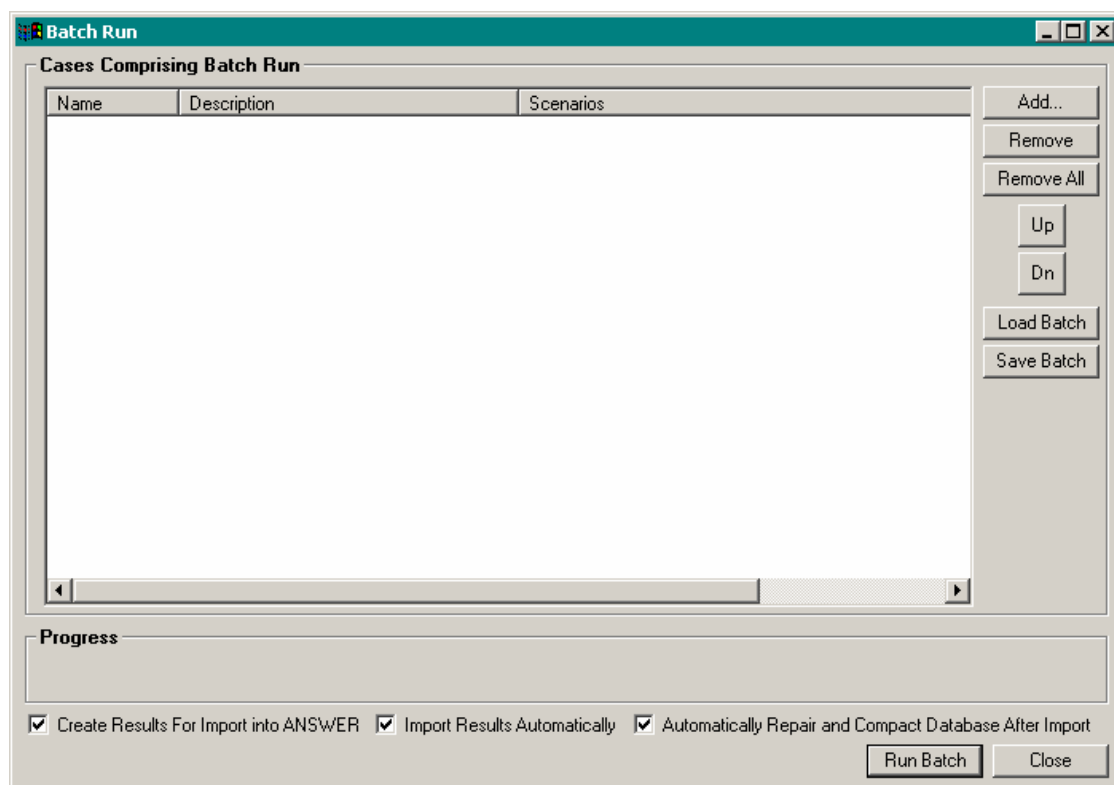
ANSWER's 'Batch Run' facility allows the user to batch up a succession of model runs to be carried out one after the other. Each of the runs (Cases) may be any combination of the BASE scenario plus multiple non-base scenarios that the user wishes. For a multi-region database, the runs in a batch do not have to involve the same regions, and indeed it is allowable to have a batch of runs where some of the runs in the batch are multi-region and others are single-region. Of course in practice, most likely the runs being carried out in a batch will be quite closely related to each other.

One restriction on the 'Batch Run' facility is that it may be used only to run Cases that already exist within the database. So prior to invoking this facility, the user must create any new Cases that are to be run. This may be done by using the 'Run Model' facility with the 'Generate Files, Do Not Run' checkbox checked. Another restriction is that there is currently no means by which the user can specify the GAMS restart files that are to be used for each model run in a batch – all runs in a batch must be solved from scratch.

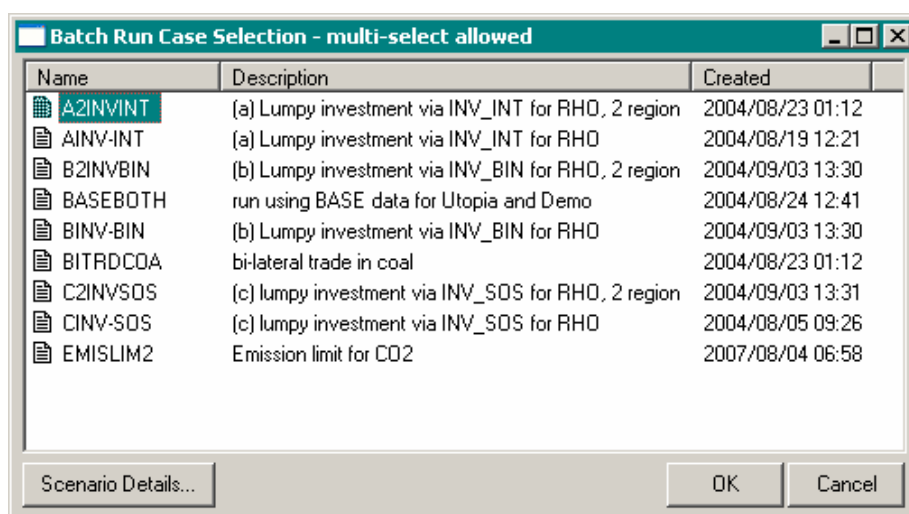
6.3.1 Setting up a Batch of Model Runs

To set up a batch of model runs:

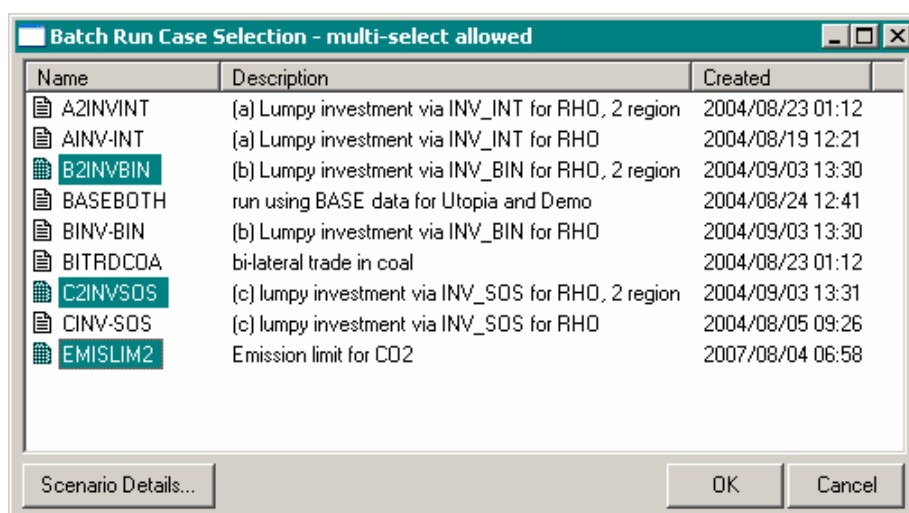
1. If on the Data/Results Screen, return to the Home Screen by clicking on the **[Home Screen]** icon .
2. Click on the **[Batch Run...]** button  below the Selected Scenarios display, or click on **Run** in the menu bar and choose **Batch Run...** in the drop menu.
3. A Batch Run dialogue box (shown below) will appear, initially empty, with an **[Add...]** button that is used to add new runs to the batch. Alternatively, if there are online stored Batches of Cases (see section 6.4 'Batch Management facility'), the **[Load Batch]** button may be used to add new runs to the batch. See section 6.3.2 below for details regarding the **[Load Batch]** and **[Save Batch]** buttons.



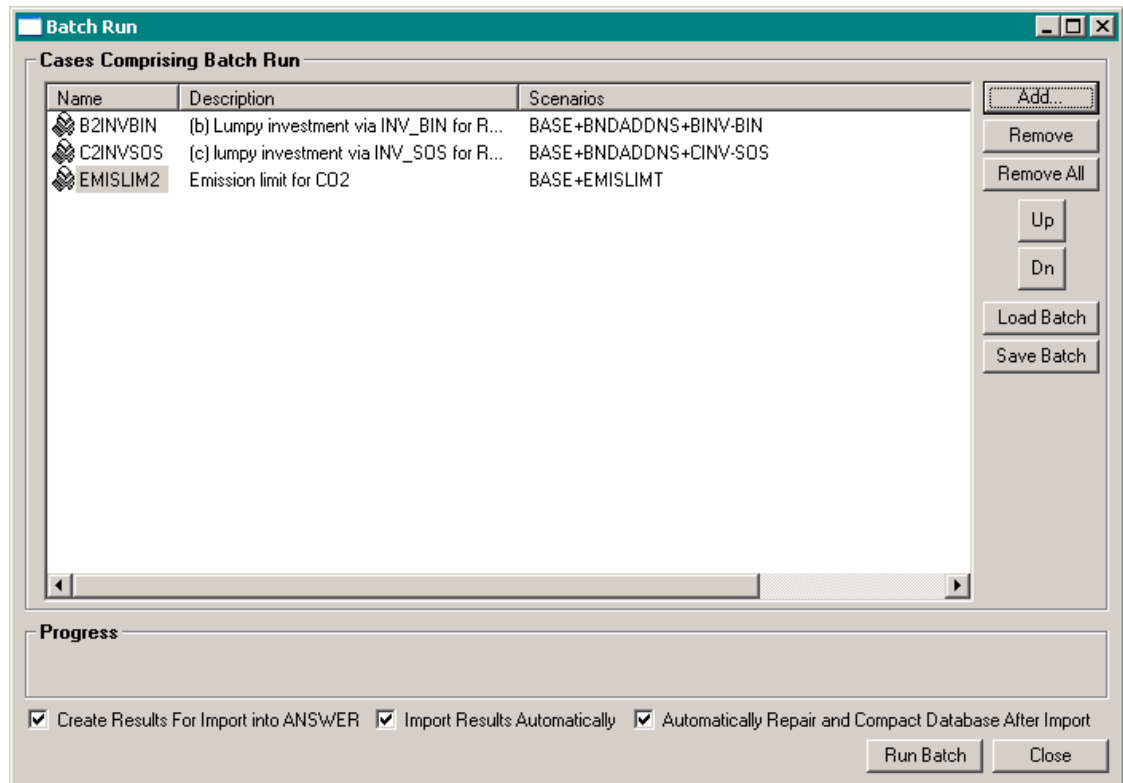
- Click on the **[Add...]** button. The Batch Run Case Selection form appears containing a list of all of the Cases that exist within the database. See below. Note that the caption of this form provides a reminder that multi-select of Cases is allowed. Note also that this form is user-resizable and that ANSWER remembers the last size and position of this form.



- Use standard Windows mechanisms to multi-select the Cases to be added to the batch. For example to multi-select the Cases B2INVBIN, C2INVSOS and EMISLIM2: hold down the Ctrl key and click on A2INVINT to deselect it, then continue to hold down the Ctrl key while clicking on B2INVBIN, C2INVSOS and EMISLIM2. The form now appears as follows:



- Click on **[OK]**. The listview on the Batch Run form now contains the Name, Description and Scenarios for each of the Cases that were multi-selected at step 5. See below.



7. Note that the Batch Run form is user-resizable and that ANSWER remembers the last size and position of this form. So for example where some Cases involve quite a few Scenarios, widening the form will allow the Scenarios that are associated with these Cases to be seen more readily. Likewise where a batch comprises many Cases, deepening the form will minimize the need for vertical scrolling to see the Cases that have been selected.
8. If necessary use the **[Add...]** button to add further Cases to the batch of runs to be carried out. ANSWER has an internal limit of 2048 on the number of runs in a batch.
9. The Batch Run dialogue box allows the user to **[Add...]** and **[Remove]** runs, and to **[Remove All]** runs. It is also possible to move runs up (**[Up]**) and down (**[Dn]**) in the order, although since each run is solved from scratch, the order in which runs are carried out does not affect their solution time.
10. Before initiating the batch run, ensure that the settings of the 'Create Results for Import into ANSWER', 'Import Results Automatically' and 'Automatically Repair and Compact Database After Import' checkboxes are appropriate. The default settings (as above) are particularly convenient for say an overnight batch run, since when the last run in the batch is finished, automatic import of results is carried out for each successful model run (see step 16 below), followed by repair and compact of the database (which is desirable after importing a large number of results and can be quite time-consuming). But if using VEDA-BE to examine Results, rather than ANSWER, uncheck the 'Create Results for Import into ANSWER' checkbox. This automatically unchecks the 'Import Results Automatically' and the 'Automatically Repair and Compact Database After Import' checkboxes.
Note that the settings of these checkboxes for the Batch Run facility are independent of the settings of the checkboxes of the same name in the Run Model facility. The settings are saved to the registry and will be used the next time the Batch Run facility is invoked.
11. To initiate the batch run once all the Cases to be run have been added to the listview, click on the **[Run Batch]** button.
12. All of the files that are needed for the batch run are generated. This includes the GEN, RPT, SLV files and the CMD/BAT files for each Case, as well as the BASE DD files and non-BASE DDS files that are needed for every Case in the batch run. (The **Progress** frame in the Batch Run dialogue box displays the generation of the DD and DDS files.) Each BASE+<region>.DD file, and each non-BASE+<region>.DDS file is generated just once.

Exception: In the context of multi-region runs, the BASE+TRADE.DD and <non-BASE scenario>+TRADE.DDS files are an exception to the "generated just once"

phrase above. It is possible that in a batch of multi-region runs, the user may have selected different regions to appear in the GAMS DD/DDS files for different runs. If this is the case, then for example the BASE+TRADE.DD file will need to differ for different runs. This is handled by ANSWER generating, for run k in the batch, files named BASE+TRADE k .DD and <non-BASE scenario>+TRADE k .DDS.

When run k in the batch occurs, files BASE+TRADE k .DD and <non-BASE scenario>+TRADE k .DDS are copied to BASE+TRADE.DD and <non-BASE scenario>+TRADE.DDS respectively.

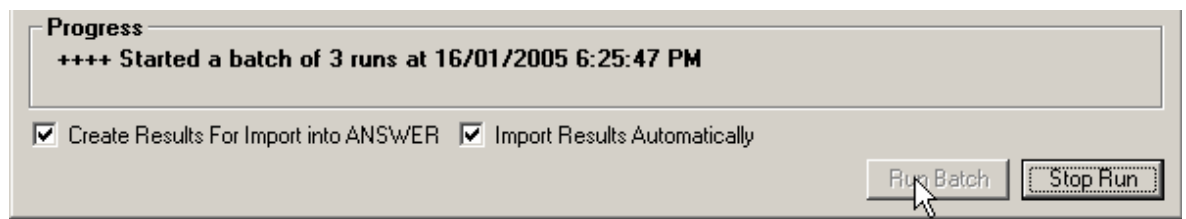
In addition, the Cases display in the Results Management region of the Home Screen is updated to show each Case's name and description, with a Status of 'GAMS running...'.¹

13. After the generation of the DD and DDS files, the Batch Run form remains open and a Command Prompt window opens and the GAMS runs for each Case occur one after the other under the control of a file called MASTER.CMD (or MASTER.BAT).

Do not close the Command Prompt Window until all the GAMS runs are completed (unless you want to prematurely terminate the GAMS runs) !!

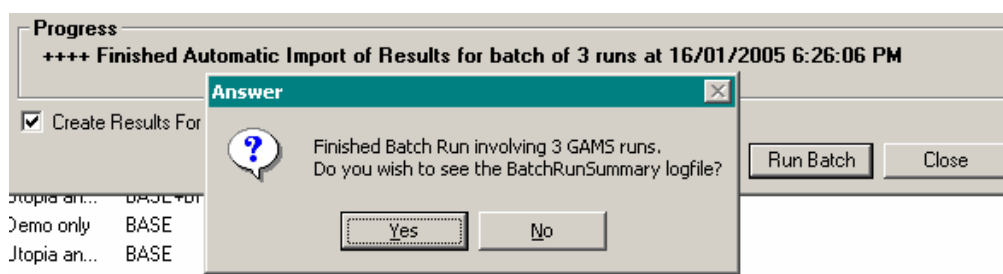
Until such time as all the GAMS runs are completed (and the results have been imported if the 'Import Results Automatically' checkbox is checked), the 'Run Batch' button is disabled and the caption on the 'Close' button changes to 'Stop Run'. Do not click on the 'Stop Run' button (or the X in the top RH corner of the Batch Run form until all the GAMS runs are completed and the results have been imported (unless you want to prematurely terminate the GAMS runs) !!

14. The Progress frame of the Batch Run form is used to display the progress of the runs in the batch. (And also serves as a visual reminder to the user that a Batch Run is being carried out and that ANSWER should not be used.) Shortly after the batch run is initiated, the Progress frame might appear as follows:



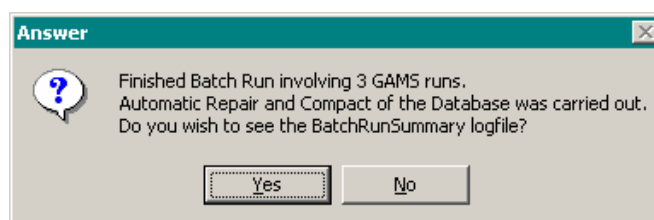
The above screen snapshot is not quite up-to-date: the 'Automatically Repair and Compact Database After Import' checkbox is missing.

15. As the GAMS run for each Case is successfully completed, the Status of that Case in the Cases display is changed from 'GAMS Running...' to 'Not Imported...', and summary information regarding the Case (scenarios, regions, model status, finish time) is written to the file BatchRunSummary.log in the ANSWER Work folder (C:\AnswerV6\Ans_WrkPRD). In addition the Progress frame of the Batch Run form is updated, and the icon associated with that case in the 'Cases Comprising Batch Run' listview changes from 'Running' (🔄) to 'Not Imported' (❌), so that it is easy to see how the runs in the batch are progressing.
16. When the GAMS run for the final Case is completed, automatic import of results is carried out for each successful model run (assuming that the 'Import Results Automatically' checkbox was checked). Summary information regarding the import of each Case's results is written to the file BatchRunSummary.log. When the import of results has finished an appropriate message is written to the Progress frame of the Batch Run form, and a message box appears as follows:



The above screen snapshot is not quite up-to-date: the 'Automatically Repair and Compact Database After Import' checkbox is missing.

If the 'Automatically Repair and Compact Database After Import' checkbox was also checked, then when the import of results has finished the Batch Run form is closed, the database is repaired and compacted, and the following message box appears:



17. Click on the **[Yes]** button to display the BatchRunSummary.log file in Wordpad. See below. If for any run in the batch the BatchRunSummary.log file indicates a Model status that is not one of 'Optimal', 'Locally Optimal', or 'Integer solution', this is an indication of a data omission or error for that particular run, whose source will need to be investigated (see Section 6.2 'Run Model Detection and Correction of Inconsistencies and Errors').

```

BatchRunSummary.log - WordPad
File Edit View Insert Format Help

++++ Started a batch of 3 runs at 16/01/2005 6:25:47 PM

Finished GAMS run B2INVBIN involving scenarios 'BASE','BNDADDNS','BINV-BIN'
and regions 'DEMO','UTOPIA'
Model status: Integer solution
Finished run 1 of batch of 3 runs at 16/01/2005 6:25:53 PM

Finished GAMS run C2INVSOS involving scenarios 'BASE','BNDADDNS','CINV-SOS'
and regions 'DEMO','UTOPIA'
Model status: Optimal
Finished run 2 of batch of 3 runs at 16/01/2005 6:25:58 PM

Finished GAMS run EMISLIM2 involving scenarios 'BASE','EMISLIMT'
and regions 'DEMO','UTOPIA'
Run failed - see file C:\A\Multi_Dev\Ans_WrkPRD\BATCH3.LOG for details.
Finished run 3 of batch of 3 runs at 16/01/2005 6:26:03 PM

++++ Started Automatic Import of Results for batch of 3 runs at 16/01/2005 6:26:03 PM

Import of Results for GAMS Run 1 (B2INVBIN):
TRADE: 0 records imported.
DEMO: Records imported 1153, not imported 1.
UTOPIA: 288 records imported.

Import of Results for GAMS Run 2 (C2INVSOS):
TRADE: 0 records imported.
DEMO: Records imported 1153, not imported 1.
UTOPIA: 297 records imported.

GAMS Run 3 (EMISLIM2) failed. Import of Results not attempted.

++++ Finished Automatic Import of Results for batch of 3 runs at 16/01/2005 6:26:06 PM
For Help, press F1

```

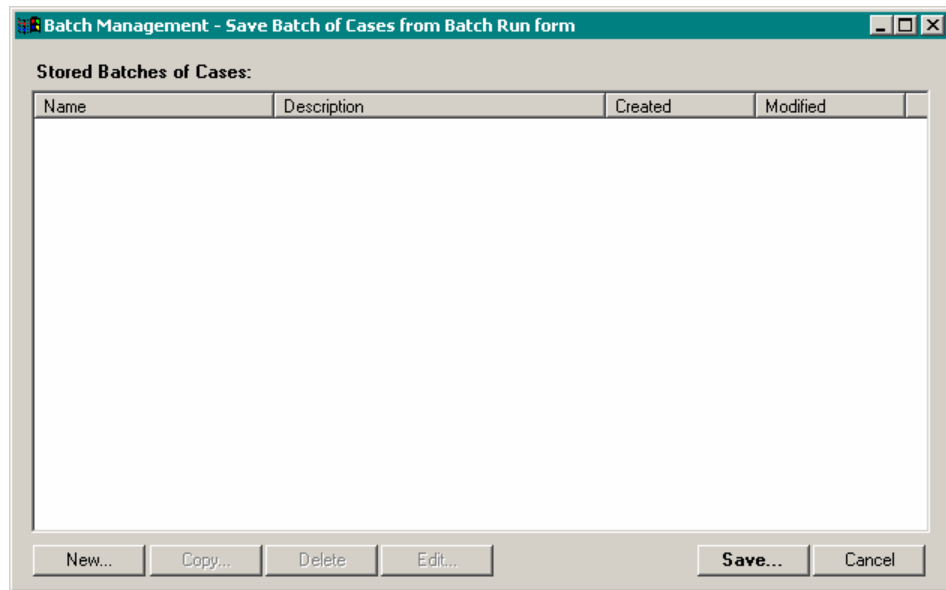
18. If the 'Import Results Automatically' checkbox was unchecked, in the Cases display the Status of each successful model run will be 'Not Imported...'. Use the **[Import...]** button below the Cases display in the standard fashion to Import the results for each successfully run Case into ANSWER.
19. A batch run is allowed to comprise stochastic runs as well as non-stochastic runs. Each stochastic run has a single entry in the Batch Run dialogue box (e.g. STOCUT-1) but will generate several Cases in the Cases display in the Results Management region of the Home Screen (e.g. STOCUT-1, STOCUT-2, ..., STOCUT-5).
20. Batch run details are retained in memory. Thus provided that ANSWER remains open and with the same database loaded, the next time the user clicks the **[Batch Run...]** button, the listview on the Batch Run form will contain the same runs as appeared when the user last clicked on either the **[Run Batch]** or **[Close]** button. However there is a caveat: if the user clicks on the **[Run Batch]** button and with the 'Automatically Repair and Compact Database After Import' checkbox checked, the batch run details are not retained.

6.3.2 Using the [Save Batch] button

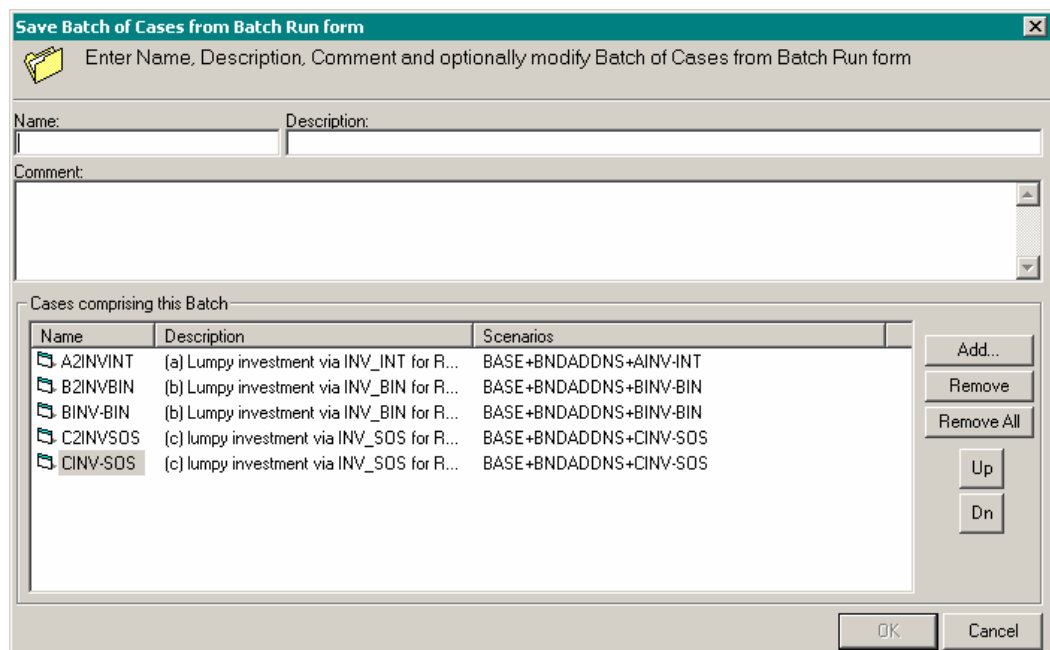
The **[Save Batch]** button allows the user who has built up a list of Cases on the Batch Run form to save this Batch inside the ANSWER database with a Name, for subsequent easy recall to the Batch Run form by use of the **[Load Batch]** button. (See section 6.3.3 below and also section 6.4 for details of the Batch Management facility).

To save the list of Cases on the Batch Run form to the ANSWER database as a stored Batch of Cases:

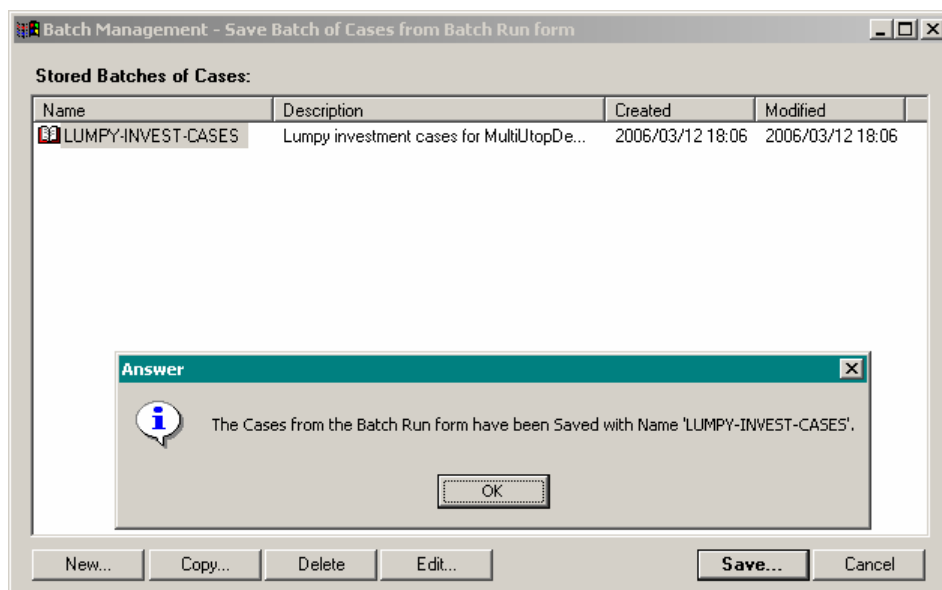
1. Click on the **[Save Batch]** button. This brings up the Batch Management form, displayed below for the situation in which there are no stored Batches of Cases in the database:



2. Click on the **[Save...]** button and a 'Save Batch of Cases ...' dialogue box will appear, with Name, Description and Comment empty, and with the 'Cases comprising this Batch' listview populated with the Cases from the Batch Run form:

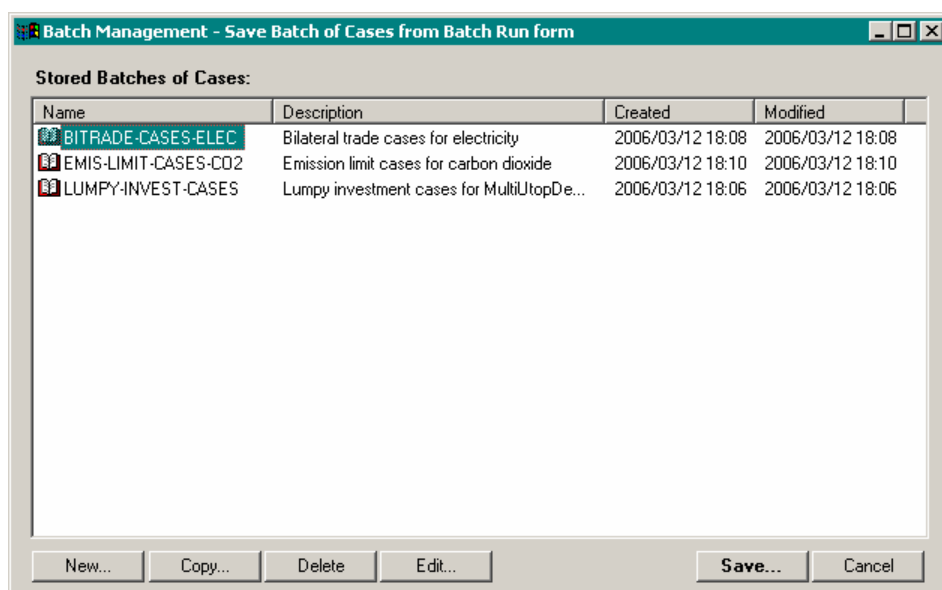


3. Enter the Name and Description for the new Batch of Cases. (Once this is done the **[OK]** button will become enabled.) Optionally enter a Comment. It is allowable to modify the Cases that comprise the Batch so that they differ from those on the Batch Run form (doing so will not affect the Cases that are on the Batch Run form). Then click on the **[OK]** button, and the following message box will be displayed:



Note that the 'Stored Batches of Cases' listview on the Batch Management form has been updated to display the Name and Description entered for the new Batch of Cases.

4. Click on the **[OK]** button for the message box, to be returned to the Batch Run form.
5. If the user clicks on the **[Save Batch]** button when there are stored Batches of Cases in the database, the Batch Management form that is displayed will appear as follows:



6. Now the user is faced with three different situations:
 - a. Wanting to save the Cases on the Batch Run form with the *same* Name and Description (Comment) as one of the existing stored Batch of Cases. That is, effectively wanting to edit one of the stored Batch of Cases to replace the Cases that currently comprise this Batch with the Cases on the Batch Run form.
 - b. Wanting to save the Cases on the Batch Run form with a *similar* Name and Description (Comment) to one of the existing stored Batch of Cases.
 - c. Wanting to save the Cases on the Batch Run form with a Name and Description (Comment) that are *dissimilar* to those of existing stored Batch of Cases.

In either of situations a. or b., select the Batch of Cases that has the same/similar Name in the 'Stored Batches of Cases' listview (by clicking on its icon), and then click on the **[Save...]** button. In situation c., simply click on the **[Save...]** button.

- 7a. Suppose that the user is in situation a., and selects the existing Batch of Cases LUMPY-INVEST-CASES and then clicks on the **[Save...]** button. The 'Save Batch of Cases ...' dialogue box will appear, with Name, Description and Comment the same as for existing Batch LUMPY-INVEST-CASES, and with the 'Cases comprising this Batch' listview populated with the Cases from the Batch Run form. (The Cases from the Batch Run form differ slightly from those displayed at 2 above, in that an extra Case AINV-INT is included.)

Name	Description	Scenarios
A2INVINT	(a) Lumpy investment via INV_INT for R...	BASE+BNDDADDNS+AINV-INT
AINV-INT	(a) Lumpy investment via INV_INT for R...	BASE+BNDDADDNS+AINV-INT
B2INVBIN	(b) Lumpy investment via INV_BIN for R...	BASE+BNDDADDNS+BINV-BIN
BINV-BIN	(b) Lumpy investment via INV_BIN for R...	BASE+BNDDADDNS+BINV-BIN
C2INVSQS	(c) lumpy investment via INV_SQS for R...	BASE+BNDDADDNS+CINV-SQS
CINV-SQS	(c) lumpy investment via INV_SQS for R...	BASE+BNDDADDNS+CINV-SQS

Click on the **[OK]** button, and a message box will be displayed confirming that "The Cases from the Batch Run form have been Saved with Name 'LUMPY-INVEST-CASES'". After clicking on the **[OK]** button for this message box, the user will be returned to the Batch Run form.

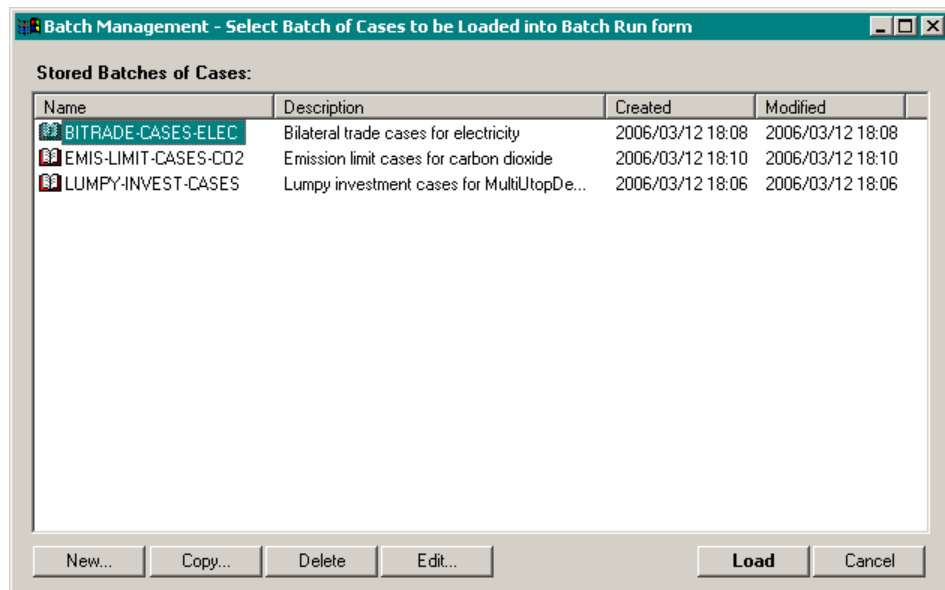
- 7b. Suppose that the user is in situation b., and selects the existing Batch of Cases LUMPY-INVEST-CASES because it has a *similar* Name and Description to what is wanted, and then clicks on the **[Save...]** button. The 'Save Batch of Cases ...' dialogue box will appear exactly as for 7a. above. Edit Name and Description (Comment) to what is wanted, and click on the **[OK]** button. Again a message box will be displayed confirming that the Cases from the Batch Run form have been Saved, and after clicking on the **[OK]** button for this message box, the user will be returned to the Batch Run form.
- 7c. Suppose that the user is in situation c., and clicks on the **[Save...]** button. The 'Save Batch of Cases ...' dialogue box will appear, with Name, Description and Comment matching whatever happens to be the currently selected Batch (this will be Batch BITRADE-CASES-ELEC, see screen snapshot at 5 above), again with the 'Cases comprising this Batch' listview populated with the Cases from the Batch Run form. Hit the Delete key to clear the Name textbox and enter the desired Name (and likewise for Description and Comment), and click on the **[OK]** button. Again a message box will be displayed confirming that the Cases from the Batch Run form have been Saved, and after clicking on the **[OK]** button for this message box, the user will be returned to the Batch Run form.
8. Note that after step 5 brings up the Batch Management form, and prior to clicking on the **[Save...]** button at step 6, it is allowable to use the **[New...]**, **[Copy...]**, **[Delete]**, **[Edit...]** buttons on the form to modify the currently stored Batches of Cases.

6.3.3 Using the [Load Batch] button

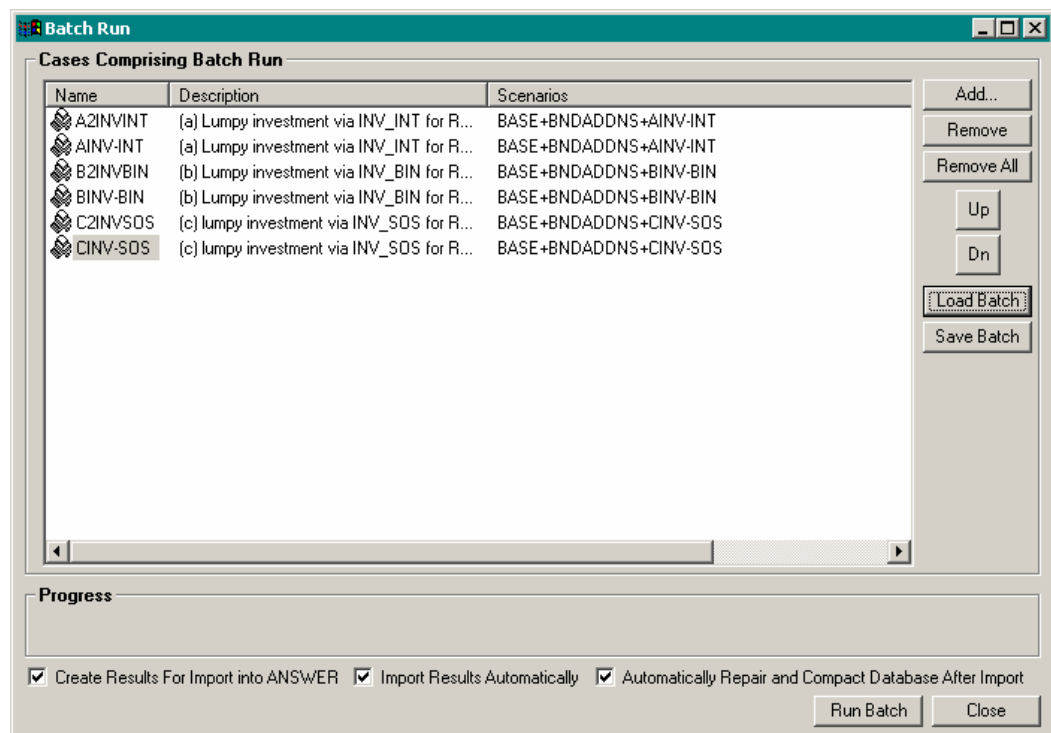
The **[Load Batch]** button allows the user to easily recall a stored Batch of Cases to the Batch Run form. The Batch of Cases that is recalled may be a Batch that was created by use of the **[Save Batch]** button, or by use of the Batch Management facility. (See section 6.3.2 above, and also section 6.4 for details of the Batch Management facility.)

To recall a stored Batch of Cases to the Batch Run form:

1. Click on the **[Load Batch]** button. This brings up the Batch Management form:



2. Select the stored Batch of Cases to be recalled to the Batch Run form, for example select LUMPY-INVEST-CASES (by clicking on its icon) and click on the **[Load]** button. The user is returned to the Batch Run form, where the Cases that comprise the Batch LUMPY-INVEST-CASES have been added:



3. The user may immediately run this Batch of Cases by clicking on the **[Run Batch]** button, or alternatively may modify the Cases comprising the Batch Run by adding or removing Cases before then clicking on the **[Run Batch]** button. In addition, the **[Save Batch]** button may be used at any time prior to invoking **[Run Batch]** to save the Batch of Cases on the Batch Run form as a stored Batch of Cases.

4. Note that after step 1 brings up the Batch Management form, and prior to clicking on the **[Load]** button at step 2, it is allowable to use the **[New...]**, **[Copy...]**, **[Delete]**, **[Edit...]** buttons on the form to modify the currently stored Batches of Cases.

6.4 Batch Management facility

The Batch Management facility allows the user to create, copy, delete and edit named Batches of Cases inside an ANSWER Database. This facility is used in conjunction with the **[Load Batch]** and **[Save Batch]** buttons on the Batch Run form to allow the user to store and hence easily recall a Batch of Cases to be re-run. See also section 6.3 'Batch Run facility for Multiple Model Runs', with particular reference to sections 6.3.2 'Using the [Save Batch] button' and section 6.3.3 'Using the [Load Batch] button'.

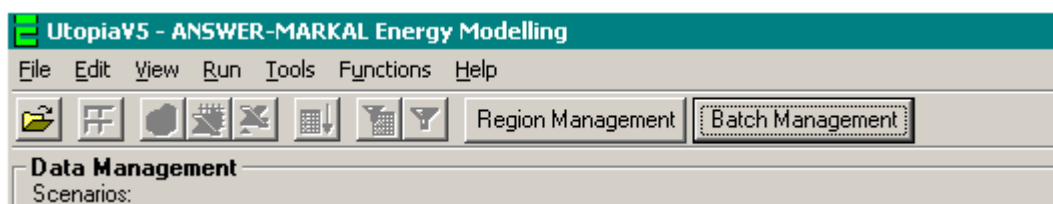
The Batch Management facility allows the user to:

5. View the Names and Descriptions of existing Batches of Cases.
6. Create a new Batch of Cases.
7. Copy an existing Batch of Cases to create a new Batch of Cases.
8. Delete an existing Batch of Cases.
9. Edit the Name, Description or Comment of an existing Batch of Cases and/or change the Cases that are associated with an existing Batch of Cases.

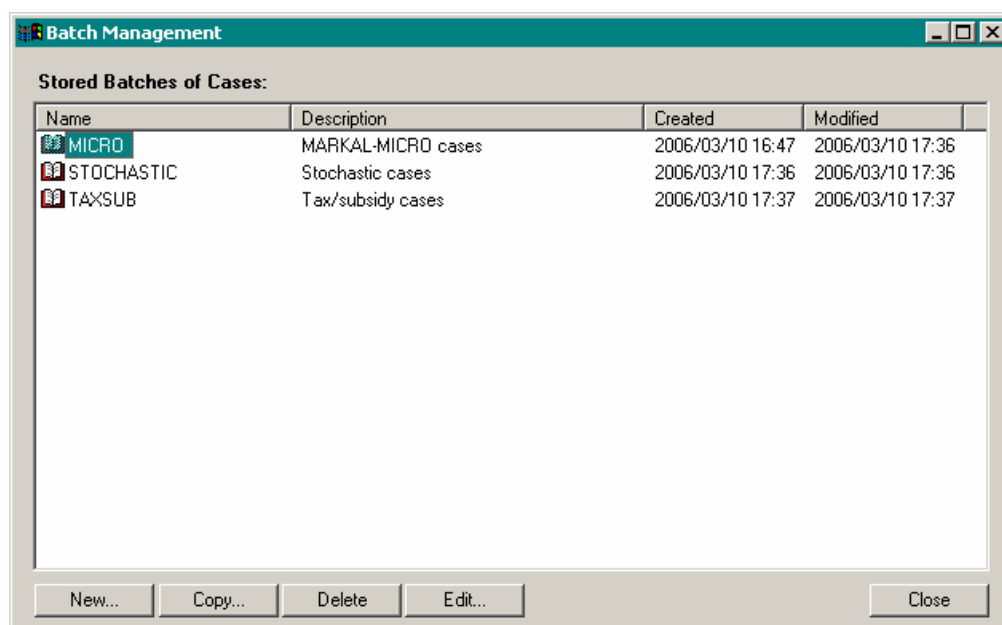
6.4.1 Invoking the Batch Management facility and viewing existing Batches of Cases

To invoke the Batch Management facility:

1. On the Home Screen, click on the **[Batch Management]** button in the Tool Bar row, or click on **E**dit in the menu bar and choose **Batch Management...** in the drop menu.



2. The Batch Management form will appear, displaying the Names, Descriptions and Dates Created and Modified of Batches of Cases stored within the Database.



(The first time you invoke this facility for a database, the Batch Management form will be empty.)

3. The **[New...]**, **[Copy...]**, **[Delete]** and **[Edit...]** buttons below the 'Stored Batches of Cases' listview allow the user to create a new Batch of Cases either from scratch or by copying an existing Batch of Cases, or to delete or edit an existing Batch of Cases. These facilities are detailed below.

6.4.2 Creating a new Batch of Cases

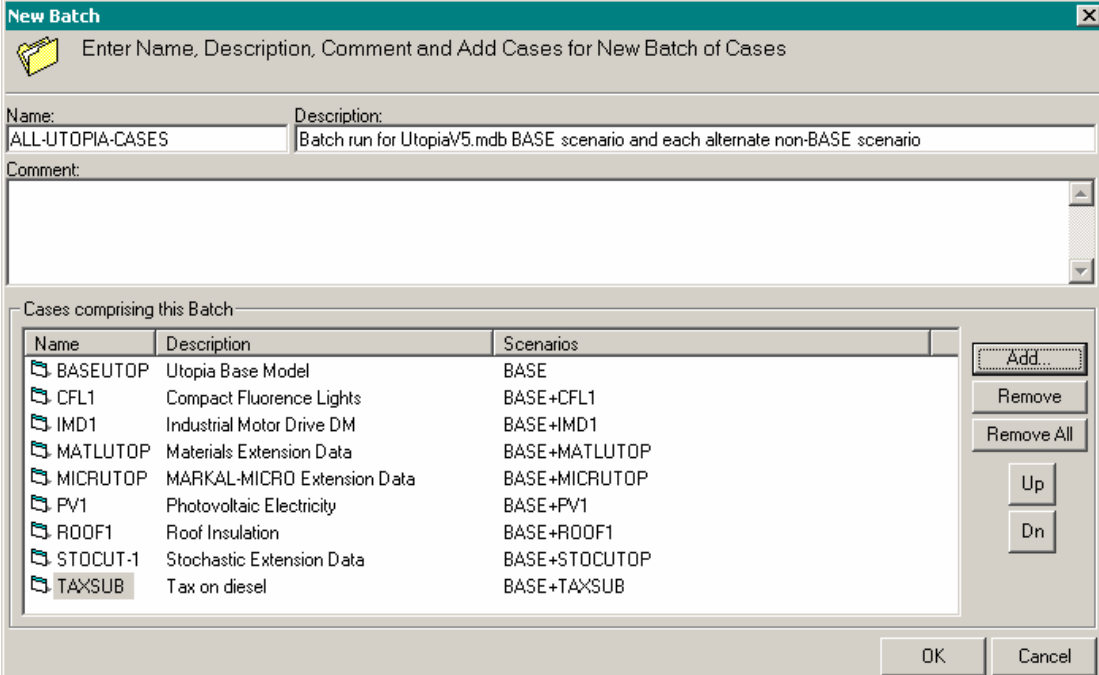
To create a new Batch of Cases from scratch:

1. Invoke the Batch Management facility to bring up the Batch Management form.
2. Click on the **[New...]** button and a New Batch form will appear, initially with Name, Description, Comment and 'Cases comprising this Batch' all empty:

3. Enter the Name and Description for the new Batch of Cases. (Once this is done the **[OK]** button will become enabled.) Optionally enter a Comment. Click on the **[Add...]** button to bring up the Case Selection form, multi-select Cases to be added to the 'Cases comprising this Batch' listview, and click on the **[OK]** button:

Name	Description	Created
<input checked="" type="checkbox"/> BASEUTOP	Utopia Base Model	2004/08/23 01:07
<input checked="" type="checkbox"/> CFL1	Compact Fluorence Lights	2004/08/02 17:51
<input checked="" type="checkbox"/> IMD1	Industrial Motor Drive DM	2004/08/02 17:52
<input checked="" type="checkbox"/> MATLUTOP	Materials Extension Data	2004/08/23 01:08
<input checked="" type="checkbox"/> MICRUTOP	MARKAL-MICRO Extension Data	2004/08/23 01:08
<input checked="" type="checkbox"/> PV1	Photovoltaic Electricity	2004/08/02 17:55
<input checked="" type="checkbox"/> ROOF1	Roof Insulation	2004/08/02 17:55
<input checked="" type="checkbox"/> STOCUT-1	Stochastic Extension Data	2004/09/03 13:05
<input checked="" type="checkbox"/> STOCUT-2	Stochastic Extension Data	2004/09/03 13:05
<input checked="" type="checkbox"/> STOCUT-3	Stochastic Extension Data	2004/09/03 13:05
<input checked="" type="checkbox"/> STOCUT-4	Stochastic Extension Data	2004/09/03 13:05
<input checked="" type="checkbox"/> STOCUT-5	Stochastic Extension Data	2004/09/03 13:05
<input checked="" type="checkbox"/> TAXSUB	Tax on diesel	2004/08/23 01:08

4. The New Batch form will now appear as follows:



New Batch

Enter Name, Description, Comment and Add Cases for New Batch of Cases

Name: ALL-UTOPIA-CASES Description: Batch run for UtopiaV5.mdb BASE scenario and each alternate non-BASE scenario

Comment:

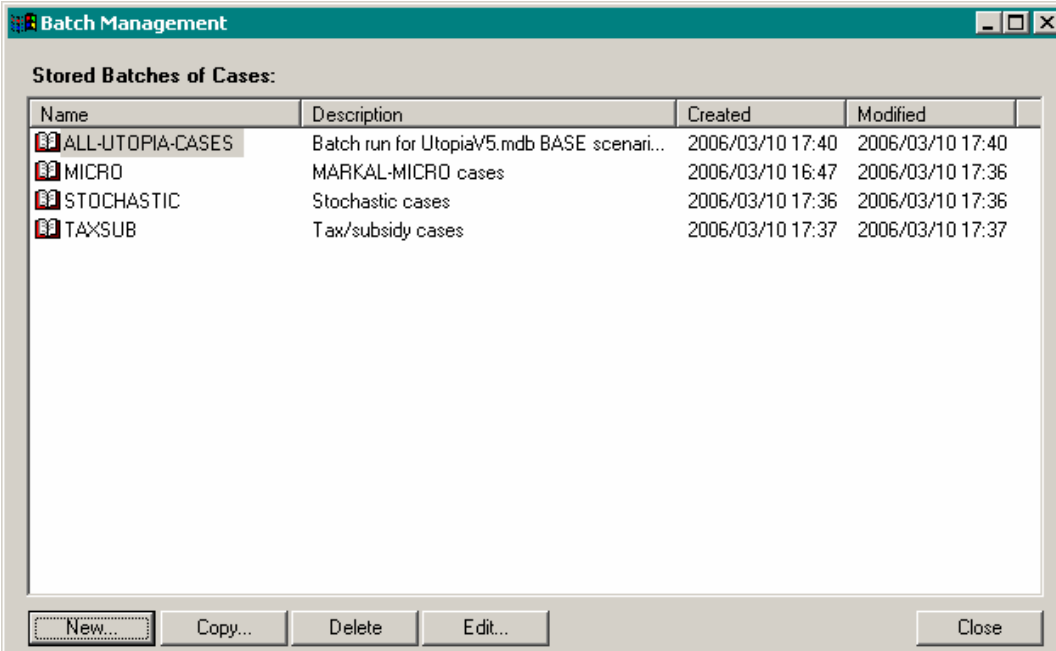
Cases comprising this Batch

Name	Description	Scenarios
BASEUTOP	Utopia Base Model	BASE
CFL1	Compact Fluorence Lights	BASE+CFL1
IMD1	Industrial Motor Drive DM	BASE+IMD1
MATLUTOP	Materials Extension Data	BASE+MATLUTOP
MICRUTOP	MARKAL-MICRO Extension Data	BASE+MICRUTOP
PV1	Photovoltaic Electricity	BASE+PV1
ROOF1	Roof Insulation	BASE+ROOF1
STOCUT-1	Stochastic Extension Data	BASE+STOCUTOP
TAXSUB	Tax on diesel	BASE+TAXSUB

Buttons: Add..., Remove, Remove All, Up, Dn, OK, Cancel

Use the **[Up]** and **[Dn]** buttons to alter the order in which the Cases occur within the Batch.

- Click on **[OK]** and the newly created Batch of Cases will be saved to the Database. It will also be displayed in the 'Stored Batches of Cases' listview of the Batch Management form.



Batch Management

Stored Batches of Cases:

Name	Description	Created	Modified
ALL-UTOPIA-CASES	Batch run for UtopiaV5.mdb BASE scenari...	2006/03/10 17:40	2006/03/10 17:40
MICRO	MARKAL-MICRO cases	2006/03/10 16:47	2006/03/10 17:36
STOCHASTIC	Stochastic cases	2006/03/10 17:36	2006/03/10 17:36
TAXSUB	Tax/subsidy cases	2006/03/10 17:37	2006/03/10 17:37

Buttons: New..., Copy..., Delete, Edit..., Close

6.4.3 Copying a Batch of Cases

Copying an existing Batch of Cases allows the user to create a new Batch of Cases that is similar to the Batch being copied.

To copy a Batch of Cases:

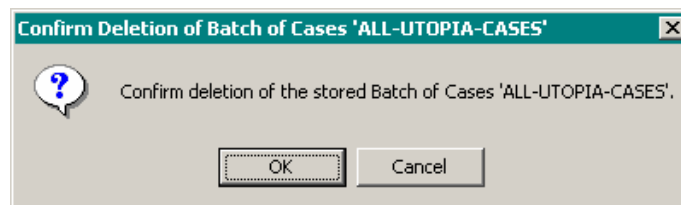
- Invoke the Batch Management facility to bring up the Batch Management form.

2. In the 'Stored Batches of Cases' listview, highlight the Batch of Cases that is to be copied.
3. Click on the **[Copy...]** button.
4. A Copy Batch form (similar to the New Batch form above) will appear.
5. Enter a new Name and new Description for the new Batch of Cases. The **[OK]** button will then be enabled. Optionally provide a Comment, and use the **[Add...]** or **[Remove]** or **[Remove All]** buttons to change the Cases comprising the new Batch of Cases. Use the **[Up]** and **[Dn]** buttons to alter the order in which the Cases occur within the Batch.
6. Click on **[OK]** and the newly created Batch of Cases will be saved to the Database. It will also be displayed in the 'Stored Batches of Cases' listview of the Batch Management form.

6.4.4 Deleting a Batch of Cases

To delete a Batch of Cases:

1. Invoke the Batch Management facility to bring up the Batch Management form.
2. In the 'Stored Batches of Cases' listview, highlight the Batch of Cases that is to be deleted.
3. Click on the **[Delete]** button.
4. A Confirm Deletion of stored Batch of Cases information box will be displayed:



5. Click on **[OK]** and the Batch of Cases will be deleted from the Database. The Batch of Cases will also be deleted from the 'Stored Batches of Cases' listview of the Batch Management form.

6.4.5 Editing a Batch of Cases

To edit the Name or Description or Comment, or change the Cases comprising a Batch of Cases, or change the Case order:

1. Invoke the Batch Management facility to bring up the Batch Management form.
2. In the 'Stored Batches of Cases' listview, highlight the Batch of Cases that is to be edited.
3. Click on the **[Edit...]** button.
4. An Edit Batch form (similar to the New Batch form above) will appear.
5. Change the Name and/or Description and/or Comment for the Batch of Cases, or use the **[Add...]** or **[Remove]** or **[Remove All]** buttons to change the Cases comprising the Batch of Cases. Or use the **[Up]** and **[Dn]** buttons to alter the order in which the Cases occur within the Batch. The **[OK]** button will become enabled when any of these changes is made.
6. Click on **[OK]** and the edited Batch of Cases information will be saved to the Database, and displayed in the 'Stored Batches of Cases' listview of the Batch Management form.

Section Seven: ANSWER MARKAL Results

This Section introduces the user to the Tables and Results Parameters used by Standard MARKAL to present the results of a model run or Case. It then takes the user through the facilities for viewing the results of a MARKAL Case. As mentioned in the Introduction, users of this manual are expected to be familiar with MARKAL, including its Results Parameters.

Multi-region

The text and the screen snapshots that follow have been updated to correspond to what the user sees when working with a multi-region database.

7.1 MARKAL Results Parameters

The results typically determined by a MARKAL model run include:

1. the activity and capacity level for each conversion technology in each time period
2. the capacity level for each demand technology in each time period
3. the level of additional capacity for each conversion, process and demand technology developed in each time period
4. the activity level for each resource technology in each time period
5. a full range of energy prices, such as
 - . the price of electricity, by season and time of day
 - . the price of gas
 - . the price of energy provided by renewable technologies
6. the emission levels for each technology and the total energy system in each time period.

In Standard MARKAL, there are some 220 different Results Parameters for reporting results of a model run or Case. When Results Parameters associated with extended versions of MARKAL are included, this number grows to over 300. To assist the user in understanding the Case results, the Results Parameters are aggregated into about 20 Results Tables (shown below). It should be noted that only a limited number of Results Parameters are likely to be of relevance to an analysis being undertaken.

A comprehensive listing of the MARKAL Results Parameters is attached at Appendix A2.2. Users of this manual are expected to be familiar with MARKAL's Results Parameters.

7.1.1 MARKAL Results Tables

ANSWER presents the results of a Case as a editable/printable file report or for browsing on-line in the Data/Results Screen. The user will observe when viewing the results in the file report and in the Parameters Component, that the Results Parameters are aggregated into about 20 standard MARKAL Results Tables, namely

Table Name	Table Title
Table T01	Scenario Indicators
Table T02	Summary
Table T03	Primary Energy Supply
Table T04	Output of Energy by Technology
Table T05	Fuel Consumption by Demand Sector
Table T06	Useful Energy by Demand Device
Table T08	Use of Energy Carriers by Technology
Table T09	Shadow Prices of Energy Carriers and Emissions
Table T11	Reduced Costs of Technologies, End-Use Demands, Emissions, etc.
Table T25	Annualised Resource and Technology Costs
Table T27ENV	Annual Environmental Effects
Table T30	Adjustments to Demand for MARKALED

Table Name	Table Title
Table ACT	Activity of Processes - Solution Values
Table CAP	Capacity Utilisation of Technologies
Table COSTBEN	Cost/Benefit Ratios
Table DEMAND	Demand Levels - Solution Values
Table GDP	Key MACRO Indicators
Table INV	Investment in Technologies - Quantity and Cost
Table MC	Demand Marginals and PREF Differences.
Table SUPPLY	Resource Supply Levels - Solution Values

See Appendix 2.2 for an alphabetical listing of the MARKAL Results Parameters which appear in each of these Tables.

New TRADE Tables

Two new Results tables allow for the display of Bilateral and Global Trade Results:

Table Name	Table Title
Table TRADE	Bilateral Trade
Table TRADE	Global Trade

7.2 Viewing a Case's results

The results of a Case can be:

1. Viewed, edited, and printed as a file report (OUT file) in Microsoft WordPad; or
2. Browsed on-line in ANSWER; or
3. Viewed and analysed by invoking Microsoft Excel chart and spreadsheet facilities from ANSWER. This feature is detailed in Section 8 'Charting and Analysing ANSWER MARKAL Results'.

7.2.1 Accessing the file report (OUT file) of a Case for editing/printing

This facility enables the user to view, edit, and print the file report(s) – OUT file(s) – of a Case, **provided that the GEN file associated with a single-region run (or the RPT files associated with a multi-region run) has been configured so that an OUT file is created.**

An OUT file will be created for a single region run if you use the **Run, Edit GEN File Template...** menu facility to edit the final line of the file Template.GEN so that it has OUT 3 after the SOLVE, as follows:

```
$BATINCLUDE MMINCLUD.INC <ModelName> <StartRestart> SOLVE OUT 3
```


OUT files will be created for each region comprising a multi-region run if you use the **Run, Edit Multi-Region GEN File Template...** menu facility to edit the final line of the file RegionTemplate.RPT so that it has OUT 3 at the end, as follows:

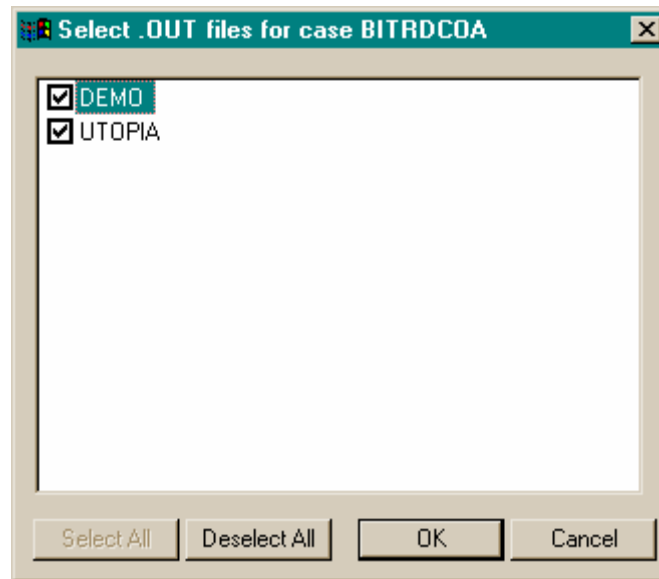
```
$BATINCLUDE REG_RW.REG <ModelName> ' ' ' ' OUT 3
```

Note that for a multi-region run, there will be separate OUT files for each region that comprised the run. The format and content of the file report is pre-set in the MARKAL report generator, and reflects the traditional MARKAL Results Tables format, shown in Section 7.1.1 'MARKAL Results Tables'.

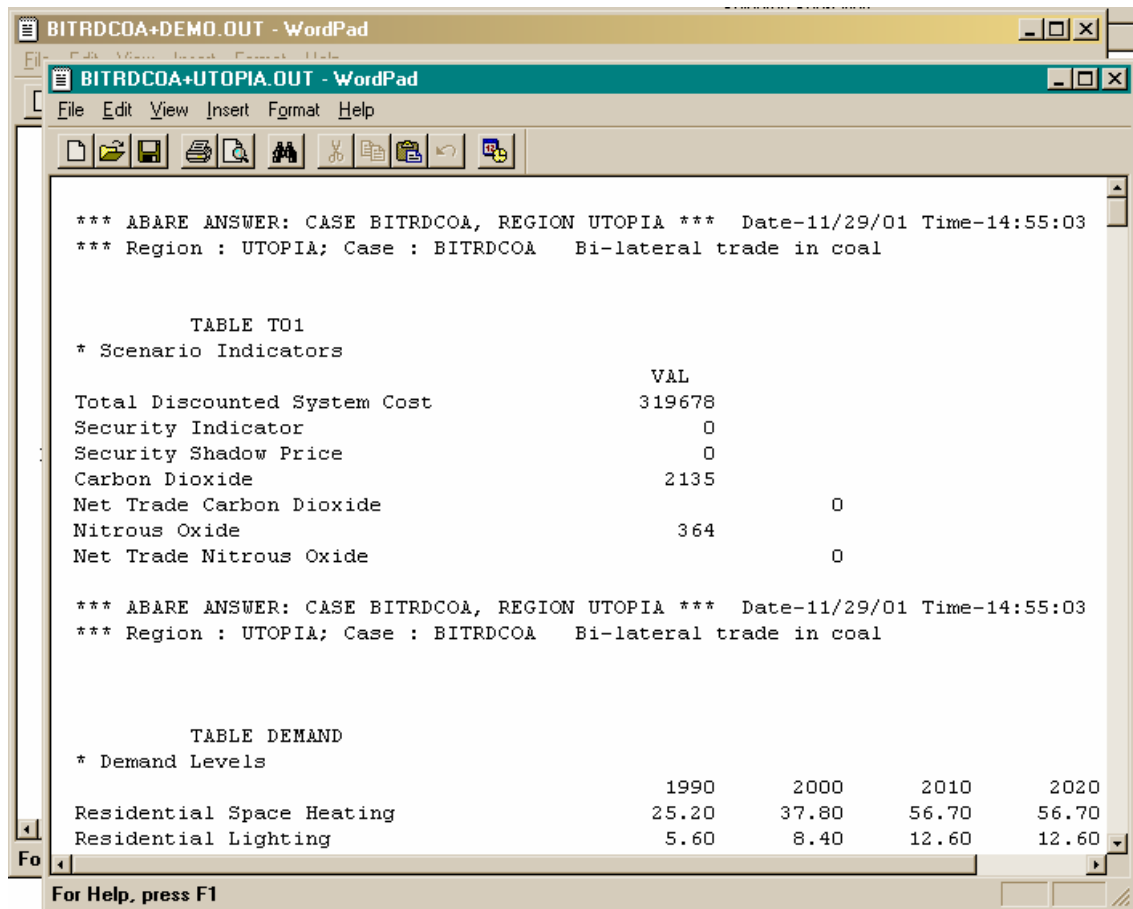
ANSWER imports the OUT file directly into MS WordPad. The user can then edit and print the file using MS WordPad editing and printing features.

To view the Case(s) results as a text file:

1. If on the Data/Results Screen, return to the Home Screen by clicking on the **[Home Screen]** icon .
2. In the Cases display, highlight the Case that is to be viewed.
3. Click on **View** in the Menu Bar and choose **Case File...** in the drop menu.
4. The 'Select .OUT files for case ...' dialogue box will appear.



5. Use the checkboxes to select those Regions for which you wish to view the file report, and click on **[OK]**.
6. The file report for each Region selected at step 5 will be displayed in a separate instance of WordPad. For example, if both DEMO and UTOPIA are selected for case BITRDCOA, BITRDCOA+DEMO.OUT and BITRDCOA+UTOPIA.OUT will be displayed in separate instances of WordPad, as shown below.



7. The reports can then be edited and printed using standard WordPad features.

7.2.2 Browsing a Case(s) results on-line


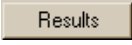
This facility takes the user into the Data/Results Screen to allow on-line browsing of the selected Case(s) results. The facilities of the Data/Results Screen when browsing results are detailed in Section 3.2 'The ANSWER Data/Results Screen'.

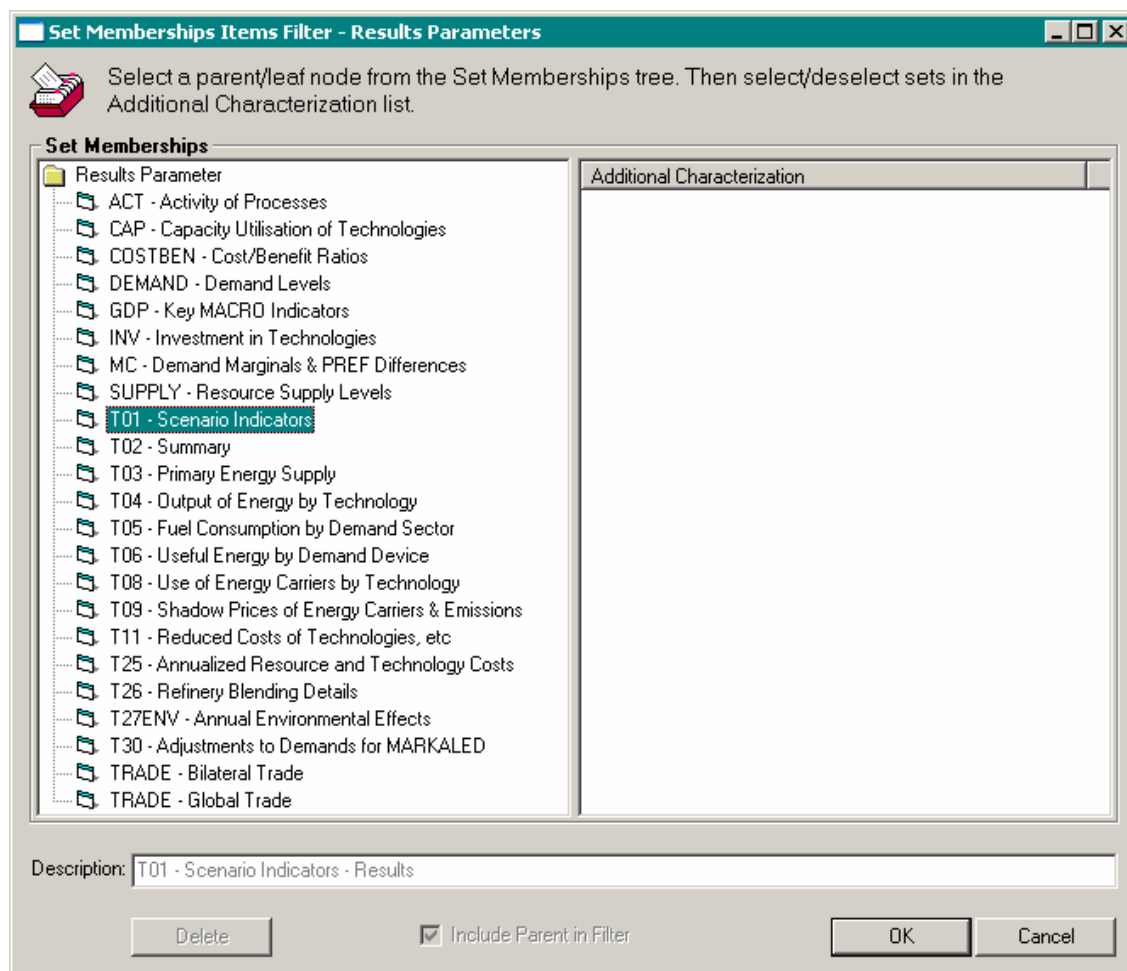
Similar to the Browse data mode, the Results mode enables simultaneous comparison of the results of multiple Cases. This feature enables the user to determine revisions to Scenario data, re-run the model(s), and compare subsequent Case results in a rapid iterative process.

Case(s) results can be browsed on-line in three different ways:

1. On the Parameter tab, with the combobox selection set to '*All Results Parameters', when the Items display will contain all the Results Parameters in alphabetical order.
2. On the Parameter tab, with the combobox selection set to one of the MARKAL Results Tables (e.g. 'T03 - Primary Energy Supply'), when the Items display will contain just those Results Parameters which appear in the selected Results Table.
3. On any other Component tab, for example Technology, in a similar manner to browsing data, when the Items display will contain those Items which comprise that Component.

To browse the selected Case(s) results:

1. If on the Data/Results Screen, return to the Home Screen by clicking on the **[Home Screen]** icon .
2. Ensure the Case(s) to be viewed on-line has(have) been imported into the Cases display.
3. Use the Case selection buttons to ensure that the Selected Cases display contains the Case(s) to be viewed.
4. Click on the **[Results]** button  below the Selected Cases display, or click on **View** in the Menu Bar and click on **Results** in the drop menu.
5. The Data/Results Screen will be displayed for the Parameter tab, initially for the setting '*All Results Parameters'. Results will be displayed for all Cases listed in the Selected Cases display.
6. Using the 'Sets Filter' facility (previously called the 'Enhance Subset Items' facility in version 5 of ANSWER) or the Items combobox (see section 3.5.1), the user can now select either the comprehensive Results Parameters alphabetical listing, i.e. '*All Results Parameters', or one of the Results Tables. In the example below, the Table 'T01 – Scenario Indicators' has been selected.



- For settings such as 'T01 – Scenario Indicators', it is useful to click on the **[Select All Items]** button, in order to see all Results Parameters associated with Table T01.

MultiUtopDemoFLEXT5-P_V6 - ANSWER-MARKAL Energy Modelling

File Edit View Run Tools Functions Help

Results Regions Filter... Items: All Cases: All

Global Energy Material Demand Emission Technology Constraint Tax/Subsidy Stochastic Parameter Trade TimeSlice

Items Filter: Sets Named T01 - Scenario Indicators - Results

Item Management: All 16 items selected

Name	Description	Status
D.TOT.EV-DAMAG	Discounted Total Environmental Damage	
D.TOT.EV-DAMIN	Discounted Total Internalised Environmental Dam...	
D.TOT.TAXSUB	Discounted Total Tax/Subsidy Revenues	
D.TOTCOST	Discounted Total System Cost, Net of Taxes & Su...	
EMIS.TRADE.TOT	Total Net Trade in Emissions	
EMISSION.TOT	Total Emissions	

TID data

Case	Parameter	Region	Emission	Value
BASEBOTH	D.TOTCOST	DEMO		14,231,367
BITRDCOA	D.TOTCOST	DEMO		14,221,774
BASEBOTH	D.TOTCOST	UTOPIA		50,406
BITRDCOA	D.TOTCOST	UTOPIA		314,668
BASEBOTH	EMIS.TRADE.TOT	DEMO	CO2	0
BITRDCOA	EMIS.TRADE.TOT	DEMO	CO2	0
BASEBOTH	EMIS.TRADE.TOT	UTOPIA	CO2	0
BITRDCOA	EMIS.TRADE.TOT	UTOPIA	CO2	0
BASEBOTH	EMIS.TRADE.TOT	UTOPIA	NOX	0
BITRDCOA	EMIS.TRADE.TOT	UTOPIA	NOX	0
BASEBOTH	EMISSION.TOT	DEMO	CO2	20,001,866
BITRDCOA	EMISSION.TOT	DEMO	CO2	21,970,261
BASEBOTH	EMISSION.TOT	UTOPIA	CO2	312
BITRDCOA	EMISSION.TOT	UTOPIA	CO2	2,135
BASEBOTH	EMISSION.TOT	UTOPIA	NOX	364
BITRDCOA	EMISSION.TOT	UTOPIA	NOX	364

Database: C:\AnswerV6\Answer_Databases\MultiUtopDemoFLEXT5-P_V6.mdl | Edit Scenario:

8. Alternatively, the user can select a Component tab other than the Parameter tab and then browse the results applying to specific Items in that Component, in the same manner as when browsing data. In the example below, the Technology Item 'E01 - Coal Steam Electric' in Region UTOPIA has been selected, and its results are displayed in the Parameters spread.

Global Energy Material Demand Emission Technology Constraint Tax/Subsidy Stochastic Parameter Trade TimeSlice

Items Filter: Sets Named *All Technologies (TCH+SRCEPCP)

Item Management: Current Technology: E01

Subset Parameters: * Technology, Specific

TS data

Case	Parameter	Region	Technology	Energy	TimeSlice	1990	2000	2010
BASEBOTH	AC.O&M.FIXED	UTOPIA	E01	-	-	20.00	22.75	15.00
BITRDCOA	AC.O&M.FIXED	UTOPIA	E01	-	-	20.00	22.75	15.00
BASEBOTH	AC.O&M.VAR	UTOPIA	E01	-	-	0.00	0.23	0.28
BASEBOTH	CAPACITY.L	UTOPIA	E01	-	-	0.50	0.33	0.15
BITRDCOA	CAPACITY.L	UTOPIA	E01	-	-	0.50	0.33	0.15
BASEBOTH	CAPACITY.M	UTOPIA	E01	-	-	0.00	0.00	0.00
BITRDCOA	CAPACITY.M	UTOPIA	E01	-	-	0.00	0.00	0.00
BASEBOTH	CAPACITY.UNUSD	UTOPIA	E01	-	-	80.00	72.51	60.00
BITRDCOA	CAPACITY.UNUSD	UTOPIA	E01	-	-	80.00	80.00	80.00
BASEBOTH	FUELUSE.TCH	UTOPIA	E01	HCO	-	0.00	2.40	2.96
BASEBOTH	INVEST.M	UTOPIA	E01	-	-	1,803.37	1,443.75	1,546.76
BITRDCOA	INVEST.M	UTOPIA	E01	-	-	2,565.91	2,830.20	3,001.70
BASEBOTH	LOAD.ANNUAL	UTOPIA	E01	-	-	0.00	7.49	20.00
BASEBOTH	LOAD.SEAS.ELC	UTOPIA	E01	-	S-D	0.00	29.96	80.00
BASEBOTH	LOAD.SEAS.ELC	UTOPIA	E01	-	S-N	0.00	29.96	80.00

Section Eight: Charting and analysing ANSWER MARKAL Results

This Section introduces the user to exporting selected Scenario data and Case results from ANSWER into Microsoft Excel's charting and worksheet facility for presentational and analysis purposes. Users of this manual are expected to be familiar with MS Excel's charting and worksheet features.

ANSWER provides three chart/worksheet facilities for presentation and analysis of Scenario data and Case results:

1. Chart (i.e., export into MS Excel chart)
2. Chart with Excel (i.e., export into MS Excel chart and worksheet)
3. Analyse with Excel (i.e., export into MS Excel worksheet).

Multi-region

ANSWER's three chart/worksheet facilities have been enhanced to allow for multi-region.

The Chart and Chart with Excel facilities are available on all tabs except the Trade tab. (The Chart that is produced is simplified if the data selected by the user for charting involves just a single region.)

The Analyse with Excel facility is available on all tabs including the Trade tab.

The screen snapshots that follow display what the user sees when working with a multi-region database.

8.1 Requirements for exporting data/results to charting/analysis

ANSWER has a number of requirements for exporting Scenario data and Case results to the charting/analysis facilities:

1. ANSWER will export both Scenario data and Case results
2. the rows of data/results that are to be exported must be adjacent to (next to) each other. ANSWER's facilities for sorting by column header and filtering (see Section 3.6.4 'The Parameters spread') may enable the user to co-locate the required rows of data/results
3. any number and configuration of data/results rows can be selected for export to the three chart/worksheet facilities
4. while the number of rows of data/results and the number of periods able to be exported to the three chart/worksheet facilities is virtually unlimited, charts quickly become difficult to understand if they plot any more than about 10 rows of data/results over 9 periods
5. by swiping just the periods required for export, ANSWER will export either all the periods or some subset. The periods must be adjacent
6. rows of data/results selected for exporting can have differing units. While this may be a questionable practice for analytical purposes, it can be useful for charting/presentational purposes. The title for the default units used in a chart will be the units of the first row of data/results, but this can be edited on the chart or in the preceding Chart Options dialogue box (see later Sections).

8.2 The Chart facility

ANSWER's charting facility exports the user's selected data/results from ANSWER into a MS Excel chart sheet.

A chart sheet is a chart on a separate sheet in an Excel workbook, but the chart sheet does not have any worksheet data or worksheets appearing with it in the workbook. A chart with worksheet data appearing in association with it is termed an embedded chart (see Section 8.3 'The Chart with Excel facility').

In ANSWER's Chart facility, the chart is not dynamically linked to the original ANSWER data/results. Consequently, a change in the ANSWER data/results will not result in a commensurate change to the chart.


To create a chart using the Chart facility:

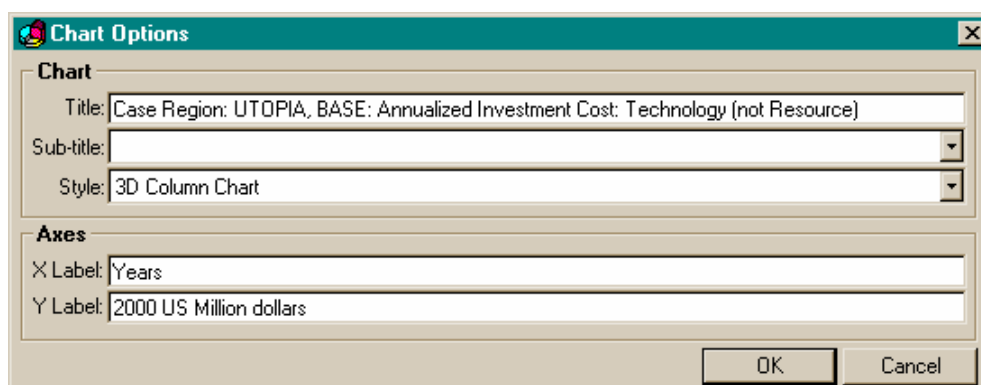
1. Select the rows of data/results in the Parameters spread to be exported by, either
 - i. swiping the left hand column of the required data/results rows (shown below) to select all periods for the selected rows; or

	Case	Parameter		Region	Technology	1990	2000	2010
	BASE	AC.INVEST	?	UTOPIA	E01	0.00	3.81	31.63
	BASE	AC.INVEST	?	UTOPIA	E31	4.53	4.53	4.53

- ii. swiping the required periods (they must be adjacent) of the required data/results rows to select a subset of the periods for the selected rows. In the example below, the periods 1990 and 2000 will be charted.

	Case	Parameter		Region	Technology	1990	2000	2010
	BASE	AC.INVEST	?	UTOPIA	E01	0.00	3.81	31.63
	BASE	AC.INVEST	?	UTOPIA	E31	4.53	4.53	4.53

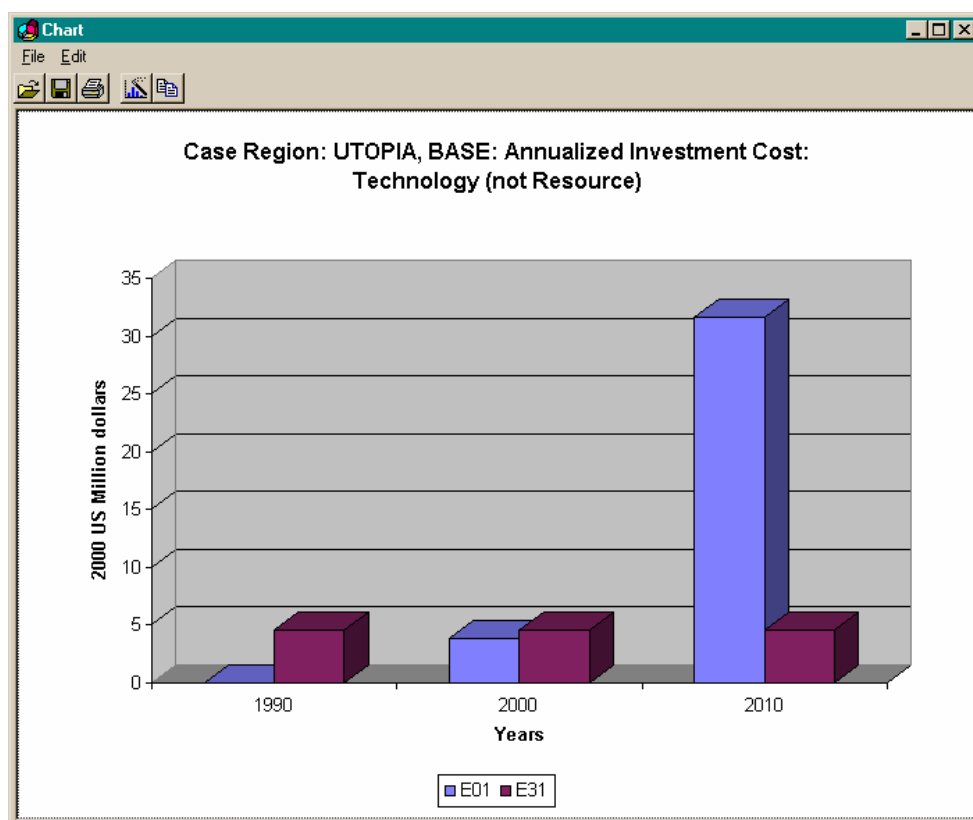
2. Click on the **[Chart] icon** , or click on **T**ools in the menu bar and click on **C**hart... in the drop menu.
3. A Chart Options dialogue box (shown below) will appear.



The Chart Options dialog box has a title bar 'Chart Options' with a close button. It contains two main sections: 'Chart' and 'Axes'. In the 'Chart' section, there are three text boxes: 'Title' (containing 'Case Region: UTOPIA, BASE: Annualized Investment Cost: Technology (not Resource)'), 'Sub-title' (empty), and 'Style' (set to '3D Column Chart'). In the 'Axes' section, there are two text boxes: 'X Label' (containing 'Years') and 'Y Label' (containing '2000 US Million dollars'). At the bottom right, there are 'OK' and 'Cancel' buttons.

4. Fill in and/or edit the Chart specifications:
 - i. Title: a suggested title based on the first selected data/results row will be displayed. The suggestion is fully editable. It can also be edited on the chart itself using MS Excel chart editing facilities.
 - ii. Sub-title: a suggested sub-title will be displayed, based on the last sub-title used. The suggestion is fully editable. It can also be edited on the chart itself using

- MS Excel chart editing facilities. The Sub-title combo box also stores the last four sub-title entries used.
- iii. Style: a suggested chart style, based on the data to be charted, will be displayed. The Style combo box stores other suitable chart styles for selection by the user if required.
 - iv. X (Axes) Label: a suggested label based on the first data/results row will be displayed. The suggestion is fully editable (shown above). In the situation of a chart requiring two X axes labels, editing of the label can be done on the chart itself using MS Excel chart editing facilities.
 - v. Y (Axes) Label: a suggested label based on the first data/results row will be displayed. The suggestion is fully editable (shown above). In the situation of a chart requiring two Y axes labels, editing of the label can be done on the chart itself using MS Excel chart editing facilities.
5. Click on the **[OK]** button and the Chart will be generated and displayed as specified in the Chart Options dialogue box. Using the example results shown in 1.i. above and the suggested chart options shown in 4. above, the following chart is produced.



6. The chart can now be edited and printed using the MS Excel chart facilities, or copied and pasted into a MS Word document.

8.3 The Chart with Excel facility

ANSWER's Chart with Excel facility exports the user's selected data/results from ANSWER into a MS Excel worksheet, with an embedded chart appearing on a separate worksheet in the same workbook.

The data/results for the worksheet and embedded chart are not dynamically linked to the original ANSWER data/results, and, consequently, a change in the ANSWER data/results will not result in a commensurate change to the worksheet and chart.

However, the embedded chart is dynamically linked to the associated worksheet data/results, and, consequently, a change in the worksheet data/results will result in a commensurate change to the chart.


To create a chart and associated worksheet using the Chart with Excel facility:

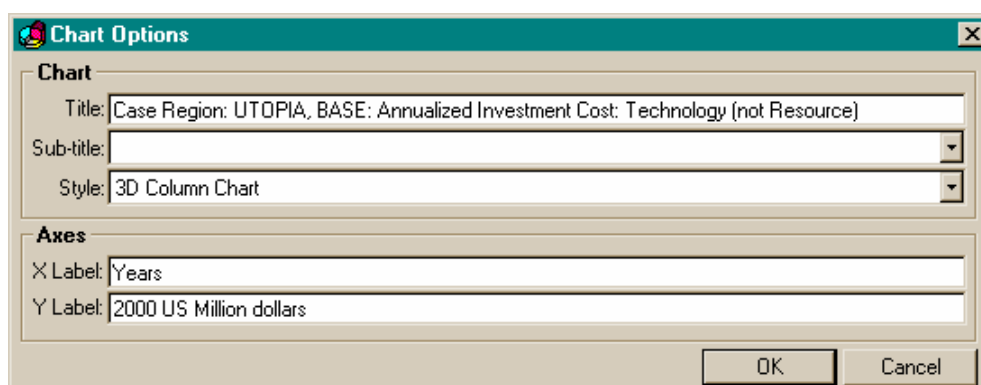
1. Select the rows of data/results in the Parameters spread to be exported by, either
 - i. swiping the left hand column of the required data/results rows (shown below) to select all periods for the selected rows; or

	Case	Parameter		Region	Technology	1990	2000	2010
	BASE	AC.INVEST	?	UTOPIA	E01	0.00	3.81	31.63
	BASE	AC.INVEST	?	UTOPIA	E31	4.53	4.53	4.53

- ii. swiping the required periods (they must be adjacent) of the required data/results rows to select a subset of the periods for the selected rows. In the example below, the periods 1990 and 2000 will be charted and written to the associated worksheet.

	Case	Parameter		Region	Technology	1990	2000	2010
	BASE	AC.INVEST	?	UTOPIA	E01	0.00	3.81	31.63
	BASE	AC.INVEST	?	UTOPIA	E31	4.53	4.53	4.53

2. Click on the **[Chart with Excel]** icon , or click on **Tools** in the menu bar and click on **Chart with Excel...** in the drop menu.
3. A Chart Options dialogue box (shown below) will appear.



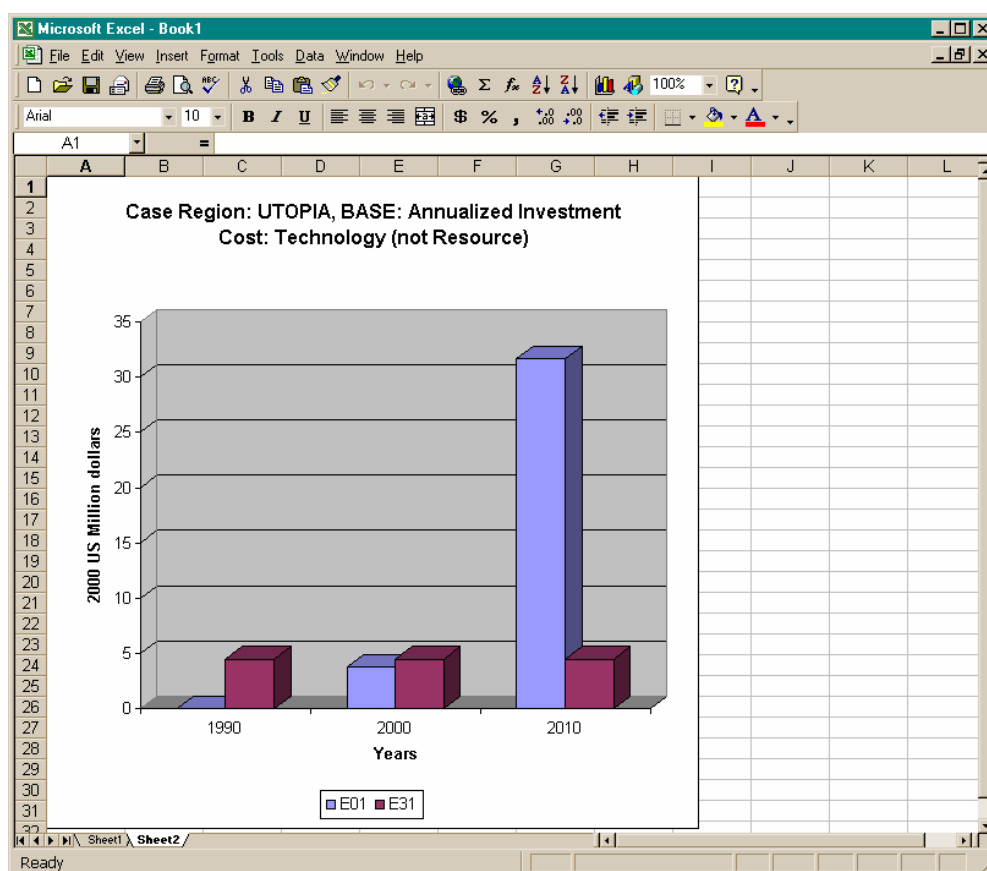
The 'Chart Options' dialog box is shown with the following settings:

- Chart**
 - Title: Case Region: UTOPIA, BASE: Annualized Investment Cost: Technology (not Resource)
 - Sub-title: (empty)
 - Style: 3D Column Chart
- Axes**
 - X Label: Years
 - Y Label: 2000 US Million dollars

Buttons: OK, Cancel

4. Fill in and/or edit the Chart specifications:
 - i. Title: a suggested title based on the first selected data/results row will be displayed. The suggestion is fully editable. It can also be edited on the chart itself using MS Excel chart editing facilities.
 - ii. Sub-title: a suggested sub-title will be displayed, based on the last sub-title used. The suggestion is fully editable. It can also be edited on the chart itself using

- MS Excel chart editing facilities. The Sub-title combo box also stores the last four sub-title entries used.
- iii. **Style:** a suggested chart style, based on the data to be charted, will be displayed. The Style combo box stores other suitable chart styles for selection by the user if required.
 - iv. **X (Axes) Label:** a suggested label based on the first data/results row will be displayed. The suggestion is fully editable (shown above). In the situation of a chart requiring two X axes labels, editing of the label can be done on the chart itself using MS Excel chart editing facilities.
 - v. **Y (Axes) Label:** a suggested label based on the first data/results row will be displayed. The suggestion is fully editable (shown above). In the situation of a chart requiring two Y axes labels, editing of the label can be done on the chart itself using MS Excel chart editing facilities.
5. Click on the **[OK]** button and the Chart with Excel will be generated and displayed as specified by the Chart options. Using the example results shown in 1.i. above and the suggested chart options shown in 4. above, the following chart is produced on Sheet 2 of the Workbook. The data/results appear on Sheet 1.



6. The chart and data/results can now be edited and printed using the MS Excel chart and data editing facilities.

8.4 The Analyse with Excel facility

ANSWER's Analyse with Excel facility exports the user's selected data/results from ANSWER into a MS Excel worksheet. There is no associated chart.

The data/results for the worksheet are not dynamically linked to the original ANSWER data/results, and, consequently, a change in the ANSWER data/results will not result in a commensurate change to the worksheet.


To create a worksheet using the Analyse with Excel facility:

1. Select the rows of data/results in the Parameters spread to be exported by, either
 - i. swiping the left hand column of the required data/results rows (shown below) to select all information and all periods for the selected rows; or

	Case	Parameter		Region	Technology	TimeSlice	1990	2000	2010
	BASE	LOAD.SEAS.ELC	?	UTOPIA	E01	I-D	21.99	48.69	48.82
	BASE	LOAD.SEAS.ELC	?	UTOPIA	E01	I-N	21.99	48.69	48.82
	BASE	LOAD.SEAS.ELC	?	UTOPIA	E01	S-D	21.99	48.69	48.82
	BASE	LOAD.SEAS.ELC	?	UTOPIA	E01	S-N	21.99	48.69	48.82
	BASE	LOAD.SEAS.ELC	?	UTOPIA	E01	W-D	37.66	80.00	80.00
	BASE	LOAD.SEAS.ELC	?	UTOPIA	E01	W-N	37.66	80.00	80.00

- ii. swiping the required information/data fields (they must be adjacent) of the required data/results rows to select a subset of the information and periods for the selected rows. In the example below, the Case, Parameter, Technology and TimeSlice information and the data/results for periods 1990 and 2000 (but not 2010) will be written to the associated worksheet.

	Case	Parameter		Region	Technology	TimeSlice	1990	2000	2010
	BASE	LOAD.SEAS.ELC	?	UTOPIA	E01	I-D	21.99	48.69	48.82
	BASE	LOAD.SEAS.ELC	?	UTOPIA	E01	I-N	21.99	48.69	48.82
	BASE	LOAD.SEAS.ELC	?	UTOPIA	E01	S-D	21.99	48.69	48.82
	BASE	LOAD.SEAS.ELC	?	UTOPIA	E01	S-N	21.99	48.69	48.82
	BASE	LOAD.SEAS.ELC	?	UTOPIA	E01	W-D	37.66	80.00	80.00
	BASE	LOAD.SEAS.ELC	?	UTOPIA	E01	W-N	37.66	80.00	80.00

2. Click on the **[Analyse with Excel]** icon , or click on **T**ools in the menu bar and click on **Analyse with Excel...** in the drop menu.
3. The 'Column Display for Analyze with Excel' form appears. On tabs except the Trade tab, this form appears with Name as the default for all columns except the Region2, Item5 and Item6 columns. On the Trade tab, this form appears with Name as the default for all columns.

Column Display for Analyze with Excel							
Case	Parameter	Region	Region2	Technology	Item2	Item3	TimeSlice
Name	Name	Name	Hide	Name	Name	Name	Name
					Hide		
					Name		
					Description		
						OK	Cancel

4. Choose, for each of the Case (or Scenario), Parameter, Region, Region2, Technology, etc columns whether to display Name or Description, or to Hide the column (that is, suppress it) in the Excel sheet. For example, to hide the Item2 column in the data that is exported to the Excel sheet, click on the combobox in the Item2 column to drop it down, as shown above, and then select Hide. Repeat this process for any other columns where you wish to either hide the column, or change Name to Description, before clicking on the **[OK]** button.

5. The Excel worksheet that is generated corresponding to case ii. above, and with Hide selected for the Item2 and Item3 columns, appears on the following page. Note that Name (rather than Description) is used for the information that appears in each of the Case, Parameter, Region, Technology and TimeSlice columns, and that the Region2, Item2, Item3, Item5 and Item6 columns do not appear. Also note that numeric data appears for periods 1990 and 2000 (but not 2010).

Book1								
	A	B	C	D	E	F	G	H
1	Case	Parameter	Region	Technology	TimeSlice	1990	2000	
2	BASE	LOAD.SEAS.ELC	UTOPIA	E01	I-D	21.99	48.69	
3	BASE	LOAD.SEAS.ELC	UTOPIA	E01	I-N	21.99	48.69	
4	BASE	LOAD.SEAS.ELC	UTOPIA	E01	S-D	21.99	48.69	
5	BASE	LOAD.SEAS.ELC	UTOPIA	E01	S-N	21.99	48.69	
6	BASE	LOAD.SEAS.ELC	UTOPIA	E01	W-D	37.66	80	
7	BASE	LOAD.SEAS.ELC	UTOPIA	E01	W-N	37.66	80	

Section Nine: Reference Energy System Graphics

This Section introduces the user to ANSWER's Reference Energy System (RES) graphics facility.

ANSWER's Reference Energy System (RES) facility provides the user with simplified graphics of the model's system. For each Technology/Energy Carrier/Material/End-Use Demand/Emission Item, RES provides a diagrammatic representation of the energy relationships associated with that Item. RES graphics is a valuable tool for visualising the often numerous and complex flows in the energy system.

The RES Graphic can be invoked from any of the Energy, Material, Demand, Emission or Technology Component tabs in the Data/Results Screen. The RES Graphic is always based on commodity flow input/output Data for a set of Scenarios, where the generic word "commodity" indicates energy carrier or material or end-use demand or emission. The set of Scenarios is determined by whether the RES facility is invoked from the Data screen or the Results screen, as discussed below. While viewing the RES, the user can also view Data if in Browse Data/Edit Data mode, or view Results if in Results mode.

New Extension: RES Graphics may now be invoked for Results

In ANSWER version 5.3.0 (and higher), the RES Graphics facility may be invoked when browsing Results. The resulting RES is based on Data for the Scenarios associated with the currently Selected Cases. (In previous versions of ANSWERv5, the RES Graphics facility could be invoked only when browsing/editing Data.)

When the RES Graphics facility is invoked from the Data screen:

- The resulting RES is based on Data for the currently Selected Scenarios (top RHS of the Home screen). That is, the RES is determined by commodity flow input/output parameters for the currently Selected Scenarios.
- The fact that the RES is based on Data for the currently Selected Scenarios is indicated by the caption on the RES form, that has " - based on Data for Selected Scenarios" appended to it after the word "region", as follows:

 **Reference Energy System - DEMO region - based on Data for Selected Scenarios**


When the RES Graphics facility is invoked from the Results screen:

- The resulting RES is based on Data for the Scenarios associated with the currently Selected Cases. (The Selected Cases are displayed at the bottom RHS of the Home screen.) That is, the RES is determined by commodity flow input/output parameters for the Scenarios associated with the currently Selected Cases.
- The fact that the RES is based on Data for the Scenarios associated with the currently Selected Cases is indicated by the caption on the RES form, that has " - based on Data for Scenarios associated with Selected Cases" appended to it after the word "region", as follows:

 **Reference Energy System - DEMO region - based on Data for Scenarios associated with Selected Cases**

Multi-region

The RES graphic is for a particular region and does not display bi-lateral trade between regions. The region for which the RES graphic applies is determined by the Region associated with the Item that is selected when the user invokes the RES facility, and is displayed in the caption bar, as follows:

 **Reference Energy System - UTOPIA region**

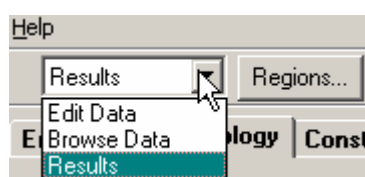
9.1 Starting/closing the Reference Energy System (RES) graphic

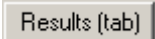
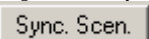
9.1.1 Starting the RES graphic


To start the RES graphic:

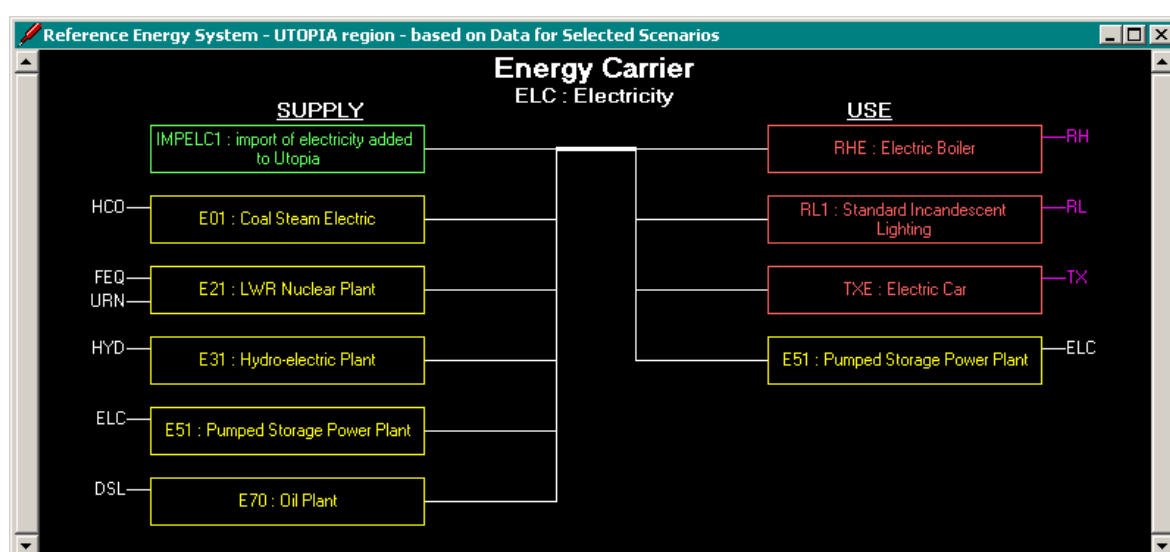
- 1a. If wanting to invoke RES graphics for Data, ensure that the Selected Scenarios display (top RHS of Home screen) contains the appropriate Scenarios of interest. Then move to the Data screen by clicking on the **[Browse Data]** or **[Edit Data]** button.
- 1b. If wanting to invoke RES graphics for Results, ensure that the Selected Cases display (bottom RHS of Home screen) contains the appropriate Cases of interest. Then move to the Results screen by clicking on the **[Results (tab)]** button.

Note: If while examining Results you sometimes like to move back and forth between Results and Data (by use of the combobox to the left of the **[Regions...]** button in the Toolbar row):




then before clicking on the **[Results (tab)]** button  you should click on the **[Sync. Scen]** button  to synchronize the Selected Scenarios with the Selected Cases.

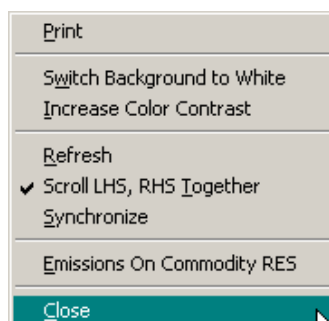
2. Click on the required Component tab (Energy or Material or Demand or Emission or Technology).
3. Click on a single Item in the Items display.
4. Click on the **[RES]** button  in the Item Management sub-region, or click on **View** in the menu bar and click on **RES Graphics** in the drop menu, or press **[Ctrl] G** on the keyboard.
5. The RES graphic for the selected Item will appear. In the example below, while on the Data screen, the Energy Carrier ELC (Electricity) was selected for the UTOPIA region, and then the **[RES]** button was clicked.



9.1.2 Closing the RES graphic

To close the RES graphic:

1. Double click on the RES icon  in the top left hand corner of the RES graphic, or click anywhere within the RES graphic using the right hand mouse button and click on **C**lose in the pop-up menu (shown below).



9.2 Features of the Reference Energy System (RES) graphics

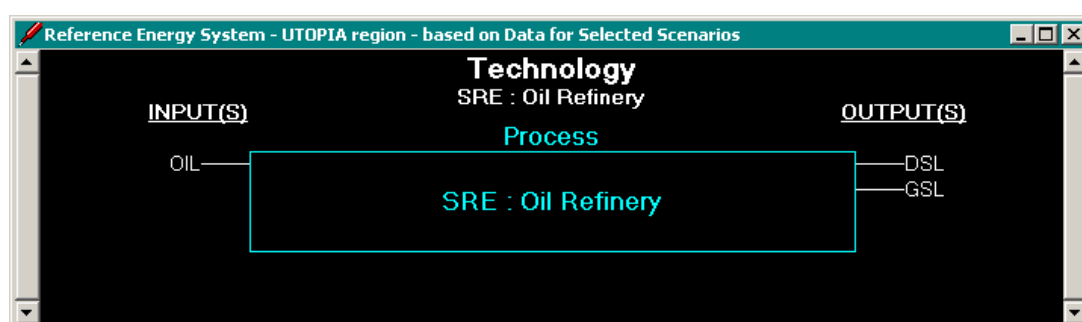
ANSWER's RES graphics has two structures:

1. the Technology RES, being centred on the selected Technology Component Item
2. the Commodity RES, being centred on the selected Commodity (Energy Carrier or Material or End-Use Demand or Emission) Component Item.

The RES also has a number of features to facilitate its use. These include cascading through the RES, page resizing and scrolling, refreshing and synchronizing, and printing.

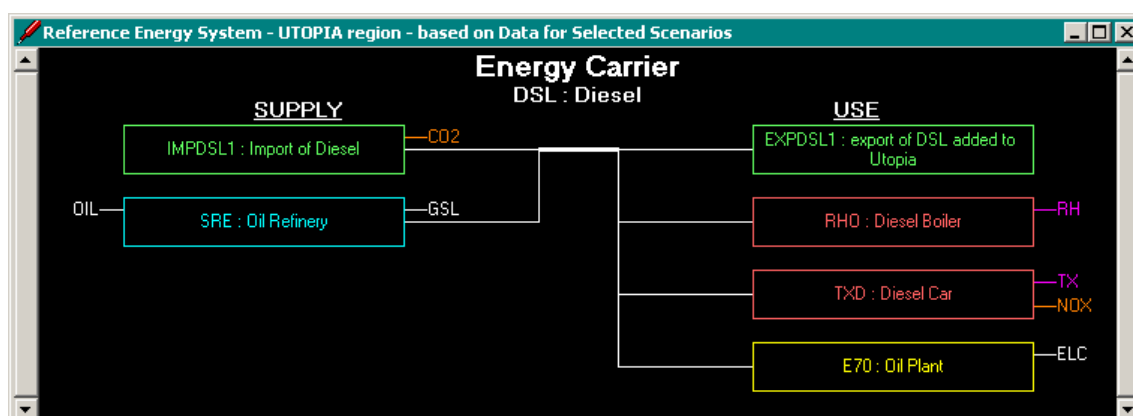
9.2.1 The Technology RES structure

The Technology RES depicts a selected Technology Item (Conversion, Process, Demand, or Resource) and its Energy Carrier/Material/End-Use Demand/Emission input(s) and output(s). The RES graphic for Process Technology Item SRE (Oil Refinery) in the UTOPIA region is depicted below, showing its crude oil (OIL) input and diesel (DSL) and gasoline (GSL) outputs.



9.2.2 The Commodity RES structure

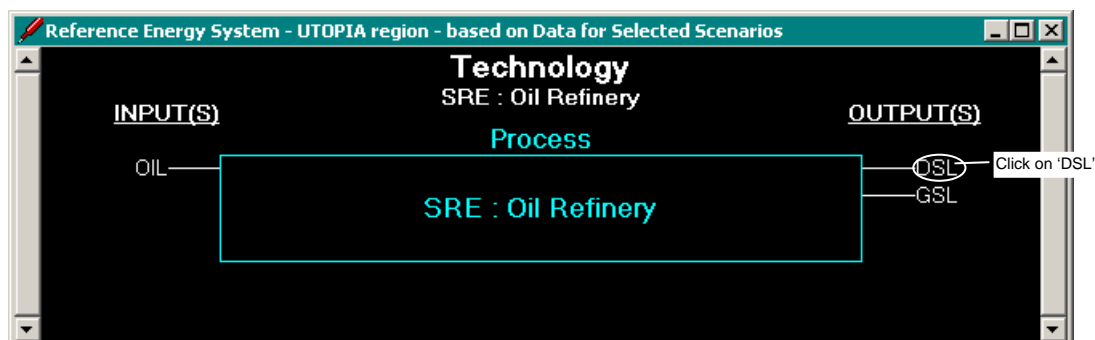
The Commodity RES depicts a selected Commodity Item (i.e., an Energy Carrier or Material or End-Use Demand or Emission Item) and those Technologies which supply and use that Commodity. The RES graphic for Energy Carrier Item DSL (Diesel) in the UTOPIA region is depicted below, showing the supply sources of diesel in the model (namely, imports and refinery production) and the uses to which it is put (namely, diesel boilers, diesel cars, and oil fired power plant).



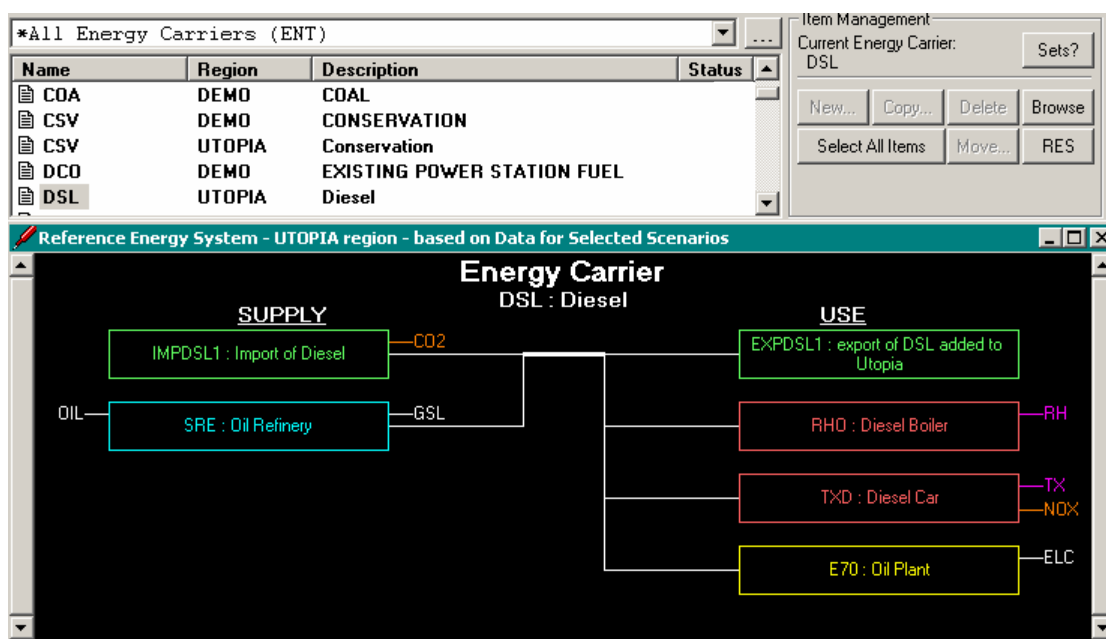
The Commodity RES also shows the other Energy Carrier/Material/End-Use Demand/Emission input(s) and output(s) to/from the supplying and consuming Technologies. For example, the RES above for DSL (Diesel) indicates that supply Technology SRE (Oil Refinery) has OIL as an Energy Carrier input and GSL as an Energy Carrier output (in addition to DSL).

9.2.3 Cascading through the RES

ANSWER's RES graphics facility allows the user to cascade through the RES, by simply clicking on any Technology or Commodity Item in the current RES graphic to initiate a new RES graphic that will be centred on the selected Item. The user can continue in this manner to cascade through the RES without having to close it. For example, when viewing the Technology SRE (Oil Refinery) RES graphic (shown below), the user may wish to see the RES graphic for the Refinery output Energy Carrier DSL (Diesel). Simply clicking on DSL will initiate a new RES graphic,





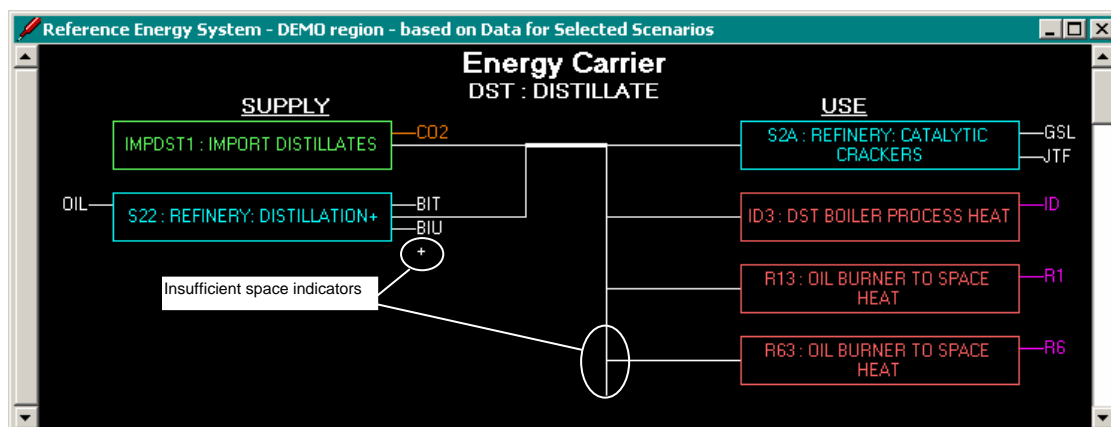
centred on Energy Carrier DSL (Diesel), as shown below. Note also that when the RES graphic for DSL is initiated, the Data/Results screen automatically switches from the Technology Component to the Energy Carrier Component, and Energy Carrier Item DSL is selected. That is, the Component and the selected Item on the Data/Results screen remain synchronized with the Item on which the RES is centred.



9.2.4 Overflow indicators

In some instances (shown below), the RES graphic will display on-screen overflow indicators to indicate insufficient space to display all Items or all inputs and/or outputs for an Item:

1. Insufficient space to display all Items is indicated by a .
2. Insufficient space to display all inputs/outputs for an Item is indicated by a .




In the case of insufficient space to display all Items, use of page resizing and/or scroll bars (see Section 9.2.5 'Page resizing and Scroll bars') will enable the user to see all Items.

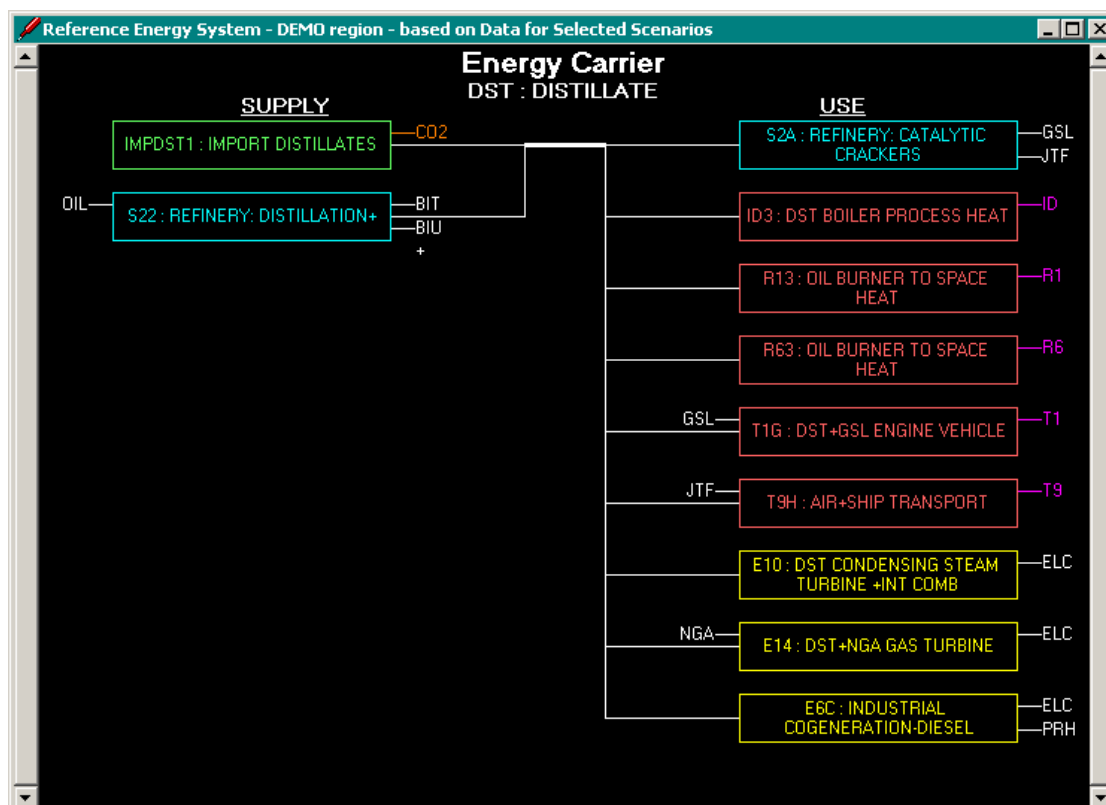
In the case of insufficient space to display all inputs and/or outputs for an Item, the user can click on the **+** indicator and a Commodity Selection box will appear (shown below). This displays all the inputs or outputs for the Item concerned.



To display the RES graphic for an Item, click on that Item in the Commodity Selection box, and then click on **[OK]**. To return without displaying a new RES graphic, click on **[Cancel]**.

9.2.5 Page resizing and Scroll bars

Expanding the RES graphics screen to full page size using the **Page Maximise** button  enables nine Technology Items to be displayed at 800x600 resolution (shown below), or 13 Technology Items at 1024x768 resolution.



Where there are more 'Supply' or 'Use' Technologies to display than will fit in the vertical space available, the vertical **scroll bars** enable the user to scroll through all Items on the RES graphic.

By default, the user can scroll both the left hand side ('Supply' Technologies) and the right hand side ('Use' Technologies) simultaneously by using either the left hand scroll bar or the right hand scroll bar. This corresponds to the default setting for the right mouse button pop-up menu option **Scroll LHS, RHS Together** of checked. See section 9.2.5.1 below.

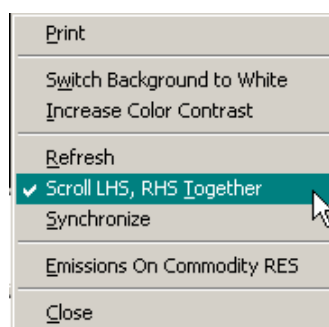
9.2.5.1 Scroll LHS, RHS Together


The Scroll LHS, RHS Together facility allows the user to control whether:

- Both the left hand side and the right hand side of the RES graphic scroll simultaneously when the user scrolls either the left hand scroll bar or the right hand scroll bar (the default, corresponding to 'Scroll LHS, RHS Together' being checked); or
- The two scroll bars act independently of each other, with the left hand scroll bar scrolling the 'Supply' Technology Items, and the right hand scroll bar scrolling the 'Use' Technology Items (corresponding to 'Scroll LHS, RHS Together' being unchecked).

By default, **Scroll LHS, RHS Together** is turned on. To turn off **Scroll LHS, RHS Together**:

- Click anywhere within the RES graphic using the right hand mouse button and a pop-up menu will appear (shown below).



2. Click on **Scroll LHS, RHS Together**. This toggles 'Scroll LHS, RHS Together' from on (as indicated by the ) to off.

Repeat steps 1. and 2. to turn on the 'Scroll LHS, RHS Together' facility.

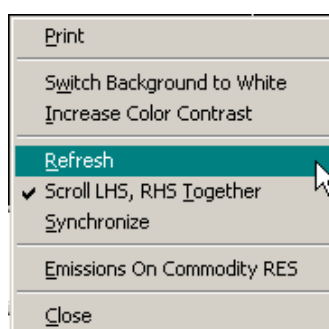
9.2.6 Refresh

The RES graphic screen can be left open while the user makes editing changes to the underlying model data. (The RES graphic screen can be minimised to get it out of the way.)

Where such editing changes are made, ANSWER does not automatically refresh the RES graphic to display any effects of these changes. Consequently, in instances where the RES graphic is open and editing changes have been made that may impact on the RES graphic, the user is strongly advised to refresh the RES graphic.

To refresh the RES graphic:

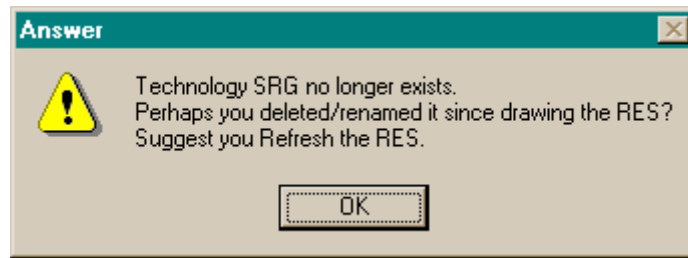
1. Click anywhere within the RES graphic using the right hand mouse button and a pop-up menu will appear (shown below).



2. Click on **Refresh**, and the RES graphic will refresh to display any relevant editing changes.

9.2.6.1 Editing changes that affect the RES

While the RES graphic screen is open, the user may make editing changes such as deleting or renaming an Item that affect an Item displayed in the RES graphic changes. If, subsequently, the user forgets to refresh the RES graphic and then attempts to resize or scroll the RES graphic, ANSWER detects the deletion/rename change(s) and advises the user to refresh the RES graphic (shown below).



If, however, the editing change that could affect an open RES graphic is the addition of a new Commodity/Technology Item(s), ANSWER is not able to detect such an editing change and cannot warn the user.

Consequently, **the user needs to remember, after making editing changes, to refresh the RES graphic.**

9.2.7 Synchronize

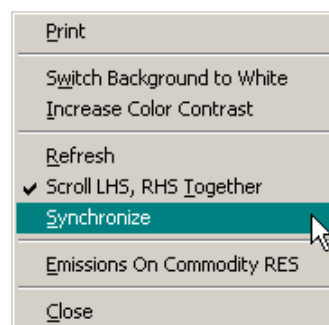
Where the user initiates each successive RES graphic by cascading through the RES (see Section 9.2.3 'Cascading through the RES'), the current Component, Item and Parameters data on the Data/Results Screen remain synchronized with the current RES graphic Item.

However, the RES graphic screen can be left open while the user moves to the Data/Results Screen and selects a new Item within the current Component, or within a new Component (involving a change of Component tab). This will result in the current RES graphic Item shown on the RES graphic screen no longer being synchronized with the currently selected Item on the Data/Results Screen.

The Synchronize feature synchronizes the RES graphic with the currently selected Item on the Data/Results Screen.

To synchronize the RES graphic with the currently selected Item on the Data/Results Screen:

1. Click anywhere within the RES graphic using the right hand mouse button and a pop-up menu will appear (shown below).

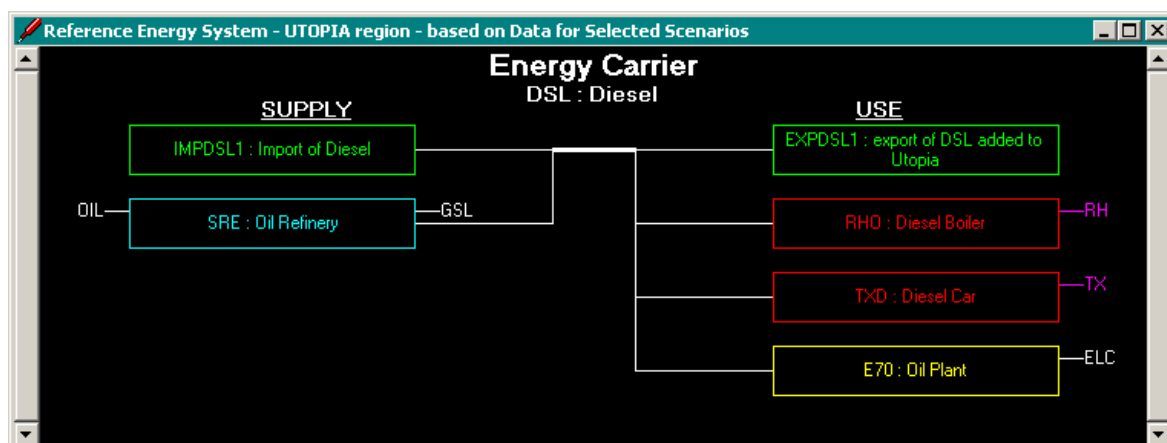


2. Click on **Synchronize**, and the RES graphic will change to that for the currently selected Item on the Data/Results Screen.

9.2.8 Switch Background to White (Black)

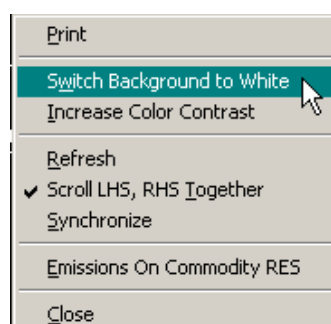
The Switch Background to White (Black) facility allows the user to switch the RES graphics background color from black to white (and from white back to black). This allows the user to retain the previous default background color of black for screen use and for presentations, while switching to a white background for the purpose of capturing RES graphics screen snapshots to paste into documents and PowerPoint slides that may subsequently be printed on black-and-white or color printers.

The screen snapshot below displays the RES graphic for Energy Carrier Item DSL (Diesel) in the UTOPIA model, in the default background color of black:

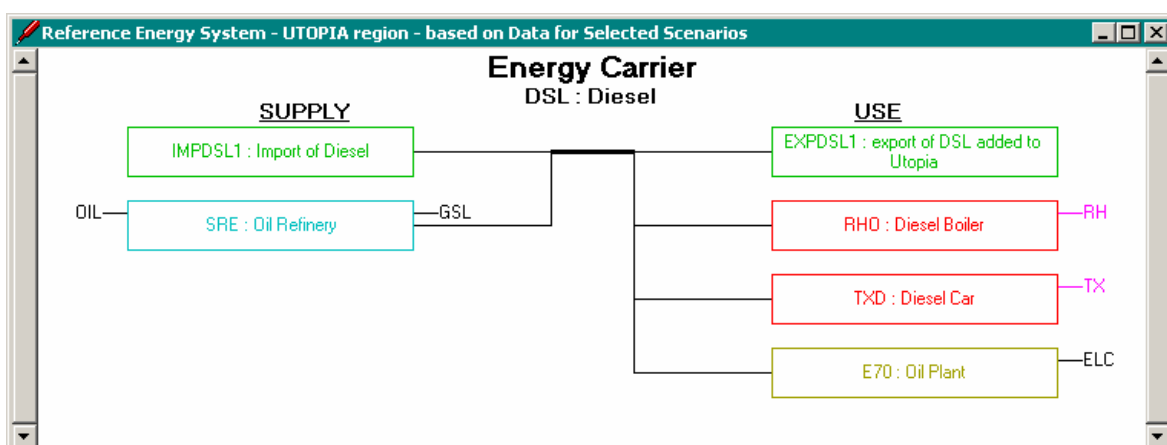


To switch the background color to white:

1. Click anywhere within the RES graphic using the right hand mouse button and a pop-up menu will appear (shown below).

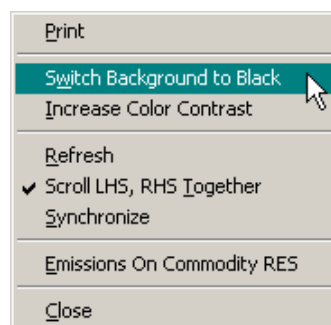


2. Click on **Switch Background Color to White**. This switches the background color from black to white, as follows:



To switch the background color from white to black, repeat steps 1. and 2. as follows:

1. Click anywhere within the RES graphic using the right hand mouse button and a pop-up menu will appear (shown below).



2. Click on **Switch Background Color to Black**. This switches the background color from white to black.

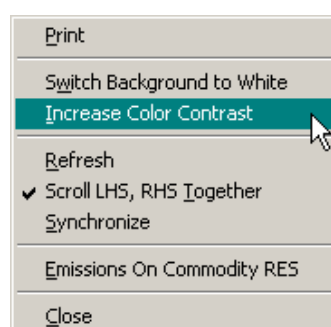
9.2.9 Increase Color Contrast

The Increase Color Contrast facility, when invoked, allows the user to slightly modify the colors that are used on the RES form so that they may better contrast with the black background, e.g. when projecting the ANSWER RES screen.

If the 'Increase Color Contrast' facility is not invoked, the RES graphic will be drawn with the red boxes and text that are used for demand technologies being 'true' red, and the green boxes and text that are used for resource technologies being 'true' green. Whereas if the 'Increase Color Contrast' facility is invoked, the RES graphic will be drawn with the red boxes and text being less red, and the green boxes and text being less green. These less red and less green colors may contrast better with the black background than the 'true' colors in some situations.

By default, **Increase Color Contrast** is turned off. To turn on **Increase Color Contrast**:

1. Click anywhere within the RES graphic using the right hand mouse button and a pop-up menu will appear (shown below).



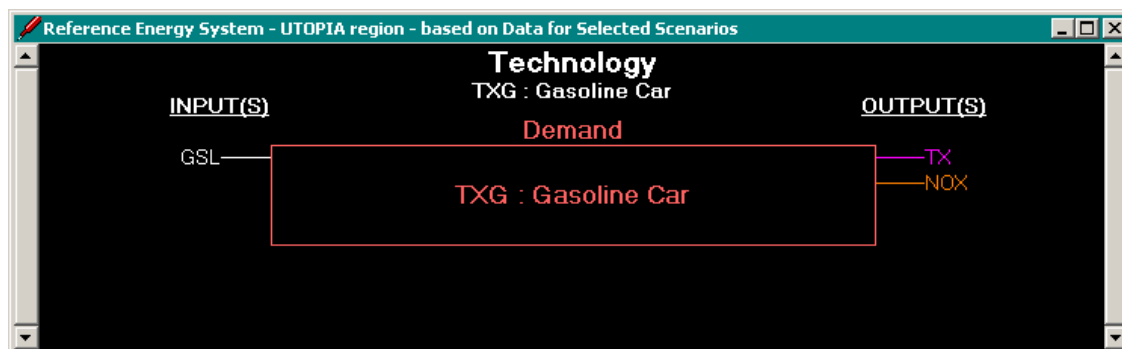
2. Click on **Increase Color Contrast**. This toggles 'Increase Color Contrast' from off to on.

Repeat steps 1. and 2. to turn off the 'Increase Color Contrast' facility.

9.2.10 Emissions On Commodity RES

The Technology RES always displays the Emissions associated with a Technology. Where the emissions-related parameters have positive coefficients, Emissions are shown as outputs from the technology; where they have negative coefficients, they are shown as inputs to the technology.

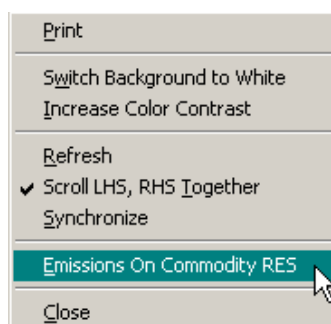
For example, the Technology RES below indicates that Emission NOX is an output from technology TXG:



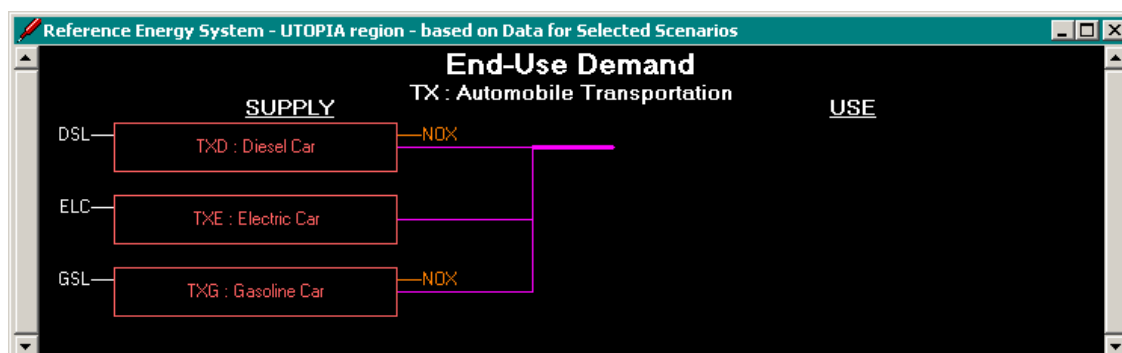
By default, the Commodity RES for commodities other than Emissions does not display the Emissions associated with Technologies that occur in the Commodity RES. To display these Emissions, it is necessary to invoke the 'Emissions On Commodity RES' facility.

To invoke **Emissions On Commodity RES**:

1. Click anywhere within the Commodity RES graphic using the right hand mouse button and a pop-up menu will appear (shown below).



2. Click on **Emissions On Commodity RES**. The Commodity RES graphic will be redrawn to display the Emissions associated with Technologies that occur in the Commodity RES. For example, the Commodity RES below for End-Use Demand TX displays the NOX Emissions associated with technologies TXD and TXG:



Repeat steps 1. and 2. to turn off the 'Emissions On Commodity RES' facility.

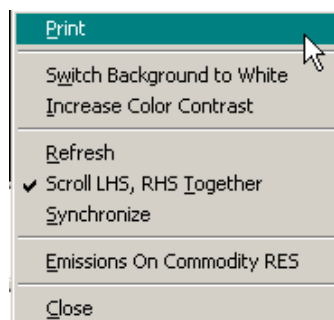
9.2.11 Print

The RES print facility provides a simple outline print of the RES graphic. The user should note that if the RES graphic is scrolled up on the left or right hand side, the print copy will reflect this.

If the RES graphic is larger than an A4 page, the overflow will not automatically print. To print the successive section(s) of the RES graphic, the user should scroll up to the last item of the RES graphic shown on the print copy and re-invoke the print facility.

To print the RES graphic:

1. Click anywhere within the RES graphic using the right hand mouse button and a pop-up menu will appear (shown below).



5. Click on **Print**, and the RES graphic will print, using the default printer and default print options associated with your computer.

Section Ten: Library Database facility (Library Region implementation)

There is a special version of ANSWER that incorporates a Library Database facility and that was developed to meet the needs of the International Energy Agency's Energy Technology Perspectives model (IEA-ETP model).

Comprehensive documentation of the Library Database facility is not currently available.

Note that the Library Database facility being used for the IEA-ETP model relies upon a special Library Region within an ANSWER database and supercedes an earlier Library Database facility that relied upon linking to a special separate Technology Library Database. (This earlier and now superceded Technology Library Database implementation was comprehensively documented in section 10 of the ANSWER version 5 User Manual.)

Section Eleven: Cross-Region Constraints in ANSWER

One of the extensions incorporated in version 5.3 of the ETSAP GAMS-MARKAL code was the provision for “cross-region” Emission and User-Defined constraints. Cross-region constraints are constraints that involve the summing over regions. For example, one type of cross-region Emission constraint involves imposing an upper limit, summing over regions, of emission ENV in period YEAR. This constraint is imposed by specifying values for a new cross-region data parameter GEMLIMT(ENV,YEAR) that represents the upper limit, summing over regions, of emission ENV in period YEAR. Note that the parameter GEMLIMT(ENV,YEAR) does not have a region index.

ANSWER version 5.3.8 (and higher) has been enhanced to allow the incorporation of cross-region parameters that do not have a region index – such as GEMLIMT(ENV,YEAR) – within a multi-region ANSWER database. Such parameters are accommodated within the ANSWER paradigm by introducing a special _GLOBAL region. This Section describes the special considerations that apply to the handling of cross-region parameters in ANSWER, specifically:

1. How to make your ANSWER database aware of cross-region parameters.
2. How to specify a cross-region Emission constraint.
3. How to specify a cross-region User-Defined constraint.
4. “Run Model” considerations.
5. “File, Import Model Data from Excel” considerations.
6. Additional considerations regarding the special _GLOBAL region.

Single-region databases

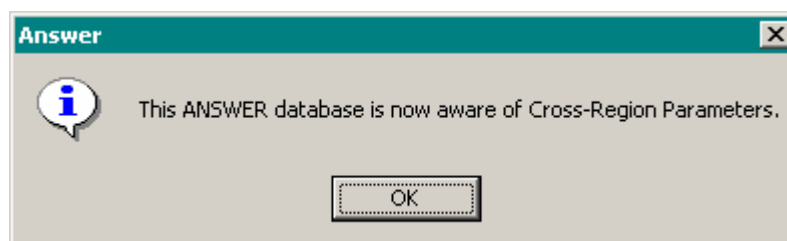
Cross-region data parameters are not relevant for single-region model databases. It is recommended that you do not carry out the steps in section 11.1 below for a single-region ANSWER database.

11.1 How to make your ANSWER database aware of Cross-Region Parameters

As noted above, if your ANSWER database is single-region and is going to remain single-region, then it is recommended that you do not make it aware of cross-region parameters.

To make your ANSWER database aware of cross-region parameters:

1. You must be running ANSWER version 5.3.8 (or higher).
2. Open your ANSWER database and ensure that you remain on the Home Screen. (If you move to the Data/Results screen, you will not be able to carry out step 3, even if you subsequently return to the Home Screen. You will need to close the database, and then re-open it.)
3. Click on **File** in the menu bar, and click on **Add Cross-Region Parameters** in the drop menu.
4. A message box will appear to confirm that cross-region parameters have been added to the database. See below.



5. Click on **[OK]**. The **Add Cross-Region Parameters** facility will have made the following additions and modifications to your ANSWER database:
 - i. Added special _GLOBAL region with Description “Special region for data parameters with no REG arg”.
 - ii. Added cross-region data parameters GEMLIM (Global cumulative emissions limit), GEMLIMT (Global emissions limit) and RAT__XRRHS (Coefficient RHS, XARAT

- user-defined constraint) to the ANSWER system table that contains all available MARKAL data parameters.
- iii. Added cross-region results parameters GEMPLIM.M (Cross-Region Cumulative Emission Constraint Marginal), GEMPLIMT.M (Cross-Region Emission Constraint Marginal) and MR_XARAT.M (Cross-Region Emission User-Defined Constraint Marginal) to the ANSWER system table that contains all available MARKAL results parameters.
- iv. Added two new 'Subset Items' categories REG_ADR (Regional User-Defined Constraints) and XARAT (Cross-Region User-Defined Constraints) on the Constraint tab.
- v. Assigned all existing User-Defined Constraints (ADRATIOs) to the REG_ADR category, that is, assumed that all existing User-Defined Constraints are Regional rather than Cross-Region.

11.2 How to specify a Cross-Region Emission Constraint

Before attempting to specify a cross-region Emission constraint, your ANSWER database needs to be aware of cross-region parameters. (Carry out the steps in section 11.1 above if you have not previously done so.)

To specify a cross-region Emission constraint, say for emission CO2:

1. For each region except the _GLOBAL region, if the emission CO2 does not already exist for the region, create it by going to the Emission tab, clicking on the **[New...]** button in the Item Management frame and specifying Name (= CO2), Region and Description and then clicking on **[OK]**.
2. For each region except the _GLOBAL region, specify the CO2 emissions coefficients that are associated with technologies (parameters ENV_ACT, ENV_CAP etc.), and/or the CO2 emissions coefficients that are associated with commodities (parameter ENV_ENT).
3. For the _GLOBAL region, create the emission CO2 by going to the Emission tab, clicking on the **[New...]** button in the Item Management frame and specifying Name (= CO2), Region (= _GLOBAL) and Description and then clicking on **[OK]**.
4. Since there is only one cross-region TS data parameter (GEMPLIMT) and only one cross-region TID data parameter (GEMPLIM) that involves the Emission component, after step 3 the TS and TID data spreads will appear as follows:

Subset Items:

*All Emissions (ENV)

Name	Region	Description	Status
CO2	_GLOBAL	Carbon dioxide - Global Region	
CO2	DEMO	CARBON DIOXIDE RELEASE	
CO2	UTOPIA	Carbon Dioxide	
NOX	UTOPIA	Nitrous Oxide	

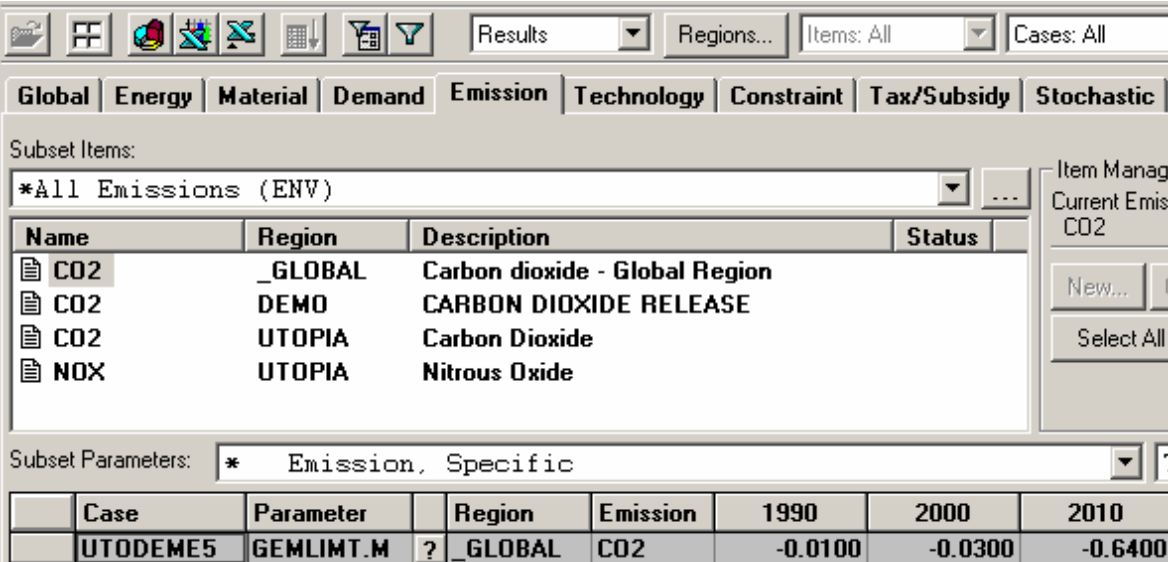
Item Management
Current Emission
CO2
New... Co...
Select All Items

Subset Parameters: Emission, Specific

	Scenario	Parameter	Region	Emission	1990	2000	2010
Add	BASE	GEMPLIMT	? _GLOBAL	CO2			

	Scenario	Parameter	Region	Emission	Value
Add	BASE	GEMPLIM	? _GLOBAL	CO2	

5. To specify a cross-region Emission constraint for CO2 for each time period, enter appropriate numeric values into the TS AddRow for the GEMLIMT parameter and add this row into the TS data spread via the ↓ key or the **Insert** key. To specify a cumulative cross-region Emission constraint for CO2, enter an appropriate numeric value into the TID AddRow for the GEMLIM parameter and add this row into the TID data spread via the ↓ key or the **Insert** key.
6. After carrying out a multi-region model run that involves a cross-region Emission constraint for CO2, say using the GEMLIMT parameter, and when the Trade Results file (<casename>+TRADE.ANT) has been imported into ANSWER, if CO2 for the _GLOBAL region is selected on the Results screen, the Time Series spread will display the marginals GEMLIMT.M associated with the cross-region emissions constraint:



The screenshot shows the ANSWER software interface with the 'Emission' tab selected. The 'Subset Items' section displays a table with the following data:

Name	Region	Description	Status
CO2	_GLOBAL	Carbon dioxide - Global Region	
CO2	DEMO	CARBON DIOXIDE RELEASE	
CO2	UTOPIA	Carbon Dioxide	
NOX	UTOPIA	Nitrous Oxide	

Below the table, the 'Subset Parameters' section shows a dropdown menu with the selected parameter: * Emission, Specific.

At the bottom, a table displays the results for the case UTODEME5:

Case	Parameter	Region	Emission	1990	2000	2010
UTODEME5	GEMLIMT.M	? _GLOBAL	CO2	-0.0100	-0.0300	-0.6400

11.3 How to specify a Cross-Region User-Defined Constraint

Before attempting to specify a cross-region User-Defined Constraint, your ANSWER database needs to be aware of cross-region parameters. (Carry out the steps in section 11.1 above if you have not previously done so.)

To specify a cross-region User-Defined Constraint, say named XREGUSC1:

1. On the Constraint tab, for each region except the _GLOBAL region, specify the User-Defined Constraint XREGUSC1 along with associated coefficients RAT_ACT, RAT_CAP etc. in the normal way. That is, create it by clicking on the **[New...]** button in the Item Management frame and specifying Name (=XREGUSC1), Region and Description, ensuring that under Set Memberships the "Cross-Region Constraint (XARAT)" leaf node is selected, and then clicking on **[OK]**. Then use the AddRow to specify the associated coefficients RAT_ACT, RAT_CAP etc.
2. On the Constraint tab, specify the User-Defined Constraint XREGUSC1 for the _GLOBAL region, by clicking on the **[New...]** button in the Item Management frame and specifying Name (=XREGUSC1), Region (= _GLOBAL) and Description, ensuring that under Set Memberships the "Cross-Region Constraint (XARAT)" leaf node is selected, and then clicking on **[OK]**.
3. Since there is only one cross-region TS data parameter (RAT__XRRHS) and no cross-region TID data parameter that involves the Constraint component, after step 2 the TS and TID data spreads will appear as follows:

Subset Items:

*All User-Defined Constraints (ADRATIO)

Name	Region	Description	Status
RATE60	DEMO	POTENTIAL FOR INDUSTRIAL COGE...	
WATSEA	UTOPIA	Hydro-electric by Season	
XREGUSC1	_GLOBAL	Cross-region constraint XREGUSC1	
XREGUSC1	DEMO	Cross-region constraint XREGUSC1	
XREGUSC1	UTOPIA	Cross-region constraint XREGUSC1	

Item Management
Current User-Defined Constraint: XREGUSC1
New... Copy...
Select All Items

Subset Parameters: User-Defined Constraint TS, T

	Scenario	Parameter	Region	Constraint	Bound	1990	2000
?	BASE	RAT_XRRHS	? _GLOBAL	XREGUSC1	-none-		
Add	BASE	RAT_XRRHS	? _GLOBAL	XREGUS			

	Scenario	Parameter	Region	Value
Add	BASE		?	

- Note that an instance of the RAT_XRRHS parameter is automatically created, but with the value in the Bound cell set to the placeholder '-none-' and with all numeric values set to null. Use direct-cell edit of the Bound cell to change the placeholder '-none-' to whichever of FX or LO or UP is appropriate according to the sense of the cross-region User-Defined Constraint (FX or LO or UP for = or >= or <= respectively), and replace the null numeric values by appropriate numeric values.
- After carrying out a multi-region model run that involves a cross-region User-Defined Constraint, say XREGUSC1, and when the Trade Results file (<casename>+TRADE.ANT) has been imported into ANSWER, if XREGUSC1 for the _GLOBAL region is selected on the Results screen, the Time Series spread will display the marginals MR_XARAT.M associated with the cross-region User-Defined Constraint:

Results Regions... Items: All Cases: All

Global Energy Material Demand Emission Technology Constraint Tax/Subsidy Stochastic Parameter

Subset Items:

*All User-Defined Constraints (ADRATIO)

Name	Region	Description	Status
RATE60	DEMO	POTENTIAL FOR INDUSTRIAL COGE...	
WATSEA	UTOPIA	Hydro-electric by Season	
XREGUSC1	_GLOBAL	Cross-region constraint XREGUSC1	
XREGUSC1	DEMO	Cross-region constraint XREGUSC1	
XREGUSC1	UTOPIA	Cross-region constraint XREGUSC1	

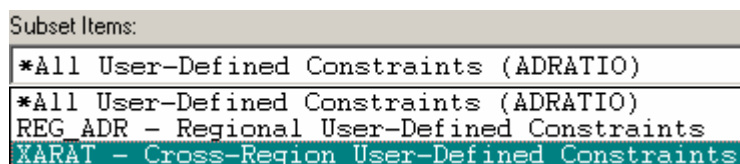
Item Management
Current User-Defined Constraint: XREGUSC1
New... Copy...
Select All Items

Subset Parameters: * User-Defined Constraint TS data

	Case	Parameter	Region	Constraint	Bound	1990	2000	2010
	UTODME5	MR_XARAT.M	? _GLOBAL	XREGUSC1	LO	50.8900	54.4900	0.000

11.3.1 How to display only User-Defined Constraints that are cross-region in the Items listview

1. To display only User-Defined Constraints that are cross-region in the Items listview, use the Subset Items combobox to select the "XARAT – Cross-Region User-Defined Constraints" row. One way of doing this is to click on the Subset Items combobox to drop it down, then select the "XARAT – Cross-Region User-Defined Constraints" row with the mouse (see below), and then click again.



11.3.2 How to display only User-Defined Constraints that are regional in the Items listview

1. To display only user-Defined Constraints that are regional (pertaining to a single region) in the Items listview, use the Subset Items combobox to select the "REG_ADR – Regional User-Defined Constraints" row.

11.3.3 How do I change a User-Defined Constraint from regional to cross-region, and what happens when I do?

1. On the Constraint tab, select the User-Defined Constraint and click on the **[Edit...]** button in the Item Management frame. This brings up the "Edit User-Defined Constraint" form.
2. Change the Set Memberships of the Constraint from Regional (REG_ADR) to Cross-Region (XARAT) by clicking on the Cross-Region (XARAT) leaf node of the Set Memberships tree, and then clicking on **[OK]**. (When ANSWER asks you to confirm change of Set Memberships, click on **[OK]**.)
3. Note that after step 2, the TS parameters associated with the User-Defined Constraint will change: ANSWER automatically deletes the RAT__RHS parameter because it is no longer appropriate for a cross-region User-Defined Constraint. Other parameters associated with the User-Defined Constraint, such as RAT_ACT, RAT_CAP etc., are not affected.
4. Steps 1-3 above change a User-Defined Constraint in a single region from regional to cross-region. *To complete the definition of a cross-region User-Defined Constraint, it is necessary to change all Constraints with the same Name in other regions from regional to cross-region, and as well to create a cross-region Constraint with this Name in the _GLOBAL region, along with appropriately specified RAT__XRRHS row.*

11.3.4 How do I change a User-Defined Constraint from cross-region to regional, and what happens when I do?

1. On the Constraint tab, select the User-Defined Constraint and click on the **[Edit...]** button in the Item Management frame. This brings up the "Edit User-Defined Constraint" form.
2. Change the Set Memberships of the Constraint from Cross-Region (XARAT) to Regional (REG_ADR) by clicking on the Regional (REG_ADR) leaf node of the Set Memberships tree, and then clicking on **[OK]**. (When ANSWER asks you to confirm change of Set Memberships, click on **[OK]**.)
3. Note that after step 2, the TS parameters associated with the User-Defined Constraint will change: ANSWER automatically creates an instance of the RAT__RHS parameter (with placeholder '-none-' in the Bounds cell) because this parameter is needed for a regional User-Defined Constraint. Other parameters associated with the User-Defined Constraint, such as RAT_ACT, RAT_CAP etc., are not affected.
4. Steps 1-3 above change a User-Defined Constraint in a single region from cross-region to regional. *It is necessary to change all Constraints with the same Name in other regions from cross-region to regional (or else to delete Constraints with this Name in other regions), and as well to delete the cross-region Constraint with this Name in the _GLOBAL region.*

11.4 “Run Model” considerations

You need to be aware of the following considerations regarding cross-region data parameters when invoking the “Run Model” facility for multi-region runs (see also Section Six):

1. When you click on the **[Regions...]** button on the Run Model form to select the regions that will be used for the model run, you will see all “real” regions in your multi-region model but you will not see the _GLOBAL region. The _GLOBAL region is assumed always to be selected when you carry out a multi-region run.
2. A corollary of 1 is that if any of the scenarios that you select to comprise the multi-region model run contain cross-region data parameters, then the cross-region data parameters in those scenarios will form part of the model run. This means that if you wish to do runs both with and without cross-region data parameters, you should place the cross-region data parameters in one or more non-BASE scenarios, and you should not place cross-region data parameters in the BASE scenario.
3. For all regions that you select by use of the **[Regions...]** button, that is for all “real” regions, <scenario>+<region>.DD / .DDS files are created in the standard fashion, that is they contain SET, PARAMETER and TABLE specifications for Items and TS and TID Data parameters respectively that are in region <region>.
4. The <scenario>+TRADE.DD / .DDS files contain Trade parameters, and also contain cross-region data parameters. That is, they also contain SET, PARAMETER and TABLE specifications for Emission/Constraint Items and TS and TID Data parameters respectively that are in the _GLOBAL region.
5. When you carry out a single-region run from a multi-region database, any cross-region data parameters that may be specified in any of the scenarios that you select are ignored.

11.5 “File, Import Model Data from Excel” considerations

To accommodate the existence of cross-region data parameters, some small adjustments have been made to the “File, Import Model Data from Excel” facility (see also section 2.10):

1. *** ITEMS *** sheet(s) may be specified with _GLOBAL as the region in cell B1. Only User-Defined Constraint or Emission Items will be accepted, Items for other Components will be rejected.
2. For upward compatibility with older XLS files, a *** ITEMS *** sheet for which the region in cell B1 is not _GLOBAL may specify just ADRATIO in column B of the ‘Sets:’ row for a User-Defined Constraint Item (with no set specified in column C), in which case the Constraint Item will be assumed to also belong to the set REG_ADR, that is, the Constraint will be assumed to be a (normal) user-defined constraint pertaining to a single region.
3. *** TS DATA *** sheet(s) may be specified with _GLOBAL as the region in cell B1. Only TS cross-region data parameters will be accepted, other parameters will be rejected.
4. *** TID DATA *** sheet(s) may be specified with _GLOBAL as the region in cell B1. Only TID cross-region data parameters will be accepted, other parameters will be rejected.
5. *** TS DATA *** sheet(s) for which the region in cell B1 is not _GLOBAL may only contain TS parameters that are not cross-region, other parameters will be rejected.
6. *** TID DATA *** sheet(s) for which the region in cell B1 is not _GLOBAL may only contain TID parameters that are not cross-region, other parameters will be rejected.

11.6 Additional considerations regarding the special _GLOBAL region

As is probably evident from the above, cross-region data parameters are accommodated within the ANSWER paradigm by requiring all such parameters to have a special _GLOBAL region index.

Appropriate adjustments have been made to the operation of the AddRow, as follows:

1. If a cross-region data parameter is selected on the Parameter tab, then _GLOBAL will be the only available choice in the AddRow Region combobox.
2. If a data parameter that is not cross-region is selected on the Parameter tab, then all regions except _GLOBAL will be available choices in the AddRow Region combobox.

3. If an Item is selected on the Emission/Constraint tab for the _GLOBAL region, then cross-region Emission/Constraint data parameters will be the only available choices in the TS and TID AddRow Parameter comboboxes.
4. If an Item is selected on the Emission/Constraint tab for a region that is not _GLOBAL, then Emission/Constraint data parameters that are not cross-region will be the only available choices in the AddRow Parameter combobox.

Section Twelve: Technology Items Filters in ANSWER

This Section introduces the user to the Technology Items Filters facility. This facility allows the user to define powerful Named Filters that are stored in the ANSWER database and thereafter are available for either or both of the following purposes:

1. To limit the Technology Items that are displayed to those of immediate interest to the user; and
2. For use with ANSWER's "Rule-based" Constraint facility. For details see section 13, 'Defining a "Rule-based" Constraint in ANSWER'.

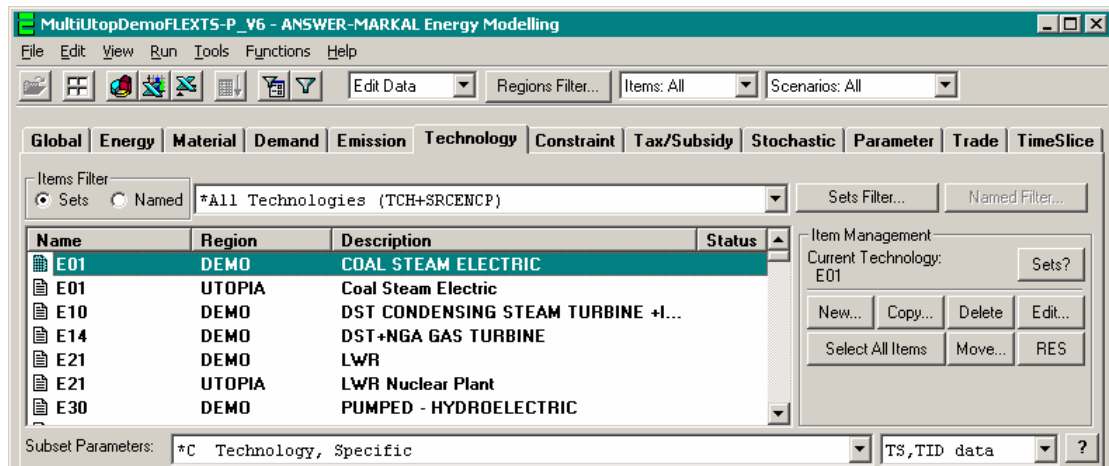
Facilities for exporting Technology Items Filters from an ANSWER database for subsequent import into a different ANSWER database are also described.

Note: The menu option "File, Add Technology Filter and Rule-based Constraints Facilities" can be used to upgrade a version 5 ANSWER database to make it Technology Filter and Rule-based Constraint aware. (You must invoke this menu option immediately after opening the database, if you move to the Data/Results screen, this menu item becomes disabled, and you will need to close the database and then reopen it in order for the menu item to be available.)

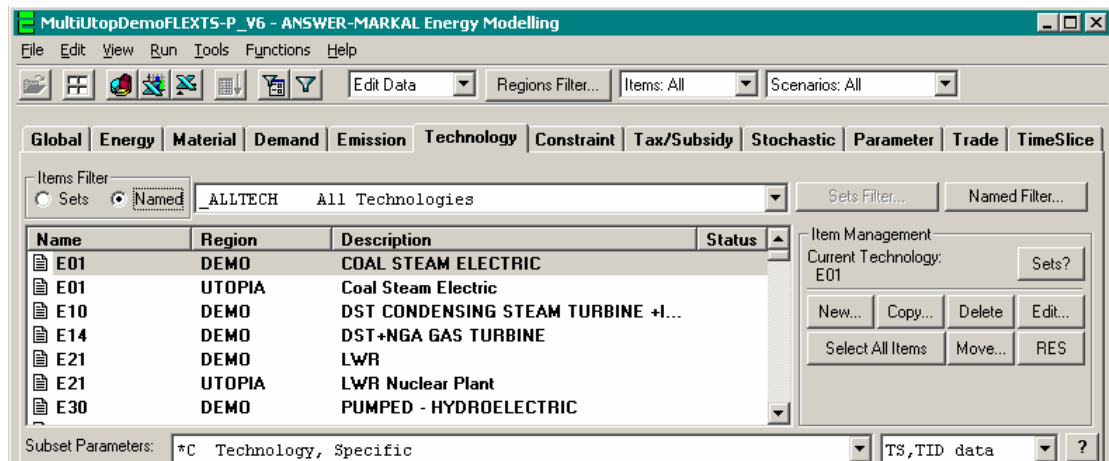
Acknowledgements: The development of the Technology Items Filters facility in ANSWER is the result of a collaborative effort between Gary Goldstein of International Resources Group and Noble-Soft Systems. While ANSWER has always incorporated Items filtering by Set Memberships, Dr Amit Kanudia of KanORS Inc was the first to introduce into MARKAL Items filtering by Name, Description etc. ANSWER's Technology Items Filters facility is technically different from the Items filtering facilities of Dr Kanudia, but with the same overall purpose – to limit the Technology Items that are displayed to those of immediate interest to the user.

12.1 Technology Items Filters

1. ANSWER's Technology Items Filters are powerful filters where any of Technology Name and/or Technology Description and/or Technology Set Membership and/or Input Commodity and/or Output Commodity can form part of the filter. These Filters are defined by the user and stored in the ANSWER database as **Named Filters** (for details see below) and thereafter are available for either or both of the following purposes:
 - They can be applied to limit the technologies that are displayed in the Technology Items listview to those that satisfy the filter rule(s), operating similarly to the filtering by Set Memberships of the Technology Items listview (e.g., to limit the technologies that are displayed to 'DMD – Demand Technologies').
 - They can be used to simplify the process of defining User Constraints by identifying a group of technologies to which a coefficient is to be applied (e.g., all renewable technologies, where these technologies have a common naming/description convention). See section 13, 'Defining a "Rule-based" Constraint in ANSWER'.
2. The changes to the Technology tab to accommodate the new Technology Items Filters, while also retaining ANSWER's previous filtering by Set Memberships, are shown below:



3. To the left of the customary Subset Items combobox, there is a new **Items Filter** frame containing a pair of option buttons that allow the user to choose either a **Sets** Filter, or a **Named** Filter (that is a Named Technology Items Filter). Initially the **Sets** option button is selected ☒ **Sets** with the Subset Items combobox presenting ANSWER's standard Set Memberships-based filters (default ***All Technologies (TCH+SRCENCP)**).
4. To the right of the Subset Items combobox, there are two buttons: **Sets Filter...** and **Named Filter...**. The **[Sets Filter...]** button plays the same role as the **[Specify Items Filter...]** button in previous recent versions of ANSWER, namely it allows the user to invoke a form to specify a Set Memberships Items Filter.
5. The **[Named Filter...]** button is initially disabled, but it becomes enabled when the **Named** option button is selected ☒ **Named**, as can be seen in the screen snapshot below:



6. When the **Named** option button is selected, the Subset Items combobox is populated with the Named Technology Items Filters that are currently defined in the database, the **[Sets Filter...]** button is disabled and the **[Named Filter...]** button is enabled.
7. Note that an ANSWER database that is Technology Filter aware contains a pre-defined Technology Filter **_ALLTECH All Technologies**, that will be the Named Filter initially selected when the **Named** option button is selected, in an analogous manner to the selection of ***All Technologies (TCH+SRCENCP)** as the Set Memberships Filter initially selected when the **Sets** option button is selected, making all technologies initially available.

8. To define new Named Technology Items Filters, click on the **[Named Filter...]** button to bring up the 'Technology Items Filter Management' form:

Name	Description	Modified
_ALLTECH	All Technologies	2006/05/26 18:29
ALL-ELE	Name-based filter defining all electric technologies	2006/05/28 16:42
IND-ALL	All industrial energy use - specified using DMD	2006/05/28 16:58
NAME-CPD	Name Like E6[0-9] + CPD	2006/05/24 10:54
RENEW-ELE	Name- and description-based filter defining all renewable electric technologies	2006/05/28 16:46
TRN-ALL	All transport DMDs	2006/05/21 22:40
TRN-GSL	Filter using DMD, Input and Output Commodity	2006/05/24 13:47

Buttons: New... Copy... Delete Edit... Close & Apply Close

9. The above form is for a database where as well as the pre-defined Technology Filter **_ALLTECH**, six other Technology Filters have been defined by the user. This form operates in a similar manner to the 'Region Management' and 'Batch Management' forms, in that it allows new Filters to be created (via **[New...]** or **[Copy...]**) and allows existing Filters to be deleted or edited (via **[Delete]** or **[Edit...]**).
(The **[Delete]** and **[Edit...]** buttons are disabled when the pre-defined Filter **_ALLTECH** is selected, since deletion and editing of this filter are not allowed.)
10. In addition, clicking on the **[Close & Apply]** button closes this form and results in the selected Technology Filter becoming the currently selected Named Filter in the Subset Items combobox, which in turn causes the Technology Items listview to be repopulated with the Technologies that qualify according to the Filter specification.
11. Clicking on any of the **[New...]** or **[Copy...]** or **[Edit...]** buttons on the 'Technology Items Filter Management' form brings up the 'Technology Items Filter' form. We now focus on presenting the main details of how the 'Technology Items Filter' form operates.

12.2 Technology Items Filters Form

The 'Technology Items Filter' form allows the user to define powerful Technology Item Filters where any of Technology Name and/or Technology Description and/or Technology Set Membership and/or Input/Output Commodity can form part of the filter.

These filters are powerful both because they allow any of Name and/or Description and/or Set Membership and/or Input/Output Commodity to be used as filtering criteria, and also because they provide for union (OR) and negation (NOT) of criteria.

For users who have strict Naming and/or Description conventions within their databases, the Name and/or Description aspects of these filters will prove valuable in filtering down to the desired subset of technologies. Even for users whose databases do not have strict Naming and/or Description conventions, the Set Membership aspects alone will prove valuable, since these filters allow the user to specify Set Membership filters that provide for union (OR) and also for negation (NOT). The capability to filter down to a subset of technologies that have specified Input and/or Output Commodities will provide an enhancement that a number of ANSWER users have suggested as desirable.

The screen snapshot below shows an empty 'Technology Items Filter' form.

New Technology Items Filter

Enter Name, Description, Comment and Specify Filter for New Technology Items Filter

Name: Description:

Comment:

Technologies to be Included:

	Name	Description	Set Memberships	Input Commodity	Output Commodity
Look for:	<input type="text"/>				
or:	<input type="text"/>				
or:	<input type="text"/>				
or:	<input type="text"/>				
or:	<input type="text"/>				

Technologies to be Excluded:

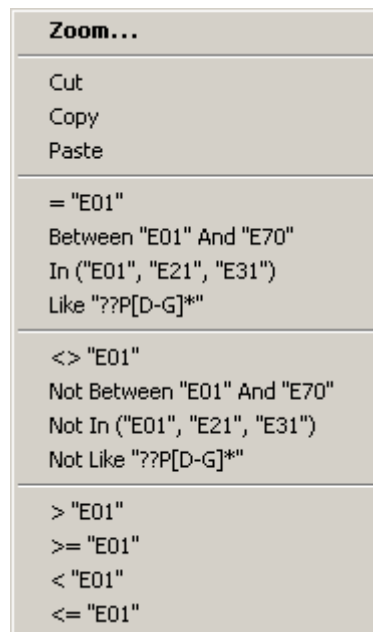
	Name	Description	Set Memberships	Input Commodity	Output Commodity
Look for:	<input type="text"/>				
or:	<input type="text"/>				
or:	<input type="text"/>				
or:	<input type="text"/>				
or:	<input type="text"/>				

Clear Included Clear Excluded OK Cancel

The main features of this form are:

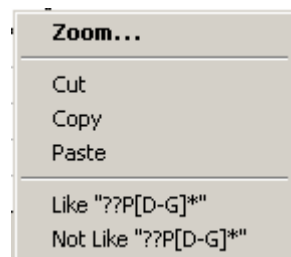
- These are Named filters so the top part of the form allows the user to specify the Name and Description of the Filter. A Comment (optional) may also be specified.
- The top specification area (Technologies to be Included) is where the user specifies – via Name and/or Description masks, and/or Set Memberships, and/or Input Commodity and/or Output Commodity masks – filtering criteria for those Technology Items that are to be included in what the filter qualifies.
- The bottom specification area (Technologies to be Excluded) is where the user specifies – via Name and/or Description masks, and/or Set Memberships, and/or Input Commodity and/or Output Commodity masks – filtering criteria for those Technology Items that are to be excluded.

- The overall effect of the filter rules in the two specification areas (spreads) is that a single filter is constructed to find Technology Items:
WHERE {criteria specified in Technologies to be Included spread}
AND NOT {criteria specified in Technologies to be Excluded spread}
are satisfied.
- For either specification area, criteria listed for individual cells on the same row are **ANDed** to form a composite row criterion, and then these composite row criteria are **ORed**.
- The nature of the filtering criteria that may be entered in individual cells of the spreads varies according to whether the cell is in the Name or Description or Set Memberships or Input Commodity or Output Commodity column.
- For a cell in the Name column, the filtering options provided are displayed in the following pop-up menu:

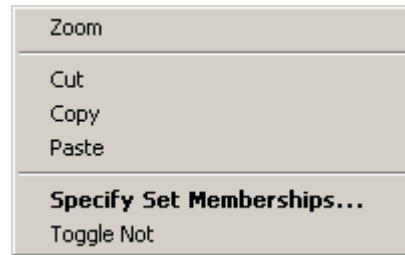


Note that it is not necessary to use the pop-up menu to specify Name filtering criteria – these criteria may simply be typed into the cell. Also, some short cuts are available. For example, if you type **E01** into the cell, on leaving the cell ANSWER will automatically convert to = **"E01"**. And if you type say **E0*** into the cell, on leaving the cell ANSWER will automatically convert to **Like "E0*"**.

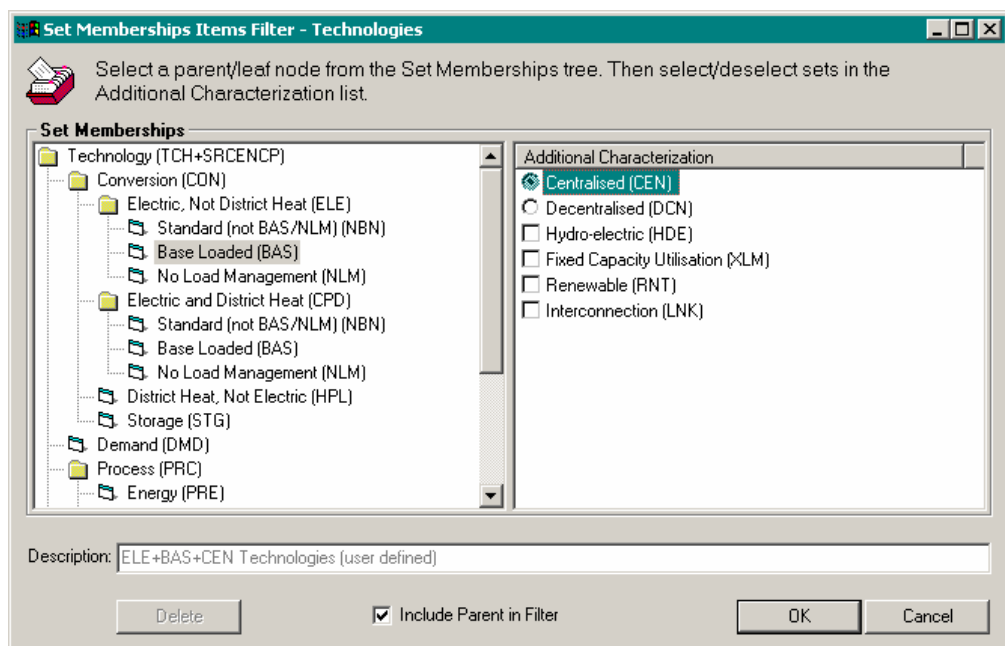
- For a cell in the Description column, only two of the above filtering options are provided: **Like** and **Not Like**. So to specify that the Description contains say "renewable" the user would specify the Description filtering criteria as **Like "**renewable**"**.



- For a cell that is in the Set Memberships column, the following right-mouse pop-up menu option is provided:



Invoking the **Specify Set Memberships...** option allows the user to bring up the 'Set Memberships Items Filter – Technologies' form that is shown below, in which the user has specified Set Membership criteria of ELE+BAS+CEN; that is, the filtering criteria is to restrict to those technologies that are in SET ELE and SET BAS and SET CEN.



- The Set Membership filtering criteria specified above will be displayed in the Technologies to be Included specification area as follows:

Technologies to be Included:				
	Name	Description	Set Memberships	Input Commodity
Look for:			ELE+BAS+CEN	
or:				

Note that it is not necessary to use the **Specify Set Memberships...** menu option to specify Set Membership filtering criteria – these criteria may simply be typed into the cell. For example, you could simply type **ELE+BAS+CEN** into the cell. On leaving the cell ANSWER will automatically check that the Sets that you have entered are valid MARKAL Sets.

- The right-mouse pop-up menu option “Toggle Not” allows the user to toggle the sense of the Set Membership criteria. Applying this menu option to the above cell would result in the following:

Technologies to be Included:				
	Name	Description	Set Memberships	Input Commodity
Look for:			Not ELE+BAS+CEN	
or:				

Applying the “Toggle Not” menu option again would remove the “Not”, so “Not ELE+BAS+CEN” would revert to “ELE+BAS+CEN”.

- For a cell in the Input Commodity (or Output Commodity) column, the filtering options provided are based on the **Name** of the Input/Output Commodity. The same range of filtering options is provided in respect of the Commodity Name as are provided for Technology Name. These are displayed (again) in the following pop-up menu:

Zoom...
Cut
Copy
Paste
= "E01"
Between "E01" And "E70"
In ("E01", "E21", "E31")
Like "??P[D-G]*"
<> "E01"
Not Between "E01" And "E70"
Not In ("E01", "E21", "E31")
Not Like "??P[D-G]*"
> "E01"
>= "E01"
< "E01"
<= "E01"

- Suppose for example that a user wants to specify a filter to select technologies that have coal (COA) as an Input Commodity and electricity as an Output Commodity, where there are several different electric commodities whose names all match “*ELC”. Then the user would specify Input and Output Commodity criteria as follows:

Technologies to be Included:					
	Name	Description	Set Memberships	Input Commodity	Output Commodity
Look for:				= "COA"	Like "*ELC"
or:					

- Note that in both the Technologies to be Included and Excluded specification areas (spreads), the filtering options that are available for all cells include **negation** options (e.g. Not Between, Not In, Not Like for Name cells; Not Like for Description cells; Not for Set Membership cells; ...). In particular this affords the user the additional flexibility of being able to specify negation options within the Technologies to be Included spread, if that is more convenient or appropriate than placing the positive option (Between, In, Like) within the Technologies to be Excluded spread.

The screen snapshot below shows a completed “Technology Items Filter” form that specifies a Filter to select all Industrial demand devices that have natural gas as an Input Commodity.

New Technology Items Filter

Enter Name, Description, Comment and Specify Filter for New Technology Items Filter

Name: IND-NGA Description: Industrial technologies with natural gas as input commodity

Comment:

Technologies to be Included:

	Name	Description	Set Memberships	Input Commodity	Output Commodity
Look for:	Like "i"		DMD	= "NGA"	
or:					
or:					
or:					
or:					
or:					

Technologies to be Excluded:

	Name	Description	Set Memberships	Input Commodity	Output Commodity
Look for:					
or:					
or:					
or:					
or:					
or:					

Clear Included Clear Excluded OK Cancel

Clicking on the **[OK]** button saves this Filter to the database and returns us to the “Technology Items Filter Management” form:

Technology Items Filter Management

Technology Items Filters:

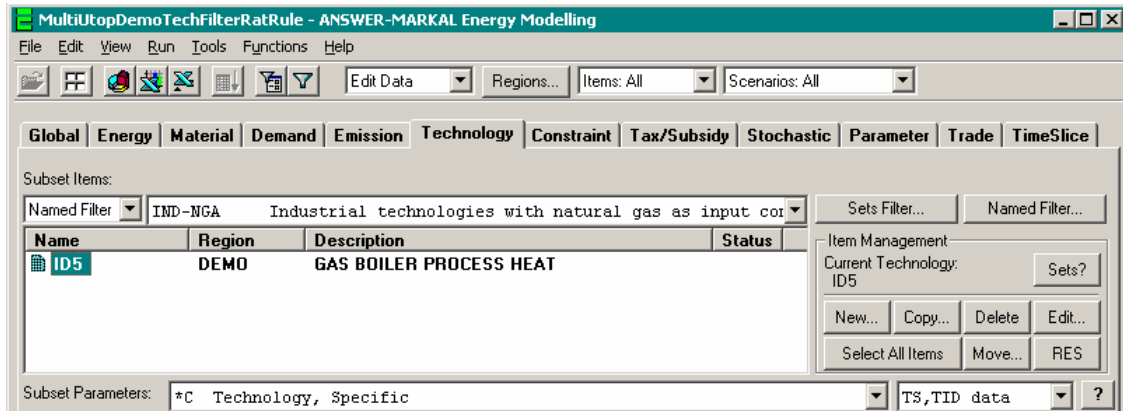
Name	Description	Modified
_ALLTECH	All Technologies	2006/05/26 18:29
ALL-ELE	Name-based filter defining all electric technologies	2006/05/28 16:42
IND-ALL	All industrial energy use - specified using DMD	2006/05/28 16:58
IND-NGA	Industrial technologies with natural gas as input commodity	2006/05/29 01:05
NAME-CPD	Name Like E6[0-9] + CPD	2006/05/24 10:54
RENEW-ELE	Name- and description-based filter defining all renewable electric technologies	2006/05/28 16:46
TRN-ALL	All transport DMDs	2006/05/21 22:40
TRN-GSL	Filter using DMD, Input and Output Commodity	2006/05/24 13:47

New... Copy... Delete Edit... Close & Apply Close

We may now create further new Technology Filters, or copy, delete or edit existing Technology Filters.

If we simply click on **[Close]** to close the form and return to the Technology tab display, the Subset Items combobox will be re-populated with the Technology Items Filters displayed above. In particular, the newly created Filter IND-NGA will now be available for sub-setting the Technology Items listview whenever needed. It may also be used when constructing Rule-based User Constraints, as discussed in section 13.

If we click on the **[Close & Apply]** button with IND-NGA as the selected Technology Filter, this closes the form and results in IND-NGA becoming the currently selected Named Filter in the Subset Items combobox, which in turn causes the Technology Items listview to be repopulated with the qualifying Technologies for the Filter, in this case just a single Technology ID5, as displayed below:



12.3 Guidelines for Specifying Technology Items Filters

The Technology Items Filter form allows the specification of quite complex filters. In general the user is encouraged to specify filters in the fashion that is most “natural” to them. But some specifications are more time-consuming to execute than others, whether this execution is related to applying a Technology Filter to subset items on the Technology tab, or to resolving a rule-based Constraint (either on the Constraint tab, or when carrying out a model run – see section 13 ‘Defining a “Rule-based” Constraint in ANSWER’).

When specifying a Technology Items Filter, and particularly if working with a large multi-region database, the user is encouraged to keep the following guidelines in mind if responsiveness becomes an issue:

1. The most efficient filter to execute is a single row filter that involves only Name and/or Description and/or Set Memberships criteria, and that does not involve any Input Commodity or Output Commodity criteria, nor involve any Technologies to be Excluded criteria. This efficiency is little affected if the filter involves multiple rows but where *every* such row involves only Name/Description/Set Memberships criteria, and does not involve any Input/Output Commodity criteria.
2. Where the Technologies to be Excluded part of a filter involves simple Name/Description/Set Memberships criteria, efficiency should be little affected unless this part of the filter generates a large number of Technologies to be excluded.
 - Nonetheless, efficiency will be enhanced if use of the Technologies to be Excluded spread can be avoided altogether. Thus the user who wishes to specify the most efficient filter that selects all industrial technologies should specify Name criteria **Like “I*”** and Set Memberships criteria **DMD** in the (same row of the) Technologies to be Included spread, rather than specify Name criteria **Like “I*”** in the Technologies to be Included spread, and Name criteria **Like “IMP*”** in the Technologies to be Excluded spread (to exclude Import Technologies).
3. The least efficient filter to execute is one that involves multiple rows in both the Technologies to be Included and Excluded spreads, and where there are rows in *each* of the following three categories:
 - Input Commodity but no Output Commodity criteria;
 - Output Commodity but no Input Commodity criteria, and
 - Input Commodity and Output Commodity criteria.
4. In view of 3, when specifying a multi-row filter that involves Input and/or Output Commodity criteria, if possible try to ensure that *every* row of the filter falls into just *one* of the following three categories:
 - Input Commodity but no Output Commodity criteria;
 - Output Commodity but no Input Commodity criteria, or
 - Input Commodity and Output Commodity criteria.

So for example a multi-row filter in which *every* row of the filter involves say Input and Output Commodity criteria (and possibly also Name/Description/Set Memberships criteria) will execute more efficiently than a filter in which some rows involve say Input but no Output Commodity criteria, and other rows involve say Output but no Input Commodity criteria.
5. A filter that involves just Input Commodity criteria, or just Output Commodity criteria, will execute more efficiently than a filter that involves both Input Commodity criteria and Output Commodity criteria.
6. If possible, try to avoid use of the **Not In (...)** construct, particularly if there are more than a few Technologies (Input/Output Commodities) specified in the list inside the parentheses **()**. The Microsoft Access query language does not handle the **Not In (...)** construct anywhere near as efficiently as constructs such as **Not Like**.

12.4 Exporting and Importing a Database's Technology Items Filters

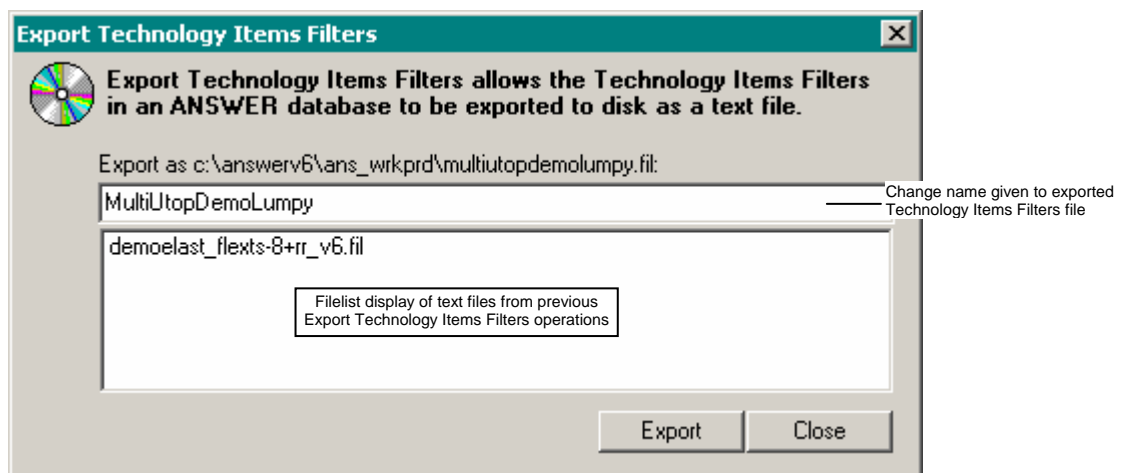
ANSWER incorporates two facilities which together enable copying of a Database's Technology Items Filter from one Database to another. The origin Database and the target Database may or may not be on the same computer. To copy the Technology Items Filters from one Database to another requires two stages:

- i. Exporting the Technology Items Filters from the origin Database into the Answer Work folder (default C:\AnswerV6\Ans_WrkPRD) as a text file; and
- ii. Importing the Technology Items Filters from the text file in the Answer Work folder into the target Database.

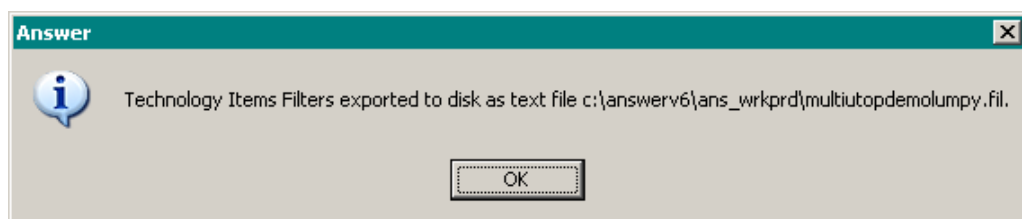
12.4.1 Exporting a Database's Technology Items Filters

To export a Database's Technology Items Filters:

1. Open the origin Database.
2. Click on **File** in the menu bar and choose **Export** then choose **Technology Items Filters...** in the drop menu.
3. An 'Export Technology Items Filters' dialogue box (shown below) will appear.



4. The name given to the Technology Items Filters file defaults to the Database name, and always has a file type of '.fil'. To vary the name given to the Technology Items Filters file, either change the name in the 'Export as c:\answerv6\ans_wrkprd<name>.fil:' text box, or choose an existing name from the file list display.
5. Click on the **[Export]** button and a message box will appear to advise that the Technology Items Filters information for the origin Database has been exported to C:\AnswerV6\Ans_WrkPRD as text file <name>.fil:

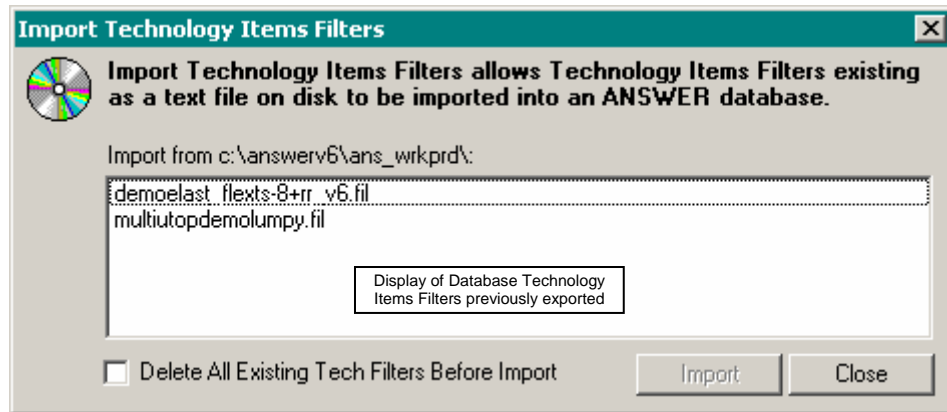


12.4.2 Importing Technology Items Filters into a Database

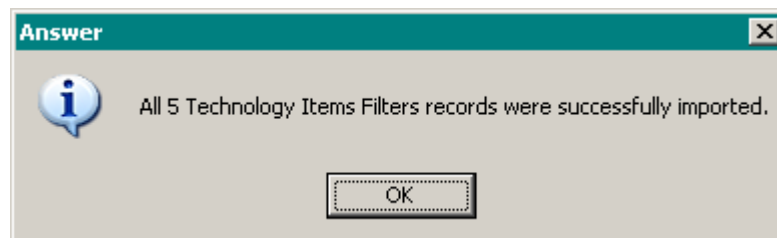
If the Technology Items Filters information in text file <name>.fil is to be copied to a Database on a separate computer, the user will need to copy/move the file to the C:\AnswerV6\Ans_WrkPRD folder in the target computer.

To import Technology Items Filters into a Database:

1. Open the target Database.
2. Click on **File** in the menu bar and choose **Import** then choose **Technology Items Filters...** in the drop menu.
3. An 'Import Technology Items Filters' dialogue box (shown below) will appear, in which all the Technology Items Filters text files (*.fil) produced by previous Export Technology Items Filters operations and held in the C:\AnswerV6\Ans_WrkPRD folder will be displayed.



4. Click on the required Technology Items Filters file <name>.fil in the filelist display. This causes the **[Import]** button to become enabled.
5. If desired, check the 'Delete All Existing Tech Filters Before Import' checkbox, so that existing Technology Filters in the target database are deleted before importing those in the the Technology Items Filters file selected at step 4.
6. Click on the **[Import]** button. The following message will appear to advise that the Technology Items Filters records have been successfully imported:



Note that any named Technology Items Filter that already exists in the target database is *replaced* by the specification in the Import .fil file.

Section Thirteen: Defining a “Rule-based” Constraint in ANSWER

This Section shows the user how to set up a “Rule-based” User Constraint in ANSWER. The purpose of “Rule-based” Constraints is to ease the burden on the user of creating and maintaining the integrity of User Constraints (ADRATIOs). Previously to specify a User Constraint in ANSWER, it was necessary for the user to specify each individual row of the Constraint. Also the user was responsible for ensuring that the integrity of the Constraint was maintained if further technologies were added to the database. The “Rule-based” constraint facility simplifies the handling of User Constraints that can be defined by “rules” (such as renewable electricity production must be at least 5% of total electricity production) in two ways:

1. It enables the user to much more easily specify such a User Constraint in ANSWER; and
2. Because the User Constraint is specified via a “rule”/“rules” it reduces the burden on the user of maintaining the integrity of the User Constraint as the model changes over time.

Acknowledgements: The development of the “Rule-based” Constraints facility in ANSWER is the result of a collaborative effort between Gary Goldstein of International Resources Group and Noble-Soft Systems. The concept of “Rule-based” Constraints for MARKAL was first introduced by Dr Amit Kanudia of KanORS Inc. The ANSWER implementation of “Rule-based” Constraints is technically different from that of Dr Kanudia, but with the same overall purpose – to ease the burden on the user of creating User Constraints.

13.1 Preliminaries

You need to be running ANSWER version 6.0.2 or higher, and to make your ANSWER database aware of “rule-based” constraints. To make an existing ANSWER database aware of Rule-Based Constraints and of the Technology Filters on which Rule-Based Constraints depend, open the database with ANSWER version 6.0.2 or higher, and invoke “File, Add Technology Filter and Rule-based Constraint Facilities” from the menu bar. (You must invoke immediately after opening the database, if you move to the Data/Results screen, this menu item becomes disabled, and you will need to close the database and then reopen it in order for the menu item to be available.)

13.2 An example: A Rule-based Constraint – renewable electricity production

For ease of explanation, we demonstrate what you would need to do to create a Rule-based Constraint requiring renewable electricity production to be at least 5% of total electricity production. That is:

$$1.0 * \{\text{renewable electricity production}\} - 0.05 * \{\text{total electricity production}\} \geq 0$$

Previously when specifying this constraint in ANSWER as a user-defined constraint the coefficients had to be “normalized” since the renewable electricity producers are included in the overall set of producers, and the equation written in the form:

$$0.95 * \{\text{renewable electricity production}\} - 0.05 * \{\text{non-renewable electricity production}\} \geq 0$$

For Rule-based Constraints, ANSWER will handle this for the user, and just the first more natural form of the equation needs to be provided by the user. This makes it much easier to adjust this constraint by simply changing the 0.05 in this case.

The overview of what you need to do to create such a constraint using the new rule-based facility is:

- A. Create a (named) Technology Items Filter (rule) that selects renewable electric technologies.
- B. Create a (named) Technology Items Filter (rule) that selects all electric technologies.
- C. Use the Constraint tab to define a Rule-based Constraint that relies on the Technology Filters that you have created at steps A and B.

This example is fleshed out in the next section.

13.3 Technology Items Filters to Select Renewable/All Electric Technologies

For details regarding ANSWER's Technology Items Filters and how to invoke the 'Technology Items Filter' form see section 12 'Technology Items Filters in ANSWER'.

In section 13.4 below, 'Using the Constraint tab to define a Rule-based User Constraint', it is assumed that the Technology Items Filter that selects renewable electric technologies is named RENEW-ELE, and that the Technology Items Filter that selects all electric technologies is named ALL-ELE. We now indicate how the user might define these two Technology Items Filters.

We assume that user-imposed naming conventions mean that the Names of all technologies that produce electricity begin with "E" and that no other technology Names begin with "E", provided that we exclude export technologies whose names begin with "EXP". We also assume that all renewable technologies, and only renewable technologies, have "renew" somewhere within their Descriptions.

Then to define the ALL-ELE filter, invoke the Technology Items Filter form, specify the Name and Description of the filter, and then enter the Name criteria **Like "E"** in the Technologies to be Included spread and enter the Name criteria **Like "EXP"** in the Technologies to be Excluded spread, as follows:

New Technology Items Filter

Enter Name, Description, Comment and Specify Filter for New Technology Items Filter

Name: ALL-ELE Description: Name-based filter defining all electric technologies

Comment:

Technologies to be Included:

	Name	Description	Set Memberships	Input Commodity	Output Commodity
Look for:	Like "E"				
or:					
or:					
or:					
or:					
or:					

Technologies to be Excluded:

	Name	Description	Set Memberships	Input Commodity	Output Commodity
Look for:	Like "EXP"				
or:					
or:					
or:					
or:					
or:					

Clear Included Clear Excluded OK Cancel

When it is invoked the ALL-ELE filter will select Technologies whose Names are **Like "E"** but whose Names are not **Like "EXP"**, that is Technologies whose Names begin with "E" but do not begin with "EXP". Given the naming conventions assumed, this filter selects all electric technologies. [Note that other filters could be constructed, such as all members of set CON with 'ELC' as an Output Commodity.]

To define the RENEW-ELE filter, invoke the Technology Items Filter form and enter both the Name criteria **Like "E"** and the Description criteria **Like "**renew"** in the top row of the Technologies to be Included spread (and specify the Name and Description of the filter itself), as follows:

New Technology Items Filter

Enter Name, Description, Comment and Specify Filter for New Technology Items Filter

Name: Description:

Comment:

Technologies to be Included:

	Name	Description	Set Memberships	Input Commodity	Output Commodity
Look for:	Like "E*"	Like "*renew*"			
or:					
or:					
or:					
or:					
or:					


Technologies to be Excluded:

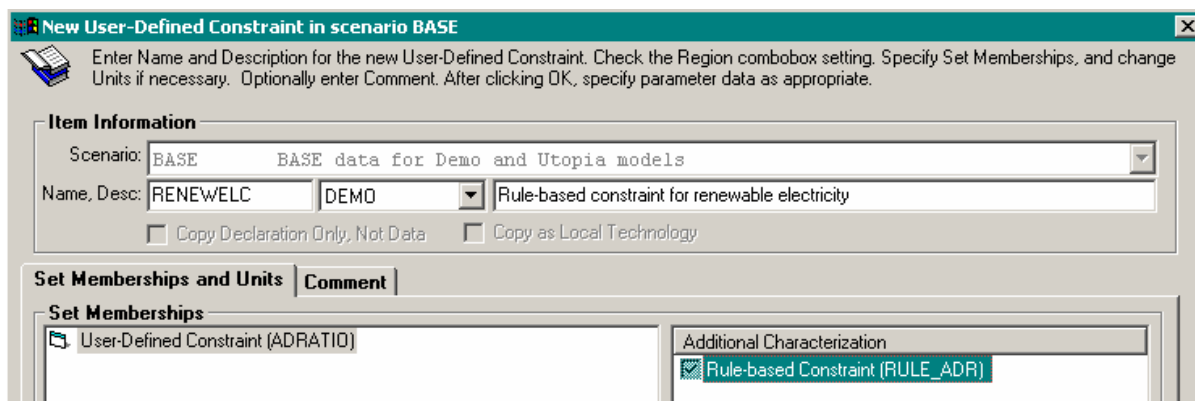
	Name	Description	Set Memberships	Input Commodity	Output Commodity
Look for:					
or:					
or:					
or:					
or:					
or:					


Clear Included Clear Excluded OK Cancel

When it is invoked the RENEW-ELE filter will select Technologies that satisfy the composite row criteria of having Names **Like "E*"** and Descriptions **Like "*renew*"**, that is Technologies whose Names begin with "E" and that have "renew" somewhere within their Descriptions. Given the naming conventions assumed, this filter selects all renewable electric technologies.

13.4 Using the Constraint tab to define a Rule-based User Constraint

1. Click on the  button in the Item Management frame to bring up the New User-Defined Constraint form.
- 2a. Specify Name, Region and Description for the Constraint. For this example, we specify Name = "RENEWELC", Region = "DEMO", Description = "Rule-based constraint for renewable electricity"
 Note that there is a new checkbox under Additional Characterization on the RHS of the Set Memberships frame:



- 2b. Check this checkbox to indicate that you wish this to be a rule-based constraint.
- 2c. Click on the  button.
3. As is the case with a standard User-Defined Constraint, ANSWER automatically creates an instance of the RAT__RHS parameter, with the entry in the Bound column containing the place-holder **-none-**:

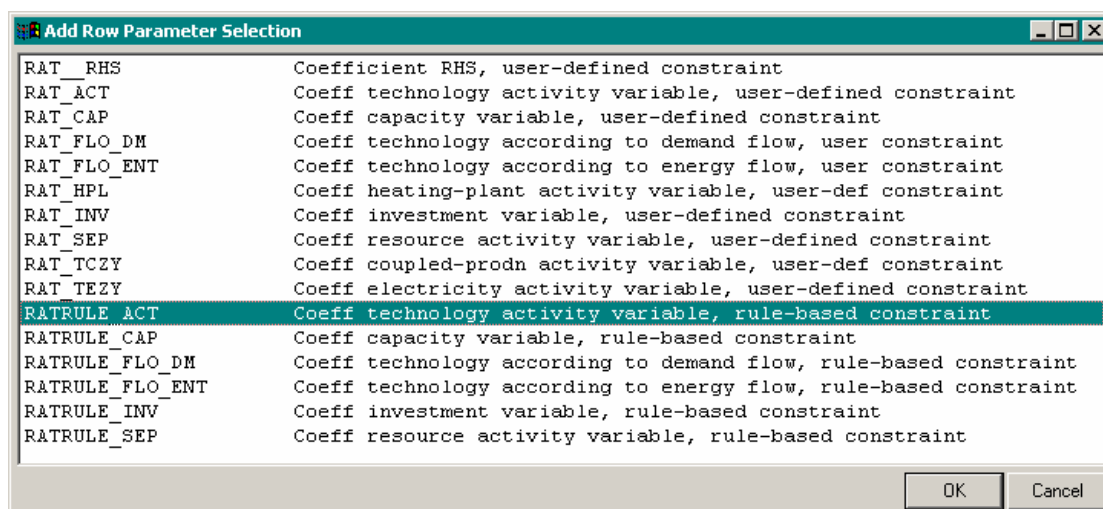
RENEWELC		DEMO		Rule-based constraint for renewable ...		Select All Items		Move...		RE	
Subset Parameters:		*C User-Defined Constraint						TS,TID data			
	Scenario	Parameter	Region	Tech/Filter	Constraint	Item3	TimeSlic	1990	2000		
?	BASE	RAT__RHS	? DEMO	-	RENEWELC	-none-	-				
Add	BASE		?								

4. Use the direct-cell edit facility to change the **-none-** to whichever of **LO/FX/UP** is appropriate according to the sense of the constraint (\geq , $=$, \leq respectively) and specify appropriate numeric values.

For this example, we replace **-none-** by **LO**, since the sense of the constraint is \geq , and we specify zeros in each time period, as follows:

RENEWELC		DEMO		Rule-based constraint for renewable ...		Select All Items		Move...		RES	
Subset Parameters:		*C User-Defined Constraint						TS,TID data		?	
	Scenario	Parameter	Region	Tech/Filter	Constraint	Item3	TimeSlic	1990	2000	2010	
	BASE	RAT__RHS	? DEMO	-	RENEWELC	LO	-	0.0000	0.0000	0.0000	
Add	BASE		?								

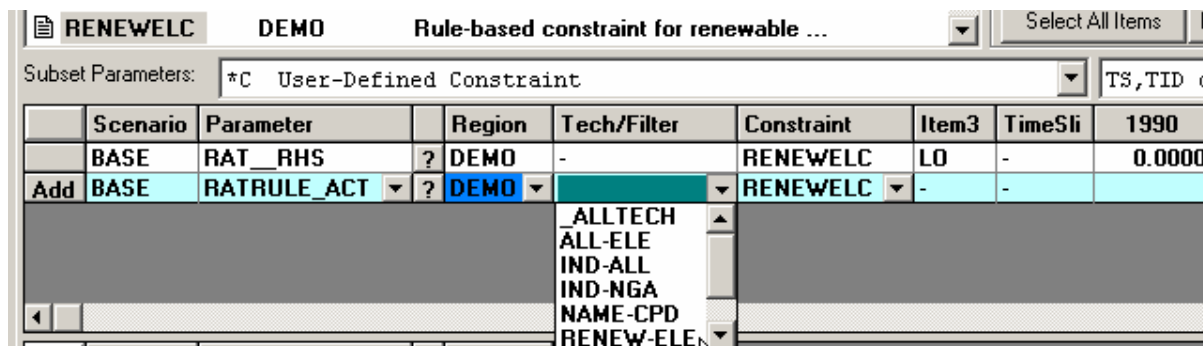
- Use the Parameter combobox in the AddRow to select the appropriate parameter. This can be done either by dropping down the combobox and using the scroll bar to display the parameters of interest, or more conveniently by right-mouse clicking on the AddRow Parameter combobox and selecting "View Descriptions" which displays all the available rule-based constraint parameters and their descriptions, as follows:



Note that for a Rule-based Constraint, and only for a Rule-based Constraint, six new "RATRULE_*" parameters (RATRULE_ACT, RATRULE_CAP, RATRULE_FLO_DM, RATRULE_FLO_ENT, RATRULE_INV and RATRULE_SEP) are available, *in addition to the standard RAT_* parameters (RAT_ACT, RAT_CAP etc) that are available for all Constraints.*

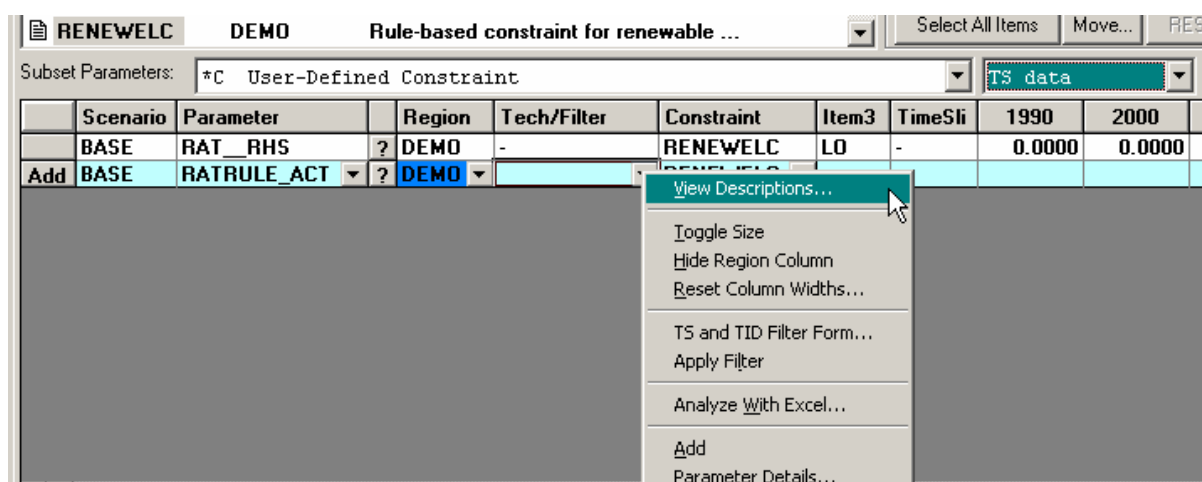
For this example we select **RATRULE_ACT**.

- Drop-down the Tech/Filter combobox in the AddRow, and select the appropriate (named) Technology Filter from the list of Technology Filters that is displayed:

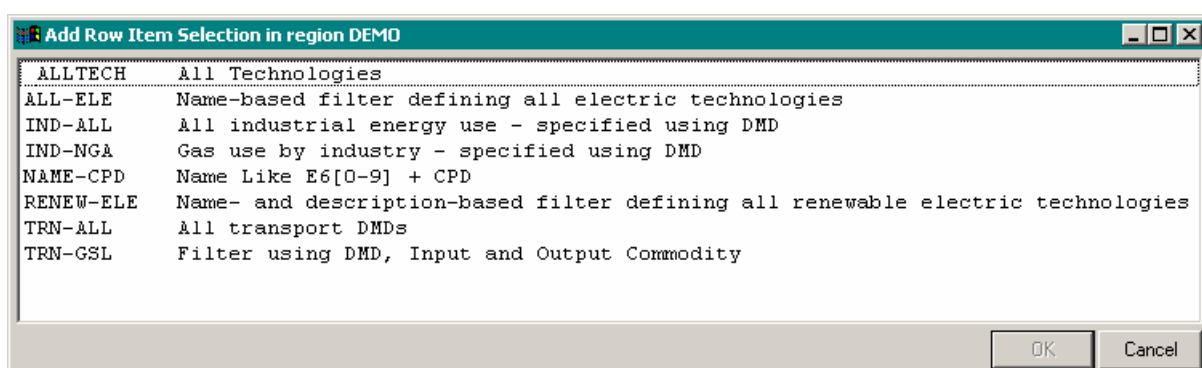


For this example, we select **RENEW-ELE**.

Alternatively, right-mouse click on the Tech/Filter combobox and select "View Descriptions":



This brings up the following form that has the benefit of displaying both the Name and the Description for each available Technology Filter:



Select the appropriate Technology Filter from this form, in this case RENEW-ELE, and click on the **[OK]** button.

7. Specify appropriate numeric values (for this example we specify **1.0** in each time period) for the renewable electric producers and press the ↓ key or hit the Add button to add the completed row into the TS spread, as follows:

RENEWELC		DEMO		Rule-based constraint for renewable ...				Select All Items		Move...	
Subset Parameters:		*C User-Defined Constraint							TS data		
	Scenario	Parameter	Region	Tech/Filter	Constraint	Item3	TimeSli	1990	2000		
	BASE	RAT_RHS	DEMO	-	RENEWELC	LO	-	0.0000	0.0000		
	BASE	RATRULE_ACT	DEMO	RENEW-ELE	RENEWELC	-	-	1.0000	1.0000		
Add	BASE										

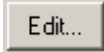
8. Repeat steps 5, 6, 7 to specify additional RATRULE_* rows as necessary to complete the Constraint.

To complete this example, we again select parameter **RATRULE_ACT** at step 5, but at step 6 select Technology Filter **ALL-ELE**, and at step 7 specify **-0.05** in each time period and then click on the ↓ key to add the row into the TS spread, as follows:

RENEWELC		DEMO		Rule-based constraint for renewable ...			Select All Items		Move...		RES	
Subset Parameters:		*C User-Defined Constraint						TS data				
	Scenario	Parameter		Region	Tech/Filter	Constraint	Item3	TimeSli	1990	2000		
	BASE	RAT_RHS	?	DEMO	-	RENEWELC	LO	-	0.0000	0.0000		
	BASE	RATRULE_ACT	?	DEMO	ALL-ELE	RENEWELC	-	-	-0.0500	-0.0500		
	BASE	RATRULE_ACT	?	DEMO	RENEW-ELE	RENEWELC	-	-	1.0000	1.0000		
Add	BASE		?									

(The RATRULE_ACT row involving ALL-ELE appears above the row involving RENEW-ELE, even though added after it, because ANSWER sorts by Parameter, then Region, then Tech/Filter.)

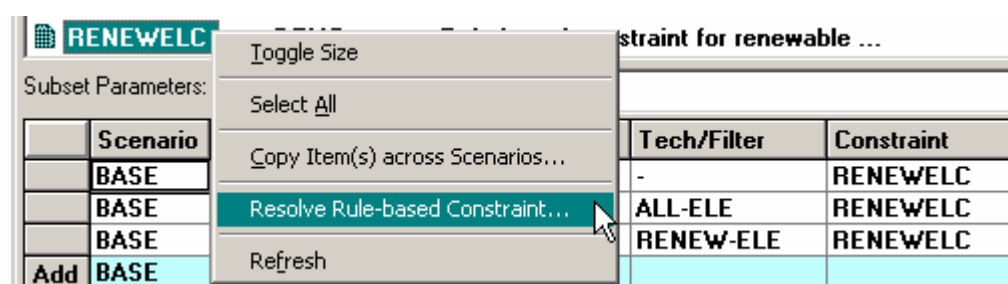
13.5 Change of Set Memberships on the Constraint tab

- The user may change the Set Memberships of a Constraint from standard to rule-based, or vice-versa, by clicking on the  button in the Item Management frame to bring up the Edit User-Defined Constraint form, and then by checking/unchecking the ☐ Rule-based checkbox to change from standard to rule-based, or vice-versa, respectively.
- If the user changes the Set Memberships of a Constraint from standard to rule-based, then all of the RAT_* parameters associated with the Constraint will be retained unchanged.
 - And after the change, the RATRULE_* parameters will now also be available for selection in the AddRow Parameter combobox.
- If the user changes the Set Memberships of a Constraint from rule-based to standard, then after asking the user to confirm change of Set Memberships, the RAT__RHS parameter and any RAT_* parameters that may be associated with the Constraint will be retained unchanged.
 - But ANSWER will automatically delete existing RATRULE_* parameters associated with the Constraint, and these parameters will no longer be available for selection in the AddRow Parameter combobox.

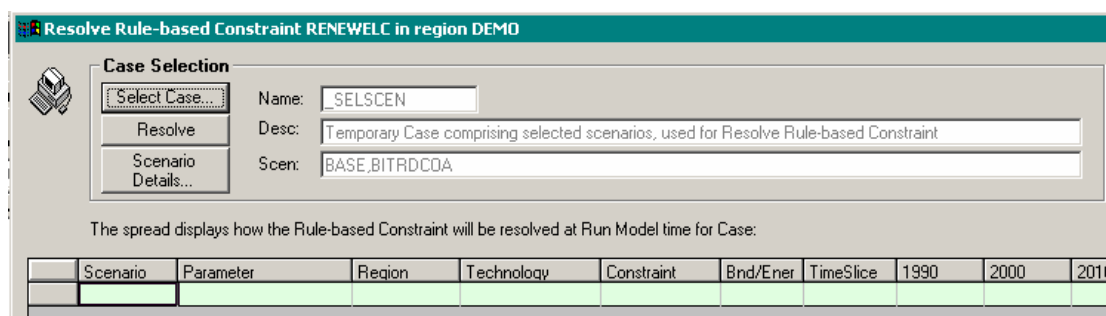
13.6 Displaying how a Rule-based Constraint will be resolved at Run Model time

As mentioned previously, an added benefit of the Rule-based Constraints is that they are resolved at run time to ensure that all technologies found in the various scenarios involved in the run are considered dynamically as candidates for the constraint. This is discussed further below, but ANSWER also provides a facility to enable the user to preview how the Rule-based Constraint will be resolved, as discussed here.

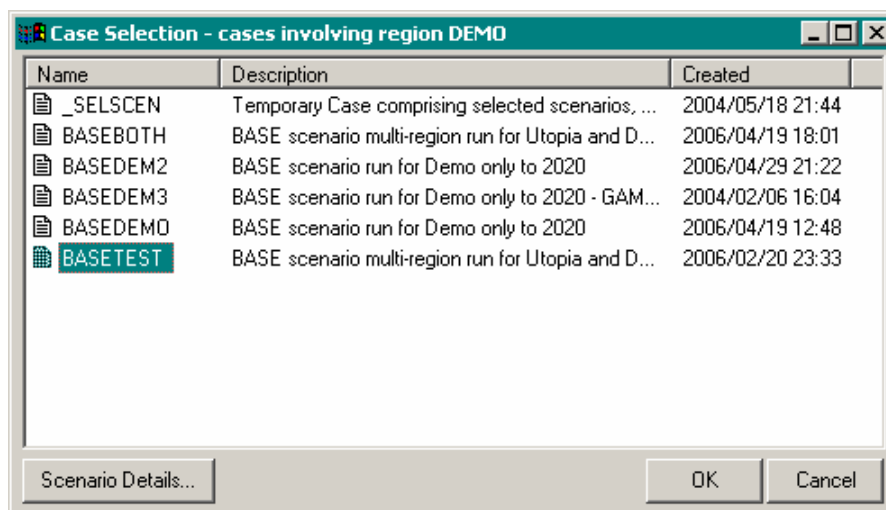
1. To display how a Rule-based Constraint will be resolved at Run Model time (that is, to display each individual row of the Constraint with the fully resolved coefficients as they will be generated at Run Model time) select the Rule-based Constraint in the Items listview, then right-mouse click and select the 'Resolve Rule-based Constraint' menu option:



2. The 'Resolve Rule-based Constraint' form will appear. Initially the form is populated with a specially constructed temporary Case named `_SELSCEN` that comprises the BASE scenario, followed by the non-BASE scenarios in the Home screen Selected Scenarios listview in alphabetical order of CaseName. (Only the upper part of the form is displayed in the screen snapshot below). Often resolving the Constraint against the `_SELSCEN` temporary Case will be sufficient for the user to determine whether the Constraint has been correctly specified. See 3 below for details of how to resolve the Constraint against an *online* Case.



3. To resolve the Constraint against an *online* Case, click on the **[Select Case...]** button to bring up a 'Case Selection' form that displays all online Cases involving the region for which the Rule-based Constraint is specified (in this case DEMO). This display will include Cases for which the results have been removed with just the Case definition remaining, and as can be seen also includes the temporary Case `_SELSCEN`:



Select the Case of interest and click on the **[OK]** button.

(If necessary the user can create a Case of interest by exiting this form and the 'Resolve Rule-based Constraint' form, moving to the Home screen, bringing up the Run Model form and specifying the ordered scenarios to be used, and then submitting with the 'Generate Files, Do Not Run' checkbox checked.)

The Case Selection form has been enhanced by the addition of a **[Scenario Details...]** button, allowing the user to display details of the scenarios comprising the selected Case.

4. The 'Resolve Rule-based Constraint' form will now appear as follows, with the Name and Desc. textboxes containing the Name and Description respectively for the selected Case, and with the Scen. textbox containing a list of the Scenarios that comprise the selected Case in Run Model scenario order. The **[Resolve]** button has the focus pending the user clicking on it to resolve the Constraint.

The spread displays how the Rule-based Constraint will be resolved at Run Model time for Case:

Scenario	Parameter	Region	Technology	Constraint	Bnd/Energv/	TimeSlic	1990	2000	2010

5. Click on the **[Resolve]** button to resolve the Constraint. The spread displays each individual row of the Constraint that will be generated at Run Model time for the scenarios involved with the selected Case BASETEST. Note that there are a number of technologies in the spread (E31, E32, E35, E3D, E6D) for which the RAT_ACT coefficients are 0.95: these are the renewable electric technologies in the DEMO database. They pick-up the value 0.95 because they qualify for both the **ALL-ELE** and **RENEW-ELE** rules so $+1 - 0.05 = 0.95$ is calculated by ANSWER as the appropriate final coefficient for RAT_ACT. The remaining technologies in the spread for which the RAT_ACT coefficients are -0.05 are the non-renewable electric technologies.

Resolve Rule-based Constraint RENEWELC in region DEMO

Case Selection

Select Case... Name: BASETEST

Resolve Desc: BASE scenario multi-region run for Utopia and Demo

Scenario Details... Scen: BASE_TEST2,TEST3,TEST

The spread displays how the Rule-based Constraint will be resolved at Run Model time for Case: BASETEST

Scenario	Parameter	Region	Technology	Constraint	Bnd/Energy/	TimeSlic	1990	2000	2010	2020
BASE	RAT_RHS	DEMO	-	RENEWELC	L0	-	0.0000	0.0000	0.0000	0.0000
BASE	RAT_ACT	DEMO	E01	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E10	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E14	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E21	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E31	RENEWELC	-	-	0.9500	0.9500	0.9500	0.9500
BASE	RAT_ACT	DEMO	E32	RENEWELC	-	-	0.9500	0.9500	0.9500	0.9500
BASE	RAT_ACT	DEMO	E35	RENEWELC	-	-	0.9500	0.9500	0.9500	0.9500
BASE	RAT_ACT	DEMO	E3D	RENEWELC	-	-	0.9500	0.9500	0.9500	0.9500
BASE	RAT_ACT	DEMO	E4G	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E4H	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E6A	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E6B	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E6C	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E6D	RENEWELC	-	-	0.9500	0.9500	0.9500	0.9500
BASE	RAT_ACT	DEMO	E82	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E99	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500

OK

- If any of the Technology Items Filters used in defining a Rule-based Constraint involve Technologies whose Set Memberships are incompatible for the RAT_* parameter with which they are associated, then the rows that correspond to these Technologies are put out to the spread colored pink, and a message box alerts the user. Note that these rows are not put out to the RULES .DDS at Run Model time. (To do so would lead to GAMS \$170 compilation errors.) For example if the definition of filter ALL-ELE had not excluded export Technologies, whose names begin with "EXP", then there would be a pink row in the spread for each export Technology, since such Technologies' Set Memberships are incompatible for the RAT_ACT parameter.

BASE	RAT_ACT	DEMO	E3D	RENEWELC	-	-	0.9500	0.9500	0.9500	0.9500
BASE	RAT_ACT	DEMO	E4G	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E4H	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E6A	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E6B	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E6C	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E6D	RENEWELC	-	-	0.9500	0.9500	0.9500	0.9500
BASE	RAT_ACT	DEMO	E82	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E99	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	EXPCOAC	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	EXPELC1	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	EXPJTF1	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500

Some Technology Set Memberships incompatible with RAT_* Parameter

Some of the Technology Items Filters used in this Rule-based Constraint generate Technologies whose Set Memberships are incompatible with those required for the RAT_* parameter with which they are associated.

In the spread, there are 3 rows (colored pink) that correspond to such Technologies, and that will NOT be put out at Run Model time.

You may wish to check the definition of the Technology Items Filters used.

OK

Close

- For additional details regarding how Rule-based Constraints are resolved at Run Model time, see section 13.7 'Run Model Considerations for Rule-based Constraints'.
- The [**Scenario Details...**] button on the form allows the user to display details of the scenarios comprising the selected Case. The only purpose of this button is to provide these extra details in case they may be useful in verifying that the selected Case is indeed the one of interest.
- Click on the [**Close**] button to close the 'Resolve Rule-based Constraint' form. The Name of the selected Case is saved to the database as the default selected Case to be used the next time that you invoke the 'Resolve Rule-based Constraint' form, and the temporary Case _SELSCEN is deleted from the database.

13.7 Run Model Considerations for Rule-based Constraints

1. Rule-based Constraints may be defined in the BASE scenario and in any non-BASE scenarios that the user wishes. As is the case with standard user-defined Constraints, the only Rule-based Constraints that will be activated in a model run are those that are defined in one of the scenarios that comprise the model run.
 - When deciding in which scenario a particular Rule-based Constraint is to be defined the user needs to bear in mind that a Rule-based Constraint that is defined in the BASE scenario will be activated in every model run.
2. The scope of a Rule-based Constraint is the set of technologies in either the BASE scenario or in any of the non-BASE scenarios that comprise the model run. So for example if one of the "rules" for a Rule-based Constraint is to select renewable electric technologies, then the set of (distinct) renewable electric technologies in the BASE scenario and in non-BASE scenarios that comprise the model run will be selected.
3. At Run Model time for the Run (Case) named <Run>, all Rule-based Constraints for each region <Region> that comprises the model run are resolved and written to a specially named DDS file, <Run>_RULES+<region>.DDS. That is, for say a 9 region run 9 such special DDS files will be created.
 - New versions of the RegionTemplate.GEN and Template.GEN files ensure that the special RULES DDS files are \$INCLUDED after the BASE DD and other non-BASE DDS files for the model run to ensure that all technologies involved in the constraints are previously defined.

13.8 Run Model Considerations for Rule-based Constraints – Fine Points

1. The user who specifies say both RAT_ACT and RATRULE_ACT parameter instances for a Rule-based Constraint needs to understand how the RAT_ACT and RATRULE_ACT instances will be cumulated when the Constraint is resolved at Run Model time.
 - Where the technology that is specified for the RAT_ACT instance is not among the technologies selected by the "rule" associated with the RATRULE_ACT instance, the individual RAT_ACT rows generated when the Constraint is resolved will simply comprise the RAT_ACT row for this technology together with the RAT_ACT rows generated for each technology that satisfies the "rule" associated with the RATRULE_ACT instance.
 - Where the technology that is specified for the RAT_ACT instance is is one of the technologies selected by the "rule" associated with the RATRULE_ACT instance, it is less clear what the individual RAT_ACT rows that are generated when the Constraint is resolved should comprise, *or indeed whether this situation should be brought to the user's attention as a likely error*. Two alternate possibilities come to mind for the technology that is specified for the RAT_ACT instance, namely:
 - (a) The explicitly provided RAT_ACT row would be used, and the RATRULE_ACT row ignored so far as this technology is concerned; or
 - (b) The explicitly provided RAT_ACT row and the RATRULE_ACT row would both be used, with the numeric coefficients obtained by adding the numeric coefficients for the RAT_ACT and RATRULE_ACT instances together.

The current ANSWER code resolves such a Constraint in the manner described at (b) above, that is, the explicitly provided RAT_ACT row and the RATRULE_ACT row are both used.

2. What happens at Run Model time if a particular Rule-based Constraint has Time Series rows associated with it in **more than one** of the scenarios that comprise the model run? For manageability, only the Time Series rows associated with this Constraint for the scenario that is lowest down in the Run Model order are used, and Time Series rows associated with this Constraint for scenarios that are higher up in the Run Model order are skipped over (ignored).
 - NOTE: It is only in respect of Rule-based Constraints that data rows for scenarios that are higher up in the Run Model order are skipped over. The user is reminded that the general rule in ANSWER is that data rows for each Run Model scenario are written to that scenario's <ScenarioName>+<Region>.DDS file, and so the effect at Run Model time is that data rows for each successive scenario in the Run Model order are merged with those for scenarios that are higher up in the order, rather than being overwritten or ignored.
3. Where a particular Rule-based Constraint has Time Series rows associated with it in more than one of the scenarios that comprise the model run, a message is written to the special run RULES DDS file informing the user as to each Rule-based Constraint and scenario for which data has been skipped over:

```

BASATEST_RULES+DEMO.DDS - WordPad
File Edit View Insert Format Help

* This DDS contains Rule-based constraints that occur in scenario(s) 'BASE','TEST2','TEST3','TEST' for
SET ADRATIO /
'RENEWELC' 'Rule-based constraint for renewable electricity '
'RENEWELC3' 'Rule-based constraint for renewable electricity 3 '
'RENEWELC4' 'Rule-based constraint for renewable electricity 4 '
/:
* Skipped over TS Data for Rule-based Constraint RENEWELC3 in scenario TEST3.
* Data for this Constraint will be taken from scenario TEST that is lower down in the Run Model order.
* Skipped over TS Data for Rule-based Constraint RENEWELC3 in scenario TEST2.
* Data for this Constraint will be taken from scenario TEST that is lower down in the Run Model order.
* Skipped over TS Data for Rule-based Constraint RENEWELC4 in scenario TEST3.
* Data for this Constraint will be taken from scenario TEST that is lower down in the Run Model order.
* Skipped over TS Data for Rule-based Constraint RENEWELC4 in scenario TEST2.
* Data for this Constraint will be taken from scenario TEST that is lower down in the Run Model order.
    
```

4. In the above example, the database contained Time Series rows for Rule-based Constraints RENEWELC3 and RENEWELC4 in scenarios TEST2, TEST3 and TEST. As can be seen from the top line of the run RULES DDS file, the scenario order is BASE, TEST2, TEST3, TEST with scenario TEST the lowest down in the Run Model order. So for example when the Rule-based Constraint TS data for RENEWELC3 in scenario TEST3 is encountered, the following lines are written to the run RULES DDS file:

```

* Skipped over TS Data for Rule-based Constraint RENEWELC3 in scenario TEST3.
* Data for this Constraint will be taken from scenario TEST that is lower down
in the Run Model order.
    
```

5. For user convenience, the Time Series data for Rule-based Constraints are put out to the run RULES DDS file grouped by Rule-based Constraint and with an initial comment line indicating from which Run Model scenario the TS data was taken. So in the above example, the TS data for Constraint RENEWELC3 is put out as follows:

```

BASATEST_RULES+DEMO.DDS - WordPad
File Edit View Insert Format Help

* TS Data follows for Rule-based Constraint RENEWELC3 taken from scenario TEST
TABLE NRAT_RTY2
'RENEWELC3' 'LO' 1990 2000 2010 2020
EPS EPS EPS EPS
;
TABLE NRAT_ACT
'RENEWELC3' 1990 2000 2010 2020
'E01' 'RENEWELC3' -.06 -.06 -.06 -.06
'E10' 'RENEWELC3' -.06 -.06 -.06 -.06
'E14' 'RENEWELC3' -.06 -.06 -.06 -.06
'E21' 'RENEWELC3' -.06 -.06 -.06 -.06
'E30' 'RENEWELC3' -.06 -.06 -.06 -.06
'E31' 'RENEWELC3' .88 .88 .88 .88
'E32' 'RENEWELC3' .88 .88 .88 .88
'E35' 'RENEWELC3' .88 .88 .88 .88
'E3D' 'RENEWELC3' .88 .88 .88 .88
'E4G' 'RENEWELC3' -.06 -.06 -.06 -.06
'E4H' 'RENEWELC3' -.06 -.06 -.06 -.06
'E6A' 'RENEWELC3' -.06 -.06 -.06 -.06
'E6B' 'RENEWELC3' -.06 -.06 -.06 -.06
'E6C' 'RENEWELC3' -.06 -.06 -.06 -.06
'E6D' 'RENEWELC3' .88 .88 .88 .88
'E82' 'RENEWELC3' -.06 -.06 -.06 -.06
'E81' 'RENEWELC3' -.06 -.06 -.06 -.06
;
* TS Data follows for Rule-based Constraint RENEWELC4 taken from scenario TEST
TABLE NRAT_RTY2
'RENEWELC4' 'LO' 1990 2000 2010 2020
EPS EPS EPS EPS
;
TABLE NRAT_ACT
'RENEWELC4' 1990 2000 2010 2020
'E01' 'RENEWELC4' -.11 -.11 -.11 -.11
'E30' 'RENEWELC4' -.11 -.11 -.11 -.11
    
```

Section Fourteen: Handling Flexible Time Slices in ANSWER

A new TimeSlice tab was introduced into version 6 of ANSWER to handle the introduction of flexible Time Slices into the GAMS-MARKAL code. This Section details special considerations that apply on the new TimeSlice tab.

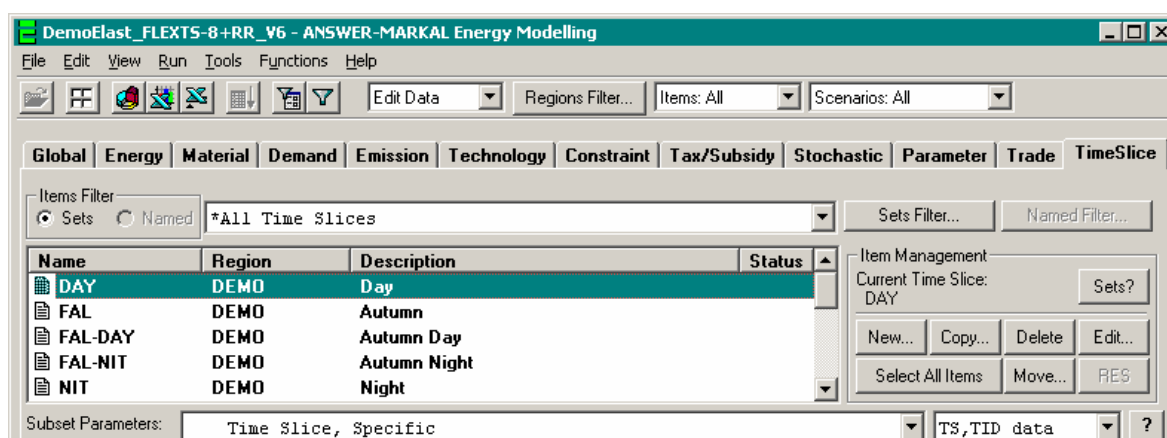
For details regarding GAMS-MARKAL aspects of flexible Time Slices, see chapter 1 'Towards More Detailed Electricity (and Heat) Modeling in MARKAL' in the Word document "MARKAL_ANSWER-TD(ZY)+RATRULE-TechFilter (6).doc" in folder C:\AnswerV6\Doc. This section 14 is a revised version of Appendix A 'Handling Flexible Time Slices Under ANSWER' of this Word document.

Note: The menu option "File, Add Flexible TimeSlice Facilities" can be used to upgrade a version 5 ANSWER database to make it Flexible TimeSlice aware. (You must invoke this menu option immediately after opening the database, if you move to the Data/Results screen, this menu item becomes disabled, and you will need to close the database and then reopen it in order for the menu item to be available.)

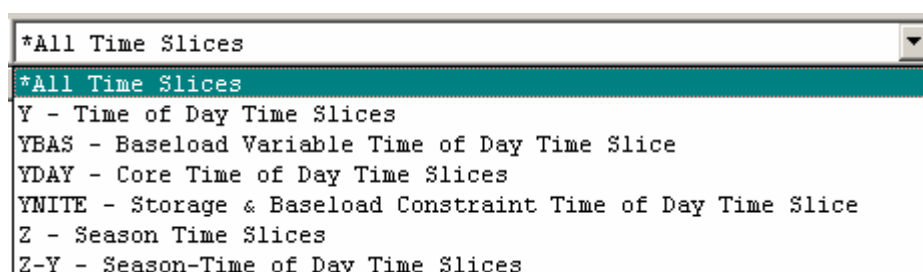
Acknowledgement: The development of the Flexible Time Slice facility in ANSWER is the result of a collaborative effort between Gary Goldstein of International Resources Group and Noble-Soft Systems.

14.1 Overview

1. There is a new TimeSlice tab to the right of the Trade/BiTrade tab:



2. The following Time Slice subsets are provided, as shown by dropping down the "**All Time Slices" combobox:



3. The same general mechanics are available for New/Copy/Delete/Edit Time Slice as on other tabs (see section 5 'Data entry and editing'), but a number of special considerations apply on the TimeSlice tab. These will be discussed in the following sections.

14.2 Creating a New Time Slice

14.2.1 Creating a New Season Time Slice (Member of Z)

To create a new Season Time Slice:

1. Click on the **[New...]** button and enter Name and Description for the new Season, then click on the "Season (Z)" node of the Set Memberships tree.

2. There are no Additional Characterization options for a Season TimeSlice, so simply click on the **[OK]** button to save the new Time Slice to the database. See also section 14.2.4 for additional special considerations that apply.

14.2.2 Creating a new Time of Day Time Slice (Member of Y)

To create a new Time of Day Time Slice:

1. Click on the **[New...]** button and enter Name and Description for the new Time of Day division, then click on the "Time of Day (Y)" node of the Set Memberships tree.

New Time Slice in scenario BASE

Enter Name and Description for the new Time Slice. Check the Region combobox setting. Specify Set Memberships, and change Units if necessary. Optionally enter Comment. After clicking OK, specify parameter data as appropriate.

Item Information

Scenario: BASE Demo Base Model

Name, Desc: H12 DEMO 3 hour period from 12 noon to 3 pm

☐ Copy Declaration Only, Not Data ☐ Copy as Local Technology

Set Memberships and Units **Comment**

Set Memberships

- Time Slice
 - Season [Z]
 - Time of Day [Y]**
 - Season-Time of Day [Z-Y]

Additional Characterization

☒ Core Time of Day (YDAY)

☐ Storage & Baseload Constraint Time of Day (YNITE)

☐ Baseload Plant Operation Time of Day (YBAS)

Units

(There are no Units associated with TimeSlice Items.)

☒ Apply TimeSlice Changes To All Regions **OK** **Cancel**

2. For a Time of Day Time Slice, there are two principal Additional Characterization alternatives – ‘Core Time of Day (YDAY)’ and ‘Storage & Baseload Constraint Time of Day (YNITE)’ – provided by the two radio buttons, with ‘Core Time of Day (YDAY)’ selected by default. There is also a ‘Baseload Variable Time of Day (YBAS)’ checkbox.
- 3a. To specify that a Time of Day division is a Core Time of Day (YDAY) division, accept the default selection of the ‘Core Time of Day (YDAY)’ radio button. Then consider whether or not this core Time of Day division is to be used as the baseload variable division of the day (YBAS):
 - If this core Time of Day division is not to be used as the baseload variable division of the day (YBAS), leave the ‘Baseload Plant Operation Time of Day (YBAS)’ checkbox unchecked.
 - If this core Time of Day division is to be used as the baseload variable division of the day (YBAS), then check the ‘Baseload Plant Operation Time of Day (YBAS)’ checkbox, as shown below:

Set Memberships

- Time Slice
 - Season [Z]
 - Time of Day [Y]**
 - Season-Time of Day [Z-Y]

Additional Characterization

☒ Core Time of Day (YDAY)

☐ Storage & Baseload Constraint Time of Day (YNITE)

☒ Baseload Plant Operation Time of Day (YBAS)

- 3b. To specify that a Time of Day division is the division when storage takes place and the baseload constraint is applied, select the ‘Storage & Baseload Constraint Time of Day (YNITE)’ radio button:

Set Memberships

- Time Slice
 - Season [Z]
 - Time of Day [Y]**
 - Season-Time of Day [Z-Y]

Additional Characterization

☐ Core Time of Day (YDAY)

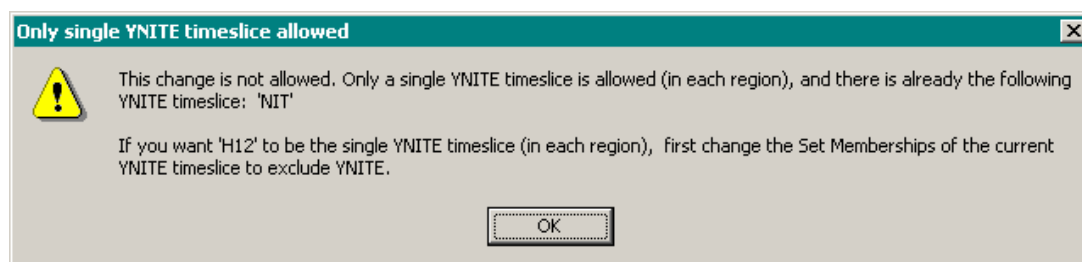
☒ **Storage & Baseload Constraint Time of Day (YNITE)**

☐ Baseload Plant Operation Time of Day (YBAS)

Note that a YNITE Time of Day division cannot be also designated to be the baseload variable division of the day (YBAS). If the YNITE radio button is selected and you attempt to check the 'Baseload Plant Operation Time of Day (YBAS)' checkbox, the checkbox remains unchecked and the following message appears:



4. After selecting the appropriate Additional Characterization options, click on the **[OK]** button to save the new Time Slice to the database. See also section 14.2.4 for additional special considerations that apply.
5. Note that ANSWER ensures that only one Time of Day division Y is tagged as YNITE and that only one Time of Day division Y (YDAY actually) is tagged as YBAS. Thus to change a previously specified YNITE or YBAS the user must first deactivate the current selection in order to select a different one.
6. If the user tries to create a second YNITE Time of Day division, then the following message appears:



A similar message appears if the user tries to create a second YBAS Time of Day division.

14.2.3 Creating a new Season-Time of Day Time Slice (Member of Z-Y)

Since a mechanism is provided which automatically generates the Season-Time of Day timeslices from the Season and Time of Day Time Slices this option is prohibited, see below. If the user having invoked "New..." clicks on the "Season-Time of Day (Z-Y)" node in the Set memberships tree, the following message appears):



14.2.4 Additional special considerations applying to the TimeSlice tab

As can be seen from the above examples of what is involved in creating new Season and Time of Day Time Slices, the same general mechanics apply on the TimeSlice tab as on most other ANSWER tabs. Below is a list of additional special considerations that have been incorporated when carrying out New/Copy/Delete/Edit Time Slice:

1. Name is restricted to be at most 3 alphanumeric characters with the first character required to be alphabetic, for both Season and Time of Day.
2. Description is restricted to be at most 40 characters, for both Season and Time of Day. (The Description for each Season-Time of Day Time Slice is automatically generated by concatenating the Season description and the Time of Day description, see 3, and so we need to ensure that the result of concatenating does not exceed ANSWER's limit on Description length.)
3. The Season-Time of Day Time Slices (Z-Ys) are automatically generated from the Season (Z) and Time of Day (Y) Time Slices. This is because proper operation of ANSWER and the ANSWER-specific parts of the GAMS-MARKAL code requires that each Name in set Z-Y comprises a Name from set Z and a Name from set Y, concatenated with a hyphen. This means that the following considerations also apply:
 - The user is not allowed to create new members of set Z-Y. (Though the user may *delete* members of set Z-Y to restrict to a subset of the full set of Z-Y possibilities.)
 - If the user creates a new Season say **AUT**, then new members corresponding to **AUT-Y** are automatically created for each existing Time of Day division Y.
 - Likewise, if the user creates new Time of Day division say **H12**, then new members corresponding to Z-**H12** are automatically created for each existing Season Z.
 - If the user *edits* the Name of a Season or a Time of Day division, then the Names of members in set Z-Y and all associated data parameter instances are automatically adjusted.
 - If the user *edits* the Description of a Season or Time of Day division, then the Descriptions of related members of set Z-Y are automatically adjusted.
 - If the user attempts to *delete* either a Season or a Time of Day division, after putting up an appropriate cautionary message and getting the user's confirmation of the delete, the related members of set Z-Y and all associated data parameter instances are deleted.
 - Only changes to Additional Characterization are allowed, that is a change from "Season (Z)" to "Time of Day (Y)" (or vice-versa) is disallowed. A corollary is that a user who gets this aspect of Set Memberships wrong when creating a new Time Slice will need to delete the Time Slice and recreate it via "New Time Slice".
4. Time Slices should be defined in the BASE scenario only.
5. It is the user's responsibility to provide the appropriate Time Sliced data parameters for each of the relevant Time Slices.

14.3 Setting the Peak Time Slices

1. The user may establish the Time Slices for which peaking constraints are to be established by explicitly identifying them on the Global tab (or the TimeSlice tab) via the PEAK(Z,Y) TID parameter. That is, use the AddRow facility to add PEAK(Z,Y) parameter instances for the Time Slices for which peaking constraints are desired.

Scenario	Parameter	Region	TimeSlice	Value
BASE	HEATCOOL(Z)	? DEMO	WNT	1
BASE	PEAK(Z)(Y)	? DEMO	SUM-DAY	1
BASE	PEAK(Z)(Y)	? DEMO	WNT-DAY	1
BASE	QHR(Z)(Y)	? DEMO	FAL-DAY	0.1250
BASE	QHR(Z)(Y)	? DEMO	FAL-NIT	0.1250
BASE	QHR(Z)(Y)	? DEMO	SPR-DAY	0.1250
BASE	QHR(Z)(Y)	? DEMO	SPR-NIT	0.1250
BASE	QHR(Z)(Y)	? DEMO	SUM-DAY	0.1250
BASE	QHR(Z)(Y)	? DEMO	SUM-NIT	0.1250
BASE	QHR(Z)(Y)	? DEMO	WNT-DAY	0.1250
BASE	QHR(Z)(Y)	? DEMO	WNT-NIT	0.1250
BASE	STARTYRS	? DEMO	-	5.0000

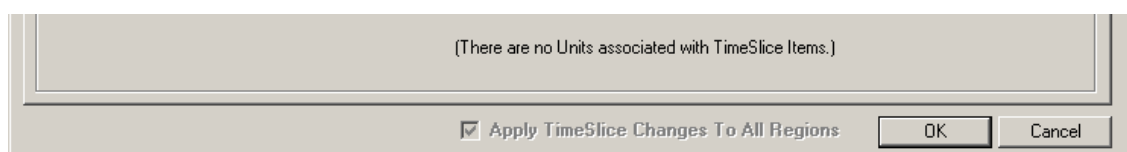
2. When no PEAK(Z)(Y) is provided (corresponding to YPEAK in the MARKAL GAMS code) it is initialized to all YDAY in each Season. Note that it is the user's responsibility to ensure that the Time Slice in which the highest daytime demand occurs is included among the PEAK(Z)(Y) entries.

14.4 Multi-region Considerations for Flexible Time Slicing

In the screen snapshots at the beginning of this section it can be seen that Time Slices occur with a Region association – in this case for region DEMO. To avoid major changes to ANSWER fundamentals Time Slices – like other Items in ANSWER – need to occur with a Region association.

However, since the GAMS-MARKAL code requires that the Time Slice structure be identical in all respects in all regions of a multi-region model (*except* that Time Slice parameter data values may be region-dependent), the following additional considerations apply to multi-region models:

1. When the user creates a new Time Slice in a region, ANSWER automatically creates this Time Slice in *every* region. Likewise when the user edits a Time Slice in a region, ANSWER automatically applies the editing changes made to this Time Slice in *every* region. (The observant reader may have noticed the disabled but checked “Apply Time Slice Changes To All Regions” checkbox to the left of the [OK] button on the New/Copy/Edit Time Slice form.)



2. When the user deletes a Time Slice from a region, ANSWER automatically deletes this Time Slice from *every* region.
3. When the user creates a new region within a multi-region database, this new region will contain the (common) Season and Time of Day Time Slices that apply in the existing regions.

14.5 Run Model Considerations for Flexible Time Slicing

1. GAMS language considerations mean that for flexible Time Slicing, the Time Slice sets must be put out before any other declarations in \$INCLUDE MMINIT.INC. To meet this requirement, the ANSWER Run Model facility generates a special DDS file that contains just the Time Slice set information, and the Template.GEN and RegionTemplate.GEN files are adjusted to pass the name of this file to MMINIT.INC for inclusion prior to any other declarations.
2. The special DDS file containing the Time Slice set information is named <Run>_TS_<Region>.DDS, where <Run> is the Run (Case) name and <Region> is the region. For a multi-region run, one of these special DDS files is generated for each region that is involved in the run.
3. For a single-region run, the Template.GEN file that is supplied with version 6 of ANSWER is adjusted so that ANSWERv6 automatically sets NEWTD to 'YES' or 'NO' according to whether or not the database is flexible timeslice aware (note the lines in the screen snapshot below that are bolded):

```

$TITLE NOBLE-SOFT ANSWER: CASE <Run>
OPTION LIMROW=0, LIMCOL=0, SOLPRINT=ON, SYSOUT=OFF, ITERLIM=200000;
OPTION RESLIM=50000, PROFILE=0, SOLVEOPT=REPLACE;
*OPTION NLP=MINOS5;
$OFFLISTING

* ANSWERv6 automatically sets RATRULE to 'YES' or 'NO' according to whether
* or not database is flexible timeslice aware
$SET RATRULE '<RuleBasedConstraint>';

* ANSWERv6 automatically sets NEWTD to 'YES' or 'NO' according to whether
* or not database is flexible timeslice aware
$SET NEWTD '<FlexibleTimeSlicing>';

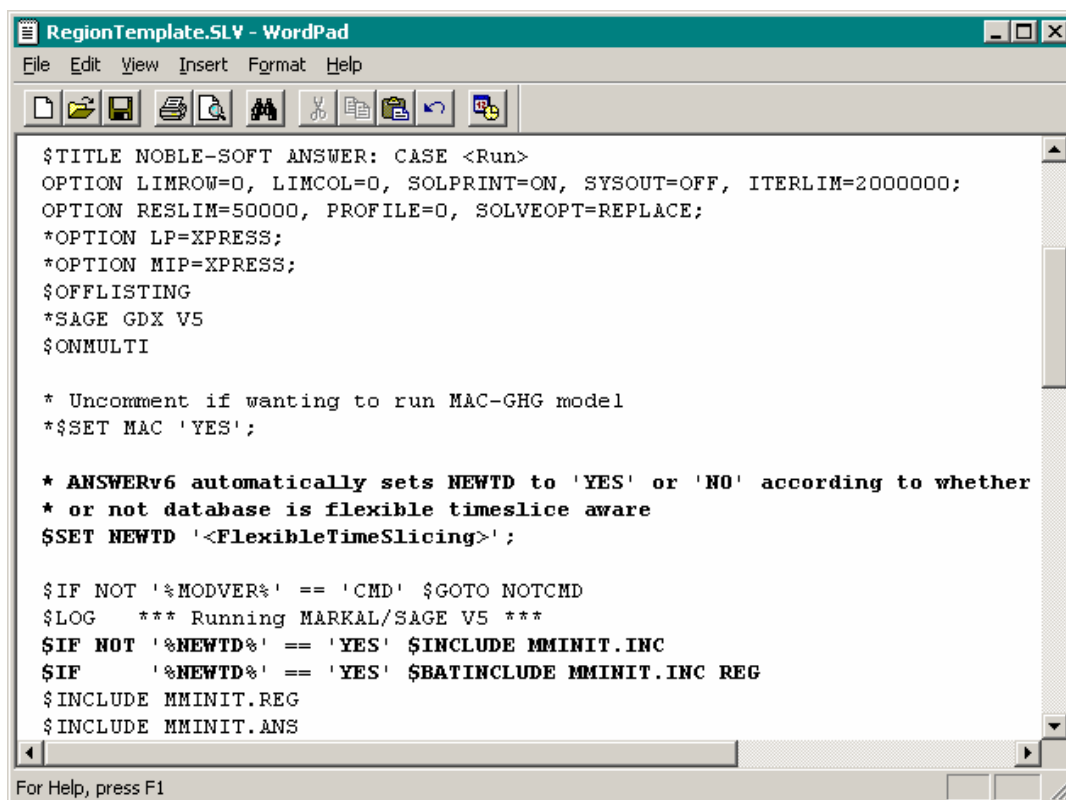
$IF NOT '%NEWTD%' == 'YES' $INCLUDE MMINIT.INC
$IF '%NEWTD%' == 'YES' $BATINCLUDE MMINIT.INC <Run>_TS_<Region>.DDS

$ONMULTI
$SET SHELL 'ANSWER';
$SET LUMPYINV '<LumpyInvestment>';
$INCLUDE MMINIT.ANS
*
SET SCENCASE / '<Run>' '<RunDesc>' /;
SET REG / '<Region>' /;
* include the .DD and .DDS files
<IncludeDDLines>

```

For a multi-region run, the RegionTemplate.GEN file that is supplied with version 6 of ANSWER is similarly adjusted.

4. In addition for a multi-region run, the RegionTemplate.SLV file that is supplied with version 6 of ANSWER is adjusted so that ANSWERv6 automatically sets NEWTD to 'YES' or 'NO' as appropriate, and REG is passed on the call to MMINIT.INC if NEWTD is 'YES' (note the lines in the screen snapshot below that are bolded):



```

RegionTemplate.SLV - WordPad
File Edit View Insert Format Help

$TITLE NOBLE-SOFT ANSWER: CASE <Run>
OPTION LIMROW=0, LIMCOL=0, SOLPRINT=ON, SYSOUT=OFF, ITERLIM=2000000;
OPTION RESLIM=50000, PROFILE=0, SOLVEOPT=REPLACE;
*OPTION LP=XPRESS;
*OPTION MIP=XPRESS;
$OFFLISTING
*SAGE GDX V5
$ONMULTI

* Uncomment if wanting to run MAC-GHG model
*$SET MAC 'YES';

* ANSWERv6 automatically sets NEWTD to 'YES' or 'NO' according to whether
* or not database is flexible timeslice aware
$SET NEWTD '<FlexibleTimeSlicing>';

$IF NOT '%MODVER%' == 'CMD' $GOTO NOTCMD
$LOG *** Running MARKAL/SAGE V5 ***
$IF NOT '%NEWTD%' == 'YES' $INCLUDE MMINIT.INC
$IF '%NEWTD%' == 'YES' $BATINCLUDE MMINIT.INC REG
$INCLUDE MMINIT.REG
$INCLUDE MMINIT.ANS

For Help, press F1

```

5. Note that from the user's perspective, the handling of flexible time slicing by version 6 of the ANSWER Run Model facility is completely automatic, with no need for the user to intervene at Run Model time. (This assumes that your GAMS Source folder contains the ANSWER version 6 files Template.GEN, RegionTemplate.GEN and RegionTemplate.SLV adjusted as noted above to automatically set NEWTD to 'YES' or 'NO' according to whether or not the database is flexible timeslice aware. This will be the case if you use the default GAMS Source folder (C:\AnswerV6\Gams_SrcPRD) that is distributed with version 6 of ANSWER.)

14.6 Other Considerations for Flexible Time Slicing

The ANSWER “smart” spreadsheets, and ANSWER’s Import Model Data from Excel, Export Scenario, Import Scenario, Export Scenario Data to Excel, Copy Scenario and Edit Scenario facilities have been reviewed and in some cases enhanced to ensure correct functioning for flexible Time Slicing.

Adding Flexible Time Slice Facilities to an existing database

The “File, Add Flexible Time Slice Facilities” menu function can be used to upgrade a current database to make it Flexible Time Slice aware.

ANSWER “smart” spreadsheets

The ANSWER “smart” spreadsheets from ANSWERver4.xls onwards will function correctly for flexible Time Slicing, *provided that the ANSWER database that is linked to when the smart XLS is opened, was established using AnswerV5.exe version 5.6.1 (or higher) and includes the pre-defined Time Slice structure for the database.*

“File, Import Model Data from Excel” for ANSWER “smart” spreadsheets

The Import Model Data from Excel facility has been enhanced so that when importing from an ANSWER “smart” spreadsheet that employs flexible Time Slicing, TS and TID data parameters involving Time Slices will be correctly imported, *provided that the ANSWER database into which the smart XLS is being imported was established using AnswerV5.exe version 5.6.1 (or higher) and includes the pre-defined Time Slice structure for the database.*

“File, Import Model Data from Excel” for older format ANSWER spreadsheets

The older format ANSWER spreadsheets are those in *** ITEMS ***, *** TS DATA ***, *** TID DATA *** format. The *** ITEMS *** sheets now allow Time Slice Items to be specified, and the Import Model Data from Excel facility has been enhanced so that Time Slice Items on *** ITEMS *** sheets are imported into the database. (To see the format required for Time Slice Items on the *** ITEMS *** sheet, use the “File, Export Scenario Data to Excel” facility to export the BASE scenario for a small database that is flexible Time Slice aware. The Time Slice Items appear at the bottom of the sheet, beneath the Technology Items, with W in column B of the Item: and Sets: rows.)

“File, Export Scenario” facility

This facility has been enhanced so that Time Slice Items (in the BASE scenario) are exported to the IMP file that the Export Scenario facility creates. Of course the Export Scenario facility has always exported TS and TID data parameters involving Time Slices to the IMP file.

“File, Import Scenario” facility

This facility has been enhanced so that Time Slice Items in the IMP file are imported into the database. Of course the Import Scenario facility has always imported into the database TS and TID data parameters involving Time Slices in the IMP file.

“File, Export Scenario Data to Excel” facility

This facility has been enhanced so that Time Slice Items (in the BASE scenario) are exported to the XLS file that the Export Scenario Data to Excel facility creates. Of course the Export Scenario Data to Excel facility has always exported TS and TID data parameters involving Time Slices to the XLS file that it creates.

Note: Currently the Export Scenario Data to Excel facility exports data *only* in the older *** ITEMS ***, *** TS DATA ***, *** TID DATA *** format.

Copy Scenario facility

This facility has always copied TS and TID data parameters involving Time Slices from the origin scenario to the destination scenario. It appears to be functioning correctly for databases that involve flexible Time Slicing.

Edit Scenario facility

This facility allows the user to edit the Scenario Name (or Description or Comment). Where it is used to edit the Scenario Name, this name change flows through to all TS and TID data parameters, including those that involve Time Slices.

Section Fifteen: Handling BiLateral Trade in ANSWER

A new **BiTrade** tab has been introduced into version 6 of ANSWER to provide improved facilities for defining new bilateral trade links and for browsing, deleting and editing existing bilateral trade links. The new **BiTrade** tab replaces what was previously called the **Trade** tab in ANSWER.

The new BiTrade tab displays only BiLateral Trade data and results (whereas the old Trade tab displayed both BiLateral Trade and Global Trade data and results). A completely new format is adopted for the top half of the screen that as well as providing improved facilities, is more consistent with the operation of the top half of the screen on most other ANSWER tabs.

This Section details special considerations that apply on the new BiTrade tab.

Note: The menu option “File, Add BiTrade Tab Facilities” can be used to upgrade a version 5 or version 6 ANSWER database to make it aware of the new bilateral trade facilities. See section 2.17.1 for details. (You must invoke this menu option immediately after opening the database, if you move to the Data/Results screen, this menu item becomes disabled, and you will need to close the database and then reopen it in order for the menu item to be available.)

While it is not possible to specify Global Trade data on the BiTrade tab, new facilities are provided to conveniently specify Global Trade data from the Parameter tab. Also, while it is not possible to view Global Trade results on the BiTrade tab, existing facilities enable Global Trade results to be viewed from the Parameter tab. For details see section 15.5 ‘Specifying Global Trade Data and Viewing Global Trade Results’.

Note that further enhancement of the bilateral trade facilities is pending.

15.1 Items Listview on BiTrade Tab Populated with Bilateral Trade Links

- On the new **BiTrade** tab, the Items listview is populated with Bilateral Trade Links, with other changes following as a consequence of this fundamental change:

MultiUtopDemo-BiTrade - ANSWER-MARKAL Energy Modelling

File Edit View Run Tools Functions Help

Edit Data Regions Filter... Items: All Scenarios: All

Global Energy Material Demand Emission Technology Constraint Tax/Subsidy Stochastic Parameter **BiTrade** TimeSlice

Items Filter
☒ Sets ☐ Named *All Bilateral Trade Links Sets Filter... Named Filter...

ExpComm	ExpTechnology	ExpRegion	P	ImpComm	ImpTechnology	ImpRegion
COA	EXPCOAW	DEMO		HCO	IMPHCOW	UTOPIA
DSL	EXPDSL1	UTOPIA	1	GSL	IMPGSL1	DEMO
ELC	EXPELC1	DEMO	1	ELC	IMPELC1	UTOPIA
JTF	EXPJTF1	DEMO	1	DSL	IMPDSL1	UTOPIA

Item Management
 Current BiTrade Link: EXPCOAW to IMPHCOW Sets?
 New... Copy... Delete Browse
 Select All Items Move... RES

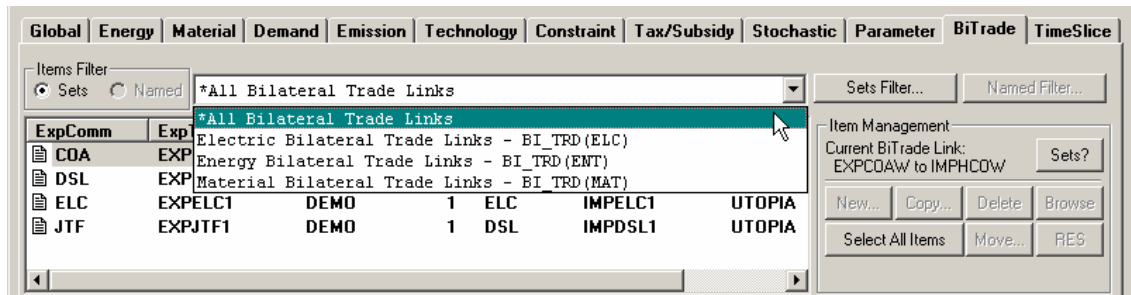
Subset Parameters: *0 Bilateral Trade TS, TID data ?

Scenario	Parameter	Region	Technology	Commodity	Bound	1990	2000	2010	2020
BASE	BOUND(BD)Or	? DEMO	EXPCOAW	-	LO	2,970.0000			
BASE	BOUND(BD)Or	? DEMO	EXPCOAW	-	UP	3,000.0000	3,000.0000	3,000.0000	3,000.0000
BASE	COST	? DEMO	EXPCOAW	-	-	1.1200	1.5000	1.5500	1.6000
M BITRDCOA	COST	? UTOPIA	IMPHCOW	-	-	0.1000	0.1000	0.1000	0.1000
BASE	ENV_SEP	? DEMO	EXPCOAW	CO2	-	-21.7000	-21.7000	-21.7000	-21.7000
BASE	INP(ENT)x	? DEMO	EXPCOAW	COA	-	1.0000	1.0000	1.0000	1.0000
M BITRDCOA	OUT(ENT)r	? UTOPIA	IMPHCOW	HCO	-	1.0000	1.0000	1.0000	1.0000

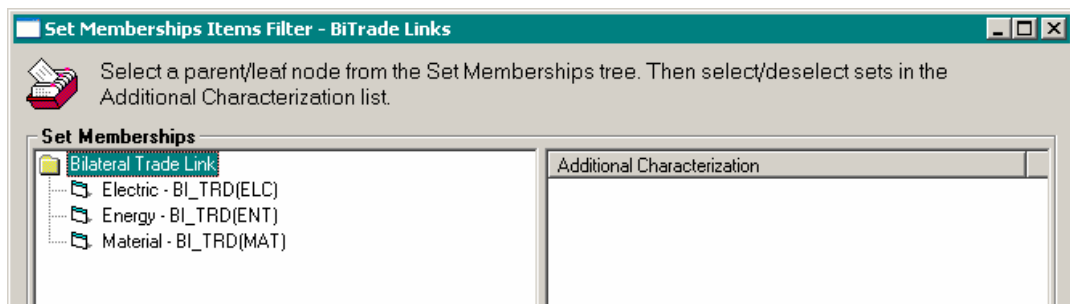
Scenario	Parameter	Region	Technology	Value
BASE	CUM	? DEMO	EXPCOAW	6,500,000
BASE	START	? DEMO	EXPCOAW	1,990
M BITRDCOA	START	? UTOPIA	IMPHCOW	1,990

Database: C:\Answer\6\Answer_Databases\MultiUtopDemo-BiTrade.mdb Edit Scenario: BASE

2. The Export Commodity Name appears as the first column (ExpComm) in the Items listview (rather than the ExpRegion column) so that the user can quick-key to the Export Commodity of interest. This is considered to be a more useful order for the columns than to have the ExpRegion column as the first column, and is consistent with other ANSWER tabs where the Name column appears first and the Region column appears second.
3. The screen snapshot above displays the default “All Bilateral Trade Links” setting of the Subset Items combobox. Alternate settings for this combobox are available so that the bilateral trade links that are displayed in the Items listview can be filtered so that just Electric (BI_TRD(ELC)) or just Energy (BI_TRD(ENT)) or just Material (BI_TRD(MAT)) Bilateral Trade Links are displayed:



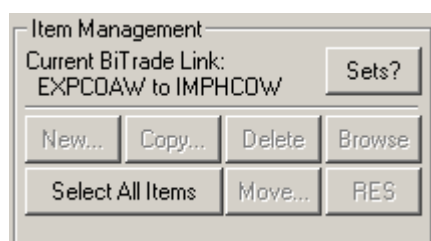
4. Alternatively, the filtering of the bilateral trade links that are displayed in the Items listview may be achieved by clicking on the **[Sets Filter...]** button to bring up the following form:



5. The bilateral trade links that are displayed in the Items listview may also be filtered by using the **[Regions Filter...]** button in the toolbar row. Where the **[Regions Filter...]** button is used on the BiTrade tab to select a subset of regions whose data is to be displayed, a bilateral trade link will be displayed if either its Export region or its Import region is in this subset of regions (and subject also to any filtering that will apply if the Subset Items combobox is not on its default “All Bilateral Trade Links” setting).
 - Thus to display bilateral trade links involving a single region (either bilateral trade links that involve *exporting* from that region to other regions, or that involve *importing* into that region from other regions) use the **[Regions Filter...]** button to select the single region desired.
6. The default sort order for BiTrade links in the Items listview is Export Commodity, Export Technology, Export Region, Import Commodity, Import Technology, Import Region (or loosely speaking the default sort order is Export Commodity then Export Region). If you click in the ExpRegion column header in the BiTrade Items listview, the BiTrade links in the Items listview are rearranged to appear in the sort order Export Region, Export Commodity, Export Technology, Import Commodity, Import Technology, Import Region (or loosely speaking the sort order becomes Export Region then Export Commodity). If you then click in the ExpComm column header, the BiTrade links in the Items listview are rearranged to appear in the default sort order.
7. No attempt is made to determine a Modified Status for BiTrade links.

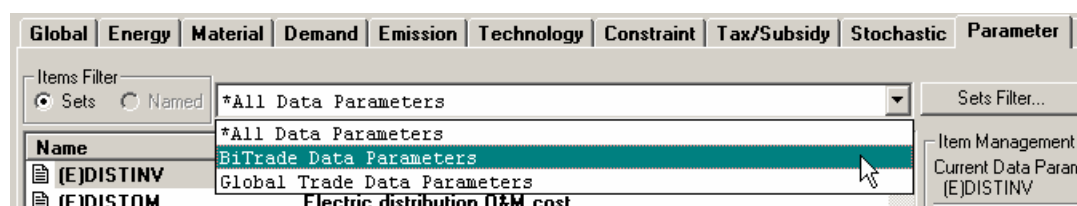
15.2 Operation of buttons in Item Management frame on the BiTrade Tab

1. In ANSWER versions 6.1.x and 6.2.x, the new BiTrade tab only provides facilities for *browsing* bilateral trade data, and consequently most of the buttons in the Item Management frame are disabled, as follows:

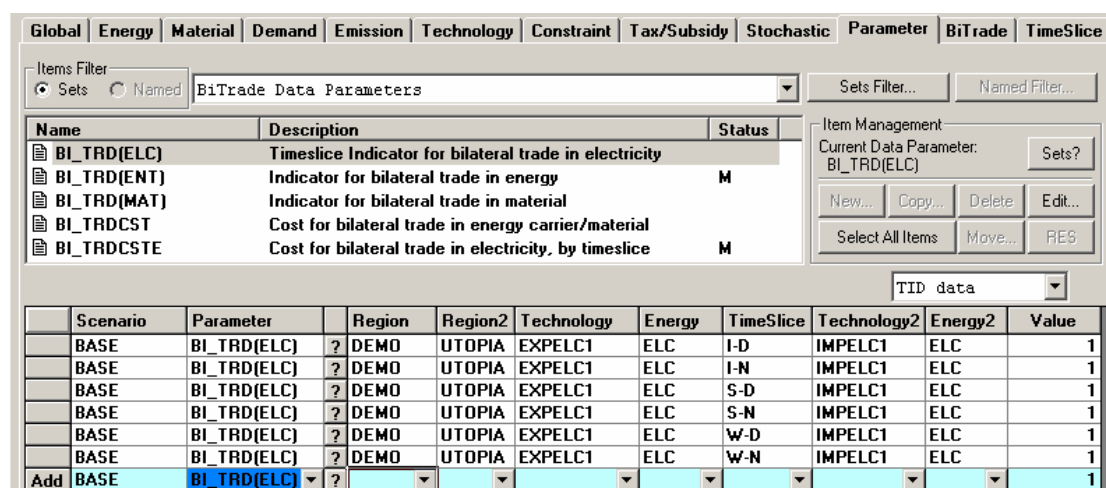


In subsequent ANSWER versions, facilities for *editing* bilateral trade data will be provided on the BiTrade tab, and so the [New...], [Copy...], [Delete], [Edit...] and [Move...] buttons will be enabled. Given the special needs of handling bilateral trade links, the forms that will be needed for [New...], [Copy...], [Delete], [Edit...] and [Move...] will be quite different from those that are displayed for most other tabs.

2. Note however that in ANSWER versions 6.1.x and 6.2.x, it is still possible to create new bilateral trade links and to delete existing bilateral trade links from the Parameter tab. This is most conveniently done by going to the Parameter tab and using the Subset Items combobox to subset down to a new "BiTrade Data Parameters" setting:



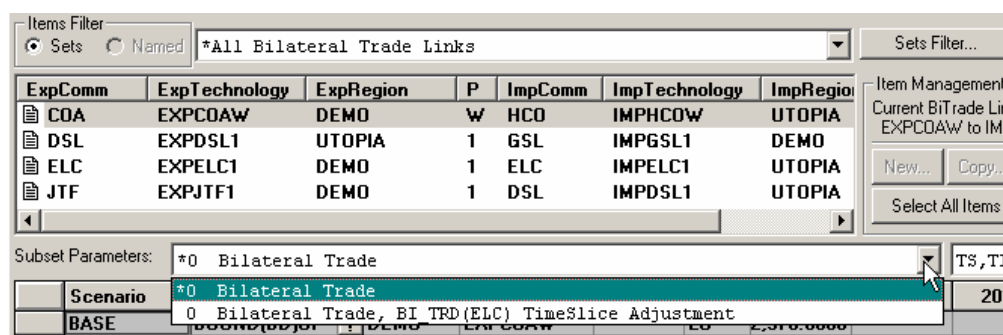
so that the listview displays only the following five bilateral trade data parameters:



To create a new bilateral trade link, use the AddRow to create a new instance of BI_TRD(ELC) or BI_TRD(ENT) or BI_TRD(MAT) as appropriate.

15.3 Data displayed in TS and TID data spreads on BiTrade Tab

- For the new BiTrade tab, the bottom half of the screen still contains the familiar TS and TID data spreads. But these spreads now display different parameters than those previously displayed on the old Trade tab. Two Subset Parameter settings are now provided, as indicated below:



- As a matter of user convenience, on the default "Bilateral Trade" setting the TS and TID data spreads now display all data for the Export and Import technologies involved in the bilateral trade link/links that are selected in the BiTrade Items listview. The screen snapshot below shows the data displayed where the selected bilateral trade link is from EXPCOAW in region DEMO to IMPHCOAW in region UTOPIA:

ExpComm	ExpTechnology	ExpRegion	P	ImpComm	ImpTechnology	ImpRegion								
COA	EXPCOAW	DEMO	W	HCO	IMPHCOAW	UTOPIA								
DSL	EXPDSL1	UTOPIA	1	GSL	IMPGSL1	DEMO								
ELC	EXPELC1	DEMO	1	ELC	IMPELC1	UTOPIA								
JTF	EXPJTF1	DEMO	1	DSL	IMPDSL1	UTOPIA								

Subset Parameters: *0 Bilateral Trade							TS, TID data							
Scenario	Parameter	Region	Technology	Commodi	Bound	1990	2000	2010	2020					
BASE	BOUND(BD)Or	?	DEMO	EXPCOAW	-	LO	2,970.0000							
BASE	BOUND(BD)Or	?	DEMO	EXPCOAW	-	UP	3,000.0000	3,000.0000	3,000.0000	3,000.0000				
BASE	COST	?	DEMO	EXPCOAW	-	-	1.1200	1.5000	1.5500	1.6000				
M	BITRDCOA	COST	?	UTOPIA	IMPHCOAW	-	-	0.1000	0.1000	0.1000	0.1000			
BASE	ENV_SEP	?	DEMO	EXPCOAW	CO2	-	-21.7000	-21.7000	-21.7000	-21.7000				
BASE	INP(ENT)x	?	DEMO	EXPCOAW	COA	-	1.0000	1.0000	1.0000	1.0000				
M	BITRDCOA	OUT(ENT)r	?	UTOPIA	IMPHCOAW	HCO	-	1.0000	1.0000	1.0000	1.0000			

Scenario	Parameter	Region	Technology	Value										
BASE	CUM	?	DEMO	EXPCOAW	6,500,000									
BASE	START	?	DEMO	EXPCOAW	1,990									
M	BITRDCOA	START	?	UTOPIA	IMPHCOAW	1,990								

We see that TS and TID data for both EXPCOAW in region DEMO and IMPHCOAW in region UTOPIA is displayed.

- As has already been noted above, in ANSWER versions 6.1.x and 6.2.x only data *browsing* facilities are provided on the new BiTrade tab, and so it is not possible from the BiTrade tab to edit the TS and TID data that is displayed for Export and Import technologies involved in a bilateral trade link.
 - In subsequent ANSWER versions, facilities for *editing* the TS and TID data that is displayed for Export and Import technologies will be provided on the BiTrade tab, including use of the AddRow to create new parameter instances for the Export and Import technologies.
- Many users may find that they need to use the alternate Subset Parameters setting of "Bilateral Trade, BI_TRD(ELC) TimeSlice Adjustment" only infrequently, if at all. Where the selected BiTrade Link is an electric link (that is, BI_TRD(ELC)), this setting displays the TimeSlices in which electric trade is possible:

By default BI_TRD(ELC) links are created with electric trade possible in all TimeSlices, as for the EXPELC1 to IMPELC1 BI_TRD(ELC) link displayed above.

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15.4 Results handling on BiTrade Tab

For the new BiTrade tab, all Bilateral Trade Results (but not Global Trade Results) are displayed in the TS spread (there are no TID Bilateral Trade Results Parameters), for the Subset Parameters setting “Bilateral Trade”, as indicated below:

ExpComm	ExpTechnology	ExpRegion	P	ImpComm	ImpTechnology	ImpRegion	Statu
COA	EXPCOAW	DEMO	W	HCO	IMPHCOW	UTOPIA	
DSL	EXPDSL1	UTOPIA	1	GSL	IMPDSL1	DEMO	
ELC	EXPELC1	DEMO	1	ELC	IMPELC1	UTOPIA	

Item Management

Current BiTrade Link:
EXPELC1 to IMPELC1

Gets?

New...Copy...DeleteBrowse

Select All ItemsMove...RES

Subset Parameters:

* Bilateral Trade

TS data

?

	Case	Parameter		Region	Region2	Technology	Energy	TimeSlice	Technology2	Energy2	1990	2000	2010
	BITRDCOA	MR_BITRD(ELC).M	?	DEMO	UTOPIA	EXPELC1	ELC	I-D	IMPELC1	ELC	0.00	0.00	0.00
	BITRDCOA	MR_BITRD(ELC).M	?	DEMO	UTOPIA	EXPELC1	ELC	I-N	IMPELC1	ELC	0.00	0.00	0.00
	BITRDCOA	MR_BITRD(ELC).M	?	DEMO	UTOPIA	EXPELC1	ELC	S-D	IMPELC1	ELC	0.00	0.00	0.00
	BITRDCOA	MR_BITRD(ELC).M	?	DEMO	UTOPIA	EXPELC1	ELC	S-N	IMPELC1	ELC	0.00	0.00	0.00
	BITRDCOA	MR_BITRD(ELC).M	?	DEMO	UTOPIA	EXPELC1	ELC	W-D	IMPELC1	ELC	0.00	0.00	0.00
	BITRDCOA	MR_BITRD(ELC).M	?	DEMO	UTOPIA	EXPELC1	ELC	W-N	IMPELC1	ELC	0.00	0.00	0.00
	BITRDCOA	R_TSEPELC.L	?	DEMO	-	EXPELC1	-	I-D	-	-	0.00	2.00	2.00
	BITRDCOA	R_TSEPELC.L	?	DEMO	-	EXPELC1	-	I-N	-	-	2.00	0.00	0.00
	BITRDCOA	R_TSEPELC.L	?	DEMO	-	EXPELC1	-	W-N	-	-	0.00	0.00	0.00
	BITRDCOA	R_TSEPELC.L	?	UTOPIA	-	IMPELC1	-	I-D	-	-	0.00	2.00	2.00
	BITRDCOA	R_TSEPELC.L	?	UTOPIA	-	IMPELC1	-	I-N	-	-	2.00	0.00	0.00
	BITRDCOA	R_TSEPELC.L	?	UTOPIA	-	IMPELC1	-	W-N	-	-	0.00	0.00	0.00
	BITRDCOA	R_TSEPELC.M	?	DEMO	-	EXPELC1	-	I-D	-	-	0.28	0.00	0.00
	BITRDCOA	R_TSEPELC.M	?	DEMO	-	EXPELC1	-	I-N	-	-	0.00	0.00	0.00
	BITRDCOA	R_TSEPELC.M	?	DEMO	-	EXPELC1	-	S-D	-	-	23.80	22.07	20.38
	BITRDCOA	R_TSEPELC.M	?	DEMO	-	EXPELC1	-	S-N	-	-	2.49	0.21	0.16
	BITRDCOA	R_TSEPELC.M	?	DEMO	-	EXPELC1	-	W-D	-	-	0.28	0.00	0.00

The BiTrade Items listview is populated on the basis of distinct instances of Results Marginals for MR_BITRD(ELC), MR_BITRD(ENT), MR_BITRD(MAT). So above, MR_BITRD(ELC).M Results Marginals are used both to populate the BiTrade Items Listview with the EXPELC1 to IMPELC1 link, and in addition the TS spread displays the values for these marginals.

In addition, the other Bilateral Trade Results parameters such as R_TSEPELC.L and R_TSEPELC.M are displayed on the “Bilateral Trade” Subset Parameters setting.

15.5 Specifying Global Trade Data and Viewing Global Trade Results

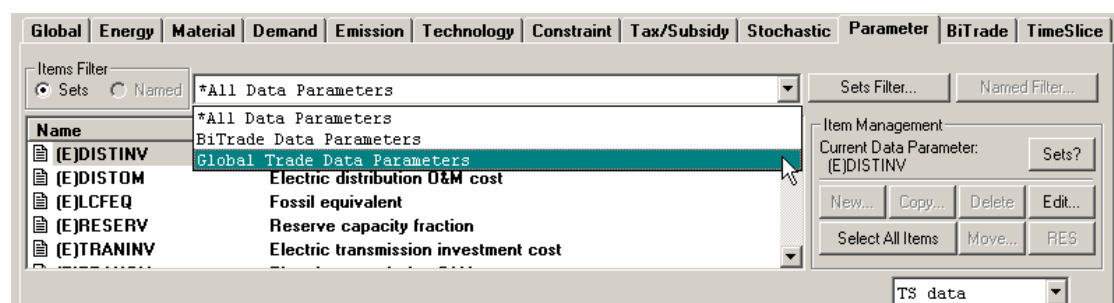
As noted above, whereas in earlier versions of ANSWER it was possible to specify all Global Trade data parameters, and view all Global Trade results parameters, from the Trade tab, it is not possible to specify or view Global Trade data and results from the new BiTrade tab. This section details how to conveniently specify Global Trade data parameters, and view Global Trade results parameters, from the Parameter tab.

15.5.1 Specifying Global Trade Data Parameters

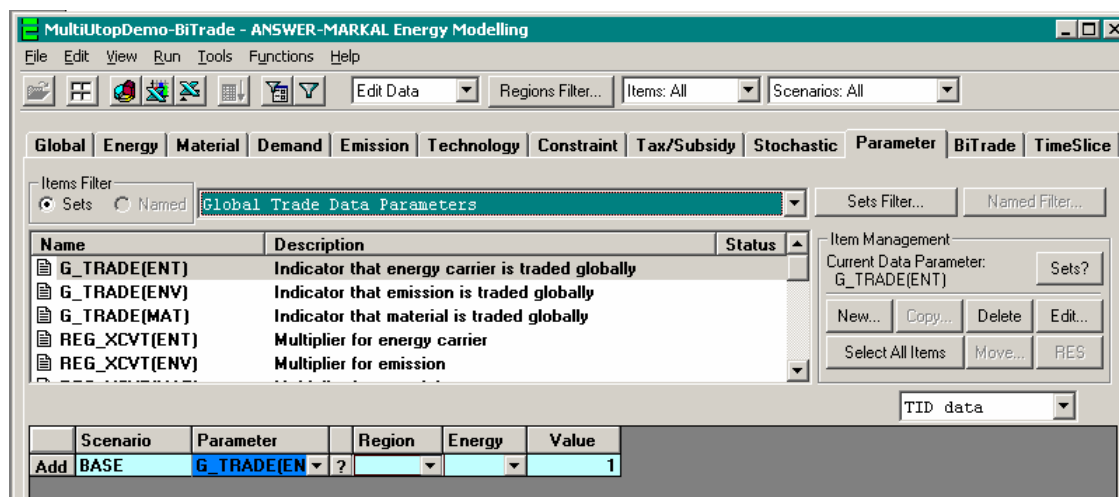
The Global Trade data parameters that are no longer accessible from the BiTrade tab are listed below first showing TS and then TID parameters:

TRD_BND(ENT)exp	Bound on exports for global trade in energy carrier
TRD_BND(ENT)imp	Bound on imports for global trade in energy carrier
TRD_BND(ENV)exp	Bound on exports for global trade in emission
TRD_BND(ENV)imp	Bound on imports for global trade in emission
TRD_BND(MAT)exp	Bound on exports for global trade in material
TRD_BND(MAT)imp	Bound on imports for global trade in material
TRD_COST(ENT)	Cost for global trade in energy carrier
TRD_COST(ENV)	Cost for global trade in emission
TRD_COST(MAT)	Cost for global trade in material
G_TRADE(ENT)	Indicator that energy carrier is traded globally
G_TRADE(ENV)	Indicator that emission is traded globally
G_TRADE(MAT)	Indicator that material is traded globally
REG_XCVT(ENT)	Multiplier for energy carrier
REG_XCVT(ENV)	Multiplier for emission
REG_XCVT(MAT)	Multiplier for material
REG_XMACRO	MACRO multiplier
REG_XMONY	Monetary unit conversion
TRD_FROM(ENT)	Year from which global trade in energy carrier can occur
TRD_FROM(ENV)	Year from which global trade in emission can occur
TRD_FROM(MAT)	Year from which global trade in material can occur

A new “Global Trade Data Parameters” Subset Items setting is provided on the Parameter tab that displays all of the above Global Trade data parameters (and only these parameters), so that instances of these parameters may be conveniently defined, browsed, deleted and edited.



That is, to define a new Global Trade data parameter instance, or to browse, delete or edit existing instances go to the Parameter tab and use the Subset Items combobox to select “Global Trade Data Parameters”. The Items listview will be populated with all the Global Trade parameters, and the screen might appear as follows:



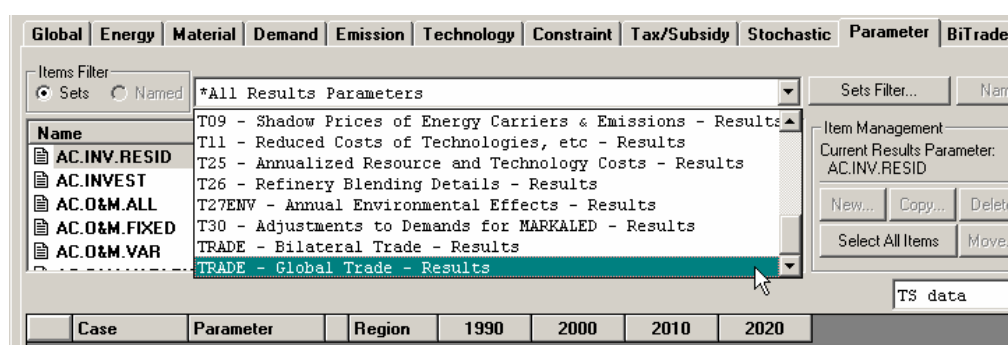
Standard ANSWER facilities may then be used to define new parameter instances (via the AddRow), or to browse, delete or edit existing instances.

15.5.2 Viewing Global Trade Results Parameters

The Global Trade results parameters that are no longer accessible from the BiTrade tab are listed below. They are all TS parameters.

MR_GTRD(ENT).M	Global Trade in Energy: Marginal
MR_GTRD(ENV).M	Global Trade in Emission: Marginal
MR_GTRD(MAT).M	Global Trade in Material: Marginal
R_GTRD(ENT)exp.L	Region Global Trade: Export of Energy: Level
R_GTRD(ENT)exp.M	Region Global Trade: Export of Energy: Marginal
R_GTRD(ENT)imp.L	Region Global Trade: Import of Energy: Level
R_GTRD(ENT)imp.M	Region Global Trade: Import of Energy: Marginal
R_GTRD(ENV)exp.L	Region Global Trade: Export of Emission: Level
R_GTRD(ENV)exp.M	Region Global Trade: Export of Emission: Marginal
R_GTRD(ENV)imp.L	Region Global Trade: Import of Emission: Level
R_GTRD(ENV)imp.M	Region Global Trade: Import of Emission: Marginal
R_GTRD(MAT)exp.L	Region Global Trade: Export of Material: Level
R_GTRD(MAT)exp.M	Region Global Trade: Export of Material: Marginal
R_GTRD(MAT)imp.L	Region Global Trade: Import of Material: Level
R_GTRD(MAT)imp.M	Region Global Trade: Import of Material: Marginal

As was the case with version 5 of ANSWER, the Global Trade results parameters may be viewed from the Parameter tab by invoking the "TRADE – Global Trade – Results" Subset Items setting (or by using the **[Sets Filter...]** button to invoke this setting):



15.5.3 Accessing Global Trade Data Parameters on Alternative Tabs

The Global Trade data parameters may also be accessed from other tabs, if that is more convenient for the user:

The 6 Global Trade data parameters that involve energy carriers (ENT) may now all be accessed from the Energy tab, on the (default) "Energy Carrier, Specific" Subset Parameters setting. Previously these 6 parameters were accessible from the Energy tab, on the (perhaps little known) "Energy Carrier, Related Trade" Subset Parameters setting.

Similarly the 6 Global Trade data parameters that involve materials (MAT) may now all be accessed from the Material tab on the (default) "Material, Specific" Subset Parameters setting, and the 6 Global Trade data parameters that involve emissions (ENV) may now all be accessed from the Emission tab on the (default) "Emission, Specific" Subset Parameters setting.

The 2 Global Trade data parameters REG_XMACRO and REG_XMONY may now be accessed from the Global tab.

Appendix One: MARKAL Data Parameters

There are over 230 MARKAL Data Parameters when Data Parameters that that are used in connection with non-standard MARKAL model variants are included. This Appendix provides a comprehensive and up-to-date list of all the Data Parameters, with all except Bilateral Trade Data Parameters and Global Trade Data Parameters arranged by Component tab, and by Subset Parameter setting. The Bilateral Trade Data Parameters and Global Trade Data Parameters are grouped according to the Parameters that are displayed on the Parameter tab for the Sets Filter settings of BiTrade Data Parameters and Global Trade Data Parameters respectively.

As mentioned in the Introduction, users of this manual are expected to be familiar with MARKAL, including its Data Parameters.

A1.1 MARKAL Data Parameters by Component, Subset Parameter Setting

MARKAL Data Parameters: Global (system wide)

Data Parameter Name	Data Parameter Description
DISCOUNT	Annual discount rate
ENV_SCALE	Emissions scaling factor
GPCSTSCL	GP cost scaling factor
GPCSTWTA	GP cost above weight
GPCSTWTB	GP cost below weight
GPSTART	Start year for GP
HEATCOOL(Z)	Indicates if LTH peak equation is created for Winter/Summer
LAMBDA	Risk aversion indicator
MED-BASEANNC	MED Undiscounted annual system cost from reference run
MED-BASEOBJ	MED Total system cost from reference run
MED-YALTGROW	MED GDP annual percentage growth rates in alternate run
MED-YREFGROW	MED GDP annual percentage growth rates in reference run
MM-DEPR	M-M Net return on capital (%)
MM-DMTOL	M-M Demand tolerance
MM-EC0	M-M Energy costs in first period
MM-ESUB	M-M Elasticity of substitution
MM-EXPF	M-M Quadratic penalty annual percentage expansion factor
MM-GDP0	M-M GDP in first year
MM-GROWV	M-M Potential GDP annual percentage growth rates
MM-IVETOL	M-M Investment tolerance
MM-KGDP	M-M Initial capital to GDP ratio
MM-KPVS	M-M Optimal share of capital to labor
MM-QFAC	M-M Quadratic penalty flag
MM-SCALE	M-M Scaling factor for results
PEAK(Z)(Y)	Indicator that peaking applies for season, time-of-day timeslice
QHR(Z)(Y)	Fraction of year for season, time-of-day
START_STG2	Start year for two-stage stochastics
STARTYRS	Discount year adjuster

A1.1 MARKAL Data Parameters by Component, Subset Parameter Setting (continued)

MARKAL Data Parameters: Energy Carrier, Specific

Data Parameter Name	Data Parameter Description
(E)DISTINV	Electric distribution investment cost
(E)DISTOM	Electric distribution O&M cost
(E)LCFEQ	Fossil equivalent
(E)RESERV	Reserve capacity fraction
(E)TRANINV	Electric transmission investment cost
(E)TRANOM	Electric transmission O&M cost
BAS(E)LOAD	Baseload fraction of total night production
DHDE(Z)	Distribution efficiency for low-temperature heat
DTRANINV	Low-temp-heat transmission investment cost
DTRANOM	Low-temp-heat transmission O&M cost
HRESERV	Reserve capacity fraction for low-temp-heat
SLKCOST(ENC)	Cost of Energy Carrier Slack
TE(ENT)	Transmission efficiency

MARKAL Data Parameters: Energy Carrier, Related Technologies

Data Parameter Name	Data Parameter Description
COST_TID	Salvage value of stockpiled energy carrier at end of horizon
DELIV(ENT)	Annual delivery cost
FR(Z)(Y)(ELC)	Fraction of electric import/export for season, time of day
INP(ENC)_TID	Energy carrier initial inventory: conversion technology
INP(ENC)_TIDp	Energy carrier initial inventory: process technology
INP(ENT)c	Energy carrier input: conversion technology
INP(ENT)p	Energy carrier input: process technology
INP(ENT)r	Energy carrier input: resource technology (not export)
INP(ENT)x	Energy carrier input: export resource technology
LAG(ENC)	Energy carrier output to next period: process technology
LED(ENT)	Energy carrier input from previous period: process technolog
MA(ENC)_TID	Energy input per unit investment: demand technology
MA(ENT)	Energy carrier input: demand technology
MO(ENC)	Energy carrier output: demand technology
MO(ENC)_TID	Energy output per unit investment: demand technology
OUT(ELC)_TID	Electricity output
OUT(ENC)c	Energy carrier output: conversion technology
OUT(ENC)p	Energy carrier output: process technology
OUT(ENT)r	Energy carrier output: resource technology (not export)
OUT(LTH)_TID	District heat output
PEAKDA(PRC)	Fraction of consumption of electricity in peak equations
PEAKDA(SEP)	Fraction of consumption of electricity in peak equations

A1.1 MARKAL Data Parameters by Component, Subset Parameter Setting (continued)

MARKAL Data Parameters: Energy Carrier, Related Taxes/Subsidies

Data Parameter Name	Data Parameter Description
TSUB_ENT(ENT)	Flag indicating energy carrier to which tax/subsidy applies

MARKAL Data Parameters: Energy Carrier, Related Trade

Data Parameter Name	Data Parameter Description
G_TRADE(ENT)	Indicator that energy carrier is traded globally
REG_XCVT(ENT)	Multiplier for energy carrier
TRD_BND(ENT)exp	Bound on exports for global trade in energy carrier
TRD_BND(ENT)imp	Bound on imports for global trade in energy carrier
TRD_COST(ENT)	Cost for global trade in energy carrier
TRD_FROM(ENT)	Year from which global trade in energy carrier can occur

MARKAL Data Parameters: Material, Specific

Data Parameter Name	Data Parameter Description
SAL_REL(MAT)	Released material price
SAL_SNK(MAT)	Sunk material price
TE(MAT)	Transmission efficiency: material

MARKAL Data Parameters: Material, Related Technologies

Data Parameter Name	Data Parameter Description
DELIV(MAT)	Annual delivery cost
INP(MAT)_TIDc	Material input at investment time: conversion technology
INP(MAT)_TIDp	Material input at investment time: process technology
INP(MAT)c	Material input: conversion technology
INP(MAT)p	Material input: process technology
INP(MAT)r	Material input: resource technology (not export)
INP(MAT)x	Material input: export resource technology
LAG(MAT)	Material output to next period: process technology
LED(MAT)	Material input from previous period: process technology
MA(MAT)	Material input: demand technology
MA(MAT)_TID	Material input per unit investment: demand technology
MO(MAT)	Material output: demand technology
MO(MAT)_TID	Material output per unit investment: demand technology
OUT(MAT)_TIDc	Material released upon decommissioning: conversion technology
OUT(MAT)_TIDp	Material released upon decommissioning: process technology
OUT(MAT)c	Material output: conversion technology
OUT(MAT)p	Material output: process technology
OUT(MAT)r	Material output: resource technology (not export)

A1.1 MARKAL Data Parameters by Component, Subset Parameter Setting (continued)

MARKAL Data Parameters: Material, Related Taxes/Subsidies

Data Parameter Name	Data Parameter Description
TSUB_MAT(MAT)	Flag indicating material to which tax/subsidy applies

MARKAL Data Parameters: Material, Related Trade

Data Parameter Name	Data Parameter Description
G_TRADE(MAT)	Indicator that material is traded globally
REG_XCVT(MAT)	Multiplier for material
TRD_BND(MAT)exp	Bound on exports for global trade in material
TRD_BND(MAT)imp	Bound on imports for global trade in material
TRD_COST(MAT)	Cost for global trade in material
TRD_FROM(MAT)	Year from which global trade in material can occur

MARKAL Data Parameters: End-Use Demand, Specific

Data Parameter Name	Data Parameter Description
DEMAND	End-use demand
DIFF_DM	Indicator to use DIFFCOST values during DIFFDMDS algorithm
DIFFCOST	Min. INVCOST used for all DMDs servicing DM if DIFF_DM(DM)=1
ELF	Fraction of capacity entering peak equations
FR(Z)(Y)	Non-default fraction of demand for season, time of day
MED-ALPHA	MED Income elasticity of demand
MED-DMBPRICE	MED Demand base price (marginal cost) from reference run
MED-ELAST(BD)	MED Elasticity of demand
MED-STEP(BD)	MED Number of demand growth/reduction steps
MED-VAR(BD)	MED Variation of demand
MI-ACOE	MICRO constant for the demand function
MI-ELASP	MICRO price elasticity of demand
MI-SHFTDD	MICRO demand shift
MM-DDATPREF	M-M Reference price of demand in base year
MM-DDF	M-M Demand decoupling factor (%)

MARKAL Data Parameters: End-Use Demand, Related Technologies

Data Parameter Name	Data Parameter Description
OUT(DM)	End-use demand output

A1.1 MARKAL Data Parameters by Component, Subset Parameter Setting (continued)

MARKAL Data Parameters: End-Use Demand, Related Stochastics

Data Parameter Name	Data Parameter Description
S_DEMAND	Stochastic end-use demand

MARKAL Data Parameters: Emission, Specific

Data Parameter Name	Data Parameter Description
ENV_BOUND(BD)	Bound on emissions
ENV_COST	Emissions tax
ENV_CUMMAX	Cumulative emissions limit
ENV_ENT	Emissions coefficient/energy carrier
ENV_ENTr	Emissions coefficient/energy carrier assoc. with resources
ENV_GWP	Global Warming Potential (multiple emissions accounting)
ENV_MAT	Emissions coefficient/material
ENV_MAXEM	Bound on emissions (upper) - use ENV_BOUND(BD) with BD=UP
EV_B	Elasticity damage with respect to emission
EV_COST	Marginal social cost of emission
EV_RLEV	Reference level of emission
EVDAMINT	Indicator of periods for which damage calc. is internalised
GPEMPCT	GP emission target percentage below REF
GPEMSCL	GP emission scaling factor
GPEMWTB	GP emission above weight
GPEMWTB	GP emission below weight

MARKAL Data Parameters: Emission, Related Technologies

Data Parameter Name	Data Parameter Description
ENV_ACT	Emissions coefficient/activity
ENV_CAP	Emissions coefficient/capacity
ENV_ENTXI	Indicator to NOT include all INP(ENT) in ENV_ENT
ENV_ENTXO	Indicator to NOT include all OUT(ENT) in ENV_ENT
ENV_INV	Emissions coefficient/investment
ENV_SEP	Emissions coefficient/resource activity

MARKAL Data Parameters: Emission, Related Stochastics

Data Parameter Name	Data Parameter Description
S_ENV_BND(BD)	Stochastic bound on emissions
S_ENV_CUM	Stochastic cumulative emissions limit
S_ENV_MAXEM	Stochastic bound on emissions

A1.1 MARKAL Data Parameters by Component, Subset Parameter Setting (continued)

MARKAL Data Parameters: Emission, Related Trade

Data Parameter Name	Data Parameter Description
G_TRADE(ENV)	Indicator that emission is traded globally
REG_XCVT(ENV)	Multiplier for emission
TRD_BND(ENV)exp	Bound on exports for global trade in emission
TRD_BND(ENV)imp	Bound on imports for global trade in emission
TRD_COST(ENV)	Cost for global trade in emission
TRD_FROM(ENV)	Year from which global trade in emission can occur

MARKAL Data Parameters: Technology, Specific

Data Parameter Name	Data Parameter Description	Related Component
AF	Annual availability	
AF(Z)(Y)	Availability for season, time of day	
AF_TID	Fraction of unavailability which is forced outage	
ARAF	Annual reservoir availability	
BI_TRDCST	Cost for bilateral trade in energy carrier/material	
BI_TRDCSTE	Cost for bilateral trade in electricity, by timeslice	
BOUND(BD)	Bound on capacity	
BOUND(BD)O	Bound on activity: conversion/process technology	
BOUND(BD)Or	Bound on activity: resource technology	
CAPUNIT	Units of activity/unit of capacity	
CEH(Z)(Y)	Ratio of electricity lost to heat gained	
CF	Annual utilisation	
CF(Z)(Y)	Utilisation for season, time of day	
COST	Annual resource cost	
COST_TID	Salvage value of stockpiled energy carrier at end of horizon	
CUM	Total resource availability	
DECAY	Limit rate at which technology capacity can be reduced	
DECAYr	Limit rate at which resource activity can be reduced	
DELIV(ENT)	Annual delivery cost	Energy Carrier
DELIV(MAT)	Annual delivery cost	Material
DISCRATE	Technology-specific discount rate	
EFF	Technical efficiency	
EFF_I	Efficiency tied to investment vintage	
EFF_R	Efficiency tied to residual capacity	
ELM	Electric loss maximum	
ENV_ACT	Emissions coefficient/activity	Emission
ENV_CAP	Emissions coefficient/capacity	Emission
ENV_ENTXI	Indicator to NOT include all INP(ENT) in ENV_ENT	Emission
ENV_ENTXO	Indicator to NOT include all OUT(ENT) in ENV_ENT	Emission
ENV_INV	Emissions coefficient/investment	Emission

A1.1 MARKAL Data Parameters by Component, Subset Parameter Setting (continued)

MARKAL Data Parameters: Technology, Specific (continued)

Data Parameter Name	Data Parameter Description	Related Component
ENV_SEP	Emissions coefficient/resource activity	Emission
ETL-CLUSTER	Cluster mapping and coupling factor	Technology
ETL-CUMCAP0	Initial cum. capacity (starting point on learning curve)	
ETL-CUMCAPMAX	Maximum cum. capacity (ending point on learning curve)	
ETL-INDIC	Indicates technology for which learning curve is specified	
ETL-INV COST0	Investment cost corresp. to starting point on learning curve	
ETL-NUMSEG	Number of segments for cumulative cost curve	
ETL-PROGRATIO	Progress ratio	
FIXOM	Annual fixed O&M cost	
FR(Z)(Y)(ELC)	Fraction of electric import/export for season, time of day	Energy Carrier
GROWTH	Maximum annual growth rate in capacity	
GROWTH_TID	Incremental capacity over and above growth constraint	
GROWTH_TIDr	Incremental activity over and above growth constraint	
GROWTHr	Maximum annual growth rate in activity, resource technology	
IBOND(BD)	Bound on investment in new capacity	
INP(ENC)_TID	Energy carrier initial inventory: conversion technology	Energy Carrier
INP(ENC)_TIDp	Energy carrier initial inventory: process technology	Energy Carrier
INP(ENT)c	Energy carrier input: conversion technology	Energy Carrier
INP(ENT)p	Energy carrier input: process technology	Energy Carrier
INP(ENT)r	Energy carrier input: resource technology (not export)	Energy Carrier
INP(ENT)x	Energy carrier input: export resource technology	Energy Carrier
INP(MAT)_TIDc	Material input at investment time: conversion technology	Material
INP(MAT)_TIDp	Material input at investment time: process technology	Material
INP(MAT)c	Material input: conversion technology	Material
INP(MAT)p	Material input: process technology	Material
INP(MAT)r	Material input: resource technology (not export)	Material
INP(MAT)x	Material input: export resource technology	Material
INV_BIN	Indicator that new capacity investment level is BLOCK, or 0	
INV_BLOCK	Min. investment level in new capacity, if investment occurs	
INV_INT	Indicator that new capacity investment level is INT * BLOCK	
INV_SOS	Indicator new cap. invest. in <=1 period, level BLOCK or 0	
INVCOST	Total cost of investment in new capacity	
LAG(ENC)	Energy carrier output to next period: process technology	Energy Carrier
LAG(MAT)	Material output to next period: process technology	Material
LED(ENT)	Energy carrier input from previous period: process technolog	Energy Carrier
LED(MAT)	Material input from previous period: process technology	Material
LIFE	Lifetime of new capacity	
LIMIT	Sum of energy carrier outputs	
MA(ENC)_TID	Energy input per unit investment: demand technology	Energy Carrier
MA(ENT)	Energy carrier input: demand technology	Energy Carrier
MA(MAT)	Material input: demand technology	Material
MA(MAT)_TID	Material input per unit investment: demand technology	Material

A1.2 MARKAL Data Parameters by Component, Subset Parameter Setting (continued)

MARKAL Data Parameters: Technology, Specific (continued)

Data Parameter Name	Data Parameter Description	Related Component
MM-EXPBND	M-M Market penetration limit	
MO(ENC)	Energy carrier output: demand technology	Energy Carrier
MO(ENC)_TID	Energy output per unit investment: demand technology	Energy Carrier
MO(MAT)	Material output: demand technology	Material
MO(MAT)_TID	Material output per unit investment: demand technology	Material
NOBASIE	Indicator that elec. imports/exports excluded from EQ_BAS	
OUT(DM)	End-use demand output	Demand
OUT(ELC)_TID	Electricity output	Energy Carrier
OUT(ENC)c	Energy carrier output: conversion technology	Energy Carrier
OUT(ENC)p	Energy carrier output: process technology	Energy Carrier
OUT(ENT)r	Energy carrier output: resource technology (not export)	Energy Carrier
OUT(LTH)_TID	District heat output	Energy Carrier
OUT(MAT)_TIDc	Material released upon decommissioning: conversion technology	Material
OUT(MAT)_TIDp	Material released upon decommissioning: process technology	Material
OUT(MAT)c	Material output: conversion technology	Material
OUT(MAT)p	Material output: process technology	Material
OUT(MAT)r	Material output: resource technology (not export)	Material
PD(Z)D	Peak duration factor	
PEAK(CON)	Fraction of capacity in peak equations	
PEAK(CON)_TID	Indicates peaking technology must actually produce	
PEAKDA(PRC)	Fraction of consumption of electricity in peak equations	Energy Carrier
PEAKDA(SEP)	Fraction of consumption of electricity in peak equations	Energy Carrier
REH	Ratio of electricity produced to heat produced	
RESID	Residual installed capacity	
SECURITY	Weight for security objective function	
SRAF(Z)	Seasonal reservoir availability	
START	Start year	
TRNEFF(Z)(Y)	Transmission efficiency of coupled-production technology	
VAROM	Annual variable O&M cost	

A1.1 MARKAL Data Parameters by Component, Subset Parameter Setting (continued)

MARKAL Data Parameters: Technology, Related User-Defined Constraints

Data Parameter Name	Data Parameter Description
RAT_ACT	Coeff technology activity variable, user-defined constraint
RAT_CAP	Coeff capacity variable, user-defined constraint
RAT_FLO_DM	Coeff technology according to demand flow, user constraint
RAT_FLO_ENT	Coeff technology according to energy flow, user constraint
RAT_HPL	Coeff heating-plant activity variable, user-def constraint
RAT_INV	Coeff investment variable, user-defined constraint
RAT_SEP	Coeff resource activity variable, user-defined constraint
RAT_TCZY	Coeff coupled-prodn activity variable, user-def constraint
RAT_TEZY	Coeff electricity activity variable, user-defined constraint

MARKAL Data Parameters: Technology, Related Taxes/Subsidies

Data Parameter Name	Data Parameter Description
TSUB_TECH	Fraction indicating technology to which tax/subsidy applies

MARKAL Data Parameters: Technology, Related Stochastics

Data Parameter Name	Data Parameter Description
S_ARAF	Stochastic annual reservoir availability
S_BOUND(BD)	Stochastic bound on capacity
S_BOUND(BD)O	Stochastic bound on activity: conversion/process technology
S_BOUND(BD)Or	Stochastic bound on activity: resource technology
S_COST	Stochastic annual resource cost
S_IBOND(BD)	Stochastic bound on investment in new capacity
S_SRAF(Z)	Stochastic seasonal reservoir availability

A1.1 MARKAL Data Parameters by Component, Subset Parameter Setting (continued)

MARKAL Data Parameters: User-Defined Constraint

Data Parameter Name	Data Parameter Description
RAT_RHS	Coefficient RHS, user-defined constraint
RAT_ACT	Coeff technology activity variable, user-defined constraint
RAT_CAP	Coeff capacity variable, user-defined constraint
RAT_EM	Coeff emission variable, user-defined constraint
RAT_FLO_DM	Coeff technology according to demand flow, user constraint
RAT_FLO_ENT	Coeff technology according to energy flow, user constraint
RAT_HPL	Coeff heating-plant activity variable, user-def constraint
RAT_INV	Coeff investment variable, user-defined constraint
RAT_SEP	Coeff resource activity variable, user-defined constraint
RAT_TCZY	Coeff coupled-prodn activity variable, user-def constraint
RAT_TEZY	Coeff electricity activity variable, user-defined constraint
RATRULE_ACT	Coeff technology activity variable, rule-based constraint
RATRULE_CAP	Coeff capacity variable, rule-based constraint
RATRULE_FLO_DM	Coeff technology according to demand flow, rule-based constraint
RATRULE_FLO_ENT	Coeff technology according to energy flow, rule-based constraint
RATRULE_INV	Coeff investment variable, rule-based constraint
RATRULE_SEP	Coeff resource activity variable, rule-based constraint

MARKAL Data Parameters: Tax/Subsidy

Data Parameter Name	Data Parameter Description
TSUB_BND(BD)	Bound on total tax/subsidy revenues
TSUB_COST	Annual cost of tax/subsidy per unit of energy carrier
TSUB_ENT(ENT)	Flag indicating energy carrier to which tax/subsidy applies
TSUB_MAT(MAT)	Flag indicating material to which tax/subsidy applies
TSUB_TECH	Fraction indicating technology to which tax/subsidy applies

A1.1 MARKAL Data Parameters by Component, Subset Parameter Setting (continued)

MARKAL Data Parameters: State of World (Stochastic)

Data Parameter Name	Data Parameter Description	Related Component
PROB	Probability for state of world	
S_ARAF	Stochastic annual reservoir availability	Technology
S_BOUND(BD)	Stochastic bound on capacity	Technology
S_BOUND(BD)O	Stochastic bound on activity: conversion/process technology	Technology
S_BOUND(BD)Or	Stochastic bound on activity: resource technology	Technology
S_COST	Stochastic annual resource cost	Technology
S_DEMAND	Stochastic end-use demand	Demand
S_ENV_BND(BD)	Stochastic bound on emissions	Emission
S_ENV_CUM	Stochastic cumulative emissions limit	Emission
S_ENV_MAXEM	Stochastic bound on emissions	Emission
S_IBOND(BD)	Stochastic bound on investment in new capacity	Technology
S_SRAF(Z)	Stochastic seasonal reservoir availability	Technology

A1.2 MARKAL Data Parameters, Parameter Tab, Bilateral Trade and Global Trade

MARKAL Data Parameters: Parameter Tab, BiTrade Data Parameters Sets Filter Setting

Data Parameter Name	Data Parameter Description
BI_TRD(ELC)	Timeslice Indicator for bilateral trade in electricity
BI_TRD(ENT)	Indicator for bilateral trade in energy
BI_TRD(MAT)	Indicator for bilateral trade in material
BI_TRDCST	Cost for bilateral trade in energy carrier/material
BI_TRDCSTE	Cost for bilateral trade in electricity, by timeslice
TRD_COST(ENT)	Cost for global trade in energy carrier
TRD_COST(ENV)	Cost for global trade in emission
TRD_COST(MAT)	Cost for global trade in material

MARKAL Data Parameters: Parameter Tab, Global Data Parameters Sets Filter Setting

Data Parameter Name	Data Parameter Description
G_TRADE(ENT)	Indicator that energy carrier is traded globally
G_TRADE(ENV)	Indicator that emission is traded globally
G_TRADE(MAT)	Indicator that material is traded globally
REG_XCVT(ENT)	Multiplier for energy carrier
REG_XCVT(ENV)	Multiplier for emission
REG_XCVT(MAT)	Multiplier for material
REG_XMACRO	MACRO multiplier
REG_XMONY	Monetary unit conversion
TRD_BND(ENT)exp	Bound on exports for global trade in energy carrier
TRD_BND(ENT)imp	Bound on imports for global trade in energy carrier
TRD_BND(ENV)exp	Bound on exports for global trade in emission
TRD_BND(ENV)imp	Bound on imports for global trade in emission
TRD_BND(MAT)exp	Bound on exports for global trade in material
TRD_BND(MAT)imp	Bound on imports for global trade in material
TRD_FROM(ENT)	Year from which global trade in energy carrier can occur
TRD_FROM(ENV)	Year from which global trade in emission can occur
TRD_FROM(MAT)	Year from which global trade in material can occur

Appendix Two: MARKAL Results Tables and Results Parameters

There are some 375 Results Parameters that are invoked by the report generator to present the results of a model run or Case. This Appendix first provides a listing of the 22 MARKAL Results Tables, and then provides a comprehensive and up-to-date list of all the Results Parameters, arranged by Results Table. This includes the Results Parameters that are used in connection with non-standard MARKAL model variants including the TRADE tables associated with bilateral and global trade in multi-region MARKAL.

As mentioned in the Introduction, users of this manual are expected to be familiar with MARKAL, including its Results Parameters.

A2.1 MARKAL Results Tables

Table Name	Table Title
Table T01	Scenario Indicators
Table T02	Summary
Table T03	Primary Energy Supply
Table T04	Output of Energy by Technology
Table T05	Fuel Consumption by Demand Sector
Table T06	Useful Energy by Demand Device
Table T08	Use of Energy Carriers by Technology
Table T09	Shadow Prices of Energy Carriers and Emissions
Table T11	Reduced Costs of Technologies, End-Use Demands, Emissions, etc.
Table T25	Annualised Resource and Technology Costs
Table T27ENV	Annual Environmental Effects
Table T30	Adjustments to Demand for MARKALED
Table ACT	Activity of Processes - Solution Values
Table CAP	Capacity Utilisation of Technologies
Table COSTBEN	Cost/Benefit Ratios
Table DEMAND	Demand Levels - Solution Values
Table GDP	Key MACRO Indicators
Table INV	Investment in Technologies - Quantity and Cost
Table MC	Demand Marginals and PREF Differences
Table SUPPLY	Resource Supply Levels - Solution Values
Table TRADE	Bilateral Trade
Table TRADE	Global Trade

A2.2 MARKAL Results Parameters by Table

MARKAL Results Table T01: Scenario Indicators

Results Parameter Name	Results Parameter Description
D.CPSURPLUS	Discounted Cons/Prod Surplus: MICRO, MARKALED
D.MED-OBJ	Discounted MARKALED Objective (without Tax)
D.MED-REF.OBJ	Discounted MARKALED Reference Objective (without Elastic)
D.MED-SURF.GRO	Discounted MARKALED Total Growth in Surface under Dem. Curve
D.MED-SURF.RED	Discounted MARKALED Total Redn. in Surface under Dem. Curve
D.MED-TESCOST	Discounted MARKALED System Cost minus Reference System Cost
D.TOT.EMIS.TAX	Discounted Total Emissions Tax Revenues
D.TOT.EV-DAMAG	Discounted Total Environmental Damage
D.TOT.EV-DAMIN	Discounted Total Internalised Environmental Damage
D.TOT.TAXSUB	Discounted Total Tax/Subsidy Revenues
D.TOTCOST	Discounted Total System Cost, Net of Taxes & Subsidies
EMIS.TRADE.TOT	Total Net Trade in Emissions
EMISSION.TOT	Total Emissions
SECURITY.L	Security Indicator Level
SECURITY.M	Security Indicator Marginal
UTILITY	Utility production function: MARKAL-MACRO

MARKAL Results Table T02: Summary

Results Parameter Name	Results Parameter Description
D.DOMFUELCOST	Discounted Domestic Fuel Cost
D.EMIS.TAX.TOT	Discounted Emissions Tax Revenues Total
D.EV-DAMAG.TOT	Discounted Environmental Damage Total
D.INV.DEMAND	Discounted Investment in Demand Technologies
D.INV.SALVAGE	Discounted Investments Salvage Cost
D.INV.SUPPLY	Discounted Investment in Supply Technologies
D.INV.TOT	Discounted Investment Total in Technologies
D.NETEXPFUEL	Discounted Net Expenditure on Fuel
D.NETIMPCOST	Discounted Net Fuel Import Cost
D.NETIMPCOST.L	Discounted Net Liquid Import Cost
D.OTHEX.DEMAND	Discounted Other Expenditures on Demand
D.OTHEX.SUPPLY	Discounted Other Expenditures on Supply
D.OTHEX.TOT	Discounted Other Expenditures Total
D.TAXSUB.TOT	Discounted Tax/Subsidy Revenues Total
D.TOTCOSTS	Discounted Total System Costs
NET.IMP.GAS	Net Imports: Gaseous Fuels
NET.IMP.LIQ	Net Imports: Liquid Fuels
NET.IMP.SLD	Net Imports: Solid Fuels
NETEXC.ELC.LNK	Net Exchange of Electricity over Links
NETEXC.LTH.HLK	Net Exchange of Heat over Links
TOT.EXP.ELC	Total Exports: Electric
TOT.EXP.ENC	Total Exports: Non-Electric
TOT.FINALNRG	Total Final Energy

A2.2 MARKAL Results Parameters by Table (continued)

MARKAL Results Table T02: Summary (continued)

Results Parameter Name	Results Parameter Description
TOT.FINALUSE	Total Final Use of Energy
TOT.IMP.ELC	Total Imports: Electric
TOT.IMP.ENC	Total Imports: Non-Electric
TOT.MIN	Total Domestic Extraction
TOT.RELNRG.CON	Total Released Energy: Conversion Technologies
TOT.RELNRG.DMD	Total Released Energy: Demand Technologies
TOT.RELNRG.PRC	Total Released Energy: Process Technologies
TOT.RELNRG.TOT	Total Released Energy: Total All Technologies
TOT.SNKNRG.CON	Total Sunk Energy: Conversion Technologies
TOT.SNKNRG.DMD	Total Sunk Energy: Demand Technologies
TOT.SNKNRG.PRC	Total Sunk Energy: Process Technologies
TOT.SNKNRG.TOT	Total Sunk Energy: Total All Technologies
TOT.STK	Total Stockpile Withdrawal
TOT.SUP.NUC	Total Supply: Nuclear Fuels
TOT.SUP.RNW	Total Supply: Renewable Fuels
TOT.USE.N-E	Total Use as Non-Energy
TOT.USEFUL	Total Useful Energy
U.ANNADJTOTCOST	Undiscounted Annually Adjusted Total System Cost (no Resid)
U.ANNINV.COST	Undiscounted Annualized New Investment Cost
U.ANNRINV.COST	Undiscounted Annualized Residual Investment Cost
U.CHNG.SURPLUS	Undiscounted MARKALED Change in Consumer/Producer Surplus
U.CPSURPLUS	Undiscounted Consumer/Producer Surplus: MICRO
U.DOMFUELCOST	Undiscounted Domestic Fuel Cost
U.EMIS.TAX	Undiscounted Emissions Tax Revenues, by Emission
U.EMIS.TAX.TOT	Undiscounted Emissions Tax Revenues Total
U.EV-DAMAG.TOT	Undiscounted Environmental Damage Total
U.INV.DEMAND	Undiscounted Investment in Demand Technologies
U.INV.SALVAGE	Undiscounted Investments Salvage Cost
U.INV.SUPPLY	Undiscounted Investment in Supply Technologies
U.INV.TOT	Undiscounted Investment Total in Technologies
U.MED.CANNCOST	Undiscounted MARKALED Change in Annual Total System Cost
U.MED-SURF.GRO	Undisc. MARKALED Total Growth in Surface under Dem. Curve
U.MED-SURF.RED	Undisc. MARKALED Total Reduction in Surface under Dem. Curve
U.NETEXPFUEL	Undiscounted Net Expenditure on Fuel
U.NETIMPCOST	Undiscounted Net Fuel Import Cost
U.NETIMPCOST.L	Undiscounted Net Liquid Import Cost
U.OTHEX.DEMAND	Undiscounted Other Expenditures on Demand
U.OTHEX.SUPPLY	Undiscounted Other Expenditures on Supply
U.OTHEX.TOTAL	Undiscounted Other Expenditures Total
U.TAXSUB	Undiscounted Tax/Subsidy Revenues, by Tax/Subsidy
U.TAXSUB.TOT	Undiscounted Tax/Subsidy Revenues Total
U.TOTCOST	Undiscounted Total System Cost

A2.2 MARKAL Results Parameters by Table (continued)

MARKAL Results Table T03: Primary Energy Supply

Results Parameter Name	Results Parameter Description
EXPFOS	Exports of Fossil Energy Carriers
IMPELC	Net Imports of Electricity, by Season, Time of Day
IMPFOS	Imports of Fossil Energy Carriers
IMPLTH	Net Imports of Low Temp Heat, by Season
MINFOS	Mining of Fossil Energy Carriers
STKFOS	Stockpiling of Fossil Energy Carriers
SUPFOS	Domestic Supply of Fossil Energy Carriers
TOT.EXPFOS	Total Exports of Fossil Energy Carriers
TOT.IMPELC	Total Net Imports of Electricity
TOT.IMPFOS	Total Imports of Fossil Energy Carriers
TOT.IMPLTH	Total Net Imports of Low Temp Heat
TOT.MINFOS	Total Mining of Fossil Energy Carriers
TOT.PRIMNRG	Total Primary Energy
TOT.STKFOS	Total Stockpiling of Fossil Energy Carriers
TOT.SUPFOS	Total Domestic Supply of Fossil Energy Carriers
TOT.SUPFOS.GAS	Total Domestic Supply of Fossil Energy Carriers: Gaseous
TOT.SUPFOS.LIQ	Total Domestic Supply of Fossil Energy Carriers: Liquid
TOT.SUPFOS.SLD	Total Domestic Supply of Fossil Energy Carriers: Solid
TOT.USECSV	Total Usage of Conservation Energy Carriers
TOT.USENUC	Total Usage of Nuclear Energy Carriers
TOT.USEREN	Total Usage of Renewable Energy Carriers
TOT.USEREN.ELC	Total Usage of Renewable Energy Carriers: Electricity
TOT.USEREN.LTH	Total Usage of Renewable Energy Carriers: Heating
TOT.USEREN.OTH	Total Usage of Renewable Energy Carriers: Other Fuels

A2.2 MARKAL Results Parameters by Table (continued)

MARKAL Results Table T04: Output of Energy by Technology

Results Parameter Name	Results Parameter Description
EXPELC.TCH.TS	Export of Electricity: By Export Technology, by TimeSlice
EXPELC.TOT	Export of Electricity: Total All Export Technologies
EXPELC.TOT.TS	Export of Electricity: Total All Export Technologies, by TimeSlice
IMPELC.TCH.TS	Import of Electricity: By Import Technology, by TimeSlice
IMPELC.TOT	Import of Electricity: Total All Import Technologies
IMPELC.TOT.TS	Import of Electricity: Total All Import Technologies, by TimeSlice
NETELC.LNK	Net Electric Grid Exchange: by Interconnection Technology
NETELC.LNK.TS	Net Electric Grid Exchange: by Interconnection Technology, by TimeSlice
NETELC.TOT	Net Electric Grid Exchange: Total All Technologies
NETELC.TOT.TS	Net Electric Grid Exchange: Total All Technologies, by TimeSlice
NETLTH.HLK	Net Heat Grid Exchange: by Interconnection Technology
NETLTH.HLK.TS	Net Heat Grid Exchange: by Interconnection Technology, by TimeSlice
NETLTH.TOT	Net Heat Grid Exchange: Total All Technologies
NETLTH.TOT.TS	Net Heat Grid Exchange: Total All Technologies, by TimeSlice
OUTELC.CEN	Output of Electricity: by Centralised Technology (not CPD)
OUTELC.CEN.TOT	Output of Electricity: CEN Technologies (not CPD): Total
OUTELC.CEN.TOT.TS	Output of Electricity: CEN Technologies (not CPD): Total by TimeSlice
OUTELC.CEN.TS	Output of Electricity: by Centralised Technology (not CPD), TimeSlice
OUTELC.CPD	Output of Electricity: by Coupled Production Technology
OUTELC.CPD.TOT	Output of Electricity: CPD Technologies: Total
OUTELC.CPD.TOT.TS	Output of Electricity: CPD Technologies: Total by TimeSlice
OUTELC.CPD.TS	Output of Electricity: by Coupled Production Technology, TimeSlice
OUTELC.DCN	Output of Electricity: by Decentralised Technology (not CPD)
OUTELC.DCN.TOT	Output of Electricity: DCN Technologies (not CPD): Total
OUTELC.DCN.TOT.TS	Output of Electricity: DCN Technologies (not CPD): Total by TimeSlice
OUTELC.DCN.TS	Output of Electricity: by Decentralised Technology (not CPD), TimeSlice
OUTELC.RNT	Output of Electricity: by Renewable ELE/STG Technology
OUTELC.RNT.TOT	Output of Electricity: Renewable ELE/STG Technologies: Total
OUTELC.RNT.TOT.TS	Output of Electricity: Renewable ELE/STG Technologies: Total by TimeSlice
OUTELC.RNT.TS	Output of Electricity: by Renewable ELE/STG Technology, TimeSlice
OUTELC.STG	Output of Electricity: by Storage Technology
OUTELC.STG.TOT	Output of Electricity: STG Technologies: Total
OUTELC.STG.TOT.TS	Output of Electricity: STG Technologies: Total by TimeSlice
OUTELC.STG.TS	Output of Electricity: by Storage Technology, TimeSlice
OUTELC.TOT	Output of Electricity: Total All Technologies
OUTELC.TOT.TOT	Output of Electricity: Total All Technologies and All Grids
OUTLTH.CPD	Output of Heat: by Coupled Production Technology
OUTLTH.CPD.TOT	Output of Heat: CPD Technologies: Total
OUTLTH.CPD.TOT.TS	Output of Heat: CPD Technologies: Total by TimeSlice
OUTLTH.CPD.TS	Output of Heat: by Coupled Production Technology, TimeSlice
OUTLTH.HPL	Output of Heat: by Heating Plant
OUTLTH.HPL.TOT	Output of Heat: Heating Plants: Total
OUTLTH.HPL.TOT.TS	Output of Heat: Heating Plants: Total by TimeSlice
OUTLTH.HPL.TS	Output of Heat: by Heating Plant, TimeSlice
OUTLTH.TOT	Output of Heat: Total All Technologies
OUTLTH.TOT.TOT	Output of Heat: Total All Technologies and All Grids

A2.2 MARKAL Results Parameters by Table (continued)

MARKAL Results Table T04: Output of Energy by Technology (continued)

Results Parameter Name	Results Parameter Description
OUTMVO.CON.TOT	Output of Materials: by Conv. Technology: Total All MVOs
OUTMVO.DMD.TOT	Output of Materials: by Demand Technology: Total All MVOs
OUTMVO.PRC.TOT	Output of Materials: by Process Technology: Total All MVOs
OUTMWT.CON.TOT	Output of Materials: by Conv. Technology: Total All MWTs
OUTMWT.DMD.TOT	Output of Materials: by Demand Technology: Total All MWTs
OUTMWT.PRC.TOT	Output of Materials: by Process Technology: Total All MWTs
OUTOTH.CON.TOT	Output of Other Fuels: by Conv. Technology: Total All Fuels
OUTOTH.DMD.TOT	Output of Other Fuels: by Demand Technology: Total All Fuels
OUTOTH.PRC.A??	Output of Other Fuels: by Process Technology: A?? Fuels
OUTOTH.PRC.GAS	Output of Other Fuels: by Process Technology: Gaseous Fuels
OUTOTH.PRC.LIQ	Output of Other Fuels: by Process Technology: Liquid Fuels
OUTOTH.PRC.RNW	Output of Other Fuels: by Process Technology: Renewable Fuel
OUTOTH.PRC.SLD	Output of Other Fuels: by Process Technology: Solid Fuels

A2.2 MARKAL Results Parameters by Table (continued)

MARKAL Results Table T05: Fuel Consumption by Demand Sector

Results Parameter Name	Results Parameter Description
FUELC.AGR.ELC	Fuel Consumption: Agricultural Sector: Electric Fuels
FUELC.AGR.GAS	Fuel Consumption: Agricultural Sector: Gaseous Fuels
FUELC.AGR.H&C	Fuel Consumption: Agricultural Sector: Heating&Cooling Fuels
FUELC.AGR.LIQ	Fuel Consumption: Agricultural Sector: Liquid Fuels
FUELC.AGR.RNW	Fuel Consumption: Agricultural Sector: Renewable Fuels
FUELC.AGR.SLD	Fuel Consumption: Agricultural Sector: Solid Fuels
FUELC.AGR.TOT	Fuel Consumption: Agricultural Sector: Total All Fuels
FUELC.COM.ELC	Fuel Consumption: Commercial Sector: Electric Fuels
FUELC.COM.GAS	Fuel Consumption: Commercial Sector: Gaseous Fuels
FUELC.COM.H&C	Fuel Consumption: Commercial Sector: Heating&Cooling Fuels
FUELC.COM.LIQ	Fuel Consumption: Commercial Sector: Liquid Fuels
FUELC.COM.RNW	Fuel Consumption: Commercial Sector: Renewable Fuels
FUELC.COM.SLD	Fuel Consumption: Commercial Sector: Solid Fuels
FUELC.COM.TOT	Fuel Consumption: Commercial Sector: Total All Fuels
FUELC.IND.ELC	Fuel Consumption: Industrial Sector: Electric Fuels
FUELC.IND.GAS	Fuel Consumption: Industrial Sector: Gaseous Fuels
FUELC.IND.H&C	Fuel Consumption: Industrial Sector: Heating&Cooling Fuels
FUELC.IND.LIQ	Fuel Consumption: Industrial Sector: Liquid Fuels
FUELC.IND.RNW	Fuel Consumption: Industrial Sector: Renewable Fuels
FUELC.IND.SLD	Fuel Consumption: Industrial Sector: Solid Fuels
FUELC.IND.TOT	Fuel Consumption: Industrial Sector: Total All Fuels
FUELC.N-E.ELC	Fuel Consumption: Non-Energy Sector: Electric Fuels
FUELC.N-E.GAS	Fuel Consumption: Non-Energy Sector: Gaseous Fuels
FUELC.N-E.H&C	Fuel Consumption: Non-Energy Sector: Heating&Cooling Fuels
FUELC.N-E.LIQ	Fuel Consumption: Non-Energy Sector: Liquid Fuels
FUELC.N-E.RNW	Fuel Consumption: Non-Energy Sector: Renewable Fuels
FUELC.N-E.SLD	Fuel Consumption: Non-Energy Sector: Solid Fuels
FUELC.N-E.TOT	Fuel Consumption: Non-Energy Sector: Total All Fuels
FUELC.RES.ELC	Fuel Consumption: Residential Sector: Electric Fuels
FUELC.RES.GAS	Fuel Consumption: Residential Sector: Gaseous Fuels
FUELC.RES.H&C	Fuel Consumption: Residential Sector: Heating&Cooling Fuels
FUELC.RES.LIQ	Fuel Consumption: Residential Sector: Liquid Fuels
FUELC.RES.RNW	Fuel Consumption: Residential Sector: Renewable Fuels
FUELC.RES.SLD	Fuel Consumption: Residential Sector: Solid Fuels
FUELC.RES.TOT	Fuel Consumption: Residential Sector: Total All Fuels
FUELC.TRN.ELC	Fuel Consumption: Transport Sector: Electric Fuels
FUELC.TRN.GAS	Fuel Consumption: Transport Sector: Gaseous Fuels
FUELC.TRN.H&C	Fuel Consumption: Transport Sector: Heating&Cooling Fuels
FUELC.TRN.LIQ	Fuel Consumption: Transport Sector: Liquid Fuels
FUELC.TRN.RNW	Fuel Consumption: Transport Sector: Renewable Fuels
FUELC.TRN.SLD	Fuel Consumption: Transport Sector: Solid Fuels
FUELC.TRN.TOT	Fuel Consumption: Transport Sector: Total All Fuels
FUELC.TTL.TOT	Fuel Consumption: Total All Sectors: Total All Fuels
FUELC_ENT_DM	Fuel Consumption by Energy Carrier by End-Use Demand

A2.2 MARKAL Results Parameters by Table (continued)

MARKAL Results Table T06: Useful Energy by Demand Device

Results Parameter Name	Results Parameter Description
USENRG.AGR.DM	Useful Energy: Agricultural Sector: by End-Use Demand
USENRG.AGR.TOT	Useful Energy: Agricultural Sector: Total All Demands
USENRG.AGR:SEC	Useful Energy: Agricultural Sector: from Secondary DMDs
USENRG.AGR_DMD	Useful Energy: Agricultural Sector: by Demand Technology
USENRG.AGR_DMD_DM	Useful Energy: Agricultural Sector: by Demand Technology, Demand Sector
USENRG.COM.DM	Useful Energy: Commercial Sector: by End-Use Demand
USENRG.COM.TOT	Useful Energy: Commercial Sector: Total All Demands
USENRG.COM:SEC	Useful Energy: Commercial Sector: from Secondary DMDs
USENRG.COM_DMD	Useful Energy: Commercial Sector: by Demand Technology
USENRG.COM_DMD_DM	Useful Energy: Commercial Sector: by Demand Technology, Demand Sector
USENRG.IND.DM	Useful Energy: Industrial Sector: by End-Use Demand
USENRG.IND.TOT	Useful Energy: Industrial Sector: Total All Demands
USENRG.IND:SEC	Useful Energy: Industrial Sector: from Secondary DMDs
USENRG.IND_DMD	Useful Energy: Industrial Sector: by Demand Technology
USENRG.IND_DMD_DM	Useful Energy: Industrial Sector: by Demand Technology, Demand Sector
USENRG.N-E.DM	Useful Energy: Non-Energy Sector: by End-Use Demand
USENRG.N-E.TOT	Useful Energy: Non-Energy Sector: Total All Demands
USENRG.N-E:SEC	Useful Energy: Non-Energy Sector: from Secondary DMDs
USENRG.N-E_DMD	Useful Energy: Non-Energy Sector: by Demand Technology
USENRG.N-E_DMD_DM	Useful Energy: Non-Energy Sector: by Demand Technology, Demand Sector
USENRG.RES.DM	Useful Energy: Residential Sector: by End-Use Demand
USENRG.RES.TOT	Useful Energy: Residential Sector: Total All Demands
USENRG.RES:SEC	Useful Energy: Residential Sector: from Secondary DMDs
USENRG.RES_DMD	Useful Energy: Residential Sector: by Demand Technology
USENRG.RES_DMD_DM	Useful Energy: Residential Sector: by Demand Technology, Demand Sector
USENRG.TRN.DM	Useful Energy: Transport Sector: by End-Use Demand
USENRG.TRN.TOT	Useful Energy: Transport Sector: Total All Demands
USENRG.TRN:SEC	Useful Energy: Transport Sector: from Secondary DMDs
USENRG.TRN_DMD	Useful Energy: Transport Sector: by Demand Technology
USENRG.TRN_DMD_DM	Useful Energy: Transport Sector: by Demand Technology, Demand Sector
USENRG.TTL.TOT	Useful Energy: Total All Sectors: Total All Demands

A2.2 MARKAL Results Parameters by Table (continued)

MARKAL Results Table T08: Use of Energy Carriers by Technology

Results Parameter Name	Results Parameter Description
ELCUSE.IMP.TS	Use of Electricity: Total All Import Resource Technologies, by TimeSlice
ELCUSE.MIN.TS	Use of Electricity: Total All Mining Resource Technologies, by TimeSlice
ELCUSE.RNW.TS	Use of Electricity: Total All Renewable Resource Technologies, by TimeSlice
ELCUSE.STK.TS	Use of Electricity: Total All Stockpile Resource Technologies, by TimeSlice
ELCUSE.TCH.TS	Use of Electricity: By Technology (not Resource), TimeSlice
ELCUSE.TOT	Use of Electricity: Total All Technologies, All TimeSlices
ELCUSE.TOT.TS	Use of Electricity: Total All Technologies, by TimeSlice
FUELUSE.EXP	Use of Energy Carriers: Exports Total
FUELUSE.IMP	Use of Energy Carriers: Imports Total
FUELUSE.MIN	Use of Energy Carriers: Mining Total
FUELUSE.RNW	Use of Energy Carriers: Renewables Total
FUELUSE.STK	Use of Energy Carriers: Stockpiling Total
FUELUSE.TCH	Use of Energy Carriers: by Technology (not Resource)
FUELUSE.TOT	Use of Energy Carriers: Total All Technologies
FUELUSEFEQ.TCH	Fossil Equiv. for Renewables/Nuclear: by Tech (not Resource)
FUELUSEFEQ.TOT	Fossil Equiv. for Renewables/Nuclear: Total All Technologies
LTHUSE.TCH.TS	Use of Heat: By Technology (not Resource), TimeSlice
LTHUSE.TOT	Use of Heat: Total All Technologies, All TimeSlices
LTHUSE.TOT.TS	Use of Heat: Total All Technologies, by TimeSlice
MATVO.USE.TCH	Use of Materials: Volume: by Technology (not Resource)
MATVO.USE.TOT	Use of Materials: Volume: Total All Technologies
MATWT.USE.TCH	Use of Materials: Weight: by Technology (not Resource)
MATWT.USE.TOT	Use of Materials: Weight: Total All Technologies

MARKAL Results Table T09: Shadow Prices of Energy Carriers and Emissions

Results Parameter Name	Results Parameter Description
EMISSION.M	Emission Marginal
EQ.BAL.ENC.L	Balance Equation Level: ECV/ERNXMAC Energy Carrier
EQ.BASELOAD.M	Baseload Constraint Marginal
EQ.PEAK.ELC.L	Peaking Constraint Level: Electricity
EQ.PEAK.ELC.M	Peaking Constraint Marginal: Electricity
EQ.PEAK.LTH.L	Peaking Constraint Level: Low Temp. Heat
EQ.PEAK.LTH.M	Peaking Constraint Marginal: Low Temp. Heat
EQ.TAXSUB.M	Tax/Subsidy Constraint Marginal
FUEL.ELC.M	Energy Carrier Marginal: Electricity, by Season, Time of Day
FUEL.ENC.M	Energy Carrier Marginal: Not Electricity/District Heat
FUEL.LTH.M	Energy Carrier Marginal: District Heat, by Season
MATL.MVO.M	Material Marginal: Volume
MATL.MWT.M	Material Marginal: Weight

A2.2 MARKAL Results Parameters by Table (continued)

MARKAL Results Table T11: Reduced Costs of Technologies, End-Use Demands, Emissions, etc.

Results Parameter Name	Results Parameter Description
ACTIVITY.M	Process Technology Activity Marginal
CAPACITY.M	Technology Capacity Marginal
DECAY.M	Technology Decay Constraint Marginal
DECAYr.M	Resource Decay Constraint Marginal
DEMAND.M	End-Use Demand Marginal
EMISSION.M	Emission Marginal
EQ.ADRATIO.M	User-Defined Constraint Marginal
EQ.BNDCON.M	Conversion Technology Activity Bound Marginal
EQ.CUMRES.M	Cumulative Resource Constraint Marginal
GROWTH.M	Technology Growth Constraint Marginal
GROWTHr.M	Resource Growth Constraint Marginal
RESOURCE.M	Resource Technology Marginal

MARKAL Results Table T25: Annualised Resource and Technology Costs

Results Parameter Name	Results Parameter Description
AC.INV.RESID	Annualised Investment Cost of Residual (MARKAL-MACRO)
AC.INVEST	Annualized Investment Cost: Technology (not Resource)
AC.O&M.ALL	Annualized O&M Cost: Fixed-Capacity Utilisation Technology
AC.O&M.FIXED	Annualized Fixed O&M Cost: Technology (not XPR, XLM)
AC.O&M.VAR	Annualized Variable O&M Cost: Technology (not XPR, XLM)
AC.O&M.VARLTH	Annualized Variable O&M Cost, Heat Component: CPD Technology
AC.RESOURCE	Annualized Cost: Resource Technology
AEXPEND.ELC.IMP.TS	Annual Expend on Aux. Electricity: Total All IMP Technologies, by TimeSlice
AEXPEND.ELC.MIN.TS	Annual Expend on Aux. Electricity: Total All MIN Technologies, by TimeSlice
AEXPEND.ELC.RNW.TS	Annual Expend on Aux. Electricity: Total All RNW Technologies, by TimeSlice
AEXPEND.ELC.STK.TS	Annual Expend on Aux. Electricity: Total All STK Technologies, by TimeSlice
AEXPEND.ELC.TCH.TS	Annualized Expenditure on Electricity: by Conversion Technology, TimeSlice
AEXPEND.FUEL.IMP	Annualized Expenditure on Auxiliary Fuel/Material: Total All IMP Technologies
AEXPEND.FUEL.MIN	Annualized Expenditure on Auxiliary Fuel/Material: Total All MIN Technologies
AEXPEND.FUEL.RNW	Annualized Expenditure on Auxiliary Fuel/Material: Total All RNW Technologies
AEXPEND.FUEL.STK	Annualized Expenditure on Auxiliary Fuel/Material: Total All STK Technologies
AEXPEND.FUEL.TCH	Annualized Expenditure on Fuel: by Technology
AEXPEND.LTH.TCH.TS	Annualized Expenditure on Heat: by Conversion Technology, TimeSlice

A2.2 MARKAL Results Parameters by Table (continued)

MARKAL Results Table T27ENV: Annual Environmental Effects

Results Parameter Name	Results Parameter Description
D.EMISSION.L	Discounted Emission Level
EMIS.COMBIN	Emissions: Combined (GWP), by Emission
EMIS.RESOURCE	Emissions: Resource Technology
EMIS.TCH.ACT	Emissions: Technology Activity
EMIS.TCH.CAP	Emissions: Technology Capacity
EMIS.TCH.INV	Emissions: Technology Investment
EMIS.TCH.TOT	Emissions: Technology Total
EMIS.TRADE.EXP	Trade in Emissions: Export
EMIS.TRADE.IMP	Trade in Emissions: Import
EMISSION.L	Emission Level (Total All Technologies)
EMISSION.NET	Net Emissions (after Trade)

MARKAL Results Table T30: Adjustments to Demand for MARKALED

Results Parameter Name	Results Parameter Description
MED-DEMAND.GRO	Total Growth in End-Use Demand
MED-DEMAND.RED	Total Reduction in End-Use Demand
MED-ELAST.GRO	Elasticity when Growth in End-Use Demand
MED-ELAST.RED	Elasticity when Reduction in End-Use Demand
MED-ERROR%.GRO	Growth Elasticity Error %
MED-ERROR%.RED	Reduce Elasticity Error %
MED-LSTEP.GRO	Level of Last Step when Growth in End-Use Demand
MED-LSTEP.RED	Level of Last Step when Reduction in End-Use Demand
U.DMSURF.GRO	Undisc Growth in Surface under Dem. Curve, by End-Use Demand
U.DMSURF.RED	Undisc Redn. in Surface under Dem. Curve, by End-Use Demand

MARKAL Results Table ACT: Activity of Processes - Solution Values

Results Parameter Name	Results Parameter Description
ACTIVITY.L	Technology Activity Level

MARKAL Results Table CAP: Capacity Utilisation of Technologies

Results Parameter Name	Results Parameter Description
CAPACITY.L	Technology Capacity Level
CAPACITY.UNUSD	Unused Capacity (%): Conversion Technology
LOAD.ANNUAL	Annual Load (%): Conversion/Process Technology
LOAD.SEAS.ELC	Seasonal Electric Load (%): Conversion Technology
LOAD.SEAS.LTH	Seasonal Heat Load (%): Conversion Technology
OUTAGE.ANNUAL	Annual Outage (%): Conversion Technology
OUTPUT.ELC	Output of Electricity: Conversion Technology
OUTPUT.LTH	Output of Heat: Conversion Technology

A2.2 MARKAL Results Parameters by Table (continued)

MARKAL Results Table COSTBEN: Cost/Benefit Ratios

Results Parameter Name	Results Parameter Description
COSTBEN	Cost/Benefit Ratios of Technologies (not Resource)

MARKAL Results Table DEMAND: Demand Levels - Solution Values

Results Parameter Name	Results Parameter Description
DEMAND.L	End-Use Demand Level

MARKAL Results Table GDP: Key MACRO Indicators

Results Parameter Name	Results Parameter Description
CAPITAL	Capital: MARKAL-MACRO
CONSUMPTION	Consumption: MARKAL-MACRO
ENERGY_COSTS	Energy Costs: MARKAL-MACRO
GDP	Gross Domestic Product: MARKAL-MACRO
INVESTMENT	Investment: MARKAL-MACRO
TOT.DEMAND	Total Demand: MARKAL-MACRO

MARKAL Results Table INV: Investment in Technologies - Quantity and Cost

Results Parameter Name	Results Parameter Description
INVEST.COST	Technology Investment Cost - undiscounted
INVEST.L	Technology Investment Level
INVEST.M	Technology Investment Marginal

MARKAL Results Table MC: Demand Marginals and PREF Differences

Results Parameter Name	Results Parameter Description
DEMAND.M	End-Use Demand Marginal
PREFDIFF	Marginal costs of demands in second period minus input PREFs

MARKAL Results Table SUPPLY: Resource Supply Levels - Solution Values

Results Parameter Name	Results Parameter Description
RESOURCE.L	Resource Technology Level

A2.2 MARKAL Results Parameters by Table (continued)

MARKAL Results Table TRADE: Bilateral Trade

Results Parameter Name	Results Parameter Description
MR_BITRD(ELC).M	Bilateral Trade in Electricity, by TimeSlice: Marginal
MR_BITRD(ENT).M	Bilateral Trade in Energy: Marginal
MR_BITRD(MAT).M	Bilateral Trade in Material: Marginal
R_TSEP.L	Region Bilateral Trade in Energy/Material: Level
R_TSEP.M	Region Bilateral Trade in Energy/Material: Marginal
R_TSEPELC.L	Region Bilateral Trade in Electricity, by TimeSlice: Level
R_TSEPELC.M	Region Bilateral Trade in Electricity, by TimeSlice: Marginal

MARKAL Results Table TRADE: Global Trade

Results Parameter Name	Results Parameter Description
MR_GTRD(ENT).M	Global Trade in Energy: Marginal
MR_GTRD(ENV).M	Global Trade in Emission: Marginal
MR_GTRD(MAT).M	Global Trade in Material: Marginal
R_GTRD(ENT)exp.L	Region Global Trade: Export of Energy: Level
R_GTRD(ENT)exp.M	Region Global Trade: Export of Energy: Marginal
R_GTRD(ENT)imp.L	Region Global Trade: Import of Energy: Level
R_GTRD(ENT)imp.M	Region Global Trade: Import of Energy: Marginal
R_GTRD(ENV)exp.L	Region Global Trade: Export of Emission: Level
R_GTRD(ENV)exp.M	Region Global Trade: Export of Emission: Marginal
R_GTRD(ENV)imp.L	Region Global Trade: Import of Emission: Level
R_GTRD(ENV)imp.M	Region Global Trade: Import of Emission: Marginal
R_GTRD(MAT)exp.L	Region Global Trade: Export of Material: Level
R_GTRD(MAT)exp.M	Region Global Trade: Export of Material: Marginal
R_GTRD(MAT)imp.L	Region Global Trade: Import of Material: Level
R_GTRD(MAT)imp.M	Region Global Trade: Import of Material: Marginal