

# ANSWERv6-MARKAL Load Templates Manual (version 6.1)

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## Acknowledgement

The development of the ANSWER Load Templates is the result of a collaborative effort between Gary Goldstein of International Resources Group and Noble-Soft Systems.

### 1. Background

The task of assembling data for a MARKAL model requires various data preparation steps that are usually performed using the power and flexibility of spreadsheets (Excel). New ANSWER “smart” load templates have been developed to allow the analyst to assemble the model data from its sources in a form readily loaded into ANSWER. The process is guided by a few rules and supported by action buttons and selection trees or lists, along with quality control checking, to facilitate the direct (and correct) loading of the data. Initially these templates are more focused on assisting the assembling of initial year data for the calibration of a (new) model, but the approach will be expanded to facilitate load of projection information as well.

The ANSWER “smart” templates are loaded into an ANSWER database by means of the “File, Import, Model Data from Excel” facility. For an overview of the use of this facility see section 11 ‘Loading the Templates into ANSWER’ of this manual, and for a detailed explanation see section 2.10 ‘Importing Model Data from Excel’ in the *ANSWERv6-MARKAL User Manual.pdf* in folder C:\AnswerV6\UserManuals.

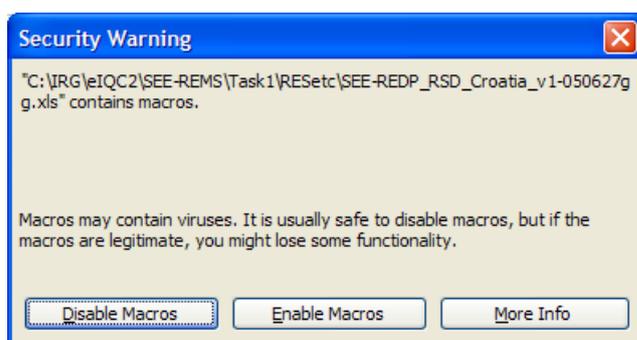
In the sections that follow each sheet will be presented. The next two sections however describe opening a “smart” workbook and the general layout and philosophy embodied in all the sheets.

Note that an example ANSWER “smart” template, UtopiaSmartXLS.xls, is now provided as part of the ANSWERv6-MARKAL installation files in folder C:\AnswerV6\UserManuals. See section 12 ‘Example ANSWER “smart” template’ of this manual.

## 2. Workbook Setup

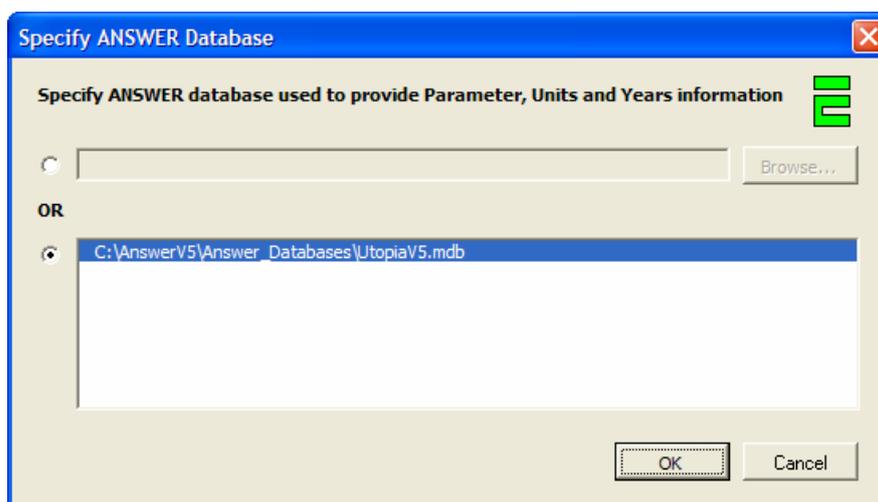
Anyone wishing to work with an ANSWER “smart” load workbook must create an existing ANSWER Smart Workbook to start. See Appendix A for more information on the various ways in which this can be done. In addition, note that the functioning of some of the macro facilities in the ANSWER load workbooks requires that ANSWER be installed on your computer.

Upon opening a “smart” workbook, depending on your Windows security level setting you may be prompted by the security warning below. Select “Enable Macros” so that the action buttons are made available.



It is recommended that you associate the workbook with a target ANSWER database in response to the prompt below. This is necessary to make available the “smart” buttons on the ANSWER workbook related to specifying Units, Set Memberships, Parameters and Parameter Qualifiers, and to make available the ‘Check Sheet’ button on each worksheet.

The functioning of the following “smart” buttons does *not* depend on associating the workbook with a target ANSWER database: the ‘CommName, CommDesc, CommUnit’ button on the Commodity Data worksheet; the ‘TechName, TechDesc, TACT, TCAP Units’ and the ‘CommIN’ and ‘CommOUT’ buttons on the Technology Data worksheet; and the ‘ConstrName, ConstrDesc, Units’ and the ‘TechName’ buttons on the Constraint Data worksheet.



It is essential that the Region in Cell B1 of each load template is the same Region as that identified inside the ANSWER database.

Before getting underway with the new templates, you should check the available units and default units settings in your new database and adjust as needed.

### 3. Worksheet Layout and Philosophy

This section briefly indicates each of the six types of “smart” worksheets managed by the ANSWER load templates, as presented in Table 1. They are segregated into two types Declare (Declaration) and Data, and are identified by one of the ANSWER Indicators Commodities, Technologies, Constraints, CommData, TechData or ConstrData appearing in cell A1 of the worksheet.

Table 1 - ANSWER Smart Worksheets

| <u>Worksheet</u> | <u>Type</u> | <u>ANSWER Indicator</u> | <u>Description</u>  |
|------------------|-------------|-------------------------|---|
| Commodities      | Declare     | Commodities             | All the commodities (energy carriers, materials, demands, emissions) are named and described, and their units and set memberships information are declared. In version 6.1 (and higher), taxes and subsidies are also declared on the Commodities sheet. See section 10.          |
| Technologies     | Declare     | Technologies            | All the technologies (resources, processes, conversion plants, and demand devices) are named and described, and their units and set memberships information are declared.   |
| Constraints      | Declare     | Constraints             | All user-defined constraints (ADRATIOs) are named and described, and their units and set memberships information are declared.  |
| Commodities Data | Data        | CommData                | Data associated with commodities (e.g., demand levels, energy carrier efficiencies, electricity transmission and distribution costs) are provided. In version 6.1 (and higher), data associated with taxes and subsidies are also provided on the CommData sheet. See section 10. |
| Technology Data  | Data        | TechData                | Data associated with technologies (e.g., residual capacity, efficiency, availability, input/output fuels, costs) are provided. In version 6.1 (and higher), data associated with taxes and subsidies are also provided on the TechData sheet. See section 10.                     |
| Constraint Data  | Data        | ConstrData              | Data associated with user-defined constraints (ADRATIOs) are provided by identifying the individual technologies that comprise the constraint, along with their coefficients in the constraint equation.  |

Note that for a single region model, only one of each type of Declare (Declaration) sheet may be included in a workbook, while any number of each type of Data sheets is permitted. The name given to the worksheet is up to the user, although the ANSWER Indicators in cell A1 must match those in Table 1. In addition, a workbook may contain as many other sheets as desired, but the user is encouraged to leave cell A1, the ANSWER Indicator cell, blank.

All of the ANSWER worksheets are governed by a few formatting guidelines (requirements), but are extremely flexible in nature. The top 7 rows of each sheet comprise the action button and header area. These rows are non-scrollable. Columns A-C on the Declare (Declaration) sheets, A-D on the Commodity Data sheets, A-F on the Technology Data sheets, and A-E on the Constraint Data sheet contain action buttons and identification columns that are also non-scrollable. A row will be ignored if the first character of the cell in column A contains an “\*”, or if the row is completely blank. Likewise, a column will be ignored if the first character of the cell in row 1 contains an “\*”, or if the column is completely blank. {Other “ignore” options to be added.}

There are a number of action buttons on each of the ANSWER worksheets. These buttons can be used to specify units and set memberships information, select parameter labels, and perform quality control checks. Some buttons are context sensitive, that is the user must first position the cursor in the appropriate cell below the column or along the row in which the action button appears. Upon selecting from the active list the resulting value is entered into the corresponding cell. When a simple value (text string) is deposited in the cell it is in **violet**, and when a linked reference is inserted (e.g., the name/description/unit of a commodity or technology or constraint on a Data sheet), it is in **blue**.

Note that when specifying Units or Set Memberships the last one provided applies down the column until another specification is provided.

In the sections that follow each sheet is presented, with the buttons explained.

## 4. Commodities Sheet

The Commodities sheet is where all the commodities (energy carriers, materials, demands, and emissions) are named and described, and their units and set memberships information are declared. An example Commodities sheet is shown below.

| CommName  | CommDesc       | CommUnit | Set Memberships | Comment |
|---|----------------|----------|-----------------|---------|
| * Upstream Energy Carriers need for the Dummy Processes |                |          |                 |         |
| BIOWOOD   | Fuel wood      | PJ       | ENT,ENC,ESY,SLD |         |
| COAL  | Brown Coal     |          | ENT,ENC,EFS,SLD |         |
| COALIGN   | Lignite        |          | ENT,ENC,EFS,SLD |         |
| ELC   | Electricity    |          | ENT,ELC         |         |
| GASGWG  | GWG            |          | ENT,ENC,EFS,GAZ |         |
| GASNAT  | Natural gas    |          | ENT,ENC,EFS,GAZ |         |
| HET   | Heat           |          | ENT,LTH         |         |
| OLDST   | Distillate     |          | ENT,ENC,EFS,LIQ |         |
| OILHFO  | Heavy Fuel Oil |          | ENT,ENC,EFS,LIQ |         |
| OILGSL  | Gasoline       |          | ENT,ENC,EFS,LIQ |         |
| OILLPG  | LPG            |          | ENT,ENC,EFS,GAZ |         |
| * all COM Energy Carriers                               |                |          |                 |         |
| AGRBIO  | Fuel wood      |          | ENT,ENC,ESY,SLD |         |
| AGRCOA  | Coal           |          | ENT,ENC,EFS,SLD |         |
| AGRELC  | Electricity    |          | ENT,ELC         |         |
| AGRGAS  | Gas            |          | ENT,ENC,EFS,GAZ |         |
| AGRLTH  | Heat           |          | ENT,LTH         |         |
| AGRLPG  | LPG            |          | ENT,ENC,EFS,GAZ |         |

If the above sheet had been created using an ANSWERv6.1.xls, **violet** would replace **green**, and there would be a **TaxSub Sets** button in column E. See section 10.

The key information entered on the Commodities sheet that is directly provided by the user are the Commodity short Names (CommName) and Descriptions (CommDesc), appearing in columns B and C respectively. In addition, after positioning the cursor in columns D or E of a row the action buttons above may be used to select the Units or Set Memberships specifications, respectively. Sample Commodity Set Memberships and Units forms are shown below.

**Set Memberships**

Set Memberships

- Energy Carrier (ENT)
  - Standard (ENC)
    - Conservation (ECV)
    - Fossil (EFS)
      - High-Temp Heat or Cooling (EHC)
      - Nuclear (ENU)
      - Renewable (ERN)
      - Synthetic (ESY)
    - Electric (ELC)
    - District Heat (LTH)
    - Fossil Equivalent (FEQ)

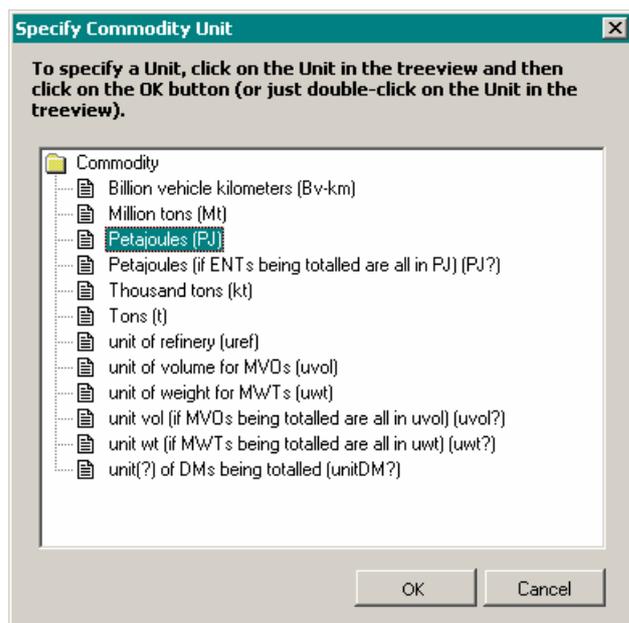
Additional Characterization

Liquid (LIQ)

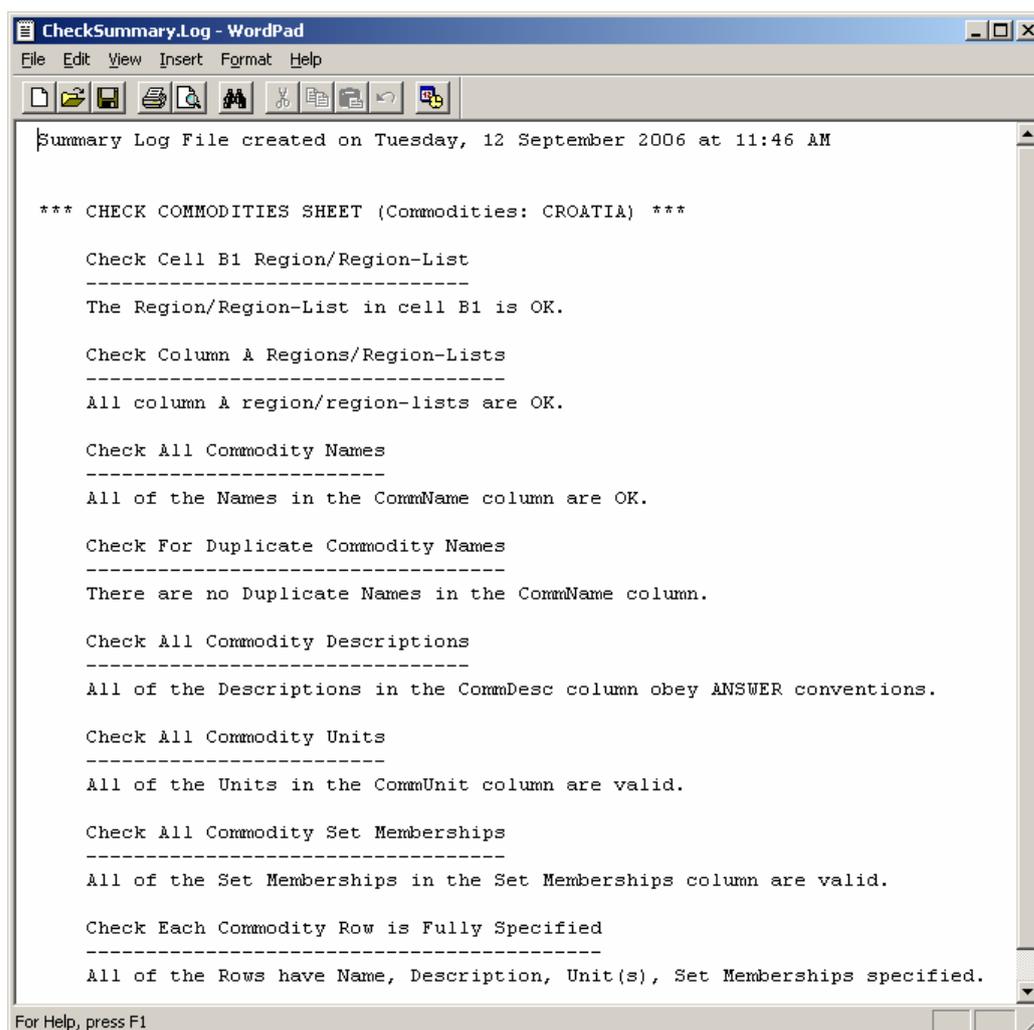
Solid (SLD)

Gaseous (GAZ)

OK Cancel



The 'Check Sheet' button may be pressed at any time to have a standard set of consistency and quality control checks performed. The results of the checking are presented in a Wordpad file as shown below.



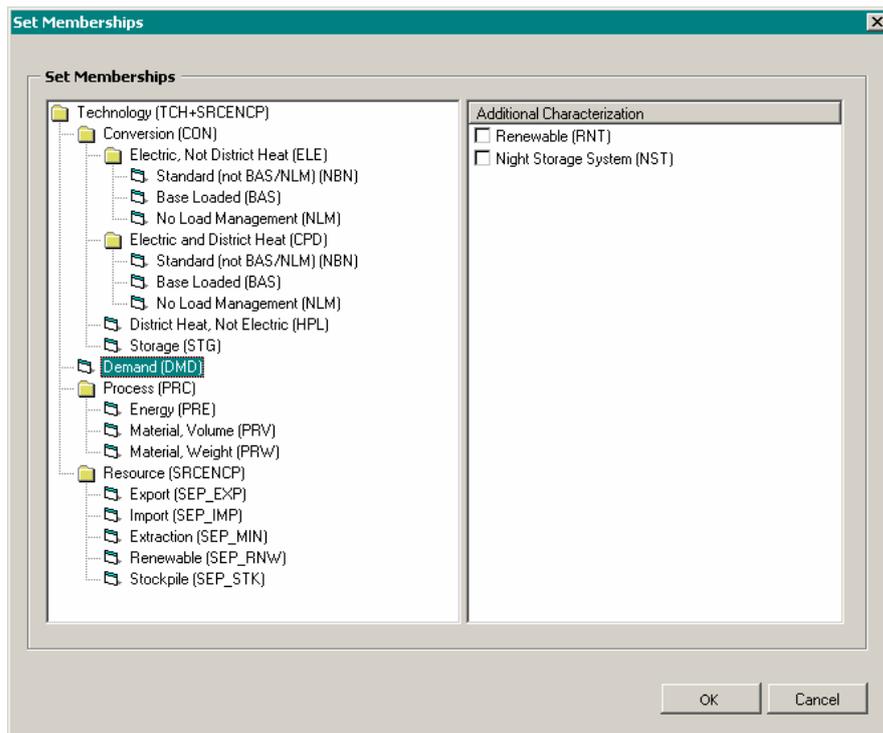
## 5. Technologies Sheet

The Technologies sheet is where all the technologies (resources, processes, conversion plants, and demand devices) are named and described, and their units and set memberships information are declared. An example Technologies sheet is shown below.

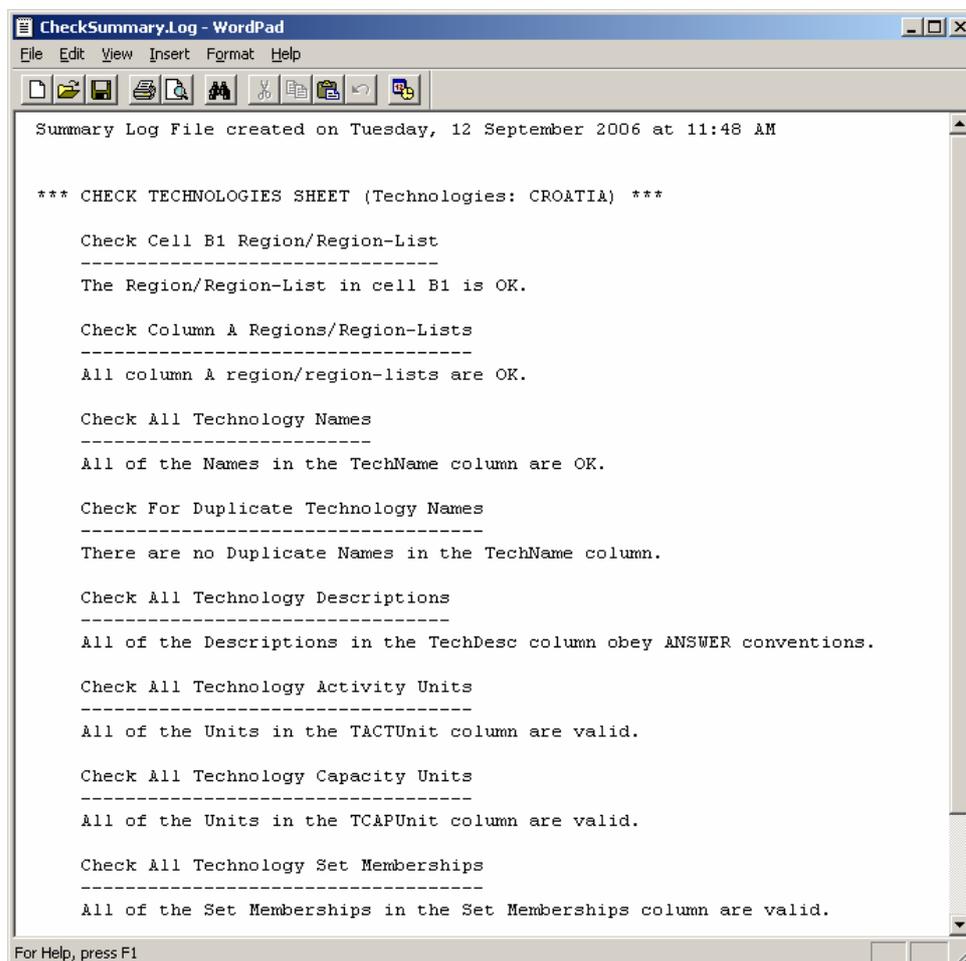
|    | A                 | B          | C  | D        | E        | F               | G       |
|----|-------------------|------------|--|----------|----------|-----------------|---------|
| 1  | Technologies      | CROATIA    |  |          |          |                 |         |
| 2  |                   |            |  |          |          |                 |         |
| 3  |                   |            |  |          |          |                 |         |
| 4  | Check Sheet       |            |  |          |          |                 |         |
| 5  |                   |            |  | TACTUnit | TCAPUnit | Technology Sets |         |
| 6  |                   |            |  |          |          |                 |         |
| 7  |                   | TechName   | TechDesc                                 | TACTUnit | TCAPUnit | Set Memberships | Comment |
| 8  | * cooling         |            |  |          |          |                 |         |
| 9  |                   | CCLEELC100 | Com.Cooling.Large.ELC.00.Fans.           | PJ       | PJ/a     | TCH,DMD         |         |
| 10 |                   | CCSEELC100 | Com.Cooling.Small.ELC.00.Fans.           |          |          |                 |         |
| 11 |                   |            |  |          |          |                 |         |
| 12 | * public lighting |            |  |          |          |                 |         |
| 13 |                   | CPLIELC100 | Com.Public Lighting.ELC.00.Generic Lamp. |          |          |                 |         |
| 14 |                   |            |  |          |          |                 |         |
| 15 | * cooking         |            |  |          |          |                 |         |
| 16 |                   | CFODELC100 | Com.Cooking.ELE.00.Stove.                |          |          |                 |         |
| 17 |                   | CFODGAS100 | Com.Cooking.GAS.00.Stove.                |          |          |                 |         |
| 18 |                   | CFODLPG100 | Com.Cooking.LPG.00.Stove.                |          |          |                 |         |
| 19 | * heating         |            |  |          |          |                 |         |
| 20 |                   | CHLECOA100 | Com.Space Heat.Large.COA.00.Stove.       |          |          |                 |         |
| 21 |                   | CHLEELC100 | Com.Space Heat.Large.ELC.00.Furnace.     |          |          |                 |         |
|    |                   |            | Com.Space                                |          |          |                 |         |

If the above sheet had been created using an ANSWERv6.xls, violet would replace green.

The key information entered on the Technologies sheet that is directly provided by the user are the Technology short Names (TechName) and Descriptions (TechDesc), appearing in columns B and C respectively. In addition, after positioning the cursor in columns D or E or F of a row the 'TACTUnit' or 'TCAPUnit' or 'Technology Sets' action buttons may be used to select the Technology Activity Units or Technology Capacity Units or Set Memberships specifications, respectively. A sample Technology Set Memberships form is shown below.



The 'Check Sheet' button may be pressed at any time to have a standard set of consistency and quality control checks performed. The results of the checking are presented in a Wordpad file as shown below.



## 6. Constraints Sheet

The Constraints sheet is where all the user-defined constraints (ADRATIOs) are named and described, and their units and set memberships information are declared. An example version 6 Smart XLS Constraints sheet is shown below.

|    | A           | B          | C   | D             | E                | F       |
|----|-------------|------------|---|---------------|------------------|---------|
| 1  | Constraints | DEMO       |   |               |                  |         |
| 2  |             |            |   |               |                  |         |
| 3  |             |            |   |               |                  |         |
| 4  | Check Sheet |            |   | Refresh Units |                  |         |
| 5  |             |            |   | Units         | Constraint Sets  |         |
| 6  |             |            |   |               |                  |         |
| 7  |             | ConstrName | ConstrDesc                                      | Units         | Set Memberships  | Comment |
| 8  |             |            |   |               |                  |         |
| 9  |             | ELEMAX     | Maximum Electricity                             | uconstraint   | ADRATIO          |         |
| 10 |             | ELEMIN     | Minimum Electricity                             |               |                  |         |
| 11 |             | WATSEA     | Hydro-electric by Season                        |               |                  |         |
| 12 |             | RENEWELC   | Rule-based constraint for renewable electricity |               | ADRATIO,RULE ADR |         |
| 13 |             |            |   |               |                  |         |
| 14 |             |            |   |               |                  |         |

Similarly to the Commodities and Technologies sheets, the key information entered on the Constraints sheet that is directly provided by the user are the Constraint short Names (ConstrName) and Descriptions (ConstrDesc), appearing in columns B and C respectively. In addition, after positioning the cursor in columns D or E of a row the action buttons above may be used to select the Units or Set Memberships specifications, respectively.

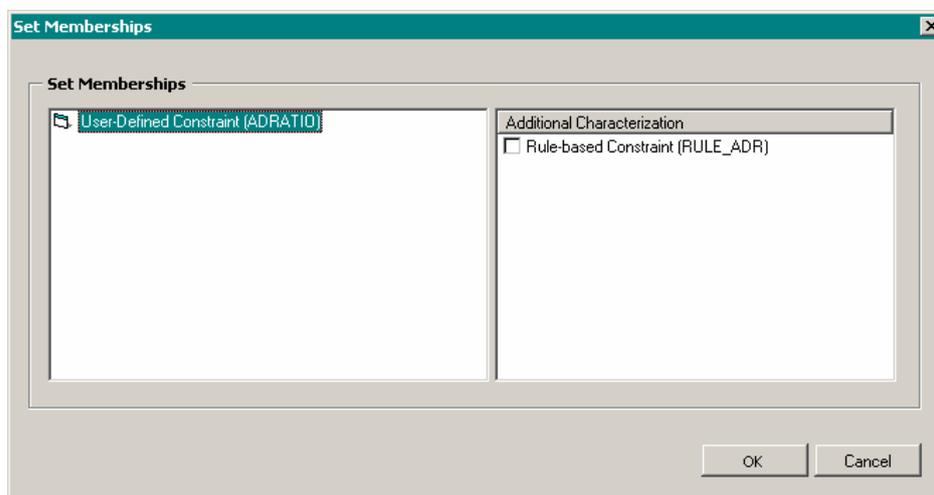
For example after positioning the cursor in column E of a row and clicking on the Set Memberships button, the following Constraints Set Memberships form appears:

The above Constraints Set Memberships form is the simplest possible for an ANSWER database associated with a smart XLS. More complicated possibilities exist – see below.

### Version 5 (and higher) Smart XLS enhancement to allow a Constraint to be declared as “Rule-based” on the Constraints sheet

ANSWER versions 6.0.1 and higher incorporate a “Rule-based” Constraint facility. This facility makes it much easier to create a user-defined constraint than in previous versions of ANSWER. (For details regarding “Rule-based” Constraints in ANSWER, see section 13 ‘Defining a “Rule-based” Constraint in ANSWER’ in *ANSWERv6-MARKAL User Manual.pdf* in folder C:\AnswerV6\UserManuals.)

The ANSWER version 5 (and higher) Smart XLS has been enhanced as compared with version 4 to allow the specification of “Rule-based” Constraints. The only requirement is that the ANSWER database that is associated with a version 5 (and higher) smart XLS must be one that is “Rule-based” Constraint-aware, and must contain the “rules” (Technology Items Filters) that are needed to define the “Rule-based” Constraints of interest. When this is the case, the Constraints Set Memberships form that appears after positioning the cursor in column E of a row and clicking on the Set Memberships button is as follows:



Note the “Rule-based Constraint (RULE\_ADR)” checkbox under Additional Characterization on the RHS of the form.

To specify that a Constraint is “Rule-based”, check this checkbox and then click on the OK button. This results in the Set Memberships of **ADRATIO,RULE\_ADR** being placed in column E at the cursor position. For example, see cell E12 on the previous page where this is the Set Memberships specification for the Constraint RENEWELC.

See section 9 “Constraints Data (ConstrData) Sheet” for details of how to specify the data associated with a “Rule-based” Constraint.

## 7. Commodity Data (CommData) Sheet

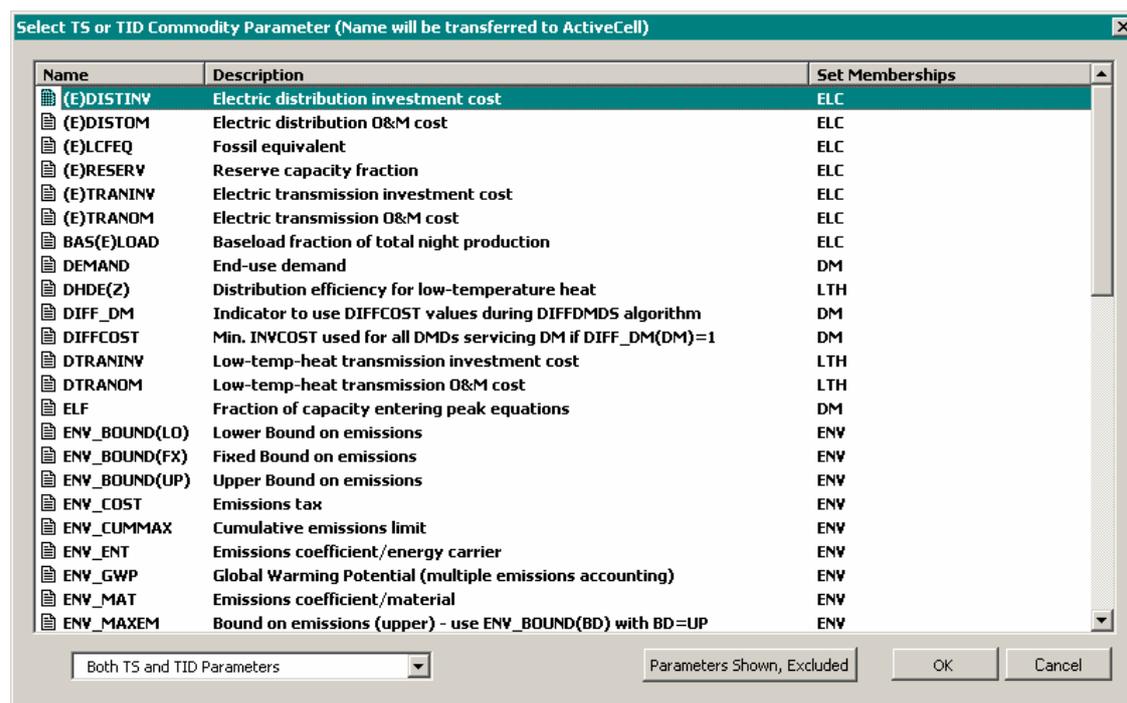
The Commodity Data sheet is where data associated with commodities (e.g., demand levels, energy carrier efficiencies, electricity transmission and distribution costs) are provided. An example of a Commodity Data sheet (for Demands) is shown below.

| CommName | CommDesc                     | Units | 2000 | DEMAND | ELF  | FR(Q)M | I-D TID | I-N TID | S-D TID | FF |
|----------|------------------------------|-------|------|--------|------|--------|---------|---------|---------|----|
| CCSE     | Commercial Cooling Small Ex  | PJ    | 0.30 | 1.00   |      |        |         |         | 0.70    |    |
| CCLE     | Commercial Cooling Large Ex  | PJ    | 1.01 | 1.00   |      |        |         |         | 0.70    |    |
| CHSE     | Commercial Heating Small Ex  | PJ    | 1.42 | 1.00   | 0.30 |        |         |         |         |    |
| CHLE     | Commercial Heating Large Ex  | PJ    | 4.77 | 1.00   | 0.30 |        |         |         |         |    |
| CWSE     | Commercial Hot Water Small   | PJ    | 0.40 | 1.00   | 0.28 | 0.14   |         | 0.16    |         |    |
| CWLE     | Commercial Hot Water Large   | PJ    | 1.35 | 1.00   | 0.28 | 0.14   |         | 0.16    |         |    |
| CLIT     | Commercial Lightning         | PJ    | 3.98 | 1.00   | 0.28 | 0.14   |         | 0.08    |         |    |
| CFOD     | Commercial Cooking           | PJ    | 0.84 | 1.00   | 0.28 | 0.14   |         | 0.16    |         |    |
| CREF     | Commercial Fridges and Free  | PJ    | 0.48 | 1.00   | 0.28 | 0.14   |         | 0.16    |         |    |
| CPLI     | Commercial Public Lighting   | PJ    | 1.07 | 1.00   | 0.28 | 0.14   |         | 0.16    |         |    |
| COth     | Commercial Other Electricity | PJ    | 0.58 | 1.00   | 0.28 | 0.14   |         | 0.16    |         |    |

If the above sheet had been created using an ANSWERv6.1.xls, **violet** would replace **green**, and there would be the possibility of specifying data for Taxes/Subsidies. See section 10.

Positioning the cursor in column B, of a row below 7, and pressing the 'CommName, CommDesc, CommUnit' action button brings up a sorted list of the user entries from the Commodities sheet. Selecting a commodity from this list results in its Commodity Name, Description and Units being inserted into columns B, C and D as cell references (links) to the Commodities sheet. Thus for example if a Commodity Name or Description is changed on the Commodities sheet, that change will automatically flow through to the Commodity Data sheet via the cell reference.

Columns E, F, G, ... are where the user provides data. Rows 5-7 are used to identify the nature of the data (parameter) being provided. Placing the cursor in row 5 of column E or F or G or ... and pressing the 'Parameter' button brings up a Parameter selection list as shown below.

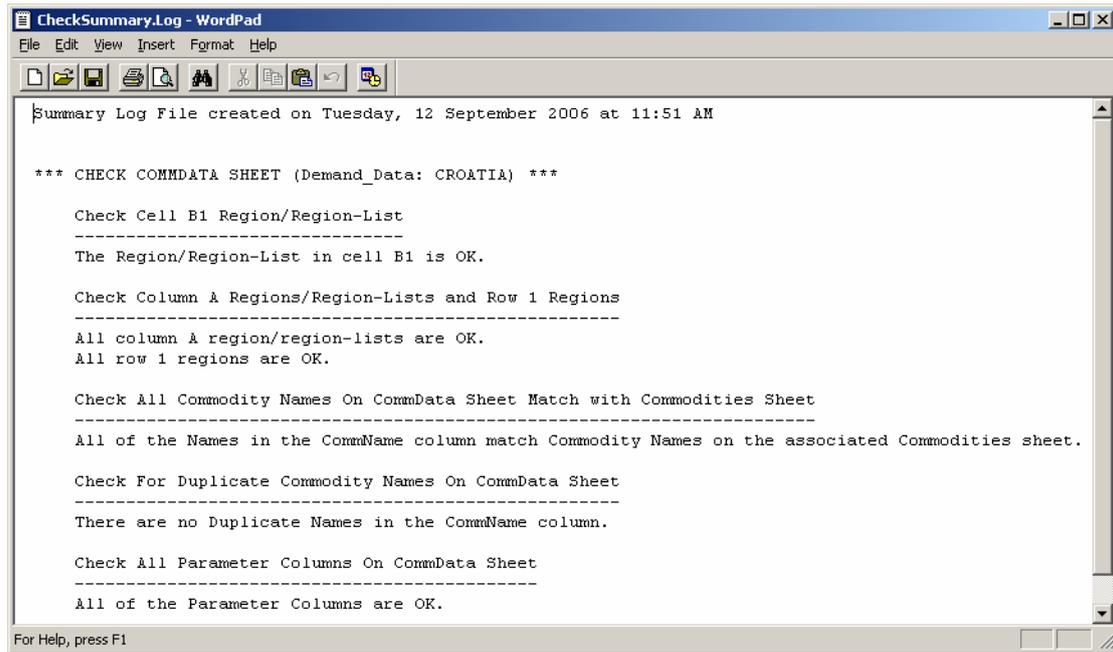


Once a Parameter is selected its Name is entered into the (row 5) cell where the cursor is placed, and if it is a TID parameter the TID indicator is automatically entered into row 7, the period row. For time-dependent parameters the user may leave row 7 blank, in which case the numeric values provided in rows 8 and downwards of the column are assumed to apply to all periods. Or the user may specify either a single year (e.g., 2000) or a pair of years separated by a comma (e.g., 2000, 2010) or a pair of years separated by a hyphen (e.g., 2000-2010).

In a situation where the Parameter requires a *Qualifier* (e.g., a parameter such as ENV\_ENT that requires an Energy qualifier, or a parameter such as FR(Z)(Y) that requires a Timeslice qualifier) the Parameter Name is entered into row 5 and the cursor positioned in row 6 below the Parameter Name and an indication of the nature of the qualifier expected is displayed. Pressing the 'Qualifier' button will display a list of the permitted qualifiers for the associated Parameter.

The parameters can be provided in any order, beginning from column E.

The 'Check Sheet' button may be pressed at any time to have a standard set of consistency and quality control checks performed. The results of the checking are presented in a Wordpad file as shown below, and any offending cells are highlighted on the sheet in yellow along with a cell comment indicating the nature of the problem.



## 8. Technology Data (TechData) Sheet

The Technology Data sheet is where data associated with technologies (e.g., residual capacity, efficiency, availability, input/output fuels, costs) are provided.

| 1  | A         | B                                    | C                                     | D      | E      | F       | G    | H     | I   |
|----|-----------|--------------------------------------|---------------------------------------|--------|--------|---------|------|-------|-----|
|    | TechData  | CROATIA                              |                                       |        |        |         |      |       |     |
| 4  | Check Sht | TechName, TechDesc, TACT, TCAP Units |                                       |        | CommIN | CommOUT |      |       |     |
| 5  | Parameter |                                      |                                       |        |        |         | LIFE | RESID | CF  |
| 6  | Qualifier |                                      |                                       |        |        |         |      |       | CAP |
| 7  |           | TechName                             | TechDesc                              | Units  | CommIN | CommOUT | TID  | 2000  | T   |
| 8  |           | CHLECOA100                           | Com.Space Heat.Large.COA.00.PJ, PJ/a  | COMCOA | CHLE   | 30      | 0.13 | 0.541 | 1.0 |
| 9  |           | CHLEELC100                           | Com.Space Heat.Large.ELC.00.PJ, PJ/a  | COMELC | CHLE   | 30      | 0.43 | 0.541 | 1.0 |
| 10 |           |                                      |                                       |        | CWLE   |         |      |       |     |
| 11 |           | CHLEELC200                           | Com.Space Heat.Large.ELC.00.PJ, PJ/a  | COMELC | CHLE   | 30      | 0.37 | 0.541 | 1.0 |
| 12 |           | CHLEGAS100                           | Com.Space Heat.Large.GAS.00.PJ, PJ/a  | COMGAS | CHLE   | 30      | 1.55 | 0.541 | 1.0 |
| 13 |           |                                      |                                       |        | CWLE   |         |      |       |     |
| 14 |           | CHLEGAS200                           | Com.Space Heat.Large.GAS.00.PJ, PJ/a  | COMGAS | CHLE   | 30      | 1.34 | 0.541 | 1.0 |
| 15 |           | CHLELPG100                           | Com.Space Heat.Large.LPG.00.PJ, PJ/a  | COMLPG | CHLE   | 30      | 0.12 | 0.541 | 1.0 |
| 16 |           |                                      |                                       |        | CWLE   |         |      |       |     |
| 17 |           | CHLELTH100                           | Com.Space Heat.Large.LTH.00.FPJ, PJ/a | COMLTH | CHLE   | 30      | 1.35 | 0.541 | 1.0 |
| 18 |           |                                      |                                       |        | CWLE   |         |      |       |     |
| 19 |           | CHLEOIL100                           | Com.Space Heat.Large.OIL.00.FPJ, PJ/a | COMOIL | CHLE   | 30      | 4.58 | 0.541 | 1.0 |
| 20 |           |                                      |                                       |        | CWLE   |         |      |       |     |
| 21 |           | CHSECOA100                           | Com.Space Heat.Small.COA.00.PJ, PJ/a  | COMCOA | CHSE   | 30      | 0.04 | 0.541 | 1.0 |
| 22 |           | CHSEELC100                           | Com.Space Heat.Small.ELC.00.PJ, PJ/a  | COMELC | CHSE   | 30      | 0.13 | 0.541 | 1.0 |
| 23 |           |                                      |                                       |        | CWSE   |         |      |       |     |

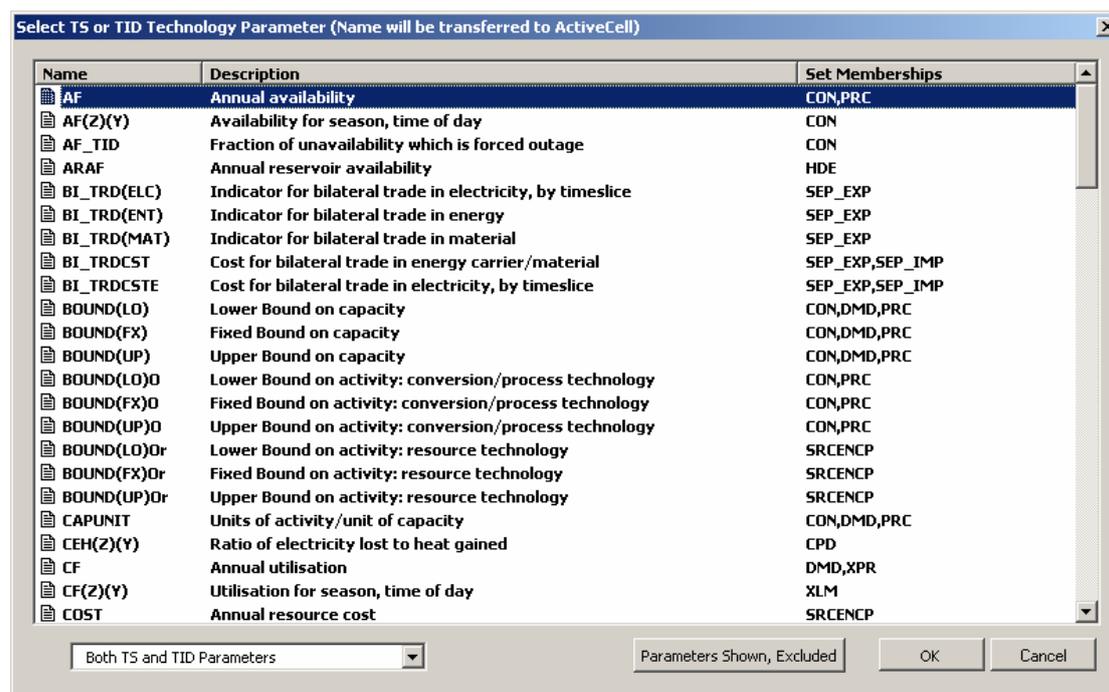
If the above sheet had been created using an ANSWERv6.1.xls, **violet** would replace **green**, and there would be the possibility of specifying data for Taxes/Subsidies. See section 10.

Positioning the cursor in column B of a row below 7, and pressing the 'TechName, TechDesc, TACT, TCAP Units' action button brings up a sorted list of the user entries from the Technologies sheet. Selecting a technology from this list results in its Technology Name, Description and Units being inserted into columns B, C and D as cell references (links) to the Technologies sheet. Thus for example if a Technology Name or Description is changed on the Technologies sheet, that change will automatically flow through to the Technology Data sheet via the cell reference.

In columns E and F the commodities input to (CommIN) and output from (CommOUT) the technology are listed. When more than one input or output commodity is involved (including emissions) a separate row must be used to identify the commodity and provide the associated data. With the cursor in column E or F of a row pressing the 'CommIN' or 'CommOUT' button respectively will bring up the list of commodities that the user provided on the Commodities Sheet. Selecting a commodity from this list results in its Name being inserted into column E or F as a cell reference (link) to the Commodities sheet.

Note that data that is not commodity dependent (e.g., AF, CF) should appear on the same line as the Technology Name.

Columns G, H, I, ... are where the user provides data. As is the case for the Commodity Data sheet, rows 5-7 are used to identify the nature of the data (parameter) being provided. Placing the cursor in row 5 of column G or H or I or ... and pressing the 'Parameter' button brings up a Parameter selection list as shown below.



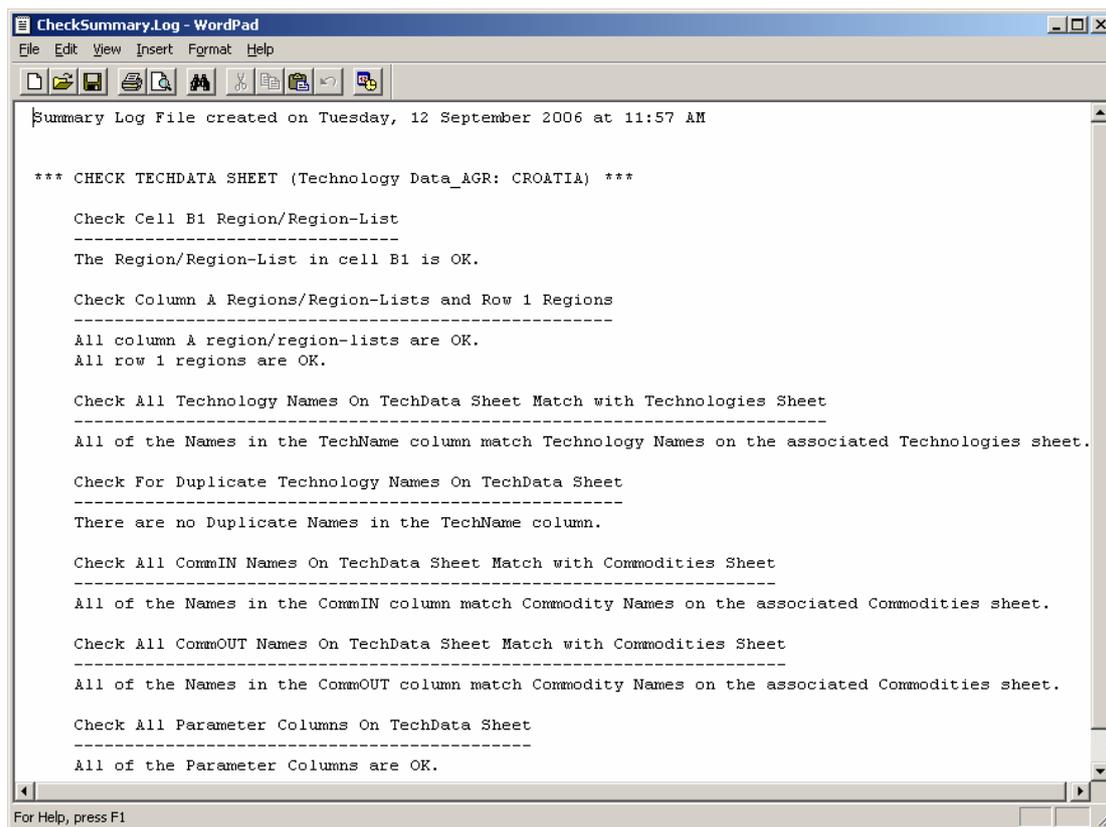
Note that the Technology Parameter list created using an ANSWERver5.xls (and higher) differs slightly from that created using an ANSWERver4.xls, in that Bilateral Trade Parameters are also displayed (these are the 5 parameters above whose name begins with "BI\_TRD"). See Appendix B.3 – "Technology Data sheet extension to handle Bilateral Trade between Regions". Of course Bilateral Trade Parameters are only relevant for multi-region models.

As is the case for the Commodity Data sheet, once a Parameter is selected its Name is entered into the (row 5) cell where the cursor is placed, and if it is a TID parameter the TID indicator is automatically entered into row 7, the period row. For time-dependent parameters the user may leave row 7 blank, in which case the numeric values provided in rows 8 and downwards of the column are assumed to apply to all periods. Or the user may specify either a single year (e.g., 2000) or a pair of years separated by a comma (e.g., 2000, 2010) or a pair of years separated by a hyphen (e.g., 2000-2010).

In a situation where the Parameter requires a *Qualifier* (e.g., a parameter such as AF(Z)(Y) that requires a Timeslice qualifier) the Parameter Name is entered into row 5 and the cursor positioned in row 6 below the Parameter Name and an indication of the nature of the qualifier expected is displayed. Pressing the 'Qualifier' button will display a list of the permitted qualifiers for the associated Parameter.

In general, the parameters can be provided in any order, beginning from column G. However there is an exception to this rule. LIFE should be specified in a column to the *left* of any RESID column if the user wishes to invoke the 'Use LIFE to set RESID where just first period RESID' option of the "Import Model Data from Excel" facility. (This option allows the user to specify the LIFE of a technology and just the first period value for the RESID parameter, and causes an automatic calculation to be done that sets RESID = 0 in the appropriate period.)

The 'Check Sheet' button may be pressed at any time to have a standard set of consistency and quality control checks performed. The results of the checking are presented in a Wordpad file as shown below, and any offending cells are highlighted on the sheet in yellow along with a cell comment indicating the nature of the problem.



## 9. Constraints Data (ConstrData) Sheet

The Constraint Data sheet is where data associated with user-defined constraints (ADRATIOS) are provided. An example version 6 Smart XLS Constraint Data sheet is shown below.

| 1  | A          | B                             | C                                | D      | E         | F       | G       | H       | I           | J        |
|----|------------|-------------------------------|----------------------------------|--------|-----------|---------|---------|---------|-------------|----------|
| 2  | ConstrData | DEMO                          |                                  |        |           |         |         |         |             |          |
| 3  |            |                               |                                  |        |           |         |         |         |             |          |
| 4  | Check Sht  | ConstrName, ConstrDesc, Units | Refresh Units                    |        | TechName  |         |         |         |             |          |
| 5  | Parameter  |                               |                                  |        |           | RAT_RHS | RAT_RHS | RAT_CAP | RATRULE_ACT | RAT_TEZY |
| 6  | Qualifier  |                               |                                  |        |           | UP      | LO      |         |             | I-D      |
| 7  |            | ConstrName                    | ConstrDesc                       | Units  | TechName  |         |         |         |             |          |
| 8  |            | ELEMAX                        | Maximum Electricity              | uconst | RHE       | 80      |         | 1       |             |          |
| 9  |            |                               |                                  |        | TXE       |         |         | 1       |             |          |
| 10 |            | ELEMIN                        | Minimum Electricity              | uconst | RHE       |         | 0       | 1       |             |          |
| 11 |            |                               |                                  |        | TXE       |         |         | 1       |             |          |
| 12 |            | RENEWELC                      | Rule-based constraint for renewe | uconst | RENEW-ELE |         | 0       |         | 1           |          |
| 13 |            |                               |                                  |        | ALL-ELE   |         |         |         | -0.05       |          |
| 14 |            | WATSEA                        | Hydro-electric by Season         | uconst | E31       | 0       |         |         |             | -1.5277  |
| 15 |            |                               |                                  |        |           |         |         |         |             |          |
| 16 |            |                               |                                  |        |           |         |         |         |             |          |

The Constraint Data sheet functions similarly to the Commodity Data and Technology Data sheets. Thus positioning the cursor in column B of a row below 7, and pressing the 'ConstrName, ConstrDesc, Units' action button brings up a sorted list of the user entries from the Constraints sheet. Selecting a constraint from this list results in its Constraint Name, Description and Units being inserted into columns B, C and D as cell references (links) to the Constraints sheet. Thus for example if a Constraint Name or Description is changed on the Constraints sheet, that change will automatically flow through to the Constraint Data sheet via the cell reference.

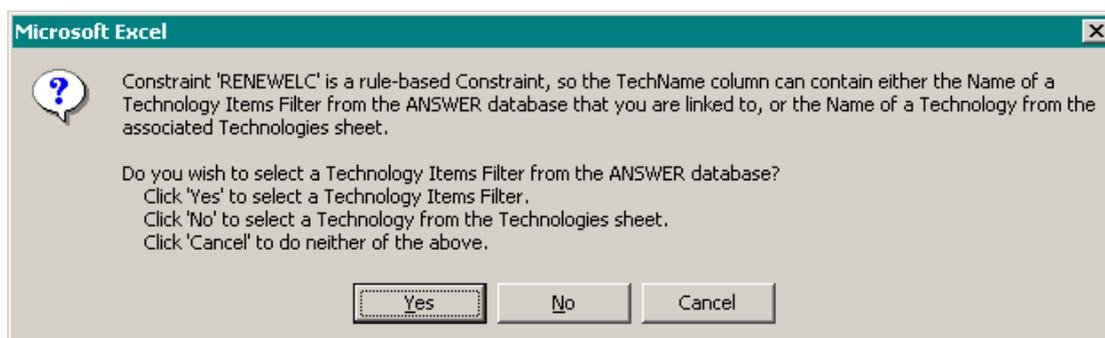
In the TechName column (column E) the technologies that comprise the constraint are listed. When more than one technology is involved in a constraint, a separate row must be used to identify the technology and provide the associated data. With the cursor in column E of a row pressing the 'TechName' button will bring up the list of technologies that the user provided on the Technologies Sheet. Selecting a technology from this list results in its Name being inserted into column E as a cell reference (link) to the Technologies sheet.

### Version 5 (and higher) Smart XLS enhancement to allow Data for a "Rule-based" Constraint to be specified on a ConstrData sheet

As already noted in section 6 "Constraints Sheet", the ANSWER version 5 (and higher) Smart XLS has been enhanced as compared with version 4 to allow the specification of "Rule-based" Constraints. The only requirement is that the ANSWER database that is associated with a version 5 (and higher) smart XLS must be one that is "Rule-based" Constraint-aware, and must contain the "rules" (Technology Items Filters) that are needed to define the "Rule-based" Constraints of interest.

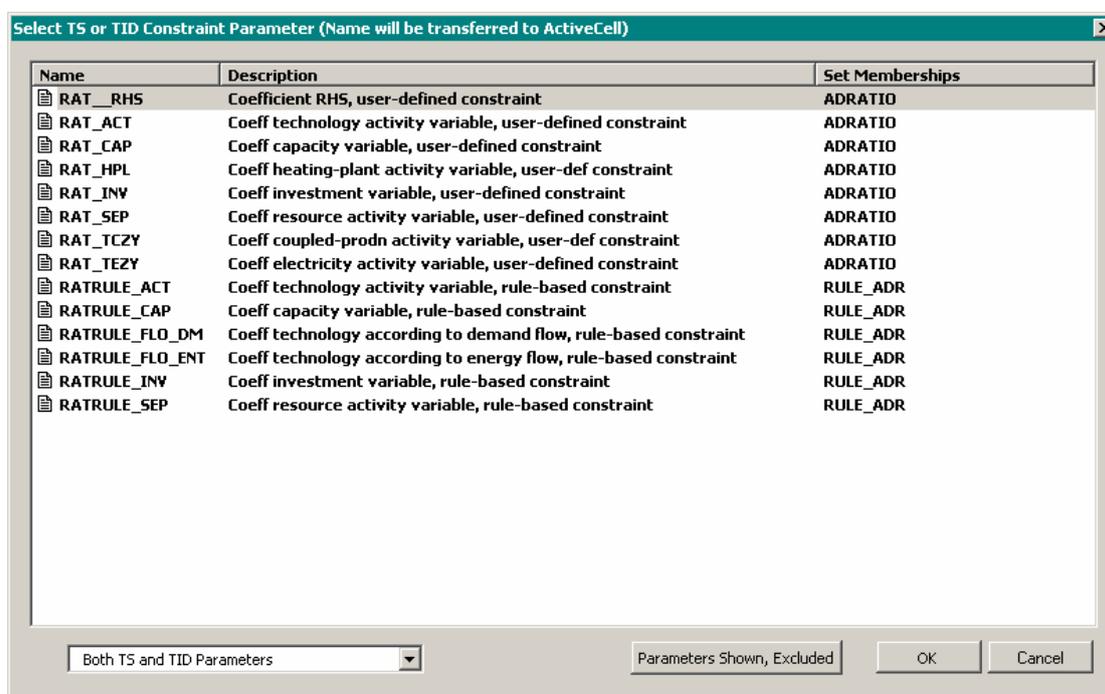
The 'ConstrName, ConstrDesc, Units' action button is used to select "Rule-based" Constraints from the Constraints sheet in exactly the same fashion as for selecting ordinary Constraints. It has been used to place the rule-based constraint RENEWELC in row 13 of the above ConstrData sheet.

However when the cursor is placed in the TechName column (column E) in a row that corresponds to a "Rule-based" Constraint (so in either row 13 or row 14 of the above ConstrData sheet) and the TechName action button is invoked, the following message appears:



As advised by the message, click on the 'Yes' button to select a Technology Items Filter from those that are available in the ANSWER database associated with the Smart XLS, or click on the 'No' button to select a Technology from the Technologies sheet.

Note also that where the ANSWER database that is associated with a version 5 (and higher) smart XLS is one that is "Rule-based" Constraint-aware, then when the 'Parameter' action button is clicked with the cursor in row 5 of column F or G or H or ..., six additional RATRULE\_\* parameters are displayed in the Parameter selection list:



These RATRULE\_\* parameters are used to define data associated with "Rule-based" Constraints, for example the RATRULE\_ACT parameter is used in column I along with associated numeric entries in rows 13 and 14 as part of defining data associated with the rule-based constraint RENEWELC.

## 10. Specifying Declaration Information and Data for Taxes/Subsidies

Version 6.1 (and higher) of the ANSWER “smart” load templates allows the specification of declaration information and data for Taxes/Subsidies. This involves extensions to the operation of the Commodities, CommData and TechData sheets.

### Commodities Sheet

Declaration information for a Tax/Subsidy is specified on the Commodities sheet, where a new **TaxSub Sets** button is provided in column E (the Set Memberships column):

|    | A                 | B        | C             | D             | E               | F             |
|----|-------------------|----------|---------------|---------------|-----------------|---------------|
| 1  | Commodities       | UTOPIA   |               |               |                 |               |
| 2  |                   |          |               |               |                 |               |
| 3  |                   |          |               |               |                 |               |
| 4  | Check Sheet       |          |               | Refresh Units | TaxSub Sets     |               |
| 5  |                   |          |               |               | Energy Sets     | Material Sets |
| 6  |                   |          |               | CommUnit      | Demand Sets     | Emission Sets |
| 7  |                   | CommName | CommDesc      | CommUnit      | Set Memberships | Comment       |
| 29 | * Taxes/Subsidies |          |               |               |                 |               |
| 30 |                   | TAX      | Tax on diesel | PJ            | TAXSUB          |               |
| 31 |                   |          |               |               |                 |               |

### CommData Sheet

Most of the data for a Tax/Subsidy is specified on the CommData sheet. Although the appearance of the CommData sheet is unchanged:

|   | A         | B                            | C        | D             |
|---|-----------|------------------------------|----------|---------------|
| 1 | CommData  | UTOPIA                       |          |               |
| 2 |           |                              |          |               |
| 3 |           |                              |          |               |
| 4 | Chk Sheet | CommName, CommDesc, CommUnit |          | Refresh Units |
| 5 | Parameter |                              |          |               |
| 6 | Qualifier |                              |          |               |
| 7 |           | CommName                     | CommDesc | Units         |

when you click on the **CommName, CommDesc, CommUnit** button the list of Commodities that is displayed now includes any Taxes/Subsidies that are specified on the Commodities sheet.

Also, when you place the cursor in row 5 of column E or F or ... and click on the **Parameter** button, the list of Commodity Parameters that is displayed now includes the following TaxSub parameters:

|               |   |        |
|---------------|---|--------|
| TSUB_BND(LO)  | Lower Bound on total tax/subsidy revenues                   | TAXSUB |
| TSUB_BND(FX)  | Fixed Bound on total tax/subsidy revenues                   | TAXSUB |
| TSUB_BND(UP)  | Upper Bound on total tax/subsidy revenues                   | TAXSUB |
| TSUB_COST     | Annual cost of tax/subsidy per unit of energy carrier       | TAXSUB |
| TSUB_ENT(ENT) | Flag indicating energy carrier to which tax/subsidy applies | TAXSUB |
| TSUB_MAT(MAT) | Flag indicating material to which tax/subsidy applies       | TAXSUB |

Both TS and TID Parameters

Parameters Shown, Excluded

OK Cancel

If you select TSUB\_ENT(ENT) as the desired TaxSub parameter, then the CommData sheet appears as follows, with **Energy** in the Qualifier row indicating that an Energy Commodity must be selected by clicking on the **Qualifier** button:

|    | A         | B                            | C             | D             | K             |
|----|-----------|------------------------------|---------------|---------------|---------------|
| 1  | CommData  | UTOPIA                       |               |               |               |
| 2  |           |                              |               |               |               |
| 3  |           |                              |               |               |               |
| 4  | Chk Sheet | CommName, CommDesc, CommUnit |               | Refresh Units |               |
| 5  | Parameter |                              |               |               | TSUB_ENT(ENT) |
| 6  | Qualifier |                              |               |               | Energy        |
| 7  |           | CommName                     | CommDesc      | Units         | TID           |
| 27 |           |                              |               |               |               |
| 28 |           | TAX                          | Tax on diesel | PJ            |               |

A completed CommData sheet that specifies TSUB\_ENT(ENT) and TSUB\_COST for Tax/Subsidy named TAX might appear as follows:

|    | A         | B                            | C             | D             | K             | L         |
|----|-----------|------------------------------|---------------|---------------|---------------|-----------|
| 1  | CommData  | UTOPIA                       |               |               |               |           |
| 2  |           |                              |               |               |               |           |
| 3  |           |                              |               |               |               |           |
| 4  | Chk Sheet | CommName, CommDesc, CommUnit |               | Refresh Units |               |           |
| 5  | Parameter |                              |               |               | TSUB_ENT(ENT) | TSUB_COST |
| 6  | Qualifier |                              |               |               | DSL           |           |
| 7  |           | CommName                     | CommDesc      | Units         | TID           |           |
| 27 |           |                              |               |               |               |           |
| 28 |           | TAX                          | Tax on diesel | PJ            |               | 1 5       |
| 29 |           |                              |               |               |               |           |

#### TechData Sheet

TSUB\_TECH data for a Tax/Subsidy is specified on the TechData sheet. The appearance of the TechData sheet is unchanged. If you click on the **Parameter** button, and select Technology TaxSub parameter TSUB\_TECH, then the TechData sheet appears as follows, with **Tax/Subsidy** in the Qualifier row indicating that a Tax/Subsidy must be selected by clicking on the **Qualifier** button:

|    | A         | B                                    | C                | D             | E      | F       | W           |
|----|-----------|--------------------------------------|------------------|---------------|--------|---------|-------------|
| 1  | TechData  | UTOPIA                               |                  |               |        |         |             |
| 2  |           |                                      |                  |               |        |         |             |
| 3  |           |                                      |                  |               |        |         |             |
| 4  | Check Sht | TechName, TechDesc, TACT, TCAP Units |                  | Refresh Units | CommIn | CommOUT |             |
| 5  | Parameter |                                      |                  |               |        |         | TSUB_TECH   |
| 6  | Qualifier |                                      |                  |               |        |         | Tax/Subsidy |
| 7  |           | TechName                             | TechDesc         | Units         | CommIn | CommOUT |             |
| 17 |           |                                      |                  |               |        |         |             |
| 18 |           | IMPDSL1                              | Import of Diesel | PJ, GW        |        | DSL     |             |

A completed TechData sheet that specifies TSUB\_TECH for Tax/Subsidy named TAX might appear as follows:

|    | A                | B   | C                | D                    | E             | F              | W         |
|----|------------------|---|------------------|----------------------|---------------|----------------|-----------|
| 1  | <b>TechData</b>  | UTOPIA                                      |                  |                      |               |                |           |
| 2  |                  |   |                  |                      |               |                |           |
| 3  |                  |   |                  |                      |               |                |           |
| 4  | <b>Check Sht</b> | <b>TechName, TechDesc, TACT, TCAP Units</b> |                  | <b>Refresh Units</b> | <b>CommIN</b> | <b>CommOUT</b> |           |
| 5  | <b>Parameter</b> |   |                  |                      |               |                | TSUB_TECH |
| 6  | <b>Qualifier</b> |   |                  |                      |               |                | TAX       |
| 7  |                  | <b>TechName</b>                             | <b>TechDesc</b>  | <b>Units</b>         | <b>CommIN</b> | <b>CommOUT</b> |           |
| 17 |                  |   |                  |                      |               |                |           |
| 18 |                  | IMPDSL1                                     | Import of Diesel | PJ, GW               |               | DSL            | 1         |
| 19 |                  |   |                  |                      |               |                |           |

## 11. Loading the Templates into ANSWER

The “File, Import, Model Data from Excel” facility is used to load information in an ANSWER “smart” template into an ANSWER database.

A brief overview of the steps involved in using this facility follows:

1. Open the ANSWER database into which you wish to import the ANSWER “smart” template.
2. Invoke “File, Import, Model Data from Excel” to bring up the following form (initially with the ‘Excel Files to be Imported’ list empty, and not necessarily with either the ‘Target Scenario’ or ‘Options’ settings that are shown below):

3. Click on the [Add...] button to bring up the common dialog file selection form and navigate to the folder in which you have stored the ANSWER “smart” template(s), then select one or more “smart” templates to be imported.
4. Adjust the ‘Target Scenario’ combobox to select the target scenario for the import.
5. Adjust the radio button and checkbox Options to suit your particular needs.
6. Click on the [Import] button to carry out the import.

If at step 1 above you are unable to open the ANSWER database, and get a message ending in “Perhaps ... it is already in use?”, most likely this database is already in use because you have an open ANSWER “smart” template and this database is associated with it. So simply close the ANSWER “smart” template so that the database is no longer associated with it, and hence no longer in use.

Most users will have a number of ANSWER “smart” templates, and will often find it convenient to load several templates in a single Import operation. To facilitate multi-selection of ANSWER “smart” templates at step 3 above, store all templates in a single folder.

## 12. Example ANSWER “smart” template

To provide users with a concrete example of an ANSWER “smart” template, the file UtopiaSmartTemplate.xls is now provided as part of the ANSWERv6-MARKAL installation files in folder C:\AnswerV6\UserManuals.

Also, an ANSWER database UtopiaWithOnlyGlobalTabData.mdb that is suitable to be associated with the UtopiaSmartTemplate.xls (as described in section 2 ‘Workbook Setup’) is provided in folder C:\AnswerV6\Answer\_Databases. This ANSWER database has time periods 1990, 2000, 2010, has a single region UTOPIA specified, and has standard MARKAL timeslices. As its name would suggest, this database contains only Global tab data (and also the special energy Carrier FEQ (Fossil Equivalent)).

To use UtopiaSmartTemplate.xls to explore various aspects of how an ANSWER “smart” template operate:

- If as part of exploring how an ANSWER “smart” template operates you intend to change the contents of the ANSWER “smart” template, it is suggested that you use Windows Explorer to make a copy of UtopiaSmartTemplate.xls.
- Open UtopiaSmartTemplate.xls and click on the [Enable Macros] button.
- When the ‘Specify ANSWER Database’ form appears, click on the top radio button and then use the [Browse...] button to select UtopiaWithOnlyGlobalTabData.mdb in folder C:\AnswerV6\Answer\_Databases.

The following points should be noted about UtopiaSmartTemplate.xls:

- Commodity Data has been specified with TID commodity data on one CommData sheet (named CommData-TID) and TS commodity data on a second CommData sheet (named CommData-TS). It would be perfectly OK to specify both TID and TS commodity data on a single CommData sheet.
- Likewise Technology Data has been specified with TID technology data on one TechData sheet (named TechData-TID) and TS commodity data on two TechData sheets (named TechData-TS1 and TechData-TS2). Again it would be perfectly OK to have a different arrangement of TID and TS technology data, including one in which one or more of the TechData sheets contained both TID and TS technology data.
- In particular, it could be argued that so far as the electric conversion technologies E01, E21, E31, E51, E70 are concerned, it would be preferable to have the TID parameter OUT(ELC)\_TID and the TS parameter INP(ENT)c both occurring on the same TechData sheet, since that way both CommIN and CommOUT for these technologies would occur on the same sheet.

The UtopiaSmartTemplate.xls contains a complete specification of the Utopia model, except that it does not contain Global tab data (DISCOUNT, HEATCOOL(Z), QHR(Z)(Y), STARTYRS): the ANSWER “smart” template does not allow the specification of Global tab data.

If you import UtopiaSmartTemplate.xls into UtopiaWithOnlyGlobalTabData.mdb, you will find that you can scan the Energy, Demand, Emission, Technology and Constraint tabs and see that the Utopia model is indeed now fully specified.

- Before attempting to use AnswerV6.exe to open UtopiaWithOnlyGlobalTabData.mdb and import UtopiaSmartTemplate.xls via the “File, Import Model Data from Excel” facility, you must first close UtopiaSmartTemplate.xls thereby closing the link to UtopiaWithOnlyGlobalTabData.mdb. (AnswerV6.exe requires exclusive access to open any ANSWER database, and so while UtopiaSmartTemplate.xls is open it will be unable to open UtopiaWithOnlyGlobalTabData.mdb.)

## Appendix A: Establishing a New ANSWER Calibration and Load Workbook

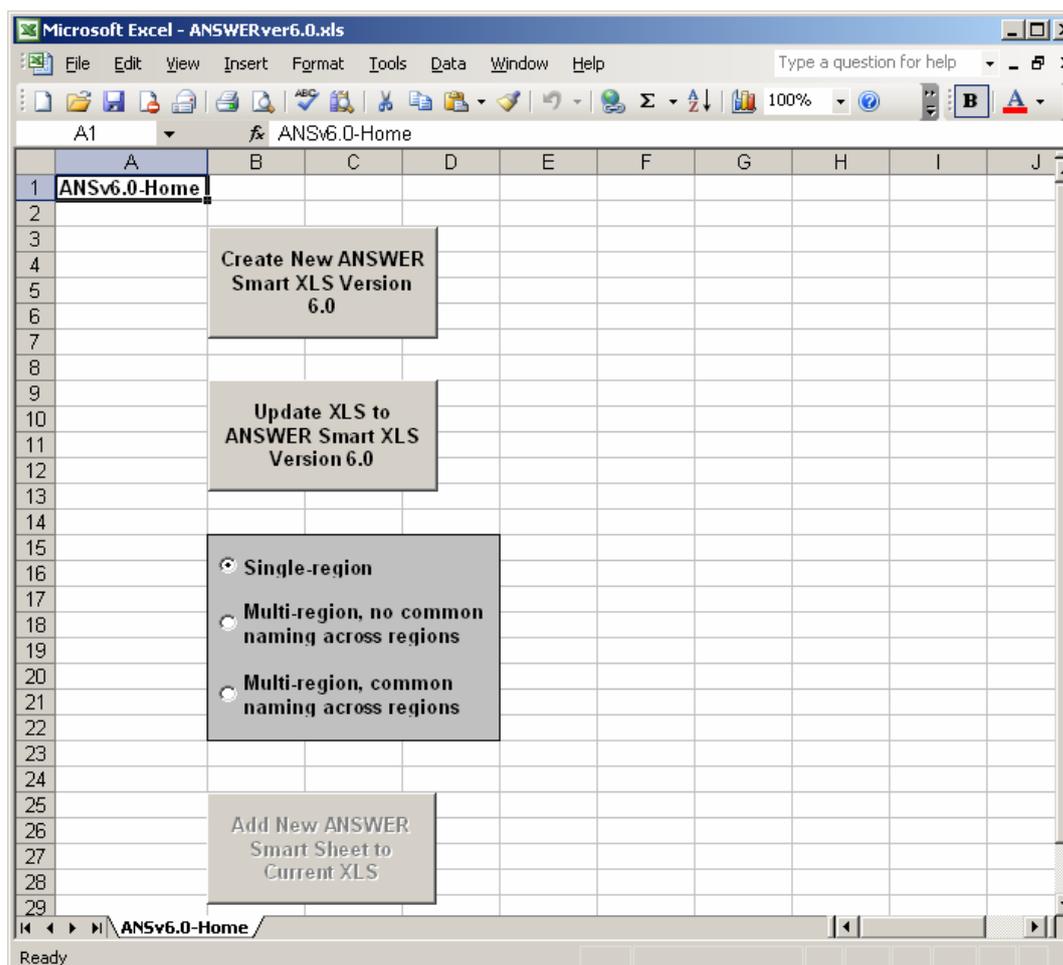
The process of establishing a new workbook must be done with care so as to ensure that all the functionality (action buttons) and cell references (links) to the Commodities, Technologies and Constraints sheets are properly retained. The following possibilities are detailed below:

- Creating a new (empty) ANSWER Smart Workbook;
- Making an existing workbook aware of ANSWER Smart Workbook facilities;
- Copying an existing workbook that is already aware of ANSWER Smart Workbook facilities to create a new workbook;
- Updating an existing workbook that is already aware of ANSWER Smart Workbook facilities when Noble-Soft distributes an updated version of the ANSWER smart XLS; and
- Adding a new ANSWER smart sheet to the current XLS.

The text and screen snapshots that follow are for an ANSWERver6.0.XLS. If working with an ANSWERver6.1.XLS, simply imagine 6.1 replacing all occurrences of 6.0 in the text and screen snapshots.

### A.1 - Creating a new (empty) ANSWER Smart Workbook

To create a new (empty) ANSWER Smart Workbook, open the file ANSWERver6 XLS distributed by Noble-Soft, for example open ANSWERver6.0.XLS. Then select “Enable Macros” to bring up the single visible sheet of ANSWERver6.0.XLS as follows:

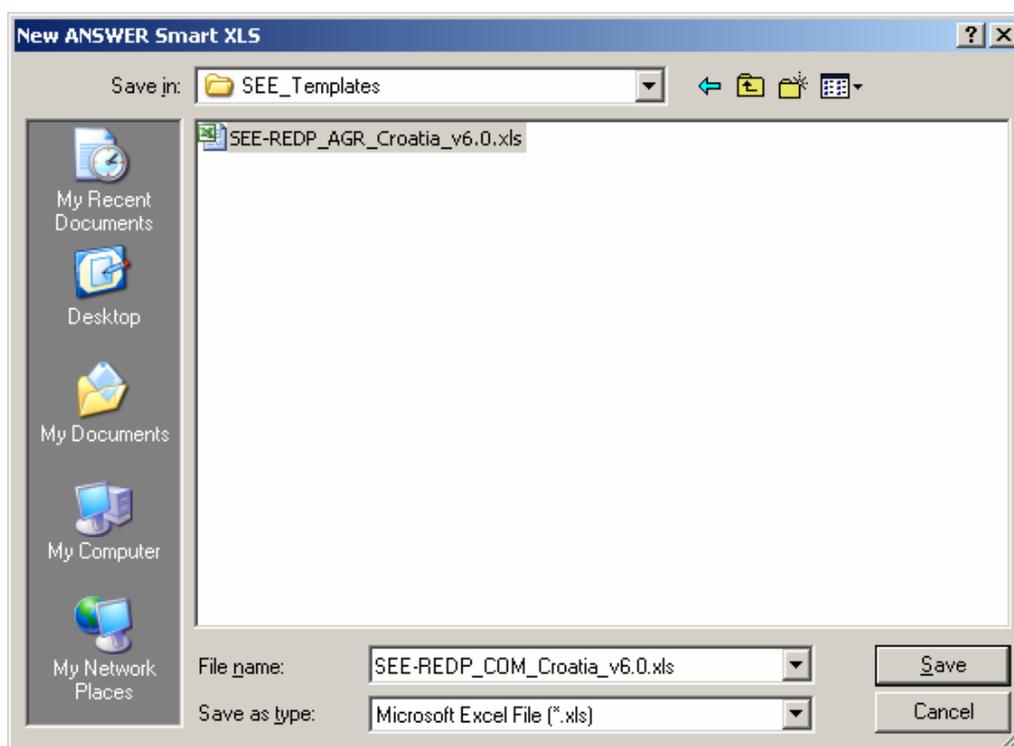


Click on whichever is appropriate of the ‘Single-region’, ‘Multi-region, no common naming across regions’ and the ‘Multi-region, common naming across regions’ radio buttons and then

click on the 'Create New ANSWER Smart XLS Version 6.0' button. This brings up the following form:



Use the 'Browse...' button to bring up the 'New ANSWER Smart XLS' common dialog form, and use the 'Save in' combobox at the top of the form to specify the folder where you want the new ANSWER Smart XLS to be located, then key in the filename for the new XLS in the 'File name' textbox near the bottom of the form, as follows:



Click on the 'Save' button. The full filename of the new XLS to be created will appear in the 'Filename of XLS to be created' textbox, as follows:



(An alternative to using the 'Browse...' button to specify the full filename of the new XLS is to key the full filename into the textbox, but using the 'Browse...' button is recommended.)

Click on the 'Create' button. The creation process will proceed, concluding with a message box indicating that the creation of the new XLS has been completed.

The form remains open so that additional new ANSWER Smart XLS files may be created, if desired.

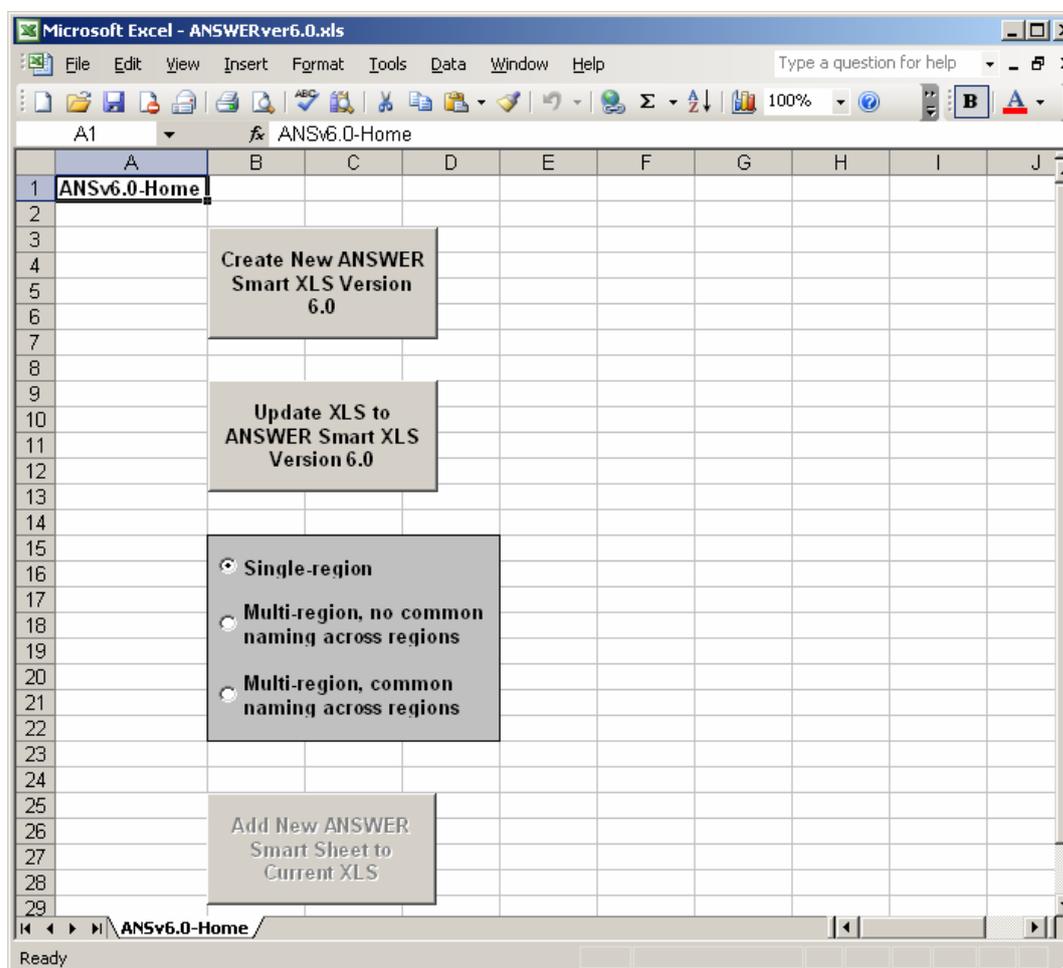
Click on the 'Close' button to close the 'Create New ANSWER Smart XLS' form.

Close ANSWERver6.0.XLS.

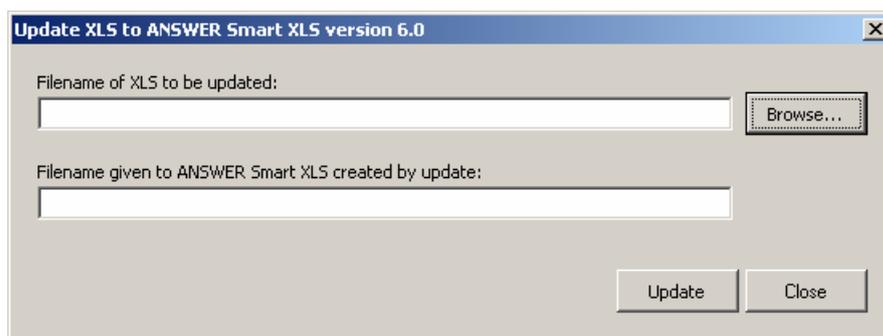
When you open any of the new ANSWER Smart XLS files that you have created, you will need to use the 'Add New ANSWER Smart Sheet to Current XLS' button to add sheets to the XLS. See A.5 below for details of the operation of this button.

## A.2 - Making an existing workbook aware of ANSWER Smart Workbook facilities

To make an existing workbook aware of ANSWER Smart Workbook facilities, ensure that this workbook is not open and open the file ANSWERver6.0.XLS distributed by Noble-Soft. Then select "Enable Macros" to bring up the single visible sheet of ANSWERver6.0.XLS as follows:

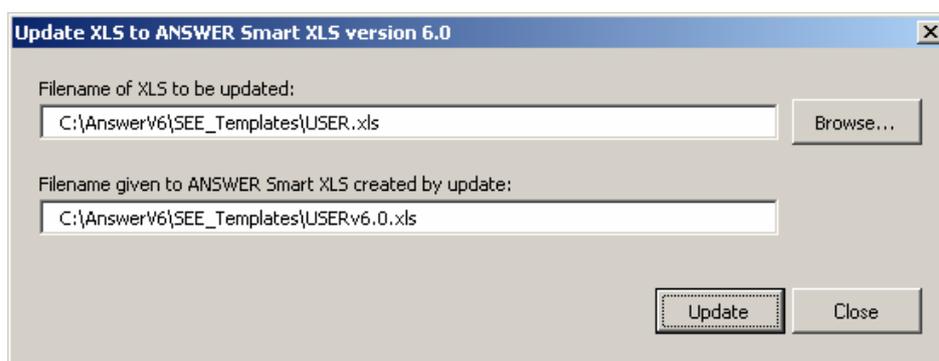


Click on whichever is appropriate of the 'Single-region', 'Multi-region, no common naming across regions' and the 'Multi-region, common naming across regions' radio buttons and then click on the 'Update XLS to ANSWER Smart XLS Version 6.0' button. This brings up the following form:



For clarity of explanation, suppose that the existing workbook that you wish to make aware of ANSWER Smart Workbook facilities is called USER.XLS.

Use the 'Browse...' button to select USER.XLS. The form now appears as follows:



The default filename given to the ANSWER smart XLS that will be created by the update is taken to be the filename of the XLS to be updated with v6.0 appended. So above v6.0 is appended to USER to provide USERv6.0 as the default filename. (There is an exception to this rule: if the filename of the XLS to be updated ends in v5, then the default filename given to the ANSWER smart XLS is taken to be the filename of the XLS to be updated with the v5 replaced by v6.0.)

Click on the 'Update' button. The update process will proceed, concluding with a message box indicating that the update has been completed.

The form remains open so that additional XLS files may be selected to be made aware of ANSWER Smart Workbook facilities, if desired.

Click on the 'Close' button to close the 'Update XLS to ANSWER Smart XLS' form.

Close ANSWERver6.0.XLS.

### ***A.3 - Copying an existing workbook that is already aware of ANSWER Smart Workbook facilities to create a new workbook***

If an existing workbook is already aware of ANSWER Smart Workbook facilities, then simply copying this workbook to create a (renamed) copy will result in the (renamed) copy being aware of ANSWER Smart Workbook facilities. There are two ways of carrying out the copy:

- Open the existing XLS in Excel and use 'File, Save As...' to resave with another name; or
- Use Windows Explorer to make a (renamed) copy of the XLS.

In either case, all cell references (links) will be associated with the new file name.

Depending upon your reasons for creating a new workbook by copying an existing workbook, consider what changes may be needed in the newly created copy. For example, consider whether the Region specified in cell B1 on each of the ANSWER smart sheets may need to be adjusted.

#### **A.4 - Updating an existing workbook that is already aware of ANSWER Smart Workbook facilities when Noble-Soft distributes an updated version of the ANSWER smart XLS**

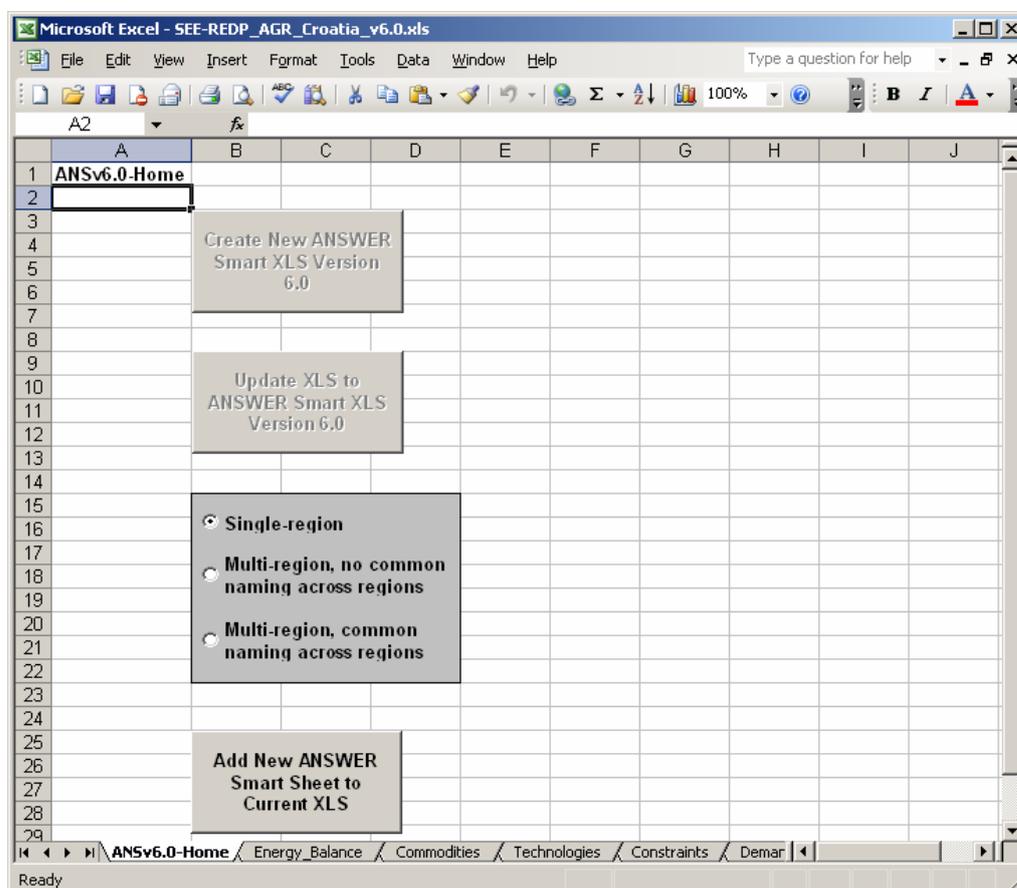
To provide additional ANSWER Smart Workbook facilities, or to correct bugs that are detected, from time to time Noble-Soft will distribute a new version of the ANSWER Calibration and Load Templates. So for example ANSWERver6.0.XLS is a new version that provides additional facilities (and corrects a few bugs) as compared with the previously available version ANSWERver5.XLS.

All that is required to update your existing (version 5) ANSWER Smart Workbook to version 6.0 is to open the file ANSWERver6.0.XLS and follow the "Making an existing workbook aware of ANSWER Smart Workbook facilities" procedure that is documented at A.2 above.

#### **A.5 - Adding a New ANSWER Smart Sheet to the Current XLS**

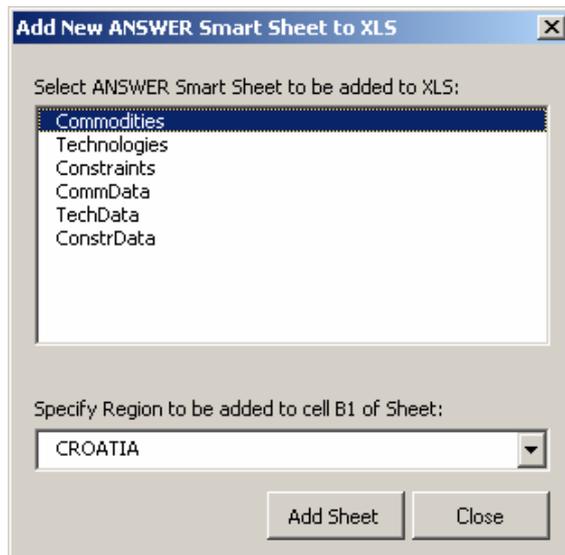
This facility allows the user to easily add a new ANSWER smart sheet to their current ANSWER Smart XLS. To use the facility, proceed as follows:

Open an ANSWER Smart XLS (default is to specify the ANSWER database to be used to provide Parameter, Units and Years information, but this is not essential to the functioning of this facility) and make the Home sheet (this is the first sheet in the XLS) the active sheet. For a version 6 ANSWER Smart XLS this sheet appears as follows:



Click on the 'Add New ANSWER Smart Sheet to Current XLS' button.

This brings up the following form:



The 'Select ANSWER Smart Sheet ...' listbox contains the six types of smart sheets, namely Commodities, Technologies, Constraints, CommData, TechData, ConstrData.

If an ANSWER database was linked to when the XLS was opened, the 'Specify Region...' combobox contains the regions in the ANSWER database.

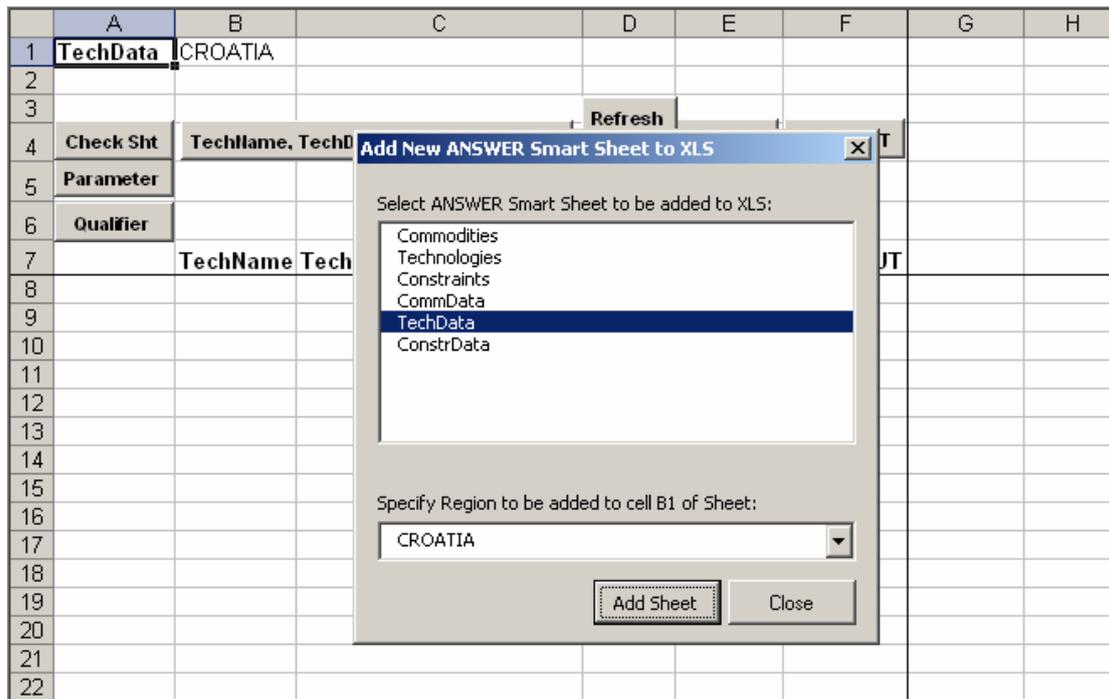
If no ANSWER database was linked to when the XLS was opened, the 'Specify Region...' combobox contains the regions that appear in cell B1 of sheets in the XLS that are smart sheets (namely, sheets that in cell A1 have Commodities, Technologies, Constraints, CommData, TechData, ConstrData).

Select the type of ANSWER smart sheet that you wish to add by clicking on it in the listbox. For example, click on TechData if you wish to add a new TechData sheet to the current XLS.

Select the Region for which this smart sheet will be created, either from the regions in the combobox, or by typing into the combobox the name of a region (if wanting to specify a region name that is not listed in the combobox).

Click on the 'Add Sheet' button.

The new smart sheet is created, and the 'Add New ANSWER Smart Sheet ...' form remains open (so that the user can add another smart sheet) as follows:



To add another smart sheet to the XLS, select the type of ANSWER smart sheet to be added, adjust the Region combobox as necessary, and click on the 'Add Sheet' button.

Click on the 'Close' button to close the 'Add New ANSWER Smart Sheet ...' form.

Note that by default, the name given to the smart sheet that is created will be the same as the name in the listbox, so for example a TechData sheet will be given the default name "TechData". If the default name is already being used for another sheet, then "(2)" is appended and used as the name for the sheet, so for example "TechData (2)". If the name with "(2)" appended is already being used for another sheet, then instead "(3)" is appended, so for example "TechData (3)", and so on.

## Appendix B: Extension of ANSWER Load Templates to handle multi-region models

With version 5 (and higher) of the ANSWER Load Templates, as with version 4, there are two different methods of specifying declarations and data for multi-region models. Which of these methods should be used depends on whether or not the multi-region model has common naming conventions across regions. In particular note that version 5 (and higher) of the ANSWER Load Templates incorporates extensions to the format allowed for sheets that considerably simplify the specification of declarations and data for multi-region models that do have common naming conventions across regions.

By way of clarification, when we say that a multi-region model *does* have common naming conventions across regions, we mean that the same item name *necessarily* has the same associated description and set memberships (and units) in each region in which it occurs. So for example if E01 is a 'Coal-fired power station' whose set memberships indicate that it is base-loaded and centralized, then with common naming conventions across regions E01 necessarily is a base-loaded and centralized 'Coal-fired power station' in each region in which it occurs.

Note that a multi-region model that does *not* have common naming conventions across regions is allowed to have the same name occurring in different regions. So for example such a model might have the same technology name, say E01, occurring in more than one region, but E01 need not necessarily have the same description or set memberships in each region.

We first present the method that should be used for handling multi-region models that do not have common naming conventions across regions, and then present the method that should be used for handling multi-region models that do have common naming conventions across regions.

### B.1 - Multi-region models that do not have common naming conventions across regions

Suppose a multi-region model that does *not* have common naming conventions across regions involves  $N$  regions, say REG1, REG2, ..., REG $N$ . In this situation, the fundamental principle used in building the Load XLS is that each Declaration or Data sheet should contain just declarations or data for a single region, corresponding to the (single) region specified on cell B1 of the sheet. More specifically, to handle such a model in the ANSWER version 5 (and higher) Load Templates, proceed as follows:

#### Declaration Sheets

- For each of the  $N$  regions create a single associated Commodities sheet. That is, create a Commodities sheet with cell B1 containing only REG1 on which the declarations for commodities in region REG1 are specified; create another Commodities sheet with cell B1 containing only REG2 on which the declarations for commodities in region REG2 are specified; ...; and create another Commodities sheet with cell B1 containing only REG $N$  on which the declarations for commodities in region REG $N$  are specified. Thus altogether there will be  $N$  Commodities sheets.
- Likewise, for each of the  $N$  regions create a single associated Technologies sheet. That is, create a Technologies sheet with cell B1 containing only REG1 on which the declarations for technologies in region REG1 are specified; create another Technologies sheet with cell B1 containing only REG2 on which the declarations for technologies in region REG2 are specified; ...; etc.
- And likewise, for each of the  $N$  regions create a single associated Constraints sheet. That is, create a Constraints sheet with cell B1 containing only REG1 on which the declarations for constraints in region REG1 are specified; create another Constraints sheet with cell B1 containing only REG2 on which the declarations for constraints in region REG2 are specified; ...; etc.

## Data Sheets

- For each of the  $N$  regions create one or more associated CommData sheets. That is, create one or more CommData sheets with cell B1 containing only REG1 on which the data for commodities in region REG1 are specified; create one or more CommData sheets with cell B1 containing only REG2 on which the data for commodities in region REG2 are specified; ...; and create one or more CommData sheets with cell B1 containing only REG $N$  on which the data for commodities in region REG $N$  are specified.
- Likewise, for each of the  $N$  regions create one or more associated TechData sheets. That is, create one or more TechData sheets with cell B1 containing only REG1 on which the data for technologies in region REG1 are specified; create one or more TechData sheets with cell B1 containing only REG2 on which the data for technologies in region REG2 are specified; ...; etc.
- And likewise, for each of the  $N$  regions create one or more associated ConstrData sheets. That is, create one or more ConstrData sheets with cell B1 containing only REG1 on which the data for constraints in region REG1 are specified; create one or more ConstrData sheets with cell B1 containing only REG2 on which the data for constraints in region REG2 are specified; ...; etc.

## Summary

In summary, to handle an  $N$ -region model that does *not* have common naming conventions across regions, for each region  $k$  ( $k = 1, 2, \dots, N$ ) there should be a single corresponding Commodities, Technologies, and Constraints sheet, and one or more CommData, TechData and ConstrData sheets, with cell B1 of each sheet containing just the single region REG $k$ . Thus altogether the Load XLS will contain  $N$  Commodities, Technologies and Constraints sheets, and  $N$  or more CommData, TechData and ConstrData sheets. (Of course the Load XLS may also contain as many other sheets as the user wishes containing assumptions, documentation, raw data, and/or data transformations.)

### ***B.2 - Multi-region models that do have common naming conventions across regions***

In version 5 (and higher) of the ANSWER Load Templates, the following format extensions have been incorporated specifically to simplify the specification of declarations and data for multi-region models that have common naming conventions across regions:

1. On both Declaration and Data sheets, cell B1 may contain a comma-separated region-list (list of regions). By default, the information on a sheet (declaration or data) applies to every region in the region-list.
2. On both Declaration and Data sheets, the cell B1 region-list may be over-riden by specifying a comma-separated region-list in **column A**, from row 8 down. (The region-list in column A must comprise a *subset* of the regions in the cell B1 region-list.) Note that a column A region-list is inherited by the rows beneath it, and applies until such time as another column A region-list is encountered. This allows the user the convenience of specifying that some declarations and data will apply to a subset of the regions specified in the cell B1 region-list.
3. On Data sheets only, the cell B1 region-list (and any column A region-list that may apply) may be over-riden by specifying a **single region in row 1** of the column above a data parameter. This allows the user the convenience of specifying on a single Data sheet, a mix of Data for all regions along with data (such as RESID) for specific regions.

Suppose a multi-region model that *does* have common naming conventions across regions involves  $N$  regions, say REG1, REG2, ..., REG $N$ . In this situation, the fundamental principle used in building the Load XLS is that each Declaration or Data sheet by default contains

declarations or data for *every* region, and so cell B1 of each sheet must contain the comma-separated region-list REG1,REG2,...,REGN. More specifically, to handle such a model in the ANSWER version 5 (and higher) Load Templates, proceed as follows:

### Declaration Sheets

- Create a single Commodities sheet with cell B1 containing the region-list REG1,REG2,...,REGN on which the declarations for commodities in every region are specified. If necessary, specify a region-list in column A to indicate that some commodities are to be included for a subset of regions, rather than for every region.
- Likewise, create a single Technologies sheet with cell B1 containing the region-list REG1,REG2,...,REGN on which the declarations for technologies in every region are specified. If necessary, specify a region-list in column A to indicate that some technologies are to be included for a subset of regions, rather than for every region.
- And likewise, create a single Constraints sheet with cell B1 containing the region-list REG1,REG2,...,REGN on which the declarations for constraints in every region are specified. If necessary, specify a region-list in column A to indicate that some technologies are to be included for a subset of regions, rather than for every region.

Note that on a declaration sheet, there is a restriction imposed by the way that the ANSWER smart XLS functions: “duplicate” Names are not permitted. *However in version 5 (and higher) of the ANSWER Load Templates what is allowable without creating a “duplicate” Name has a different and more flexible meaning than in version 4.* In version 5 (and higher), it is allowable for a row to have the same Name in column B as for a row above it, provided that there is no overlap in the column A region-lists in the respective rows. Only where two rows have the same Names in column B and where there is overlap in the column A region-lists in the respective rows is this considered to be a “duplicate” Name situation.

Suppose for example that the user wants to specify that technology XYZ123 occurs in five regions say R1, R3, R4, R5, R8. In version 5 and higher, this may be specified on the Technologies sheet in a number of different ways. Of course one way is to have a single row with XYZ123 in column B, and with this row having region-list R1,R3,R4,R5,R8 in column A. Another way is to have five separate rows each with XYZ123 in column B, and with the first such row having R1 in column A, the second such row having R3 in column A, etc. Since there is no overlap in the region-lists of these five rows, this does not create a “duplicate” Name situation.

### Data Sheets

- Create one or more CommData sheets (with cell B1 of each sheet containing the region-list REG1,REG2,...,REGM) on which by default the data for commodities in every region are specified. If necessary, specify a region-list in column A to indicate that data for some commodities apply to a subset of regions, rather than to every region. Or, specify a single region in row 1 of the column above a data parameter to indicate that data in that column apply only for that region.
- Likewise, create one or more TechData sheets (with cell B1 of each sheet containing the region-list REG1,REG2,...,REGM) on which by default the data for technologies in every region are specified. If necessary, specify a region-list in column A to indicate that data for some technologies apply to a subset of regions, rather than to every region. Or, specify a single region in row 1 of the column above a data parameter to indicate that data in that column apply only for that region.
- And likewise, create one or more ConstrData sheets (with cell B1 of each sheet containing the region-list REG1,REG2,...,REGM) on which by default the data for constraints in every region are specified. If necessary, specify a region-list in column A to indicate that data for some constraints apply to a subset of regions, rather than to

every region. Or, specify a single region in row 1 of the column above a data parameter to indicate that data in that column apply only for that region.

### Additional Considerations

The user should be aware of the following means of handling the situation where some data parameter instances apply in every region, but other data parameter instances (such as BOUNDS, RESIDs) are region-specific. This will be described for TechData sheets, but also applies for CommData and ConstrData sheets.

- Create a TechData sheet on which the data parameter instances that apply in every region are specified. As is the case for all TechData sheets, cell B1 contains the region-list REG1,REG2,...,REGN. (Since these data parameter instances are to apply in every region, do not use column A to specify a region-list that overrides the cell B1 region-list, and do not specify a single region in row 1 of the column above any data parameter.)
- For each region  $k$  ( $k = 1, 2, \dots, N$ ) create a TechData sheet on which the data parameter instances that are specific to region  $k$  are specified, with cell A8 containing the single region REG $k$ , and with other cells in column A empty (apart from comments that begin with an \*). The single region REG $k$  that is specified in cell A8 overrides the cell B1 region-list REG1,REG2,...,REGN and by inheritance applies to every data parameter instance on the sheet. (So there is no need to specify a single region in row 1 of the column above any data parameter.)

There are other means of handling the above situation. For example a single TechData sheet may contain data parameter instances (rows containing numeric values) that apply in every region, then a row with REG1 in column A followed by data parameter instances that are specific to region REG1, then a row with REG2 in column A followed by data parameter instances that are specific to region REG2, etc. Or a single region may be specified in row 1 of the column above any data parameter. Version 5 (and higher) of the ANSWER Load Templates provides considerable flexibility, but ultimately the user must decide which of a number of possible means is most convenient.

Note that "Check Sheet" (and the "Import Model Data from Excel" facility) check to ensure that any region that may be specified in row 1 does not conflict with any (inherited) region-list that may be specified in column A.

### Summary

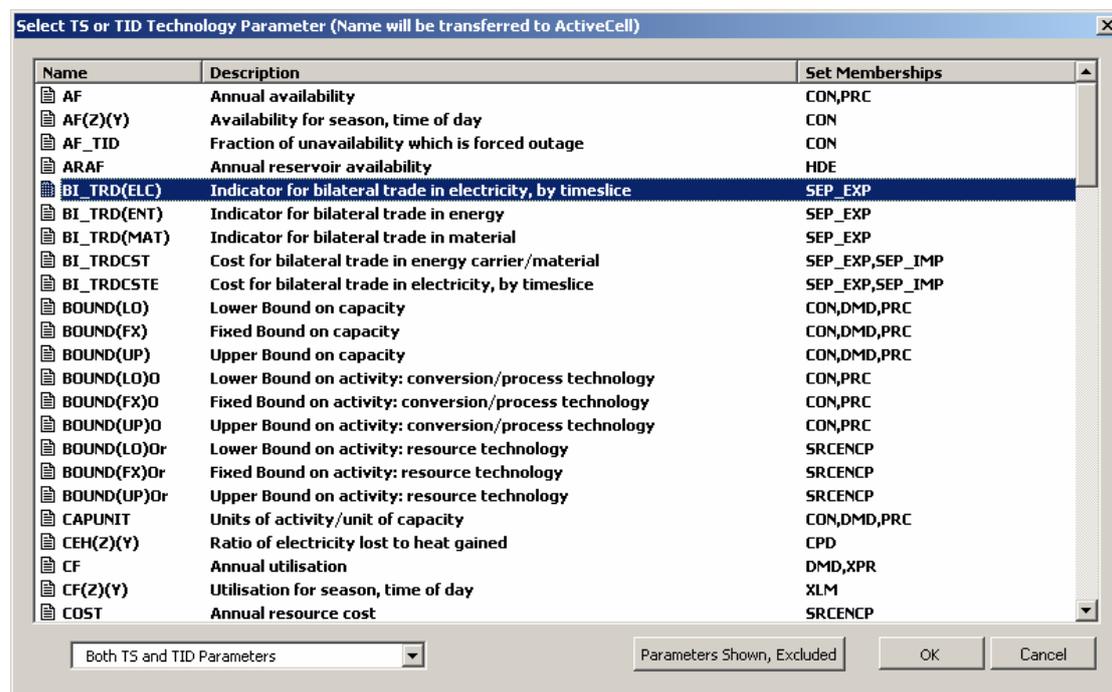
In summary, to handle an  $N$ -region model that *does* have common naming conventions across regions, cell B1 of each sheet must contain the comma-separated region-list REG1,REG2,...,REGN. There should be a single Commodities sheet, a single Technologies sheet, a single Constraints sheet, and one or more CommData, TechData and ConstrData sheets. On both declaration and data sheets, a region-list in column A (that is inherited by following rows) may be used to indicate that declarations or data apply to a subset of regions. On data sheets only, a single region may be specified in row 1 of the column above any data parameter.

### ***B.3 - Technology Data sheet extension to handle Bilateral Trade between Regions***

Version 5 (and higher) of the ANSWER Load Templates allows for the display of Bilateral Trade parameters on TechData sheets, so permitting the user to specify Bilateral Trade between regions of a multi-region model.

To be more specific, when the user clicks on the 'Parameter' action button on a TechData sheet, in addition to the parameters that were previously displayed, five Bilateral Trade parameters are now displayed as follows:

- Three TID indicator parameters BI\_TRD(ELC), BI\_TRD(ENT), BI\_TRD(MAT), and
- Two TID cost parameters BI\_TRDCST, BI\_TRDCSTE.



NOTE: If the target database associated with the workbook is an older version ANSWER database, parameters BI\_TRD(ELC) and BI\_TRDCSTE will appear on the above screen named as BI\_TRDEL(Z)(Y) and BI\_TRDCSTELC respectively. In that case, you should cancel out of this form, and save and exit your workbook. Then open the target ANSWER database with ANSWER version 5.5.8 or higher, and close it again. Now when you re-open the workbook and associate it with this target database, you will find that parameters BI\_TRD(ELC) and BI\_TRDCSTE appear in place of BI\_TRDEL(Z)(Y) and BI\_TRDCSTELC.

### Special Considerations for Parameters BI\_TRD(ELC), BI\_TRD(ENT), BI\_TRD(MAT)

As compared with the operation of the “smart” XLS for other data parameters, special considerations apply for the Bilateral Trade parameters BI\_TRD(ELC), BI\_TRD(ENT), BI\_TRD(MAT). These special considerations will be explained using the BI\_TRD(ELC) parameter. The same considerations apply for the BI\_TRD(ENT) and BI\_TRD(MAT) parameters.

Explanation of the special considerations is easiest if we first display part of the completed worksheet that specifies bilateral trade in electricity via a link where export technology EXPELC2 in region R1 exports electricity (named ELC in region R1) to region R2, and then consider the actions that the user needed to take in the BI\_TRD(ELC) column (column H below) to put it into its completed state.

|    | A         | B                                    | C                                 | D        | E      | F       | G         | H           |
|----|-----------|--------------------------------------|-----------------------------------|----------|--------|---------|-----------|-------------|
| 1  | TechData  | R0,R1,R2,R3,R4,R5,R6,R7,R8,R9        |                                   |          |        |         |           | R2          |
| 2  |           |                                      |                                   |          |        |         |           |             |
| 3  |           |                                      |                                   | Refresh  |        |         |           |             |
| 4  | Check Sht | TechName, TechDesc, TACT, TCAP Units |                                   | Units    | CommIN | CommOUT |           |             |
| 5  | Parameter |                                      |                                   |          |        |         | INP(ENT)x | BI_TRD(ELC) |
| 6  | Qualifier |                                      |                                   |          |        |         |           | <Same>      |
| 7  |           | TechName                             | TechDesc                          | Units    | CommIN | CommOUT |           | TID         |
| 11 | R1        | EXPELC2                              | Electricity Exports from R1 to R2 | PJ, PJ/a | ELC    |         | 1         | 1           |

The *Export* part of the bilateral trade link is specified via the row 11 information in columns A-G of the above worksheet, namely that region R1 contains export technology EXPELC2 with the CommIN entry of ELC coupled with the INP(ENT)x data entry of 1 indicating that this technology exports ELC.

The *Import* part of the bilateral trade link is specified via the column H information in rows 1 and 5-7 coupled with the data entry of 1 in cell H11. In particular note that:

1. The cell H1 entry of R2 indicates that the import region is region R2.
2. The cell H6 Qualifier entry of **<SAME>** indicates that the import commodity in the import region has the *same name* as the export commodity in the export region (so in this case ELC). Alternate Qualifier options to **<SAME>** are available, see below.
3. The BI\_TRD(ELC) data entry of 1 in cell H11 indicates that this column H import technology is linked to the row 11 export technology.
4. For this bilateral trade link, the name of the import technology is taken to be IMPELC2, determined by forming:  

“IMP” + <import commodity name> + <final character of export technology name>
5. The import commodity must exist on the Commodities sheet.
6. The import technology must exist on the Technologies sheet, and an OUT(ENT)r of 1 must be specified for the import technology and its associated import commodity on a TechData sheet.

Now we consider the actions that the user needed to take in the BI\_TRD(ELC) column (column H) to put it into its completed state, as shown above.

After positioning the cursor in cell H5, clicking on the ‘Parameter’ action button and selecting parameter BI\_TRD(ENT) from the Technology Parameter list, column H appears as follows:

|    | A         | B                                    | C                                 | D             | E      | F       | G         | H           |        |
|----|-----------|--------------------------------------|-----------------------------------|---------------|--------|---------|-----------|-------------|--------|
| 1  | TechData  | R0,R1,R2,R3,R4,R5,R6,R7,R8,R9        |                                   |               |        |         |           |             | Region |
| 2  |           |                                      |                                   |               |        |         |           |             |        |
| 3  |           |                                      |                                   |               |        |         |           |             |        |
| 4  | Check Sht | TechName, TechDesc, TACT, TCAP Units |                                   | Refresh Units | CommIN | CommOUT |           |             |        |
| 5  | Parameter |                                      |                                   |               |        |         | INP(ENT)x | BI_TRD(ELC) |        |
| 6  | Qualifier |                                      |                                   |               |        |         |           | <Same>      |        |
| 7  |           | TechName                             | TechDesc                          | Units         | CommIN | CommOUT |           | TID         |        |
| 11 | R1        | EXPELC2                              | Electricity Exports from R1 to R2 | PJ, PJ/a      | ELC    |         | 1         |             |        |

The following actions need to be taken:

1. In cell H1, replace the text “Region” by the desired import region name, in this case by R2. Note that the cursor is automatically positioned in cell H1 to facilitate this.
2. In cell H6, consider whether the default Qualifier of **<SAME>** is appropriate. It is appropriate if you want the import commodity in the import region to have the *same name* as the export commodity in the export region. To select from the alternative Qualifier options, place the cursor in cell H6 and click on the ‘Qualifier’ action button. This will be discussed below
3. In cell H11, insert a 1 to indicate that the export part of the bilateral trade link is EXPELC2 in region R1.

### Qualifier Options for Parameters BI\_TRD(ELC), BI\_TRD(ENT), BI\_TRD(MAT)

If you place the cursor in row 6 of a column for which one of the parameters BI\_TRD(ELC), BI\_TRD(ENT), BI\_TRD(MAT) is specified, and click on the 'Qualifier' action button, you will bring up the following form that displays the three alternative Bilateral Trade Qualifier options:



Each of these options is now discussed.

- **<SAME>** - This is the default option, and has already been noted above, is the appropriate option if you want to specify a bilateral trade link in which the import commodity in the import region has the *same name* as the export commodity in the export region.
- **<EXPREG>** - This is a rather specialized option that was created for the US EPA 9 region project. Use this option if you want to specify a bilateral trade link in which the import commodity name in the import region is formed by taking the export commodity name and appending the export region name. So if the export commodity name is ELC and the export region name is R1, use of the **<EXPREG>** option results in the import commodity name in the import region being taken to be ELCR1.

NOTE: The resultant import commodity name <ent> must not exceed 6 characters in length, since the associated import technology name will be of the form IMP<ent>P where P is the final character of the export technology name, and ANSWER has a limitation of 10 characters on the length of technology names.

- **Select Import Commodity from List** - Use this option if you want to specify a bilateral trade link in which the import commodity name in the import region *differs* from the export commodity name, and where you want to choose the import commodity name from a list of commodities for the import region, specified in row 1 of the Bilateral Trade column. (*Note that for this option to work, it is essential that you have specified a valid region in row 1!*) If you select this option, say for a BI\_TRD(ENT) parameter, an Energy Carrier selection form will be displayed (only the top half of the form is shown) that lists all appropriate energy carriers that occur for the row-1 region (region R2):

| Name   | Region                     | Description                                 | Set Memberships |
|--------|----------------------------|---|-----------------|
| ASP    | R1,R2,R3,R4,R5,R6,R7,R8,R9 | Asphalt                                     | ENT,ENC,EFS,LIQ |
| ASPB   | R2,R3,R4,R5,R6,R7          | ASP Traded by Barge/Vessel                  | ENT,ENC,EFS,LIQ |
| ASPB3  | R2,R5,R6,R7                | ASP Traded by Barge/Vessel Imported ...     | ENT,ENC,EFS,LIQ |
| ASPB4  | R2,R5,R6,R7                | ASP Traded by Barge/Vessel Imported ...     | ENT,ENC,EFS,LIQ |
| ASPB6  | R1,R2,R3,R4,R5,R8,R9       | ASP Traded by Barge/Vessel Imported ...     | ENT,ENC,EFS,LIQ |
| ASPB7  | R1,R2,R3,R4,R5,R6,R8,R9    | ASP Traded by Barge/Vessel Imported ...     | ENT,ENC,EFS,LIQ |
| ASPR3  | R2,R6,R7,R8                | Asphalt Imported from R3                    | ENT,ENC,EFS,LIQ |
| ASPR4  | R2,R6,R7,R8                | Asphalt Imported from R4                    | ENT,ENC,EFS,LIQ |
| ASPR5  | R2,R6                      | Asphalt Imported from R5                    | ENT,ENC,EFS,LIQ |
| COMDSL | R1,R2,R3,R4,R5,R6,R7,R8,R9 | Distillate-Heating Oil No. 2 to the Comm... | ENT,ENC,EFS,LIQ |
| COMKER | R1,R2,R3,R4,R5,R6,R7,R8,R9 | Kerosene and Other Refined Products t...    | ENT,ENC,EFS,LIQ |
| COMLPG | R1,R2,R3,R4,R5,R6,R7,R8,R9 | LPG to the Commercial Sector                | ENT,ENC,EFS,LIQ |
| COMNGA | R1,R2,R3,R4,R5,R6,R7,R8,R9 | Natural gas to Commercial sector            | ENT,ENC,EFS,GAZ |

Note that for a multi-region model with common naming conventions across regions, we should not be surprised to see that many such energy carriers in the list occur in several if not all regions.

Select the desired commodity from this list and click on the [OK] button. The name that you selected will be transferred to the Qualifier row and used as the import commodity name in the bilateral trade link.

### Summary

The following points should be kept in mind when specifying the Bilateral Trade parameters BI\_TRD(ELC), BI\_TRD(ENT), BI\_TRD(MAT) on a TechData sheet:

- The *Export* part of the bilateral trade link is specified via a row that contains: the export region in the (possibly inherited) column A region/regionlist; the export technology name in the TechName column; and the export commodity name in the CommIN column coupled with an INP(ENT)x data entry of 1.
- The *Import* part of the bilateral trade link is specified via the BI\_TRD(\*) column that contains: the import region in row-1; the implied/actual import commodity name in the Qualifier row; and coupled with a data entry of 1 in the row where the export part of the bilateral trade link is specified.
- The Qualifier either implies the import commodity name (in the case of a Qualifier of **<SAME>** or **<EXPREG>**), or is the actual import commodity name. *The import commodity must exist on the Commodities sheet.*
- Regardless of which Qualifier option applies, the name of the import technology is always determined by forming IMP<ent>P where <ent> is the implied/actual import commodity name, and P is the final character of the export technology name. *The import technology must exist on the Technologies sheet, and an OUT(ENT)r of 1 must be specified for the import technology and its associated import commodity on a TechData sheet.*
- Since the name of the import technology is always determined by forming IMP<ent>P where <ent> is the import commodity name, the import technology name always satisfies standard SRCENCP naming conventions (namely that the first 3 characters are IMP, and the remaining characters from 4 to the second-to-last character comprise the name of the import commodity). It therefore follows that it is only possible to use the “smart” XLS to specify a bilateral trade link in which the import technology name satisfies standard SRCENCP naming conventions.
- The export technology name does not need to satisfy standard SRCENCP naming conventions.

- Finally, note that BI\_TRD(ELC) instances are automatically generated for every TimeSlice for the *TimeSliced* Bilateral Trade parameter BI\_TRD(ELC). (This is also the case for the *TimeSliced* Bilateral Trade parameter BI\_TRDCSTE.)