Recent MARKAL/ANSWER Enhancements:
Flexible Time-slices
Technology Items Filters
Rule-based User Constraints

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ETSAP Annex X Meeting

Cape Town, South Africa

30 June 2006

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Outline

◆ *Flexible time-slices in MARKAL supported by ANSWER*

◆ *New Technology Item Filters in ANSWER*

◆ *"Rule-based" user constraints (ADRATIOs) in ANSWER*

{These enhancements were made possible through financial support provided by the US Environment Protection Agency as part of their US9r multi-region US national model development undertaking}

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Flexible Time-slices

◆ *Allow user control over the MARKAL time-slice Sets*

> Z = season (formerly only Summer/Winter/Intermediate)

> Y = time-of-day (formerly only Day/Night)

> TD(Z,Y) = 2-tuple of the combination of ZxY (formerly only 6)

> Set Z and Y members may have up to 3-char name, with 40-char description

◆ *Definition of the nature of the time-slices*

> Y = all time-of-day instances

> YNITE = the 1 time-slice during which the storage technologies consume energy and when the baseload constraint is generated (default = 'N')

> YDAY = all time-of-day instances other than YNITE (default = 'D')

> YBAS = the single YDAY time-of-day to be used for modelling baseload power plants (those that operate in all time-of-day if they operate in a season, default ='D')

> TD(Z,Y) = full enumeration of ZxY (handled internally by ANSWER, but permitting instances to be deleted)

> YPEAK(Z,Y) = the time-slices for which peaking constraints are to be generated (default = each YDAY)

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Flexible Time-slices - 2

◆ *New Time-slice Tab in ANSWER – creating Z and Y*

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Flexible Time-slices - 3

◆ *New Time-slice Tab in ANSWER – data view*

Flexible Time-slices - 4

◆ *QHR(Z,Y) and YPEAK designation*

Flexible Time-slices - 5

◆ *Multi-region considerations*
  ➢ **The definition and meaning of the time-slices must be the same in all regions**
  ➢ **The load curve therefore needs to be standardized to a particular "clock"**
  ➢ **Data values for time-slice parameters may differ between regions**

◆ *Reporting*
  ➢ **All time-sliced results are reported for each time-slice**

◆ *VEDA-BE supports the flexible time-slices*

◆ *VEDA-FE implementation is pending, conditional based upon user needs*

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Technology Items Filters

◆ *<u>Named</u> user-defined Filters stored in an ANSWER database*

◆ *Enables technology groups to be established according to*
  ➢ **Name/Description, and/or**
  ➢ **Set Membership, and/or**
  ➢ **RES Topology (input/output commodities)**

◆ *Once defined may be used:*
  ➢ **To limit Technologies that are displayed in Technology Items listview, e.g. limit to industrial demand technologies that have NGA as input commodity**
  ➢ **As part of the process of defining "rule-based" User Constraints (ADRATIOs)**

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Technology Items Filters - 2

◆ *ANSWER has always allowed filtering by Set Membership*

| Global | Energy | Material | Demand | Emission | **Technology** | Constraint | Tax/Subsidy | Sto |

Subset Items:

*All Technologies (TCH+SRCENCP) ▼ Specify Item Filter...

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

Subset Parameters: *C Technology, Specific

Subset Items:

CON - Conversion Technologies ▼ Specify Item Filter...

*All Technologies (TCH+SRCENCP) Status
BAS - Base Loaded Conversion Technologies
CEN - Centralised Conversion Technologies
CON - Conversion Technologies
CPD - Electric and District Heat Conversion Techn...
DCN - Decentralised Conversion Technologies
DMD - Demand Technologies
DUM - Dummy Process Technologies

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Technology Items Filters - 3

◆ *Modifications to also allow Named Technology Items Filters*

| Global | Energy | Material | Demand | Emission | **Technology** | Constraint | Tax/Subsidy | Stochastic | Parameter | Trade | ◄ ► |

Subset Items:

Sets Filter ▼ | *All Technologies (TCH+SRCENCP) ▼   Sets Filter... Named Filter...

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

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

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

➢ *New Sets Filter/Named Filter small combobox (initial default is Sets Filter)*

➢ *Large combobox displays Sets Filter description/Named Filter name and description*

➢ *[Sets Filter…]/[Named Filter…] buttons replace [Specify Items Filter… button] (initially [Sets Filter…] button is enabled)*

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Technology Items Filters - 4

◆ *After changing small combobox to Named Filter setting*

➢ *Large combobox displays name and description for default Named Technology Items Filter, "_ALLTECH All Technologies"*

➢ *[Named Filter…] button becomes enabled and [Sets Filter…] button becomes disabled*

➢ *Technology Items listview is populated with all qualifying technologies*

Technology Items Filters in - 5

◆ *After clicking on [Named Filter…] button*

➢ *Initially Technology Items Filter Management form displays just default Technology Items Filter "_ALLTECH All Technologies"*

➢ *Click on [New…] button to define a new Technology Items Filter*

Technology Items Filters - 6

◆ *After clicking on [New…] button and specifying Filter details*

Technology Items Filters - 7

◆ *After clicking on [OK] button, return to Filter Management form*

➢ *Click on [Close & Apply] button to apply the Filter*

Technology Items Filters - 8

◆ *After applying Named Filter IND-NGA*

| Global | Energy | Material | Demand | Emission | Technology | Constraint | Tax/Subsidy | Stochastic | Parameter | Trade | ◀ ▶ |

Subset Items:

| Named Filter ▼ | IND-NGA | Natural gas use by Industry | ▼ | Sets Filter... | Named Filter... |

Name	Region	Description	Status
ID5	DEMO	GAS BOILER PROCESS HEAT	

Item Management
Current Technology: ID5

Sets?
New... | Copy... | Delete | Edit...
Select All Items | Move... | RES

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

◆ *Export/Import Technology Items Filters facilities enable easy exchange of Technology Items Filters between ANSWER databases*

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"Rule-based" User Constraints (ADRATIOs)

◆ *New "Rule-based" Constraint facility greatly simplifies dealing with an ADRATIO such as "renewable electricity production must be at least 5% of total electricity production":*

   ➢ **Easily specified to ANSWER via two Technology Items Filters, one that selects renewable electric technologies and the other that selects all electric technologies**

   ➢ **Since Constraint is generated by a "rule" at run time, burden of maintaining integrity of Constraint as database changes over time is greatly reduced**

◆ *Once defined in ANSWER:*

   ➢ **"Resolve Rule-based Constraint" facility allows user to preview Constraint that will be generated at Run Model time**

   ➢ **At Run Model time special RULES DDS file is created and $INCLUDEd after the BASE DD and other DDS files**

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"Rule-based" Constraints (ADRATIOs) – 2
{Hid this slide, just walk thru the next ones}

◆ ***Creating "Rule-based" Constraint to specify that "renewable electricity production must be at least 5% of total electricity production":***

- ➢ **Create Technology Items Filter RENEW-ELE that selects all renewable electric technologies (perhaps via Set Memberships = ELE+RNT)**

- ➢ **Create Technology Items Filter ALL-ELE that selects all electric technologies**

◆ ***On Constraint tab:***

- ➢ **Create new User-Defined Constraint RENEWELC, specifying Additional Characterization "Rule-based Constraint"**

- ➢ **Use AddRow to specify RAT_RHS in normal fashion**

- ➢ **New RATRULE_* parameters are available for rule-based Constraints**

- ➢ **Use AddRow to specify RATRULE_ACT rows for RENEW-ELE and ALL-ELE**

"Rule-based" Constraints (ADRATIOs) - 3

➢ **Create new rule-based User-Defined Constraint RENEWELC**

➢ **Use AddRow to specify RAT__RHS in normal fashion**

"Rule-based" Constraints (ADRATIOs) - 4

➤ **New RATRULE_* parameters available for rule-based Constraints**

➤ **Use AddRow to specify RATRULE_ACT row for RENEW-ELE**

"Rule-based" Constraints (ADRATIOs) - 5

➤ **After use of AddRow to specify RATRULE_ACT row for RENEW-ELE**

➤ **After use of AddRow to specify RATRULE_ACT row for ALL-ELE**

"Rule-based" Constraints (ADRATIOs) - 6

➤ **"Resolve Rule-based Constraint" facility allows user to preview Constraint that will be generated at Run Model time [note evaluation of coefficients]**

| Resolve Rule-based Constraint RENEWELC in region DEMO | | | | | | | | | | |

Case Selection

Select Case...   Name: BASEDEMO
Resolve   Desc: BASE scenario run for Demo only to 2020
Scenario Details...   Scen: BASE

The spread displays how the Rule-based Constraint will be resolved at Run Model time for Case: BASEDEMO

Scenario	Parameter	Region	Technology	Constraint	Bnd/En	TimeSlic	1990	2000	2010	2020
BASE	RAT__RHS	DEMO	-	RENEWELC	LO	-	0.0000	0.0000	0.0000	0.0000
BASE	RAT_ACT	DEMO	E01	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E10	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E14	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E21	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E31	RENEWELC	-	-	0.9500	0.9500	0.9500	0.9500
BASE	RAT_ACT	DEMO	E32	RENEWELC	-	-	0.9500	0.9500	0.9500	0.9500
BASE	RAT_ACT	DEMO	E35	RENEWELC	-	-	0.9500	0.9500	0.9500	0.9500
BASE	RAT_ACT	DEMO	E3D	RENEWELC	-	-	0.9500	0.9500	0.9500	0.9500
BASE	RAT_ACT	DEMO	E4G	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E4H	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E6A	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E6B	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E6C	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500
BASE	RAT_ACT	DEMO	E6D	RENEWELC	-	-	0.9500	0.9500	0.9500	0.9500
BASE	RAT_ACT	DEMO	E82	RENEWELC	-	-	-0.0500	-0.0500	-0.0500	-0.0500

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Acknowledgments

◆ *Gary Goldstein for providing significant input into assorted aspects of "rule-based" Constraints, and for encouraging me to make Technology Items Filters more powerful by allowing filtering by Input and Output Commodity*

◆ *US Environment Protection Agency for providing Noble-Soft with financial support for these enhancements via US 9 region contract with International Resources Group*

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