

ANSWERv6 for TIMES: Status Report

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Overview

- ◆ *Background*
- ◆ *Multi-region ANSWER-TIMES*
- ◆ *ANSWERv6 for TIMES: Summary*
- ◆ *Benefits of ANSWERv6 for TIMES*
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- ◆ *Future Intentions*
- ◆ *Acknowledgments*



Background

- ◆ *2000: Single-region ANSWERv3 for MARKAL adapted to create single-region ANSWER-TIMES prototype (ABARE)*
- ◆ *Dec 04, Jun 05: Single-region ANSWER-TIMES prototype updated*
- ◆ *Sep-Nov 2005: Single-region ANSWER-TIMES further updated, feasibility of adapting multi-region ANSWERv5 for MARKAL to create multi-region ANSWER-TIMES investigated*
 - *“ANSWERv6 for TIMES: Status Report”, Oxford ETSAP Meeting, Nov 2005*
- ◆ *Sep 2006: ANSWERv6 for MARKAL released*
 - *Flexible Timeslices, Technology Items Filters, Rule-based Constraints*
- ◆ *Oct-Nov 2006: Good progress on adapting multi-region ANSWERv6 for MARKAL to create multi-region ANSWERv6 for TIMES*



Multi-region ANSWER-TIMES - 1

- ◆ *Ingredients in the multi-region ANSWERv6 for TIMES pot:*
 - *ANSWER-TIMES multi-region database structure from Nov 2005*
 - *ANSWERv6 for MARKAL Visual Basic code (100,000+ lines)*
 - *ETSAP TIMES GAMS code v150 (with modified *.ANS routines) and ETSAP TIMES GAMS code v217*
 - *Some TIMES GAMS DDs*
 - *Lessons learned from Sep-Nov 2005 multi-region ANSWER-TIMES feasibility study and from single-region ANSWER-TIMES*
- ◆ *The main game – modify the ANSWERv6 for MARKAL code such that the modified code supports working with both MARKAL and TIMES*
 - *And handles the special needs of TIMES*



Multi-region ANSWER-TIMES – 2 Home Screen

Data Management

Name	Description	Created	Modified
DELETED	Items deleted from Data that occur ...	2005/10/27 14:58	2005/10/27 14:58
BASE	D3-FR3+3 BASE scenario create...	2005/10/27 14:58	2005/11/10 20:08
TEST	test scenario inside template TIMES...	2005/10/27 14:58	2005/10/27 14:58

Selected Scenario:

Name	Description	Modified
BASE	D3-FR3+3 BASE scenario created ...	2005/11/10 20:08

Results Management

Name	Description	Scenario	Created	Status
BAD3F33	D3-FR3+3 BASE scenar...	BASE	2005/11/03 15:33	Run Pe...
BBD3F33	D3-FR3+3 BASE scenar...	BASE	2005/11/14 21:25	Imported...

Selected Cases:

Name	Description	Created
BBD3F33	D3-FR3+3 BASE scenario created ...	2005/11/14 21:25

Database: C:\AnswerV6_Dev\Answer_Databases\D3FR3+3multi.mdb | Edit Scenario: BASE



Multi-region ANSWER-TIMES – 3 Data Screen – Process Tab

Global | Commodity | CommaGroup | Process | Constraint | TimeSlice | Parameter | Bitrade

Name	Region	Description	Status
CCCDLN	D	New Coal Plant, Condensing 800 MW	
CCCDLN	FR	New Coal Plant, Condensing 800 MW	
CCCDLN	IT	New Coal Plant, Condensing 800 MW	
CCGMN	D	New Combined Cycle / Gas 500 MW	
CCGMN	FR	New Combined Cycle / Gas 500 MW	
CCGMN	IT	New Combined Cycle / Gas 500 MW	
CCLN	D	New Lignite power plant IGCC	

Subst Parameters: *C Process, Specific

Scen	Parameter	Region	Process	Commodity	CommaG	CommaG	TimeSlic	Bou	1990	1995	2000	2005
BASE	NCAP_AFA	2	D	CCCDLN	-	-	-	UP	0.8500	0.8500	0.8500	0.8500
BASE	NCAP_BND	2	D	CCCDLN	-	-	-	FX	175.9500	0.0000	897.8930	4.077.9100
BASE	NCAP_CDS1	2	D	CCCDLN	-	-	-	-	869.200.00	869.200.00	869.200.00	865.140.00
BASE	NCAP_FUM	2	D	CCCDLN	-	-	-	-	34.770.00	34.770.00	34.770.00	34.770.00
BASE	NCAP_TLIFE	2	D	CCCDLN	-	-	-	-	35	35	35	35

Database: C:\AnswerV6\TS Bitrade619MKT\Answer_Databases\D3FR3+3multi2.mdb | Edit Scenario: BASE



Multi-region ANSWER-TIMES – 4 Process Form – “Set Memberships” Tab

The screenshot shows the 'Set Memberships' tab of the software. The 'Item Information' section at the top includes a scenario dropdown set to 'TEST', a name field 'ANEWPRC', and a description field 'D'. Below this, there are checkboxes for 'Copy Declaration Only, Not Data' and 'Change to Local Technology'. The main area is divided into two panes: 'Process' on the left, which contains a tree view with categories like 'Combined Heat & Power (CHP)', 'Demand Device (DMD)', 'Electric Generation (ELE)', 'Energy (PRE)', 'Heat Generation (HPL)', 'Material (by weight) (PRW)', 'Material (by volume) (PRV)', and 'Miscellaneous (MISC)'; and 'Additional Characterization' on the right, which lists various options such as 'Annual Time Slice Level', 'Seasonal Time Slice Level', 'Weekly Time Slice Level', 'Day-Night Time Slice Level', 'Extension (TRACT)', 'Input/Export (IRE)', 'Night Storage (NST)', 'Refinery (REF)', 'Renewable (RENEW)', and 'Stockpiling (STK)'. 'OK' and 'Cancel' buttons are at the bottom right.



Multi-region ANSWER-TIMES – 5 Process Form – New “I/O Commodities, Units” Tab

The screenshot shows the 'I/O Commodities, Units' tab. It features two main tables: 'Input-based Process Activity' and 'Output-based Process Activity'. Each table has columns for 'CommIN' or 'CommOUT', 'Description', 'Type', and 'ANEWPRC-SPG' or 'ANEWPRC-PCG'. In the input table, 'oil' is listed with type 'NRG'. In the output table, 'diesel' and 'gasoline' are listed with type 'NRG'. Below the tables are buttons for 'Add Comm...', 'Delete Comm', 'Add User CG...', and 'Delete User CG'. At the bottom, there are fields for 'Process Activity Units' (set to 'petajoules'), 'Process Capacity Units' (set to 'petajoules/annum'), and 'PRC_CAPACITY Value' (set to '1'). 'OK' and 'Cancel' buttons are at the bottom right.



Multi-region ANSWER-TIMES – 6 Data Screen – Constraint Tab

Database: C:\Answer\VF\m1\TS\BITad619MK1\Answer_Databases\D3FR3T3multi2.m | Edit Scenario: UCRT

Name	Region	Description	Slab
UCRT	D	user constraint by region, period (sum over timeslices)	SM
UCRT	FR	user constraint by region, period (sum over timeslices)	SM
UCRT	IT	user constraint by region, period (sum over timeslices)	SM
UCRULE-RT	D	rule-based constraint by region, period (sum over timeslices)	SM

Scema	Parameter	Region	Constraint	Side	Proc/Filtes	Commod	TimeSic	Item	1990	1995	2000	2005	2010
M	UCRT	UC_RHSRT	UCRULE-RT	-	-	-	-	UP	1,111.11	1,111.11	1,111.11	1,111.11	1,111.11
M	UCRT	UC_T_EACH	UCRULE-RT	-	-	-	-	1	1	1	1	1	1
M	UCRT	UCRULE_ACT	UCRULE-RT	LHS	COAL_DESC	-	ANNUAL	-	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00

Scema	Parameter	Region	Constraint	Side	Var Type	ParamN	TimeSic	Value
M	UCRT	UC_R_EACH	UCRULE-RT	-	-	-	-	1
M	UCRT	UC_TS_SLIM	UCRULE-RT	-	-	-	ANNUAL	1



Multi-region ANSWER-TIMES – 7 All User Constraints Handled + Rule-based

Edit Name/Description for User-Defined Constraint UCRULE-RT in Region D, or change Set Memberships/Units if necessary, or edit Comment.

Item Information

Scenario: UC-RT DC - by region, period (sum over timeslices)

Name, Desc: UCRULE-RT D rule-based constraint by region, period (sum over timeslices)

Copy Declaration Only, Not Data Change to Local Technology

Set Memberships and Units Comment

Set Memberships

- User-Defined Constraint
 - Constraint by Region (Sum over Periods, Time Slices)
 - Constraint by Region, Period (Sum over Time Slices)
 - Constraint by Region, Period, Time Slice
 - Dynamic Constraint by Region (Sum over Time Slices)
 - Dynamic Constraint by Region, Time Slice
 - Constraint (Sum over Regions, Periods, Time Slices)
 - Constraint by Period (Sum over Regions, Time Slices)
 - Constraint by Period, Time Slice (Sum over Regions)
 - Dynamic Constraint (Sum over Regions, Time Slices)
 - Dynamic Constraint by Time Slice (Sum over Regions)

Additional Characterization

Rule-based Constraint

Units

Constraint Units: unit of user-defined constraint



Multi-region ANSWER-TIMES – 8 Resolve Rule-based Constraint

Scena	Parameter	Region	Constraint	Side	Proc/Filter	Commod	TimeSlic	Item	1990	1995	2000	2005	2010
UC-RT	UC_RHSRT	D	UCRULE-RT	-	-	-	-	UP	1,111.11	1,111.11	1,111.11	1,111.11	1,111.11
UC-RT	UC_T_EACH	D	UCRULE-RT	-	-	-	-	-	1	1	1	1	1
UC-RT	UCRULE_ACT	D	UCRULE-RT	LHS	COAL_DESC	-	ANNUAL	-	1.0000	1.0000	1.0000	1.0000	1.0000

Scena	Parameter	Region	Constraint	Side	Technology	Commod	TimeSlic	Run	1990	1995	2000	2005	2010
UCRT	UC_RHSRT	D	UCRULE-RT	-	-	-	-	UP	1,111.1100	1,111.1100	1,111.1100	1,111.1100	1,111.1100
UCRT	UC_ACT	D	UCRULE-RT	LHS	CCCOLN	-	ANNUAL	-	1.0000	1.0000	1.0000	1.0000	1.0000
UCRT	UC_ACT	D	UCRULE-RT	LHS	MP_HCO	-	ANNUAL	-	1.0000	1.0000	1.0000	1.0000	1.0000
UCRT	UC_ACT	D	UCRULE-RT	LHS	STC	-	ANNUAL	-	1.0000	1.0000	1.0000	1.0000	1.0000
UCRT	UC_T_EACH	D	UCRULE-RT	-	-	-	-	-	1.0000	1.0000	1.0000	1.0000	1.0000



Multi-region ANSWER-TIMES – 9 Home Screen – Run Model



Multi-region ANSWER-TIMES – 10 Run Model and Results

- ◆ *Run Model from multi-region ANSWER-TIMES database fully functional*
 - Separate DDs generated for each internal region
 - TRADE DD generated containing bitrade links
 - Special RULE DDs generated if any rule-based constraints
- ◆ *Results - ANSWER-TIMES VB code adjusted to import results contained in single ANT file created by multi-region TIMES run*
 - But, ANT file code dates back to 2000 so must run with REDUCE 'NO'
 - And not all results parameters are put out to ANT file that are put out to VEDA-BE



ANSWERv6 for TIMES: Summary - 1

- ◆ *Majority of standard TIMES Sets and Parameters in v2.1.7 TIMES GAMS code recognized*
 - Will enhance to support advanced TIMES model variants, if there appears to be a demand
- ◆ *Representation inside ANSWER-TIMES of “internal”, “external” regions and bitrade links has been refined*
- ◆ *Most Home Screen functions already working*
- ◆ *“Run Model” for single/multiple regions is fully operational for standard TIMES*
- ◆ *ANSWER-TIMES Import Results mechanism already working*
 - But TIMES GAMS code that produces ANT file for ANSWER import needs some updating



ANSWERv6 for TIMES: Summary - 2

- ◆ **Most Data Screen functions already working**
 - New/Copy/Delete/Edit Item, Add Row, Direct Cell Edit, Text Tip, etc
- ◆ **Process tab facilities enhanced to better handle special needs of TIMES**
 - “New Process”, “Edit Process” specification form incorporating I/O Commodities, definition of Commodity Groups, with auto-generation of associated TIMES Sets and Parameters (not yet fully operational)
 - Technology (Process) Items Filters facility available
- ◆ **User Constraints revised so that all types are now handled**
 - Special _GLOBAL region handles cross-region constraints
 - Rule-based Constraints facility available
- ◆ **RES graphics mechanism has been adjusted to cater for bitrade links between regions**



Benefits of ANSWERv6 for TIMES

- ◆ **For those familiar with ANSWER-MARKAL, easy to approach TIMES within the same interface paradigm**
 - Can focus on TIMES aspects and not have to be concerned with interface aspects
- ◆ **For new users, ANSWER has a gentle learning curve**
 - Beneficial in promoting use of TIMES, perhaps especially within universities?
 - Particular interest in constructing ANSWER-TIMES training databases to demonstrate important TIMES features
- ◆ **New ANSWER features will become available for both TIMES and MARKAL**
- ◆ **ANSWER-TIMES User Manual can be created based very substantially on existing ANSWER-MARKAL User Manual**



Loose ends - 1

- ◆ *“New Process”, “Edit Process” form made fully operational*
- ◆ *BiTrade tab layout to be devised and made operational*
 - Right now BiTrade links can be defined using other tabs
- ◆ *“Import TIMES GAMS DD” made fully operational*
- ◆ *More TIMES GAMS DDs are needed for integrity testing*
 - ANSWER-TIMES “Import TIMES GAMS DD” – “Run Model” cycle should generate the same LP matrix as that from running TIMES GAMS DD directly against TIMES GAMS code in Command Prompt window
 - A fairly demanding test of integrity!
- ◆ *Check to ensure all standard TIMES Sets and Parameters in latest TIMES GAMS code are supported*



Loose ends - 2

- ◆ *Insert additional TIMES knowledge into ANSWER database re domains for parameters (only IREs for IRE_* parameters, etc)*
- ◆ *Constraints Set Memberships tree made more user-friendly?*
- ◆ *User option “identical timeslices in each region”*
- ◆ *Facility to insert model years into ANSWER-TIMES database*
- ◆ *Allow >10 character Item names, etc, etc*

- ◆ *“Nothing is particularly hard if you divide it into small jobs”*
 - Henry Ford



Future Intentions

- ◆ *ANSWERv6 for TIMES available early 2007 for evaluation by interested parties (ETSAP Partners, existing ANSWER-MARKAL clients)*
- ◆ *Collaborate with ETSAP TIMES experts to construct ANSWER-TIMES training databases*
- ◆ *ANSWER-MARKAL User Manual updated to include documentation of TIMES-specific facilities*
- ◆ *Enhance to support advanced TIMES model variants, if there appears to be a demand*
- ◆ *Develop ANSWER-TIMES “smart” spreadsheets, if there appears to be a demand*



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