

# Using ANSWER-TIMES to create a miniature multi-region TIMES model

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## Overview

- ◆ *Create miniature single-region TIMES model from scratch*
- ◆ *Use bulk-copying facilities to replicate single-region model in several other regions*
- ◆ *Specify trade between regions*
- ◆ *Specify rule-based user constraint*
- ◆ *Status of ANSWER-TIMES*
- ◆ *Where to from here?*
- ◆ *Benefits of ANSWER-TIMES*
- ◆ *Acknowledgments*



## Thought for the day

*“Nothing is particularly hard if you divide it into small jobs”*

Henry Ford

*“Provided that you focus on the small jobs one at a time”  
(instead of allowing yourself to feel overwhelmed by the number of  
small jobs to be done)*

Ken Noble



## Create miniature single-region TIMES model from scratch - 1

### ◆ *Nine TimeSlices (apart from ANNUAL)*

### ◆ *Seven Commodities*

- OIL, NGAS
- DSL, GSL, ELC
- RHEAT, TCAR (demands)

### ◆ *Nine Processes*

- MIN\_OIL, MIN\_NGAS (extraction)
- OILREFIN, ECCGT
- RHEATELC, RHEATGAS (DMDs for RHEAT)
- TCAR-DSL, TCAR-GSL, TCAR-ELC (DMDs for TCAR)



## Create miniature single-region TIMES model from scratch - 2

*New form to allow specification of I/O Commodities, PCG*

Item Information

Scenario: BASE    Stanford demo

Name: Desc: DILREFIN    REG1    Oil refinery

Copy Declaration Only, Not Data

Set Memberships    I/O Commodities, Units    Comment

Input/Output Commodities

Input-based Process Activity     Output-based Process Activity

Commodity	Description	Type	PCG
Oil	Oil	NRG	
DSL	Diesel	NRG	<input checked="" type="checkbox"/>
GSL	Gasoline	NRG	<input checked="" type="checkbox"/>

Add Comm...    Delete Comm    Add Comm...    Delete Comm

In the PCG column, check Commodities of the same Type that comprise the PCG.



## Use bulk-copying facilities to replicate single-region model in several other regions

- ◆ **Create new Regions**
  - Specify Global tab parameters
- ◆ **Bulk-copy TimeSlices**
  - Copy Season TimeSlices first, then DayNite TimeSlices
- ◆ **Bulk-copy Commodities**
- ◆ **Bulk-copy Commodity Groups**
- ◆ **Bulk-copy Processes**



## Specify trade between regions - 1

*New TradeProcess Tab (no Region column in Items listview)*

Stanford demo - ANSWER-TIME'S Energy Modelling

Global | TimeSlice | Commodity | CommGroup | Process | TradeProcess | Constraint | Parameter

Items Filter: Sets | Named | All Trade Processes | Sets Filter... | Named Filter...

Name: TRD\_NGAS | Description: Trade in nat. gas | Status: S

Item Management: Current Trade Process: TRD\_NGAS | Sets? | New... | Copy... | Delete... | Edit... | Select All Items | Move... | REF

Subset Parameters: 0 Trade Process, Specific | TS, TID data | ?

Scenario	Parameter	Region	Region2	Process	Commodity	Item3	Item5	Item6	2005	2010
Add	TRDNGAS	?	?							
M	TRDNGAS	PRC_ACTUNT	?	REG1 -	TRD_NGAS	NGAS	-	-	1	
M	TRDNGAS	PRC_ACTUNT	?	REG2 -	TRD_NGAS	NGAS	-	-	1	
M	TRDNGAS	PRC_CAPACT	?	REG1 -	TRD_NGAS		-	-	1.0000	
M	TRDNGAS	PRC_CAPACT	?	REG2 -	TRD_NGAS		-	-	1.0000	
M	TRDNGAS	TOP_IHE	?	REG1 REG2	TRD_NGAS	NGAS	-	-	1	
Add	TRDNGAS	?	?							

Database: C:\Answer\TIME'S\Answer\_Databases\Stanford demo.mdb | Edit Scenario: TRDNGAS



## Specify trade between regions - 2

*New form to allow specification of Trade Process*

New Trade Process in scenario TRDNGAS

Enter Name and Description for the new Trade Process. Specify Set Memberships. Specify Traded Commodities and necessary. After clicking OK, specify parameter data as appropriate.

Item Information

Scenario: TRDNGAS | allow trade in NGAS from REG1 to REG2

Name, Desc: TRD\_NGAS | Trade in nat. gas

Copy Declaration Only, Not Data

Set Memberships | Traded Commodities, Units

Traded Commodities

Specify Trade Matrix of Export, Import Commodities for Regions between which Trade occurs:

EXP/IMP		REG1	REG2	REG3	REG4
	Commodities		NGAS		
REG1	NGAS		✓		
REG2					
REG3					
REG4					



## Specify Rule-based User Constraint - 1

*Electric car at least 10% of automobile transport demand*

### 1. Define TechFilter ALLTRN\_DMD to select all automobile transport DMDs

**New Technology Items Filter**

Enter Name, Description, Comment and Specify Filter for New Technology Items Filter

Name: ALLTRN\_DMD Description: All transport DMDs

Comment:

**Technologies to be Included:**

Look for:	Name	Description	Set Memberships	Input Commodity	Output Commodity
or:			PRC_DMD		"TCAR"
or:					



## Specify Rule-based User Constraint - 2

### 2. Define Rule-based User Constraint, using UCRULE\_ACT and TechFilter ALLTRN\_DMD

**Stanford demo - ANSWER TIMES Energy Modeling**

Global | TimeSlice | Commodity | CommGroup | Process | TradeProcess | Constraint | Parameter

Items Filter: \*All User-Defined Constraints (UC\_N)

Name	Region	Description	Status
UC_CAR-ELC	REG1	Electric car at least 10% of transport demand	SM

Subset Parameters: \*C User-Defined Constraints

Scenario	Parameter	Region	Constraint	Side	Proc/Filter	Commod	TimeSlic	Item6	2005	2010	2015	2020
M	UCCARELC UC_RHSRT	REG1	UC_CAR-ELC	-	-	-	LO		0.0000	0.0000	0.0000	0.0000
M	UCCARELC UC_ACT	REG1	UC_CAR-ELC	LHS	TCAR-ELC	-	ANNUAL		1.0000	1.0000	1.0000	1.0000
M	UCCARELC UC_T_EACH	REG1	UC_CAR-ELC	-	-	-	-		1	1	1	1
M	UCCARELC UCRULE_ACT	REG1	UC_CAR-ELC	LHS	ALLTRN_DMD	-	ANNUAL		-0.1000	-0.1000	-0.1000	-0.1000

Scenario	Parameter	Region	Constraint	Side	VarType	ParamK	TimeSlic	Value
M	UCCARELC UC_R_EACH	REG1	UC_CAR-ELC	-	-	-	-	1
M	UCCARELC UC_TS_SUM	REG1	UC_CAR-ELC	-	-	-	ANNUAL	1

Database: C:\Answer\TIMES\Answer\_Database\Stanford demo.mdb Edit Scenario: UCCARELC



## Specify Rule-based User Constraint - 3

### 3. Resolve Rule-based Constraint (to check we got it right)

Scenario	Parameter	Region	Constraint	Side	Technology	Commodi	TimeSlice	Bound	2005	2010	2015	2020
UCCARELC	UC_RHSRT	REG1	UC_CAR-ELC	-	-	-	LO	0.0000	0.0000	0.0000	0.0000	0.0000
UCCARELC	UC_ACT	REG1	UC_CAR-ELC	LHS	TCAR-DSL	-	ANNUAL	-	-0.1000	-0.1000	-0.1000	-0.1000
UCCARELC	UC_ACT	REG1	UC_CAR-ELC	LHS	TCAR-ELC	-	ANNUAL	-	0.9000	0.9000	0.9000	0.9000
UCCARELC	UC_ACT	REG1	UC_CAR-ELC	LHS	TCAR-GSL	-	ANNUAL	-	-0.1000	-0.1000	-0.1000	-0.1000
UCCARELC	UC_T_EACH	REG1	UC_CAR-ELC	-	-	-	-	1.0000	1.0000	1.0000	1.0000	1.0000



## Status of ANSWER-TIMES - 1

- ◆ **Majority of standard TIMES Sets and Parameters in latest v2.3.6 TIMES GAMS code recognized**
  - Also some VDA extension parameters supported (ACT\_EFF, FLO\_EMIS, NCAP\_AFC, NCAP\_CEH, PRC\_RESID)
  - Will enhance to support advanced TIMES model variants, if there appears to be a demand
- ◆ **ANSWER-TIMES representation of “internal”, “external” regions and trade links has been refined**
- ◆ **All Home Screen functions already working**
  - Except for some Import TIMES GAMS DD loose ends
- ◆ **“Run Model” for single/multiple regions is fully operational for standard TIMES**



## Status of ANSWER-TIMES - 2

- ◆ ***“Import Results” is fully operational***
  - TIMES GAMS code that produces ANT file for ANSWER-TIMES import needs to be enhanced to create aggregate results for import
- ◆ ***Most Data Screen functions are fully operational***
  - New/Copy/Delete/Edit Item, Add Row, Direct Cell Edit, Text Tip, etc
- ◆ ***Process tab facilities enhanced to better handle special needs of TIMES, with new form to specify I/O commodities, PCG***
  - Including auto-generation of some associated TIMES Sets and Parameters
  - Technology (Process) Items Filters facility available
  - A few loose ends to be attended to



## Status of ANSWER-TIMES - 3

- ◆ ***RES graphics mechanism has been adjusted to cater for trade links between regions***
- ◆ ***All types of TIMES User Constraints are handled***
  - Special \_GLOBAL region handles cross-region constraints
  - Rule-based Constraints facility available
- ◆ ***New TradeProcess tab to handle IRE Processes in TIMES, with new form incorporating Trade Matrix specification of trade***
  - A few loose ends to be attended to
- ◆ ***Right now 10 character Item name limit***
  - A few hours' work to allow >10 character Item names
- ◆ ***Further tailoring of ANSWER-TIMES database re domains for parameters desirable (only IREs for IRE\_\* parameters, etc)***



## Where to from here? - 1

- ◆ ***ANSWER-TIMES available July 2007 for evaluation by interested parties (ETSAP Partners, existing ANSWER-MARKAL clients)***
  - Including preliminary documentation of TIMES-specific facilities
  - Most facilities already documented in ANSWER-MARKAL User Manual
- ◆ ***Extensive testing is essential !!***
  - Will aim to quickly fix bugs that are detected
- ◆ ***As part of refining “Import TIMES GAMS DD” facility, during July will load any existing TIMES GAMS DDs that I’m provided with into ANSWER-TIMES and check integrity of what’s been loaded***



## Where to from here? - 2

- ◆ ***Create ANSWER-TIMES User Manual - using ANSWER-MARKAL User Manual as starting point***
  - For many facilities, just replace ANSWER-MARKAL screen snapshots by corresponding ANSWER-TIMES screen snapshots
- ◆ ***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***
- ◆ ***Collaborate with ETSAP TIMES experts to construct ANSWER-TIMES training databases***



## Benefits of ANSWER-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*



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