Software Installation

- Drag GAMS_Install and ANSWER_Install to your Desktop
- Run GAMS Setup
  - Install in default (C:\Program Files\GAMS22.5)
  - Copy the GAMSLICE file from the GAMS_Install folder when prompted
- Run ANSWER Setup (Password in Eval Install DOC)
  - Install in default (C:\ANSWERv6)
  - Copy ANSWERv6.LIC into C:\ANSWERv6

Software Installation (Cont)
Software Installation (Cont.)

- Drag the AnswerTIMESv6 folder to C:\
  - Drag Tabctl32.ocx in C:\AnswerTIMESv6 to the C:\WINDOWS\system32
- {Send the ANSWER-TIMES icon to the desktop, if desired}
- Establish the GAMS path
- Start-up ANSWER-TIMES
  - Open the Stanford database
  - Select and rerun the BASREG12 (as BASREGX)
  - Check that REG_OBJ matches
Presentation Outline

- Brief History
- Philosophy and features
- Managing input data
- Running a model
- Examining model results
- ANSWER “Smart” Templates for bulk-loading data

ANSWER-MARKAL Brief History

- First Windows interface for MARKAL
- Originally developed by former Australian ETSAP Partner ABARE over the period 1996-2003
- Now owned/developed by Noble-Soft Systems
- Substantial contributions by Gary Goldstein
- Used in >100 institutions world-wide for MARKAL modeling
Philosophy and Features

- ANSWER EXE communicating with self-contained database (bulk-load of data from Excel possible)
- Relatively flat learning curve
- Closely tied to the RES and MARKAL paradigm
- Employs a simple, consistent approach to accessing and presenting data
- RES diagramming, imbedded data spreadsheet, filtering, analyst graphs
- Supports the standard MARKAL reports
- Requires the user to enumerate all aspects of the data (substantial assistance in enforcing MARKAL rules)

Home Screen: Scenario and Case Management, Run Model
**Input Data, Primary Component Tabs**

- **Globals**: Those parameters that describe aspects of the overall energy system, such as a discount rate.
- **Energy Carriers/Materials**: All energy forms and materials in the system, e.g., petroleum, coal, electricity, steel, permits.
- **End-use Demands**: Demands for energy services in the economy, e.g., residential space heating/cooling, commercial lighting, industrial motor drive, automobile passenger transportation.
- **Emissions**: Environmental loadings related to an activity/capacity/investment in the energy system, e.g., tonnes of SO2 per tonne of coal consumed.

**Primary Component Tabs**
Primary Component Tabs (Cont.)

- **Technologies**: Four broad groups of technologies
  - **Resource**: Activities that lead to an energy carrier entering into or exiting from the system (e.g., mining/extraction, imports, exports)
  - **Conversion**: Technologies that convert primary energy to electricity and/or district heat
  - **Process**: Technologies that convert one energy carrier/material into another, with the exception of electricity and district heat (e.g., oil refineries, town gas facilities, pipelines, coal gasification).
  - **Demand**: Technologies used to satisfy the demand for energy service (e.g., refrigerators, electric motors, light bulbs, air conditioners, cars).

Primary Component Tabs (Cont.)

- **Ad Hoc Constraints**: User defined constraints that are additional to standard constraints defined in MARKAL.
- **Parameters**: cross-tab view of data
  - Alphabetic listing of parameters
  - Allows for easy access across items to sub-sets of the data
  - Differing lists for Data vs. Results
    - Data – input data rows for item characterization
    - Results – the row of the selected standard MARKAL report tables

- Bi-lateral and global trade: identify energy/material moving between regions
- **TimeSlice**: division of seasons and days
Input Data Screen, Parameter Tab

New Technology w/ Set Membership and Units specification
New Technology w/ default Parameters and “pick” lists

RES Network Diagram
Rule-based UC’s with TechFilters

Commenting Data Sources
**Scenario: BASE**

| All Technologies (TCH); Technologies: Conversion (CON); Electric, Not District Heat (ELE); Centralised (CE); Base Loaded (BAS) |

<table>
<thead>
<tr>
<th>TIME SERIES DATA</th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual availability</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Annual fixed O&amp;M cost</td>
<td>29.8718</td>
<td>29.8718</td>
<td>29.8718</td>
</tr>
<tr>
<td>Energy carrier input: conversion technology</td>
<td>3.125</td>
<td>3.125</td>
<td>3.125</td>
</tr>
<tr>
<td>Coal - After Emissions Accounting (teraJoules/teraJoules)</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Fraction of capacity in peak equations</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Residual installed capacity (megawatts)</td>
<td>600</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>Annual variable O&amp;M cost</td>
<td>0.5897</td>
<td>0.5897</td>
<td>0.5897</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TIME INDEPENDENT DATA</th>
<th>TID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction of unavailability which is forced outage</td>
<td>1</td>
</tr>
<tr>
<td>Units of activity/unit of capacity</td>
<td>31.54</td>
</tr>
<tr>
<td>(teraJoules/megawatts)</td>
<td></td>
</tr>
<tr>
<td>Lifetime of new capacity (number of years)</td>
<td>40</td>
</tr>
<tr>
<td>Electricity output</td>
<td>1</td>
</tr>
<tr>
<td>Start year</td>
<td>1990</td>
</tr>
</tbody>
</table>

**Excel with Full Descriptions**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Scenario: BASE</th>
<th>Technology: Hydroelectric Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Annual availability</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>B. Bound on capacity</td>
<td>-</td>
<td>Lower</td>
</tr>
<tr>
<td>C. Bound on capacity</td>
<td>-</td>
<td>Lower</td>
</tr>
<tr>
<td>D. Annual fixed O&amp;M cost</td>
<td>-</td>
<td>Lower</td>
</tr>
<tr>
<td>E. Annual fixed O&amp;M cost</td>
<td>-</td>
<td>Lower</td>
</tr>
<tr>
<td>F. Energy carrier input: conversion technology</td>
<td>3.125</td>
<td>3.125</td>
</tr>
<tr>
<td>G. Total cost of investment in new capacity</td>
<td>5000</td>
<td>5000</td>
</tr>
<tr>
<td>H. Fraction of capacity in peak equations</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>I. Residual installed capacity (megawatts)</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>J. Annual variable O&amp;M cost</td>
<td>0.5897</td>
<td>0.5897</td>
</tr>
</tbody>
</table>

**Note:**
- Units of activity/unit of capacity
- Units of investment in new capacity
- Units of capacity in peak equations
- Units of electricity output
- Units of start year
Model Run Forms

Model Run GAMS Dialog-box
Model Batch Run Form

Preliminary Look at Analysis Tools

- Over 220 different results parameters are available through ANSWER.
- Results are organized into standard report tables.
- Results can be viewed via the ANSWER Results Form or through MS Word/Word Pad (from the HOME screen use the ‘View Case File’ menu option).
- On the Results Form information may be accessed by table via the Parameters tab, or from the RES component by means of the other tabs.
- Results can also be exported to a spreadsheet or graphed.
ANSWER Results - Technology Tab

ANSWER Results - Parameter Tab
ANSWER Results – Final Energy Consumption

- T01 Scenario Identifiers
- T02 Summary
- T03 Primary Energy
- T04 Energy Output of Technologies at Gate
- T05 Final Energy Use by Fuel/Demand Sector
- T06 Useful Energy (Services) from Demand Devices
- T08 Use of Energy Carriers
- T09 Shadow Price (Marginal Cost) of Energy Carriers
- T11 Marginals for Tech., Res, Demand, Cum., User-defined constraints (ADRATIOs)
- T25 Annualized Costs of Technologies & Resources

ANSWER Report Tables
ANSWER Report Tables (Cont.)

- T26 Elastic Demands [MED]
- T27 Annual Environmental Indicators
- T30 Flexible Refinery
- ACT Activity of Each Technology
- CAP Capacity of Each Technology
- COSTBEN Benefit/Cost Ratios
- DEMAND Useful Energy (Service) Demand by Sector
- GDP M-M Macroeconomic Results [MACRO]
- INV Investment in Each Technology
- MC M-M Marginal Cost of Demands [MACRO] (Plus PREF Differences)
- SUPPLY Activity of Each Resource Supply Option

ANSWER – Export Results to Excel
Exporting and Graphing Data: Analyze with Excel Graphing

<table>
<thead>
<tr>
<th>Case</th>
<th>Parameter</th>
<th>Emission Marginal Carbon Dioxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base w/ CO2</td>
<td>Emission</td>
<td>0 -20.91 -19.54</td>
</tr>
<tr>
<td>Adv &amp; Eff technology w/ CO2</td>
<td>Emission</td>
<td>0 -17.81 -18.92</td>
</tr>
<tr>
<td>MM - Base w/ CO2</td>
<td>Emission</td>
<td>0 -22.62 -21.25</td>
</tr>
<tr>
<td>MM - Adv &amp; Eff technology w/ CO2</td>
<td>Emission</td>
<td>0 -21.92 -18.91</td>
</tr>
</tbody>
</table>

Emissions Marginal Cost: CO2

ANSWER Smart Template
Worksheets for bulk-loading data

- Associate Database with Templates
- Declaration Sheets
  - Commodities
  - Technologies
  - Constraints
- Data Sheets
  - Commodity Data
  - Technology Data
  - Constraint Data
- Load Templates into Database
Associating a Database with the Templates

ANSWER Smart Template Buttons

- Selection Buttons
  - Set membership
  - Units
  - Declared commodities/technologies
  - Parameters and qualifiers
- Consistency Checking
  - “Check Sheet” button
ANSWER Calibration Workbook - Commodity Load Sheet

Template Use – Declaration “Smart” Buttons
ANSWER Calibration Workbook - Data Load Sheet

Template Use – Data “Smart” Buttons
ANSWER Calibration Workbook - Data Sheet Consistency Check

Load Templates into ANSWER Database