Robust R&D Strategies for Natural Gas

Presentation
USAEE Capitol Section
Washington, DC
September 20, 2002

Caveat to Model Users

" . . .the applicability, accuracy, and appropriateness of any model or method for a particular issue or question is a matter of professional judgement."

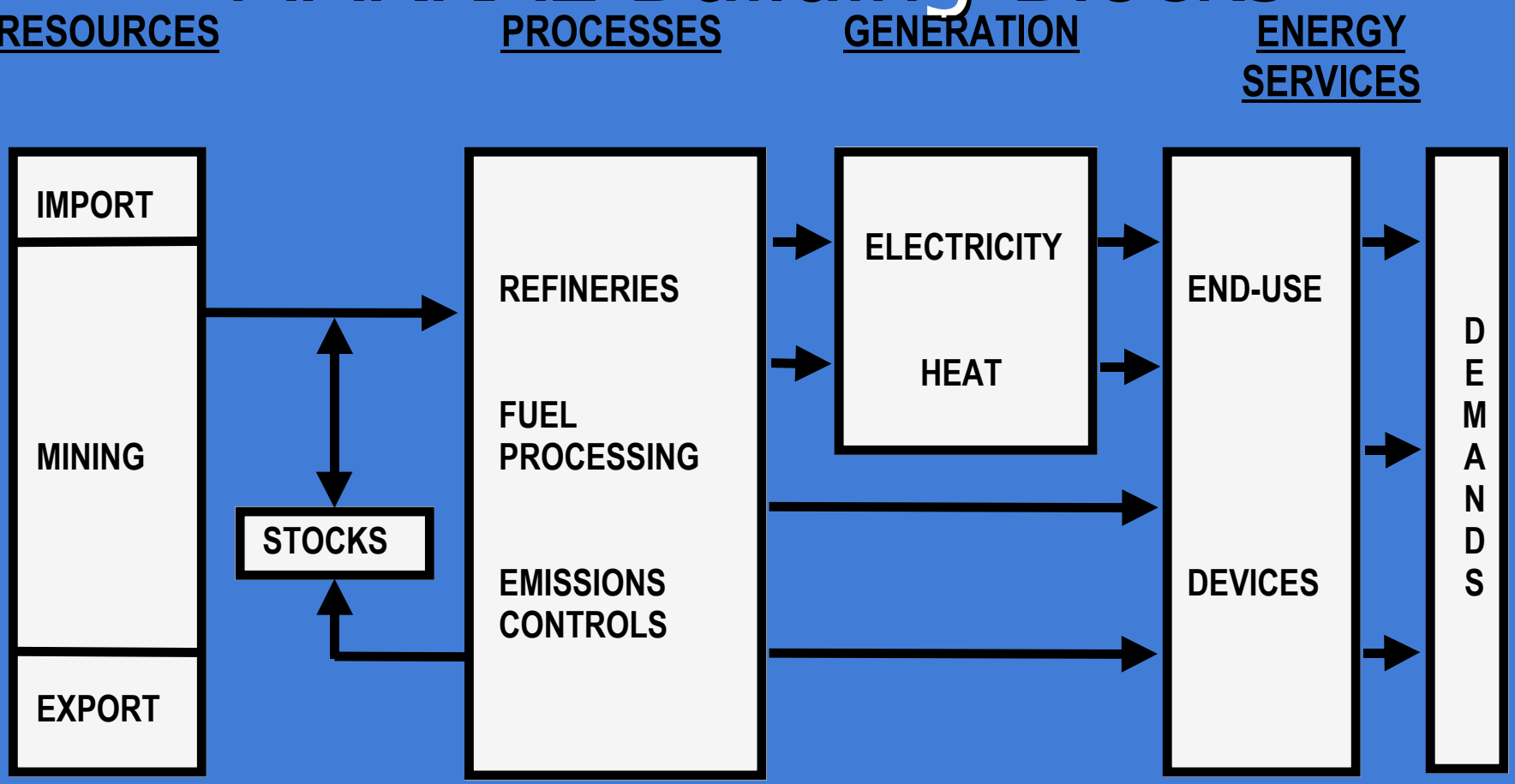
What MARKAL Does?

- Identifies least-cost solutions for energy system planning.
- Evaluates options within the context of the entire energy/materials system by:
  - balancing all supply/demand requirements,
  - ensuring proper process/operation,
  - monitoring capital stock turnover, and
  - adhering to environmental & policy restrictions.
- Selects technologies based on life-cycle costs of competing alternatives.

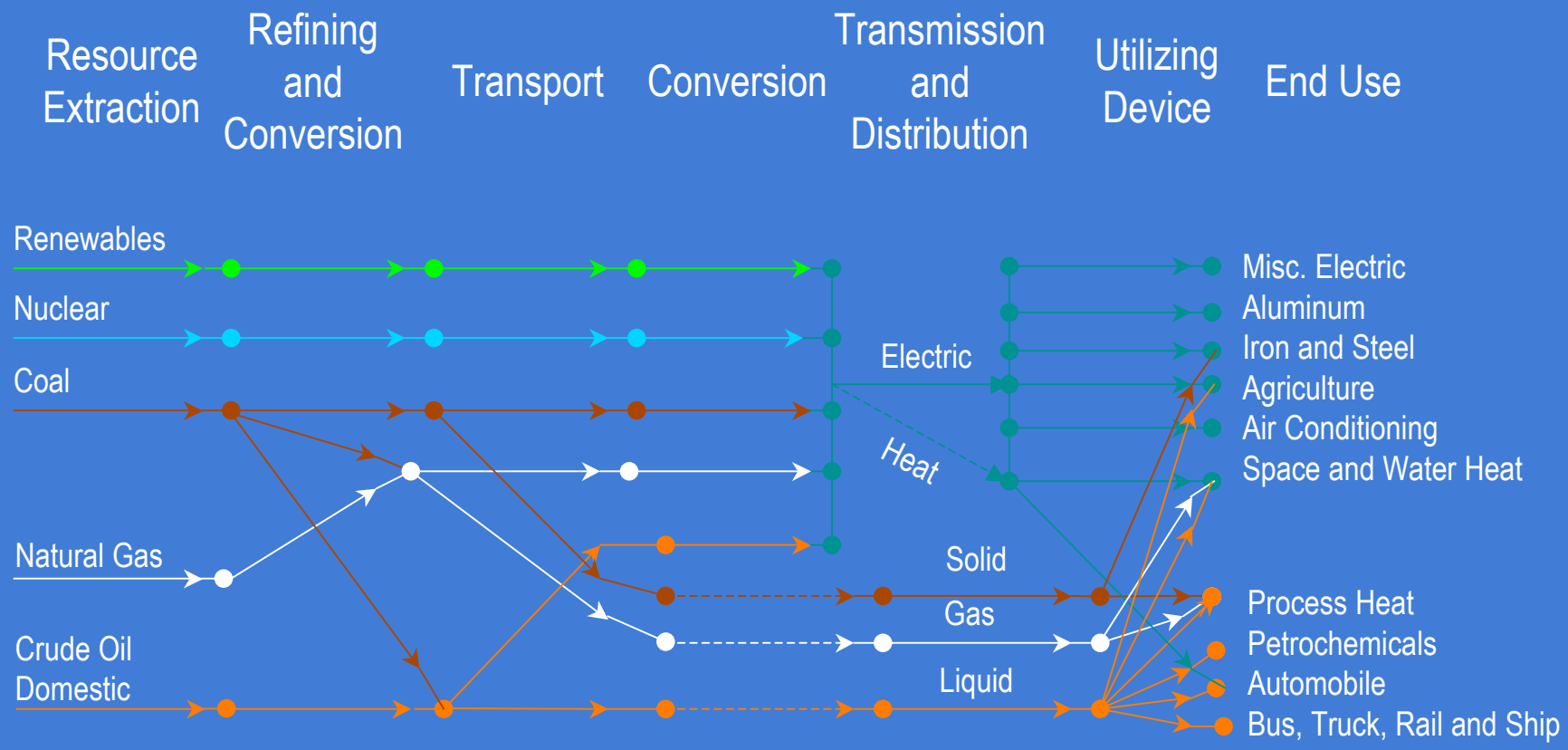
What MARKAL Does? (Cont.)

- Establishes baselines and the implications of alternate futures.
- Provides estimates of:
  - energy/material prices,
  - demand activity,
  - technology and fuel mixes,
  - GHG and other emission levels, and
  - mitigation and control costs.

MARKAL Building Blocks



Simplified Reference Energy System



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Expansion of Technology Sets

- Use of publicly available verifiable sources.
- Expansion to:
  - More than 2400 industrial technologies.
  - Over 300 commercial technologies (geothermal heat pumps and distributed generation).
  - Over 300 residential technologies.
  - Over 150 transportation technologies.

Documentation and Public Availability

- Written documentation with spreadsheets supporting parameter calculations.
- AEO 2002 "parallel" reference case with required constraints clearly defined and segregated from database.
- Presentation of results to groups of peers and at professional conferences.
- Availability on web: www.osoenergymodel.com

Summary of Base Case Results

- Overall the AEO reference case is approximately 7% less in energy consumption than AEO 2002.
- Explanations for this:
  - Missing end-use demand categories.
  - Slight differences in penetration rates of new technologies.
  - Overall model structure.

Summary (cont.)

- Economy-wide emissions of CO_2 are approximately 10% below levels forecast by AEO 2002.
- Explanations:
  - Lower fuel consumption due to missing demands.
  - More aggregate nature of emissions coefficients in MARKAL.
- Other emissions (SO_2, NOx, mercury, PM10, VOCs) vary from 20 to 40% from the base year. This is an area of on-going work.

Stochastic Approach in MARKAL

- Uncertainty is represented by a two-stage decision tree.
- Probabilities are assigned to various outcomes.
- The expected value is then calculated.
- The difference between the scenario using uncertainty and the deterministic base case represents the option value of a strategy.
- This technique dates to Dantzig, 1957.

Preliminary Results and Conclusions

- Advances in drilling technologies (resulting in reductions in finding costs) are robust in all potential scenarios.
- Advances in energy use technologies (increased energy efficiency) are less consistent.
- Advances in electric generation technologies also are less consistent.
- The technique appears to have potential for strategy development.

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