White Paper on Development of A Liquid Fuels Market Module for NEMS

LFMM Technical Workshop
U.S. Energy Information Administration

September 30, 2009

Revised Presentation: October 14, 2009

Dave Hirshfeld
MathPro Inc.

1. A perspective on refinery modeling
2. Some thoughts on the modeling platform
3. Forecasting (AEO and IEO) applications
4. Special studies
5. A proposed modeling approach
6. Model calibration
7. Representation of advanced biofuels supply

1. A perspective on refinery modeling

- A model should be as simple as possible, but not simpler
- It is better to be approximately right than precisely wrong
- Analysis is done by analysts, not by models

2. Some thoughts on the modeling platform

- Start fresh
- Adopt best practice in system design
  - User interface based on Web conventions and tools
  - Data maintained in relational database
  - “Facts” and “Choices” maintained in separate classes
  - Crude assay library and assay manager
  - Promote visibility – symbolic modeling and model analysis components
  - Advanced case management capabilities

3. Forecasting applications

- Relatively simple and compact multi-region model adequate for forecasting applications
- Model should encompass not only U.S. regions but also short-haul and European export regions
- Model should produce estimates of
  - Net refinery consumption of purchased fuel and power
  - Refinery emissions of CO_2
  - Energy density of transportation fuels

4. Special study applications

- Moderately detailed, but highly flexible, refining sector model template needed for special studies
- Model and platform should be capable of processing many cases in the course of any given study
- Model and platform should be capable of representing refining sector
  - At various levels of aggregation, and
  - With different routes for capacity investments

4. Special study applications (cont'd.)

- Special studies require modeling at various levels of aggregation
  - Aggregate national model
  - Regional models
  - Notional ("generic") models
- Notional models can capture various types of investment economics
  - "Grass roots"
  - Expansion
  - Retro-fitting to a new service
  - Capacity creep

5. Different applications ⇨ different models

- Two distinct LFMM models (see Exhibits 3 and 4)
  - Simple, multi-regional one for AEOs and IEOs
  - More complex, flexible modeling template for special studies
  - Both process-oriented optimization models
  - Same modeling platform
- EIA might want a third LFMM model, representing all U.S. refineries individually in highly simplified form
  - Spread-sheet based, non-optimizing
  - For identifying advantaged/disadvantaged refineries
  - For assessing credit trading programs

6. Model calibration

- Models should be *calibrated* annually to most-recent year regional operations, as reported
  - Production rates of primary refined products
  - Capacity utilization
  - Properties of gasoline and distillated pools
  - Refined product prices (marginal refining costs)
- Calibration addresses two vexing issues
  - Matching reported prices of refined products
  - Over-optimization due to aggregation
- Calibration establishes credibility

7. Representation of advanced biofuels

- Current status of advanced bio-fuels (e.g., cellulosic ethanol)
  - Uncertain technical and economic feasibility
  - Unknown time to achieve any given production volume
  - Inherent fragmentation of any future industry
  - No commercial production ⇨ no commercial data
- Cellulosic and corn ethanol are intrinsically different
  - Maturity: technology, infrastructure, operating data, markets
  - Granularity: technology, feedstock, region

7. Representation of advanced biofuels (cont'd.)

- Granularity implies extensive, expensive, and continuing effort to
  - Capture and analyze data
  - Create and update formal supply models
- Without commercial data, one cannot forecast; one can only speculate
- Adding a virtual sector to the set of real sectors represented in NEMS would be pernicious