Findings of the EMF Study 23: World Natural Gas Markets

Hillard Huntington
Energy Modeling Forum, Stanford University

Liquefied Natural Gas Interagency
Permitting Working Group
Hercules, CA   September 20, 2007
“Centrally Isolated” Supply Sources

Source: US Geological Survey
Qatar and Iran

Courtesy of the University of Texas Libraries, The University of Texas at Austin.
Large Sunk Costs

Capital costs of large liquefaction plants in Qatar

$7 B

Total Economy’s 2005-6 Growth ($)

Kentucky - The Bluegrass State
Regional LNG Competition in Models

Source: EMF Presentation by Hartley and Medlock on the Rice Model
**Several Organizations Used Models to Support EMF 23**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Organization</th>
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<tbody>
<tr>
<td>RITE</td>
<td>Research Institute of Innovative Technology for the Earth</td>
</tr>
<tr>
<td>CRA</td>
<td>Charles River Associates</td>
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<tr>
<td>STAT</td>
<td>Statistics Norway</td>
</tr>
<tr>
<td>SAIC</td>
<td>Science Applications International Corporation</td>
</tr>
<tr>
<td>INGM</td>
<td>US Energy Information Admin. and ICF Consulting</td>
</tr>
<tr>
<td>Rice</td>
<td>Rice University</td>
</tr>
<tr>
<td>DIW</td>
<td>DIW Berlin (German Institute for Economic Research)</td>
</tr>
<tr>
<td>GASTALE</td>
<td>ECN Policy Studies (Energy research Center Netherlands)</td>
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<tr>
<td>CPB</td>
<td>CPB, Netherlands Bureau for Economic Policy Analysis</td>
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<tr>
<td>- -</td>
<td>International Institute for Applied Systems Analysis *</td>
</tr>
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<td>- -</td>
<td>University of Maryland *</td>
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<tr>
<td>NEMS</td>
<td>US Energy Information Administration</td>
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<td>NANGAS</td>
<td>US Environmental Protection Agency and ICF Consulting</td>
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Notes: * Did not submit standardized results for this study.
EMF Report is Available

• Full discussion of models, standardized scenarios and key results are contained in the working group’s report at:
  
  http://www.stanford.edu/group/EMF/

• Or Google “energy modeling”
Comparing Energy Models

Scenarios \( \rightarrow \) Models \( \rightarrow \) Results

could
What will be

“The purpose of computing is insight, not numbers.”

- R. W. Hamming
Rising Imports

• Future imports will grow as consumption outstrips production in the United States, Europe and Asia
European Self Sufficiency

% p.a., 2005-2020

Product: CPB, RITE, GASTALE, CRA, STAT, DIW, INGM, RICE
Consumption: CPB, RITE, GASTALE, CRA, STAT, DIW, INGM, RICE
USA Self Sufficiency

% p.a., 2005-2020
LNG Fills Much of this Gap

- A large share of this expanded trade will be LNG.

Source: Free Nature Pictures
Source: National Oceanic and Atmospheric Administration/Department of Commerce
Russia Loses Market Share

% p.a., 2005-2020

Western Russia Exports
Western Persian Gulf

RITE, GASTALE, CRA, STAT, DIW, INGM

-5% to 25%
Energy Security

- Rising natural gas imports will enable some countries to cope better with insecure supplies if their markets are connected to diverse supply sources.
Long-Run Price Paths

- New Price Path
- Old Price Path

Years

Price
Fuel Pricing

• The long-run natural gas price path will move with world crude oil prices over the next two decades, although there is not a fixed relationship between the two energy prices.
Why Oil Prices Lead Gas Prices

Despite lost fuel-switching capacity -

• Oil prices influence all energy prices.
• Oil and gas production use similar inputs.
• Refineries quickly switch to cheaper fuel.
• Petrochemicals relocate to Middle East.
• GTL may link natural gas and diesel prices.
European-United States Price Ratio (%)

- Shipping costs keep North American prices as high or higher than in Europe -

Delivered Prices for All Models except SAIC (wellhead prices)
Demand Growth and Prices

- Modestly higher growth will not cause large increases in the long-run delivered natural gas price. For 2020,
  - U.S. delivered price increases by 1.2% for each 1% shift in demand.
  - European delivered price increases by 0.8% for each 1% shift in demand.
USA Prices / Demand Shift
Response in 2020

Price Impacts per 1% Shift in Demand Conditions

- RITE
- NEMS
- INGM
- NANGAS
- CRA
European Prices / Demand Shift Response in 2020

Price Impacts per 1% Shift in Demand Conditions

- RITE
- GASTALE
- INGM
- DIW
- CRA
LNG Restrictions

- Failure to build a particular liquefied natural gas (LNG) facility will not seriously harm a well-integrated United States or European market with many interconnections. More worrisome would be a concerted policy that systemically curtailed the construction of new plants over an extended period.

- For 2020, delivered US & European prices increase by 0.8% for each 1% supply constraint due to LNG restrictions.
USA Prices / LNG Constraints
Response in 2020

Price Impacts per 1% Change in Total Market (Consumption)
European Prices/LNG Constraints
Response in 2020

Price Impacts per 1% Change in Total Market (Consumption)
Models Provide Value; Have Limitations

- These newly developed models capture the essence of regional competition in the world market, provided that the analysts adequately incorporate the appropriate political and technical constraints.
- They often do not represent demand conditions with as much detail.