

Findings of the EMF Study 23: World Natural Gas Markets

Hillard Huntington

Energy Modeling Forum, Stanford University

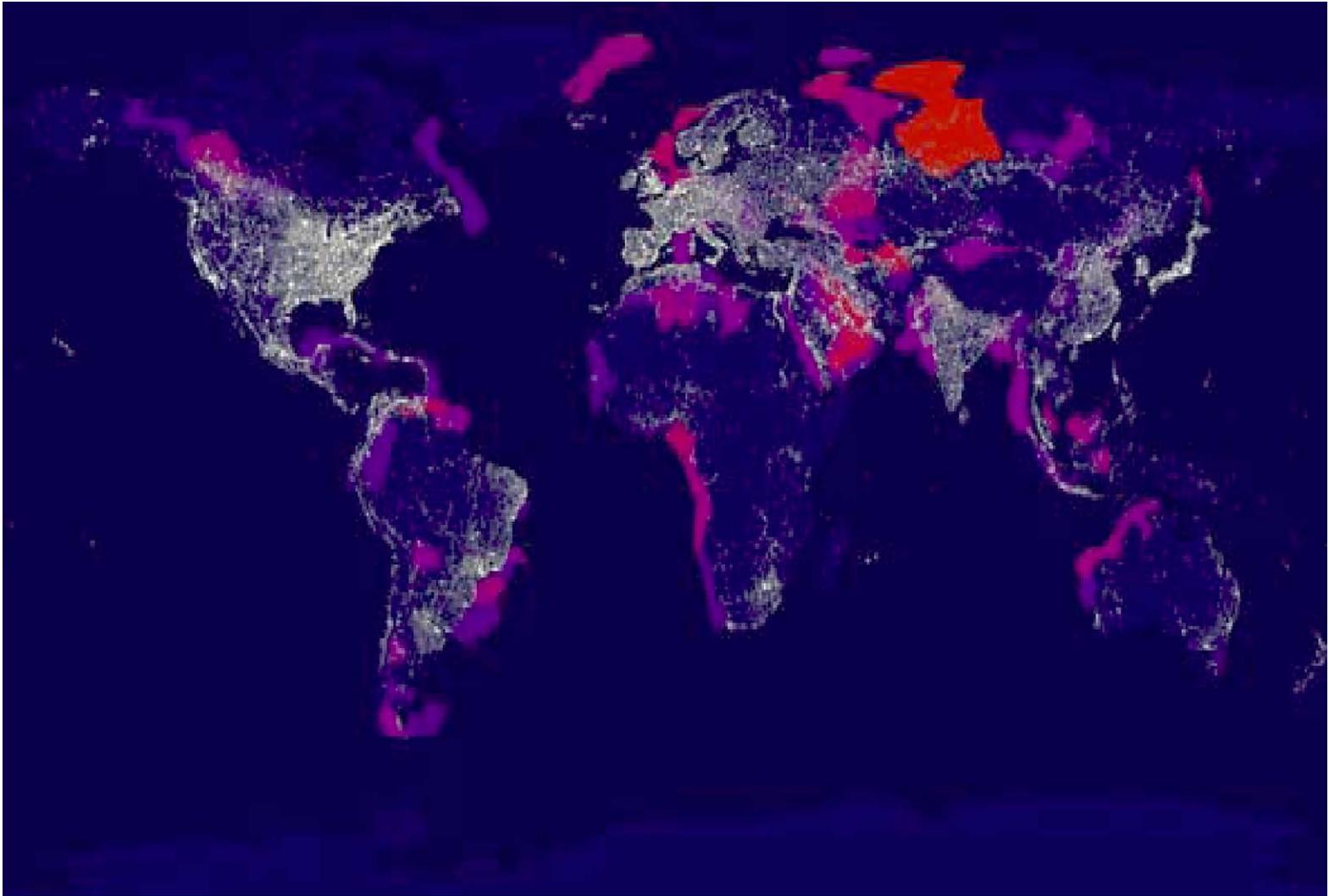
Liquefied Natural Gas Interagency

Permitting Working Group

Hercules, CA

September 20, 2007

“Centrally Isolated” Supply Sources



Source: US Geological Survey

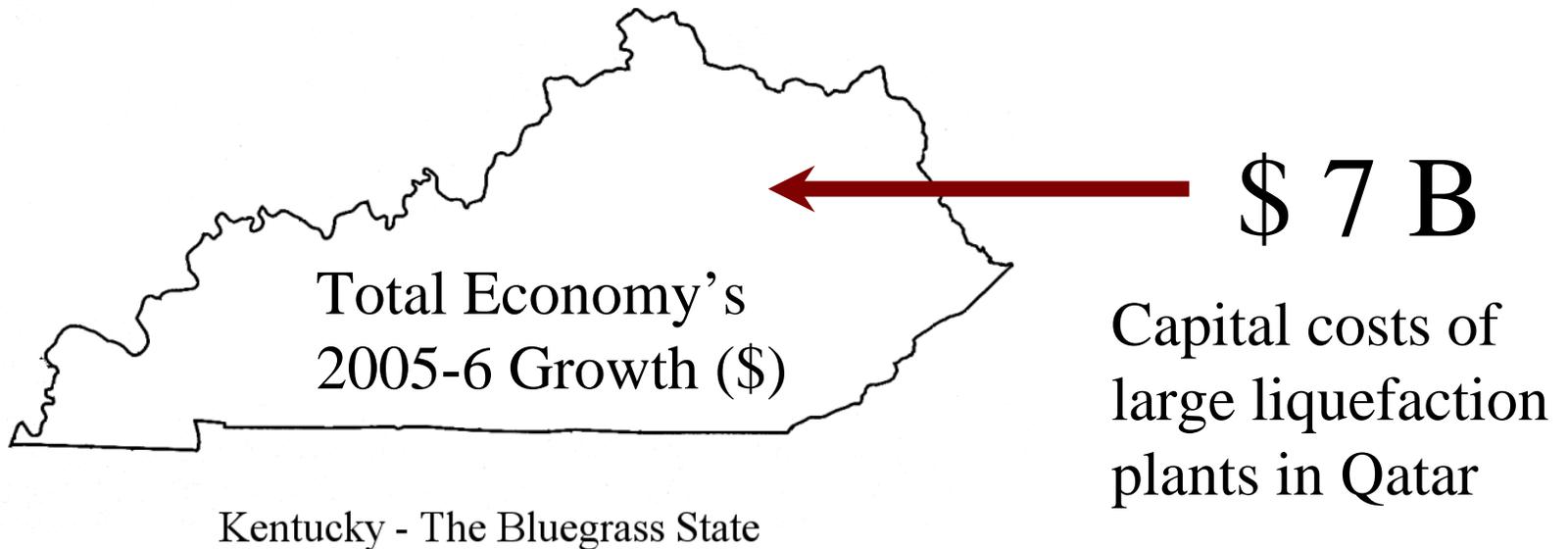
Qatar and Iran



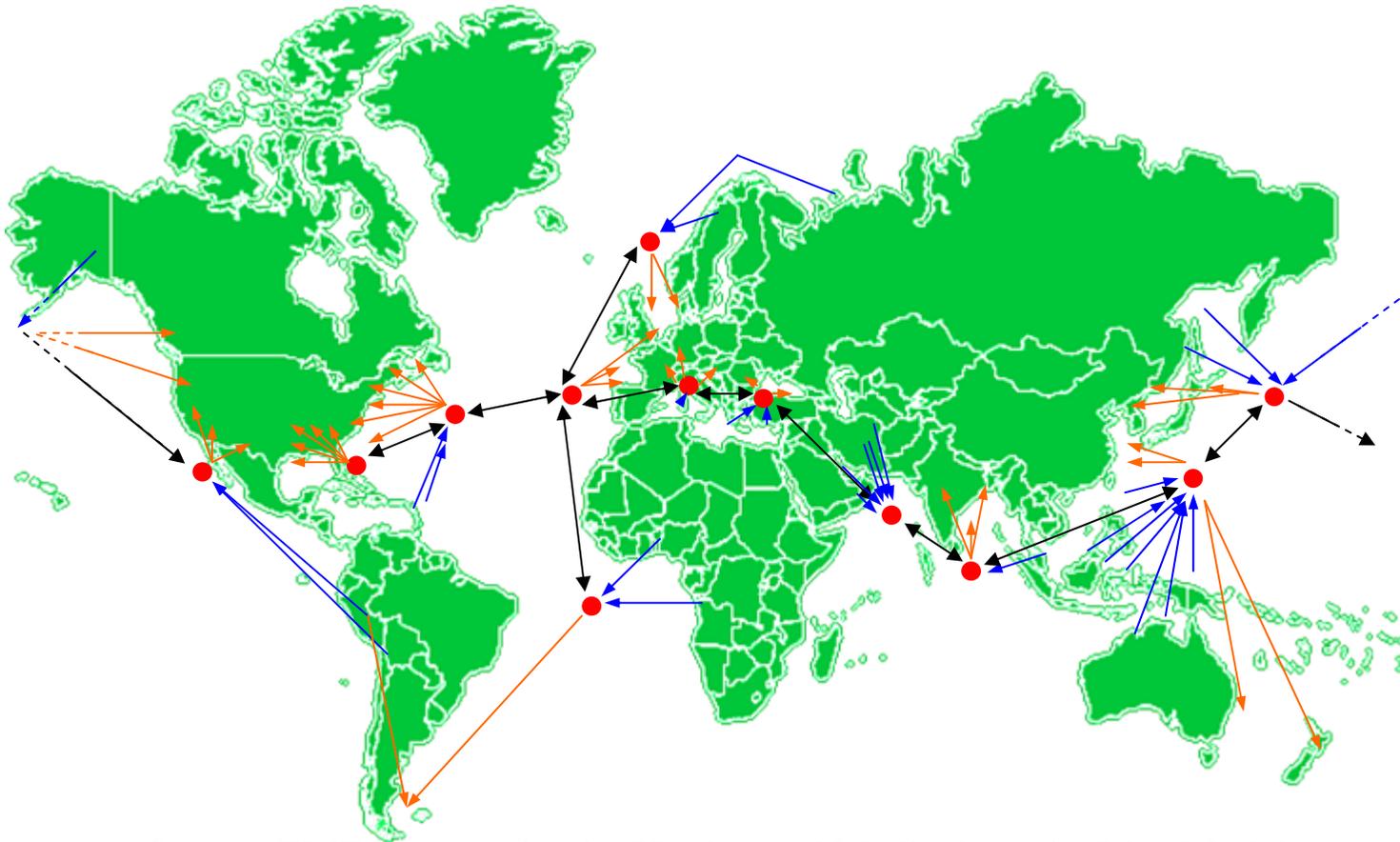
Courtesy of the University of Texas Libraries, The University of Texas at Austin.



Large Sunk Costs



Regional LNG Competition in Models



Source: EMF Presentation by Hartley and Medlock on the Rice Model

Several Organizations Used Models to Support EMF 23

<u>Symbol</u>	<u>Organization</u>
• RITE	Research Institute of Innovative Technology for the Earth
• CRA	Charles River Associates
• STAT	Statistics Norway
• SAIC	Science Applications International Corporation
• INGM	US Energy Information Admin. and ICF Consulting
• Rice	Rice University
• DIW	DIW Berlin (German Institute for Economic Research)
• GASTALE	ECN Policy Studies (Energy research Center Netherlands)
• CPB	CPB, Netherlands Bureau for Economic Policy Analysis
• - -	International Institute for Applied Systems Analysis *
• - -	University of Maryland *
• NEMS	US Energy Information Administration
• NANGAS	US Environmental Protection Agency and ICF Consulting

Notes: * Did not submit standardized results for this study.

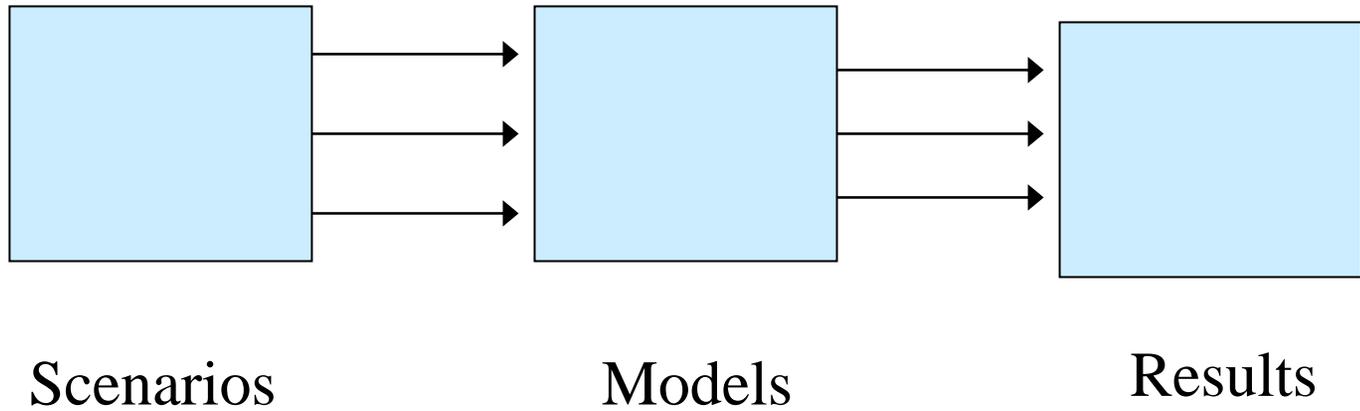
EMF Report is Available

- 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



could
What ~~will~~ be

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

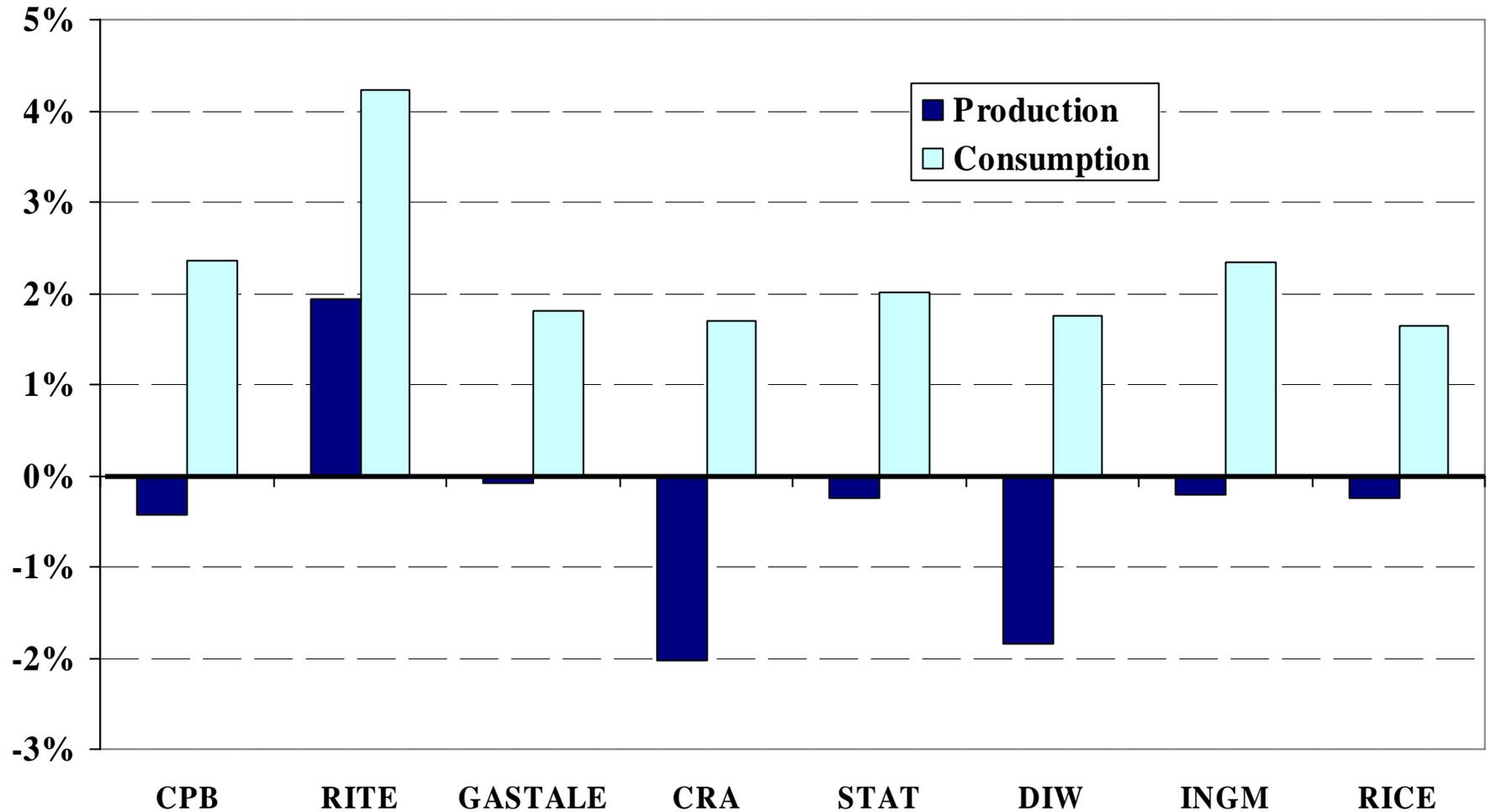
- R. W. Hamming

Rising Imports

- Future imports will grow as consumption outstrips production in the United States, Europe and Asia

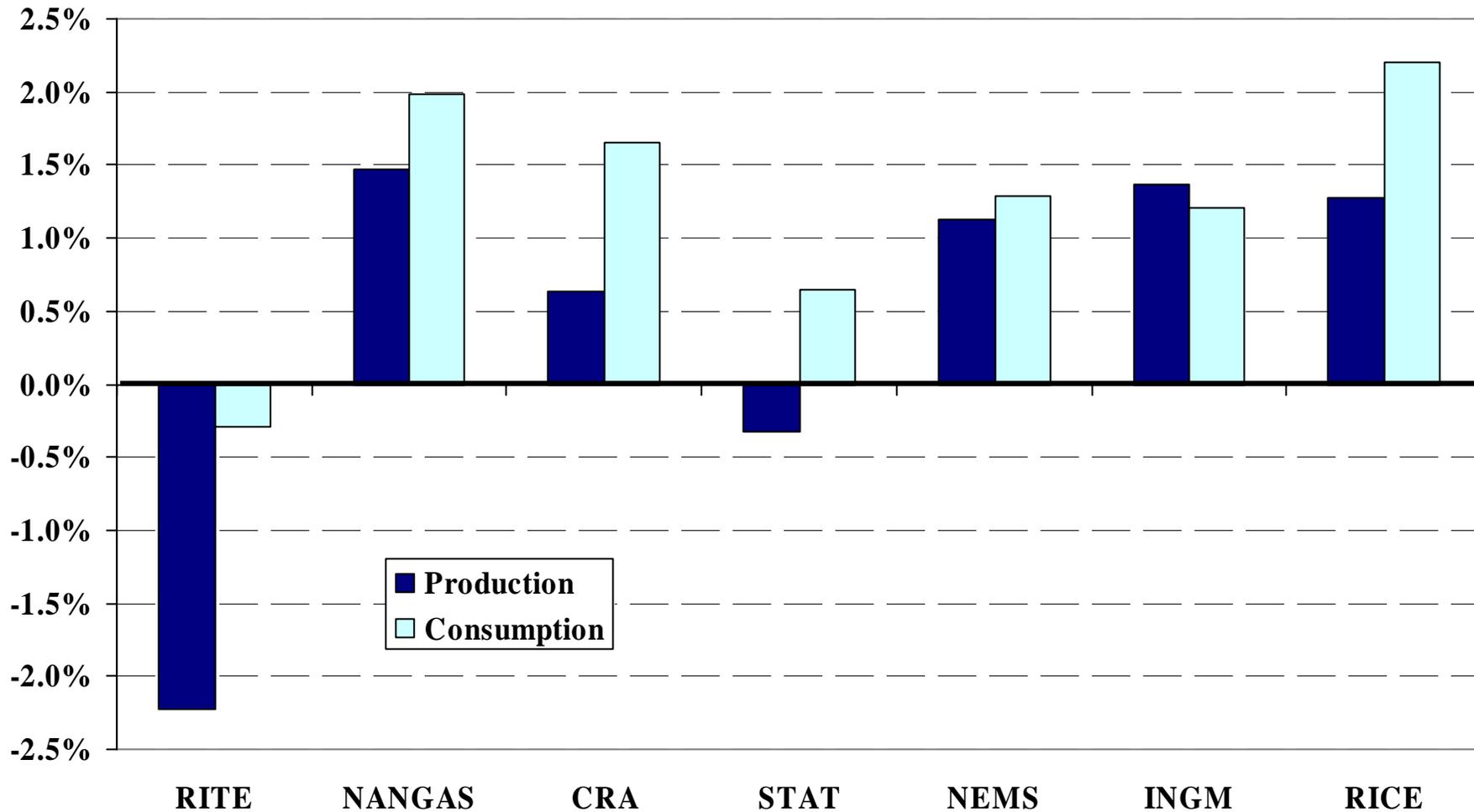
European Self Sufficiency

% p.a., 2005-2020



USA Self Sufficiency

% p.a., 2005-2020



LNG Fills Much of this Gap

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



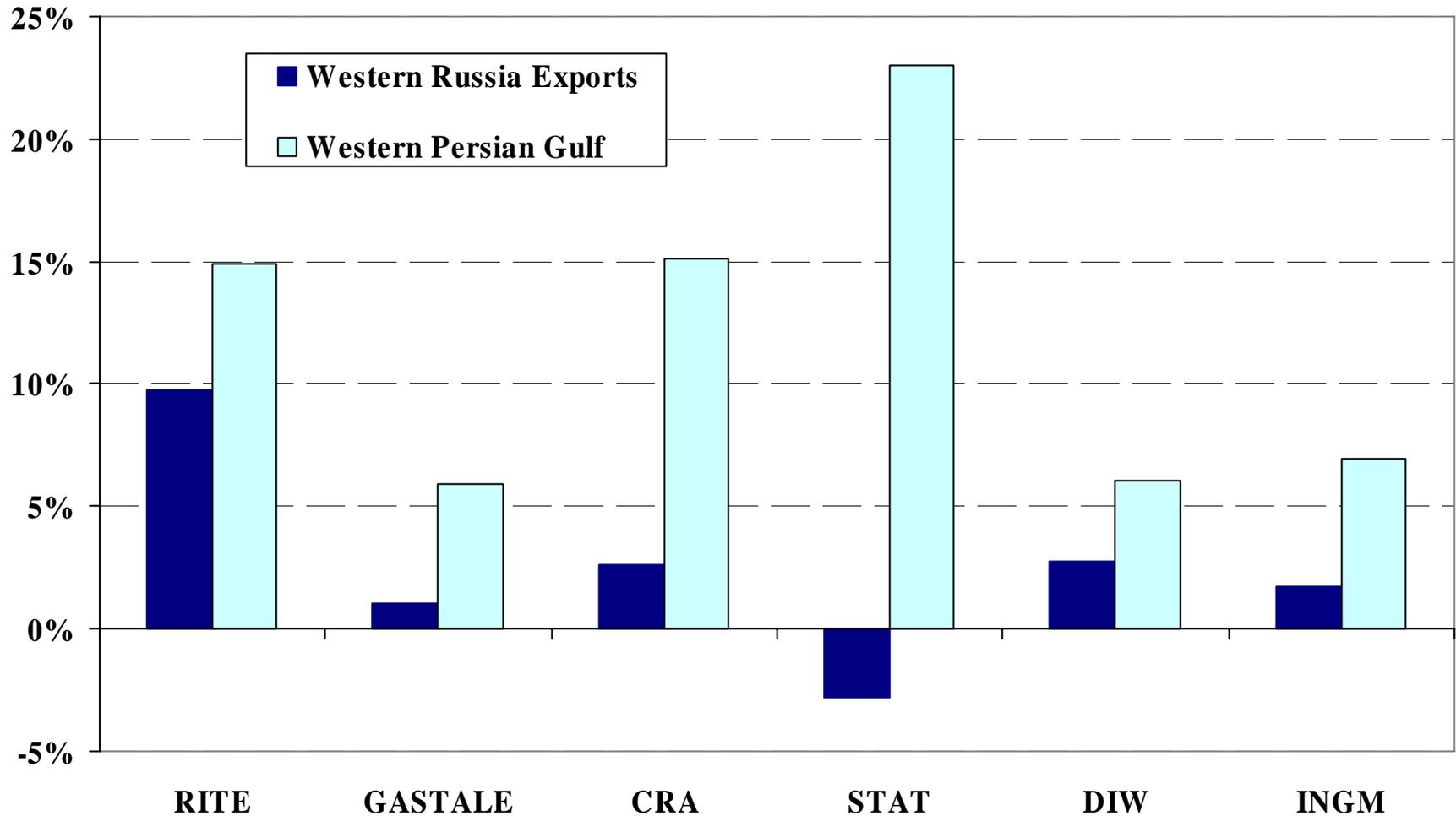
Source: Free Nature Pictures



Source: National Oceanic and Atmospheric Administration/Department of Commerce

Russia Loses Market Share

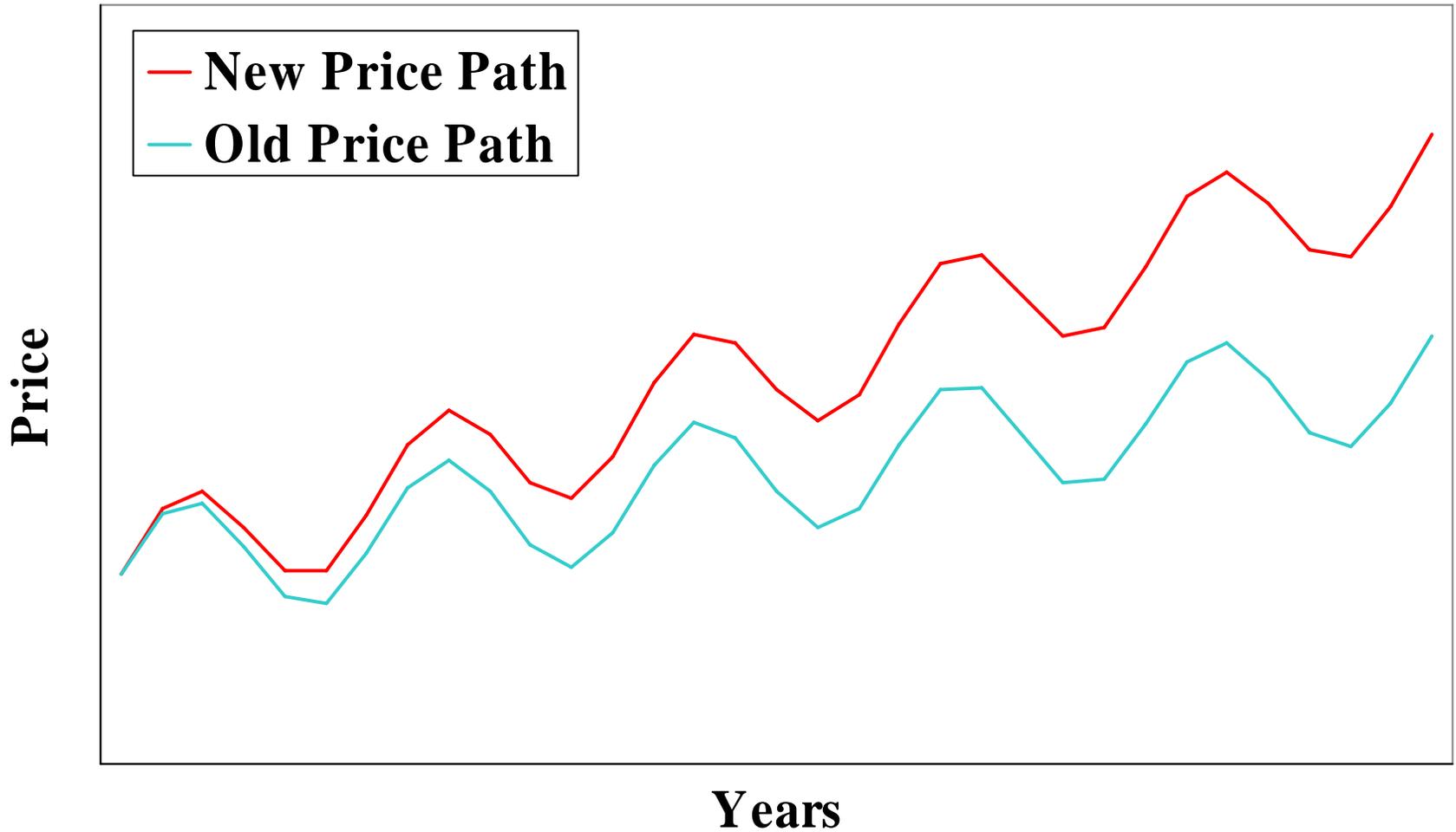
% p.a., 2005-2020



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



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

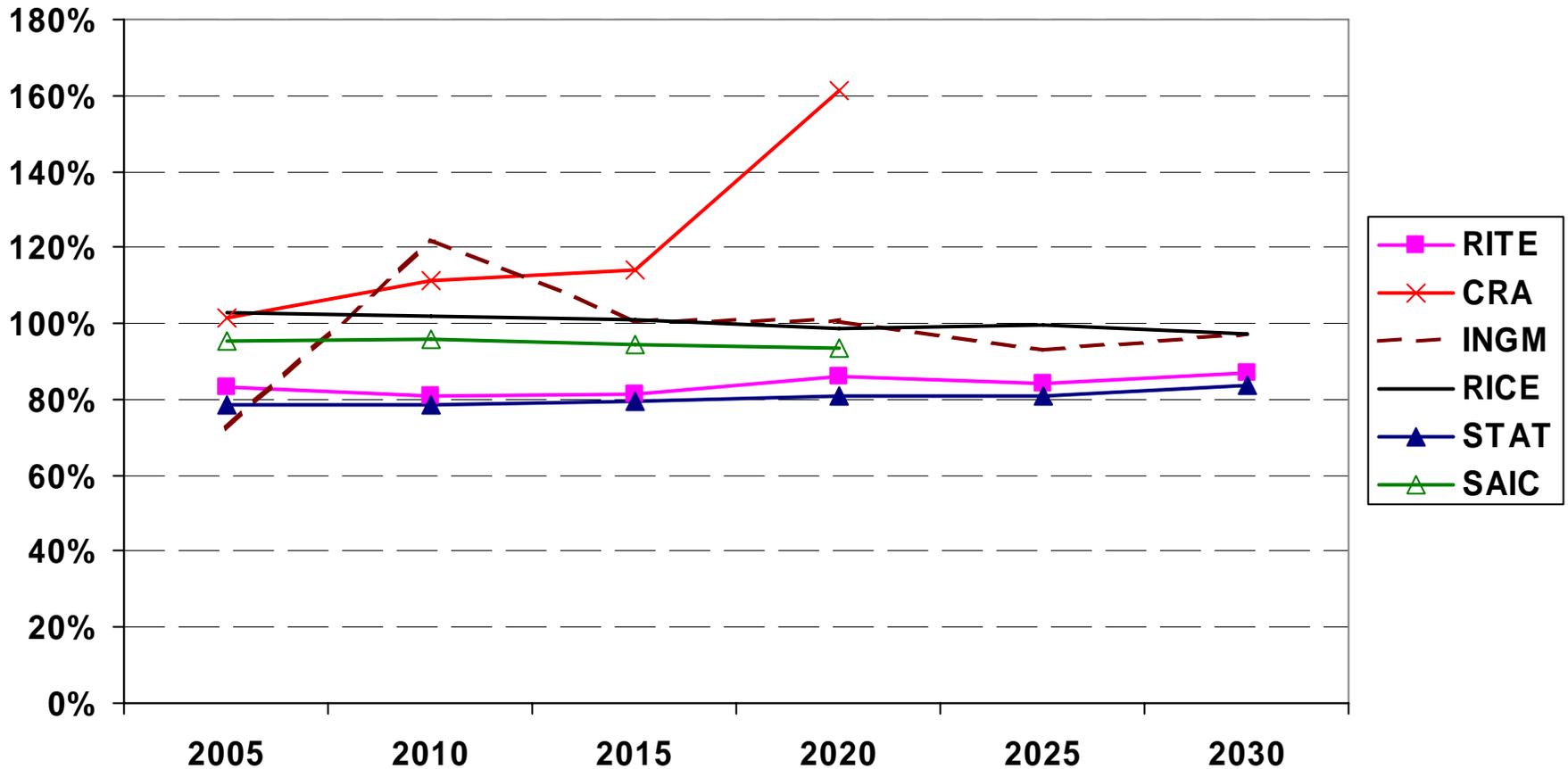
Despite lost fuel-switching capacity -

- 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)

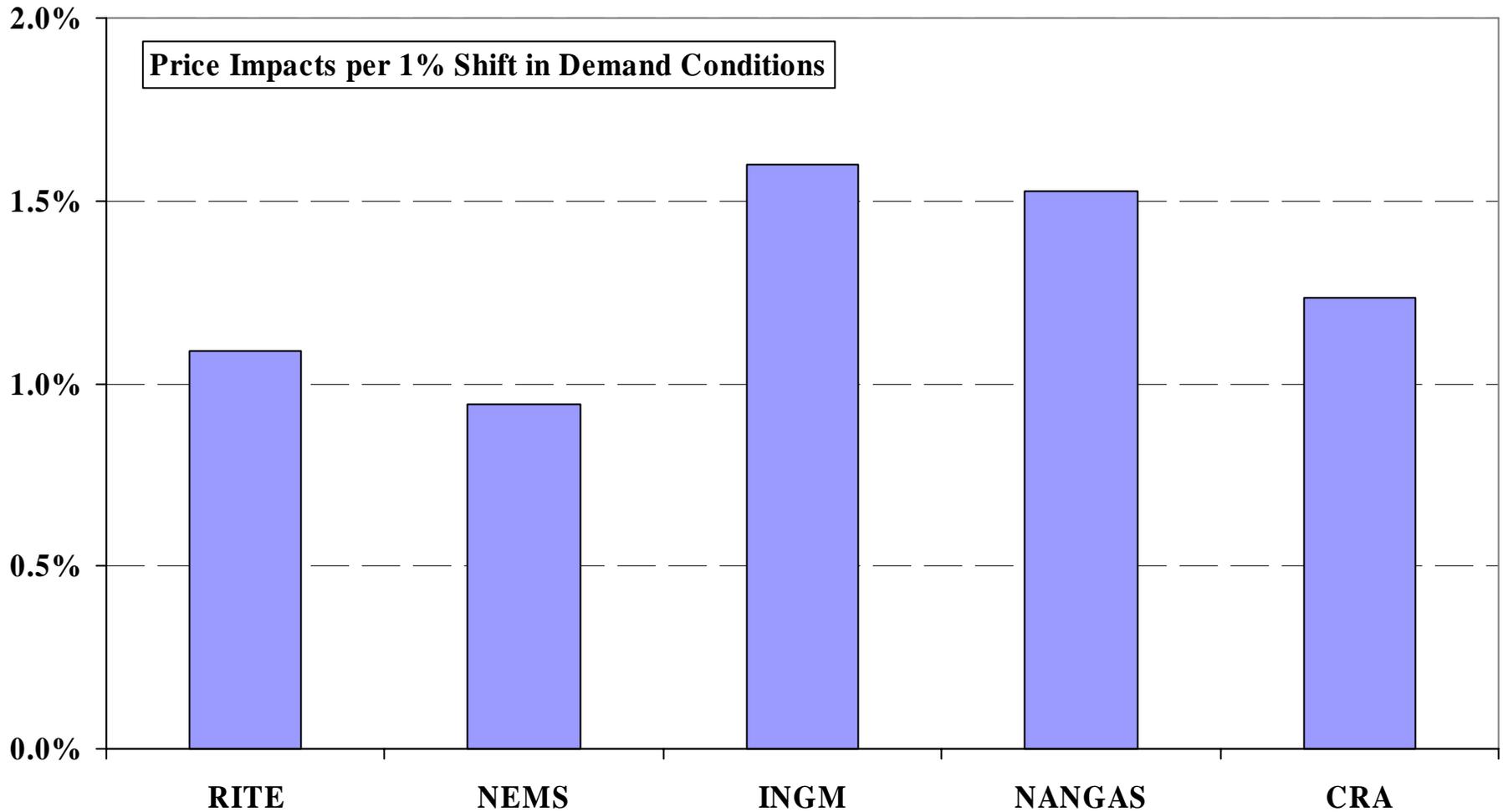


Demand Growth and Prices

- 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.

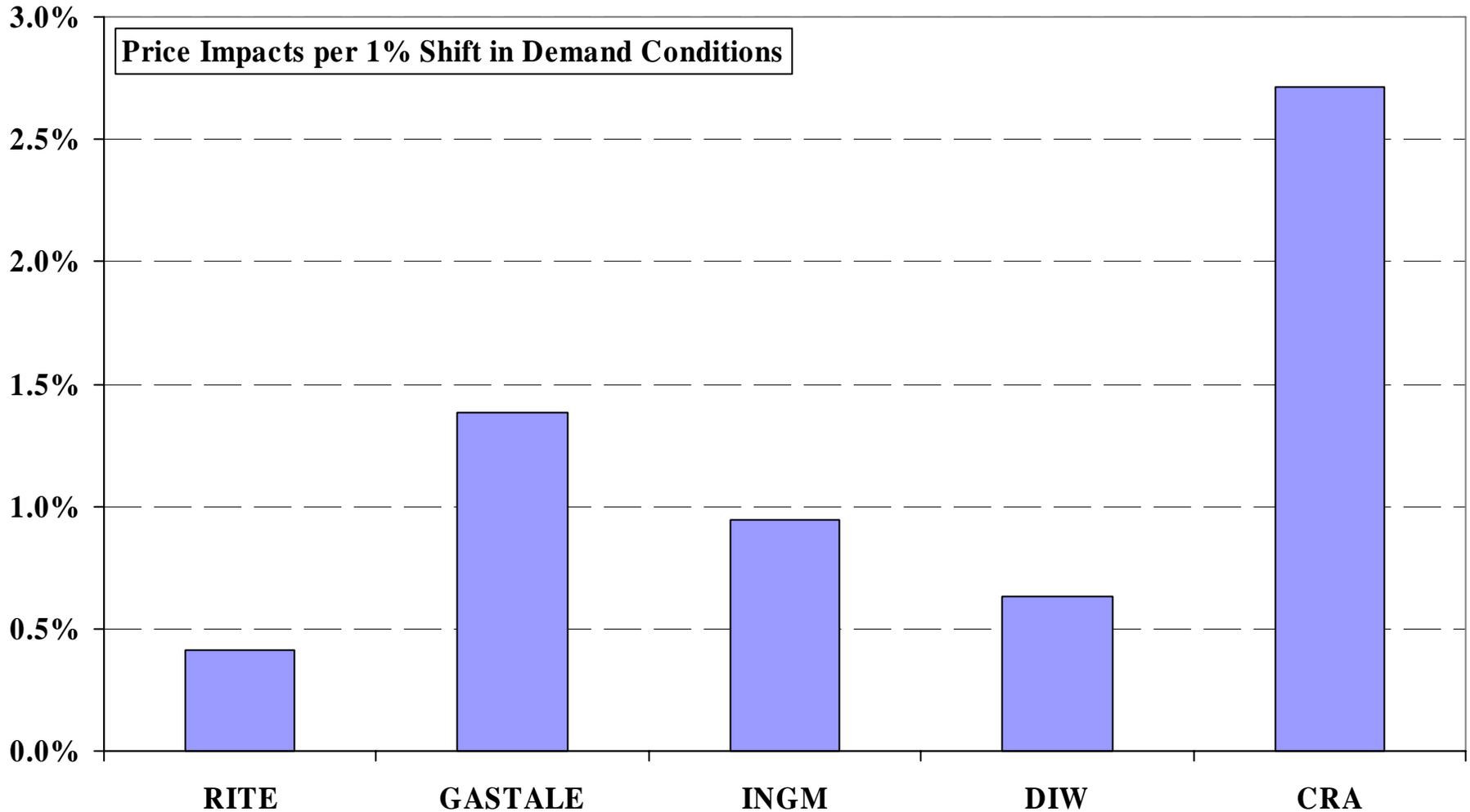
USA Prices / Demand Shift

Response in 2020



European Prices / Demand Shift

Response in 2020

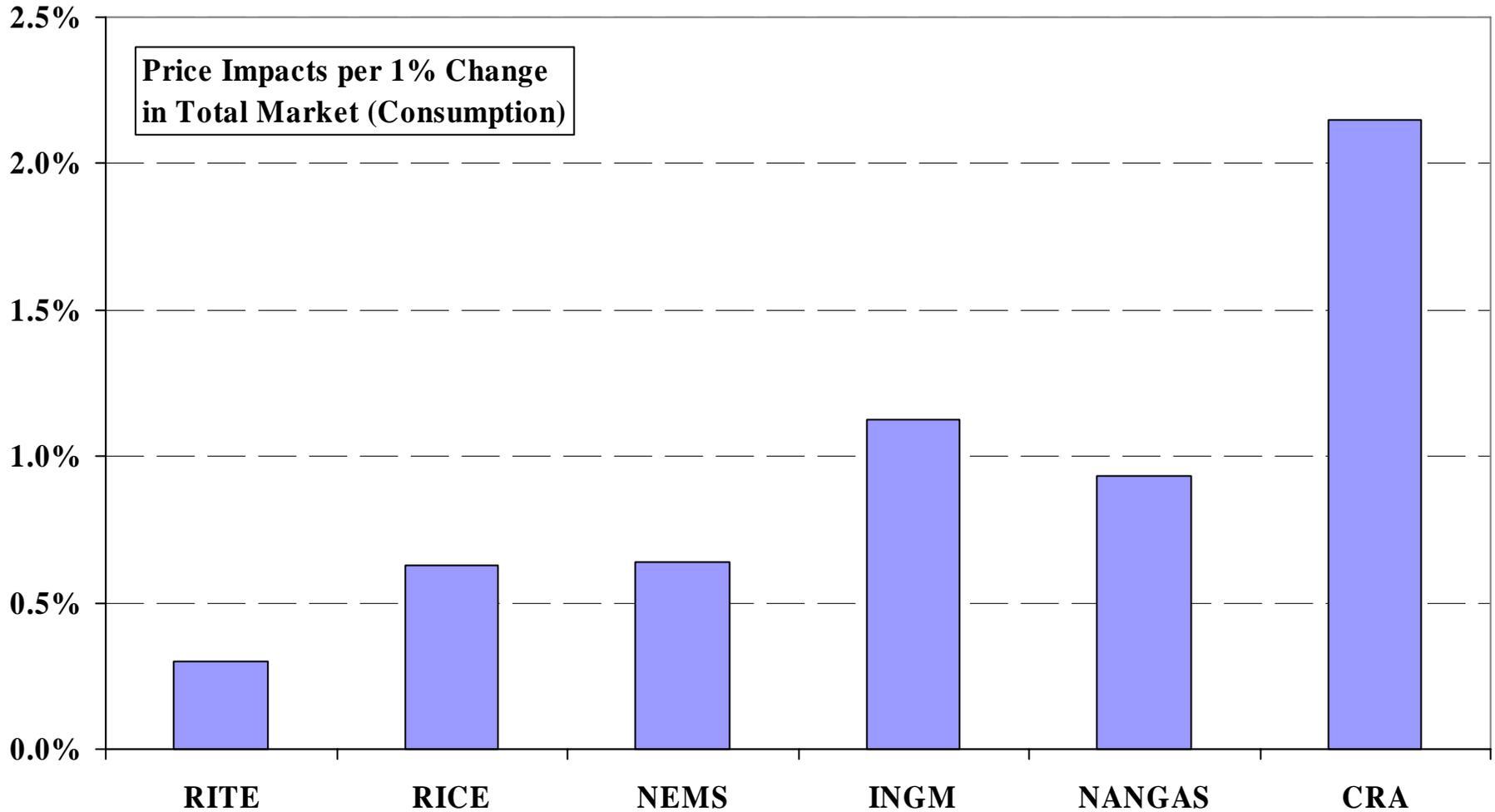


LNG Restrictions

- 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.

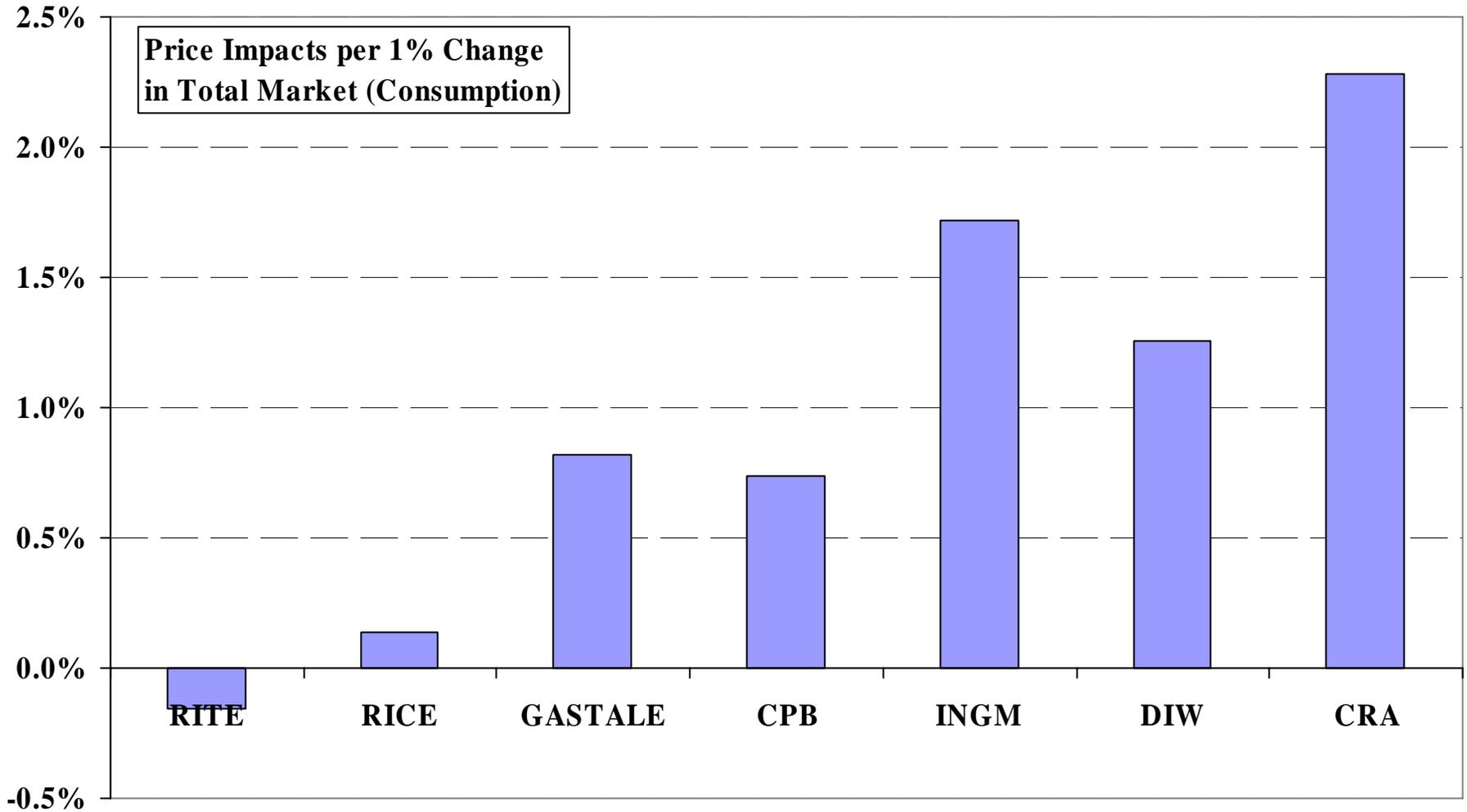
USA Prices / LNG Constraints

Response in 2020



European Prices/LNG Constraints

Response in 2020



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.