World Petroleum Markets
What the Past Tells Us About the Future

April 11, 2008
Capitol Hill
Washington, DC

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Washington, DC
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Introduction

Energy Policy Research Foundation Inc. (EPRINC), formerly the Petroleum Industry Research Foundation Inc. (PIRINC)

Founded in NY in 1944

- Moved to Washington from NYC in Feb 2007
- EPRINC brings policy analysis and industry economics to bear on current energy issues

Note: All data in this presentation are from EIA unless otherwise noted. Summary conclusions, comments, etc, are the sole responsibility of EPRINC.
TOPICS FOR TODAY

EPRINC’s Perspective on Structure and Pricing in the Upstream Crude Market (some history is useful)

Why Are Crude Prices So High Today?

What Does History and the Structure of the Crude Oil Market Tell Us About Policy Choices (and what is the problem we are trying to fix?)

Assessments of Trends in US and World Petroleum Product Markets
1973-74 Arab Oil Embargo

NOT AN EMBARGO, but instead a

• Structural Shift in Ownership and Control of the Resources of the Middle East

• Fundamental Change in Expectations on Production from Middle East Producers

As an Embargo it was a failure, market was integrated (lesson not yet learned by Chavez)
1979 Price “Shock”

OIL MARKET WAS NOT FRAGILE, but instead there was a shift in:

• expectations regarding regional risk; i.e. more risky

• Prospects for future output from Iran and Iraq were reduced substantially, i.e., access to those reserves would now be delayed
1986 Price Collapse

- Saudi Arabia abandons role as swing producer at low levels of net demand for SA crude
- Shift in expectations on Saudi decision making within OPEC and as regulator of world oil market
- Sustained reduction in oil use as a percentage of GNP in major Western countries
1998 Price Collapse: Six Central Issues

Asian economic crisis brings a collapse in net demand

• OPEC misreads the oil market
• Warm 1997-98 summers in N. America, Europe, Asia
• Increase in Russian oil exports as Ruble collapses
• Chinese authorities decrease imports in Q4 of 1998
• UN authorizes increase in Iraqi exportation in 1998
• Asian economic crisis brings a collapse in net demand
A Series of Unfortunate Events Leading to New Expectations

Positive Expectations

- Oil development in Iraq delayed
- Iraq invasion: outlook positive for new oil field rehabilitation
- Outlook positive for expanded output from Nigeria, Mexico, Venezuela, Russia, North Slope

Expectations Shift

- Yukos -- Kremlin taking control of Russian oil development
- Russia takes over Sakhalin II, Chavez Nationalizes Projects
- Congress continues ban on ANWR and offshore development
- OPEC Excess Capacity remains limited

Negative Expectations

- Congress continues ban on ANWR and offshore development
- Russia takes over Sakhalin II, Chavez Nationalizes Projects
- Continuing civil strife in Sudan, Nigeria
- Nigeria rebels hurt output

World Oil Production (EIA)
Expected Production (EIA 2001 Predictions)
OPEC Excess Capacity (EIA)
Crude Oil Price
The Peak Oil Problem:
New Supplies Will Be More Expensive, but We Are Not Running Out of Oil

"One thing is clear: the era of easy oil is over. What we all do next will determine how well we meet the energy needs of the entire world in this century and beyond."
- David J O'Reilly, Chairman & CEO, Chevron Corporation, July 2005
## San Joaquin Valley

Testing Hubbard-Method Predictions for Reserves and Production
(Billions of Barrels)

<table>
<thead>
<tr>
<th></th>
<th>1964</th>
<th>1982</th>
<th>2000</th>
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<tbody>
<tr>
<td>Cumulative</td>
<td>7.7</td>
<td>11.8</td>
<td>16.1</td>
</tr>
<tr>
<td>Discoveries</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Percent</td>
<td>49%</td>
<td>69%</td>
<td>76%</td>
</tr>
<tr>
<td>Attributable to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1915</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cumulative</td>
<td>8.0-9.5</td>
<td>11.9-12.1</td>
<td>16.1-16.2</td>
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<tr>
<td>production as of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>44-112</td>
<td>189</td>
<td>597(actual)</td>
</tr>
<tr>
<td>Year 2000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>production</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>projected in:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(mmb/d)</td>
<td></td>
<td></td>
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Source: EPRINC, October 2006. *Does the Hubbard Method Provide a Reliable Means for Predicting Future Oil Production*, Richard Nehring, October 2006,
### Permian Basin

Testing Hubbard-Method Predictions for Reserves and Production

(Billions of Barrels)

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<th>1964</th>
<th>1982</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative Discoveries</td>
<td>17.6</td>
<td>27.9</td>
<td>35.2</td>
</tr>
<tr>
<td>Percent Attributable to 1950</td>
<td>85%</td>
<td>86%</td>
<td>84%</td>
</tr>
<tr>
<td>Cumulative production as of</td>
<td>19-27.5</td>
<td>28.5-30.5</td>
<td>35.8-37.5</td>
</tr>
<tr>
<td>Year 2000 production projected in: (mmb/d)</td>
<td>162-479</td>
<td>326-479</td>
<td>910(actual)</td>
</tr>
</tbody>
</table>

Source: EPRINC, October 2006. *Does the Hubbard Method Provide a Reliable Means for Predicting Future Oil Production*, Richard Nehring, October 2006,
What Does the Permian and San Joaquin Tell Us About the Hubbard Predictions

- Knowledge and technology grow over time
- Big payoff to long term access to both existing and new oil provinces
- More importantly Hubbard Method does not reveal ...........
  - The Backstop Price
  - Total Recovery
WHAT DOES THIS ANALYSIS TELL US ABOUT THE ENERGY SECURITY PROBLEM?

- Current Market Price Probably Tied to a “Perfect Storm” of Unfortunate Events – More Than Declining Reserves (Peak Oil)
- This Concentration of Low Cost Reserves Poses Risks to the US (wealth transfers, price spikes)
- What Would be the Elements of an Effective Strategy Given This Analysis?
The Refining Sector

Imbalances and Uncertainties

Capitol Hill Briefing
April 11, 2008
Declining Dollar Value Relative to Foreign Currency Basket

Nominal and Dollar-Adjusted Crude Prices

*Note: Actual Refiner Acquisition Cost
What’s a Refinery?

- Vacuum Distillation
- Atmospheric Distillation

- gas oils
  - Gas oils
  - Deasphalting
  - Coking

- naphthas
  - Alkylation
  - Isomerization
  - Catalytic Reforming

- distillates
  - Hydrocracking
  - Fluid Catalytic Cracking
  - Hydrotreating

- residue
  - Lubricants

- gases
  - Fuel Gas
  - Propane

Products:
- Gasoline and Distillate Blendstocks
- Jet Fuel
- Diesel Fuels and Heating Oils
- Gasoline
- Diesel Fuels and Heating Oils
- Gasoline and Distillate Blendstocks
- Lubricating Oils
- Coke
- Asphalt
Modular Investment in Refinery Upgrades

Need to:

- Make high specification products
- Make cleaner gasoline
- Make gasoline for ethanol blending
- Make ultra-low sulfur diesel (ULSD)
- Make across-the-board sulfur reduction
- Adjust to declining crude quality
- Reduce refinery site emissions
U.S. Oil Refineries History: 1970 - Present

* Many sub-economic, little refineries could not make unleaded gasoline.

* Small unit issues: population shift and US crude supply runs out
U.S. Oil Refineries History: 1970 - Present

- **1970s:** The Small Refiner Bias in the 1973 price control program encouraged the building of excess small refineries.
- **1979:** Price controls end.
- **1980-1990:** Rationalization of refining.
  - Closure of small, uneconomic units - adversely impacted by population and crude supply shifts.
  - Capacity at existing, better-located facilities expanded.
    - Remaining refinery campuses become bigger, more efficient.
- **Mid-1990s:** Capacity grows; demand grows faster.
- **2000s:** More investment needed to expand existing refineries.
  - Regulatory issues
  - Capital requirements and investment decisions

*What happened to “Refining’s Golden Age?”*

* Global excess capacity until early 1990s - investment climate?

* 2003: Demand catches up with capacity - China?

* 2007: Demand exceeds capacity?
U.S. Gasoline and Diesel Pump Prices 2005 - 2008


2006: Relationship changes.

2007/8: Dramatic change.
Global Distillate Consumption Growth: 2003 - 2006

Distillate Consumption Growth 2003-2006

USA: 334 Thousand bd
Europe: 619 Thousand bd
China: 744 Thousand bd
World: 2489 Thousand bd


Refining Capacity
Refining Consumption

(millions b/d)


22,000
20,000
18,000
16,000
14,000
12,000
10,000
U.S. Gasoline and Diesel Pump Prices 2005 - 2008


2006: Relationship changes.

2007/8: Dramatic change.

Wholesale Gasoline Price and Crude Cost

Note recent refiner margin compression
Gasoline and Distillate Prices: NYH vs. Rotterdam
2006 - 2008

• 2006/7: Gaso & distillate prices track. NYH gaso has summer spike.

• 2007/8: World distillate prices exceed gasoline.

2005 - 2008 Wholesale Distillate Price and Crude Cost

(cents/gal)

<table>
<thead>
<tr>
<th>January-05</th>
<th>March-05</th>
<th>May-05</th>
<th>July-05</th>
<th>September-05</th>
<th>November-05</th>
<th>January-06</th>
<th>March-06</th>
<th>May-06</th>
<th>July-06</th>
<th>September-06</th>
<th>November-06</th>
<th>January-07</th>
<th>March-07</th>
<th>May-07</th>
<th>July-07</th>
<th>September-07</th>
<th>November-07</th>
<th>January-08</th>
<th>March-08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Cost</td>
<td>Wholesale Distillate Price</td>
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</tbody>
</table>
Gasoline Imports as Percentage of Consumption: 2005 - 2008

Note recent decline in gaso imports

Note steady distillate import decline
US Ethanol Consumption: 2000 - Present

US Ethanol Consumption 2000 - Present

(000 b/d)

January-00 July-00 January-01 July-01 January-02 July-02 January-03 July-03 January-04 July-04 January-05 July-05 January-06 July-06 January-07 July-07 January-08

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US Ethanol Consumption:
2000 - Present

- Quick ramp-up made it look easy—but really was displacement of MTBE
- Ethanol does not displace much foreign oil. 6 bil gallons per year of ethanol saves approx 100 million bbls of oil.
- Corn prices have risen from $1.60 to $6.00. How much attributable to ethanol driven demand? $1.00? $2.00?
- At $1.00/bu, oil saved cost $130/bbl; at $2.00/bu, the figure is $230 per bbl.
- Current Ethanol Economics Looks Dicey—With high corn prices, low fuel ethanol prices, existing plants earn losses.
- Existing plants have 7 bil gal capacity; mandate calls for 2 bil more
- Plants under construction and planned may not be completed/brought on line
- If corn prices remain stable at current levels, ethanol prices must rise by at least $0.50 per gallon in order for ethanol to be sufficiently profitable to attract investment.
- More capacity needed to meet 9 bil gal mandate for 2008
CBOT Ethanol Futures versus CBOT Corn Futures

Correlation -- -.0413
## Ethanol Production Cost ($/Gal)

<table>
<thead>
<tr>
<th>Cost</th>
<th>Wet Mill</th>
<th>Dry Mill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>Miscellaneous Inputs</td>
<td>0.56</td>
<td>0.52</td>
</tr>
<tr>
<td>Corn ($6/bu)</td>
<td>2.31</td>
<td>2.14</td>
</tr>
<tr>
<td>Co-product credit</td>
<td>-1.03</td>
<td>-0.41</td>
</tr>
<tr>
<td>Subtotal</td>
<td>2.14</td>
<td>2.55</td>
</tr>
<tr>
<td>Remaining To Cover Fixed Costs/Profit</td>
<td>0.36</td>
<td>-0.05</td>
</tr>
</tbody>
</table>

Sources: Simmons & Company International; EPRINC Calculations
U.S. Retail Prices: Gasoline vs. Diesel 2006 - 2008

Retail Prices: Gasoline vs. Diesel Jan 2006 - April 2008

- US Regular - All
- US Diesel - All
- US Ultra Low Sulfur
- US Low Sulfur
Global Oil Consumption – All Products and Middle Distillates

Global Oil Consumption - All Products and Middle Distillates

- Total World
- Middle Distillates


- 0-15 ppm
- 15-500 ppm
- 500-2000 ppm
- >2000 ppm

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U.S. Distillate Consumption and Imports: 2005 - 2008

US Distillate Consumption and Imports 2005 - 2008

US Distillate Consumption
US Distillate Imports

(000 b/d)
U.S. Gasoline Consumption and Imports: 2005 - 2008

U.S. Gasoline Consumption and Imports: 2005 - 2008

U.S. Gasoline Imports
U.S. Gasoline Consumption
THE END