PRISM™
Refining and Marketing Industry Analysis

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Baker & O’Brien Overview

• History
  – Founded in 1993
  – Independently owned and managed
  – Combined technical and commercial expertise
  – Over 1,300 assignments completed

• Consulting Staff
  – Chemical, mechanical, civil, and electrical engineers
  – Most have advanced degrees – MBA, economics, or finance
  – Consultants average over 30 years experience
  – Experienced problem solvers
  – Supported by highly-trained analytical staff
Baker & O’Brien’s unique combination of expert and strategic consulting services allows us to provide the breadth and depth of support that is needed by clients making decisions on complex issues.
What Is PRISM?

• Refining and Marketing Industry Database
• Refinery Simulator
• Crude Assay Library
• Archive for Commercial Intelligence
• Menu-Driven System for Viewing and Reporting
• Open Architecture Using Microsoft® Access and Excel
Refining and Marketing Industry Database

- **Extensive Historical Performance Database**
  - United States
    - Essentially all U.S. refineries
    - Updated quarterly
    - Historical data back to 1995
  - Canada
    - Essentially all Canadian refineries (excluding Fort McMurray)
    - Updated annually
    - Historical data back to 2007
  - Europe
    - 74 European refineries representing roughly 65% of European refining capacity (everything west of Russia - plus Turkey)
    - Updated annually
    - Historical data back to 2005
  - Asia-Pacific
    - 16 refineries including all the Australian, New Zealand, and Singapore, and selected refineries in India, Malaysia, Taiwan, Japan, and Korea
Refining and Marketing Industry Database

• Detailed Analysis of Refinery Operations
  – Crude and other feedstock logistics, quantities, qualities, and costs
  – Individual unit capacities, operating, and replacement costs
  – Product yields, qualities, and distribution patterns
  – Fixed and variable expenses and replacement costs
  – Carbon dioxide emissions

• Comprehensive Economic Treatment of Supply Chain
  – Crude from load port or initial injection point
  – Products to wholesale terminals
  – Pipelines and waterborne transportation included
  – Delivered product cost to sales terminals
  – Can model pipeline capacity constraints
• **Consistent Basis for Competitive Analysis**
  – Try to match actual physical operations but not financial reports
  – No inventory modeling; no FIFO or LIFO effects
  – No “hedging” or other trading profits or losses
  – No profits or losses due feedstock or product contracts including exchange agreements
  – No preferential or “incentive” shipping rates

• **Based on “Public” Information plus Baker & O’Brien Judgment**
  – State, national, and international agency sources
  – Company reports and presentations
  – Country and state reports
  – Articles and newsletters
Refinery Simulator

- **Non-linear, Sequential Solution, Deterministic Model**
  - Case study tool
  - Mass balanced
  - LP used to optimize product blending

- **Individual Process Unit Models**
  - One of almost every refinery process
  - Multiple crude distillation trains, distillate hydrotreaters, and hydrocrackers
  - Over 800 tuning parameters - each with a default
  - Logical “control valves” used to configure flow scheme
  - Over 65 product properties (i.e., specific gravity, aniline point, etc.) used to drive yield correlations
  - Utility consumption and replacement costs built-up from unit models
Refinery Simulator (Cont.)

• **Carbon Dioxide Emissions**
  – Direct (boilers, heaters, FCC, etc.) based on actual fuel composition
  – Indirect electrical consumption (optional)
  – Structure exists for tracking indirect product and feedstock carbon dioxide
  – Can assign a cost to emissions

• **Fixed Cost and Replacement Cost Unit Factors**
  – Rigorous calculation of replacement cost index
  – Separate unit factors used to estimate fixed operating costs

• **Location and Inflation Indices for Labor and Replacement Costs**
• Over 210 Crude Assays Included
• Correlation Coefficients for Property Curves
  – Crudes can be “re-cut” instantaneously
  – No swing cuts
• Crude Assay Director Used to Regress Correlation Coefficients
Who Uses PRISM?

- **Refining Companies**
  - Long-Range Planning
  - Mergers and Acquisitions
  - Competitive Analysis (peer comparisons)
  - Supply Chain Analysis

- **Marketers and Traders**
  - Crude oil economics
  - Downstream integration analysis
  - Crude and product supply balances
  - Impact of refinery shutdowns

- **Financial Institutions**
- **Technology Licensors**
- **Petroleum Pipeline Companies**
- **Hydrogen and Industrial Gas Producers**
- **Engineering and Construction Firms**
Typical PRISM Uses

**Competitive Benchmarking**

<table>
<thead>
<tr>
<th>Refinery</th>
<th>Total Crude Charge (MMB)</th>
<th>Total Inputs</th>
<th>API</th>
<th>Crude Sulfur</th>
<th>Variable Margin (MMB)</th>
<th>Crude Sulfur Margin (MMB)</th>
<th>Total Fixed Cost (MMB)</th>
<th>Cash Margin (MMB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refinery 1</td>
<td>207,212</td>
<td>219,975</td>
<td>31.9</td>
<td>0.8657</td>
<td>1.08%</td>
<td>10.33</td>
<td>3.60</td>
<td>6.52</td>
</tr>
<tr>
<td>Refinery 2</td>
<td>202,786</td>
<td>258,596</td>
<td>34.2</td>
<td>0.8539</td>
<td>1.45%</td>
<td>10.34</td>
<td>3.56</td>
<td>6.39</td>
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<tr>
<td>Refinery 3</td>
<td>40,693</td>
<td>41,197</td>
<td>41.6</td>
<td>0.0180</td>
<td>0.45%</td>
<td>15.04</td>
<td>3.52</td>
<td>11.52</td>
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<tr>
<td>Refinery 4</td>
<td>139,302</td>
<td>149,027</td>
<td>26.0</td>
<td>0.9396</td>
<td>2.53%</td>
<td>7.57</td>
<td>2.66</td>
<td>5.09</td>
</tr>
<tr>
<td>Refinery 5</td>
<td>8,154</td>
<td>9,223</td>
<td>19.5</td>
<td>0.9370</td>
<td>2.10%</td>
<td>10.94</td>
<td>4.22</td>
<td>6.72</td>
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<tr>
<td>Refinery 6</td>
<td>222,136</td>
<td>239,371</td>
<td>22.0</td>
<td>0.9218</td>
<td>1.73%</td>
<td>7.63</td>
<td>2.51</td>
<td>5.02</td>
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<tr>
<td>Weighted Average</td>
<td>136,712</td>
<td>152,659</td>
<td>29.1</td>
<td>0.8811</td>
<td>1.60%</td>
<td>9.43</td>
<td>3.35</td>
<td>6.09</td>
</tr>
</tbody>
</table>

**Refining Industry Margin Curve**

- Lowest performing million barrels of capacity

**At-Risk Refinery Analysis**

**Product Supply Curve Analysis**
Typical PRISM Uses

Netback Analysis

Marketing Analysis

Transportation Analysis

Commercial Intelligence Analysis
Typical PRISM Uses

Crude Valuation and Marketing Strategy

- **Methodology**
  - **PRISM™** Simulator and Database used to calibrate base case and calculate yields
  - Crude assays provided by client or from Baker & O’Brien
  - Base case crude slates reviewed and agreed with client
  - Average breakeven values calculated over entire crude increment
  - Absolute and relative refining values calculated using 10 years of pricing data for reference (monthly data)
  - Breakeven refining values calculated as follows:
    \[ \Sigma (\text{Prod Vol.}) \times (\text{Prod Price}) \text{ minus } \Sigma (\text{Feedstock Vol.}) \times (\text{Feedstock Price}) \text{ minus } \Sigma (\text{Energy, etc. Vol.}) \times (\text{Energy, etc. cost}) \]
The *PRISM* system facilitates use through the user interface (MS Access) or directly with the simulator (MS Excel).

- Open Microsoft Excel Based Simulator
- One of “Every” Type of Unit
- Non-linear Unit Models
- LP Blending of Gasoline and Distillates
- Automated Data Transfer to/from Access Database

- Open Microsoft Excel Based Assay Analysis/Generator
- Use Properties from Similar Crudes to Supplement Available Data
- Curve-fit Property Data and Generate Coefficients
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