Crude Oil: Scenarios and Perspectives of the Market

“Heavy Sour Crude Oil”

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Comisión de Investigación de los Precios del Petróleo
The Market’s view of the long-term has changed

Price of WTI for delivery 5 – 7 years out has moved up dramatically since 2003 and prices all along the forward curve have moved up to new highs in recent weeks.

Source: Barclays Capital Aug 5, 2005
Refinery Capacity Tight

U.S. Refining Capacity & Inputs

Tight Refinery Capacity. Today is not the whole Story --we have been there before.
Crude Supply Capacity extremely tight

... and the Marginal Supply from OPEC is sour and heavy.
Benchmark crude oil (WTI) setting record prices
As oil prices increased, differentials have widened: both Sweet – Sour…

WTI – Mars (spot)

Courtesy HETCO
...and Light – Heavy: WTI – Maya

![Graph showing the price of WTI and Maya crude oil over time. The graph includes dates and corresponding prices, with the x-axis representing dates from 02/08/2004 to 01/08/2005 and the y-axis representing US$/bbl from 9.00 to 21.00. The graph shows fluctuations in price over the specified period.]

Courtesy HETCO
These differentials all reached a peak in late 2004; Canadian bitumen netbacks were negative ~$5.00/bbl. Companies reduced booked reserves.
Why were heavy sour crudes so discounted?
World Crude Quality

Light Sweet Crudes

Medium Sour Crudes

Heavy Sour Crudes

Source: ENI World O&G Review, 2004
World Crude Quality

Excludes ‘ultra-heavy crudes’

Source: ENI World O&G Review, 2004
World Crude Quality ‘stable’ since 1994

Source: ENI World O&G Review, 2004
Quality & Volumes of Main Crude streams, Americas

Maya is the main player in the Heavy Sour Stream, against mostly Venezuelan & Canadian streams.

Source: ENI World O&G Review, 2004
Crude Streams by Quality: Americas

~ 47% in 1994 and ~ 60% in 2003 of crude streams with assigned qualities. Heavy & Sour stream increased from 35% to 42%

Source: ENI World O&G Review, 2004
Heavy Crude Oil (HCO)

- ‘Reversing nature’s work’ costs money all along the HCO supply chain
- Producer ↔ Refiner: opposing interests—reconcilable through contracts
- Supply bbl and Demand bbl headed in different directions re Sulfur  [More crudes with more sulfur for markets wanting less/no sulfur]
- Relatively few suppliers
World Oil Market: Microeconomic Characterization

**WORLD PRODUCTION**

2001 = 68 MMBD

**SPECIALTY CRUDES**

12.5 MMBD

**GENERAL PURPOSE**

53 MMBD

**CONDENSATES**

2.5 MMBD

<table>
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<th>Specialty crude markets:</th>
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<tr>
<td>• Require special capital assets with single base-load feedstock (switching costs are high).</td>
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<tr>
<td>• Strong bilateral commercial co-dependence for the long term.</td>
</tr>
<tr>
<td>• Restricted to few sets of counter-parties.</td>
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Source: OIES, J-C Boué
Different Crudes yield different products

- **Maya**
  - 22 °API
  - 3.3% S

- **Isthmus**
  - 33 °API
  - 1.5% S

- **Olmeca**
  - 40 °API
  - 0.8% S

<table>
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<tr>
<th>Product</th>
<th>Maya</th>
<th>Isthmus</th>
<th>Olmeca</th>
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<tr>
<td>Light ends</td>
<td>1.4%</td>
<td>2.3%</td>
<td>4%</td>
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<tr>
<td>Gasoline/Naphtha</td>
<td>19.6</td>
<td>38.2</td>
<td>36%</td>
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<tr>
<td>Distillates</td>
<td>20.9</td>
<td>19.4</td>
<td>31%</td>
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<tr>
<td>Gasoil</td>
<td>36.6</td>
<td>27.9</td>
<td>22%</td>
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<tr>
<td>Resid/HFO</td>
<td>3.3%</td>
<td>14.6</td>
<td>10%</td>
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</table>

Graph showing the percentage distribution of different products from each crude.

- **Light ends**
- **Gasoline/Naphtha**
- **Distillates**
- **Gasoil**
- **Resid/HFO**
Different Markets want Different Products

...and use different refinery configurations
And the Product Barrel must meet more stringent environmental specs

<table>
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<th>EU Auto Oil:</th>
<th>2000</th>
<th>2005</th>
<th>2010E</th>
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<tr>
<td>Sulfur Gasoline</td>
<td>150 ppm</td>
<td>50 ppm</td>
<td>10 ppm</td>
</tr>
<tr>
<td>Sulfur Diesel</td>
<td>350 ppm</td>
<td>50 ppm</td>
<td>10 ppm</td>
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[Germs 10 ppm/03]

**United States**

Reformulated Gasoline required in urban areas of the East Coast (DC-Boston); Midwest; Texas; and most of California

- **Sulfur**
  - Conventional Gasoline: 330 ppm
  - Reformulated Gasoline: RFG 125 CA 40

**Diesel (Highway)**

500 ppm

A complex set of standards introduced in steps 2004, 2005, 2006, involving phased in specs including pool averages, % share off-spec, eventual caps with full compliance for both Gasoline and Diesel @ 15 ppm by 2010
Economic incentives for deep conversion—to increase Gross Product Worth (GPW)

Source: OIES, J-C Boué

<table>
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<tr>
<th>Processing Units</th>
<th>Very Complex</th>
<th>Coking</th>
<th>FCC/Alkyl</th>
<th>FCC</th>
<th>Simple Hydroskimmer</th>
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<td>Atmospheric Dist.</td>
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<td>Vacuum Dist.</td>
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<td>Reforming</td>
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<td>Alkylation</td>
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<td>Coking</td>
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<td>Hydrocracker</td>
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Typical feedstock

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<tr>
<th>CIF Price (USD/B)</th>
<th>Maya</th>
<th>Maya</th>
<th>Arab medium</th>
<th>Arab light</th>
<th>Brent</th>
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<tr>
<td></td>
<td>15.57</td>
<td>15.57</td>
<td>17.00</td>
<td>18.10</td>
<td>21.03</td>
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<tr>
<td>GPW (USD/B)</td>
<td>20.50</td>
<td>20.06</td>
<td>19.70</td>
<td>18.35</td>
<td>18.88</td>
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</tbody>
</table>

1997 Prices

Gasoline

50%

Distillates

Fuel oil/ others

Source: OIES, J-C Boué
The heavy crude supply comes essentially from the Western Hemisphere (2001)

Source: OIES, J-C Boué
World Market for Heavy Sour Crude

…and Heavy sour crudes don’t travel far—they stay in the Western Hemisphere

The US and USGC in particular takes the Lion’s share. (2002)

Source: OIES, J-C Boué
Where Residual Oil* goes (USGC, 2002)

* >650°F

- Power Gen. Mono-fuel 6%
- Bi-fuel < 1%
- Bunkers ~2%
- Others < 1%

~75% at refineries

Bulk of residual oil consumed by CAPTIVE consumers. When supply exceeds demand in these uses, price of heavy crude collapses.

Source: OIES, J-C Boué
Main HCO Suppliers: Prospects & Strategies

**CANADA**
- Expanding supply
- Gov’t support success:
  - Upstream = Yes
  - Downstream = No
- Landlocked
- Seeking new outlets to west
- Many players (discounting?)
- Diversifying by blending

**MEXICO**
- Volumes flat/declining?
- Domestic upgrading $$$
- Contractual rigidity w/ buyers
- Focused regional strategy

**VENEZUELA**
- Strategy changing/unclear
- Maximum upgrading?
- SCO increasing

**US**
- Declining supply
- Main buyer

**USA**
- Destination Restrictions

**SAUDI ARABIA**
- CIF exporting; integrated
- Blending
- Domestic upgrading to come

**BRAZIL**
- New volumes
- Low S, high TAN
  - → Asia?

**FUTURE:**
- More Upgrading
  - At Source:
    - Brazil
    - Canada
    - Venezuela
    - Saudi Arabia

**MAIN HCO SUPPLIERS:**
- Prospects & Strategies
Oil Resource Plays

Continuous-type Deposits of Hydrocarbons

• The global *in-place* resources of the three principal oil resource plays:
  • Extra-heavy oil
  • Bitumen in oil-sands
  • Shale oil

• ~ 7,500 billion bbls → 3 times *recoverable* resources of conventional oil discovered to date.

• Canada, USA & Venezuela account for over 86% of these in-place resources.

Courtesy: K.Chew, IHSE
Heavy Oil Categories

- **A Class:** Medium Heavy
- **B Class:** Extra Heavy
- **C Class:** Bitumen

- Canadian Oil Sands
  - Athabasca
  - Cold Lake
  - Peace River
  - Boscan

- Orinoco
  - Tia Juana
  - Kern River

- Chinese steam projects
  - Duri
  - Bachaquero

OIES, After Kupcic, 2003
All ‘heavy’ is not ‘heavy’ when it gets to the Market

CERA’s Projected Gross Liquids Capacity Additions, 2004 to 2010

Source: Cambridge Energy Research Associates.
Oil Resource Plays

Venezuela Orinoco Extra-heavy Oil Historic and Forecast Production

- **Greenfield Projects**
- **Expansion of Existing Associations**
- **Hamaca Debottleneck**
- **Sincor Debottleneck**
- **Cerro Negro Debottleneck**
- **Hamaca**
- **Sincor**
- **Cerro Negro**
- **Petrozuata**
- **Orimulsion 1 (BITOR)**

*Raw heavy crude*

Source: IHSE after PDVSA
Alberta Oil Sands Projected Supply

1000 b/d

Estimated (risked) output based on project schedules

Source: OIES
Potential heavy/medium sour supply from Canada

Source: CAPP, 2005
Oil Sands Risks

Project execution, especially for large-scale projects (materials, equipment and skilled manpower)

- Infrastructure and labor supply in small area with simultaneous projects
- High CAPEX projects limit scope for investments elsewhere
- Operational Risks: asset reliability in northern environment
- Market volatility: supply upsets, access, differentials, margins, natural gas costs.
- Environmental issues and performance
- Regulatory issues with expansions
- Financing: Business cycle; interest and exchange rates
Summary

• Crude supply is increasingly heavy & sour
• Refinery investment must ‘catch up’ to meet heavier crude slate
• Especially as product barrel must meet more strict sulfur standards
• And as HFO demand continues to decline
• Crudes that produce a lot of unwanted HFO will be discounted until new coking capacity is available—either at source or in the end market
Today’s Fundamentals

**Economy**
World GDP: 3.7-3.9/4.7 2005/2004
China still airborne; USA still consuming and driving ‘UAV’s to Walmart

**Demand**
- Global growth 1.77 - 2.2 mb/d in 05.
- U.S., China and rest of Asia & M.E.
- Lighter (less HFO) & sweeter
- Demographics and incomes trump price
- Asymmetrical elasticity versus supply

**Supply**
- Non-OPEC outlook lower in short term
- Russian atavism → wobbly supplier?
- West Africa, GOM, Unconventional
- Lumpy supply; costs rising
- Supply heavier & more sour
- Investment up, but slow response
## Budget Price Assumptions for Selected Oil-Producing Economies

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*For Export crude