Liquid Shale Plays: Niobrara and Eagle Ford Focus- Production, Logistics and Refining Market Outlooks

Extracts from EAI, Inc.’s North American Crude Supply, Logistics and Refining & U.S. Gulf Coast-Eagle Ford Outlook Studies- 2011

for

Crude Oil Quality Association

Salt Lake City

9-June-2011

Location of fractured shale and carbonate trends found along the Western Interior Seaway.

Eagle Ford drilling ramping up and shifting from gas to liquids focus.

Niobrara potential being tested in the Powder River Basin and the DJ Basin.

In the Bakken, drilling expanding in the Tyler and Spearfish formations.
Gulf Coast Onshore Production Comparison 2008 vs 2010
County Average Annual MBPD

*Inland supply growth is dominated by light sweet crude and condensate from Eagle Ford, Woodford-Bone Spring, Sprayberry and Granite Wash developments.*
Eagle Ford Specifics

The majority of new liquid is coming from gas wells with high condensate and NGL yield and from high GOR oil wells in the shallow western region. Historically the refineable liquids have been delivered to San Antonio, Three Rivers and Corpus Christi.
Eagle Ford County Level Grade Allocation

Based on well completions and sample data available as of February 2011

API Gravity of stock tank liquid downstream of separator. (Eagle Ford)

45 API Gravity cutoff (approximate limit)

API Gravity from whole crude assay properties (all formations)
Eagle Ford Production Outlook

- **Eagle Ford Fairway:** Eagle Ford fairway lays parallel to the highly developed Austin Chalk trend extending from the Maverick Basin on the Texas=Mexico border through San Antonio and Austin and continuing east into Louisiana.
  - Formation ranges from 100 to 350 in thickness and dips southeast toward the coastline with oil found at depths of 2500 to 9000 feet.
  - Transitions from oil to light oil to condensate with increasing depth.

- **Eagle Ford Drilling Activity as of Early 2011:** There were 143 rigs active in the play. An estimated 400 Eagle Ford wells had been drilled, 75 By Anadarko, 46 By Petrohawk, and 45 by EOG. (drillinginfo.com). Roughly 850 permits remain to be drilled (1229 issued during 2010).

- **Liquids vs Natural Gas Focus:** Recovery in natural gas prices would broaden the ‘liquids fairway’ and contribute to longer term condensate supply. The condensate yield for ‘wet gas’ wells ranges from less than 1 barrel per MMCF (dry gas) to over 200 barrels per MMCF (excluding NGL). This material is stable at STP, and is typically recovered at the well pad, downstream of the separator, before gas processing.

- **Production Forecast:** Developed for each county based on permits as available in early 2011. Each county has different proportion of crude versus condensate. Players are able to shift from crude to gas-condensate play within undrilled leasehold as guided by respective oil/gas prices.
EAI, Inc. Eagle Ford Production Tracking & Outlook

EAI, Inc. continues to track, analyze and update its production outlook to account for latest developments

- Potentially increase to 550-780 MBPD by 2013 with the Base Case of 550 MBPD built around current well liquid EURs in the 210-250 range (cnd-crude).
- High case assumes the Estimated Ultimate Recovery (EUR) to increase closer to the Eagle Ford operators targeted 400-600 MBOE per well
Eagle Ford Horizontal Well Count

There had been 200 Horizontal Well Completions over the 2009-2010 timeframe (*) and roughly 590 wells to be completed.

Data vintage through September 2010 for this slide.
Condensate Production Curves – Eagle Ford Completions

Based on RRC gas well completions and sample data available as of February 2011. The model (average) curve shown below generates 210 MB condensate. Gas production is variable across the play and represent 40 to 80% of revenue (wet gas play: range from 1.2 – 4.0 BCF per well).
Crude Production Curves – Eagle Ford Completions

Based on RRC gas well completions and sample data available as of February 2011. The model (average) curve shown below generates 250 MB crude. Operators are targeting 350 to 550 MBOE per well.
The total transportation capacity & local refining (within EF production area) is in the range of 1600 to 1780 MBPD.

The east bound capacity - Enterprise crude system which is expanding to EF western counties and will provide access to Cushing, Houston-Pasadena-Texas City markets plus KM’s gas & NuStar’s product pipeline conversion projects.

Corpus Christi-refining/marine focused projects are Koch, NuStar, Arrowhead, Magellan and Plains.
Gulf Region Coastal Refining Capacity
Atmospheric Tower, MBPD

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>CAPACITY, MBPD</th>
<th>PERCENT OF TTL GC</th>
</tr>
</thead>
<tbody>
<tr>
<td>ExxonMobil</td>
<td>1521.3</td>
<td>18.1%</td>
</tr>
<tr>
<td>Valero</td>
<td>1218.7</td>
<td>14.5%</td>
</tr>
<tr>
<td>ConocoPhillips</td>
<td>806.0</td>
<td>9.6%</td>
</tr>
<tr>
<td>Citgo</td>
<td>596.8</td>
<td>7.1%</td>
</tr>
<tr>
<td>Shell</td>
<td>584.5</td>
<td>6.9%</td>
</tr>
<tr>
<td>Marathon</td>
<td>512.0</td>
<td>6.1%</td>
</tr>
<tr>
<td>BP</td>
<td>451.3</td>
<td>5.4%</td>
</tr>
<tr>
<td>Chevron</td>
<td>330.0</td>
<td>3.9%</td>
</tr>
<tr>
<td>FlintHills</td>
<td>279.3</td>
<td>3.3%</td>
</tr>
<tr>
<td>Saudi Arabia Oil</td>
<td>183.0</td>
<td>2.2%</td>
</tr>
<tr>
<td>Total Petroleum</td>
<td>173.6</td>
<td>2.1%</td>
</tr>
<tr>
<td><strong>TOTAL ABOVE</strong></td>
<td><strong>6656.3</strong></td>
<td><strong>79.1%</strong></td>
</tr>
<tr>
<td><strong>TOTAL GC</strong></td>
<td><strong>8413.1</strong></td>
<td></td>
</tr>
</tbody>
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Refining Capacity above is summary of largest refinery capacity ownership positions for overall U.S. Gulf Coast region.
- Gulf Coast refining capacity at 8390 MBPD
- Total crude runs averaging 7250 MBPD in 2010 & utilization rate of 86.4%.
- Total crude imports for Gulf Coast refining averaging 5200-5300 MBPD.
- The total light-medium sweet crude market for imported crude is 1052 MBPD
- With inclusion of light sour, the total Gulf Coast imported light crude market is approximately 1833 MBPD

![Refinery Utilization and Imported Crude Runs Chart]

*Refinery Utilization and Imported Crude Runs Chart*
Estimated Condensate Market Netbacks

Market outlets for Eagle Ford condensate include nearby Houston Mt. Belvieu market, Canada and export to Northwest Europe. Generally, Northwest Europe estimated to provide best netback to Corpus Christi.

<table>
<thead>
<tr>
<th>EUROPEAN MARKET</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Qatar LSC condensate (Platts spot)</td>
<td>87.77</td>
<td></td>
</tr>
<tr>
<td>Waterborne to UKC</td>
<td>2.13</td>
<td>Clean tanker rate</td>
</tr>
<tr>
<td>Waterborne Transport Corpus Christi to UKC</td>
<td>2.96</td>
<td>Clean tanker rate</td>
</tr>
<tr>
<td>Netback to Corpus Christi</td>
<td>86.94</td>
<td></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>HOUSTON MARKET</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt. Belvieu Natural Gasoline (Platts spot)</td>
<td>86.6</td>
<td>Maximum price allowable</td>
</tr>
<tr>
<td>Waterborne Transport Corpus Christi to Houston</td>
<td>1.18</td>
<td>Estimate</td>
</tr>
<tr>
<td>Netback to Corpus Christi</td>
<td>85.42</td>
<td></td>
</tr>
</tbody>
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<thead>
<tr>
<th>EDMONTON MARKET</th>
<th></th>
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<tbody>
<tr>
<td>Edmonton Spot Condensate (Platts spot)</td>
<td>89.13</td>
<td>89.13</td>
</tr>
<tr>
<td>Transport via Cushing to Southern Lights*</td>
<td>9.56</td>
<td>Originates at Sealy</td>
</tr>
<tr>
<td>Transport via Capline to Southern Lights*</td>
<td>10.39</td>
<td>Corpus to St. James barge</td>
</tr>
<tr>
<td>Netback to Corpus Christi*</td>
<td>79.57</td>
<td>78.74</td>
</tr>
</tbody>
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Timeframe: Mar 2010 to April 2011 average Units: $/Bbl

* Uses Southern Lights lowest tariff 5.48 $/Bbl Manhattan to Neche
Koch pipelines taking the majority of stock tank liquids in 2010 with EPPL pipeline to pull the most new supply east into Houston area on startup. Spec2 volume of 100-120 MBPD available in base case but not assigned to specific counties.

<table>
<thead>
<tr>
<th>Area</th>
<th>Supply</th>
<th>Throughput (MBPD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koch pipelines</td>
<td>Stock tank liquids</td>
<td>100-120 MBPD</td>
</tr>
<tr>
<td>EPPL pipeline</td>
<td>New supply</td>
<td>50 MBPD</td>
</tr>
</tbody>
</table>

**Note:**
- **Koch pipelines** taking the majority of stock tank liquids in 2010.
- **EPPL pipeline** pulling the most new supply east into Houston area.
- **Spec2 volume** of 100-120 MBPD available in base case but not assigned to specific counties.
D-J/Niobrara Fairway: Transitioning from Vertical to Horizontal Drilling

*Fairway can be broken into 2-3 distinct cells (so far).*

**VERTICAL (historical)**

- **35-38° API Crude**
  - SILO TREND: VERTICAL (historical)
  - VERTICAL WELL: EUR 23-38 MBOE
  - 25-40 ACRE DRAINAGE
  - 500-750 MBO OOIP

- **EOG (JAKE AREA): VERTICAL (historical)**
  - VERTICAL WELL: EUR 40-90 MBOE
  - 80-120 ACRE DRAINAGE
  - 1500-2000 MBO OOIP

- **WATTENBERG: VERTICAL (historical)**
  - VERTICAL WELL: EUR 23-38 MBOE
  - 25-40 ACRE DRAINAGE
  - 500-750 MBO OOIP

**HORIZONTAL**

- **WYOMING HORIZONTAL**
  - SILO Horizontal (1990’s Vintage)
  - EUR: 150-200 MBOE
  - 150-480 ACRE DRAINAGE
  - 5-18 MILLION BARRELS OOIP
  - NEW WELLS PROPOSED BY JONAH GAS
  - Expect better completions and more efficient drainage

- **NORTHERN DJ: 35-45° API Crude**
  - EOG (JAKE AREA): Horizontal
  - EUR: 250 MBOE (one well sample)
  - 18-20 MILLION BARRELS OOIP (640 AC)

- **WATTENBERG: GAS CONDENSATE**
  - 45-58° API Condensate
  - Horizontal (Core vs Non-Core)
  - 18-25 MILLION BOE OOIP (650 AC)
Niobrara Play

Overall Activity Update-2011

Permit Activity Heating Up: 370 in Weld County, CO, 18 in Laramie County, WY (33 with Cirque-Jonah Gas Silo redevelopment), 10 locations in Goshen County, WY. A dozen Niobrara locations scattered throughout PRB-GGRB.

DJ Basin Play is Evolving: Expect horizontal development of Wattenberg gas-condensate area will persist as an alternative to high density vertical development. Noble has the only core area completion to date (Gemini well, Cum: 0.8 BCF and 1800 barrels condensate) and a dozen locations in various lateral configurations. Anadarko (Kerr-McKee) has 10 locations.

Results Outside Core Wattenburg: Estimated 56 wells have been spudded outside the Wattenberg Core (condensate) play. Comprise 3 to 4 groups of locations that have tested 31-39° API crude with results available for 22 of these horizontal wells. IP: range from 20 BPD to 1558 BOPD. Best two operated by EOG (Jake 2-01H, Red Poll 10-16H).

Assessment to Date: Jury is out on the Niobrara crude play in NE Colorado – SE Wyoming. Operators appear to be finding the same proportion of marginal wells (many) to economic producers (few to date) which is typical of most resource plays. If these wells are indeed in ‘sweet spots’ then the operators have yet to solve the reservoir-completion puzzle. Need to cure an extremely rapid decline rate (same problem encountered in the 1990’s exploration).

Powder River-Niobrara Potential: PRB offers an equally broad range of potential targets for Niobrara exploration with a high proportion being more gas prone. Chesapeake wells in Converse County are encouraging.
Niobrara Permit Activity

Roughly 300 horizontal permits have been filed for in Colorado and another 80 horizontal permits filed in SE Wyoming for testing of Niobrara objectives. At this point roughly 90 of these locations have been drilled or have a rig on them. Results for these wells is limited to about 30 of the completions.

**DJ Basin / Niobrara Production Outlook**

**Conservative Basis with Information Known To Date**

**DJ Basin liquids production is directly related to gas drilling activity, particularly at Wattenberg and will vary according to natural gas prices. Base production is comprised of condensate ranging from 45 to 55° API. Niobrara crude is shown as speculative curves (Includes Weld County and Wyoming DJ Basin).**
Niobrara Production Data Through May 2011
Post 2009 horizontal completions Wyoming and Colorado by well

Only two wells stand out.

Source: WOGCC & COGCC monthly production databases

Vertical scale: barrels per month
Normalized on first month of oil sales (Horizontal scale)

CHSPKE SPILLMAN DRAW UNIT CONVERSE COUNTY GAS WELL

SSDU 16-4 (CONVERSE)
ATLAS 1-19H
CRITTER CK 4-09H
CRITTER CK 6-12H
CRITTER CK 9-15H
ELMER 8-31H
GARDEN CK 6-11H
GEMINI 01-99HZ
JAKE 2-01H DISC
LONGHORN B3-36H
LONGHORN B5-36H
MOONSHINE 36-11-65H
RED POLL 10-16H
SIMS 7-25 VERT CONVERSE

SM ENERGY ATLAS 1-19H WELL COMPLETED 2010
Bakken-PRB-Niobrara-Canadian
Pushing through the Eastern RM Corridor

Generally RM represents higher end market values—more insular from competition on both crude and product. Crude flowing through Eastern Corridor can access Eastern WY-CO refineries, back flow to Casper/SLC or move east to Holdredge/Wood River or Cushing.
Williston and Niobrara Market Margins
1Q2011 Average Spot Prices – Posted Prices Net of Transportation

1Q2011 LLS – WTI spread grew dramatically as world crude prices responded to Middle East turmoil. Posted prices of Williston particularly low making for high incentives to ship to St. James via rail. Cushing margins while lower still attractive. Clearing prices at coastal markets, e.g. St. James LLS, determined by laid in world prices whereas Cushing North prices subject to significant discounts from transportation, market and storage constraints.

Besides St. James, numerous other rail markets being pursued – Port Arthur, Houston, Corpus Christi, Bakersfield, Anacortes

Calculated as Platts spot minus posted price minus transportation. Units: $/Bbl
How do we deliver value?

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