D-J and Niobrara Activity and Outlooks: Production, Logistics and Refinery Market Options

Crude Oil Quality Association
Denver, Colorado
June 5, 2014
EAI, Inc. (Energy Analysts International)
EAI, Inc. (Energy Analysts International) is a provider of leading edge and high quality products, consulting and services since 1981.

EAI, Inc. provides industry study products, client specific consulting and IT business applications and services.

The company’s niche was and continues to be a “bottom-up” and integrated approach to developing opportunities, projects and strategies for companies ranging in size from the Fortune 500 to smaller, regional niche entities.

Recently released industry study products include:

- North American Crude Supply, Logistics, Refining and Price Outlook (March 2014 & Tracking)
- North American Condensate Supply, Logistics and Market Outlook (May 2014)
- East of the Rockies Downstream Business Analysis and Outlook with an Outlook for the Greater Atlantic Basins (March 2014)
- Western Region Downstream Business Analysis and Outlook (June, 2014)
- Gulf Coast Crude Deep Dive Study (June, 2014)
EAI, Inc. North American Crude Study Flowsheet
Supply, Logistics, Refining & Pricing Outlook Drivers and Relationships: 1Q-2014

Outside Western Hemisphere
- Sluggish Product Growth
- Refining Expansion & Rationalization
- OPEC / Saudi Production Restraint
- Absolute & Grade Differential Price Outlook

Western Canada
- Growing Heavy / Bitumen Output
- Pipeline Constraints
- Delays in PL Access to East & West Coasts
- Rail Logistics Ramp-Up

Latin America
- Crude Production Growth
- Shifting Export Patterns
- Refining Capability Constraints
- Mexico investment Reform

U.S. Central Corridor
- Crude Production Ramp-up
- Shift to Heavy
- Gasoline Market Wall
- WTI – Bakken-LLS-Brent Differential Outlook

U.S. Gulf Coast
- Light Product Market Access
- Crude Slate Shift Ability
- Light Crude Run Limits
- Heavy vs. Light Paradox
- Refining Shift to Diesel / Export Growth
- GOM Production Growth

Rocky Mountains
- Growing Crude Surplus
- Product Push West
- Crude Push East
- Logistical Shifts

U.S. East Coast
- Gasoline Demand Decline
- Refinery Rationalization
- NES vs. Europe
- Crude Market Sustainability
- Bakken vs. Eagle Ford & Canadian Crude

Near Term Events, Impacts and Crude Hub Pricing Triggers
- Light Crude Market Outlook
  - NA Outlook by Plant / Refining Hub
  - Basin-Specific Production Outlooks
  - NA Crude Hub Price Outlooks vs Global
  - Logistics Capabilities / Movement Outlooks: Pipeline, Rail & Marine

Heavy Crude Outlook
- Western Canada, LAM, U.S.
- Refining Capabilities
- Competition for Market & PL Capacity
- Blending Options
- Rail vs Pipeline Logistics
- Venezuelan Shift vs Canadian Coastal Access
- Heavy – Light Crude Price Outlook

Medium Sour Outlook
- Grade substitution
- Crude blending
- GOM ramp-up

Client Driven Output Objective Insights & Strategy Support

NA Outlook by Plant / Refining Hub
- Basin-Specific Production Outlooks
- NA Crude Hub Price Outlooks vs Global
- Logistics Capabilities / Movement Outlooks: Pipeline, Rail & Marine

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Supply, Logistics, Refining & Pricing Outlook Drivers and Relationships: 1Q-2014
North American Crude Business Tracking: Resources, Logistics, Refining, Economics
The North American Central Fairway: Petroleum Long and Logistics Limited

- Numerous project barriers & delays
- Canadian crude has limited East and West outlets through at least 2017-2018
- Small expansion & new pipeline approval barriers
- Capacity constraints
- Limited transport capacity west
- GC product limited access to NYH
- Excess GC/EF crude competing for limited Jones Act Tanker capacity
- Product pipelines constrained
- Increasing crude, condensate, and product exceeding U.S. market or logistics pushing to foreign markets

Refinery
Crude Movements
Product Movements
Waterborne Crude
Waterborne Product
Rail Network

Panama Canal expansion - 2015
## Integrated Crude Supply, Demand, Logistics & Price Triggers

**Light/Medium (L/M), Heavy Crude Supply, Demand & Fundamentals Drivers**

- **NA Shale Fairway (NASF), MBPD**
  - 2012: 8115
  - 2013: 8214
  - 2014: 8012
  - 2015: 8080
  - 2016: 8025
  - 2017: 7907

- **L/M Refinery Runs**
  - 2012: 4795
  - 2013: 5843
  - 2014: 6847
  - 2015: 7413
  - 2016: 7879
  - 2017: 8114

- **L/M Foreign Imports (Marine)**
  - 2012: 2340
  - 2013: 1571
  - 2014: 842
  - 2015: 627
  - 2016: 250
  - 2017: 250

- **NA Fairway L/M Surplus**
  - 2012: 0
  - 2013: 543
  - 2014: 886
  - 2015: 1173
  - 2016: 1327
  - 2017: 1608

- **Canadian Hwy to GC/USCC**
  - 2012: 0
  - 2013: 0
  - 2014: 304
  - 2015: 532
  - 2016: 671
  - 2017: 775

- **Bakken RR to WC/ES/St James-Memphis**
  - 2012: 280
  - 2013: 543
  - 2014: 686
  - 2015: 849
  - 2016: 941
  - 2017: 1009

### DEMAND

- Refinery crude demand moderately growing and supported by displacing foreign gasoline imports and maintaining or expanding light product exports. Disconnect between product slate demand and incremental light crudes that will become very significant.

### PRODUCTION

- Production continues to grow assuming an 80 $/BBL Brent-Gulf Coast price floor. Global crude discounting and light crude price deterioration could approach threshold level which impacts drilling activity. Production/drilling response would be immediate.

### CRUDE BALANCES

- Gulf Coast Light/Medium L/M crude market attains saturation at medium sour import floor set at 250 MBPD—largely Saudi medium sour. GOM rampup has potential to displace remainder.

### TRANSPORTATION / LOGISTICS

- North-South pipeline constraints limit Gulf Coast market access.

- Bakken/Eagle Ford RR/Marine movements reach 1300 MBPD.

- Bakken PI Capacity needs 280 in 2016 & near 500 by 2018.

- WTX-NM PL capacity to Gulf to 330-2013, 530 by 2014 and potentially 870 MBPD by 2015. Still need northern market access for supply beyond GC PL Access.

- Rampup of Eagle Ford marine movements to Eastern Seaboard.

- Rampup of GC PL system opening & rail; main growth via displacing Venezuelan.

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From EAI, Inc. North American Crude and North American Condensate Studies 2014
North American Crude Logistics Network

Major connectivity between pipelines and rail lines across North America. Most crude logistic activity is occurring in the N.A. Shale Fairway region (Canada, USCC, Rocky Mountains, Gulf Coast).
Crude Oil Production Basins and Logistics Corridors
Rocky Mountain Region
Guernsey is the primary crude hub in the Rocky Mountain region and interacts with crude source hubs; Edmonton-Hardisty, Casper, Green River-Wamsutter, and the Eastern Corridor. Crude market hubs downstream of Guernsey include the U.S. Central Corridor via Platte, Frontier Refining, Suncor Refining and backhaul to Casper on Sinclair Pl.

- **Enbridge expansion to Cromer and Wascana Reversal** to transport 75-225 MBPD to Enbridge mainline
- **Tesoro expanded by 10 MBPD-2012**
- **Keystone XL will pick up 100-130 MBPD of Bakken crude in Baker, MT**
- **Platte at near capacity in near term Exit Wyoming Capacity 165 MBPD.**
- **Tallgrass Pony Express 230-320 MBPD range - to Cushing Aug. 2014 startup date target**

**Enbridge ND Line:**
- Expanded to 210 MBPD. Sandpiper (225 MBPD) to Clearbrook in 2016
- Butte/BPL expanded to 150/has plans to go to 180 MBPD
- Butte/BPL expanded to 150/has plans to go to 180 MBPD

**Bakken-PRB-DJ Eastern RM Corridor Access**
- Butte (150)
- Express (280)
- Big Horn (59)
- RMP (63)
- Wascana PL

**SLC refineries expanding runs of Uinta crude**
- Calumet expanding Great Falls refinery crude capacity by 10 MBPD
- SLC REFINING Chevron Flying J HollyFrontier Tesoro
- White Cliffs to Cushing Looping Line/expanding to 150 MBPD by 3Q-2014

**Current Pipeline Movement**
- Crude-by-Rail Loading
- Refinery
- Major Crude Gathering & Distribution Points
- Planned Pipeline Movement
- Current Pipeline Movement
Guernsey to Cushing Crude Corridor Assessment
Existing and New Projects

Alternative Routes

Bakken
E. Corridor

E. Montana
MT Bakken

Powder River
Eastern WY

Niobrara
Codell

Canadian via
Express / Platte

Other RM
Production

Baker

Enbridge
Railroad
Keystone XL

RM Eastern
Corridor
Refining

Other RM
Markets

Net Crude
Supply for
USCC/Gulf
Markets

Wood River

Cushing

Coasts/
Other Inland

Competing Systems

SLC
Rawlins
Casper
Billings

Suncor
HollyFrontier
WY Refining

Platte

White Cliffs

Pony Express

Ponca City

RR/Other Projects

Wood River

Cushing

Coasts/
Other Inland

Competing Systems
Guernsey is the primary crude hub in the Rocky Mountain region and interacts with crude source hubs; Edmonton-Hardisty, Casper, Green River-Wamsutter, and the Eastern Corridor. Crude market hubs downstream of Guernsey included the U.S. Central Corridor via Platte, Frontier Refining, Suncor Refining and backhaul to Casper on Sinclair Pl.
U.S. Rocky Mountain Western Corridor Crude Logistics
Key Rail Facilities and Pipelines

Black Thunder Terminal
Gillette, WY
JV with Meritage and Arch Coal
10 MBPD takeaway, expandable to 120 MBPD

Enserco/Crestwood
Douglas, WY
JV in Douglas WY, unit train takeaway completed Q1-2014, at 60 MBPD expandable to 120 MBPD

Cogent/Granite Peak Dev.
Casper, WY
Announced plan for crude by rail facility in Feb 2013, 154 MBPD capacity

Plains All American
Carr, CO
Active rail loading facility expanding to 35 MBPD in 2014 and will expand further to handle unit trains

Musket Corp
Windsor, CO
Active rail loading facility opened 2012 and unit train capable as of Q4 2013 – 20 MBPD

Plains All American
Douglas, WY
130 MBPD since Dec 2013; Double loop; served by UP and BNSF; 200 MBbl storage; new possible connection to Express

Eighty Eight Oil
Guernsey, WY
Unit train loading near Guernsey, multiple True Co. pipeline access. 80 MBPD since April 2014

Granite Peak Dev./Watco
Cheyenne, WY
New planned unit train loading facility, expected in 2015

Plains All American
Tampa, CO
Active unit train loading facility opened Nov 2013 – serves Niobrara
Rocky Mountain Resource Plays
2014 Horizontal Permitting Activity

- **Green River Basin**
  - Horizontal Fort Union Appraisal Wells

- **Niobrara Tight Sands**
  - Fort Union
  - Waxed Play

- **Piceance Basin**
  - Hingeline Structural Play

- **Powder River Basin**
  - Niobrara Tight Sands
  - Ogallala Tight Sands

- **Raton Arch**
  - Niobrara

- **Wax Play**
  - Mazard Field Trend
  - Two Antlers Field Trend

- **Hugoton Enbayment**
  - Niobrara

- **Nebraska**
  - Prb Hz Developments ranging from Condensate Bearing Niobrara to Tight Clastics

- **Developing Yellow Wax Potential on Tribal Land**
  - Newfield Deep Wasatch Hz

- **DJ Basin**
  - Leading Niobrara Growth from Wattenberg Re-development, Co Mineral Belt Extensions (Northern Weld) and Laramie County Wy Wildcats

- **Western Interior Seaway**

- **Idaho**

- **Utah**

- **Wyoming**

## Rocky Mountain Activity Updates
### Horizontal Drilling and Niobrara Production

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Williston (MT)</td>
<td>86</td>
<td>161</td>
<td>115</td>
<td>36</td>
<td>Continental’s Bakken drilling extends into MT.</td>
</tr>
<tr>
<td>Powder River</td>
<td>34</td>
<td>97</td>
<td>261</td>
<td>102</td>
<td>Niobrara and tight sand (Parkman, Shannon and Turner) development.</td>
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<tr>
<td>Green River</td>
<td>13</td>
<td>13</td>
<td>28</td>
<td>2</td>
<td>Samson’s Fort Union Wildcats.</td>
</tr>
<tr>
<td>Denver Julesburg</td>
<td>271</td>
<td>648</td>
<td>1082</td>
<td>357</td>
<td>Noble and Anadarko leading Wattenberg activity. Whiting Red Tail Prospect.</td>
</tr>
<tr>
<td>Uinta</td>
<td>6</td>
<td>25</td>
<td>44</td>
<td>1</td>
<td>Developing yellow wax potential.</td>
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</table>

<table>
<thead>
<tr>
<th>Operator</th>
<th>2011 Production</th>
<th>2012 Production</th>
<th>2013 Production</th>
<th>CURRENT ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anadarko</td>
<td>19.1 MBPD</td>
<td>22.1 MBPD</td>
<td>32.8 MBPD</td>
<td>Utilizing 13 rigs to drill 360 wells. Improvements in economics following acreage exchange.</td>
</tr>
<tr>
<td>Noble</td>
<td>17.3 MBPD</td>
<td>19.8 MBPD</td>
<td>22.4 MBPD</td>
<td>$2 Billion Cap. Ex. Implementing IDPs. Planning on drilling 369 wells with 96 extended reach laterals.</td>
</tr>
<tr>
<td>Encana</td>
<td>3.7 MBPD</td>
<td>5.1 MBPD</td>
<td>6.4 MBPD</td>
<td>6 rigs, 40-50 wells, $250-$300 million Cap. Ex. Improving well performance - decreasing costs.</td>
</tr>
<tr>
<td>PDC Energy</td>
<td>5.3 MBPD</td>
<td>5.3 MBPD</td>
<td>4.0 MBPD</td>
<td>5 rigs, $467 million Cap. Ex. Bringing core Wattenberg wells online.</td>
</tr>
<tr>
<td>EOG Resources</td>
<td>5.5 MBPD</td>
<td>3.5 MBPD</td>
<td>2.3 MBPD</td>
<td>3 rigs – Laramie County WY, Niobrara + Codell. Presence in PRB Clastic plays</td>
</tr>
</tbody>
</table>

Production from Niobrara + comingled reservoirs excludes PRB tight clastics completed independently from Niobrara.
Exploration has reduced the Niobrara sweet spots to the Wattenberg trend and smaller regions in Wyoming DJ, CO Mineral Belt Extensions and along the CO-WY state line. Noble and Anadarko maintain large leaseholds in the Wattenberg core which represents the main source of condensate in the DJ Basin. The recent acreage exchange between these two companies represents their commitment to the basin. Pipeline export capacity will grow with the startup of Pony Express and the White Cliffs expansion project.

From EAI, Inc. North American Crude and North American Condensate Studies 2014
Production Outlook: EAI, Inc. is tracking and re-assessing Niobrara production growth based on assessment of new wells to develop characteristic drilling and performance expectations coupled with indicative activity trackers (permits, rig counts, drilling density, etc.). EAI, Inc. develops and maintains well to basin production models using industry leading shale based, physics influenced decline curves.

Comparative Analysis: While the Niobrara has significantly less recoverable reserves than other key shale basins, the single well economics and the productivity gains led by extended reach laterals will lead to long term production growth.

<table>
<thead>
<tr>
<th>Case</th>
<th>Reservoir</th>
<th>Well Type</th>
<th>EUR (MBO)</th>
<th>Oil percent of revenue</th>
<th>Well Cost $MM</th>
<th>Recoverable Reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wolfcamp</td>
<td>Penn. Shale</td>
<td>Horizontal</td>
<td>300</td>
<td>75%</td>
<td>$7.0-8.5</td>
<td>35000-50000 MMBO</td>
</tr>
<tr>
<td>Eagle Ford Crude</td>
<td>Cretaceous Carbonate</td>
<td>Horizontal</td>
<td>240-350</td>
<td>80%</td>
<td>$6.7-7.5</td>
<td>7000-10000 MMBO</td>
</tr>
<tr>
<td>Bakken</td>
<td>Devonian Shale</td>
<td>Horizontal</td>
<td>220-560</td>
<td>90%</td>
<td>$7.0-9.5</td>
<td>7500-8000 MMBO</td>
</tr>
<tr>
<td>Niobrara Crude</td>
<td>Cretaceous Carbonate</td>
<td>Horizontal</td>
<td>230-450</td>
<td>75%</td>
<td>$4.1-7.7</td>
<td>2500-3500 MMBO</td>
</tr>
</tbody>
</table>

Recoverable Reserves for Wolfcamp reflect aggregate of Permian Basin Shale Plays. Well Economics for Northern Weld Niobrara; Reserve estimates are for entire Niobrara Play.
Northeastern Colorado Crude Production Forecast
Denver Julesburg Basin

DJ Basin condensate is primarily sourced from the Wattenberg core where API ranges from 50 to 56° and current focus remains on liquid rich production. North of the Wattenberg core a locus of horizontal activity surrounds a sweet spot in Weld County. Crude from this sweet spot averages 38-44° API.

Total production expected to increase to over 300 MBPD by end of forecast period with 52 percent of this condensate.
The Sussex, Shannon and Parkman produce 38-45° API crude. Frontier-Turner sandstones are more gas prone and yield 45-57° API liquid. Niobrara completions range from 36° API to 57° API with gravity increasing with depth. The Niobrara and Frontier have the potential to drive up area condensate output by 30-50 MBPD.
Niobrara production expanding significantly in the PRB through recent horizontal developments. Growth is occurring in 38° API crude similar to the Niobrara of Weld County CO, and condensate from the tight clastics ranging from 45 to 57° API gravity.
Foreign crude summarized by grade category. Domestic crude consists primarily of light sweet and light sour crude with the exception of GOM-Mars medium sour, OK-Velma heavy, CA – heavy/AK ANS, and Wyoming heavy crude streams. EAI, Inc. tracks and analyzes all plants; Shale Fairway consists of 23 refinery hubs and 88 plants.
Crude runs increased significantly in 2012 and 2013 and are down a bit in 2014. Rockies refineries have hit peak monthly highs of 610-617 MBPD over this period. Increases driven by startup of UNEV pipeline and increased product volumes moving to Nevada, E. Washington and North Dakota. Crude price discounting stimulating some expansion with 30 to 45 MBPD of new capacity additions being constructed and planned.
Key Operating Units vs Atmospheric Tower Utilization
Rocky Mountain Operating Region

Crude tower tends to be throughput limiting. Coking and hydrocracker units have been running underutilized. Overall utilization based on crude towers is between 90 and 95 percent during peak demand season. Refinery crude slate maximizing heavy and lights with API gravity relatively constant.
Incremental Naphtha Disposition: Resource to Market

Primary Incremental Gulf Coast Crude Supply

- Inland/Cushing South
  - Par/Synthetic
  - Bakken
  - DJ/Niobrara/PRB
  - MS Lime/OK Sweet
  - Granite Wash

- Eagle Ford Light/Condensate
  - EF Condensate
  - EF Crude

- Permian Basin
  - WTS
  - WTI
  - PRML

- Gulf of Mexico
  - Medium Sour

- Canadian Bitumen
  - WCS/SynBit/Kearl
  - DilBit
  - RailBit
  - RawBit

Distillation Column or Splitter

- C5-C6
  - Paraffinic Light Naphtha
  - Light Naphtha Reformer
  - Heavy Naphtha Reformer

- Kero/Jet
- Gas Oil/Diesel
- Incremental Naphtha Sources

- Chemical Market
- Diluent Market
- Low Yield-Octane Penalty
- Global Gasoline Push
- Domestic Support
- Global Pull-Diesel/Cetane

Refining
Market Drivers and Outlets for Light Crudes and Condensates

- The **tipping point for light crude and condensate** market penetration and pricing is the incremental outlet for the naphtha fraction of the barrel with the following observations and insights:
  - The **naphtha fraction of these growing light crude** and condensate streams is relatively high when compared to a traditional North American light sweet crude such as WTI. WTI naphtha yield is on the order of 25 volume percent whereas Eagle Ford Crude and Eagle Ford Condensate are on the order of 30 to 50 volume percent naphtha and D-J/Green Canyon condensates on the higher end.
  - **Tight oils tend to have inferior properties** for making finished gasoline:
    - They tend to have **relatively high C5-C6 content which is low octane**. Refiners use isomerization units to upgrade this stream to higher octane gasoline blendstocks but lower than reformate.
    - The **naphtha boiling range material portion is generally highly paraffinic with relatively low naphthenic and aromatic content**. To compensate, reforming units have to be run at higher severity to meet target reformate octane levels resulting in lower liquid yields and higher LPG and coke make. For these reasons, **tight oil paraffinic naphtha has a lower feedstock value** than those light naphtha streams having higher naphthenic and aromatic contents.
    - The kerosene and atmospheric gas oil fractions of condensate are likely the highest value components with respect to fuels production. The very light condensates tend to have lower yields of gas oil boiling range material.
- Rocky Mountain condensate stream production is growing (GRB and D-J). D-J/Green River condensate pricing relative to WTI likely to experience some downward pressure with Gulf getting saturated with light crude/condensate streams and growing naphtha long in 2016. Some combination of Export Ban relief and splitter projects could relieve some of this overhang increase value. Canadian diluent market could provide some support but naphtha moving back to US/GC.

How do we deliver value?

EAI, Inc. Global Resources Group

Industry Studies

Client Services
Enhancement & Outsourcing

Client Specific Consulting & Value Building