Crude quality and US spot markets

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3 March 2016
San Antonio
Crude oil markets in momentous change

- Lifted export controls shape search for a global benchmark price
  - North Sea declining
  - Dubai is too small, too easily gamed, and a follower, not a leader
  - Russian crude is plentiful, but transparency and predictability issues
  - US Gulf – backed by deep reserves, high iteration of spot trade, financial transparency
Infrastructure + quality determine where crude trades

- Prerequisites for spot trade/price discovery:
  - Surplus supply
  - Fungible grade (agreed spec)
  - Easy access to multiple buyers
  - Agreed timing and modality
  - “Apples to apples” comparison
  - Trade data reported to PRA

Source: Argus Global Markets, 19 Feb 2016
Focus on infrastructure and quality

- How is US infrastructure evolving, particularly in Houston/Midland/Cushing triangle?
- How infrastructure is shaping DSW quality and divergence from “pure” WTI
- WTI Houston – a case study in emerging spot markets
- Texas Gulf coast infrastructure and the support of crude oil exports
- Will a transparent fob export market emerge?
- Will a spot market for WCS emerge at the US Gulf coast?
US crude oil infrastructure
Texas infrastructure seeing rapid build out

Source: Argus Petroleum Transport North America
Permian production still growing; Midland is the hub

- Plains header system connects Permian area to coast by:
  - Bridgetex
  - Longhorn
  - Permian Express I & II
  - Cactus

Source: Plains presentation, Dec 2015

Source: EIA Drilling Productivity Report, February 2016

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Longhorn (Magellan)

- Online Apr 2013
  - 275,000 b/d Mid-2014
- Crane, Texas uncommitted rates
  - MEH and Ship Channel
    - $3.9258/bl
  - Genoa Junction
    - $4.1884/bl
  - Galveston Bay and Texas City
    - $4.3306
- WTI
  - 36-44 API
  - ≤0.45 sulfur
- WTS
  - 30-35 API
  - ≤2.20 sulfur
BridgeTex (Magellan/Plains)

- Started September 2014
  - 300,000 b/d
- Colorado City origin
  - Uncommitted rate:
    - $3.8591/bl
- Destination:
  - MEH
  - Speed Junction
  - Genoa Junction
  - Texas City
- WTI
  - 36-44 API
  - ≤0.45 sulfur
- WTS
  - 30-40 API
  - ≤2.20 sulfur
Magellan East Houston terminal (MEH)
WTI Houston volumes and participants growing
Permian Express 1

- June 2013
  - 150,000 b/d by May 2014
- Wichita Falls and Ringgold Texas origin
- Nederland and Sour Lake, Texas
- Uncommitted rates
  - Wichita Falls - $2.3576/bl
  - Ringgold, Tx - $2.1404/bl
- WTI
  - 36-42 API
  - ≤ 0.42 sulfur
- WTS
  - 30-35 API
  - ≤2.20 sulfur

Source: Sunoco Logistics
Permian Express 2

- Started July 2015
  - 230,000 b/d capacity
- From Colorado City and Garden City, Texas
- To Nederland and Sour Lake, Texas
- Uncommitted rates:
  - Garden City: $4.05/bl
  - Colorado City: $3.15/bl
- WTI
  - 36-42 API, ≤ 0.42 sulfur
- WTI light
  - 42-45, ≤ 0.42 sulfur
- WTS
  - 30-35 API, ≤ 2.2 sulfur

Source: Sunoco Logistics
**Cactus**

- Started April 2015
- 330,000 b/d Nameplate
  - Q3 100,000 b/d avg
  - Q4 expected ave 145,000 b/d
- McCamey Station (origin)
- Uncommitted rates:
  - Midland-Gardendale - $2.8232/bl
  - McCamey Station-Gardendale - $2.4467/bl
- WTI
  - 44 API max
  - ≤0.45 sulfur
- WTS and Yates crude petroleum grades also accepted post Aug 1

Source: Argus Petroleum Transportation North America
# Upcoming Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Details</th>
<th>Capacity</th>
<th>Estimated completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Midland-Sealy line</td>
<td>Midland, TX to Sealy, TX (Destined for ECHO)</td>
<td>540,000 b/d</td>
<td>2017 Q2</td>
</tr>
<tr>
<td>Magellan East Houston connection to TransCanada</td>
<td>Connect TransCanada Houston terminal to MEH</td>
<td>TransCanada: 700,000 bl MEH: additional 1.5mn</td>
<td>Pipeline connectivity: Late 2016</td>
</tr>
<tr>
<td>Fairway caverns</td>
<td>Pierce Junction storage – connect to Genoa and Speed junctions</td>
<td>10mn initial; 17mn eventual</td>
<td>Late 2016 – 1st phase</td>
</tr>
<tr>
<td>Dakota Access</td>
<td>North Dakota to Patoka to Nederland</td>
<td>450,000 – 570,000 b/d</td>
<td>Late 2016</td>
</tr>
<tr>
<td>Bayou Bridge</td>
<td>Nederland, TX to Lake Charles, LA</td>
<td>30-inch diameter</td>
<td>2016 1Q</td>
</tr>
<tr>
<td>Bayou Bridge</td>
<td>Lake Charles, LA to St. James, LA</td>
<td>Open season determines size</td>
<td>2017 2H</td>
</tr>
</tbody>
</table>
Cushing infrastructure
Cushing awash in new inbound light crude

New light crude routes inbound:

- Mississippian Lime
- Pony Express
- White Cliffs
- Double H
- Saddlehorn (2016)
SCOOP and STACK production adds to light at Cushing
Lower rail use means more Bakken/Niobrara to Cushing

Williston basin crude-by-rail movements

Source: Argus Petroleum Transport, 19 Feb 2016
Cushing flooded with light crude; DSW quality suffers

- Flood of light sweet
- Not enough heavier to blend to Nymex-deliverable spec
- Not enough tankage for blending
- DSW ends up with metals, asphaltenes, high light ends

Source: EIA data through 22 Feb 2016
Closeup on Texas crude export infrastructure
US oil exports had risen even with “ban” in place

- Pres. Obama signed bill including lift of export controls in December 2015
  - A trade off for renewables
- Many exceptions existed already
  - Licenses to Canada were approved automatically
  - Re-export of Canadian
- Distilled condensate exports were legalized from June 2014

Source: US EIA
Crude is a small part of total US liquids exports

- Blendstocks
- Kerosene
- Naphtha
- Jet
- Fuel oil
- Finished gasoline
- Diesel/heating oil
- LPG
- Crude

000 barrels per day


Diesel/heating oil
LPG
Crude

illuminating the markets

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US export infrastructure is limited

Potential US crude export sites

Exports of Alaskan North Slope (ANS) crude have been legal for 20 years, but they have required more expensive US-flagged vessels to make the journey. That restriction is no longer in effect, potentially thinning the Brent premium needed to make a trans-Pacific journey economical.

The terminus of TransCanada’s proposed 1.1mn b/d Energy East pipeline is primarily envisioned as an escape route for western Canadian crude, but the connecting 300,000 b/d Upland pipeline could give Bakken production unfettered access to the Atlantic basin.

The Enterprise Hydrocarbon Terminal is the legacy Oiltanking Houston facility. The site of the second known unlicensed crude export that set sail last week, it has six deepwater docks and access to 20.1mn bl of storage.

NuStar Energy laid claim to the first unlicensed US crude export in four decades on 31 December. Its 400,000 b/d North Beach facility has been a leading outbound shipper of crude for years and is in prime position to load overseas exports.

The Louisiana Offshore Oil Port (LOOP) is seeking commitments for loading exports, which could require major infrastructure changes, including a new inbound pipeline from onshore facilities such as the hub at St James.

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Corpus Christi – connected to shale and growing

- First export cargo of Eagle Ford left NuStar’s North Beach facility in December
- Several docks with 45’ draft; more being developed
- Corpus Christi has access to both Eagle Ford and Permian crude
But Corpus Christi is off its peak

- Corpus Christi outbound crude movements were about 550,000 b/d in November 2015
  - Destinations: US Gulf, Atlantic US & Canada
- Peak was 673,000 b/d in January 2015
  - Lower Eagle Ford production
  - 150,000 b/d of new splitters
  - Adverse arbs

Source: Port of Corpus Christi/Argus Petroleum Transport, 18 Dec 2015
Houston: Infrastructure needs some work

- Second export cargo of Eagle Ford crude left Enterprise early January
- Houston ship channel suffers congestion and has 45’ drafts
- Freeport, Texas City, Seabrook and other nearby pipeline-connected sites offer nearby alternatives
Near Houston: Nederland/Beaumont/Port Arthur

Attributes
- Aframax and Panamax capable docks
- Multiple in-bound pipelines
- Bakken direct from North Dakota

Liabilities
- Most docks configured for imports

Third export cargo left Nederland for PdV
Exports will price vs the Gulf coast pipeline market

- Unlikely to be a transparent FOB USGC cargo market
- US Gulf domestic pipeline market is the seller’s alternative market
- Pipeline market assessments done according to long-standing and accepted Argus index methodology
- Robust financial products indexed to Argus pipeline prices

<table>
<thead>
<tr>
<th>Average physical volume</th>
<th>b/d last 3 trade months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argus Sour Crude Index (ASCI)</td>
<td>512,274</td>
</tr>
<tr>
<td>Argus WTI Midland</td>
<td>430,381</td>
</tr>
<tr>
<td>Argus Mars</td>
<td>357,589</td>
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<tr>
<td>BFOE</td>
<td>313,043</td>
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<tr>
<td>Argus LLS</td>
<td>186,754</td>
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<tr>
<td>Argus WTI Houston</td>
<td>121,186</td>
</tr>
<tr>
<td>Maya formula</td>
<td>81,600</td>
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What about WCS?
Canadian crude continues to move to the US

- Canada making little progress on export lines to its own coasts
- Export via US ports is an alternative, including Houston
- Canadian access to US by pipe is growing despite Keystone XL
  - Flanagan South/Seaway, Southern Access Extension, TransCanada’s Marketlink from Cushing to Nederland
More Canadian heavy heading to Houston

Houston area recipients of Canadian Heavy from Flanagan South and Marketlink (b/d)
Spot market emerging for WCS at the Texas coast?

• New volumes coming, but limited spot trade so far
• Recent Enterprise connection to Nederland has essentially eliminated tariffs between locations
  ◦ Allows for pooled liquidity, if participants will report trades
• Many in market recognize need for new benchmark
  ◦ Maya is a government formula based on defunct 3% fuel oil and WTS
  ◦ Mars is not a match in timing, location or quality
• Key terminal operators express interest in establishing fungible storage at agreed quality (WCS only)
WCS would complete array of US Gulf price discovery
Conclusions

- Infrastructure and quality determine where crude trades
- The lifting of US crude oil export controls reconnects US Gulf coast light crude pricing to the world market
  - Texas coast may be the most active, transparent price discovery point in the world; could eventually replace Brent as dominant price benchmark
- Quality segregation/fungible storage was the key to WTI at Houston’s success
- WCS could emerge this year with an active spot market at the Texas coast – complete the array of price benchmarks at the Gulf coast
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