OGJ special reports

• Annual Forecast & Review (Jan. 1)
  • Conglin Xu and Laura Bell

• Worldwide Pipeline Construction (Feb. 5)
  • Chris Smith

• Midyear Forecast (Jul. 2)
  • Conglin Xu and Laura Bell

• Pipeline Economics (Oct. 1)
  • Chris Smith
Market summary

• OPEC cuts buoyed market (despite US shale)

• Activity recovered onshore. Starting to see signs offshore.

• But abundance still dominates the market
Crude oil prices are...

**Up because...**
- The Forties Pipeline closed Dec. 11-Jan. 2
- Supplies are in jeopardy in Venezuela, Iran, Libya, etc.
- Many think the slump is over

**Inventories are down, and...**
- Production agreements start

Source: Charts from US Energy Information Administration Short Term Energy Outlook, January 2018
Geopolitical variables in the oil price

• Developments that would lower supply and increase the crude price:
  • Iraq disrupts pipeline exports from Kurdistan
  • Iranian protests spread to oil fields
  • Venezuela collapses
  • Nigerian militancy resumes (as Niger Delta Avengers promise)
  • Libya sinks further into civil conflict
  • Saudi-Iranian conflict escalates, by proxy or otherwise

• Development that would raise supply and lower the crude price:
  • Saudi Arabia abandons supply restraint because it...
    • Uses confiscated wealth instead of Aramco IPO to finance economic reform
    • Sees strategic advantage in lowering crude price to weaken Iran and Russia
OGJ F&R: US gas outlook 2018 (tcf)

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<table>
<thead>
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<tbody>
<tr>
<td>Consumption</td>
<td>27.594</td>
<td>+2.4%</td>
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<tr>
<td>Production</td>
<td>31.000</td>
<td>+7.6%</td>
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<tr>
<td>Imports</td>
<td>2.864</td>
<td>-3.8%</td>
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<tr>
<td>Exports</td>
<td>3.778</td>
<td>+19.0%</td>
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Not shown: supplemental gas, losses, storage

### Gas trade

<table>
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<tr>
<th></th>
<th>IMPORTS</th>
<th>EXPORTS</th>
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<tbody>
<tr>
<td>Canada</td>
<td>2.785</td>
<td>-3.9%</td>
<td>LNG</td>
</tr>
<tr>
<td>Mexico</td>
<td>.001</td>
<td>0</td>
<td>Pipeline</td>
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<tr>
<td>LNG</td>
<td>0.078</td>
<td>+1.8%</td>
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US LNG is changing the global market

• Price linked to Henry Hub rather than indexed to oil
• Contracts free of destination restrictions
• Combines with new supply from Australia, imminent supply from East Africa, small FLNG increment in West Africa, elsewhere to challenge traditional trade dominated by Qatar
• Competitive so far in Middle East, North Africa, Asia, South America
• Struggling to compete in Europe vs. pipeline gas from Russia
  • Gazprom dropped price to as low as $4/MMbtu in 2016; now ~$5/MMbtu

*Center for Strategic and International Studies, October 2017
OGJ pipeline construction: 2018 only (miles)*

• Global - 14,657 miles, +89%
  Return to 2013 levels

• US, Canada - 3,596 miles, +49%
  Natural gas = 2,824 (78.5%)

Land pipeline construction costs:
  2017, $5.94-million/mile
  2016, $7.65-million/mile

*Projects planned to be completed in 2018.
OGJ pipeline construction: 2018 and beyond (miles)*

- Global – 33,653 miles, -2.6%
  Continuing general decline since 2009

- US, Canada – 10,911 miles, +2.6%
  Natural gas = 5,706 (52.2%)
  Crude = 4,073
  Products = 1,132

*Projects under way at start of or set to begin in 2018 and be completed after 2018. Also includes some large projects not yet under construction but expected to advance.
Approvals one year ago (Jan.-Feb. 2017)...

• Northern Access (97 miles, Pennsylvania-NY)
• Atlantic Sunrise (200 miles, Marcellus-market)
• Rover (511 miles, Pennsylvania-Ontario)
• Rayne Xpress (adding HP Kentucky-Louisiana)
• Leach Xpress (160 miles, WV-Southern Ohio)
...and status now

• Northern Access – blocked by New York state
• Atlantic Sunrise – under construction (Spring 2014)
• Rover – ongoing delays, but being built
• Leach Xpress – started service Jan. 1, 2018

Delay updates!
• NEXUS (Enbridge), 255 miles, 1.5 bcf/d, Ohio-Michigan
  - being built, still local delays, year-end 2018 in-service

• PennEast, 115 miles, 36-in., Pennsylvania-NJ
  - NJ Attorney General rejected easement offers
Rover
Atlantic Sunrise – Transco expansion

Source: Williams
Escape from the Permian
Escape from the Permian: Crude projects

• Buckeye; South Texas Gateway, 24-in. OD, 600,000 b/d to Corpus, Ingleside, Houston, 2020
• Phillips 66, Enbridge; Gray Oak, 385,000 b/d to Corpus, Freeport, Houston, 2019
• EPIC Crude; 700-mile, 550,000 b/d, 2019
• Magellan; 645-mile, 24-in. OD, 350,000 b/d, Crane-to-Three Rivers-Corpus Christi/Houston, 2019
• PAA; Cactus II, 515-mile, 24-in. OD, Wink-to-McCamey-Ingleside/Corpus, +185,000 b/d, 2019
Buckeye South Texas Gateway
EPIC Crude and Y-Grade Pipelines
Magellan Proposed Crude Oil Pipeline to Corpus Christi and Houston
Escape from the Permian: Gas, NGL

• NAmerico Partners; Pecos Trail, 468-mile 1.85 bcf/d to Corpus, 2020
• Kinder Morgan; Gulf Coast Express, 430-mile, Waha to Agua Dulce, 1.92 bcf/d, October 2019
• Sempra, Boardwalk; Permian-Katy, 470-mile, 2 bcf/d, phased in starting December 2019
• EPIC Y Grade; 650-mile, 220,000 b/d, 2019
• Enterprise; Shin Oak, 571-mile, 250,000 b/d, 2019
Kinder Morgan Gulf Coast Express

Legend:
- Other KM Gas Pipeline
- KMBP - Kinder Morgan Border Pipeline
- EPN - El Paso Natural Gas Pipeline
- KMTP - Kinder Morgan Texas Pipeline
- TEJAS - Kinder Morgan Tejas Pipeline
- Proposed Gulf Coast Express Pipeline
- KM Compressor Station
- KM Gas Storage
- Permian Basin

Permit Receipt Points:
- EPNG/KMTP Mendoza Trails
- EPNG Waha Header
- DCP/Atmos Waha Header
- ETC Trans-Pecos Header
- Atmos Enterprise Oasis

Proposed Gulf Coast Express Pipeline

Delaware Basin
Midland Basin
Waha
Midland
Express to Mexico
Exports to Mexico

LNG Export Supply
Aguadulce Delivery Points
- KM Tejas
- KM Border
- Spectra Valley Crossing
- NET Mexico
- Howard Webb County Header
- Katy Hub
- Tres Palacios Storage
- NGPL
- TGP
- HPL
- Southcross

Dallas
Austin
Houston
Monterrey
Permian-to-Katy (P2K)
Permian-to-Gulf NGL pipelines

Planned NGPL pipelines from Permian to Gulf Coast

Source: U.S. Energy Information Administration
Global crude

• Caspian-Xinjiang – Kazakh crude to China – 1,384 miles, 2018
• Basra-Aqaba – Export Iraqi crude – 1,043 miles, 2020
• Uganda-Indian Ocean – roughly 930 miles, 2020
Global natural gas projects

• SCP/TAP/TANAP (Shah Deniz II) – Caspian to Europe
  • SCP (expansion) = 441 km, 56-in. OD, 2017
  • TANAP = 1,800 km, 48- and 56-in., 2018
  • TAP = 800 km, incl. 115 offshore, 2020

• Power of Siberia (CNPC, Gazprom) – Russian gas to China – 2,465 miles, 2019
SCP, TANAP, TAP – Shah Deniz to Europe
Russian gas pipelines, Power of Siberia
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