NGL and LPG
Supply and Price Outlook

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Global Head, NGL and Petrochemical Analytics
April 11, 2017
Overview

- Ethane picks up on petrochemicals, exports
- LPG exports drive prices up for propane, butanes
- Butane demand for gasoline blending likely flat
- Balance between petrochemical demand and exports
NGLs proving their worth relative to gas, crude

Value Gap

$/MMBtu Equivalent

Source: Platts

S&P Global
Platts
NGL market experiences dramatic price swings

Source: Platts
NGL Supply Forecast 1Q 2017
US NGL supply flat in 2017, return to growth in 2018

US NGL production at gas plants (before ethane rejection)

Source: Platts Analytics’ Bentek Energy Market Call: North American NGLs, 1Q2017
Forecasted Long-Term NGL Growth Driven By Marcellus/Utica, Permian, and Eagle Ford Ford

NGL Production from Gas Plants (Mb/d)

- Williston
  - 2015: 215
  - 2017: 248
  - 2019: 270

- Anadarko
  - 2015: 515
  - 2017: 700
  - 2019: 1035

- Permian
  - 2015: 404
  - 2017: 413
  - 2019: 472

- Eagle Ford/Texas Gulf Coast
  - 2015: 805
  - 2017: 733
  - 2019: 920

- Wet Marcellus/Utica
  - 2015: 557
  - 2017: 786
  - 2019: 1051

No pipeline capacity from Northeast to Gulf Coast for LPG, only for ethane

Source: Bentek Market Call: North American NGLs 1Q 2017
Ethane recovery under incremental demand
Increasing premium over natural gas resulted in high ethane recovery in 2016

Ethane Price Spread to HH vs. Ethane Recovery

Record EIA Recovery

Source: EIA, Platts
Higher stock levels make sense to cover growing demand

**Ethane Stocks**

- 2015 Stocks
- 2016 Stocks
- 2017 Stocks

*Source: EIA*

**Stock volumes to maintain 30 days forward cover**

- 2016 Act.
- 2016 Est.
- 2017
- 2019

*Source: Platts Analytics*
Ethane recovery driven from back of the curve

Platts M2M-NGL Forward Curves
Mont Belvieu Ethane (non-LST)

S&P Global
Platts

Source: Platts
Eight greenfield crackers under construction to add 535 Mb/d to US ethane demand by 2019

Source: Platts Analytics’ NGL Facilities Databank
Eight greenfield crackers under construction to add 535 Mb/d to US ethane demand by 2019

Ethane Demand from Steam Crackers

Source: Platts Analytics’ NGL Facilities Databank
Two US ethane terminals are available for waterborne exports

<table>
<thead>
<tr>
<th>Owner</th>
<th>Project Name</th>
<th>Location</th>
<th>Ethane Capacity (Mb/d)</th>
<th>In-Service Date</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunoco Logistics</td>
<td>Marcus Hook</td>
<td>Delaware, PA</td>
<td>~70</td>
<td>March 2016</td>
<td>Northeast</td>
</tr>
<tr>
<td>Enterprise</td>
<td>Morgan’s Point</td>
<td>Houston Ship Channel, TX</td>
<td>200</td>
<td>3Q2016</td>
<td>US Gulf Coast</td>
</tr>
</tbody>
</table>

Source: Platts cFlow

Source: Bentek NGL Facilities Databank
US ethane exports to grow from 93 Mb/d in 2016 to ~280 Mb/d in 2019

Source: Platts Analytics’ Bentek Energy Market Call: North American NGLs, 1Q2017
Will incremental recovery need to be incentivized by higher prices? Permian will be the key.

Source: Platts Analytics’ Bentek Energy Market Call: North American NGLs, 1Q2017
LPG: choppy seas as exports accelerate
LPG market experiences dramatic price swings

LPG Prices at Mont Belvieu

- EPD isomerization unit goes down
- US exports record levels of LPG above 1.1 MMb/d
- Gasoline blending season begins
- LPG exports stay above 1MMb/d; propane forward cover as low as Feb. 2014
- Gasoline blending season ends; will butane prices finally stabilize?

Source: Platts
Propane and butane exports averaged 886 Mb/d in 2016, supported by high propane stocks.

Record high: 1,158 Mb/d

Weekly Propane Stocks

Source: EIA
C3 days forward cover approaching Jan 2014 levels

Propane Days Supply

Days Supply or Forward Cover

2013 2014 2015 2016 2017

Days Supply or Forward Cover

Source: EIA, Platts Analytics’ Bentek Energy  Market Call: North American NGLs 1Q2017
US LPG export grows 700 Mb/d in four years; emerges as global supplier
US spot price roughly 20 cents below Saudi

Global propane prices

Spot propane prices

Source: Platts
VLGC spot rates on the decline as more ships enter the market

**VLGC Spot Freight Rates**

- **VLGC Freight Houston-Northwest Europe**
- **VLGC Freight Houston-Japan**
- **VLGC Freight Persian Gulf-Japan**

*Source: Platts*
US PDH oriented for export, domestic margins have been challenged, causing delays, cancellations

### Current and Announced US PDHs

<table>
<thead>
<tr>
<th>Company</th>
<th>Capacity (MMlbs/yr)</th>
<th>C3 Demand (Mb/d)</th>
<th>ISD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flint Hills</td>
<td>1,450</td>
<td>26</td>
<td>Completed</td>
</tr>
<tr>
<td>Dow Chemical</td>
<td>1,650</td>
<td>29</td>
<td>Completed</td>
</tr>
<tr>
<td>Enterprise</td>
<td>1,650</td>
<td>35</td>
<td>2Q2017</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,750</strong></td>
<td><strong>90</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Cancelled/On-hold US PDHs

<table>
<thead>
<tr>
<th>Company</th>
<th>C3 Demand (Mb/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formosa</td>
<td>23</td>
</tr>
<tr>
<td>REXTac</td>
<td>12</td>
</tr>
<tr>
<td>Ascend/C3 Petrochemicals</td>
<td>39</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>74</strong></td>
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</table>

Source: Platts Analytics

**US Propane - Propylene Margin**

- Platts Propane non-LST Mt Belvieu pipe
- Platts Propylene Poly Grade FD USGC

Margins are shown in cents per lb.
Development of additional Chinese PDH challenged by lower margins

Source: Platts, Platts Analytics

Low margins decrease utilization of existing units

S&P Global
Platts

Source: Platts, Platts Analytics
## Asian PDH projects

<table>
<thead>
<tr>
<th>Country</th>
<th>Producer</th>
<th>Location</th>
<th>Capacity (000 mt)</th>
<th>Start Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>ONGC Mangalore</td>
<td>Mangalore</td>
<td>500</td>
<td>Q4 2020?</td>
</tr>
<tr>
<td>South Korea</td>
<td>SK Gas/ Saudi APC</td>
<td>Ulsan</td>
<td>600</td>
<td>Q2 2016</td>
</tr>
<tr>
<td>China</td>
<td>Fujian Meide Petrochemical - Phase I</td>
<td>Fuzhou</td>
<td>660</td>
<td>H1 2017</td>
</tr>
<tr>
<td>China</td>
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<td>Fuzhou</td>
<td>660</td>
<td>Q3 2019?</td>
</tr>
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<td>China</td>
<td>Haiwei Group Hengshui PDH I</td>
<td>Hengshui</td>
<td>500</td>
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<td>Oriental Energy</td>
<td>Caofedian</td>
<td>660</td>
<td>2019</td>
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<td>Ningbo Fortune - Phase I</td>
<td>Ningbo</td>
<td>660</td>
<td>Q4 2016</td>
</tr>
<tr>
<td>China</td>
<td>Dongguan Juzhengyuan</td>
<td>Zhanjiang</td>
<td>900</td>
<td>Q3 2018</td>
</tr>
<tr>
<td>Poland</td>
<td>Grupa Azoty Police II</td>
<td>Police</td>
<td>400</td>
<td>2019</td>
</tr>
</tbody>
</table>

Source: Platts Analytics
Isobutane supply disruption crashes iso/normalspread; market playing catch up

US Isobutane Stocks and Production

Isobutane – Normal butane spread at Mont Belvieu

S&P Global Platts

Source: EIA through November 2016, Platts
Natural gasoline constrained between Chicago-Edmonton, not to Chicago

Canadian Diluent Demand

- US Natural Gasoline Exports
- Canadian Diluent Supply
- Canadian Diluent Demand
What will save the US: new crackers or exports?
New Crackers Are Largest Source Of Incremental Demand

**Ethane Supply - Demand**

- **2016**
  - 1.7 MMb/d
  - Petchem 57%
  - Rejection 31%
  - Exports 5%
  - Stock chg 6%

- **2022**
  - 2.3 MMb/d
  - Petchem 69%
  - Rejection 19%
  - Exports 12%
  - Stock chg 6%

Source: Bentek

**Market Call: North American NGLs, 1Q 2017**
Lower exports in 2017 due to lower supply growth, domestic demand

Propane Supply/Demand Balance

Butanes Supply/Demand Balance

Source: Platts Analytics’ Bentek Energy  Market Call: North American NGLs 1Q2017
Natural Gasoline: diluent export via rail to Canada

Natural Gasoline Supply - Demand

Diluent Exports

Source: Platts Analytics' Bentek Energy  Market Call: North American NGLs 1Q2017
US ethane demand comes in two waves; petchem only part of the solution to growing supply

US Petrochemical Demand

First Wave
Second Wave

Source: Platts Analytics' Bentek Energy Market Call: North American NGLs, 1Q2017
US will export over 30% of its NGL production by 2022; three-fold increase over 2011.
Thank you

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