Webinar: Global Refining & Petrochemicals - Mid Year Review - 2016

Webinar
July 7, 2016
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Agenda

Stratas Advisors Overview

Crude Oil Production and Refinery Input Outlook (2013-2035)

Crude Oil Trade flow By Crude Type (2013-2035)

Update On Light Oil, Conversion And Hydroprocessing Capacity

Update on Regional Refinery Margins, Steam Cracker Margin For Naphtha Based And Ethane Based Steam Cracker
Dedicated Teams for Each Segment

Strategic insights across the energy value chain

**Upstream**
Drill down with a ground-level look at the fields, wells and companies involved in E&P.

**Midstream**
Move confidently in new frontiers that are being shaped by changing supply/demand dynamics coupled with investments in pipeline, rail and ship logistics.

**Downstream**
Thrive in an environment where crude oil supply dynamics and product demand trends are structurally evolving.

**Fuel & Transport**
Accelerate innovation with a comprehensive understanding of policies pertaining to petroleum-based fuels, biofuels and other alternative fuels.
# Service Matrix

<table>
<thead>
<tr>
<th>Upstream</th>
<th>Midstream</th>
<th>Downstream</th>
<th>Fuel &amp; Transport</th>
<th>Executive Suite</th>
<th>By Region</th>
<th>By Industry</th>
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<tbody>
<tr>
<td>Global Hydrocarbon Supply</td>
<td>North American NGL</td>
<td>Base Petrochemicals</td>
<td>Global Biofuels Assessment</td>
<td>Macroeconomic Outlook</td>
<td>Europe</td>
<td>Power</td>
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<td>Global Natural Gas Outlook</td>
<td>Global Syngas Conversion</td>
<td>Global Automotive</td>
<td>Long-term Price Forecasting</td>
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<td>Middle East</td>
<td>Financial</td>
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<td>Global NGL Outlook</td>
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<td>Short-term Price Forecasting</td>
<td>North America</td>
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<td>Global LNG</td>
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<td>Russia &amp; CIS</td>
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</tbody>
</table>
Global Refining and Products

Focus and Coverage

Focus of the Analysis & Capabilities

Crude Oil Outlook
- Volume and quality

Refined Product Outlook
- LPG, Naphtha, Gasoline, Jet/Kero, Diesel, Fuel Oil, Other Products
- Gasoline and Diesel fuel quality outlook by sulfur category
- Bunker split distillate/fuel oil

Global Refinery Capacity
- Crude Distillation
- Light Oil (Reforming, Isomerization, Alkylation/Polymerization)
- Conversion (Coking, Catalytic Cracking, Hydrocracking)
- Hydroprocessing (Gasoline, Naphtha, Middle Distillates, Heavy Oil/Residual Fuel)

Regional Coverage

On the ground coverage of:
- North America
  - Including U.S. and Canada
- Latin America
- Europe
  - EU, EFTA, Turkey and Balkan countries
- CIS
  - Special focus on Russia
- Asia-Pacific
  - Special focus on China, India and Japan
- Middle East
  - Special focus on Saudi Arabia
- Africa
# Global Refining and Products

## Enhancements

### Focus of the Analysis & Capabilities

<table>
<thead>
<tr>
<th>Regional Refinery Margins</th>
<th>Petrochemical Links</th>
<th>Wider regional crude coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on regional actual refinery configuration, no simplification</td>
<td>Steam crackers</td>
<td>Regional crude selected from available over 200 crudes globally</td>
</tr>
<tr>
<td>Includes blending components such as Oxygenates and Bio-diesel</td>
<td>Reformers</td>
<td>Condensate balanced with naphtha</td>
</tr>
</tbody>
</table>

### Additional Features

- Quarterly updates
- Improved interactive data tools and database
- Crude oil trade flows between regions
- Refinery products trade flows between regions for
  - Gasoline,
  - Naphtha,
  - Middle Distillate, and
  - Fuel Oil
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Crude Oil Production Outlook (2013-2035)
Crude Oil Production Outlook (2013-2035)

Key Insight: North America

- From 2013 to 2015, total crude oil production in North America grew 0.2 million b/d from 10.8 to 11 million b/d.
- North America's total crude oil production will peak in 2020 at 11.8 million b/d and decrease afterwards, reaching 11.4 million b/d by 2035.

Source: Stratas Advisors, 2016
Key Insight: Latin America

- From 2013 to 2015, total crude oil production in Latin America grew 0.009 million b/d from about 9.401 million b/d to 9.410 million b/d.
- Latin America total crude oil production will peak at 9.5 million b/d by 2030.

Source: Stratas Advisors, 2016
Key Insight: Middle East

Between 2013 and 2015, the Middle East's total oil production grew 1.2 million b/d day from about 25.4 million to 26.6 million. In 2013.

The Middle East's total crude oil production will grow (1.25% per year on average) and reach 34 million b/d through 2035.

Source: Stratas Advisors, 2016
Key Insight: Russia & CIS

- Between 2013 and 2015, crude oil production in Russia & CIS grew 47,000 b/d from 13.33 million b/d to 13.38 million b/d.
- Russia and CIS's total crude oil production will grow 0.27 million b/d, reaching 13.65 million by 2035.
Key Insight: Europe

- Between 2014 and 2015, Europe's total crude oil production will decrease 1.08 million b/d from around 3 million to 2.9 million.
- Europe's total crude production will continue to decrease, reaching 2.4 million b/d by 2035 (a 0.51 million b/d drop in 20 years).

Source: Stratas Advisors, 2016
Refinery Input Outlook (2013-2035)
Refinery Input Outlook (2013-2035)

Key Insight: North America

- Between 2013 and 2015 the refinery crude input volume in North America increased 0.21 million b/d, going from 16.1 to 16.3 million b/d.
- From 2015 to 2035, North America's refinery crude input volume will grow and reach 16.9 million b/d by the end of the period.
Key Insight: Latin America

• Between 2013 and 2015 the refinery crude input volume in Latin America increased 0.56 million b/d, going from 5.8 to 6.4 million b/d.
• From 2015 to 2035, Latin America's total refinery crude input volume will grow and reach 7.8 million b/d.

Source: Stratas Advisors, 2016
Refinery Input Outlook (2013-2035)

Key Insight: Asia

- Between 2013 and 2015, Asia refinery input grew 0.4 million b/d going from 24.8 to 25.2 million b/d.
- According to our forecast, Asia refinery crude input volume will continue grow and reach 27.8 million b/d through 2035, driven by strong demand of refined products.

Source: Stratas Advisors, 2016
Refinery Input Outlook (2013-2035)

Key Insight: Middle East

- Between 2013 and 2015 Middle East refinery crude input increased 0.9 million b/d, going from 7.3 to 8.2 million b/d.
- From 2015 to 2035, the Middle East's total refinery crude input volume will increase (at an average annual rate of 2.8%) and reach 14.4 million b/d.

Source: Stratas Advisors, 2016
Refinery Input Outlook (2013-2035)

Key Insight: Russia & CIS

- Between 2013 and 2015, the refinery crude input volume in Russia & CIS grew 0.14 b/d from 6.7 to 6.8 million b/d.
- According to our forecast, Russia & CIS refinery crude input will continue growing and reach 7.2 million b/d by 2035.

Source: Stratas Advisors, 2016
Crude Oil Tradeflow by Crude Type (2013-2035)
Crude Oil Tradeflow by Crude Type (2013-2035)

Global Crude Oil Trade Flow

Source: Stratas Advisors, 2016
## Crude Oil Tradeflow by Crude Type (2013-2035)

### Heavy Sour Crude Oil

<table>
<thead>
<tr>
<th>From-To</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
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<tr>
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<td>0.33</td>
<td>0.31</td>
<td>0.29</td>
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<td>0.19</td>
<td>0.20</td>
<td>0.22</td>
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<td>Europe to North America</td>
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<td>0.01</td>
<td>0.02</td>
<td>0.07</td>
<td>0.03</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Latin America to North America</td>
<td>2.27</td>
<td>2.12</td>
<td>1.96</td>
<td>1.18</td>
<td>1.18</td>
<td>1.17</td>
<td>1.14</td>
</tr>
<tr>
<td>Middle East to Asia</td>
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<td>0.37</td>
<td>0.40</td>
<td>0.58</td>
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<td>0.00</td>
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<tr>
<td>Russia &amp; CIS to North America</td>
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<td>0.22</td>
<td>0.15</td>
<td>0.13</td>
<td>0.13</td>
</tr>
</tbody>
</table>

*Source: Stratas Advisors, 2016*

- North America is the world largest importer of heavy sour crude. In 2013, North America imports amounted to 2.3 million b/d. These crude grade is coming mainly from Latin America.

- However, the imports forecast through 2035 show a declining trend, reaching 1.99 million b/d, due to increased local production, especially in Canada.
**Crude Oil Tradeflow by Crude Type (2013-2035)**

**Light Sour Crude Oil**

<table>
<thead>
<tr>
<th>Light Sour Crude Tradeflow Oil million b/d</th>
<th>From-To</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa to Europe</td>
<td>0.11</td>
<td>0.11</td>
<td>0.11</td>
<td>0.11</td>
<td>0.14</td>
<td>0.15</td>
<td>0.19</td>
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<tr>
<td>Africa to North America</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Middle East to Asia</td>
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<td>4.59</td>
<td>4.58</td>
<td>4.50</td>
<td>4.56</td>
<td>4.56</td>
<td>4.66</td>
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</tr>
<tr>
<td>Middle East to Europe</td>
<td>0.63</td>
<td>0.60</td>
<td>0.56</td>
<td>0.36</td>
<td>0.36</td>
<td>0.36</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>Middle East to Latin America</td>
<td>0.02</td>
<td>0.03</td>
<td>0.05</td>
<td>0.12</td>
<td>0.18</td>
<td>0.17</td>
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<td>Middle East to North America</td>
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<td>0.64</td>
<td>0.65</td>
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<td>0.69</td>
<td>0.69</td>
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<td>0.03</td>
<td>0.03</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td></td>
</tr>
<tr>
<td>Russia &amp; CIS to Asia</td>
<td>0.68</td>
<td>0.73</td>
<td>0.77</td>
<td>0.99</td>
<td>1.02</td>
<td>1.08</td>
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<tr>
<td>Russia &amp; CIS to Europe</td>
<td>1.07</td>
<td>1.08</td>
<td>1.08</td>
<td>1.13</td>
<td>1.14</td>
<td>1.14</td>
<td>1.11</td>
<td></td>
</tr>
<tr>
<td>Russia &amp; CIS to Latin America</td>
<td>0.03</td>
<td>0.02</td>
<td>0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Russia &amp; CIS to North America</td>
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<td>0.01</td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Stratas Advisors, 2016*

- The Middle East is by far the largest exporter of light sour crude oil (5.9 million b/d in 2013) and the main supplier to Asia. More than 85% of Asia's light sour crude imports come from the Middle East.

- Exports from Middle East to North America are expected to rise from 0.65 to 0.69 million b/d in 20 years.
Crude Oil Tradeflow by Crude Type (2013-2035)

Medium Sour Crude Oil

<table>
<thead>
<tr>
<th>Medium Sour Crude Oil Tradeflow- million b/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>From-To</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Africa to Asia</td>
</tr>
<tr>
<td>Africa to Europe</td>
</tr>
<tr>
<td>Africa to Latin America</td>
</tr>
<tr>
<td>Africa to North America</td>
</tr>
<tr>
<td>Latin America to Asia</td>
</tr>
<tr>
<td>Latin America to Europe</td>
</tr>
<tr>
<td>Latin America to North America</td>
</tr>
<tr>
<td>Middle East to Asia</td>
</tr>
<tr>
<td>Middle East to Europe</td>
</tr>
<tr>
<td>Middle East to Latin America</td>
</tr>
<tr>
<td>Middle East to North America</td>
</tr>
<tr>
<td>Middle East to Africa</td>
</tr>
<tr>
<td>Russia &amp; CIS to Asia</td>
</tr>
<tr>
<td>Russia &amp; CIS to Europe</td>
</tr>
</tbody>
</table>

Source: Stratas Advisors, 2016

- The Middle East is the world's largest producer and exporter of medium sour crude oil grade. In 2013, the region exported 9.9 million b/d of medium sour crude. Asia's refinery configuration compatibility and geographical proximity makes it a preference for Middle Eastern oil producers.
Update on Refinery Capacity
### Update on Refinery Capacity

**CDU Capacity additions projections**

<table>
<thead>
<tr>
<th>Region</th>
<th>2012</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
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</thead>
<tbody>
<tr>
<td>Africa</td>
<td>3.5</td>
<td>4.1</td>
<td>4.1</td>
<td>4.1</td>
<td>4.1</td>
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<td>Europe</td>
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<td>14.5</td>
<td>14.5</td>
<td>14.5</td>
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<td>Latin America</td>
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<td>9.7</td>
<td>9.7</td>
<td>9.7</td>
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<td>21.0</td>
<td>21.0</td>
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<tr>
<td>Russia &amp; CIS</td>
<td>8.3</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
</tr>
</tbody>
</table>

**Note:** Based on anticipated announced expansions and projected expansions from our proprietary LP regional refinery models

**Source:** Stratas Advisors, 2016

- Additional crude distillation capacity in the period to 2035, will be coming in Asia and the Middle East
Capacity Additions for Middle Distillate Markets

Volume and quality improvements via conversion and hydroprocessing units

- Push for clean diesel (ultra-low-sulfur) continues around the world
- Significant volume of ULSD will come from hydrocrackers and upgraded existing hydrotreaters

Source: Stratas Advisors, 2016
Announced Refinery Projects

FCC and Alkylation

<table>
<thead>
<tr>
<th>Region</th>
<th>Location</th>
<th>Project</th>
<th>Capacity (b/d)</th>
<th>Status</th>
<th>Expected Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASIA</td>
<td>Mumbai, India</td>
<td>FCC</td>
<td>28000</td>
<td>Under Construction</td>
<td>-</td>
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<tr>
<td>ASIA</td>
<td>Limay, Philippines</td>
<td>Catalytic cracker</td>
<td>35900</td>
<td>Engineering</td>
<td>-</td>
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<tr>
<td>ASIA</td>
<td>Yeosu, South Korea</td>
<td>Catalytic cracking</td>
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<td>Planning</td>
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<td>EU</td>
<td>Pembroke, UK</td>
<td>FCC</td>
<td>-</td>
<td>Engineering</td>
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<tr>
<td>LA</td>
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<td>42500</td>
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<tr>
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<td>40000</td>
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<td>Talara, Peru</td>
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<td>19000</td>
<td>Engineering</td>
<td>-</td>
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<tr>
<td>NORTH AMERICA</td>
<td>Port Allen, USA</td>
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<td>Engineering</td>
<td>-</td>
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<tr>
<td>RUSSIA &amp; CIS</td>
<td>Kstovo, Russia</td>
<td>Catalytic cracking</td>
<td>26000</td>
<td>Planning</td>
<td>2018</td>
</tr>
</tbody>
</table>

- Major initiatives include large refinery expansions in Asia Pacific, North America, and the Middle East.
- FCC expansions projects are under way in Asia, Europe, Latin America, North America, and Russia & CIS. They are expected to be completed between 2018 to 2020.
- An Alkylation expansion project has been announced in Asia.

Source: Stratas Advisors, 2016
Update on Regional Refinery Margins
Refinery Margins

Methodology

- Our model has the following features:
  - For feedstock it considers the actual regional crude slate, not just a single representative crude.
  - Considers the regions as a one big refinery.
  - Includes biofuels as part of the gasoline and diesel blending pool volumes.
  - The actual refinery configuration is considered.
  - Fuel specifications are built in the model.
  - Takes into account H2 cost.
Update on Regional Refinery Margins

North America

The North America refinery margin is 11 $/bbl and will drop to 9 $/bbl by 2017 due to reduction in price differential between WTI and Brent. It is expected to improve to 12.66 $/bbl by 2025 and to 13.35 $/bbl by 2035.

Source: Stratas Advisors, 2016
Update on Regional Refinery Margins

Middle East

- The Middle East's current refinery margin is 8 $/bbl, which will decline below 3 $/bbl by 2020. The advantage of adding secondary processing capacity units will help improve the margins after 2020. The refinery margin will increase to 8 $/bbl by 2035.

Source: Stratas Advisors, 2016
Naphtha vs Ethane Cracker Margin
Steam Cracker Projects – North America

Impact of Feedstock Availability: The Shale Gas Boom

US New Steam Cracker Projects

<table>
<thead>
<tr>
<th>Company</th>
<th>Ethylene Capacity (metric tonnes/year)</th>
<th>Location</th>
<th>Expected Start-up</th>
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</thead>
<tbody>
<tr>
<td>Appalachians Resins</td>
<td>300000</td>
<td>Salem Township, OH</td>
<td>2019</td>
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<tr>
<td>Balands-Vinmar</td>
<td>1000000</td>
<td>North Dakota</td>
<td>2020</td>
</tr>
<tr>
<td>Chevron Phillips Chemical Co. LP</td>
<td>1500000</td>
<td>Cedar Bayou, Tex</td>
<td>3Q/4Q 2017</td>
</tr>
<tr>
<td>Dow Chemical Co.</td>
<td>1500000</td>
<td>Freeport, Tex.</td>
<td>2017</td>
</tr>
<tr>
<td>Exxonmobil Chemical Co.</td>
<td>1550000</td>
<td>Baytown, Tex.</td>
<td>4Q 2016</td>
</tr>
<tr>
<td>Formosa Plastics Corp. USA</td>
<td>1000000</td>
<td>Point Comfort, Tex.</td>
<td>2017</td>
</tr>
<tr>
<td>Ingleside Ethylene LLC</td>
<td>544311</td>
<td>Ingleside, Tex.</td>
<td>2017</td>
</tr>
<tr>
<td>PTT Global Chemical/Marubeni</td>
<td>1000000</td>
<td>Belmont County, Oh.</td>
<td>4Q 2019</td>
</tr>
<tr>
<td>Sasol North America Inc.</td>
<td>1500000</td>
<td>Lake Charles, La.</td>
<td>2017</td>
</tr>
<tr>
<td>Shell Chemicals Ltd.</td>
<td>1500000</td>
<td>Monaca, Pa.</td>
<td>2020</td>
</tr>
<tr>
<td>Shintech</td>
<td>500000</td>
<td>Plaquemine Parish, La.</td>
<td>2019</td>
</tr>
<tr>
<td>Total Petrochemicals</td>
<td>1000000</td>
<td>Port Arthur, Tex.</td>
<td>2019</td>
</tr>
</tbody>
</table>

Source: Stratas Advisors, 2016

- North America will be adding 8-14 million metric tonnes/year of ethylene capacity by 2020, both through new crackers and expansions.
- The availability of cheaper ethane in North America and technological advantages makes ethylene production more attractive than the production based on naphtha, although the difference starts to fade as oil prices decline.
Stratas Advisors Petrochemical Margin

Strength Across Feedstock Availability

- USGC ethane-based cracker margin was 578 USD/metric tonne in 2015
- USGC naphtha-based cracker margin was 206 USD/metric tonne in 2015.

Source: Stratas Advisors, 2016
Petchem Margin Outlook

Key Insight: Potential Economics

• Ethane cracker margins will remain strong due to significantly lower feedstock price results in margins around two-times greater than its naphtha counterpart.

• As an increasing volume of ethane is cracked in North America, propylene and co-products production is reduced. This pushes prices to higher levels and hence increasing co-product credits for naphtha cracker margins.

• Based on our assessment, the North America ethane margin advantage will remain when compared to the North America naphtha-based steam cracker.
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