ASIA CHEMICAL CONFERENCE

Global Petrochemical Market Outlook

Planning For Growth Given Heightened Uncertainty In Market Fundamentals

November 2016, Singapore

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### Global Chemical Industry: Enabling Modern Living

#### Natural Resources
- Mining, drilling, refining, gas processing
- Oil
- Gas
- Coal
- Minerals
- Renewables

#### Chemical Industry Value Chain

<table>
<thead>
<tr>
<th>Base Chemicals</th>
<th>Chemical Intermediates</th>
<th>Formulated products / performance materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olefins (Ethylene, propylene, butylene)</td>
<td>Commodity specialties</td>
<td>Plastics and engineering resins</td>
</tr>
<tr>
<td>Aromatics (benzene, toluene, xylenes)</td>
<td>Differentiated commodities</td>
<td>- Extruded films, pipe, profiles, coatings, sheet, foams</td>
</tr>
<tr>
<td>Chlor-akali (chlorine, caustic soda)</td>
<td>Technical specialties</td>
<td>- Blow-molded parts</td>
</tr>
<tr>
<td>Others (ammonia, phosphorous)</td>
<td></td>
<td>- Composites</td>
</tr>
</tbody>
</table>

#### Customers
- Automotive / transportation
- Consumer products
- Packaging
- Building / construction
- Recreation / sport
- Industrial
- Medical
- Pharmaceutical
- Personal care
- Textiles
- Electrical / electronics
- Aircraft / aerospace
- Business equipment

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Planning For Growth Given Heightened Uncertainty

AGENDA

• Impact of Energy on Chemical Investment Decisions.
• Where are the major investments in new capacity?
• Energy extremes enabling non-conventional capacity.
• Declining CAPEX and rising Mergers & Acquisitions
• Strategic Considerations
Energy & Economic Fundamentals Impact Investment Decisions

- **Energy trends** impact regional competitiveness and profitability

- Advantaged investments in North America and China, see **lower margins in low crude oil** market.

- Economy and energy assumptions **drive key decisions** of location, feedstock, technology, scale...

- Uncertainty results in **delayed approvals**; when combined with steady growth leads to tighter market conditions in basic chemical value-chains

- **Crude oil (energy) “at the extremes”** impacts demand for chemicals and plastics. On the high end, it can “destroy” demand and on the low end it can stimulate demand.
Steady Increase In Crude Oil Price; Stable/Low Natural Gas In North America; Moderate Global Economic Growth

% Change, GDP

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
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<td>World</td>
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<td>1.4</td>
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<tr>
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<td>India</td>
<td>7.2</td>
<td>7.5</td>
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<tr>
<td>Russia</td>
<td>0.7</td>
<td>-3.7</td>
<td>-0.7</td>
<td>0.8</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Global Crude Oil vs. USGC Natural Gas

$43.5/bbl
Gas-to-Crude Ratio Favors North America Investments Since 2010

USGC Natural Gas Versus WTI Crude Oil Pricing (US$ / MM BTU)
Impact of Changing Energy Dynamics On Regional Chemical Capacity Additions

Annual Change - Total Basic Chemicals Capacity:
Ethylene, Propylene, Methanol, Benzene, Paraxylene, Chlorine

<table>
<thead>
<tr>
<th>Year</th>
<th>China</th>
<th>Middle East</th>
<th>North America</th>
<th>West Europe</th>
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<td>2021</td>
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</table>

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Impact of Changing Energy Dynamics On Regional Chemical Capacity Additions

Annual Change - Total Basic Chemicals Capacity: Ethylene, Propylene, Methanol, Benzene, Paraxylene, Chlorine

Gas-To-Crude BTU Ratio, %
Impact of Changing Energy Dynamics On Regional Chemical Capacity Additions

Annual Change - Total Basic Chemicals Capacity:
Ethylene, Propylene, Methanol, Benzene, Paraxylene, Chlorine

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Impact of Changing Energy Dynamics On Regional Chemical Capacity Additions

Annual Change - Total Basic Chemicals Capacity:
Ethylene, Propylene, Methanol, Benzene, Paraxylene, Chlorine

Annual Change

<table>
<thead>
<tr>
<th>Year</th>
<th>North America</th>
<th>Gas-To-Crude BTU Ratio, %</th>
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</thead>
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<tr>
<td>2019</td>
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<td></td>
</tr>
<tr>
<td>2021</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

North America
Gas-To-Crude BTU Ratio, %
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GLOBAL BASE CHEMICAL ASSETS BY LOCATION

580 MM metric tons in 2015
Investment Decisions Must Evaluate Many Factors Beyond Energy & Economy

**Investment Assumptions:**
- Global crude oil price scenarios
- Global economic growth outlook
- **Geo-political considerations**
- North American energy market
- Current state of the profit cycle
- **China structural changes**
- Non-conventional technology
- **Sustainability**
- Levels of integration
- **Regional CAPEX differentials**
- Logistics investments

Braskem-Idesa Ethylene/PE Plant
Nanchital, Veracruz, Mexico
Start-Up: June 2016
Base Chemical Capacity To Exceed 750 MM Metric Tons By 2025

Chemical Investment “Drivers”

• Secure an energy & feedstock advantage.

• Leverage current technology and build world-scale.

• Invest with proximity to local markets and/or access to trade routes.

• Build to leverage an upstream and/or downstream integrated position.
Beyond 2020...Where Will The Next Wave Of Capacity Be Built?

<table>
<thead>
<tr>
<th>Region</th>
<th>2015</th>
<th>2025</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>90</td>
<td>137</td>
<td>47</td>
</tr>
<tr>
<td>South America</td>
<td>24</td>
<td>26</td>
<td>2</td>
</tr>
<tr>
<td>Europe</td>
<td>89</td>
<td>101</td>
<td>12</td>
</tr>
<tr>
<td>Middle East / Africa</td>
<td>77</td>
<td>119</td>
<td>42</td>
</tr>
<tr>
<td>Asia/India (less China)</td>
<td>130</td>
<td>163</td>
<td>33</td>
</tr>
<tr>
<td>China</td>
<td>172</td>
<td>241</td>
<td>69</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>582</strong></td>
<td><strong>787</strong></td>
<td><strong>205</strong></td>
</tr>
</tbody>
</table>

*Ethylene, Propylene, Methanol, Benzene, Paraxylene, Chlorine"
China: Slower Pace Of New Capacity & Increased Focus On:
> Industry Competitiveness
> Safety & Pollution control
> Segment Consolidation

- Tighten pollution control; industry safety performance; rationalize inefficient/non-competitive assets.
- Develop modern coal chemicals asset base.
- Consolidation of 100+ chemical industry parks into seven national chemical industrial zones.
- Rapid growth in private investment potentially changes future behavior.
- Overseas investment activity.
China 13th 5-Year Plan Slows Pace Of Investment; Focus On Competitive Position, Safety & Pollution, Consolidation

Basic chemicals expansions of 200 MM metric tons over two decades (2005 – 2025).

Self-sufficiency in propylene 85+% by 2020; ethylene remains near 60%.
Middle East Rate Of Investment Slows;

> Adding Diverse Feedstocks;
> Focused On Operational Efficiencies

- Ethane prices in Saudi Arabia raised to reflect transition in strategy for future investments.
- Low crude prices sharpen focus on operational costs.
- Sadara project in Saudi Arabia represents measured approach to diversify businesses.
- Lifting of nuclear sanctions on Iran has re-opened plans to expand the chemical space.
- Significant dependence on exports continues well into the future.
Middle East Focus Shifting To Feed-slate Diversity And Improving Operational Efficiencies

Middle East Base Chemical Capacity

- Propylene (PG/CG)
- Ethylene
- Paraxylene
- Benzene
- Methanol
- Chlorine

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North America: An Attractive Place For Chemicals Investments Once Again

- Low cost energy and natural gas liquids provide sustainable advantage.

- Advantaged feedstock will enable an additional wave beyond 2020, assuming crude oil price recovery (near $80/bbl) and low natural gas pricing (near $4/MM BTU).

- Domestic and International companies seek to invest; leveraging the low-cost opportunities. New entrants to create increased competition in domestic markets.

- Logistics & port infrastructure investment needed to support higher level of exports.
North America Low Cost Brings Back Base Chemical & Associated Derivative Investments

North America - Base Chemical Total Capacity

Source: IHS
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Energy At The Extremes Has Catalyzed A “New Era” In Light Olefins Production

- For decades, light olefins supply based on refinery & naphtha cracker integrated sites
- Ethane crackers emerged where ethane was advantaged; USGC, Mexico, Alberta, Middle East; other areas where liquids rich gas was “trapped”.
- Propylene was a byproduct of refining and heavy or flexible steam cracking.
- Today light olefins are being made on purpose via a variety of technologies beyond refining and steam cracking: PDH, CTO/P, MTO/P, Metathesis, GTO/P, OCM
Energy & Feedstocks Influence Location & Technology For New Capacity Decisions

• Energy and feedstock deltas emerged in 2009 as part of the North America shale developments.

• These spreads supported “on-purpose” capacity to be viable as an incremental supply option.

• The spreads remained high through 2014, attracting a new investment wave.

• 2015 collapse in crude pricing has created a pause in new approvals.

Notes: China Coal is on a 6000kcal/kg basis, Qinhuangdao FOB
Source: IHS
Non-conventional Technology Providing Options For Future Investments In Olefins Production

Conventional Light Olefins Cash Cost

<table>
<thead>
<tr>
<th>Year</th>
<th>US Ethane</th>
<th>US PDH</th>
<th>NEA PDH</th>
<th>NEA Naphtha</th>
<th>WEP Naphtha</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>700</td>
<td>900</td>
<td>800</td>
<td>1000</td>
<td>1200</td>
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<td>2013</td>
<td>800</td>
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<tr>
<td>2015</td>
<td>900</td>
<td>1100</td>
<td>1000</td>
<td>1200</td>
<td>1400</td>
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Non-Conventional Light Olefins Cash Cost

<table>
<thead>
<tr>
<th>Year</th>
<th>US GTP</th>
<th>US GTO</th>
<th>NEA CTO</th>
<th>NEA MTO</th>
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<tbody>
<tr>
<td>2011</td>
<td>400</td>
<td>500</td>
<td>600</td>
<td>700</td>
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<tr>
<td>2013</td>
<td>500</td>
<td>600</td>
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<td>2015</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td>900</td>
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</tbody>
</table>

PDH = Propane Dehydro; GTP = Gas to Propylene; GTO = Gas to Olefins; CTO = Coal to Olefins; MTO = Methanol to Olefins

Brent Crude and Natural Gas Prices

<table>
<thead>
<tr>
<th>Year</th>
<th>Brent Crude ($/Bbl)</th>
<th>Natural Gas ($/MM Btu)</th>
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</thead>
<tbody>
<tr>
<td>2011</td>
<td>111</td>
<td>4.14</td>
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<td>2015</td>
<td>52</td>
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</table>
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- Where are the major investments in new capacity?
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- Strategic Considerations
As CAPEX Declines, M&A Activity Increases As Means To Achieve Growth

Global Chemical Capital Expenditures

Annual M&A Value and EBITA Multiples

Source: IHS
Planning For Growth Given Uncertain Fundamentals

Strategic Implications

- **Higher level of uncertainty** (in market fundamentals) presents difficulty in planning best options for future growth.

- **Board level decisions delayed**; non-conventional technology being considered; higher CAPEX; higher risk premiums; increased M&A

- Investment decisions delays in 2015/16 could lead to **supply limitations in the 2020+**.

- **On-purpose supply options** are viable given “extreme energy”; will be key drivers of market dynamics in the future.
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