Polyester Demand Outpace GDP

Polyester Growth = 2.6 X GDP Growth
Asia Dominates Demand Growth

Million Metric Tons

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Agenda

• PX
• PTA
• MEG
Main Rule: Secure Feedstocks

- Reformate
- Heavy Naphtha
- Heavy aromatics
- Condensate

- Pygas
- Mix. Xylenes
- Toluene
- Coke (coal)
Aromatics Will Need More Reformate

Global BTX Demand for Reformate
Million Tons Per Year

<table>
<thead>
<tr>
<th>Year</th>
<th>BTX in the Gasoline Pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td></td>
</tr>
<tr>
<td>2021</td>
<td></td>
</tr>
<tr>
<td>2026</td>
<td></td>
</tr>
</tbody>
</table>

Aromatics BTX Ratio

- 2006: 32%
- 2011: 35%
- 2016: 37%
- 2021: 40%
- 2026: 43%

Buy octane from gasoline  OR  Buy different feedstocks
Aromatics have highest octane.
Feedstock Diversification

North America & Europe

- Crude → Refining → Crude
- Crude → Refining → CCR
- CCR → BTX
- BTX → Condensate
- Condensate → Gas
- Gas → Oil
- Oil → Crude

Asia

- Crude → Refining → CCR
- CCR → BTX
- BTX → HN
- HN → Crude
- Crude → Refining → CCR
- CCR → BTX
- BTX → Condensate

Feedstock Diversification

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Asia Quest for Condensate Intensifies

Condensate Splitter

Fuel Gas 5%
Lt. Naphtha 15%
Hv. Naphtha 45%
Kero & Distillate 25%
650F+ 10%

East of Suez Condensate Demand

Million Barrels Per Day

2006 2010 2014 2018

Other Demand
Fuels Capacity
Field Process. Capacity
Olefins Capacity

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Healthy Demand Growth

China 75% of PX Growth

Million Metric Tons

2008

China
Indian Subc.
Europe

NE Asia (ex-China)
N. America
Middle East

SE Asia
S. America

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Who’s Adding New Capacities?

World Demand Growth

Million Metric Tons

2008 2010 2012 2014 2016 2018

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Trade Flow to Increase Significantly

Million Metric Tons

Net Exporters


Net Importers

-10 -8 -6 -4 -2 0 2 4 6 8 10

Middle East | Northeast Asia | Southeast Asia | Indian Subc.
N. America | S. America | W. Europe | C. Europe
CIS & Baltics | Africa

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• PX
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World PTA Demand Versus Capacity

Million Metric Tons

2008 2013 2018 2023

- China
- Asia-China
- EMEA
- Americas

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Diminishing PTA Trade

2010/2013/2018 NET IMPORT/EXPORT MILLION METRIC TONS

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Asia PTA Spreads

Dollars Per Metric Ton

Operating Rate, %

85% OR

$125 Per Ton Spread

PTA Spread Over PX

PTA Global Operating Rate

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Is Realistic Rationalization Possible?

To Achieve 85% Industry Utilization:

- **Capacity to Rationalize (MMT):**
  - 2013: 9
  - 2018: 20
- **Plants to Rationalize (#):**
  - 2013: 31
  - 2018: 55
- **Plant Size (KMT):**
  - 2013: <= 380
  - 2018: <= 520

**Capacity (MMT):**
- 2013: 67
- 2018: 95

**Demand (MMT):**
- 2013: 49
- 2018: 64

**Number of Plants:**
- 2013: 117
- 2018: 140

**Average Plant Size (KMT):**
- 2013: 567
- 2018: 675
Changes in Pricing—A Salvation?

Capacity Lost

PTA(contract)-PX

Thousand Metric Tons

CNY

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Agenda

• PX
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Capacity In Sync With Demand?

Million Metric Tons

Global Net Annual Capacity Change

Global Demand Change

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The Pioneer: Tongliao GEM
- 1,100KTA On-stream
- 2,800KTA under Construction
- Over 4,000KTA in the works

Polyester Clusters
An Emerging Dark Horse

- Conventional
- METEOR (Dow Trademark)
- Bio Ethanol – Ethylene – EO
- Coal-Based Oxalate Ester
- Selective EO Hydration
- OMEGA (Shell Trademark)
- Glycerine/Sorbitol Hydrogenolysis
- Methanol - Ethylene - EO
Nameplate Capacity Can Mislead

Production

• 2013 production less than 300KT.

• 70-80% or higher run rate achievable, but in most cases, not sustainable.

• Frequent outages happened to most units.

Quality

• Only products from Tianye are regarded as acceptable and stable for polyester manufacture.

• Blend with conventional MEG remains the predominant way.
Evident cost competitiveness in terms of ideal conditions.

Reality was far less that inspiring:

<table>
<thead>
<tr>
<th>Producer</th>
<th>Revenue</th>
<th>Cost</th>
<th>Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEM</td>
<td>507.2</td>
<td>523</td>
<td>-15.8</td>
</tr>
<tr>
<td>TIANYE</td>
<td>232.3</td>
<td>172</td>
<td>60.3</td>
</tr>
</tbody>
</table>

Drawbacks:
- Investment of demo units are relatively high.
- Run rate matters enormously!
- Logistic costs

Potential Risks:
- Carbon Tax
Global Supply Chain May Raise Concerns

Saudi Operations issues are expected to reduce available capacity

- Multiple extended (10–12 week) shutdowns in 2014–2015 for reactor replacement
- Rumored to be running at reduced rates at 4–5 units, very high rates at the rest to fill the gap
- They have managed the situation effectively

We assume 400–600 KTA lost production each year in 2014–2015. Increased risk of unplanned shutdowns should not be ignored.
Adjusted Capacity Growth

Net Capacity, Million Metric Tons

Global Net Annual Capacity Change

Global Demand Change
Stressful World MEG Operating Rate

Million Metric Tons

Operating Rate (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Demand</th>
<th>Operating Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>35</td>
<td>89%</td>
</tr>
<tr>
<td>2018</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

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Conclusions

PX
• Significant over capacity is set to come up.
• Feedstock availability not as much a constraint as costs.
• Potential downside for both prices and margins.

PTA
• A tough cycle remains on track until after expansions slow down.
• Proactive operating management better than forced shutdowns.

MEG
• Next wave of new EO-EG capacity online 2016-2018
• The rise of unconventional MEG still takes time and efforts.
• Prepare for a tightening market.