Balancing Global Olefins Capacity and Demand

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- Olefins – Changing Dynamics
- New Capacities and Demand drivers
- Regional Olefins Trade
Reliance at a Glance

- India’s largest private company.
- Global player in integrated energy value chain.
- Growing presence in retail & digital services.

- US$ 44.7 Billion Annual Revenue
- US$ 4.2 Billion Net Profit (FY 15-16)

- 151 Major products & brands
- Jio: fastest growing 4G network in India

Global Rankings

- Polyester 2nd
- PTA 4th
- PX 6th
- PP 6th
- MEG 8th
Major Projects under implementation in Reliance

Ethane Feed Flexibility in Crackers
- 6 Nos VLEC (Very Large Ethane Carriers).
- Cryogenic Storage & handling facility in India.
- Provide feed security to Crackers with Minor increase in Ethylene capacity.
- Cross Country pipeline (480 km) to transport Ethane across Reliance’s sites.

Refinery Offgas Cracker with PE & MEG
- 1.5 Million MT/yr Cracker using Refinery Offgas as feed integrates Refinery with Petrochemical Complex
- Downstream LLDPE, LDPE & MEG Capacities
- Coke Gasification in Refinery
- Additional 2.2 Million MTA PX capacity
Olefins – Changing Dynamics
US, post Shale, is now largest producer of oil (>12 mbbl/d) & has kept Nat Gas and Ethane prices low in US.

Fall in Crude prices has direct implication for Petchem Feedstocks

Low price stimulates demand apart from making production competitive.

Source: Platts
Changes in US Olefins Business

Ethylene Margin in US Crackers is going down

- New Ethane Crackers are under Construction

Increasing US Propane Exports

- New PDH Capacity starting in US

Source: RIL Working/IHS

Source: Platts
Naphtha margins remains strong

- Prolonged period of high margins for Naphtha Crackers for Asian and European Crackers.
- Cycle with lows in 2001-03 & 2011-13, doesn’t seem to trough soon.
- Large Investments in Gas Crackers to ensure by-product credit remains healthy for Naphtha Crackers. Most Naphtha Crackers are integrated with downstream BD & BTX.

Source: RIL Working
US Crackers are predominantly Ethane/Propane after plentiful supply post Shale revolution

Europe, mainly Naphtha, is now importing Ethane from US

NEA relies on Naphtha with some capacity now from MTO/CTO
Cash Cost Curve for Crackers

Cost Curve is flattening

- Middle East Gas Crackers
- US Gas Crackers
- Asian Naphtha Crackers
- JKT & European Naphtha Crackers
- CTO & MTO

- @ 100+ $/bbl Crude
- @ ~50 $/bbl Crude
- @ 100 $/bbl Crude
- @ 50 $/bbl Crude

$/MT

Million MT

@ 100 $/bbl Crude

@ 50 $/bbl Crude

1000

500
New Capacities & Demand Drivers
US Capacity additions

- **6 Million MT of Low Cost (Ethane) capacity in US by 2018**
- **Ethylene Downstream capacity by 2018 is 4.5 Mn MT and would result in lower Op rate of Crackers in US.**
- **No new Crackers envisaged in Mid East.**

### Propylene

- **750 KTA PDH by Enterprise in Q2 2017 without downstream Polymers would result in surplus Propylene in US**
- **On Purpose Propylene Production is around 20% of overall propylene Globally and is expected to rise to 25% by 2020**

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Ethylene Cap KTA</th>
<th>Start-up Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxy/Mexichem JV</td>
<td>Ingleside, TX</td>
<td>550</td>
<td>Started</td>
</tr>
<tr>
<td>Dow</td>
<td>Freeport, TX</td>
<td>1,500</td>
<td>Q3 2017</td>
</tr>
<tr>
<td>Chevron Phillips</td>
<td>Cedar Bayou, TX</td>
<td>1,500</td>
<td>Q4 2017</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>Baytown, TX</td>
<td>1,500</td>
<td>Q1/Q2 2018</td>
</tr>
<tr>
<td>FPC USA</td>
<td>Point Comfort, TX</td>
<td>1,150</td>
<td>Q4 2018</td>
</tr>
<tr>
<td>Shin Etsu</td>
<td>Plaquemine, LA</td>
<td>500</td>
<td>2019</td>
</tr>
<tr>
<td>SASOL</td>
<td>Lake Charles, LA</td>
<td>1,550</td>
<td>2019</td>
</tr>
<tr>
<td>Shell</td>
<td>Pennsylvania</td>
<td>1,500</td>
<td>2020</td>
</tr>
</tbody>
</table>

**US Production of Butadiene is now lower by 30% from pre 2014 as feed gets lighter.**
Country is doubling its Ethylene capacity after completion of these projects.

No major plans in Propylene expansions.

New Capacities are with mix feed
- OPaL is dual feed while BRPL has Naphtha feed
- GAIL & RIL Crackers are Gas based

India is surplus in Naphtha – New Naphtha Cracker may be expected beyond 2020

No major capacity planned in the Mid-East, but Iran may start producing in future with gas availability
China Capacity additions

<table>
<thead>
<tr>
<th>China – CTO</th>
<th>Location</th>
<th>Ethylene Cap KTA</th>
<th>Start-up Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zongtiang Hechuang 2</td>
<td>Erdos</td>
<td>300</td>
<td>2017</td>
</tr>
<tr>
<td>SXY CPC Yan'an</td>
<td>Yan'an</td>
<td>450</td>
<td>2018</td>
</tr>
<tr>
<td>Zhong'an Coal Chem</td>
<td>Huainan</td>
<td>300</td>
<td>2019</td>
</tr>
<tr>
<td>Quinghai Damie</td>
<td>Xining</td>
<td>200</td>
<td>2019</td>
</tr>
<tr>
<td>Shanxi Coking Corp</td>
<td>Hongtong</td>
<td>300</td>
<td>2020</td>
</tr>
<tr>
<td>Yulin Energy &amp; Chem</td>
<td>Jingbian</td>
<td>300</td>
<td>2020</td>
</tr>
<tr>
<td>Baotou Shenua</td>
<td>Baotao</td>
<td>300</td>
<td>2020</td>
</tr>
<tr>
<td>CPI / Total JV</td>
<td>Erdos</td>
<td>330</td>
<td>2020</td>
</tr>
<tr>
<td>Quinghai Mining</td>
<td>Haixi</td>
<td>270</td>
<td>2020</td>
</tr>
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</table>

- Around 1.9 Mn MT/yr capacity CTO plants are commissioned, but operating at lower capacity
- More than 4 Mn MT/yr of MTO & CTO based capacity addition planned in China
- Some delays expected as economic viability for these projects is challenged, so are issues with Environment and Water stress.

Apart from above, CNOOC Shell 1000 KTA & Shenhua 450 KTA Naphtha Crackers will be added in 2017
Polyethylene dominates the demand for Ethylene and is growing faster (4%) for its use in packaging & non durable applications. LLDPE demand growth leads with nearly 5% growth projections.

MEG too has robust growth (3%) for its use in Polyester fibres, PET, Antifreeze, etc.

PVC has high growth (2.5%) in developing countries for its application in pipes, PVC films & Coatings.

Asia with high GDP countries is largest demand center. Overall we need nearly 5.5 – 6 Mn MT/yr of Ethylene for its derivatives.

Crackers to run at high Op Rate in mid term.
Polypropylene is the major share as well as fastest growing (4.5%) derivative of Propylene. Asia (India + China) lead the demand growth.

Other major Propylene consumer are
- ACN for Acrylic fibres and ABS Polymers.
- Propylene Oxide for antifreeze & Poly-Urethanes
- Oxo Alcohols for coatings & plasticizers
- Cumene/Phenol for Poly carbonates & resins
- Acrylic Acid for coating, Adhesives & Super Absorbent Polymers

On Purpose Propylene gaining strength (PDH/MTP)
Regional Olefins Trade
Ethylene Trade

Regional Ethylene Monomer Net Trade

<table>
<thead>
<tr>
<th>Year</th>
<th>N. America</th>
<th>S. America</th>
<th>W. Europe</th>
<th>C. Europe</th>
<th>CIS &amp; Baltics</th>
<th>Africa</th>
<th>Middle East</th>
<th>Indian Subc.</th>
<th>NE Asia</th>
<th>SE Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td>2015</td>
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<td></td>
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<tr>
<td>2020</td>
<td></td>
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</tbody>
</table>

Source: IHS

© 2016 IHS

US to take over Ethylene Exports from ME

US Export 120-180 KTA

China currently imports 9 Mn MT of PE & 4 Mn MT of MEG

+ China currently imports 9 Mn MT of PE & 4 Mn MT of MEG
Regional PG/CG Propylene Net Trade

Net Imports

Net Exports

Forecast

Million Metric Tons

11 12 13 14 15 16 17 18 19 20

N. America S. America W. Europe C. Europe CIS & Baltics Africa Middle East Indian Subc. NE Asia SE Asia

Source: IHS © 2016 IHS

NEA Short by -250KTA
Deficit high in 2016-2019

C EU (KTA)
2011 100
2015 100
2020 200

SEA (KTA)
2011 -120
2015 350
2020 500

ME (KTA)
2011 200
2015 -120
2020 100

+ China imports 8 Mn MT of Propylene derivatives (PP)
Key Concerns

Ethylene
- Delay in New Ethylene Capacity addition and also delays in downstream capacities to impact S-D Balances & Trade flow and firms up Cracker Operating rates (87+) in mid-term.
- Prolonged delays in CTO & MTO capacity would impact China’s Ethylene & derivatives balances
- Lighter feedstock changing downstream Butadiene availability & high price fluctuations

Propylene
- On-Purpose PDH in US without downstream capacity (PP or others) to impact Propylene trade flow in the mid-term
- Price volatility due to high regional imbalance in the mid-term.
- PDH competing with MTP in China – Low Cost Propane v/s higher cost Coal to Methanol or with imported Methanol
Thank You

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