Impact of Shale Oil on Petrochemicals

2015 Tulane Engineering Forum
Friday, April 17th
Karl Bartholomew, Vice President, Americas
The Rise of Shale Oil
Major Global Crude Oils - 2012

Source: ICIS Consulting, ENI 2012 World Oil & Gas Report
Major Global Crude Oils - 2014

Source: ICIS Consulting, ENI 2014 World Oil & Gas Report
Shale oil production history

Source: EIA
Shale gas growth similar to oil

Source: EIA
US production hitting record levels

29 years since we produced as much as October 2014!

Source: EIA
PADD 3 Crude Imports

<table>
<thead>
<tr>
<th>Type</th>
<th>API Gravity</th>
<th>%S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lt Swt</td>
<td>&gt;=35°</td>
<td>&lt;=0.3%</td>
</tr>
<tr>
<td>Lt Sour</td>
<td>&gt;=35°</td>
<td>&gt; 0.3%</td>
</tr>
<tr>
<td>Med Sweet</td>
<td>27°-35°</td>
<td>&lt;1.1</td>
</tr>
<tr>
<td>Med Sour</td>
<td>27°-35°</td>
<td>&gt;=1.1</td>
</tr>
<tr>
<td>Hvy Sweet</td>
<td>&lt;27°</td>
<td>&lt;1.1</td>
</tr>
<tr>
<td>Hvy Sour</td>
<td>&lt;27°</td>
<td>&gt;=1.1</td>
</tr>
</tbody>
</table>

Source: EIA

ICIS
Chemicals Energy Fertilizers Prices News Analysis Consulting

www.icis.com
When oil prices drop, margins...?

- In 1980s & 1990s, refiners benefited when oil price dropped because product market was ‘sticky’

- Dynamic changed in 2000s
  - More market data
  - Financial hedges, futures much larger than physical barrels

- Margins / oil prices are like an accordion – when price drops, refining margins eventually tighten
One Comment on Oil Forecasts

- Forecast 1 – “Oil will last only 13 more years”
  - US Geological Survey – 1939
- Forecast 2 – “End of Oil is in sight”
  - US Secretary of the Interior – 1949
- Forecast 3 – The US has only a 10 year supply of oil & gas left
- Forecast 4 – “Oil production could peak next year… Just kiss your lifestyle goodbye”
  - The Guardian – April 2005
What about Petrochemicals?
Ethylene, C₂= 

H \ C=\ C \ H

Ethane C₂

Oil / Gas Fractions → Ethylene → Ethylene Oxide → Ethylene Dichloride → Vinyl Chloride → PVC

Low Density Polyethylene (LDPE) & Linear Low Density Polyethylene (LLDPE) → Houseware, Food Containers, Crates, Bottles

Vinyl Acetate → Adhesives, Coatings, Finishing, Flooring

Vinyl Chloride → Polyvinyl Chloride (PVC)

Ethylene Glycol → Automotive Antifreeze

Polyester Fibres → Packaging

Ethanolamines

Styrene

Polystyrene Resin

Acrylonitrile Resins

Styrene Butadiene Rubber

Styrene Butadiene Latex

Polyester Resin

Ammonia

H \ C--\ C \ H

Ethylene

Food containers, Film, Rubbish bags, Nappies, Toys, Houseware

Window Frames, Swimming Pool Liners, Pipes, Flooring

Tyres, Footwear, Sealants

Carpet Backing, Paper Coatings

www.icis.com
Propylene

Box Color Key:
Primary Product(s)  Alternate Value Stream
Chemical prices track oil

$r^2$ US IPEX, natural gas = 2.2%
$r^2$ US IPEX, crude oil = 89.8%
Oil & Petrochemicals

• As previous slide shows, petrochemicals generally track oil price because refining is major source of feed globally

• Two major product chains – olefins, aromatics:
  • Olefins product chain (ethylene, propylene, butadiene) greatly impacted by shale in U.S.
    • Cheap ethane, propane
    • Rest of the world runs on naphtha (from refining)
  • Aromatics chain (benzene, toluene, xylenes) not impacted as much in U.S.
    • Ethanol mandate, CAFE standard, cheap natural gas much larger factors
U.S. Steam Cracker Margins

Shale made U.S. more competitive

Lower oil price makes Europe, Asia more competitive

Source: ICIS Consulting

www.icis.com
Petrochemical Stocks vs. Brent

Source: ICIS, NYSE
More on Olefins

- Steam cracking is primary source for ethylene
- Propylene supply ~40% from crackers, ~50% from refining
- Supply won’t meet demand, so on-purpose units being built
How will Oil Price Impact Petrochemical Projects?

![Graph showing variable margins for Methane-Methanol-Propylene (US) and PDH (US) from 2000 to 2025.](image)

**Forecast for flat Brent Crude @ ~$90/bbl (Constant 2013 Dollars)**

**SOURCE:** ICIS Consulting
How will Oil Price Impact Petrochemical Projects?

Forecast for flat Brent Crude @ ~$50/bbl (Constant 2013 Dollars)

Variable Margin Constant 2013 USD/tonne

SOURCE: ICIS Consulting
Recap

• Shale oil & gas fundamentally changed U.S. feedstock position

• Cheaper feed from shale made U.S. petchems more cost competitive

• However, lower oil prices makes other regions competitive again

• Large number of projects underway – how many will delay or cancel?
One last thought....