A Brief Background

US Petrochemical was started in 1987 and supplies feedstocks to Petrochemical Plants in niche markets globally and has experienced buyer/seller relationship with Major Oil Companies such as BP, ExxonMobil, Phillips66 as well as other major companies such as Formosa, Lotte Group, MEGlobal, Nanya, Petkim, Sinochem, CNOOC, Shandong Energy, Petkim, Idesa, Mexichem, Sanmar, Tianjin Dagu, Thai Oil, Petrotemex, Indelpro, Polioles, ADNOC, Tasweeq, PDVSA, Braskem, Taiwan Fertilizer, Shanghai Huachen Energy, Far East Textile and others
SHALE GAS....a game changer

- Shale effect will not be limited to change in feedstock mix
- There is no event in our current history that will have a major global impact on the lives on ordinary people than the advent of shale gas in US
- Globally it redraws the manufacturing map of the world for key industries
- Change will not just be limited to Petrochemical sector but cheap power costs will encourage investment in energy intensive industries such as steel and others
- Over a 100 Billion dollars are expected to be invested in the US Petrochemical sector over the next few years
- Geopolitically it reduces US reliance on foreign sources of Energy
- U.S. is projected to have a 100-year supply of natural gas
Shale production in USA is projected to increase from 20% of total production to over 50% by 2040.

Around 64% of the feedstock for Ethylene in US is now Ethane while Naphtha is less than 13%.
A De-linking of Gas & Liquid Prices in USA

- Graphs show the close linkage between gas and liquids until 2008 in US Gulf. It shows natural gas at over $9/MMBTU while Naphtha was over $900/MT (crude was over $120 /barrel)
- Today with gas around $4.5/MMBTU, Naphtha over $900/MT (crude is around $95 the gas-liquid link has disappeared in US)
Shale gas concentrations in Texas and Pennsylvania
Why usa

- Power costs in Texas are around 3.5 cents / KWhr versus 10 cents in Thailand, 7 in Indonesia and 12 cents in India. According to one Thai producer they currently spend 6.5 cents /KWhr for in house power generation.

- We have one of the worlds cheapest gas. Qatar sells LNG to Japan over $15 per MMBTU and our natural gas is around $4 per MMBTU.

- US Today is still the center of technology and global finance.

- US provides political stability and security second to none.
Asian plants are mainly liquid based or can use 20% LPG

- To date LPG receives the highest premium from residential and commercial markets for heating and cooking in homes and use by businesses and about 50% is used by this sector almost 120 million MT annually

- The second largest market for LPG remains the Petrochemical sector at almost half the above use
LPG Uses vary regionally

- In China more than 75% of LPG is used in residential-commercial whereas the average in North East Asian is slightly over 50%
- In Middle East more than 50% of LPG demand is as Petrochemicals feedstock
This slide shows the close linkage still exists between Crude and Gas price in the rest of the world.
CHANGING TIMES

- US HAS CROSSED THE ROAD FROM BEING A IMPORTER TO EXPORTER
- BY 2013 END THE UNITED STATES HAS 15 PERCENT OF THE GLOBAL LPG EXPORT BUSINESS,
US Propane in recent times has been $200-500 / MT lower than Saudi CP.

US Propane today is the cheapest in the world but this gap has narrowed as US terminals have started to export. In January 2013 the US price was $455 and Saudi CP $955 and now US price is around $780 and Saudi CP is $1010.

The infrastructure in US today is still incomplete, there are new planned pipelines and terminals to connect the shale gas to its destinations so the affect on LPG prices will not really been felt until 2020 yet but you can already see the changes.

Panama Canal is being widened by 2014-2015 to take VLGC’s Gas carriers which will shorten the sailing time on VLGC’s by 11 days to Asia.
FEEDSTOCKS

• As the world becomes technologically advanced the demand for Chemicals will continue to increase dramatically.
• Liquids remain the dominant feedstock globally.
• In Asia, petrochemical producers typically switch from naphtha to LPG as cracker feedstock when the latter's price falls to 90-93% or lower compared with naphtha.
• If the current trend continues globally with gas being substantially lower than crude oil like in USA the percentage of gas as feedstock will increase globally. Already Ineos is looking at US Ethane for their European Plants.
• Already gas to liquids plants are operating successfully in Qatar with the breakeven being at $60/barrel crude oil for their plant. If more are built globally this could also impact the price of liquids.
• Asian Petrochemical Plants cannot use Natural Gas as feedstock and have limitation of using LPG to a max of 20%. Asian plants will need modifications if they can switch between Gas and Liquid like US plants.
• With the Advent of Shale Gas the world of Petrochemicals has entered unchartered territory and it will be interesting to see how the market forces will eventually play out.
FEEDSTOCKS

- US flexi crackers can use either gas or liquid as feed.
- Middle East in the past has been mostly Gas.
- Saudi Arabia is now looking at liquid based plants or gas/liquid plants for future.
- Saudi Aramco has begun using LPG in Petchem sector thereby decreasing the exports. The shortfall from ARAMCO LPG exports will be covered with increased production from Qatar, UAE and other.
- Asia is about 80-100% liquid with flexibility to use about 20% LPG.
- Saudi Petrochemical Plants use Associated gas and faced challenges in the past when crude oil production was reduced and new ones will need to allow gas/liquid feedstock.
- North America (Canada and USA) uses about 37% LPG for Petrochemical production but uses a lot of Gas.
- Because of higher percentage of LPG use is in residential/commercial sector in Asia there is greater uncertainty on the price of LPG for the Petrochemical sector.
- In spite of all the increase in Global LPG production other factors such as Japanese Nuclear accident, new demand from India, Thailand, Indonesia, Vietnam keeps holding up the LPG prices.
- As the move towards use of gas intensifies the market forces will eventually have a downward pressure on the liquid feedstock ie Naphtha.
## Cracking Yields Gas vs Naphtha

The above cracking yield is developed by Platts based on Sep 17 prices.

<table>
<thead>
<tr>
<th>Product</th>
<th>Value (US¢/Lb)</th>
<th>%</th>
<th>US¢/Lb</th>
<th>%</th>
<th>US¢/Lb</th>
<th>%</th>
<th>US¢/Lb</th>
<th>%</th>
<th>US¢/Lb</th>
<th>%</th>
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<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<td></td>
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<tr>
<td></td>
<td>E/P MIX (80/20)</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>PROPANE</td>
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<tr>
<td></td>
<td>NORMAL BUTANE</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LT. NAPHTHA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethylene</td>
<td>53.25</td>
<td>81.00</td>
<td>43.13</td>
<td>72.70</td>
<td>38.71</td>
<td>39.50</td>
<td>21.03</td>
<td>35.60</td>
<td>18.96</td>
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<td>1.80</td>
<td>1.01</td>
<td>6.40</td>
<td>3.58</td>
<td>24.90</td>
<td>13.94</td>
<td>17.30</td>
<td>9.69</td>
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<td>Butadiene</td>
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<td>1.90</td>
<td>0.91</td>
<td>1.80</td>
<td>0.86</td>
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<td>0.72</td>
<td>3.40</td>
<td>1.63</td>
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<td>1.66</td>
<td>3.60</td>
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<td>1.60</td>
<td>0.90</td>
<td>1.80</td>
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<td>1.05</td>
<td>4.50</td>
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<td>No.6 Oil</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
<td>0.30</td>
<td>0.08</td>
<td>3.00</td>
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<tr>
<td>Fuelgas-$/MMBTU</td>
<td>6.65</td>
<td>0.00</td>
<td>0.00</td>
<td>1.70</td>
<td>0.41</td>
<td>8.50</td>
<td>1.52</td>
<td>8.50</td>
<td>1.50</td>
<td>4.00</td>
</tr>
</tbody>
</table>

|                | Revenue (US¢/Lb C$_2$H$_4$) | 45.71 | 49.55 | 81.25 | 86.44 |
|                | Operating Cost              | 2.00  | 2.57  | 3.08  | 3.41  |
|                | Feedstock Cost              | 8.27  | 9.15  | 54.17 | 62.38 |
|                | Total Costs                 | 10.27 | 11.72 | 57.25 | 65.79 |

**Gain/Loss (US¢/Lb)**

- Ethylene Produced: **35.44**
- **37.83**
- **24.01**
- **20.65**
- **-3.60**
US Cracker Margins are improving

The green line represents European Margins, the blue for straight Ethane and Red for Ethane/Propane mix
As US is switching lighter feeds there is less Propylene and Butadiene produced. This will increase the demand for stand alone plants for the manufacture of Propylene and Butadiene.
ASIAN LPG IMPORTS

- Chinese imports show a decline
- New Markets of India, Indonesia, Thailand and Vietnam have emerged.
but imports have decreased

Chinese import demand showed a small uptick over 2010 but it is still lower than its peak years. The demand for Propane should increase with all the upcoming PDH plants.

Chinese LPG import demand is price sensitive. China’s LPG imports went up after the world financial crisis when Global LPG prices fell and imports went down after Global LPG prices went up..
Even though the imports declined, China continues to build new terminals.
<table>
<thead>
<tr>
<th>Company</th>
<th>Capacity</th>
<th>Est Startup</th>
</tr>
</thead>
<tbody>
<tr>
<td>ChevronPhilips</td>
<td>1,500,000 MT</td>
<td>2018</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>1,500,000 MT</td>
<td>2018</td>
</tr>
<tr>
<td>Formosa</td>
<td>800,000 MT</td>
<td>2017</td>
</tr>
<tr>
<td>Shell</td>
<td>900,000 MT</td>
<td>2020</td>
</tr>
<tr>
<td>Dow</td>
<td>15000000 MT</td>
<td>2018</td>
</tr>
<tr>
<td>Sasol</td>
<td>1,400,000 MT</td>
<td>2018</td>
</tr>
<tr>
<td>Oxychem</td>
<td>500,000 MT</td>
<td>2016</td>
</tr>
<tr>
<td>Aither</td>
<td>NA</td>
<td>2016</td>
</tr>
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</table>
## US PETCHEM GOLDRUSH

### METHANOL

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>LOCATION</th>
<th>CAPACITY</th>
<th>ETA</th>
</tr>
</thead>
<tbody>
<tr>
<td>LyondelBasel</td>
<td>Texas</td>
<td>780,000 MT / YR RESTART</td>
<td>2013</td>
</tr>
<tr>
<td>Methanex</td>
<td>Louisiana</td>
<td>Chile Relocation</td>
<td>2014</td>
</tr>
<tr>
<td>Celanese</td>
<td>Texas</td>
<td>1,300,000 MT/YR</td>
<td>2015</td>
</tr>
<tr>
<td>OCI</td>
<td>Texas</td>
<td>1,750,000 MT/YR</td>
<td>2016</td>
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### GAS TO LIQUIDS

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>LOCATION</th>
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<tbody>
<tr>
<td>SASOL</td>
<td>WESTLAKE, LA</td>
</tr>
<tr>
<td>SHELL</td>
<td>LOUISIANA</td>
</tr>
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</table>
## US PETCHEM GOLDRUSH (PROPYLENE)

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Capacity</th>
<th>Start-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dow Chemical</td>
<td>Texas</td>
<td>600,000 MT</td>
<td>2016</td>
</tr>
<tr>
<td>Enterprise</td>
<td>Texas</td>
<td>600,000 MT</td>
<td>2016</td>
</tr>
<tr>
<td>Williams (Canada)</td>
<td>Canada</td>
<td>500,000 MT</td>
<td>2016</td>
</tr>
<tr>
<td>Formosa</td>
<td>Texas</td>
<td>600,000 MT</td>
<td>2017</td>
</tr>
<tr>
<td>Enterprise ??</td>
<td>Texas</td>
<td>600,000 MT</td>
<td>2017</td>
</tr>
<tr>
<td>C3 Petrochemical</td>
<td>Texas</td>
<td>1,200,000 MT</td>
<td>2017</td>
</tr>
<tr>
<td>Dow Chemical ??</td>
<td>Texas</td>
<td>600,000 MT</td>
<td>2019</td>
</tr>
<tr>
<td>Petrologistics ??</td>
<td>Texas</td>
<td>600,000 MT</td>
<td>2019</td>
</tr>
</tbody>
</table>

**PROPYLENE THRU PDH IN AMERICA**
**US PETCHEM GOLDRUSH (PROPYLENE)**

<table>
<thead>
<tr>
<th>Company</th>
<th>Capacity MT</th>
<th>Startup</th>
<th>Status</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tianjin Bohai Chemical</td>
<td>600,000</td>
<td>2013</td>
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<tr>
<td>Zhejiang Sanjin Chemical first stage</td>
<td>450,000</td>
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<td></td>
<td>UOP PDH</td>
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<tr>
<td>Satellite Petrochemicals</td>
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<td>Under Construction</td>
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<td>Yangzi Petrochemical a</td>
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<td>Under Construction</td>
<td>UOP PDH</td>
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<td>2014</td>
<td>Under Construction</td>
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<tr>
<td>Yangtze River Natural Gas Chemical</td>
<td>650,000</td>
<td>2014</td>
<td>Under Construction</td>
<td>UOP PDH</td>
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<td>Oriental energy company first stage</td>
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<td>2014</td>
<td>Under Construction</td>
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<tr>
<td>Fujian Meide Chemical first stage</td>
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<td>2014</td>
<td>Under Construction</td>
<td>UOP PDH</td>
</tr>
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<td>Wanhua chemical group company</td>
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<td>2014</td>
<td>Under Construction</td>
<td>UOP PDH</td>
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<td>Hai-wei group first stage</td>
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<td>2015</td>
<td>Under Construction</td>
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<td>Zhejiang Sanjin Chemical Second stage</td>
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<tr>
<td>SK</td>
<td>600,000</td>
<td>2016</td>
<td>Under Construction</td>
<td>Lummus PDH</td>
</tr>
</tbody>
</table>

**PROPYLENE THRU PDH IN CHINA AND SOUTH KOREA** also will be relying on US Propane as one of their sources. There are a 23 PDH units planned in China 12-13 under construction.
Shale Gas is a Global phenomena
According to above EIA map shale gas in Asia appears to have heavy concentrations in Central and Western China, Australia, Southern Pakistan and South Eastern Turkey.
Saudi Arabia is not included in the EIA map, but the country expects to be producing from shale gas by 2020 which they say are substantial.
The LNG terminal which was built in US Gulf Coast to receive LNG supplies is now being used as a re-export facility.

Modifications to terminal are being planned to allow export of US Gas by 2015. This is going to be the first LNG export facility.

The advent of Shale Gas is not only going to affect gas markets but its effects will be felt in all sectors. Coal power generation companies in US are suffering today because of cheaper shale gas.

Shale Oil Production continues to grow in North Dakota.

In US today it is not just cheaper feedstock but also cheaper energy costs vital to the plant operations. Today US power costs in Texas are around 3.5 cents per KW hr versus 10 cents in Thailand, 7 in Indonesia and 12 cents in India. According to one Thai producer they currently spend 6.5 cents /KW hr for in house power generation.
ITS ALL ABOUT POLITICS

US GROWTH RATE WILL RELY ON WHO IS ELECTED

• MORE REGULATIONS
• SLOWER GROWTH AS A RESULT OF SLOWER PROCESSING OF NEW PERMITS
• MORE GOVERNMENT INVESTMENTS IN GREEN VENTURES LIKE SOLYNDRA

• LESS REGULATIONS
• FASTER GROWTH
CONCLUSIONS

SUMMARY

• As US is turning to lighter feeds the demand for stand alone plants will increase ie PDH plants for Propylene and others. There are currently 6 PDH plants planned for USA and 13 for China and 1 for Korea.

• Once the infrastructure becomes available LPG prices will eventually have to reflect the more competitive natural gas prices which will also effect naphtha prices.

• There is a lot of room for Gas to grow in the Asian Petrochemical sector which is very liquid heavy unlike Middle East or North America.

• Already Ineos is planning to export Ethane from US to Europe.

• Because of advent of Shale Gas, North America is enjoying lower Natural Gas and LPG prices. The gap between US prices and Saudi CP may narrow when US LPG export start.

• In the past 83% of LPG imported in Asia was from Middle East. As infrastructure gets completed in other places more volume will flow from other regions.

• There are two LPG export terminal in US Gulf. There are more export terminals being planned. The freight to China is around USD 120 per MT today and terminal processing fees is over USD 80 per MT on Propane.

• Now with the production of Shale Oil in US we are yet to see more impact on global liquid and gas prices. So maybe it is not going to be gloom and doom for liquid crackers as many analysts are predicting. Market forces will eventually have to play themselves out until an equilibrium is once again established in terms of BTU between energy sources such as gas, liquids, coal etc.
THANK YOU

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