International Markets for
Crude, Refined Products and LPG

IPAA’s Annual Meeting – Napa, FL
Kristine Klavers
9 November 2017
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- Forecasts
- Market Studies
- Due Diligence

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- Project feasibility studies & financial modeling
- Due diligence for banks and equity investors
- Process technology evaluations and comparisons
- Quantitative risk analysis
- Capital projects portfolio optimization
- Transportation vehicle forecasts
- Logistics analysis
- Process technology development & licensing support
- Operating cost reduction
- Regulations analysis
- Training

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Global energy market in transition – International markets

<table>
<thead>
<tr>
<th>Population and energy demand growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply will diversify</td>
</tr>
<tr>
<td>Demand will diversify and shift</td>
</tr>
<tr>
<td>Environmental pressure will continue</td>
</tr>
<tr>
<td>Trade flows will change</td>
</tr>
<tr>
<td>Shale oil and gas boom – New technologies</td>
</tr>
<tr>
<td>Geopolitical events</td>
</tr>
</tbody>
</table>

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Population keeps growing

Population growth vs annual growth rate 1950-2050

Source: U.S. Census Bureau, International Data Base.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Population</th>
<th>Energy consumption kgoe per 1000 capita</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>1,379,302,771</td>
<td>2.2</td>
</tr>
<tr>
<td>2</td>
<td>India</td>
<td>1,281,935,911</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>United States</td>
<td>326,625,791</td>
<td>7.0</td>
</tr>
<tr>
<td>4</td>
<td>Indonesia</td>
<td>260,580,739</td>
<td>0.9</td>
</tr>
<tr>
<td>5</td>
<td>Brazil</td>
<td>207,353,391</td>
<td>1.5</td>
</tr>
<tr>
<td>6</td>
<td>Pakistan</td>
<td>204,924,861</td>
<td>0.5</td>
</tr>
<tr>
<td>7</td>
<td>Nigeria</td>
<td>190,632,261</td>
<td>0.8</td>
</tr>
<tr>
<td>8</td>
<td>Bangladesh</td>
<td>157,826,578</td>
<td>0.2</td>
</tr>
<tr>
<td>9</td>
<td>Russia</td>
<td>142,257,519</td>
<td>4.9</td>
</tr>
<tr>
<td>10</td>
<td>Japan</td>
<td>126,451,398</td>
<td>3.5</td>
</tr>
<tr>
<td>11</td>
<td>Mexico</td>
<td>124,574,795</td>
<td>1.5</td>
</tr>
<tr>
<td>19</td>
<td>Germany</td>
<td>80,594,017</td>
<td>3.8</td>
</tr>
<tr>
<td>22</td>
<td>United Kingdom</td>
<td>64,769,452</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Source: World Bank
## Global GDP PPP outlook

<table>
<thead>
<tr>
<th>Region</th>
<th>2010-2015</th>
<th>2015-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia and central Asia</td>
<td>3.7%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Western Europe</td>
<td>2.5%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>5.8%</td>
<td>7.1%</td>
</tr>
<tr>
<td>North America</td>
<td>3.9%</td>
<td>4.0%</td>
</tr>
<tr>
<td>Middle East</td>
<td>4.5%</td>
<td>5.2%</td>
</tr>
<tr>
<td>China</td>
<td>9.7%</td>
<td>8.3%</td>
</tr>
<tr>
<td>India</td>
<td>8.5%</td>
<td>9.9%</td>
</tr>
</tbody>
</table>

Source: IMF, Argus Consulting
Topics

Review of market fundamentals for:

- Crude
- Refined products
- LPG
## Crude market dynamics

<table>
<thead>
<tr>
<th>Technology: Shale &amp; Offshore</th>
</tr>
</thead>
<tbody>
<tr>
<td>US is a growing oil exporter 2015</td>
</tr>
<tr>
<td>Oil peak demand?</td>
</tr>
<tr>
<td>Geopolitical events</td>
</tr>
<tr>
<td>Wildcards</td>
</tr>
<tr>
<td>• Demand diversity</td>
</tr>
<tr>
<td>• Environmental pressure:</td>
</tr>
<tr>
<td>o Cleaner fuels</td>
</tr>
<tr>
<td>o Fracking regulations, activities</td>
</tr>
</tbody>
</table>
Global oil supply, demand and cumulative oversupply

World Oil Demand, Supply and Cumulative Oversupply

Global oil demand (left axis)
Global oil supply (left axis)
Cumulative oversupply since Q1, 2014 (right axis)

July, 2017 Update
Data Source: IEA
Calculations by Argus
Rebalancing process has started
Opec will become key marginal supplier again
Continued growth, but a slowdown from 2030
US crude exports – More than 1mn b/d and climbing

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Asia is the growing destination for US exports

US crude exports

Source: EIA and US Customs data

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US crude accelerates relative decline of ME into China

Chinese crude imports by pricing benchmark & origin

- Blue bars: Dubai/Oman-related crude from Middle East
- Red bars: WTI, Brent-related crude from Americas, Africa, Europe & Asia-Pacific plus ESPO

Source: Argus China Petroleum
Permian is leading recovery in shale oil output growth
Prolific low cost Permian Basin driving US growth

![Graph showing Permian drilled and Permian wells completed over time from Jan-16 to Jun-17. The graph indicates an increasing trend in both categories, with Permian drilled wells leading Permian wells completed.]
Don’t forget about the US offshore growth

Forecast US crude output growth
(Jun '17 - Dec '18, in '000 b/d)
Alberta heavy oil import growth continues

Canadian Oil Imports to US versus US Oil Production and Mexican and Venezuelan Imports

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Multiple export routes safeguard liquidity during storms
World has been turning back to WTI/US Gulf pricing

Futures open interest
(combined Nymex and Ice contracts)

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Most likely scenario – Sticking in the shale band

Shale Band: $35 - $65/bbl
# Refined product market dynamics

<table>
<thead>
<tr>
<th>Supply/production</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental pressure</td>
<td></td>
</tr>
<tr>
<td>• Sulfur regulations</td>
<td></td>
</tr>
<tr>
<td>• Biofuels/CO2</td>
<td></td>
</tr>
<tr>
<td>• Café – Corporate Average Fuels</td>
<td></td>
</tr>
<tr>
<td>Replacements</td>
<td></td>
</tr>
<tr>
<td>• Alterative fuels</td>
<td></td>
</tr>
<tr>
<td>• Battery</td>
<td></td>
</tr>
</tbody>
</table>
Global refining

North America

South America

Asia & Pacific

Europe & Eurasia

Middle East

Africa

China

* less China & India

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US gasoline demand

US - Yearly Domestic Gasoline Component Demand and US Refinery Oil-Derived Gasoline Production

- Data from EIA. Calculations by Argus.

2017 data through June
US distillate demand

US- Yearly Domestic Distillate Demand and US Refinery Oil-Derived Distillate Production

- Data from EIA. Calculations by Argus.

2017 data through June
US refined products exports continue to increase

Major US Refined Product Exports
(Year 2017 values are through June)

Jet fuel & other kero.
Resid fuel oil
Pet. coke
Gasoline & blendstocks
Distillate

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Gasoline – Regional surplus and established trade flows
Middle Distillate – Regional surplus and established trade flows
Prospects for growth in US refining?

- **Two main sources of growth**
  - Domestic demand and exports demand

- **High level of uncertainty going forward**
  - US refined products demand growth rates
  - MARPOL VI & the Light-Heavy spread
  - RFS (RINs) and Cafe regulations (and octane requirements)
  - Export growth outlook
  - Oil prices
  - Effects of Alberta distillate surplus
  - G/D demand ratio shifts
  - Border taxes
# LPG market dynamics

<table>
<thead>
<tr>
<th>Global market</th>
<th>~300mn t/yr... Expected 360mn t/yr by 2027</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>US production</strong></td>
<td>has grown 25% since 2010</td>
</tr>
<tr>
<td>US produces</td>
<td>25% of global production, at 67mn t/yr+</td>
</tr>
<tr>
<td>China and Saudi Arabia produce</td>
<td>close to 10% each</td>
</tr>
<tr>
<td><strong>US consumes</strong></td>
<td>about 20% of global production</td>
</tr>
<tr>
<td>China is the next largest consumer and the fastest growing market</td>
<td></td>
</tr>
<tr>
<td>US became <strong>exporter</strong> in 2012</td>
<td></td>
</tr>
<tr>
<td><strong>US largest global exporter</strong>; almost double to over 50mn t/yr by 2027</td>
<td></td>
</tr>
<tr>
<td>Consumption <strong>growth</strong> will depend on the energy and petrochemical markets, prices of competing feedstock like naphtha and ethane, and also subsidy regimes in Asia</td>
<td></td>
</tr>
<tr>
<td>Global overcapacity expected until 2020</td>
<td></td>
</tr>
</tbody>
</table>

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Nomenclature – Gas, LPG, NGL, propane, butane, etc.

- **Methane (C$_1$H$_4$)**
- Ethane (C$_2$H$_6$)
- Propane (C$_3$H$_8$)
- Butane (C$_4$H$_{10}$)
- Isobutane (C$_4$H$_{10}$)
- Pentanes (C$_5$H$_{12}$)
- Naphtha
- Natural gasoline
- Condensate
- Non-hydrocarbon gases such as: CO$_2$, H$_2$O, H$_2$S, N$_2$, etc.

- **Dry gas or "natural gas"**
- **LPG**
- **NGLs**
- **Heavier fractions**

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*International Energy Agency*
Regional LPG production

![Regional LPG production chart showing production in '000t for US, Europe, Middle East, Asia-Pacific, and Russia and Central Asia for the years 2016, 2017, and 2018.](chart)

— Argus

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Global LPG consumption

<table>
<thead>
<tr>
<th>Year</th>
<th>Africa</th>
<th>Asia Pacific</th>
<th>Latin America</th>
<th>Middle East</th>
<th>Europe</th>
<th>North America</th>
<th>Russia and Central Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>2011</td>
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<tr>
<td>2012</td>
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<tr>
<td>2013</td>
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<td>2014</td>
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<td>2015</td>
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<td>2016</td>
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</tbody>
</table>

Growth area

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Global LPG consumption by sector

Notes: 2016 data is provisional

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Global LPG balances

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- **Total Production**
- **Total Consumption**

Notes: 2016 data is provisional

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Prospects for LPG market

• Production growth will continue to come from US, but other regions will also increase.
• Demand growth will be concentrated in Asia, in both the petrochemical and energy markets.
• Structural supply will outstrip demand globally – the world will be long LPG until 2025.
• The additional length in LPG must find a home, and will price lower relative to other oil products as a result.
• Despite a significant divergence in the net position of each region, the global surplus will prevent sustained arbitrages emergence.
• Trade flows will follow seasonal/temporary patterns.
• Post 2025 should see a rebalancing, which might effect LPG pricing.
In summary

- Continued growth in demand, of all products
- Shift in demand centers and trade flows
- Peak demand
- China
- MARPOL
- Petrochemicals
THANK YOU!

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