Polyethylene – Issues and Trends 2019 and beyond

Flexible Packaging Association

March, 2019
Agenda

- Economy/ Energy
- Ethylene
- Polyethylene
GDP projections lowered for key regions

Real GDP growth for select areas in 2019

- United States: 2.8% (June 2018 outlook), 2.6% (December 2018 outlook)
- Eurozone: 1.7% (June 2018 outlook), 1.4% (December 2018 outlook)
- Japan: 0.9% (June 2018 outlook), 1.0% (December 2018 outlook)
- Mainland China: 6.4% (June 2018 outlook), 6.3% (December 2018 outlook)
- India*: 7.0% (June 2018 outlook), 7.5% (December 2018 outlook)
- Brazil: 2.5% (June 2018 outlook), 1.8% (December 2018 outlook)
- Russia: 1.8% (June 2018 outlook), 1.5% (December 2018 outlook)
- Saudi Arabia: 3.2% (June 2018 outlook), 2.0% (December 2018 outlook)
- World: 3.0% (June 2018 outlook), 1.7% (December 2018 outlook)

*Fiscal years begin April 1.

Source: IHS Markit

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Key signposts in the global oil market

1. **Strong demand**: How long will it continue—Economic strength?

2. **Vienna Alliance**: 1.2 MM BBI/day cut effective Jan 1. by opec and non opec – reverses plan to increase by 1 MM BBL/day. What is price impact

3. **US oil production**: will grow from 11.7 MMb/d in 4Q18 to 12.9 MMb/d in 4Q19 as new pipelines provide more takeaway capacity for Permian oil. Growth continues in 2020, with output averaging 13.5 MMb/d. $30 breakeven

4. **Iran and Venezuela output**: What are export capabilities?

5. **Storm Alert**: The course of US-China relations—spanning trade, technology, and geopolitics implications?
Saudi output cuts plus embargoed barrels push Brent higher in 1H19, but increase in US production stabilizes prices in 2H19 and 2020

**Dated Brent and WTI-Cushing crude oil price outlook to 2020**

**Benchmark crude price outlook (dollars per barrel)**

<table>
<thead>
<tr>
<th></th>
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<td><strong>Dated Brent</strong></td>
<td>$52.06</td>
<td>$61.31</td>
<td>$66.81</td>
<td>$74.40</td>
<td>$75.08</td>
<td>$68.06</td>
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<td>$65.95</td>
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<td><strong>WTI</strong></td>
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<td>$68.03</td>
<td>$69.63</td>
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<td>$61.75</td>
<td>$61.64</td>
<td>$60.56</td>
<td>$57.43</td>
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Source: IHS Markit, Argus Media Limited (historical)

Note: For our monthly Dated Brent and WTI price outlook, please see the accompanying "IHS Markit Outlook for Global Oil Market Fundamentals" file.
New demand likely to pressure ethane prices upward

- Ethane price corrects after September spike.
- 2019 - Ethane moves to parity with next best feed.
- 2020 ethane tracks down with NGL infrastructure additions. Pipes and fractionation
- Ethane prices to remain volatile as new crackers come on line and continuing export flows.
- 2019 ethane average = 44.5 cpg… today = 28 cpg
Ethylene
World Ethylene Cash Costs

US loses some cost advantage but maintains about $300/ton spread to NEA Naphtha in 2020

World Ethylene Cash Cost Comparison

<table>
<thead>
<tr>
<th>Region</th>
<th>2016 Cost</th>
<th>2018 Cost</th>
<th>2020 Cost</th>
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<tbody>
<tr>
<td>US Ethane</td>
<td>$300/ton</td>
<td>$400/ton</td>
<td>$300/ton</td>
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<tr>
<td>US Weighted Avg</td>
<td>$300/ton</td>
<td>$400/ton</td>
<td>$300/ton</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>$400/ton</td>
<td>$500/ton</td>
<td>$400/ton</td>
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<tr>
<td>Northeast Asia</td>
<td>$500/ton</td>
<td>$600/ton</td>
<td>$500/ton</td>
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<td>West Europe</td>
<td>$500/ton</td>
<td>$600/ton</td>
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<tr>
<td>China CTO</td>
<td>$600/ton</td>
<td>$700/ton</td>
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<tr>
<td>China MTO</td>
<td>$700/ton</td>
<td>$800/ton</td>
<td>$700/ton</td>
</tr>
</tbody>
</table>

Source: IHS Markit

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North America Ethylene and Der. Capacity Additions

No surprises on what is coming, question is when and ramp up timing.

2018 US capacity = 33.5 mmt : 7.7 mmt scheduled: 4.7 mmt in 2019

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Total Growth</th>
<th>Derivative</th>
<th>Startup Cracker</th>
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<tbody>
<tr>
<td>Indorama</td>
<td>Lake Charles, LA</td>
<td>430</td>
<td>Back Integrate</td>
<td>Q4-18/Q1-19</td>
</tr>
<tr>
<td>Formosa</td>
<td>Point Comfort, TX</td>
<td>1,250</td>
<td>PE</td>
<td>Q2/3-2019</td>
</tr>
<tr>
<td>Sasol</td>
<td>Lake Charles, LA</td>
<td>1,550</td>
<td>EOX, PE, other</td>
<td>1H-2019</td>
</tr>
<tr>
<td>LACC</td>
<td>Lake Charles, LA</td>
<td>1,000</td>
<td>EOX, back integrate</td>
<td>1H-2019</td>
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<tr>
<td>Shin-Etsu</td>
<td>Plaquemine, LA</td>
<td>500</td>
<td>Back Integrate</td>
<td>2H-2019</td>
</tr>
<tr>
<td>Bayport Polymers</td>
<td>Port Arthur/Bayport, TX</td>
<td>1,000</td>
<td>PE</td>
<td>2020+</td>
</tr>
<tr>
<td>Dow</td>
<td>Freeport, TX</td>
<td>500</td>
<td>Back Integrate</td>
<td>2020+</td>
</tr>
<tr>
<td>Shell</td>
<td>Monaca, PA</td>
<td>1,500</td>
<td>PE</td>
<td>2021+</td>
</tr>
</tbody>
</table>

- Other ethylene projects in the news: Exxonmobil/Sabic, PTT/Daelim (new partner), Formosa (2 trains in LA over time), Badlands (2 trains over time), Ascent (or another on footprint in WV), NovaChem in Giesmer, others
US Ethylene price moves back to par with rest of world. 2019 a transition year. Higher ethane and new export capability fcst to push prices higher

**US Net Transaction vs Weighted Average Spot**

Source: IHS Markit
Polyethylene
Global PE demand strength...but headwinds developing – or just normalization of demand

Global PE demand growth

Source: IHS Markit

© 2019 IHS Markit
PE Key Issues and Trends: 2019 and beyond

Headwinds develop??

### International

- Economic slowdown impacts demand growth in 2019 / 2020
- China – “global demand driver” impacted by internal and external issues
- US / China trade war impacts demand, trade flows, operating rates, margins
- Sustainability movement dampens demand growth
  - Bag bans proliferate
  - PE “deselection” continues as major consumer packaged goods companies implement sustainable programs
  - Aggressive targets set by several governments designed to increase use of recycle content in packaging products
# China Slows

China key indicators reflect slow-down

<table>
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<tr>
<th></th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
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<tbody>
<tr>
<td>GDP</td>
<td>6.9</td>
<td>6.7</td>
<td>6.3</td>
<td>6.1</td>
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<tr>
<td>Elasticity</td>
<td>1.6</td>
<td>1.3</td>
<td>1.1</td>
<td>1.1</td>
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<tr>
<td>Demand Change (%)</td>
<td>10.8</td>
<td>9.5</td>
<td>6.6</td>
<td>6.4</td>
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<tr>
<td>Op Rate (%)</td>
<td>93.7</td>
<td>90.5</td>
<td>88.3</td>
<td>85.4</td>
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<tr>
<td>Intgrtd. Mgn. - LLDPE $/MT</td>
<td>381.0</td>
<td>144.0</td>
<td>101.0</td>
<td>74.0</td>
</tr>
</tbody>
</table>

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Global excess capacity stabilizes in 2019
Surplus capacity returns in 2020

Global PE annual demand growth versus capacity growth by major regions

- 2017-2018 surplus exceeds 1.7 MMT
- 2020 surplus exceeds 2.0 MMT

Source: IHS Markit

© 2019 IHS Markit
Increased surplus capacity for LLD, Less for LD & HD

PE Operating Rates

Source: IHS Markit

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North America: Issues and trends

**Significant new capacity**: ramp up 2017 projects + 2018 starts – additional 2019 starts

**Domestic demand strength** + ~5%

**Export volume** ramps up

**Trade war** diverts China exports

**PE prices and margins** pressured by new capacity

**NAM cost advantage** declines with lower crude and higher feedstock prices

**Sustainability** issues loom…
Demand drivers NAM
Region sees best domestic demand growth since 2010

- **Converter base appears to be expanding**
- **Strong 2018 GDP**
- **Reshoring to support “Made in America” campaigns**
  - China tariffs reduces PE finished goods from China
  - PE Pipe market (8% of total demand) growing near 16% due to the strong oil industry and municipal use
  - Inventory restocking in the first quarter of 2018 to offset effect of Hurricane Harvey
- **Improved PE competitiveness versus other materials like PET and PP**
- **2018 Tax bill friendly for business, drives machinery capacity investment**
Canada USA Polyethylene: Strong Growth Projected

AAGR 17-18
- Domestic Demand = 4.8%
- Total Demand = 14.6%
- Exports = 36.4%

AAGR 18-19
- Domestic Demand = 3.7%
- Total Demand = 10.1%
- Exports = 25.1%

AAGR 19-20
- Domestic Demand = 2.7%
- Total Demand = 6.2%
- Exports = 13.4%

Source: IHS Markit

Flexible Packaging Association / March 2019
## North America - New Polyethylene Projects
### 2015 Year End Total PE Capacity 20,400 KTA

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Country</th>
<th>LDPE</th>
<th>LLDPE</th>
<th>HDPE</th>
<th>TBA</th>
<th>Startup</th>
<th>Comments</th>
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<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Braskem Idesa</td>
<td>Nanchital, Veracruz</td>
<td>Mexico</td>
<td>300</td>
<td>750</td>
<td>75</td>
<td>Q2 2016</td>
<td>Q2 2016</td>
<td></td>
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<tr>
<td>Dow</td>
<td>Seadrift, TX</td>
<td>United States</td>
<td>400</td>
<td>60</td>
<td>3Q 2016</td>
<td></td>
<td>Q4 2016</td>
<td></td>
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<tr>
<td>Nova</td>
<td>Joffre</td>
<td>Canada</td>
<td>432</td>
<td></td>
<td></td>
<td>Q4 2016</td>
<td></td>
<td></td>
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<td><strong>2017</strong></td>
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<tr>
<td>Chevron Phillips</td>
<td>Old Ocean, TX</td>
<td>United States</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>Q3 2017</td>
<td>Q3 2017</td>
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<td>650</td>
<td>650</td>
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<td>Q3 2017</td>
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<td>United States</td>
<td>650</td>
<td>60</td>
<td>60</td>
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<td>Q3 2017</td>
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<td>Mont Belvieu, TX</td>
<td>United States</td>
<td>650</td>
<td></td>
<td>650</td>
<td>Q4 2017</td>
<td>Q4 2017</td>
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<td>Ineos Sasol</td>
<td>Deer Park, TX</td>
<td>United States</td>
<td>470</td>
<td></td>
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<td>Q4 2017</td>
<td>Q4 2017</td>
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<tr>
<td><strong>2018-2020</strong></td>
<td></td>
<td></td>
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<tr>
<td>Dow</td>
<td>Plaquemine, LA</td>
<td>United States</td>
<td>350</td>
<td></td>
<td>350</td>
<td>Q1 2018</td>
<td></td>
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<td>Dow</td>
<td>Taft, LA</td>
<td>United States</td>
<td>320</td>
<td></td>
<td>320</td>
<td>Q4 2018</td>
<td></td>
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<td>Dow (Elastomers)</td>
<td>Freeport, TX</td>
<td>United States</td>
<td>470</td>
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<td>Q1 2019</td>
<td></td>
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<td>United States</td>
<td>400</td>
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<td>400</td>
<td>Q3 2019</td>
<td></td>
<td>Delay from Q1 2019</td>
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<td>Q3 2019</td>
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<td>Delay from Q1 2019</td>
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<td>Sasol</td>
<td>Lake Charles, LA</td>
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<td>420</td>
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<td>420</td>
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<td>650</td>
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<td>Q4 2019</td>
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<td><strong>Post 2021</strong></td>
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<tr>
<td>Shell</td>
<td>Monaca, Pa</td>
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<td>500</td>
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<td>500</td>
<td>Q3 2021</td>
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<td>Gulf Coast Growth Ventures*</td>
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<td>United States</td>
<td></td>
<td></td>
<td>1300</td>
<td>Q2 2022</td>
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<td>FID Not Made; waiting on permit</td>
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<td>625</td>
<td>Q3 2022</td>
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<td>United States</td>
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<td></td>
<td>600</td>
<td>2022</td>
<td></td>
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<td>PTTGC Daelim</td>
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<td>FID Not Made; waiting on permit</td>
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<td>FG LA LLC</td>
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### Totals, 000's MT

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<th></th>
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<td>Ascent (Braskem)</td>
<td>Marcellus WV</td>
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<td>1500</td>
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<td></td>
<td>Badlands NGL</td>
<td>North Dakota</td>
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<td>1200</td>
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<td>1200</td>
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### Totals, 000's MT

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<th>1575</th>
<th>20272</th>
</tr>
</thead>
</table>

* Sabic and Exxon Mobil joint venture
US/CAN Monthly Operating Rates: Stabilizing at high levels
NAM price forecast reflects near term upward pressure until full production materializes
Domestic premium reduced through 2020

LLDPE Netback to US Producer Plant

- 2018 avg = 14 cpp
- 2019 VG = 4.7 cpp

Source: IHS Markit

© 2018 IHS Markit
Integrated margins pressured through 2019
Ethylene component dominates 2020 forward with lower ethane

US HDPE BM Chain Margins

- 2018 avg = 32.2 cpp
- 2019 avg = 20.38 cpp
- 2019 = 19.7 cpp

Source: IHS Markit
Export surge: US PE exports accelerate through 2020

China accounting for 50%+ of total (Pre tariff estimates)

US PE Exports

Source: IHS Markit © 2019 IHS Markit
Tariff impact on US PE exports to China

2019 exports decline from forecast of 3.5 MMT to 845 KT

Source: IHS Markit
Trade war – impact!

- Weakened China’s economy
- Reduced China PE demand
- Shifts trade routes
- US shifts from price taker to price maker
- Global price reduction of 3 – 5 cpp
If overall plastics consumption continues with the same usage patterns, plastics waste in landfills and the environment will grow to over 10.5 billion metric tons by 2030,
Sustainability impacts PE

- Plastic Deselection (Bag Bans) restrictions on single use applications
- Increased use of PCR or recycle content
- EPR (Extended Producer Responsibility)
- Legislative edicts and directives – EU Circular Economy
- Corporate Self imposed plastic bans
Sustainability has potential to displace a significant portion of PE growth – but hurdles exist

- **Prime demand impacted by:**
  - Bans, movement to alternative materials and returnable/circular consumption schemes
  - Increased replacement by post consumer/commercial resin (PCR)
  - Potentially offset by technology/infrastructure development for monomer and feedstock recycling
  - Single use applications under attack: retail bags, cups, lids
  - Food Packaging Film
    - Cost/Risk outweigh the benefit of incorporating packaging waste back into packaging
  - Non-Food Packaging Film
    - More susceptible to increased use of PCR but still a high cost/performance issue vs benefit
  - Others more amenable to PCR depending on specific applications
Global plastic bans or restrictions trend higher recycle targets set around the world

196 bag bans or fees currently in place around the world

- 34 bans or fees including EU-wide laws + 20 individual countries
- **Target:** recycle 50% of plastic packaging by 2025 and 55% by 2030

- 25 states have full or partial bans on PE carry bags
- Mumbai banned single use packaging; Penalty = 25,000 rupees AND 3 months jail for repeat offenders
- **Target:** eliminate all single use packaging by 2022

Source: EPI
Global plastic bans or restrictions trend higher
recycle targets set around the world

196 bag bans or fees currently in place around the world

- Approximately 570 laws within 30 states placing restrictions or fees on plastic bags and EPS food service
- Nearly one half of the laws in CA
- since 2008: retailers must charge for plastic shopping bags
- 6 provinces have bans or fees

Source: EPI
Global Polyethylene: Sustainability drives PCR demand

### Global Polyethylene Industry Evolution

<table>
<thead>
<tr>
<th>Year</th>
<th>ROW Prime</th>
<th>Prime MCS Regions</th>
<th>PCR MCS Regions</th>
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<td>2017</td>
<td>34</td>
<td>63</td>
<td>6</td>
</tr>
<tr>
<td>2030 Base</td>
<td>55</td>
<td>107</td>
<td>12</td>
</tr>
<tr>
<td>2030 MVT</td>
<td>55</td>
<td>162 mmt prime</td>
<td>31 mmt prime</td>
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<tr>
<td>2019</td>
<td>97 mmt prime</td>
<td>140 mmt prime</td>
<td></td>
</tr>
</tbody>
</table>

Source: IHS Markit

Source: Flexible Packaging Association / March 2019
Polyethylene Summary

- Global demand growth moderates
- China market weakened by trade war
- 2.9 MMT US capacity additions in 2019 pressure market
- US adopts price maker posture re exports
- Domestic premium erodes as new capacity starts
- Sustainability beginning to dampen PE demand growth
- Embracing a sustainable product line may be necessary to maintaining “social license to operate”