North American Oil & Gas and Petrochemical Supply Chain

Latest Impact to Rail

PLG CONSULTING

Experience // Expertise // Excellence

Prepared For:

MARS 2018 Summer Meeting

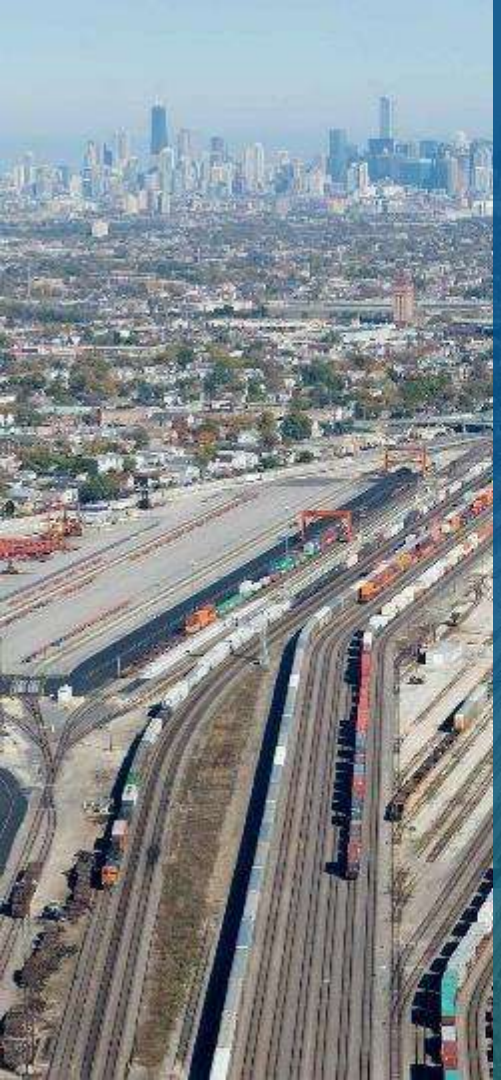
July 17, 2018
Lake Geneva, WI

Taylor Robinson, President
PLG Consulting

Experience // Partial List

PLG TEAM	CORE EXPERTISE	SERVICES INCLUDE
▪ Real-world, industry veterans	▪ Bulk commodity logistics	▪ Supply chain design and operational improvement
▪ Over 50 logistics, supply chain, market, and engineering experts	▪ Surface transportation and logistics	▪ Market analysis & strategy
▪ Delivering value to over 200 clients since 2001	▪ Energy and chemical market intelligence	▪ Investment thesis, target identification, due diligence, post-transactional support
	▪ Investment strategy and corporate development	▪ Diagnostic assessments and supply chain optimization
	▪ Logistics infrastructure design	▪ Independent logistics technology assessment and implementation
		▪ Site selection

Our Clients // Partial List



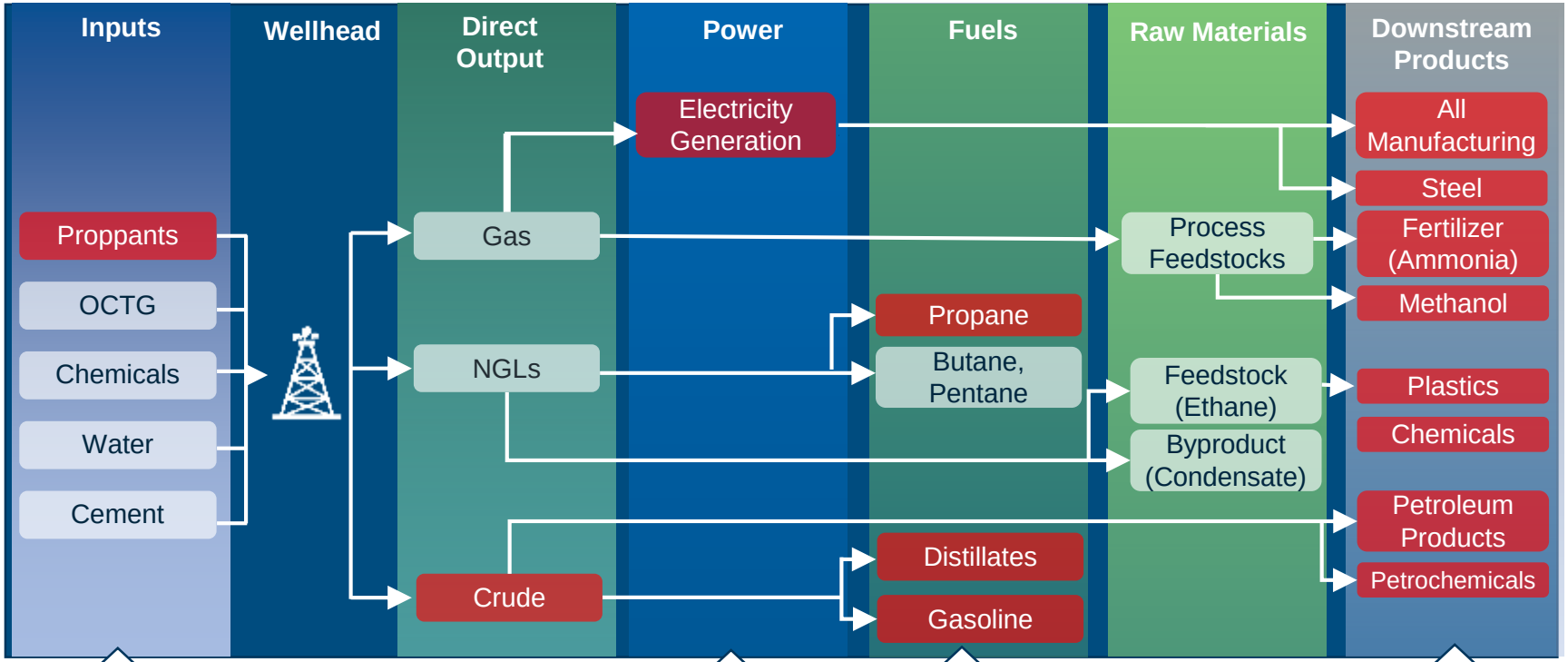
Today's Presentation Agenda

1. The Energy and Chemicals Value Chain
2. Frac Sand Trends
3. Crude and Petroleum by Rail
4. U.S. Chemical Industry Build-Out and Resulting Rail Impacts

Presentation available for download now at:
https://plgconsulting.com/presentations/

The Energy & Chemicals Value Chain

Rail Impacts

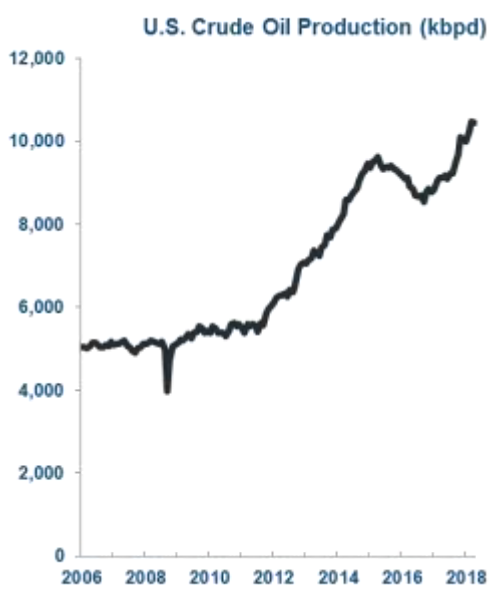


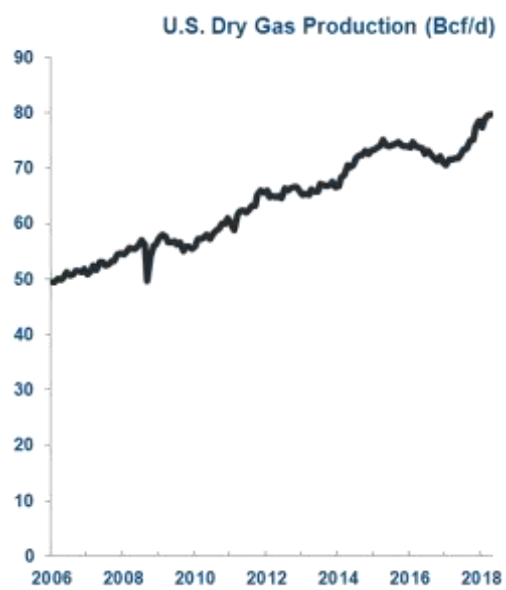
MACRO IMPACTS TO-DATE INCLUDE
Dramatic reduction in crude imports, lower electricity costs, lower gasoline prices, increased refined products

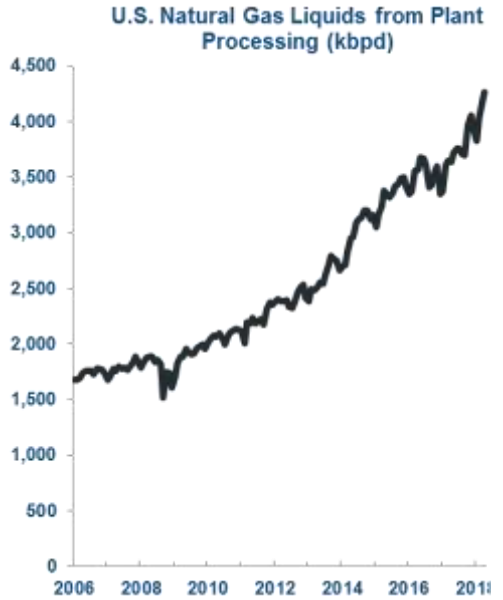
THE WAVE CONTINUES
U.S. petrochemical expansion based on abundant, low cost energy and feedstocks is impacting other manufacturing industries

US Hydrocarbon Production at Record Highs

Resurgence in oil prices will likely continue to drive further production growth

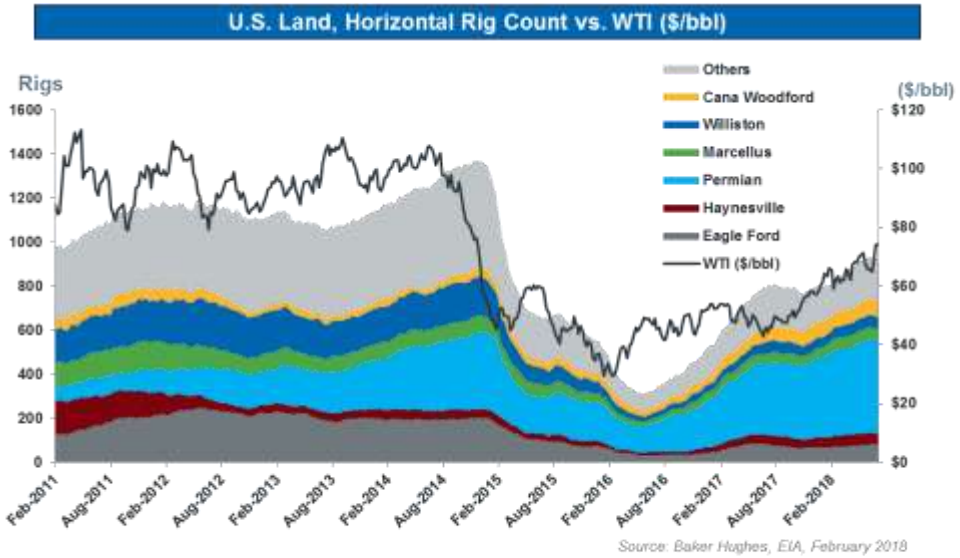






Source: EIA, June 2018

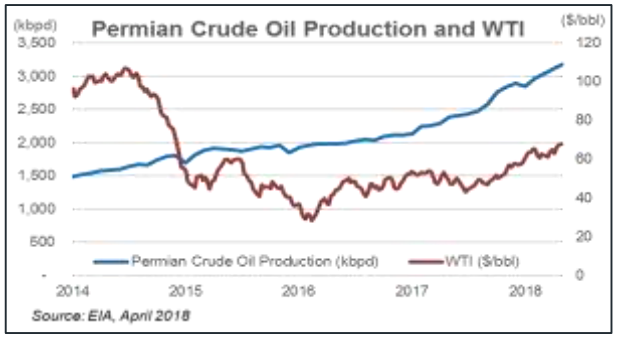
U.S. Crude Production at Record Levels with 35% Fewer Rigs Than 2014 Peak

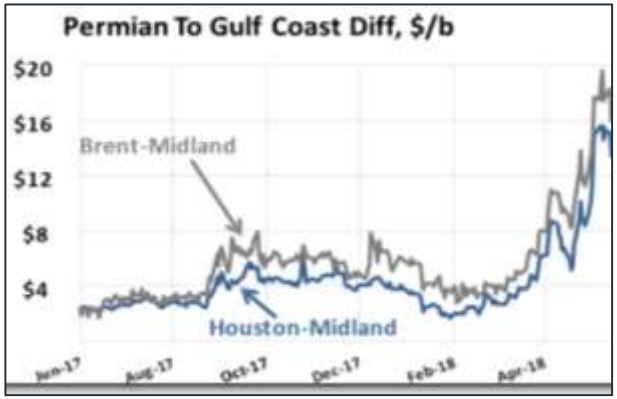


- Permian is now ~45% of onshore rigs
- Southern shale plays comprise 65% of onshore rigs
- “Mass production” drilling & completions will drive further efficiency in future

*Note: Southern shale plays include: Permian, Eagle Ford, Cana Woodford & Haynesville

Pipeline Capacity Issue in Permian Will Impact Crude Production Growth for Next ~18 Months





- Midland-MEH differentials continue in the $15+ range
- Takeaway capacity is “hitting the wall” – differentials forecasted to grow further
- No major pipeline projects possible till mid/late 2019
  - Sunrise 120kbpd – mid 2019
  - 2 large pipelines ~1MMbpd – late 2019

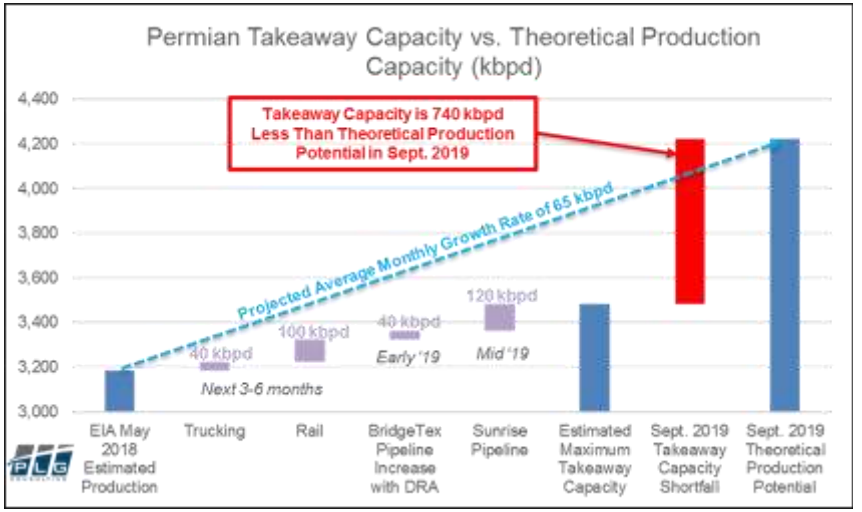
Logistics Alternatives Analysis

Rail challenges include:

- No existing high-volume rail loading terminals in operation
- Rail infrastructure in the region is congested with limited capacity available
- A number of frac sand or mothballed terminals are trying to develop truck to railcar transloading

Trucking challenges include:

- National driver shortage
- Permian even more driver-challenged!
- No existing long haul crude trucking market
- Only 180 barrels per truckload
- 500-650 one-way trip depending on origin/destination
- ~$20/barrel cost adder



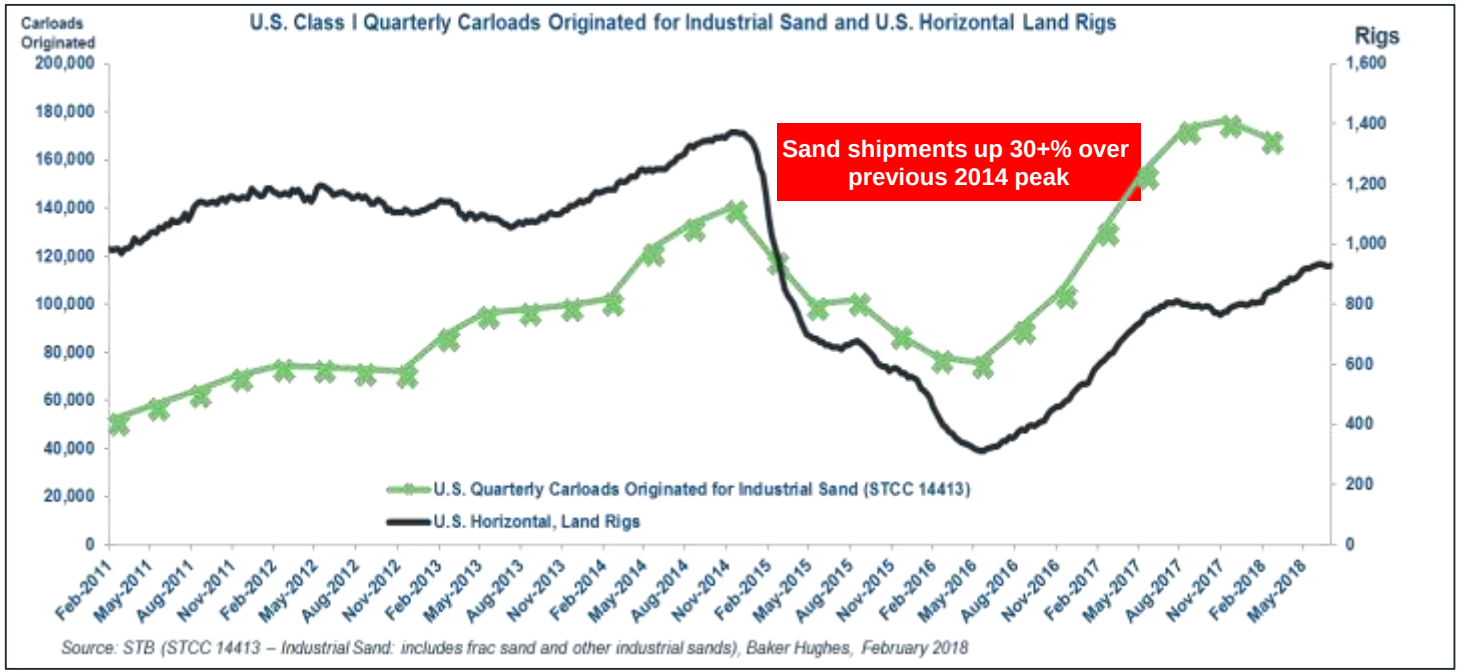
May 9, 2018

Download this PLG whitepaper at www.plgconsulting.com/presentations

Large differentials will disincentivize further production growth in Permian until late 2019 / early 2020

Frac Sand by Rail Market To-Date

Q1 volume impacted by rail performance issues. Sand rail shipments may reach peak in Q2 2018.



Frac Sand Supply Chain Overview

The Northern White supply chain is long and complex. Logistics makes up about 3/4 of the total delivered cost.

Operating Costs = **$10 - $30 / ton**

Freight + Railcar Leases + Fuel Surcharges + Logistics = **$30 - $60 / ton**

Transload Facility Fees = **$7 - $20 / ton**

"Last Mile" Trucking Costs = **$15 - $50 / ton**

	Mining	Processing	Rail Load-out	Long Haul Rail	Transloading and Storage	Trucking to Well
Northern White	X	X	X	X	X	X
Local Sand	X	X				X

Local Permian Sand

Cost Savings Impact in Two Waves

1st wave (Logistics)

-$50~$60/ton

x

5k-7k tons

=

$250k-$420k

Eliminate rail & transload

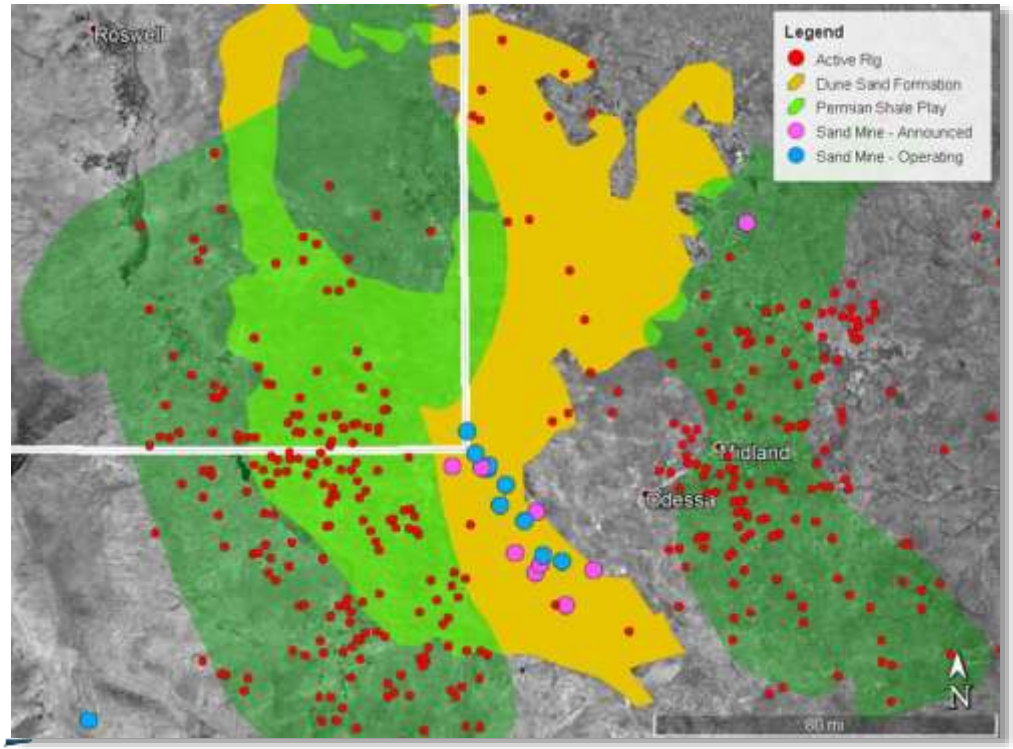
Average sand per well

Savings range per well

2nd wave (Competition)

Reduced market pricing after adequate supply…$100k+ savings/well

Local Permian Sand Development in Progress



Permian Mines in Production

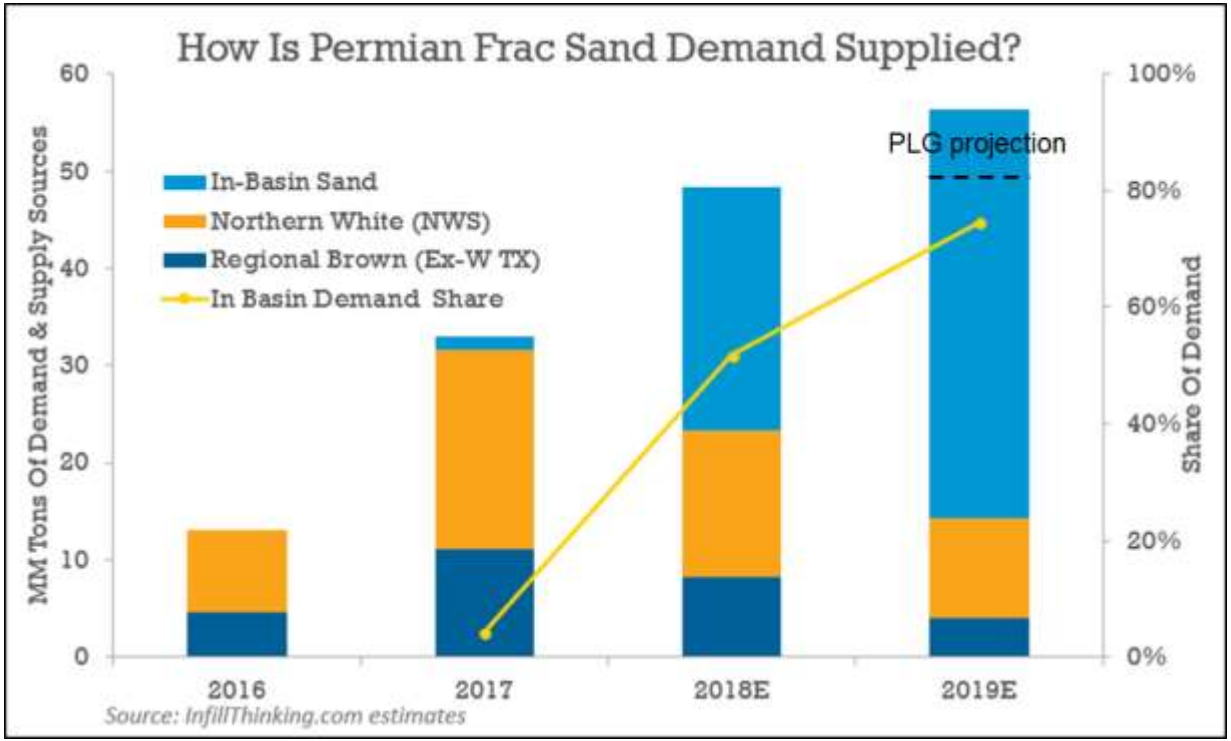
1. Hi-Crush
2. Aequor
3. Alpine Sand
4. Black Mountain Vest
5. High Roller
6. Vista
7. Preferred Sands Monohans
8. Black Mountain El Dorado
9. Fairmont Santrol
10. U.S. Silica Crane County
11. Schlumberger

Announced – Not yet in Production

1. Unimin
2. Badger Mining
3. Atlas Energy Kermit
4. U.S. Silica Lamesa
5. Preferred Sands Kermit
6. West Texas Sand
7. Atlas Sand #2

Source: Baker Hughes (11/24/17), EIA, Infill Thinking, PLG Analysis, May 2018

Local Sand Could Become Majority of Permian Supply Later in 2018

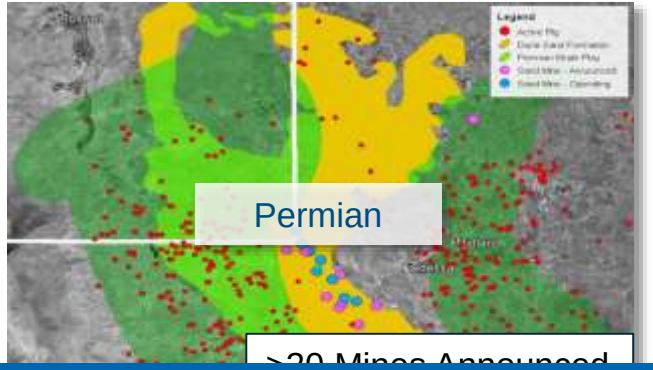


With further share growth expected in 2019

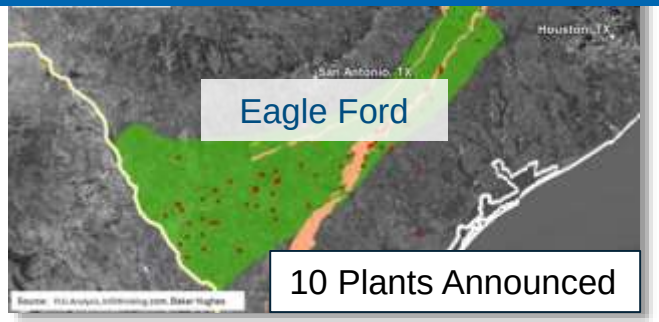
However, total sand volume will flatten in 2019 due to crude logistics constraints

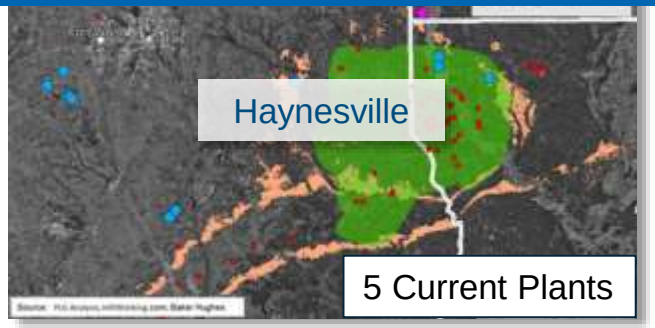
2020 growth could be large

Local Sand Growth – Not Just the Permian



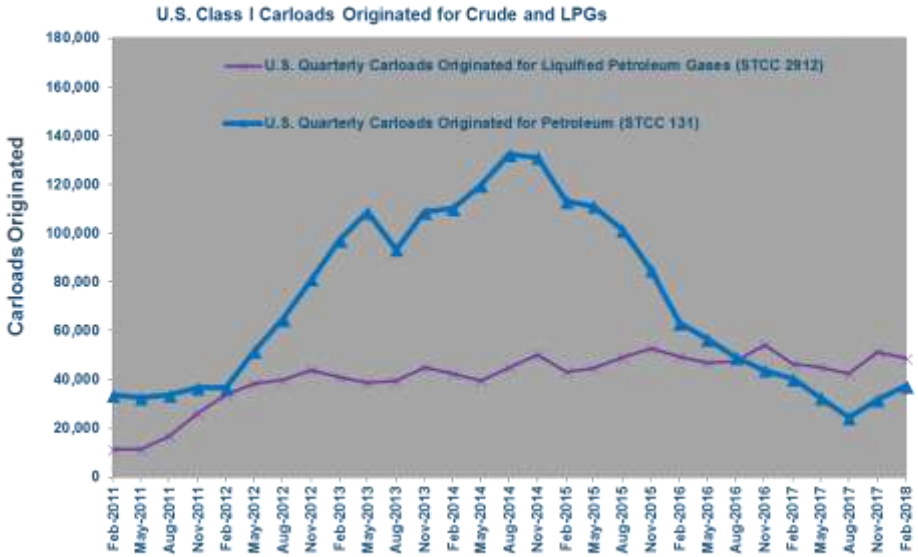
Northern White volume will flatten in 2nd half of 2018, likely losing volume as more local sand comes online in 2019



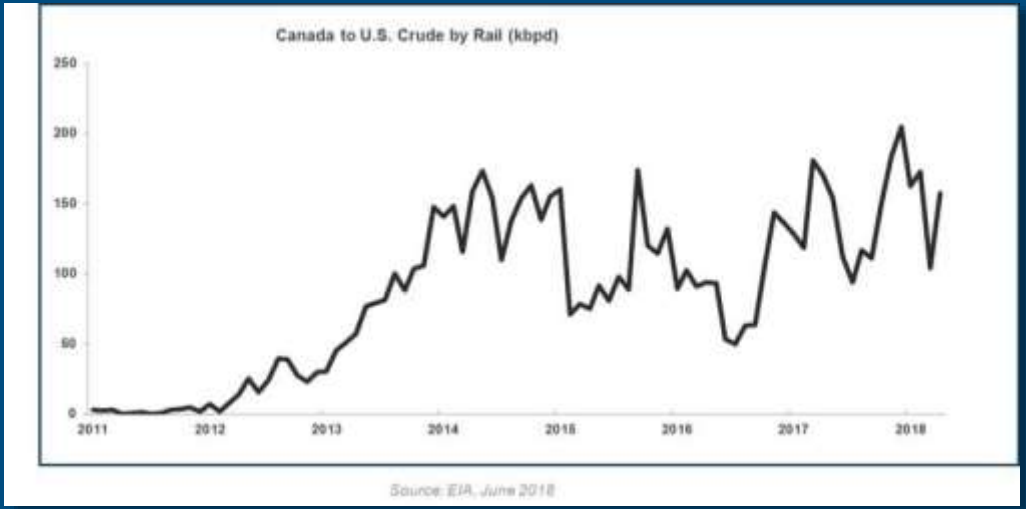


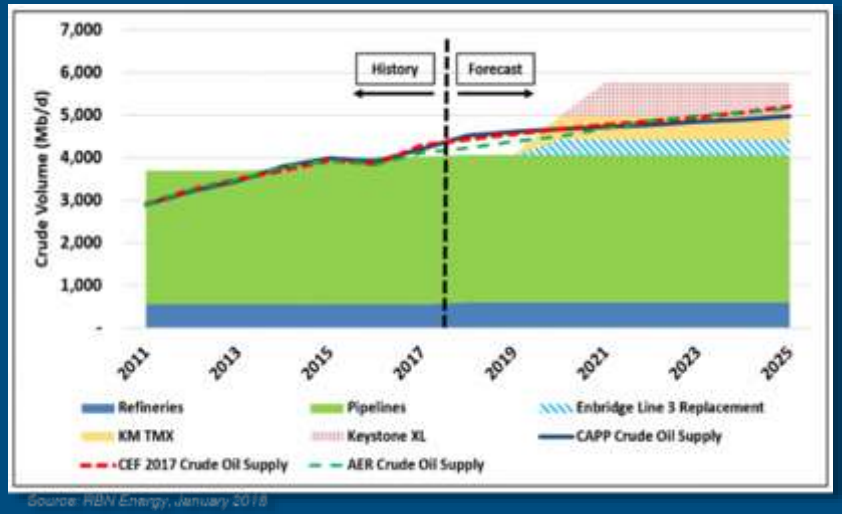
U.S. Crude By Rail Overtaken by LPG Volume

- US-originated CBR volume has dropped significantly since 2014 peak
  - Shipments to East and Pacific Northwest are around 100M b/d each
- LPG carloads surpassed CBR in 2016
- New growth opportunities
  - Permian CBR to Gulf Coast
  - Bakken CBR growth in 2019?



Western Canadian CBR Opportunity





Canadian pipeline projects still challenged – late 2019 / early 2020 best case

- Enbridge Line 3 – approved by MN but activists not giving up
- TransMountain taken over by Canadian federal government to ensure development
- Keystone XL still has potential

Canadian CBR has 2-3 year window with up to 500M b/d potential

Mexican Energy Reform is Creating New Opportunities for U.S. Refined Products

75-year state monopoly over energy has ended

- 2013 Constitutional amendment
- Affects all aspects: E&P, refining, distribution, retail pricing

Reform objectives

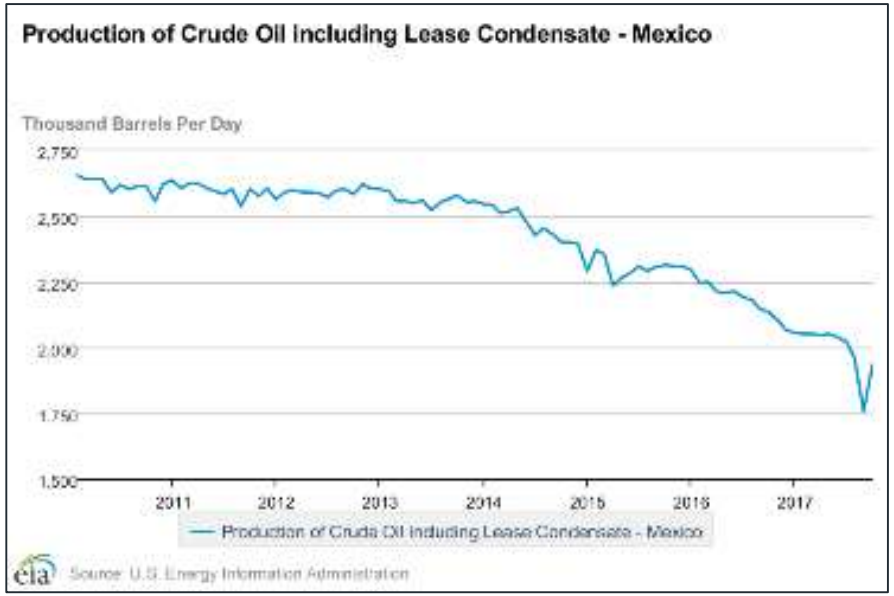
- Move from state control to open market
- Tap foreign direct investment and expertise
- Meet growing consumer demand
- Strengthen the energy security of Mexico

Progress to-date

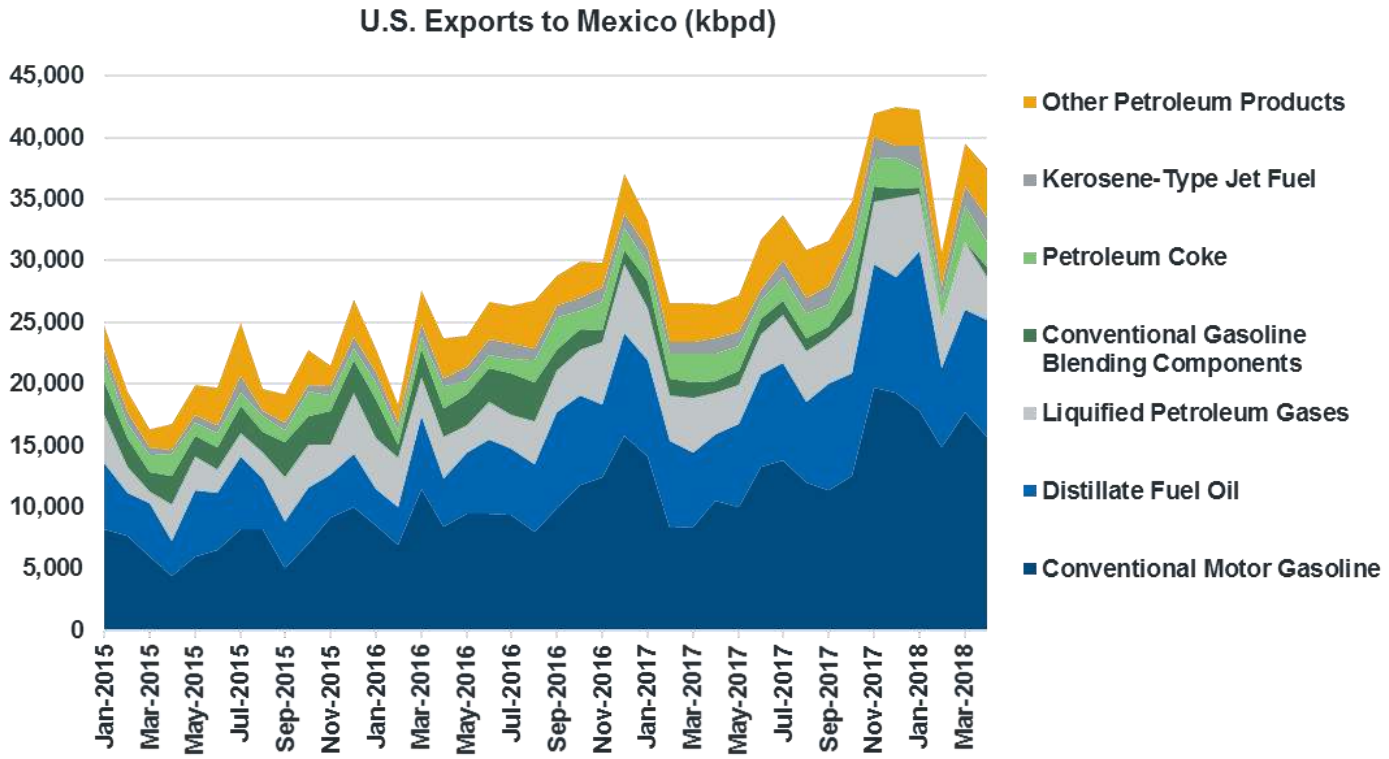
- Offshore and some onshore E&P concessions
- Open season for third party use of PEMEX pipelines and terminals
- Roll-back of price controls
- New entrants in retailing

Mexican Crude Production Has Declined Sharply . . .

Mexican refining assets are running at ~50% capacity due to reduced crude input and production issues, opening the door for more petroleum product imports

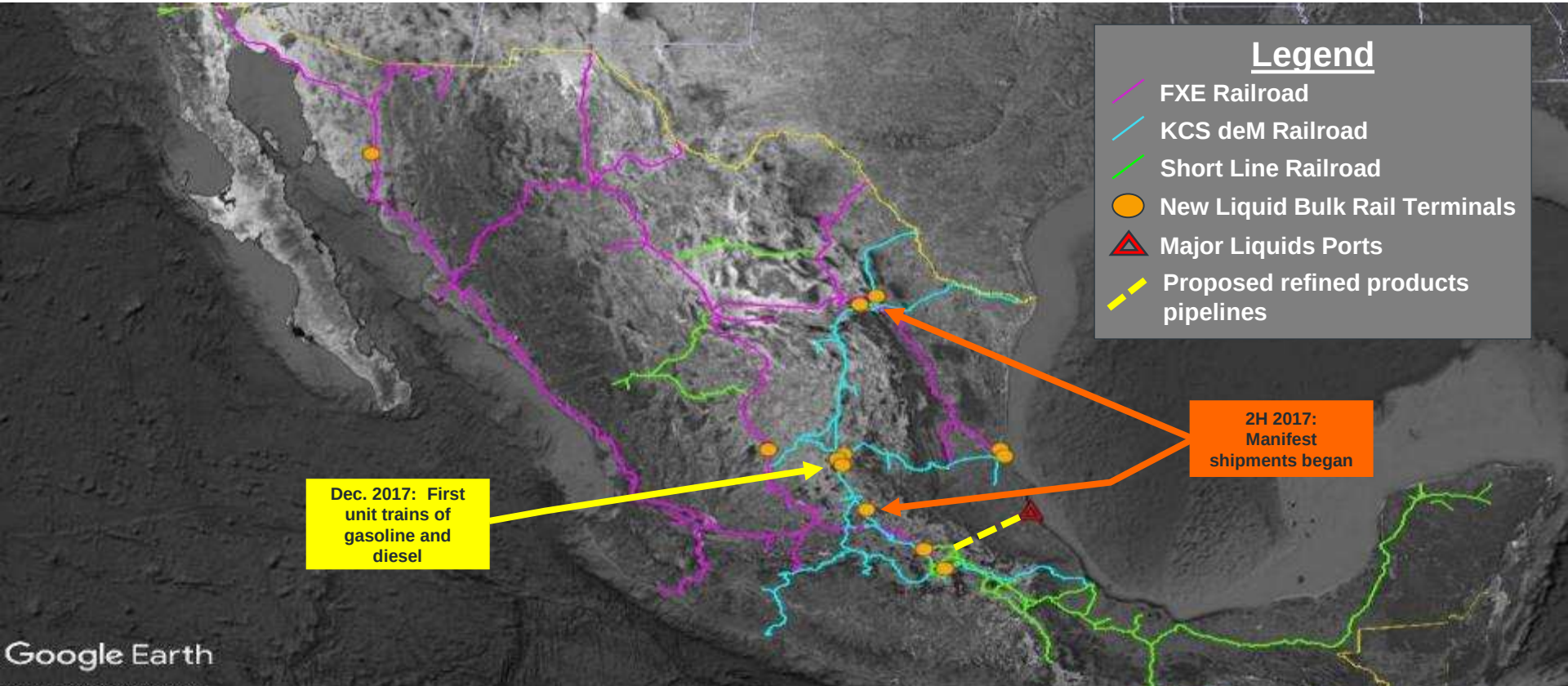


. . . While Fuel Exports from the U.S. are Increasing

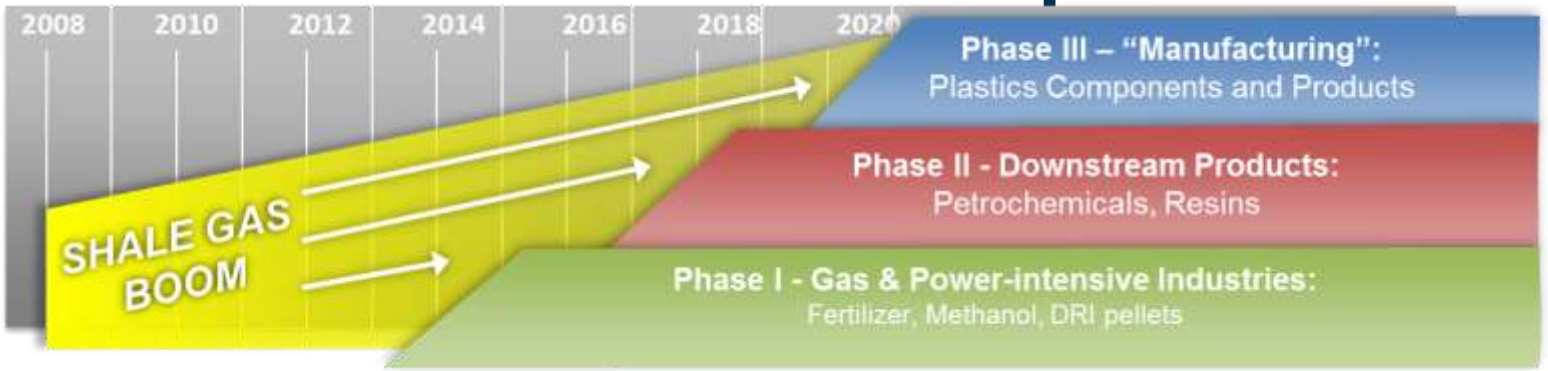


Source: EIA, February 2018

Build-Out of New Liquid Bulk Rail Terminals Now Underway



Phased Impact of Shale Gas to North American Industrial Expansions

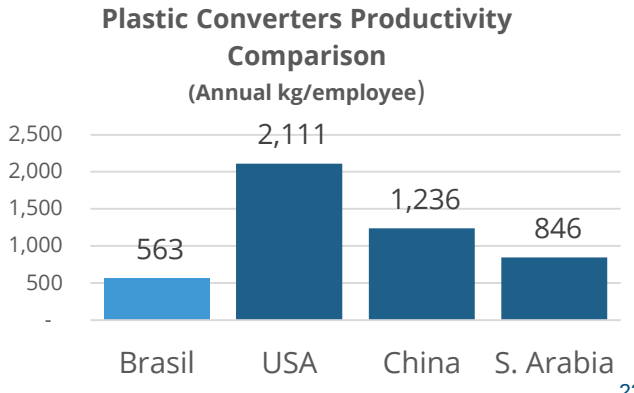


Source: PLG Consulting

Phase I
Dry gas feedstock industries

Phase II
Wet gas feedstock with large investments and longer lead time

Phase III
Downstream manufacturing industries grow as a result of low power prices, advantaged material costs and more competitive labor costs.

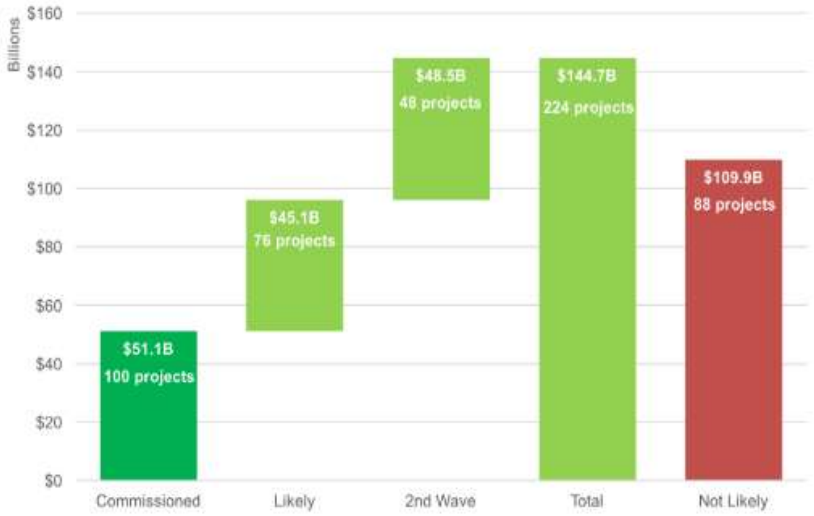


Shale-Driven Industrial Investment Forecast Through 2025

Shale Gas Industrial Expansion Logistics Database

The North American petrochemical industry will likely invest ~$145B in industrial facilities

- **Total Announced** - $255B
- **Commissioned** - since 2011 - $51.1B of investment
- **Likely start** up by the end of 2019 - $45.1B of investment
- **2nd Wave** – Likely between 2020 and 2025 – $48.5B of investment
- **Not Likely** - $109.9B of announced investment

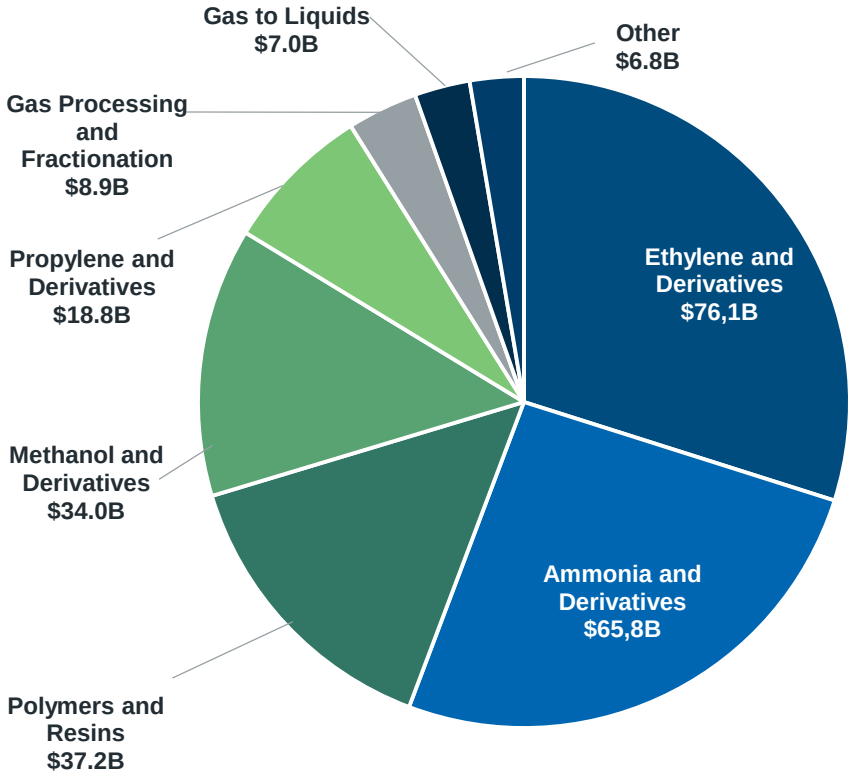


Shale-Driven Industrial Investment Forecast (cont'd)

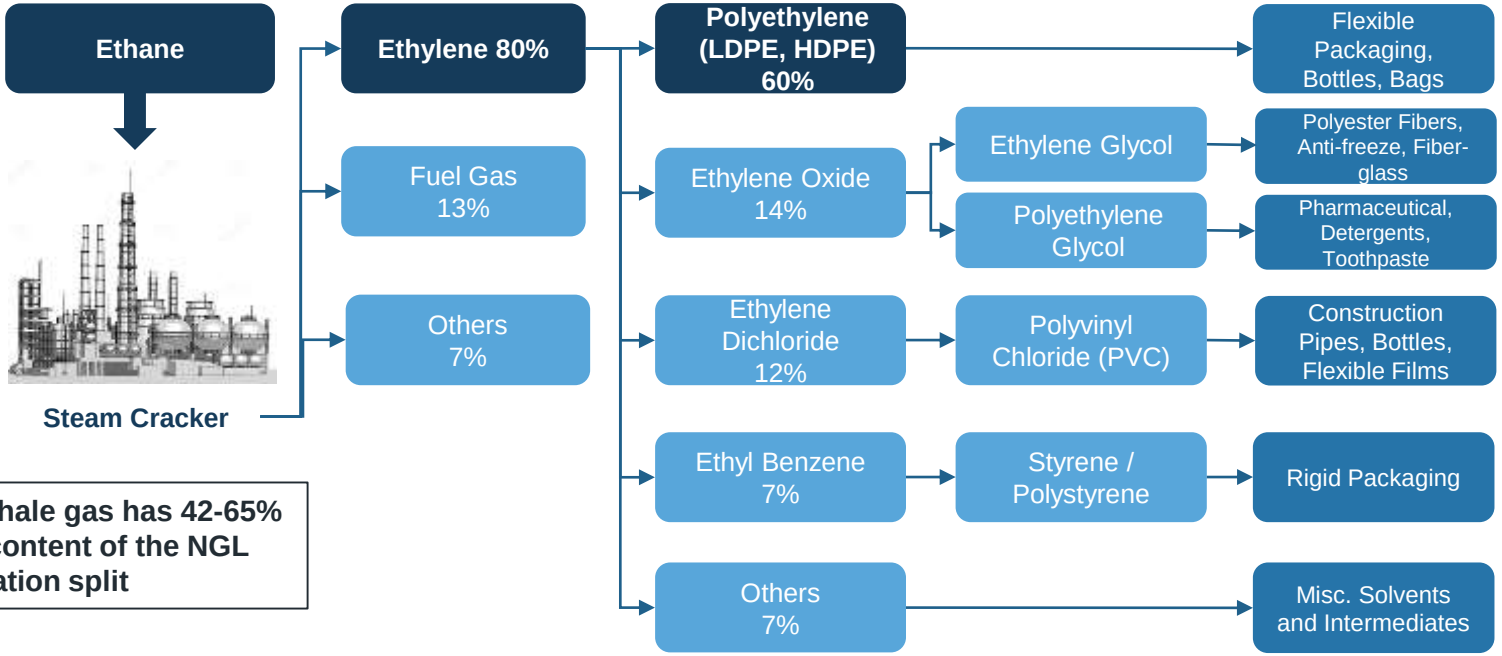
Processed gas, ethylene, methanol, and resins account for >80% of product volume output

Product Category Breakdown

All Announced Industrial Projects in SHIELD



Ethane Cracking Downstream Products



*Note: Shale gas has 42-65% ethane content of the NGL fractionation split

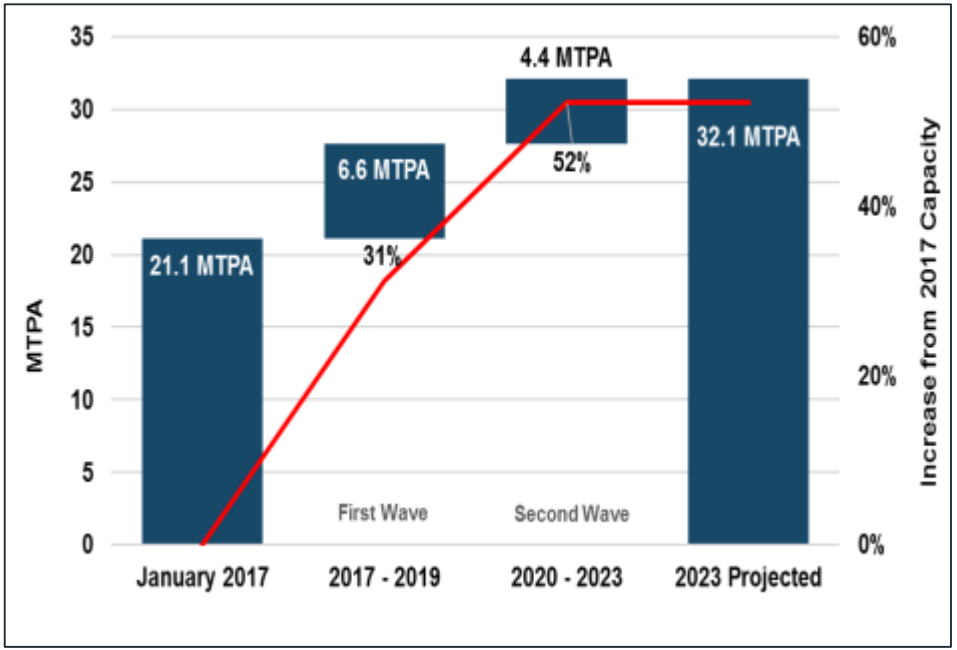
Transportation Continuum

Pipeline → Integrated Facilities / Pipeline ▶ Rail → Rail / Truck

Source: PLG Consulting

North American PE Expansion Plans

Production capacity growth is unprecedented



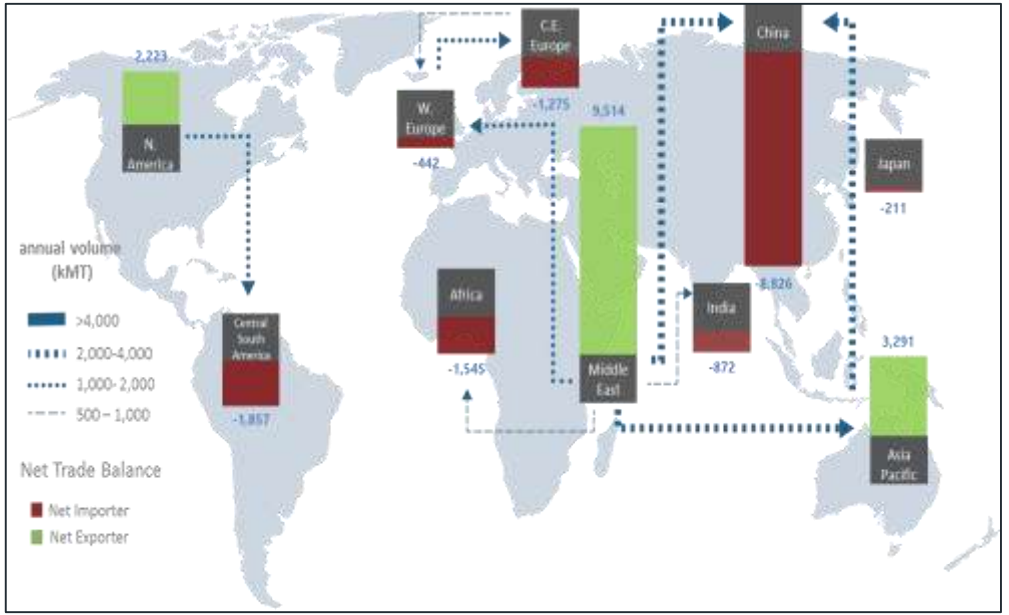
Source: Townsend Solutions, PLG SHIELD

- Exports will be relief valve for oversupply being created with first wave capacity
- Extent of “Third Wave” PE capacity growth (after 2023) for North America will be determined by cracker-build decisions, demand growth, and global export competitiveness

Major Global Polyethylene Trade Flows

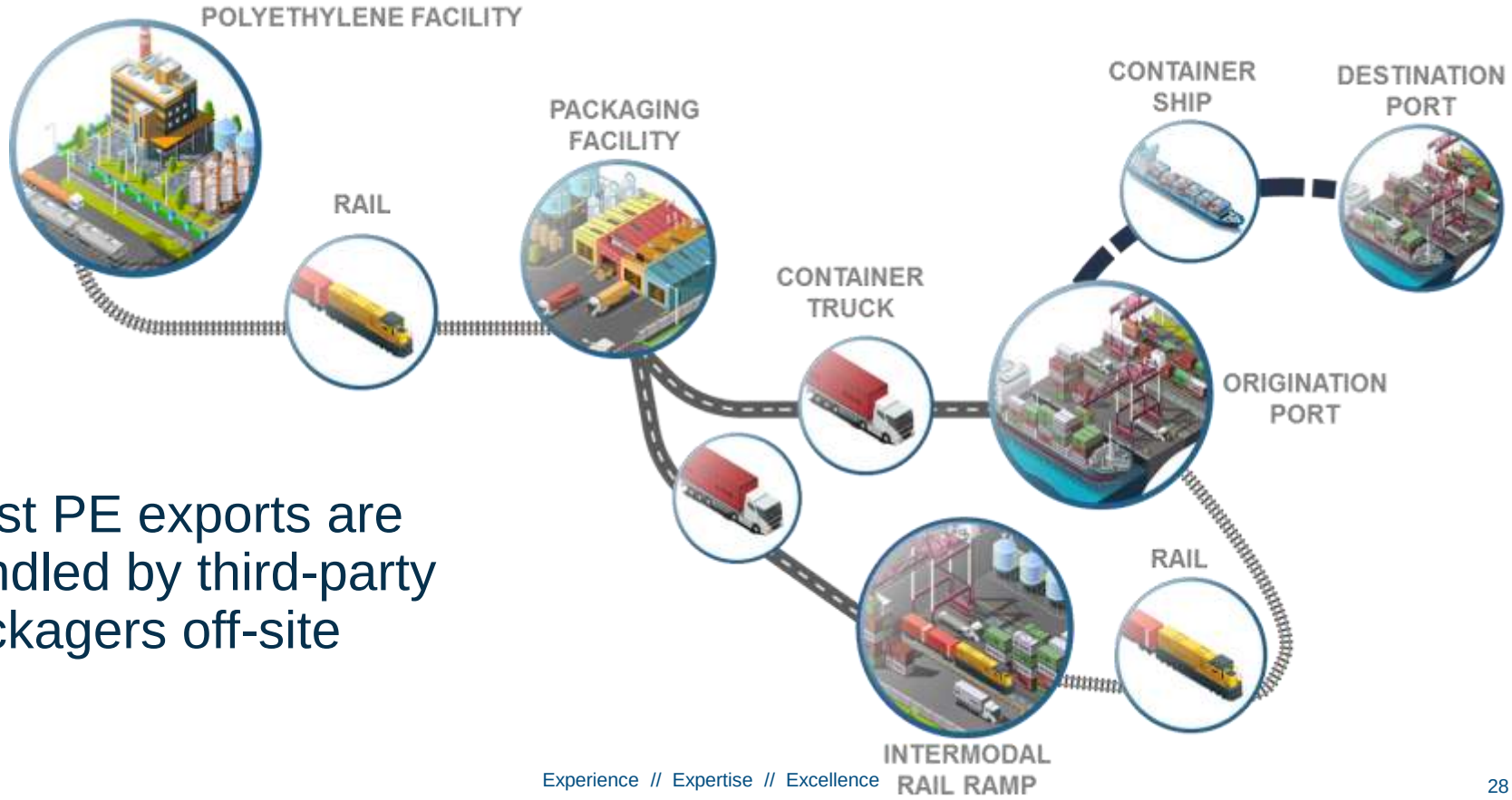
By 2025, North America will be a major PE exporter with >1M MTA being exported to Central/South America, Western Europe, Africa, China, and India each

Opportunity will come from overall demand growth plus displacement of volumes from the Middle East



Source: Townsend Solutions

North American PE Export Logistics Chain



Most PE exports are handled by third-party packagers off-site

Majority of North American PE Export Logistics Chain Located in Houston Area

Currently the great majority of PE volume is exported from the Port of Houston

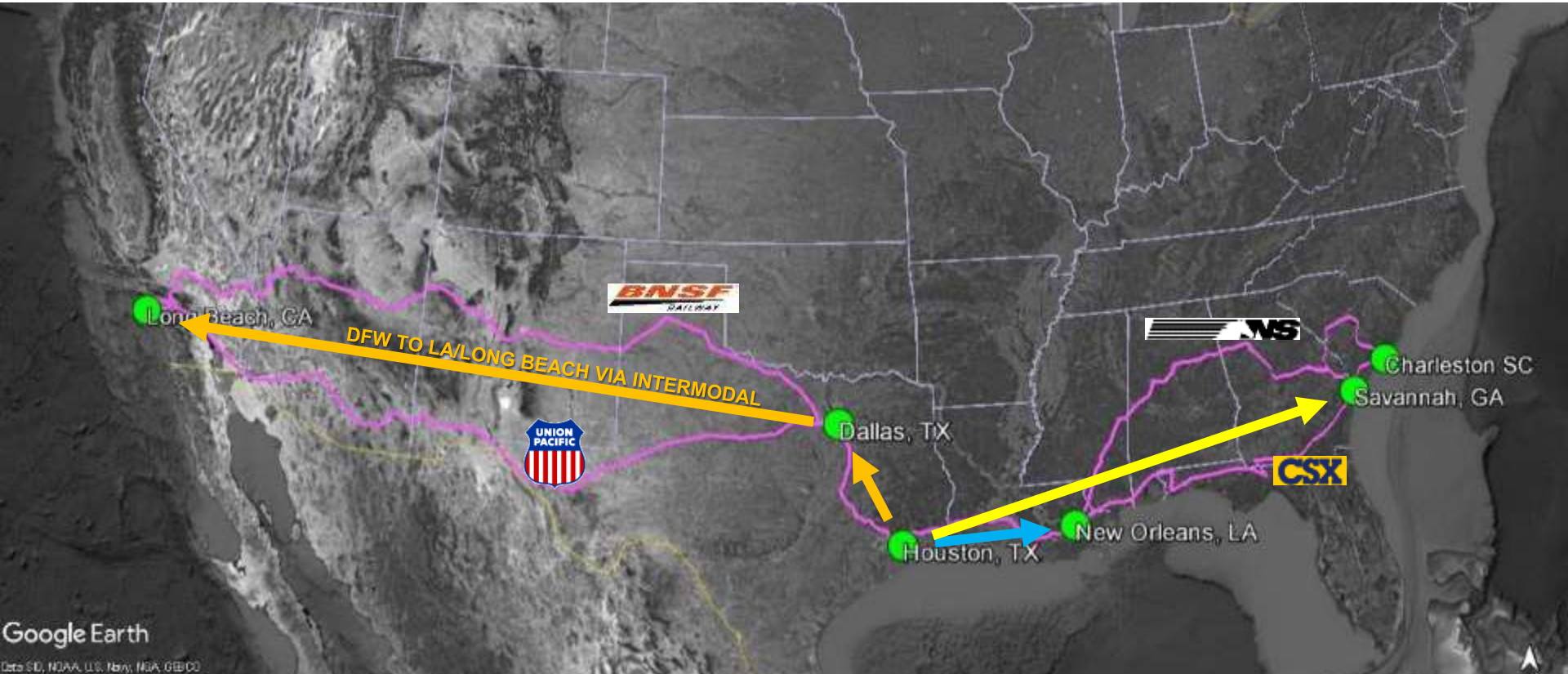
Nine major packaging companies in operation throughout the area, some with multiple sites

Source: PLG analysis

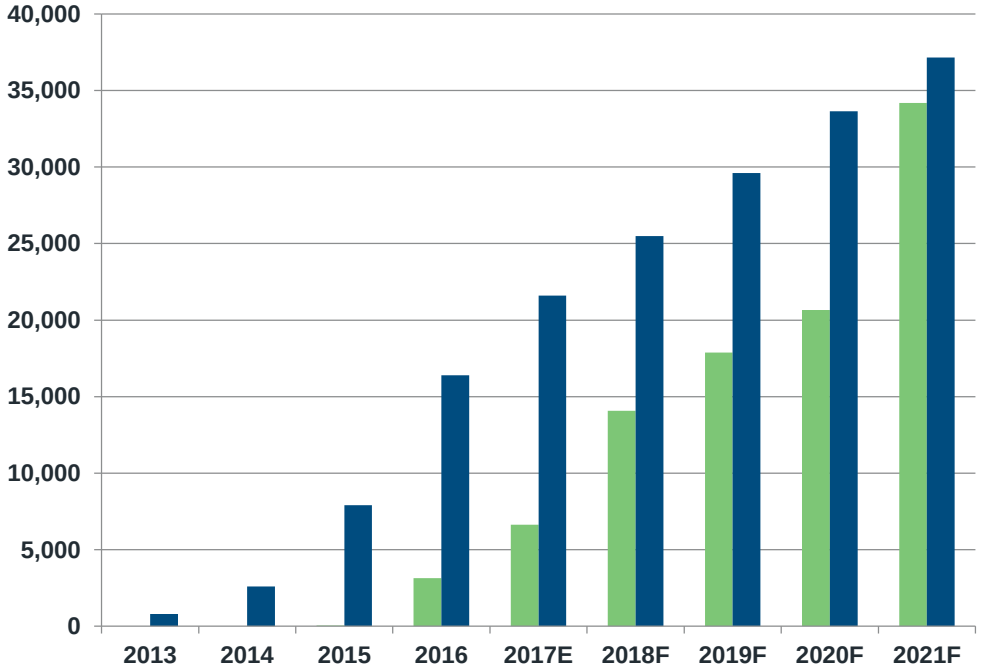
North American PE Export Logistics Chain

Packaging facilities expanding in other markets to accommo-date growth and account for potential constraints in Houston such as congestion, container supply, weather, and export vessel sailings

Alternative to Houston Resin Export Routes in Place and Under Development



N.A. Plastic Pellet New Car Deliveries and Forecasted Demand



- 2015-2021 Cumulative –N.A. Plastic Pellet New Car Deliveries
- 2015-2021 Cumulative – Large Covered Hopper Railcar Fleet Required for Chemical Build-out

Source: Wells Fargo Rail, PLG SHIELD, PLG Analysis, March 2018

Key Shale Oil Issue

Crude production growth rate will be hindered due to Permian pipeline takeaway capacity issue through 2019

What It Means for Rail

Frac sand beginning transition to more local sand – will impact rail volumes beginning in Q3

What It Means for Rail

CBR windows opening

- Permian ~100M b/d for 18 months
- Bakken 2019 growth?
- Western Canadian up to 500M b/d for 2-3 year window

What It Means for Rail

Mexican petroleum products opportunity viable but increasing political risk

What It Means for Rail

Chemical and plastics growth is long term and sustainable due to shale gas competitiveness

- Chinese tariff threat could impact PE exports

I Look Forward To Your Questions!

Thank You!

For follow up questions and information, please contact:

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