From Upstream to Downstream

Opportunities and Challenges for Rail

Prepared For:

North American Rail Shippers Association

NARS Annual Meeting

May 16, 2019
San Antonio, TX

Graham Brisben, CEO
PLG Consulting

Experience // Expertise // Excellence

Experience // Partial List

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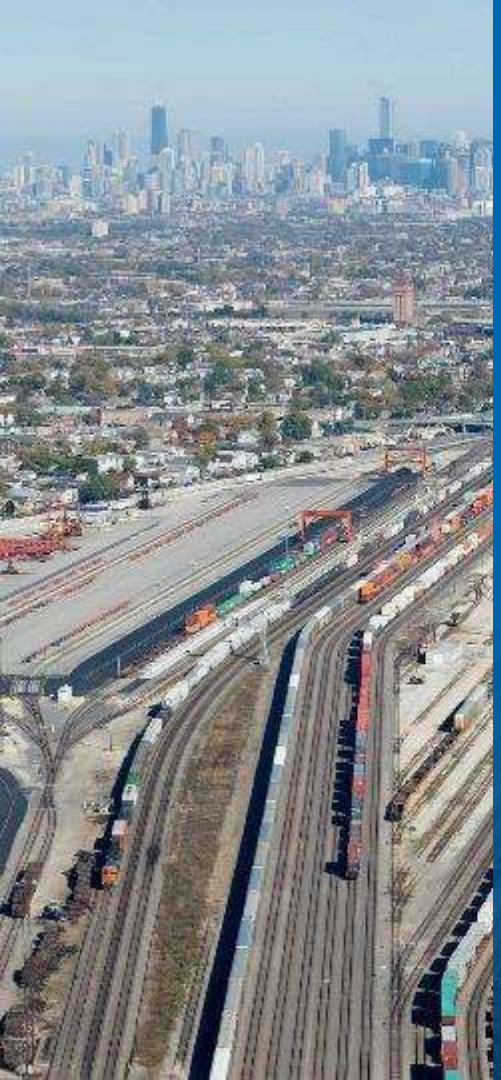
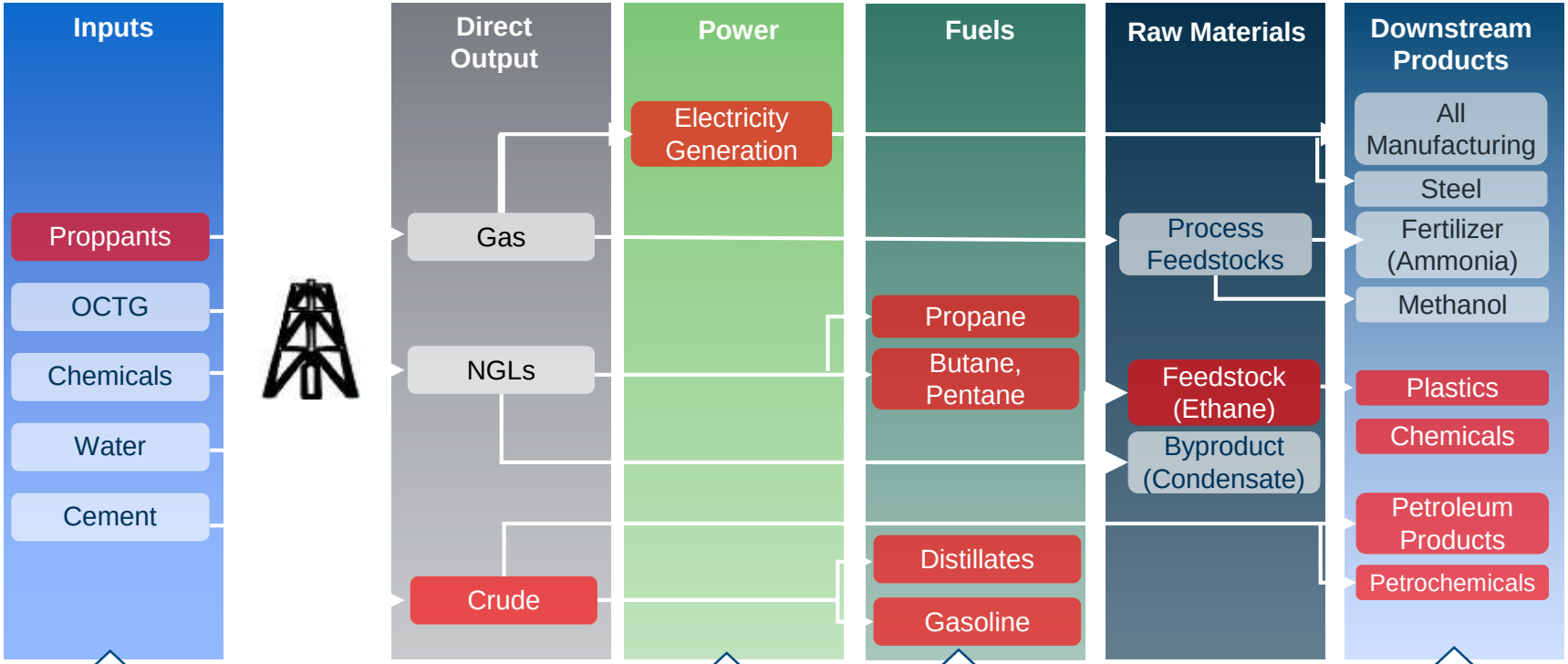


Today's Presentation Agenda

1. The Energy and Chemicals Value Chain
2. Upstream: Frac Sand Dynamics Impacting Rail
3. Midstream: Energy-by-Rail Revival
4. Downstream: Refined Products, Chemicals, and Plastics

Presentation available for download now at:
https://plgconsulting.com/resources/presentations-and-white-papers/

The Energy & Chemicals Value Chain

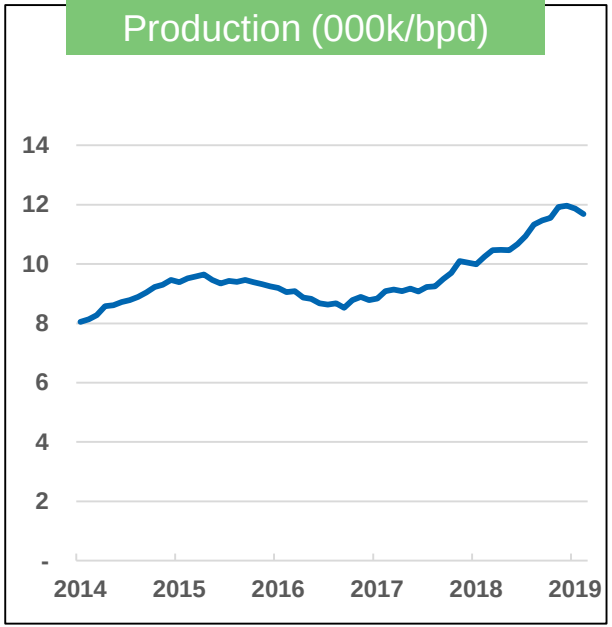


MACRO IMPACTS TO-DATE INCLUDE
Dramatic reduction in crude imports, lower electricity costs, lower gasoline prices, increased refined products

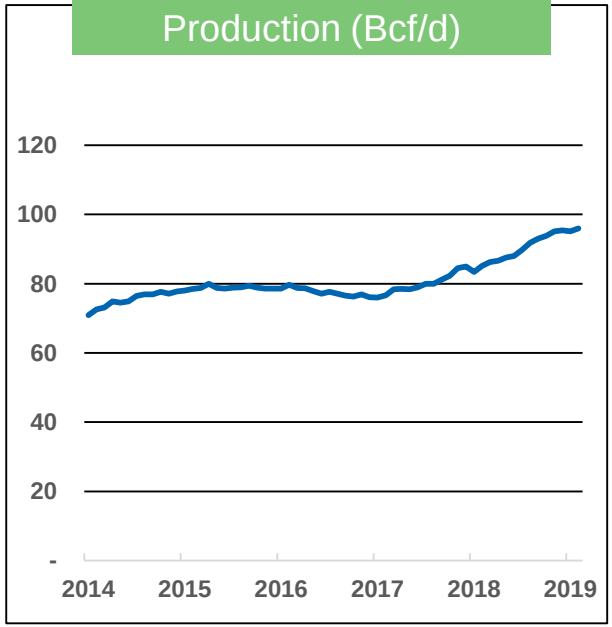
THE WAVE CONTINUES
U.S. petrochemical expansion based on abundant, low cost energy and feedstocks is impacting other manufacturing industries

US Hydrocarbon Production at Record Highs

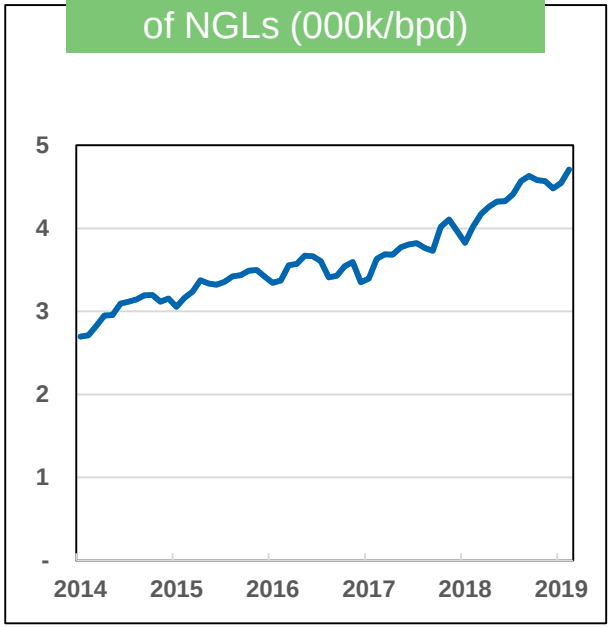
U.S. Crude Oil Production (000k/bpd)



U.S. Natural Gas Marketed Production (Bcf/d)



U.S. Gas Plant Production of NGLs (000k/bpd)



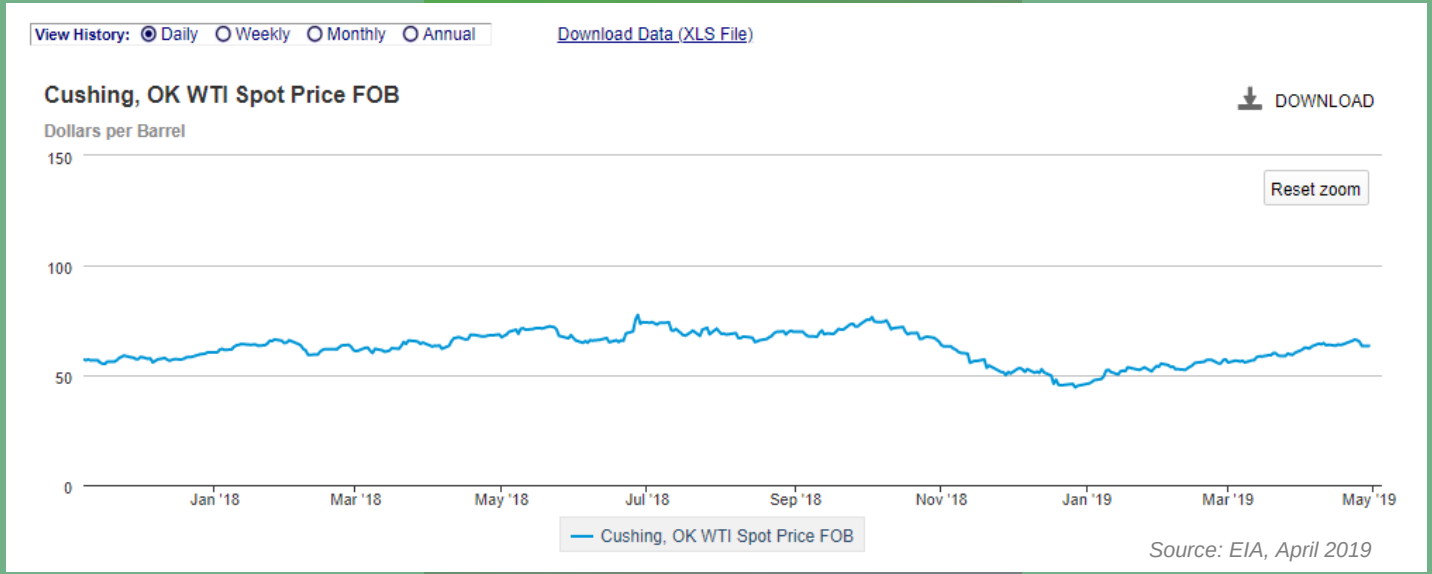
Source: EIA, April 2019

“Stable” Price / Rig Count Environment

$40

Crude prices of at least $40/bbl will support continued production growth

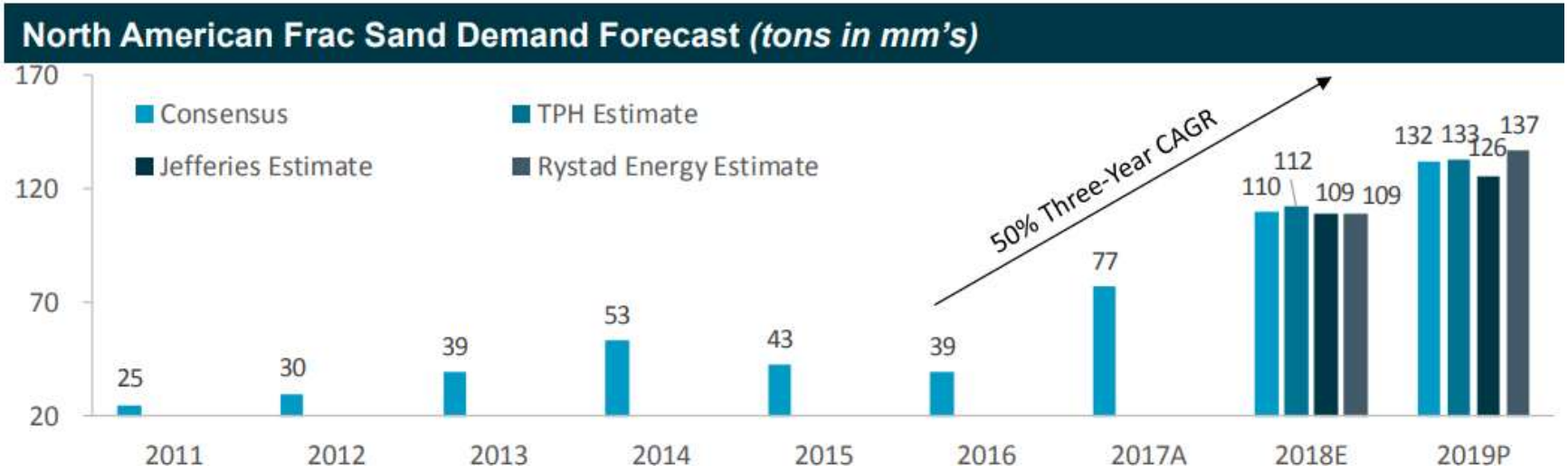
$60



Source: EIA, April 2019

Upstream Sand Dynamics

Continued Production Growth Led to Record Frac Sand Consumption in 2018



Source: Wall Street Research, Rystad Energy, Spears & Associates (from Emerge November 2018 presentation)

Frac Sand Supply Chain Overview

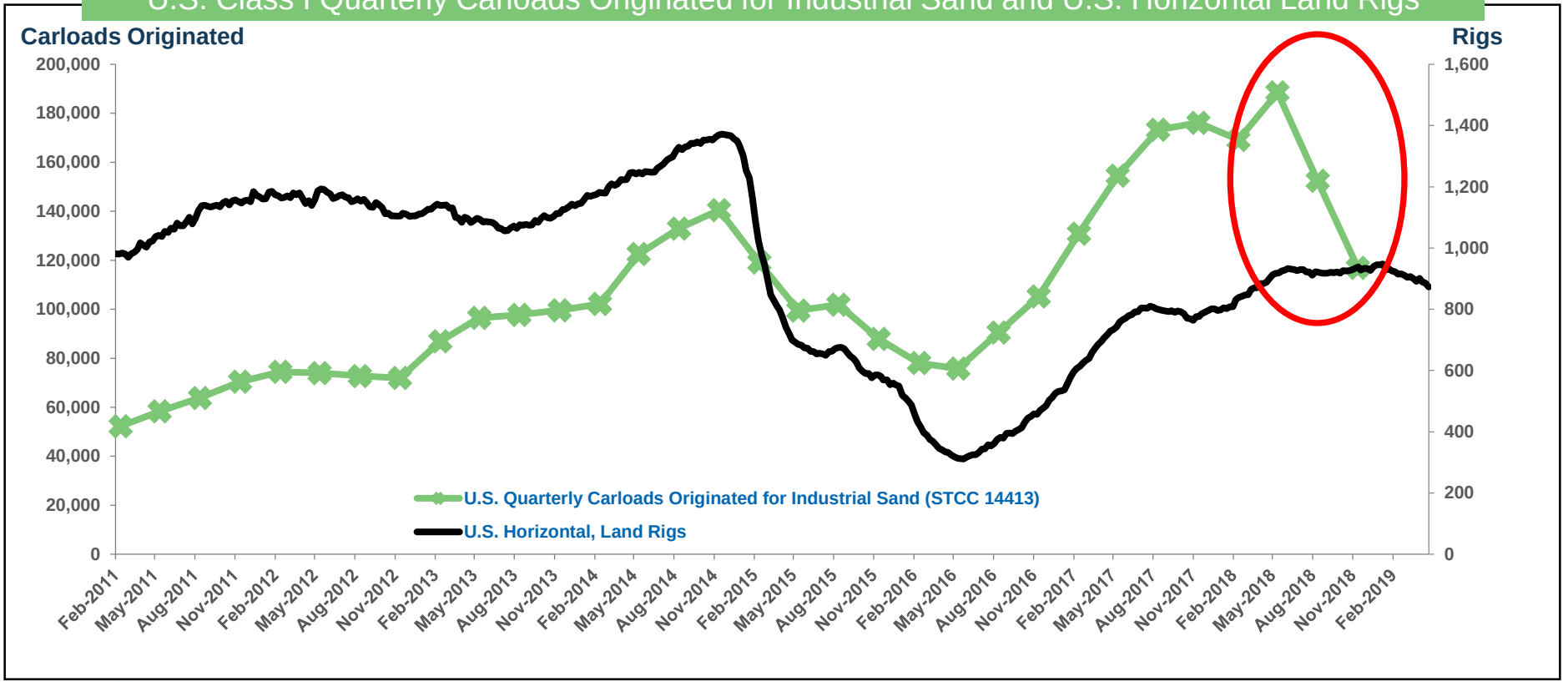
The Northern White supply chain is long and complex – Logistics makes up about 3/4 of the total delivered cost

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
Regional Sand	X	X			Some forward staging	X

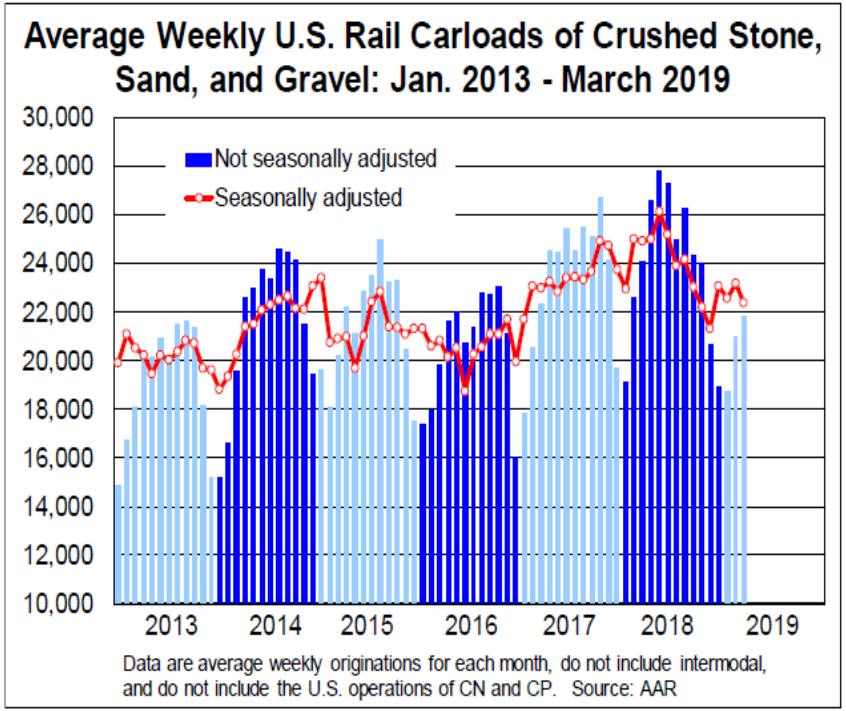
Frac Sand Rail Shipments Peaked in May 2018

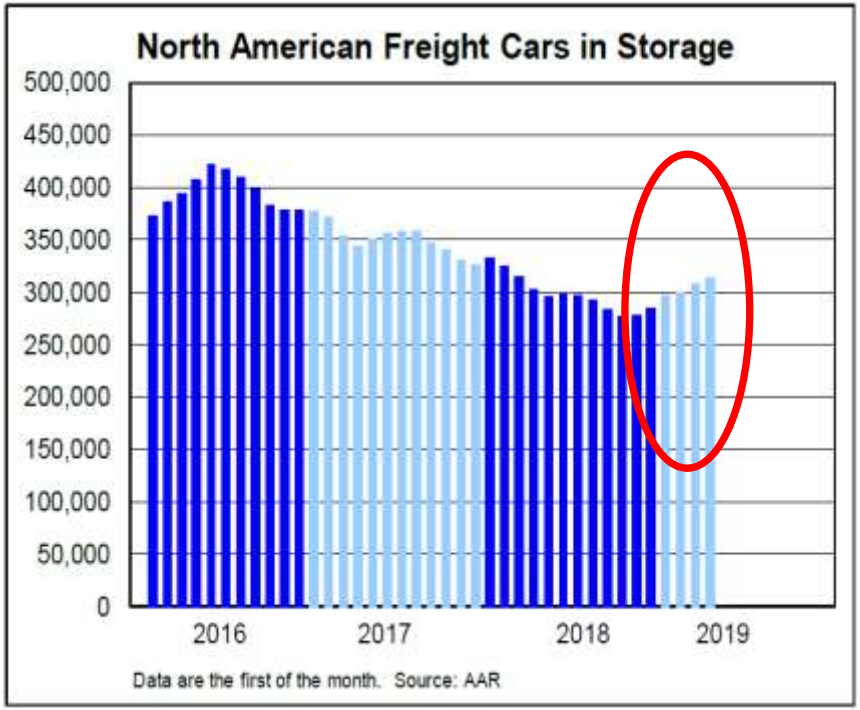
U.S. Class I Quarterly Carloads Originated for Industrial Sand and U.S. Horizontal Land Rigs



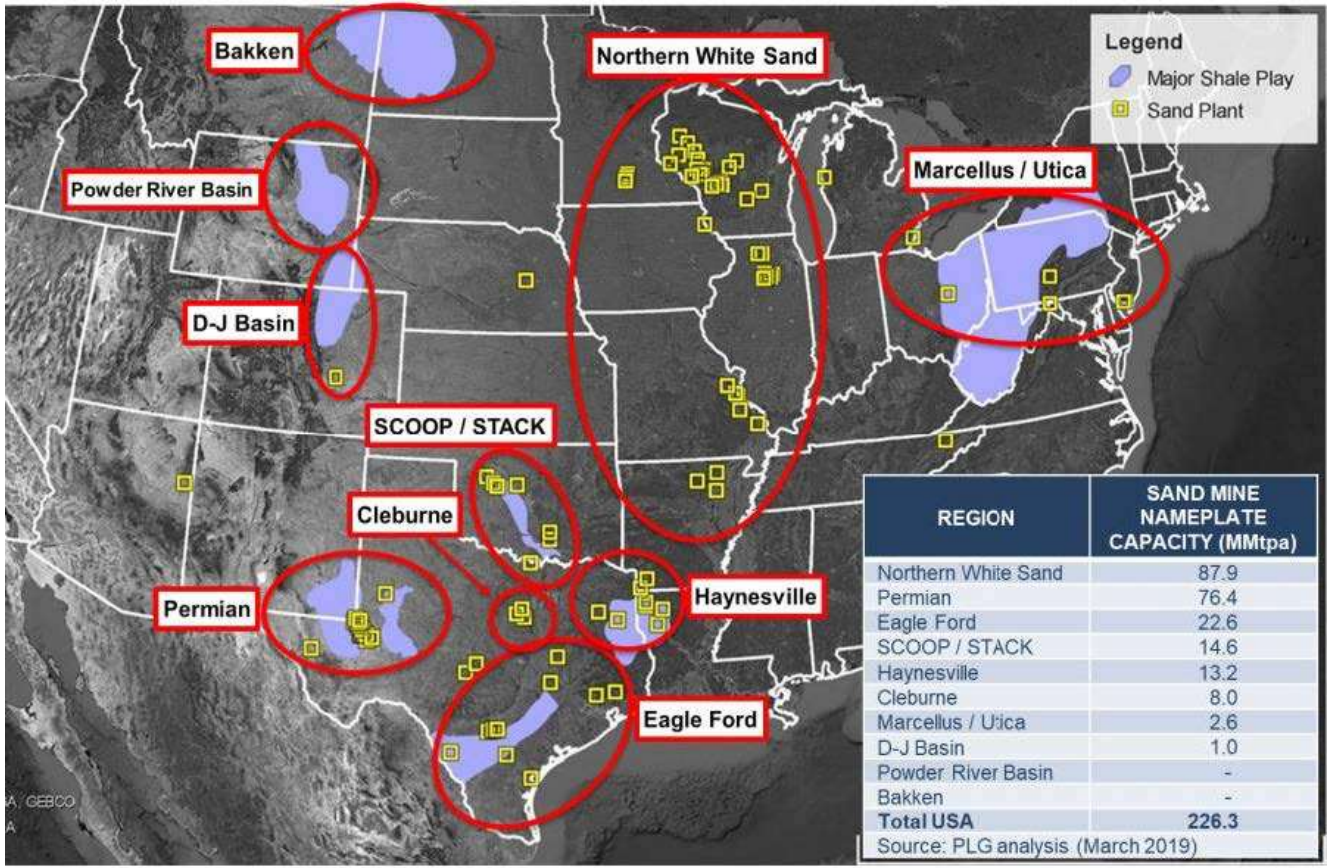
Source: STB (STCC 14413 – Industrial Sand: includes frac sand and other industrial sands), Baker Hughes, April 2019

Small Cube Hoppers Driving Uptick in Cars-In Storage





Regional Sand Growth – Not Just the Permian

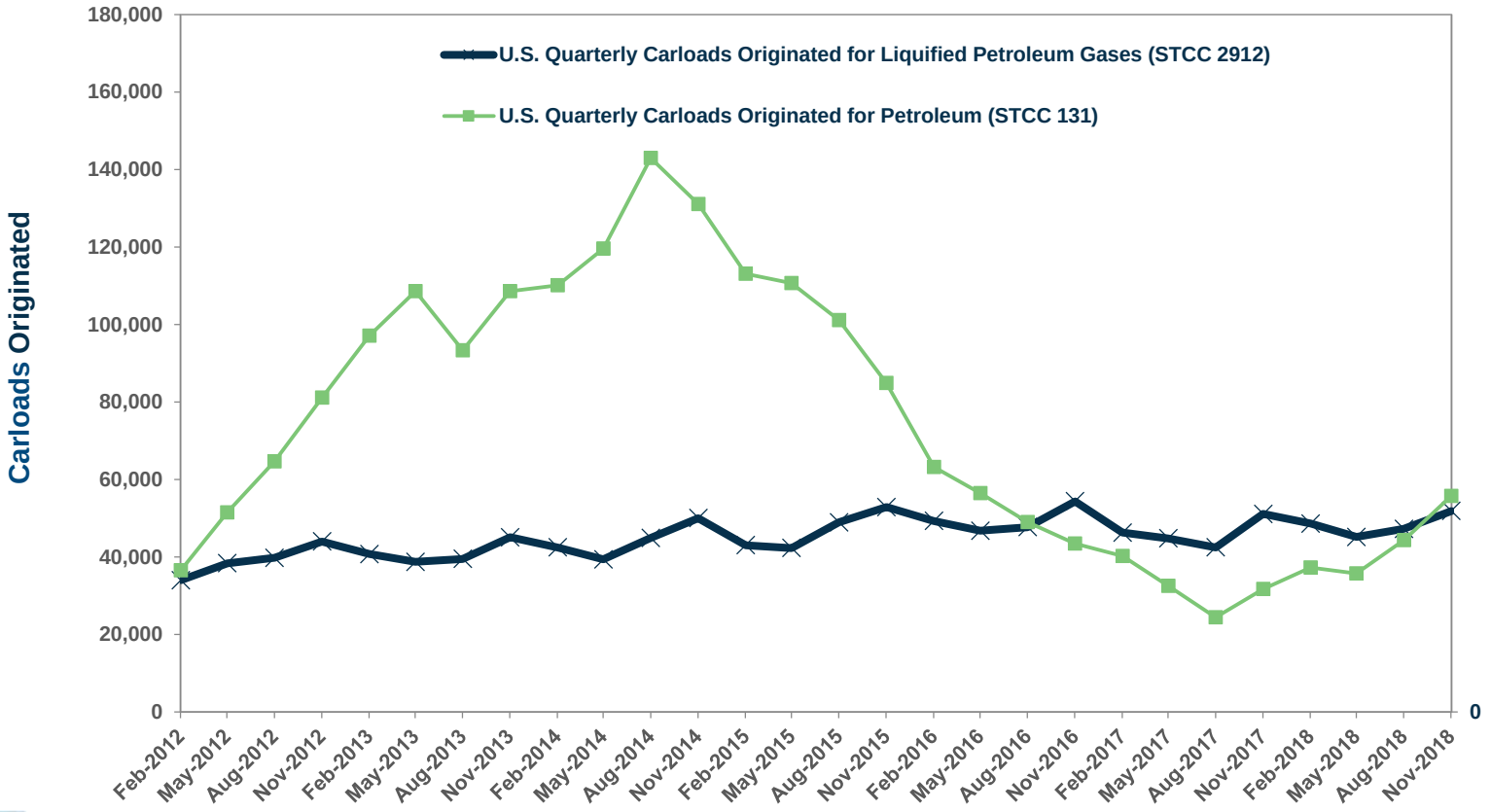


REGION	SAND MINE NAMEPLATE CAPACITY (MMtpa)
Northern White Sand	87.9
Permian	76.4
Eagle Ford	22.6
SCOOP / STACK	14.6
Haynesville	13.2
Cleburne	8.0
Marcellus / Utica	2.6
D-J Basin	1.0
Powder River Basin	-
Bakken	-
Total USA	**226.3**

Source: PLG analysis (March 2019)

Energy By Rail Developments

US Crude and LPG Carloads Originated



Canadian Production Increasing Amid Ongoing Pipeline Uncertainty

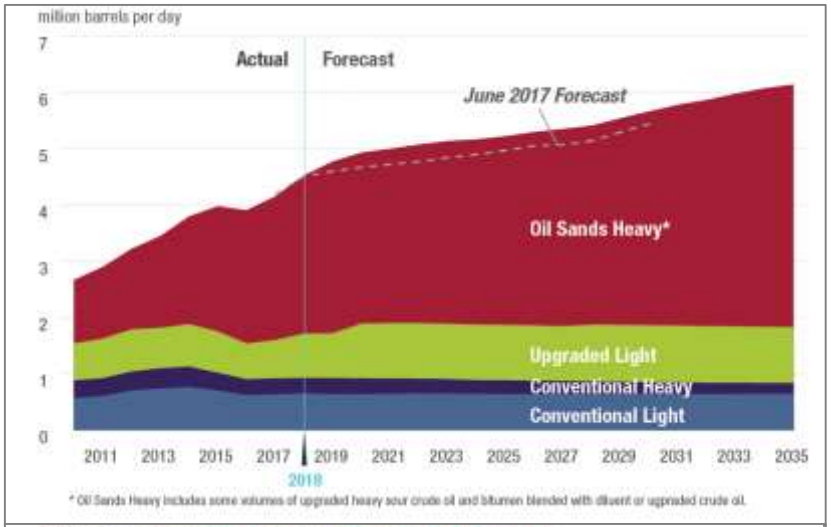


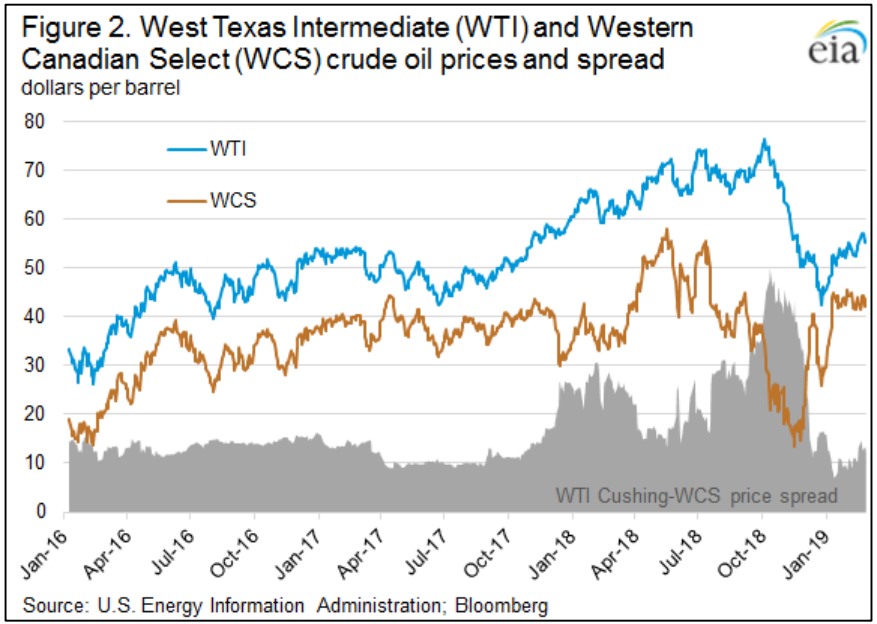
Table 2.5 Western Canada Crude Oil Supply

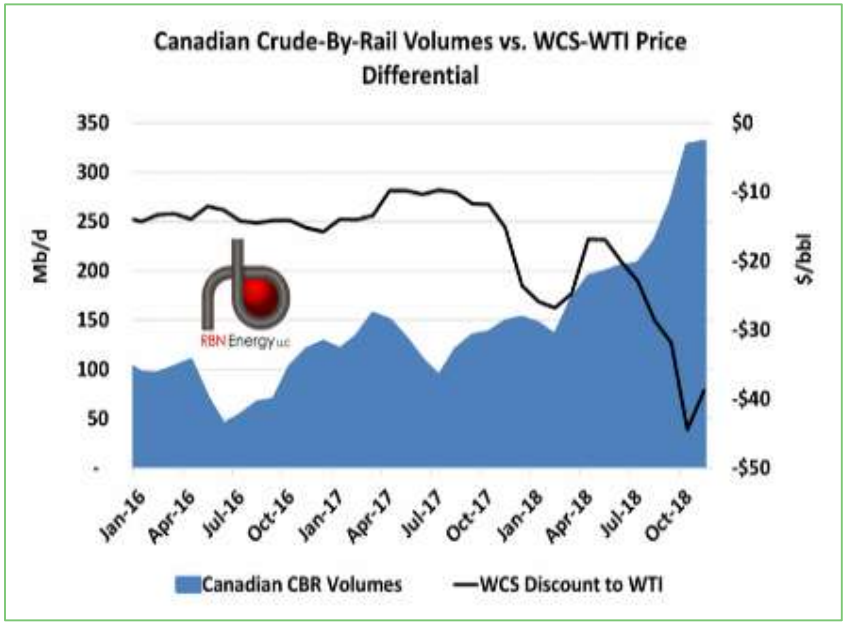
million b/d	2017	2020	2025	2030	2035	Change
Light	1.31	1.62	1.63	1.64	1.61	+0.30
Heavy	2.89	3.32	3.62	4.05	4.55	+1.66
Total Supply*	4.19	4.94	5.25	5.69	6.16	+1.96

*Total may not add up due to rounding.

Source: Canadian Association of Petroleum Producers, 2018 Crude Oil Forecast Markets & Transportation

Differentials Drove Canadian CBR to Record High in 2018





Source: RBN Energy, February 2019

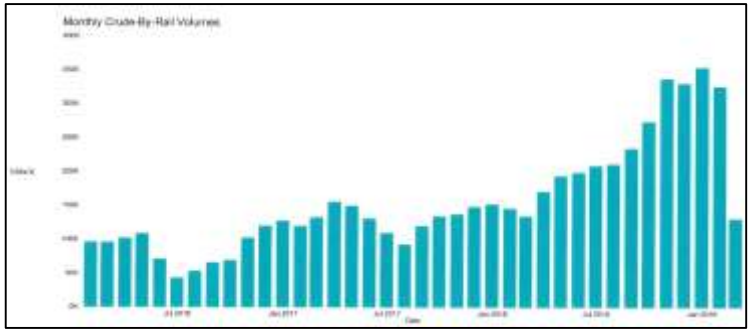
However, Differentials Also Prompted Market Intervention by Government of Alberta

- December 2018 mandated curtailment of about 9% of production (325 k/bpd) and is gradually being reduced with plan to be at 150 Kbpd by June and ended by December 2019
- Dramatically reduced differential vs. WTI to less than $10/bbl., reducing CBR volumes by about 50% -- plan has been very controversial
- New conservative oriented government (UCP) sworn into office April 30th – generally against market intervention but during election campaign was supportive of this measure – no signals yet but expect they may try and wrap up program at faster pace given impact it has had on takeaway capacity by rail

Source:http://www.history.alberta.ca/energyheritage/bitumount/oil-sands/where-are-the-oil-sands.asp

Market Intervention on Production was Followed by Acquisition of Railcar Assets

- February 2019 announcement of plan to lease up to 4,400 railcars by the NDP government designed to move ~ 120 Kbpd
- However, production curtailments undercut differentials that supported CBR
- New UCP government campaigned on cancelling this lease deal – may be too late but major oil producers have already signalled they would be willing to discuss taking over the contracts
- Most likely scenario is that production curtailment ends sooner (early Q3) and government strikes a deal for industry to take over railcar leases

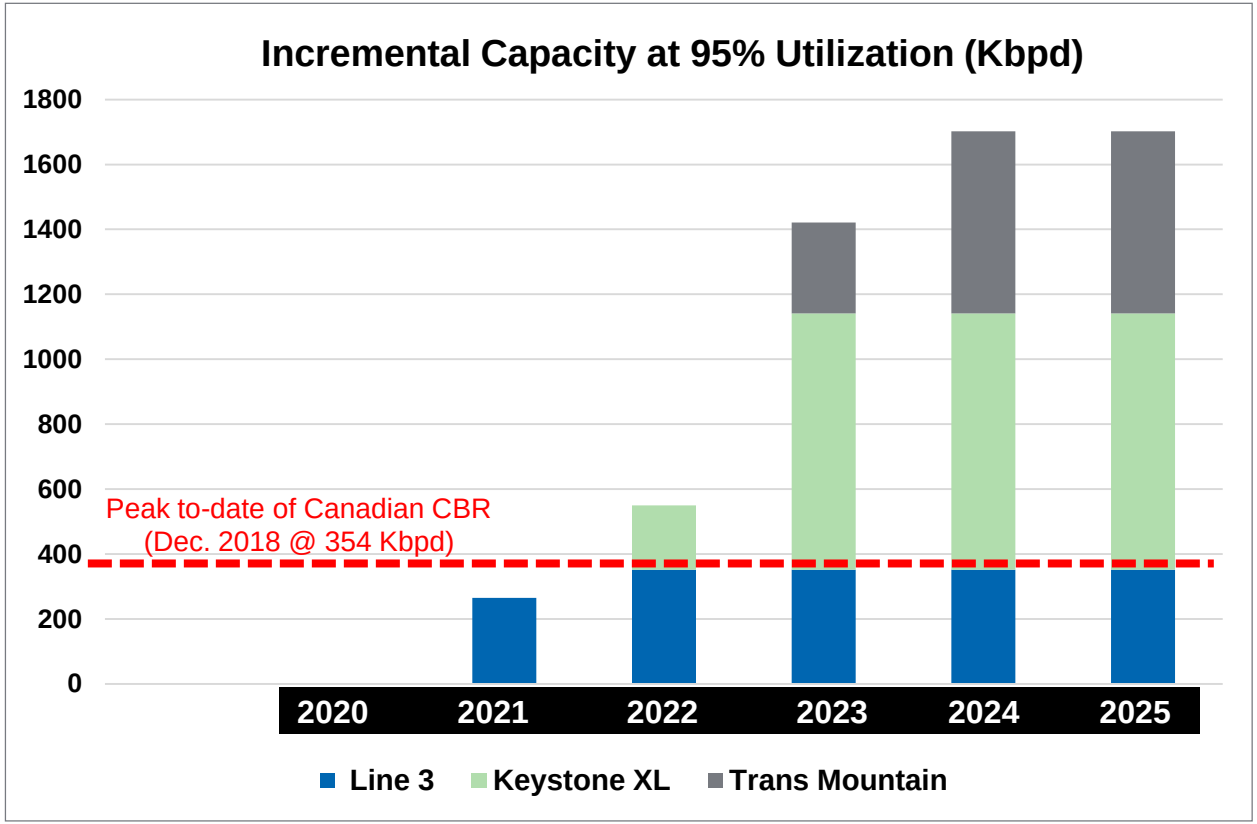


Source: Daily Oil Bulletin, JWN Energy May 1, 2019; NEB

Continued Pipeline Delays are Extending the Canadian CBR Opportunity

Delayed or Canceled Projects

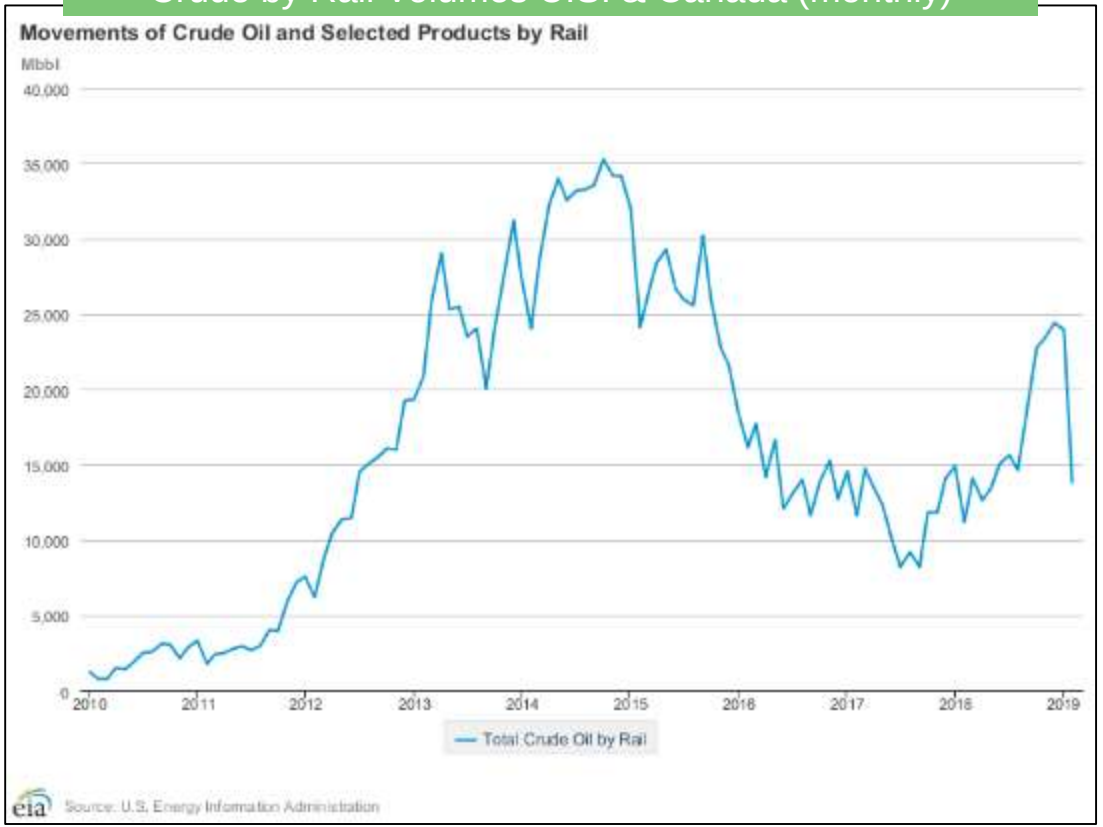
- Enbridge Line 3 expansion
- Keystone XL
- Energy East
- Northern Gateway



Source: PLG Analysis; NEB Canadian Crude Oil Exports by Rail February 2019

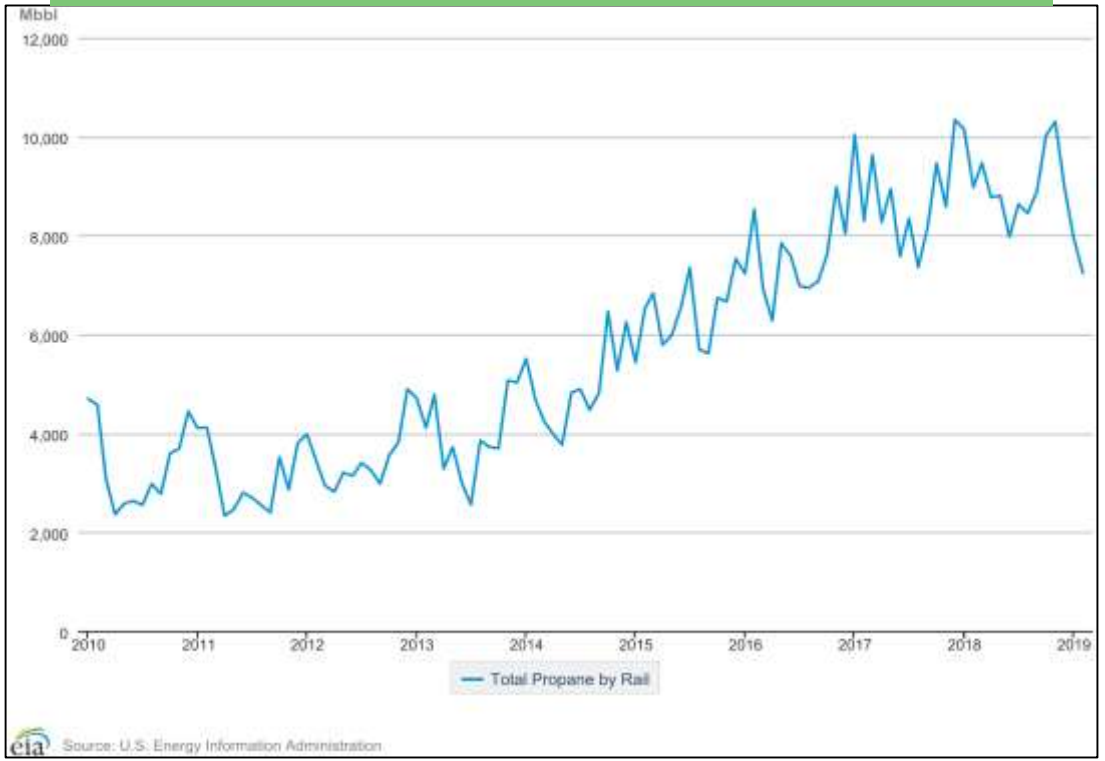
US & Canadian Crude By Rail Growth

Crude by Rail Volumes U.S. & Canada (monthly)



US & Canadian Propane By Rail Growth

Propane by Rail Volumes U.S. & Canada (monthly)



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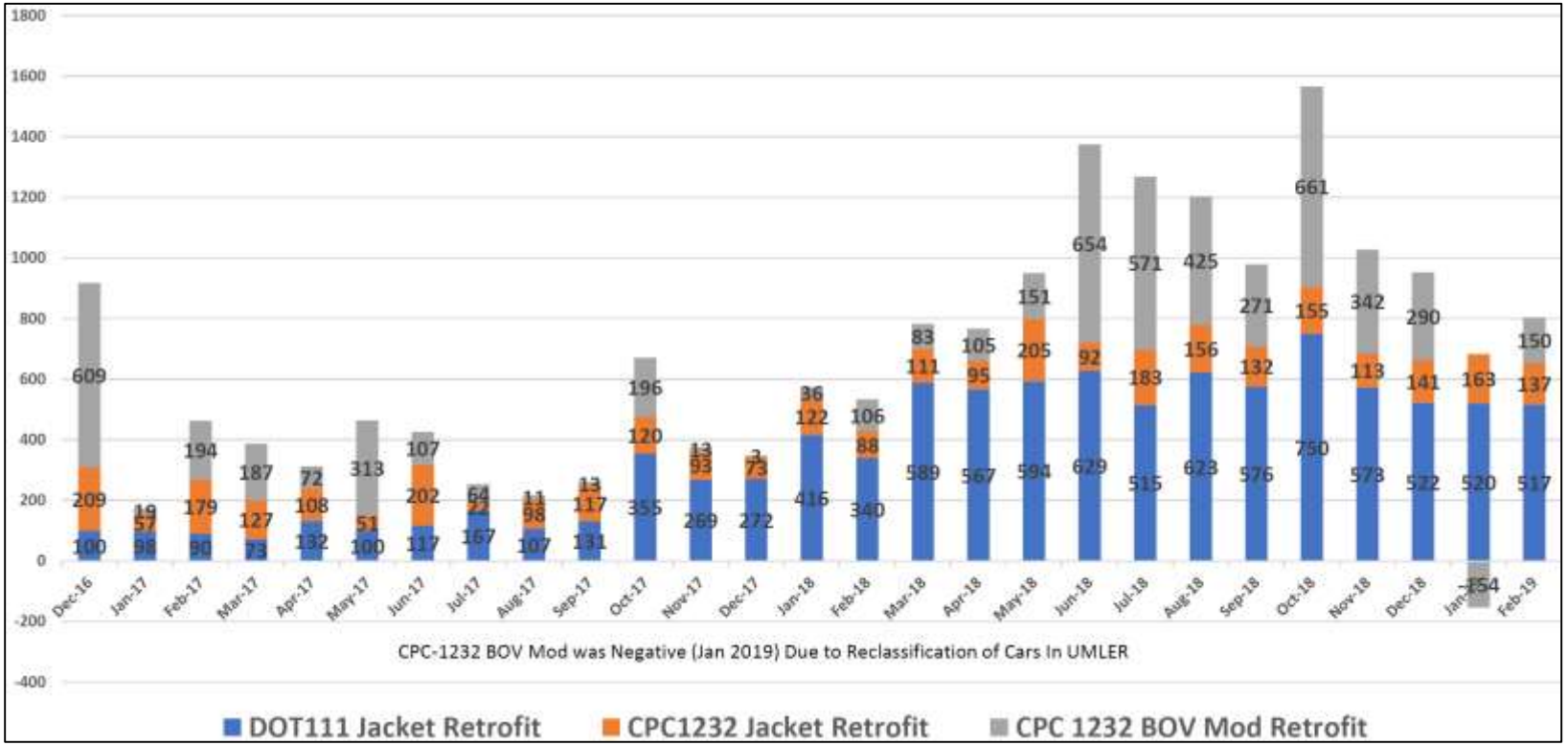
Cars Required for CBR and Other Flammable Service

- DOT-117J and 120J200 fleet size as of February 2019 is 23,926 cars
- DOT-117J and 120J200 annual production in 2018 was 313 cars/month, but last 3 months is averaging 625 cars/month
- DOT-117R fleet size as of February 2019 is 21,119 cars
- DOT-117R annual production in 2018 was 989 cars/month and last 3 months is averaging 783 cars/month
- Total DOT-117J/R fleet size is 45,045 as of February 2019 and is being utilized for all types of flammable liquids (not just crude)

Retrofit Production by Month

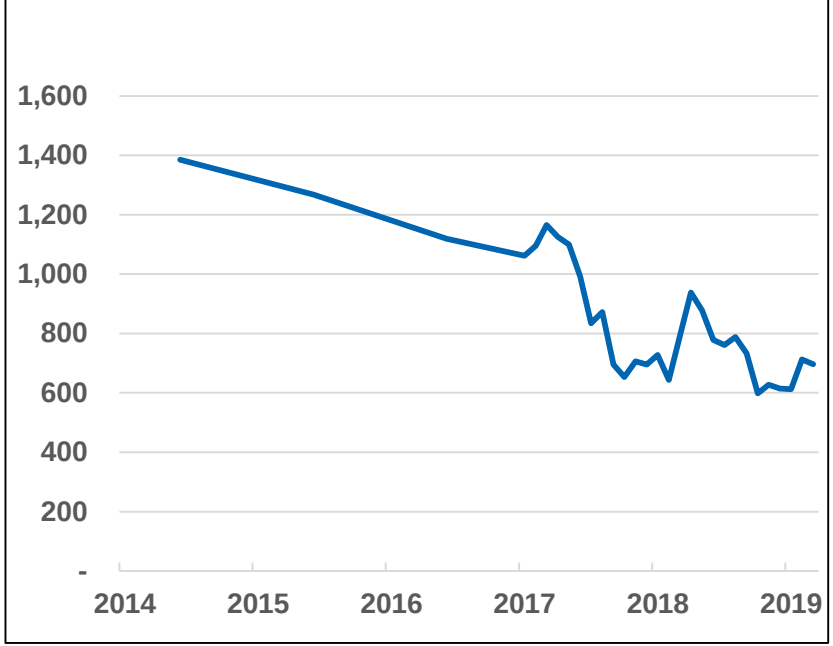


Based on 3/1/2019 UMLER

Mexican Crude Production Has Declined Sharply in the Past Four Years

Production of Crude Oil including Lease Condensate - Mexico

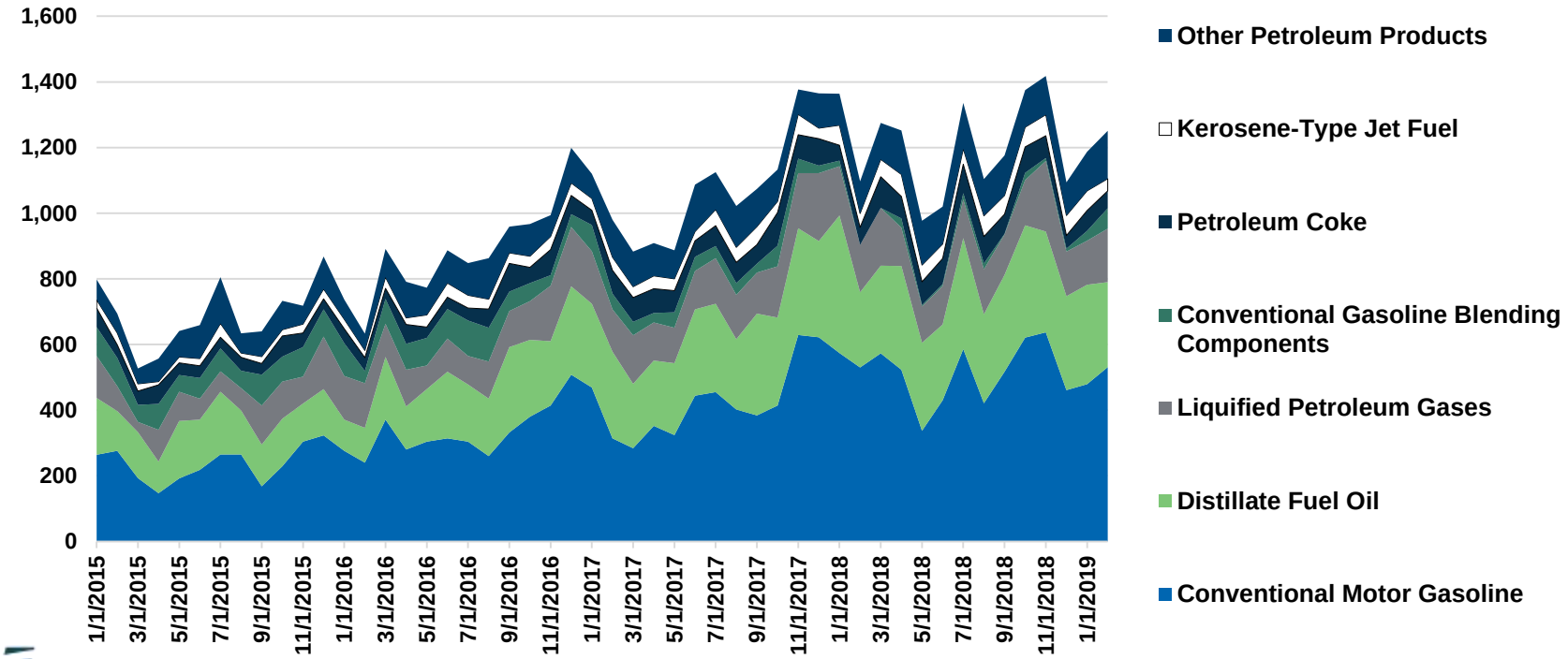
PEMEX (Mexico) Refined Petroleum Products Production (k/bpd)



Source: PEMEX, April 2019

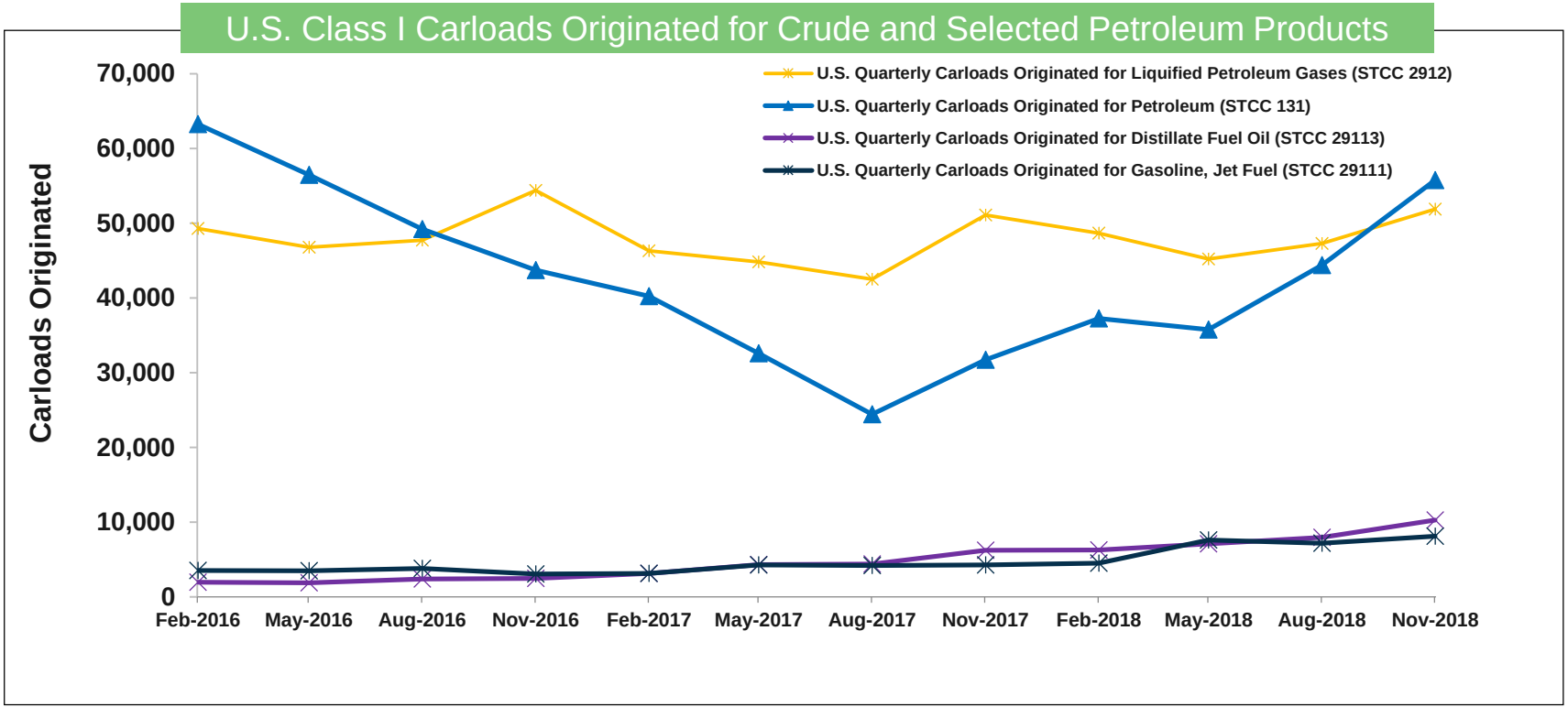
US Refined Products Exports Meeting the Growing Demand for Energy in Mexico

U.S. Exports to Mexico (k/bpd)



Source: EIA, April 2019

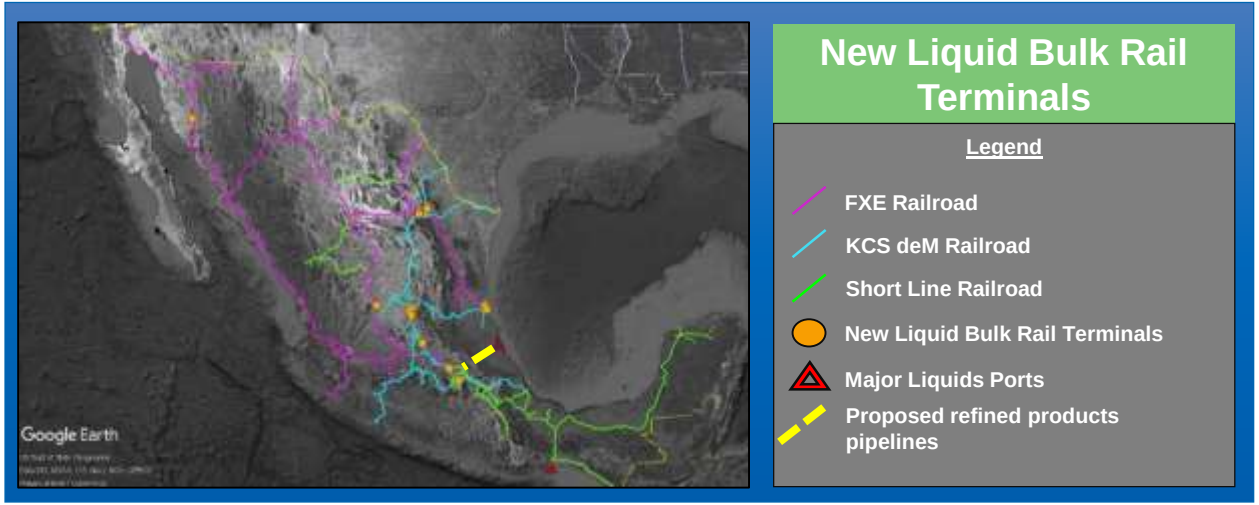
Mexico Represents Significant New Potential for Diesel, LPG, and Gasoline Rail Shipments



Source: Surface Transportation Board, April 2019

Build Out of New Liquid Bulk Terminals

- Nearly 2MM bbl of new tank capacity is being built at rail-served terminals
- Capacity being developed near population and industrial areas of central Mexico
- Private investment not reliant on Pemex infrastructure



Grupo SIMSA – San Jose Iturbide

TCM – San Luis Potosi

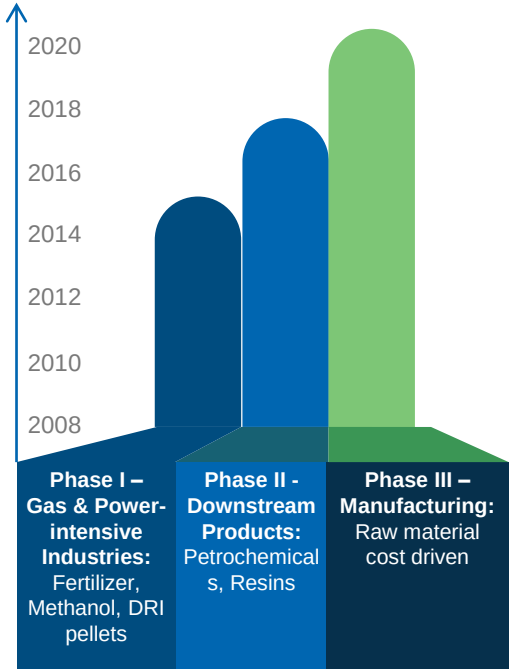
US Chemical Industry Build-Out and Resulting Rail Impacts

Shale Gas Phased Impact To U.S. Industrial Renaissance

Phase I Industries using natural gas as primary feedstock have global cost competitiveness; new US factories built or in progress

Phase II Downstream products require significant processing facilities investment and lead time – in the middle of the first wave build-out

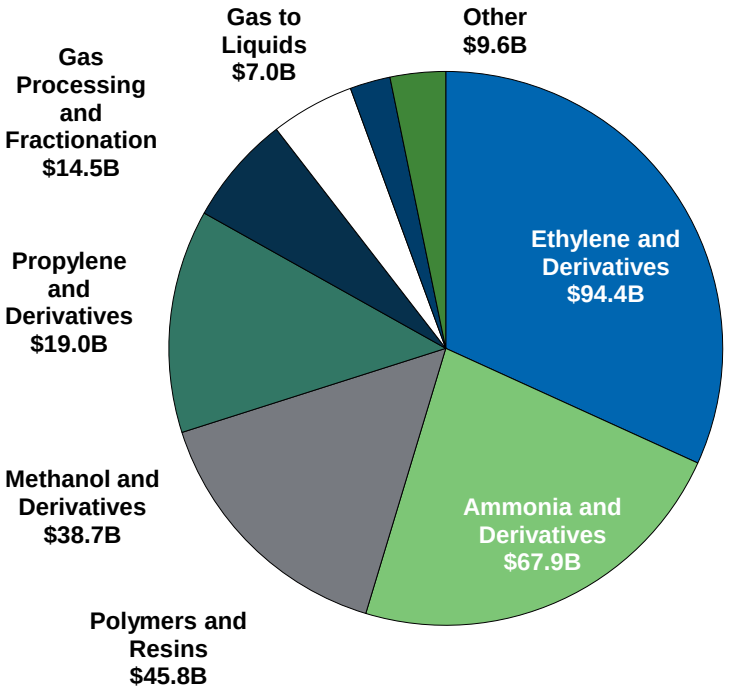
Phase III U.S. material cost advantage will enable traditional manufacturing to return to the North America as about 65% of the cost of manufactured product is material cost and the U.S. has a very efficient workforce



Shale-Driven Industrial Investment Forecast

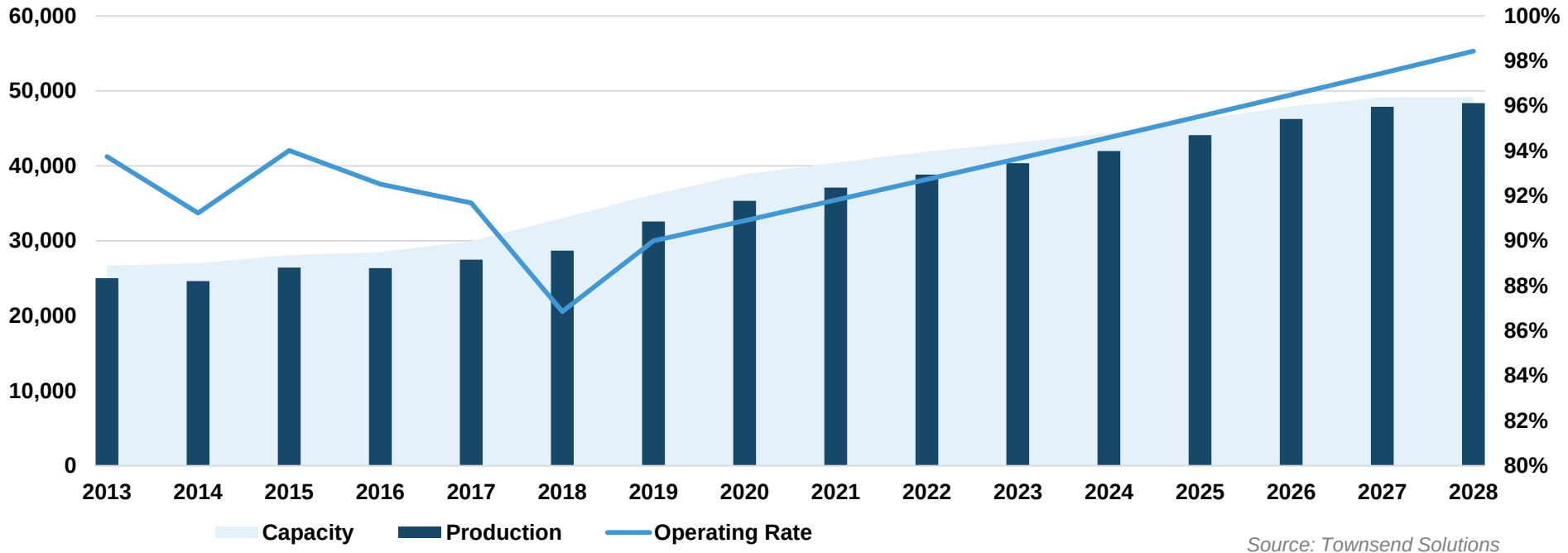
// All Announced Industrial Projects in SHIELD

- The North American petrochemical industry will invest ~$200B in industrial facilities as a result of shale gas by 2025
- Processed gas, ethylene, methanol, and resins account for >80% of product volume output



U.S. Ethylene Capacity & Production (KTPA)

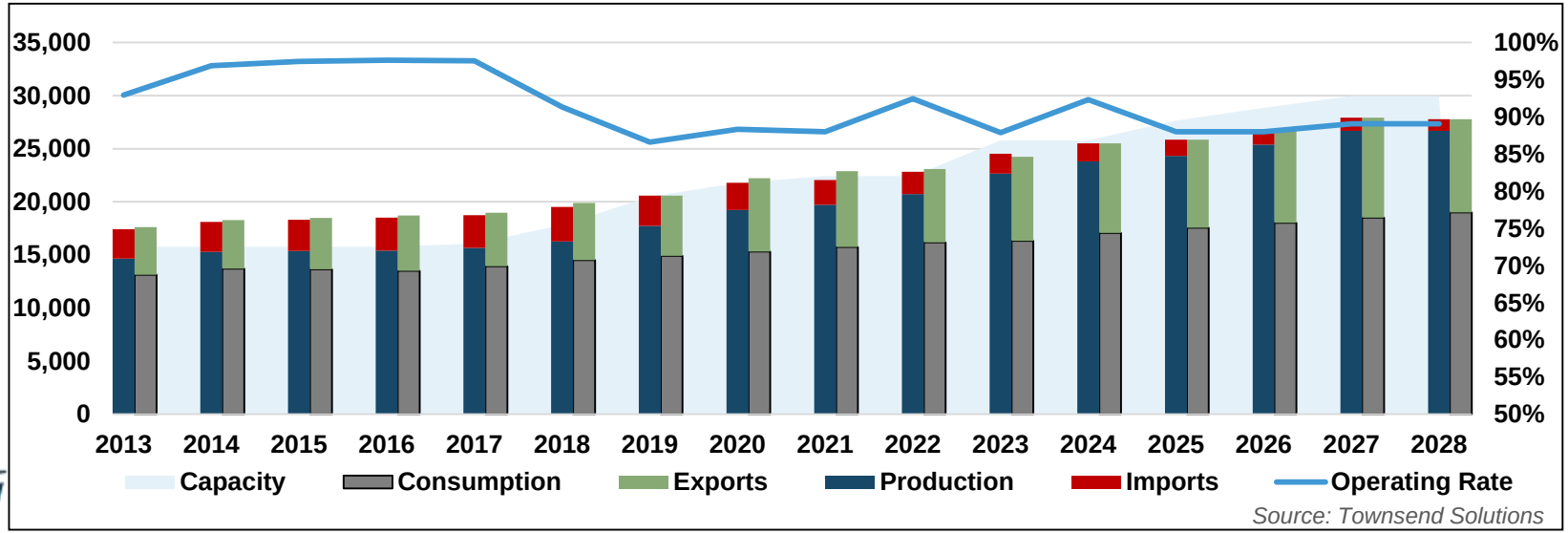
Production of ethylene tends to follow the capacity growth due to global market demand of derivatives



Source: Townsend Solutions

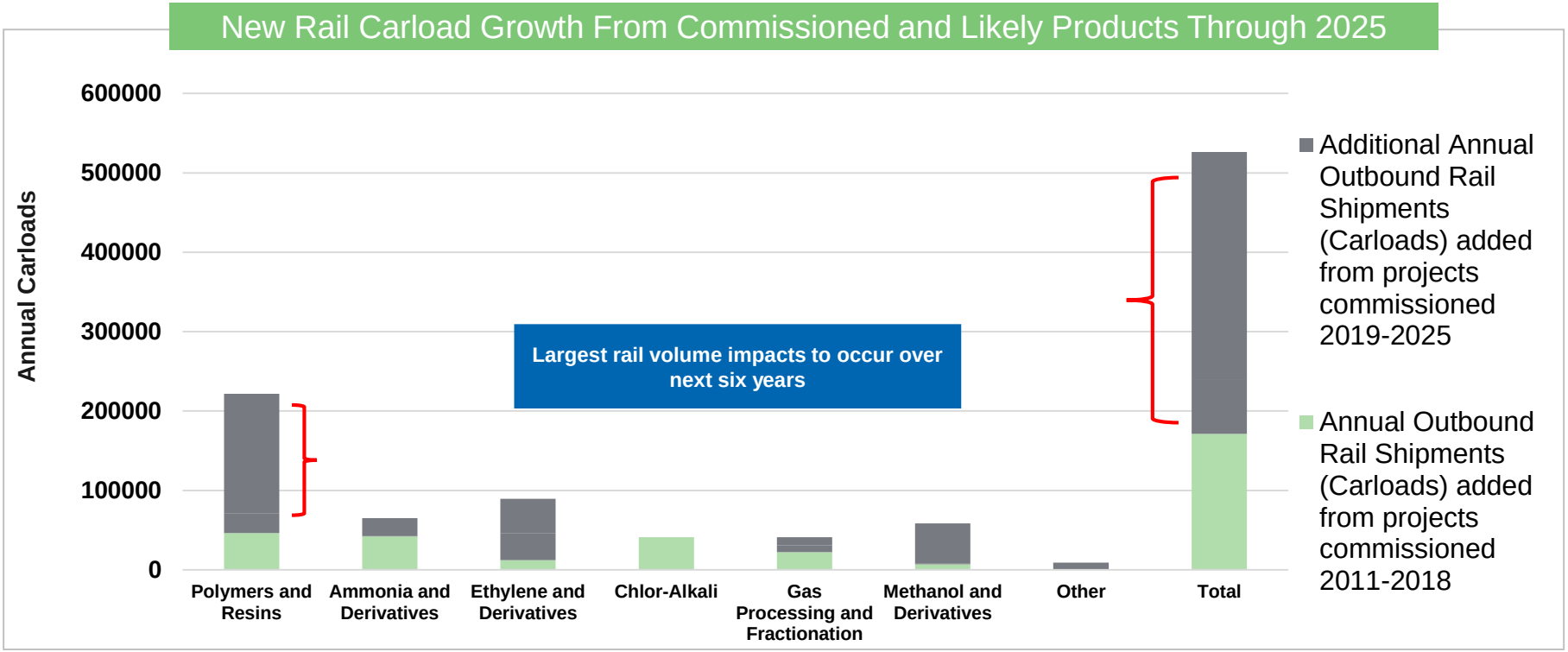
U.S. Polyethylene Capacity & Production (KPTA)

- Domestic consumption is expected to grow ~3% per year for the next 10 years. This rate provides an additional 6 MM tons of consumption, eventually supporting the new capacities added in the next three years.
- North American exports will grow from a current 2.5 MM tons to 6.7 MM tons over the forecast period, meaning an additional 4 MM tons annually will leave the region. The large U.S. producers may be able to accelerate the export growth with aggressive strategies to displace uncompetitive producers in some regions.



Source: Townsend Solutions

Projected Rail Volume Impacts from Shale Gas-Related Industrial Expansion



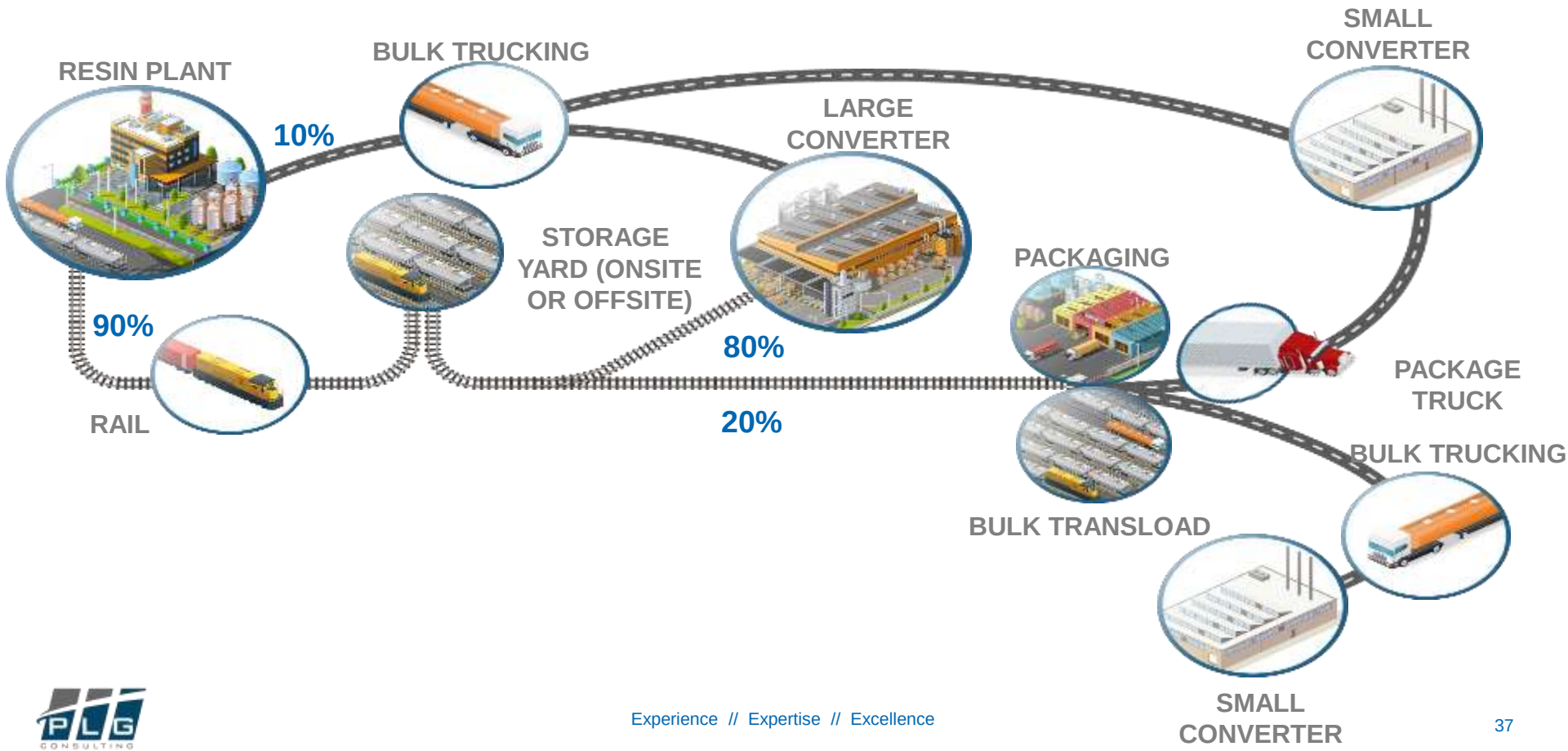
Increases in Outbound Logistics From Likely Projects

These forecasts are based on initial product moves from the production facilities. Products and by-products can be moved multiple times downstream.

Project Start Year	Truck Shipments Annually	Rail Shipments Annually (Carloads)	Railcar Fleet Required			
			Total	Large Covered Hopper	Small Covered Hopper	Tank
2017	183,500	30,800	5,200	4,700	900	500
2018	111,500	33,000	5,300	3,300	200	2,000
2019	46,200	66,800	10,400	5,600	-	4,800
2020	115,400	37,600	5,400	3,600	-	1,800
Total	456,600	168,200	26,300	17,200	1,100	9,100

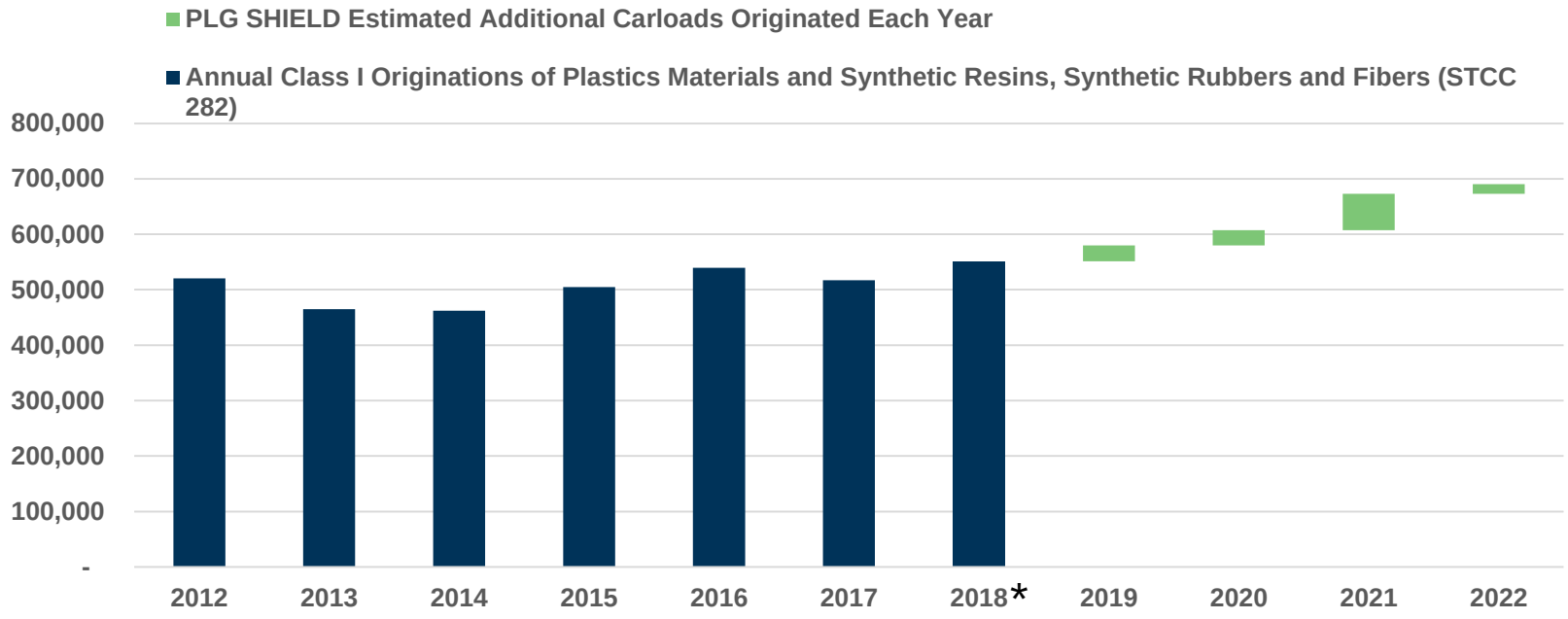
Source: SHIELD by PLG, February 2019

North American Resin Supply Chain



Plastic Resin Railcar Shipment Forecast

Plastic Resin Related Railcar Originations

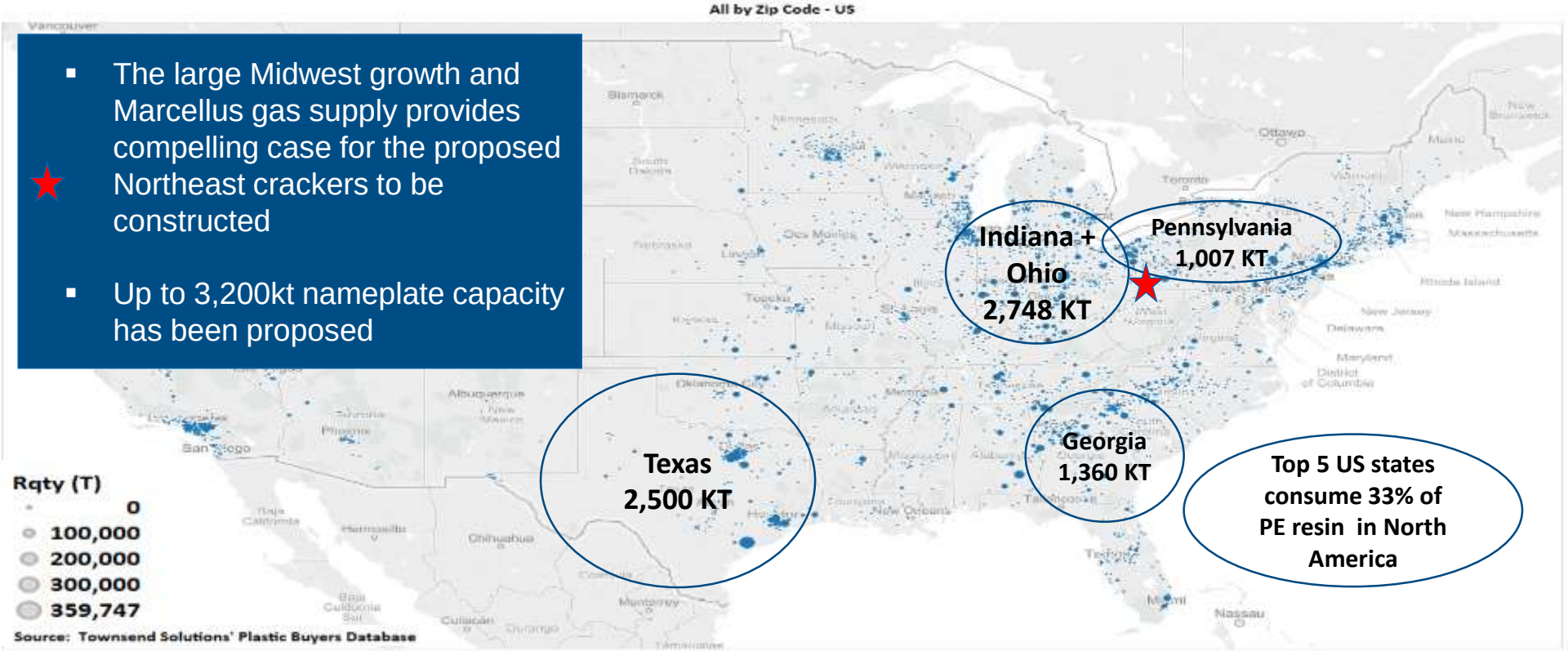


*Q4 estimated as Q1-Q3 average (not yet published)

Source: Surface Transportation Board, PLG Analysis, December 2018

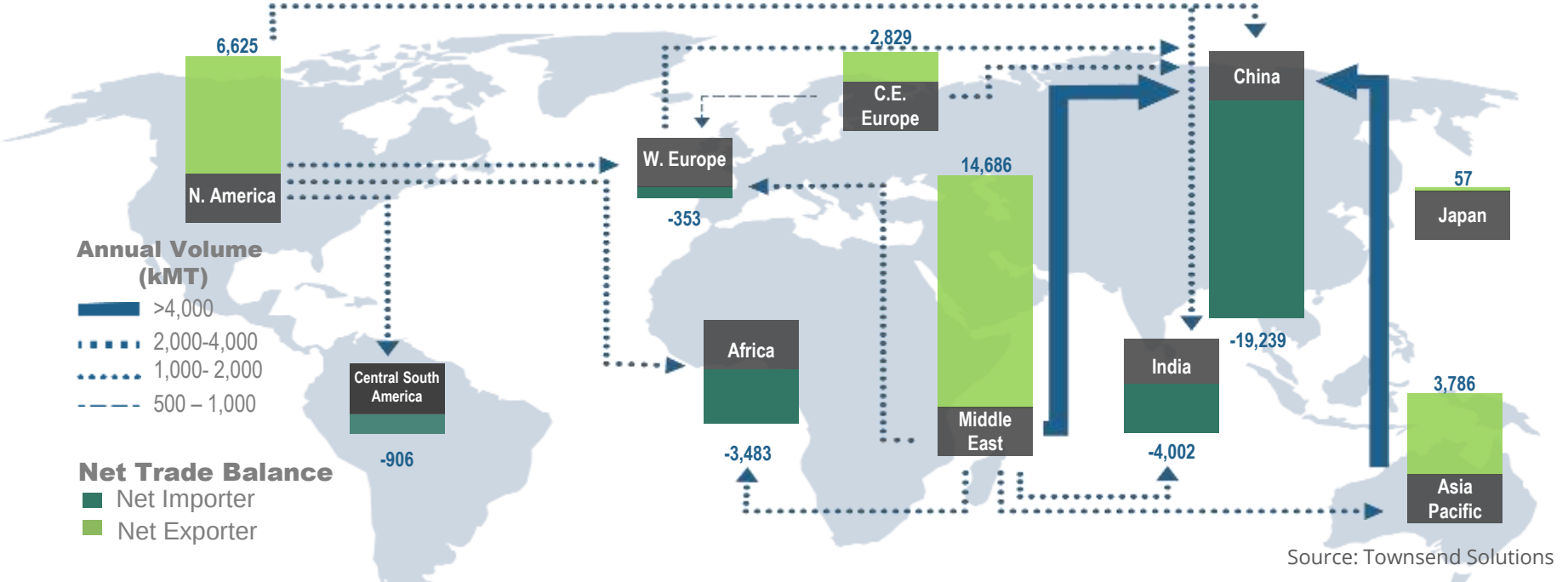
Domestic PE Consumption and Proposed Northeast PE Production

- The large Midwest growth and Marcellus gas supply provides compelling case for the proposed Northeast crackers to be constructed
- Up to 3,200kt nameplate capacity has been proposed



Major Global Polyethylene Trade Flows - 2026

// Global Impact/Opportunities

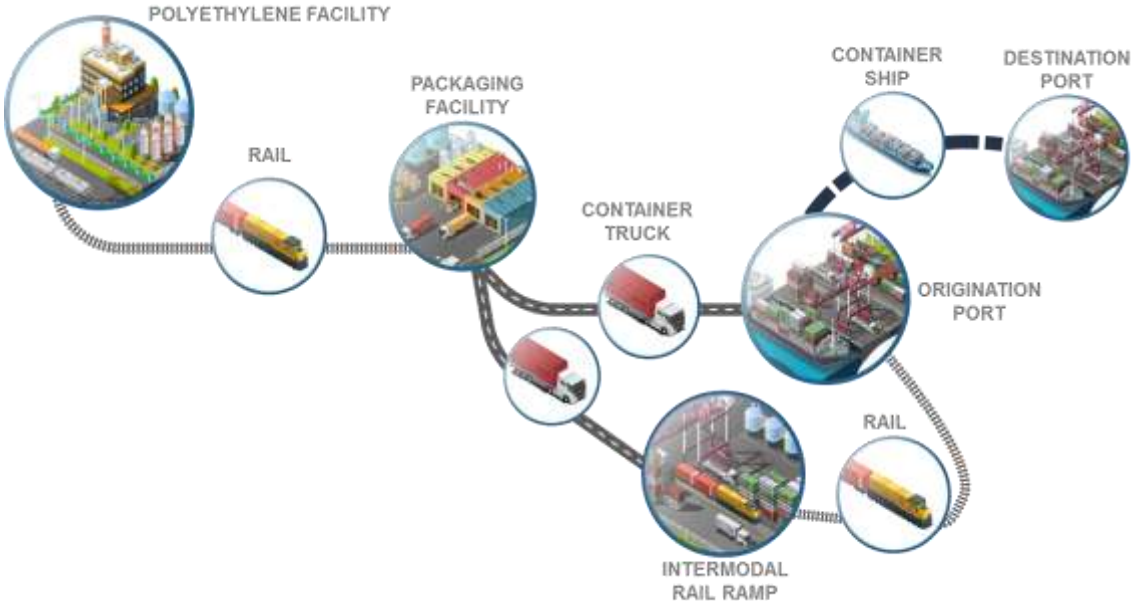


Source: Townsend Solutions

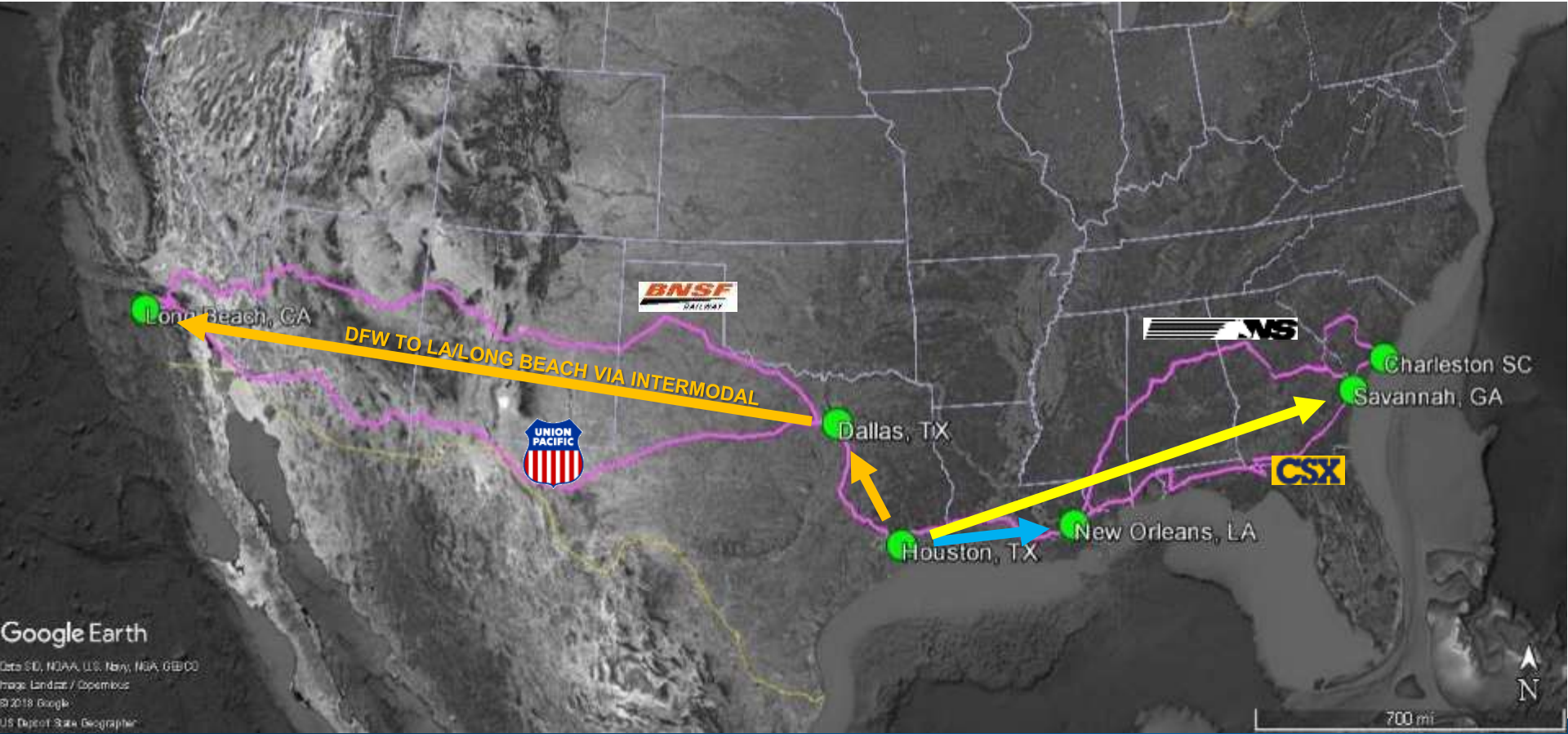
- Global trade volume is expected to grow by an additional~17% between 2021 and 2026 to 36.9 MM tons annually
- China becomes the mega trade destination with 52% of global trade volume with 5 regions shipping over 1 MM tons per year
- North America adds significant volume to four regions (China, WE, Africa, India) beyond current Central/South America flow of over 1 MM tons per year
- India and Africa will become 2nd and 3rd largest import regions with a combined volume of 7.5 MM tons per year

North American PE Export Logistics Chain

- Most PE exports are handled by third-party packagers offsite
- Adequate packaging capacity will be available for first wave of export growth through the end of the decade; more facilities will be needed for second wave, including the Northeast
- Packaging facilities expanding in other markets to accommodate growth and account for potential constraints in Houston such as congestion, container supply, weather, and vessel sailings



Alternative Resin Export Routes in Place and Under Development



Thank You!

For follow up questions and information, please contact:

Graham Brisben

CEO

PLG Consulting

+1 (312) 957-7757 | gbrisben@plgconsulting.com