PLG Consulting

Logistics | Engineering | Supply Chain

Still in the Early Innings of the N.A. Energy Revolution - Implications for Rail

MARS Summer Meeting

Lake Geneva, WI

July 14, 2015

Taylor Robinson, President, PLG Consulting

About PLG Consulting

Experience

- Delivering value to over 200 clients since 2001
- Real-world, industry veterans
- Logistics, engineering & supply chain experts with operational experience

Core Expertise

- Bulk Logistics
- Freight Rail
- Energy & Chemical Markets
- Investment Advisory and Corporate Development

Services

- Diagnostic assessments & optimization
- Logistics Infrastructure design
- Supply chain design & operational improvement
- Investment strategy, target identification, due diligence, post-transactional support
- Crude by rail (CBR) and rail tank car (RTC) forecasts
- Independent technology assessment & implementation
- Hazmat training, auditing & risk assessment

Partial Client List

PLG's Oil & Gas and Petchem Industry Qualifications

Deep rail industry experience

- Operational
- Commercial
- Design & engineering
- Equipment market

Broad industry client experience

- E&P companies
- Oilfield services
- Refiners
- Terminal developers/midstream
- Investors – private equity, hedge funds, investment banks
- Government agencies, industry trade groups
- Equipment manufacturing & leasing
- Chemical and resin producers
- Chemical and resin distributors

Diverse projects

- Frac sand supply chain design & implementation
- CBR supply chain optimization
- Rail commercial negotiations
- Rail car acquisition – commercial & technical inspection
- Logistics infrastructure design
- EH&S training
- Investment advising
- Industry's only long term, CBR volume forecast with complimentary rail tank car forecast

Recognized industry thought leader on topics including:

- Crude by Rail
- Frac sand supply chain
- Petchem industry expansion
- Shale gas impact to downstream industries

Today's Agenda

I. North American energy market overview

II. Crude By Rail forecast

Including tank car update

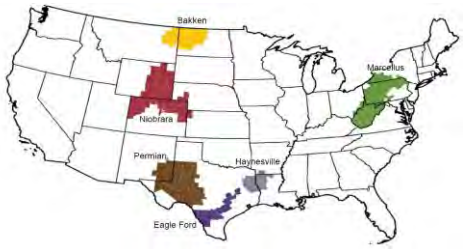
III. Frac Sand market update

Including small covered hopper update

IV. Shale gas and downstream industries

Unconventional Energy Resources and Extraction Technologies

US Shale



Source: EIA, May 2014

Horizontal Drilling & Hydraulic Fracturing

Source: Marathon, February 2014

"Moore's Law" at play: Exponential advances in technology, resulting in

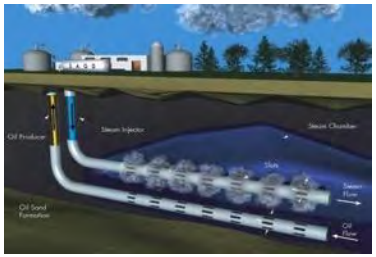
Declining costs

Surging production

Western Canadian (WC) Oil Sands

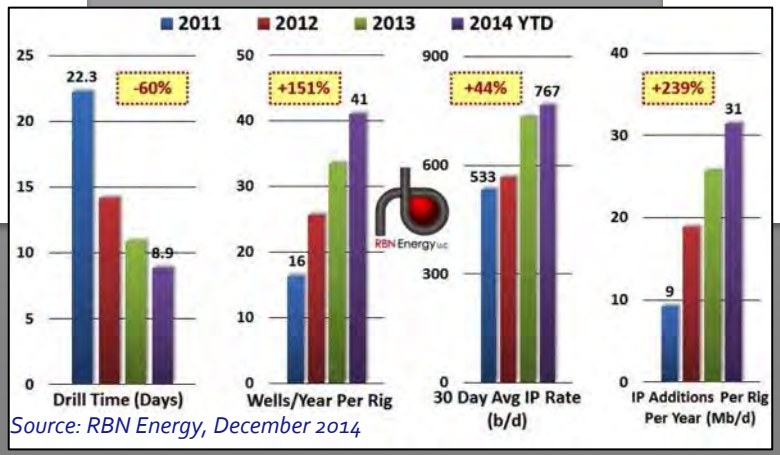
Source: CAPP, About Oil Sands

SAGD



Source: www.epmag.com

Representative Producer Gains, Eagle Ford



Source: RBN Energy, December 2014

The North American Energy Revolution…Not Only Crude

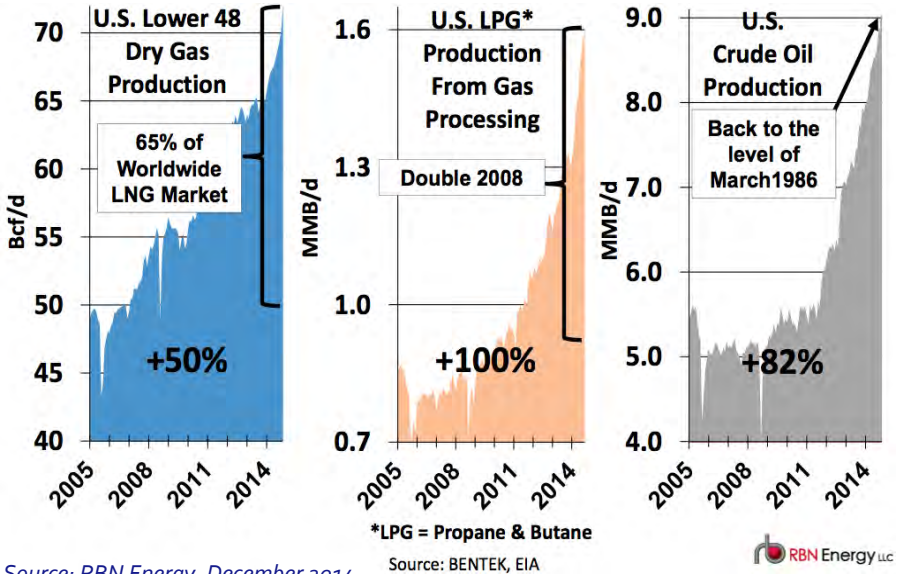
New extraction technologies resulting in record production of gas, natural gas liquids (NGL), and crude oil

Water-borne imports of crude being displaced by domestic production

Large exports of LNG and NGLs coming in the future

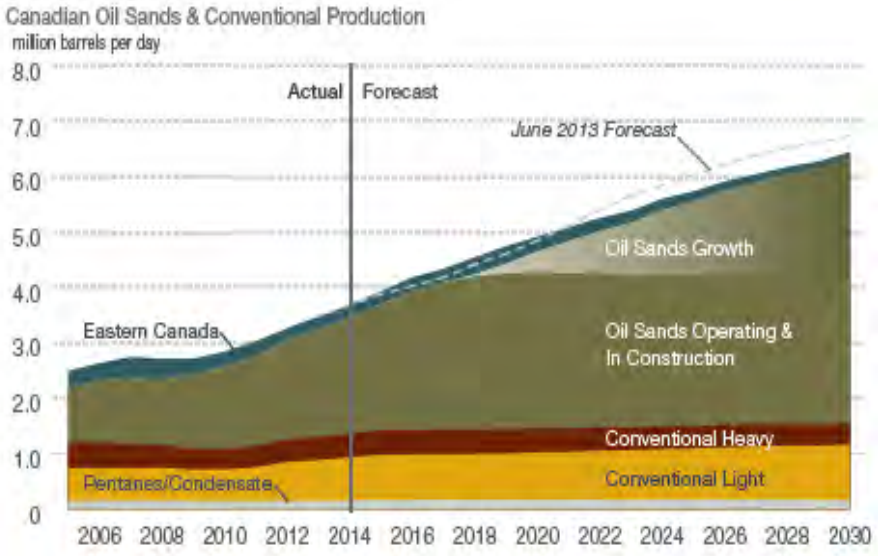
North America on pace toward full "energy independence" by 2020

United States



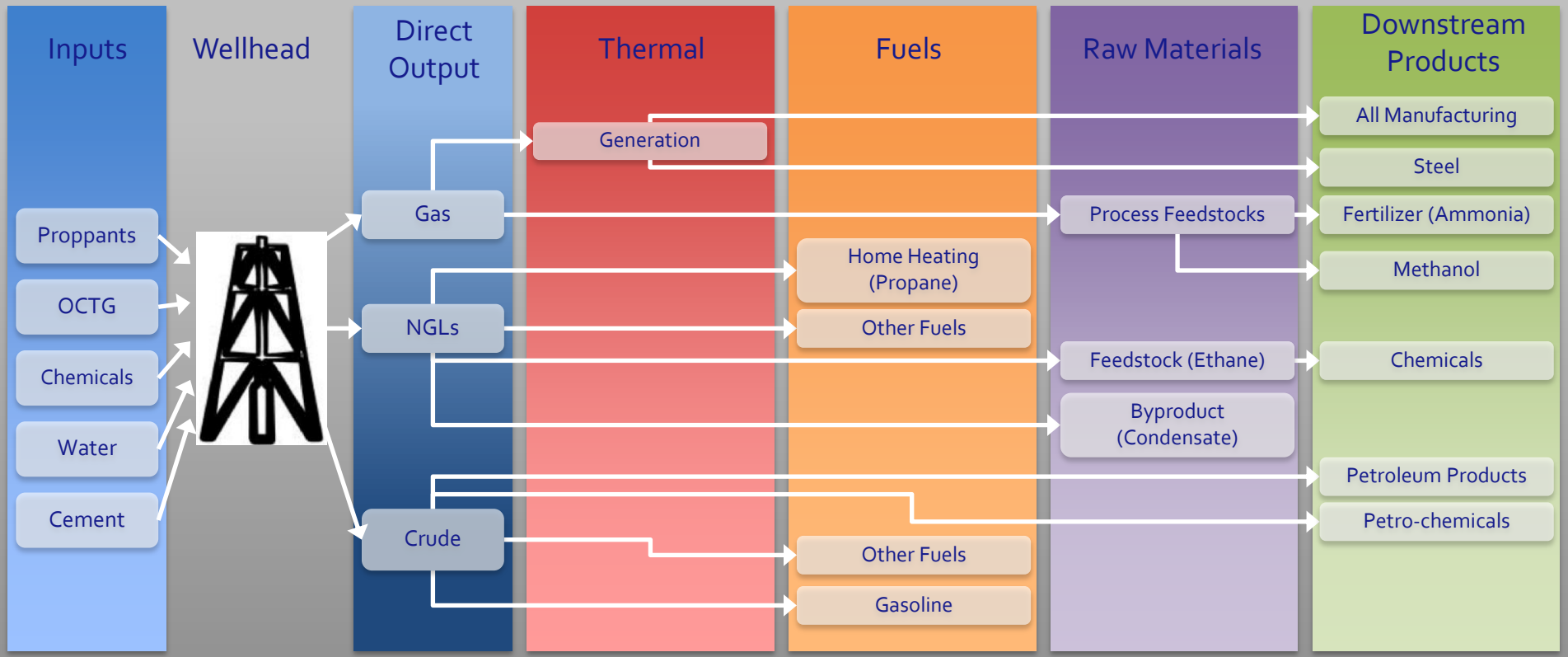
Source: RBN Energy, December 2014

Canada



Source: CAPP Report, June 2014

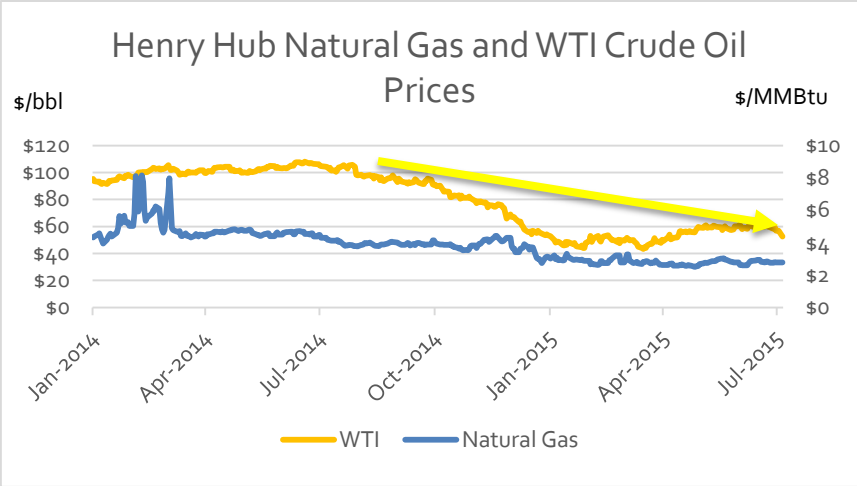
Shale Supply Chain and Downstream Impacts



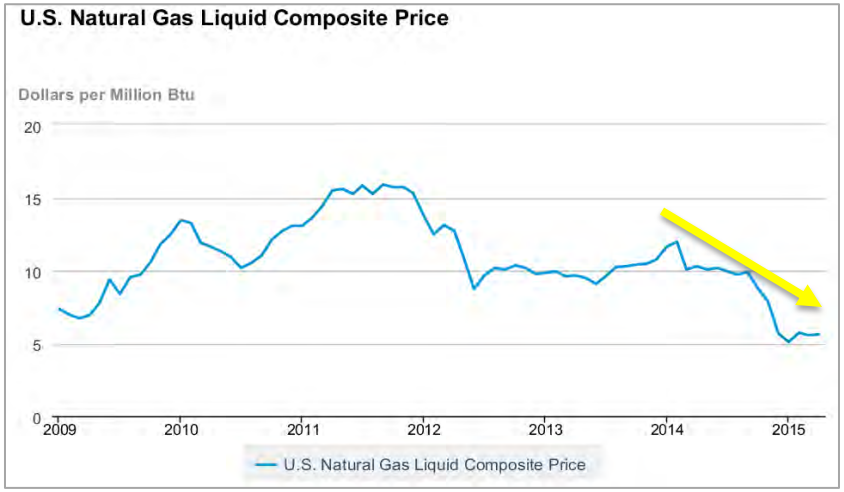
Impacts to-date include:
Dramatic reduction in crude imports, lower electricity costs, lower gasoline prices, increased refined products exports

The next wave:
Manufacturing renaissance in the US based on abundant, low cost energy and feedstocks

Impact of the Large Drop in Hydrocarbon Prices in the Past Year



Source: EIA, CME Group July 10 th settlements



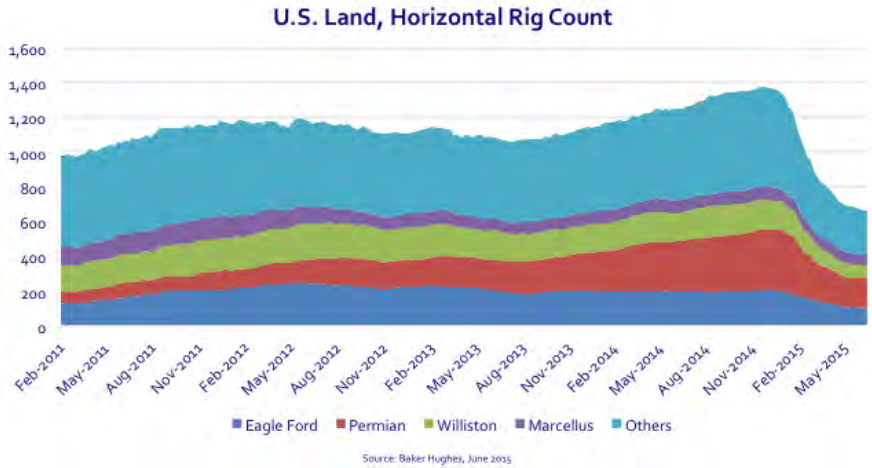
Source: EIA, July 2015

Oversupply of all three hydrocarbons was one cause of the large price declines

We have seen this story before with shale gas in 2011

- U.S. market oversupply caused by shale gas boom caused a similar price drop in 2010
- Started a major dislocation in drilling rigs from dry gas to liquid plays
- Major consolidation amongst gas producers – "survival of the fittest" ensued
- Tremendous improvements in well productivity have continued
- Production continues to increase despite drastically fewer dry gas wells

Will shale oil follow a similar script?



Cost Reduction Has Been Main Focus for Shale Oil Producers Since Last Fall

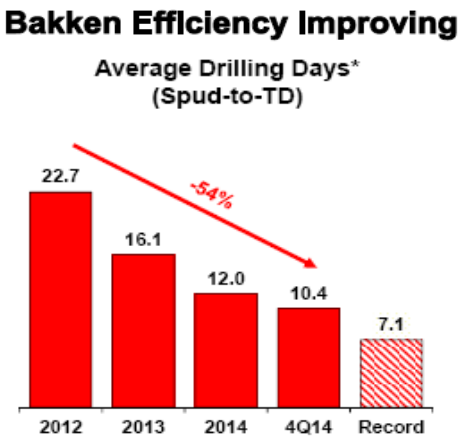
Oil price drop was major driver for an industry "belt tightening"

Producers had already been working hard on their internal productivity – and sped up the process by:

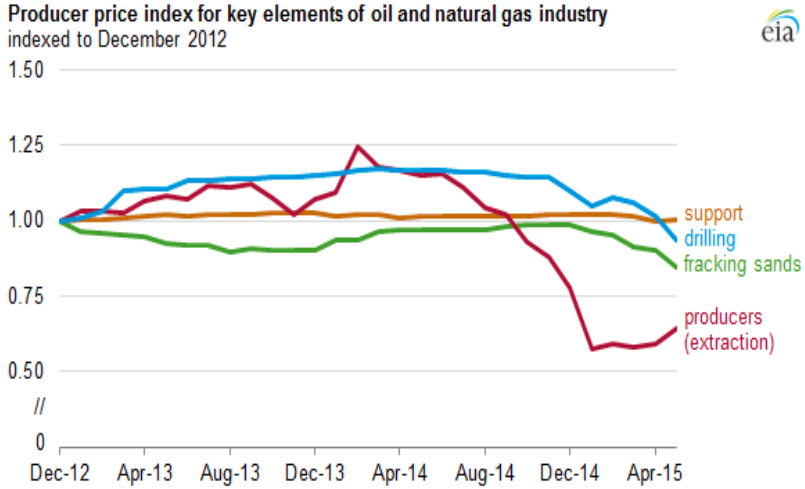
- Focusing on drilling "sweet spots" only
- Eliminated exploratory drilling – R&D budgets down by 30-50% for 2015
- Focusing on perfecting latest, most productive fracking techniques

In Q4 2014, E&Ps asked for 25-30% price reductions from all suppliers and the request flowed down supply chain

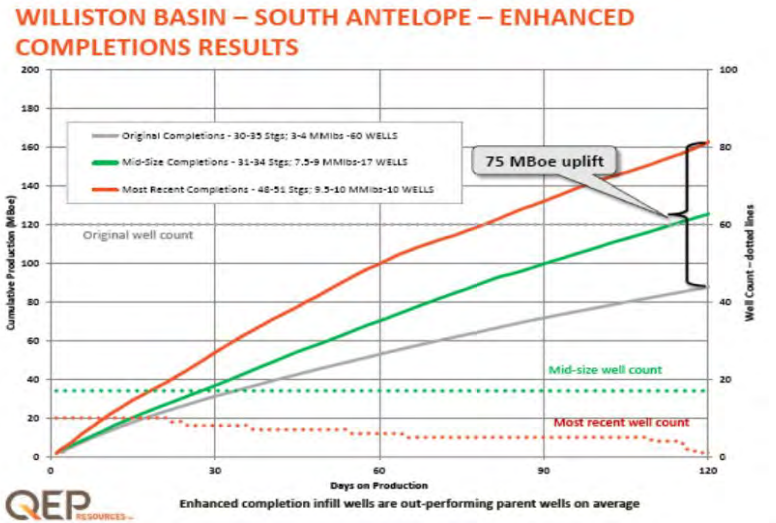
- Many suppliers have responded with 5-25% price reductions



Source: EOG Resources, May 2015



Source: U.S. Energy Information Administration, based on United States Bureau of Labor Statistics, Industry Producer Price Indexes



Fracking Trends – "High Intensity" Fracking and DUC

High intensity techniques producing 25-100% productivity increases

- Inner "perf" distances reduced by half
- Large increases in stages per well – up to 80!
- Sand per lateral foot increases 2X to 5X
- Slickwater technique enables higher sand intensity
- Some are reducing or eliminating ceramics

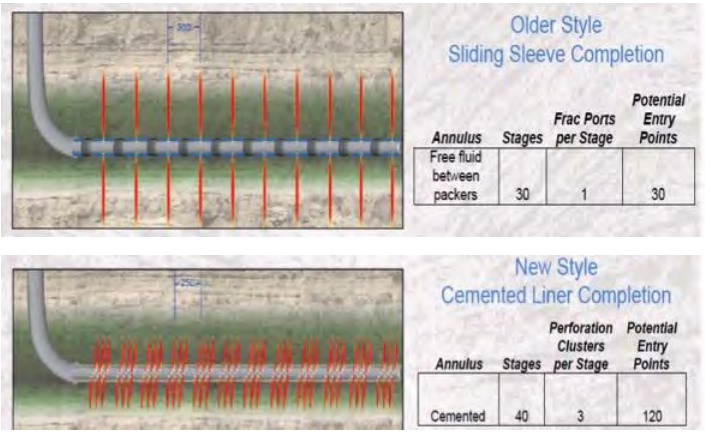
Still a growing trend over the next 2-3 years

- Leaders began trials in 2013
- Impacted market in 2014
- Adopted by 25-50% of producers so far
- Expansion at all liquid shale plays

Growth of "Fracklog" has contributed to the volume decrease of frac sand

- **Also called "Drilled, Uncompleted Wells" (DUCs)**
- **Estimated in total to be 3,000 to 5,000**
- **Producers are holding off completion of wells in the some locations until price recovers to $65-70/barrel**

High Intensity Fracking Visual



Source: Whiting Petroleum, December Investor presentation

Bakken Fracklog Example

Source: North Dakota Industrial Commission, May 2015

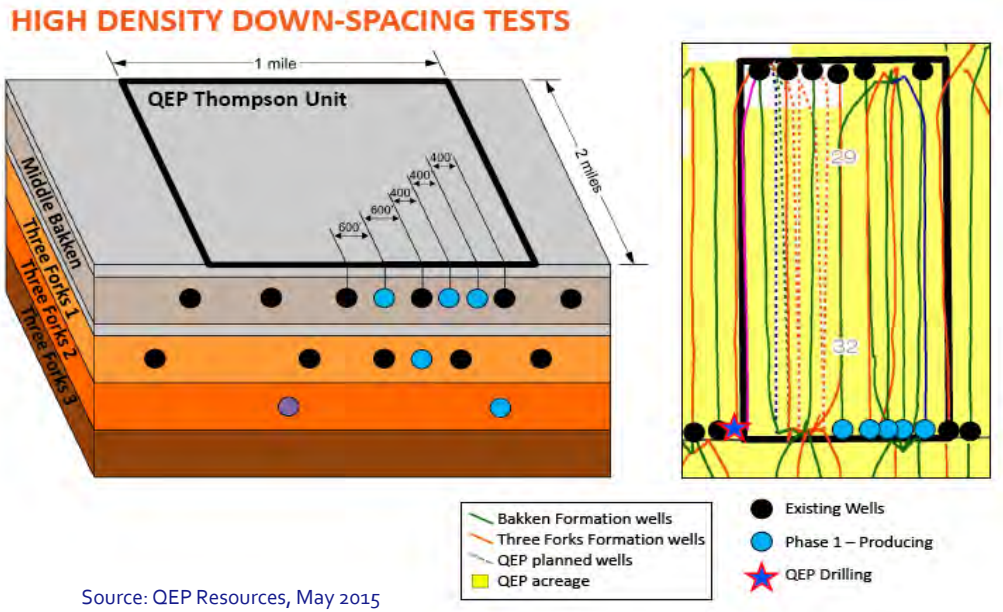
Fracking Technology

Well down-spacing means:

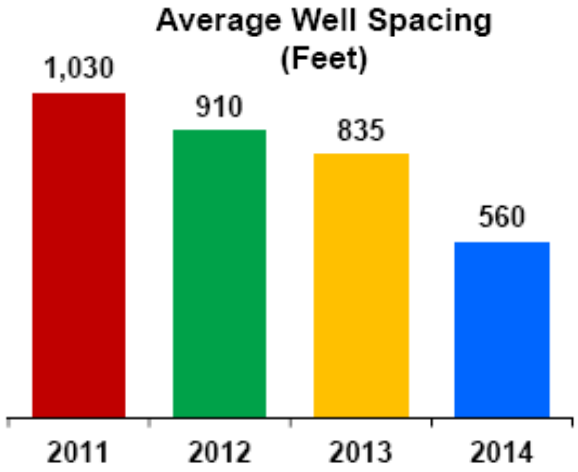
- Continued trend toward placing wells much closer together
- Used in conjunction with pad drilling to enhance total volume of production from each drilling pad
- Operators testing out different well spacings with different completion techniques to optimize production
- Enables infilling – drilling additional wells next to wells that have previously been drilled

Refracturing

- Returning to an older, low producing well and pressure pumping again
- Thought to be a low cost alternative by eliminating drilling
- 2015 – some activity in the Barnett and Haynesville
- 2016 some growth, but won't move the needle on overall sand volume
- Major producers are focusing on maximizing returns on new wells with the latest technology, not refracturing

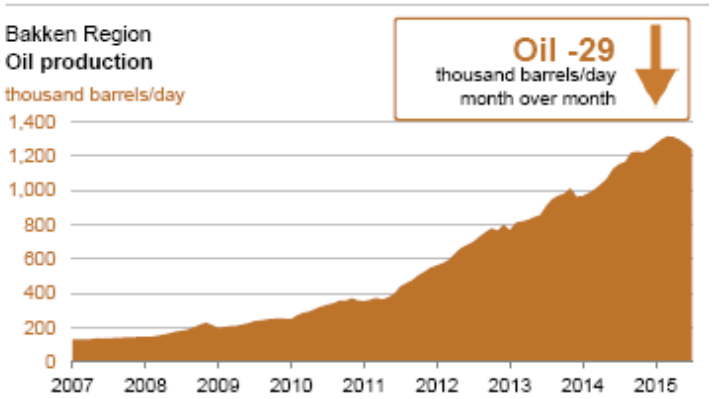


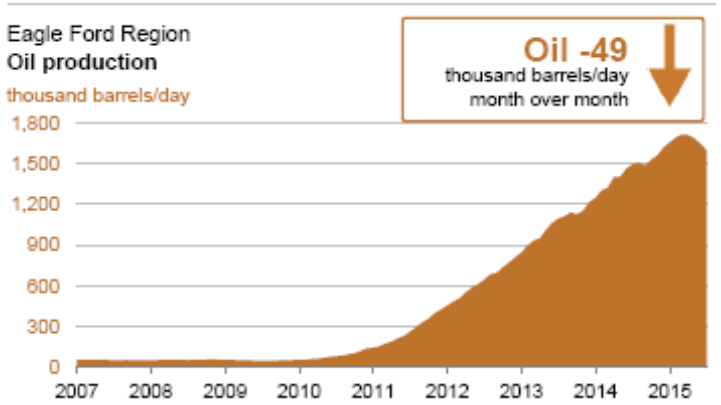
Source: QEP Resources, May 2015

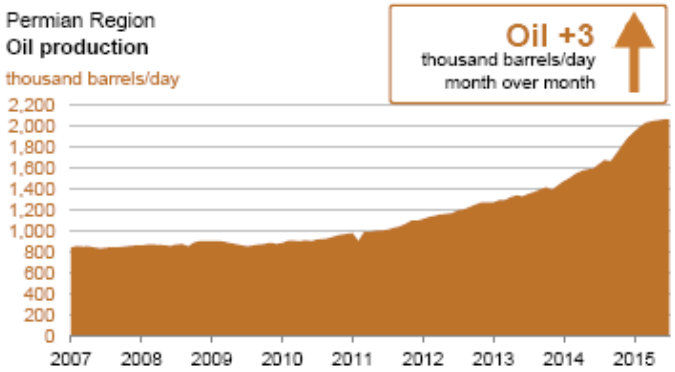


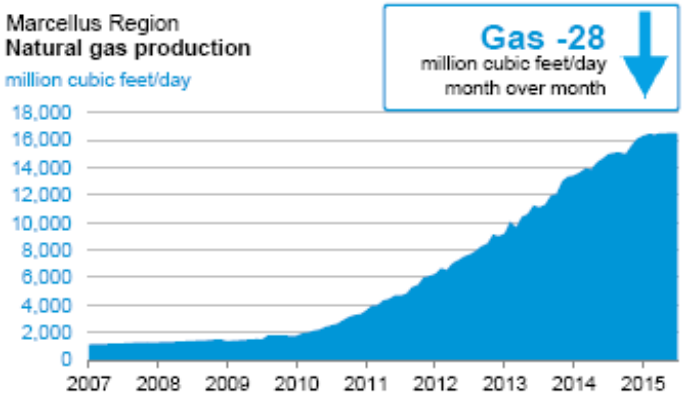
Source: EOG Resources (Leonard Shale), May 2015

Despite Low Prices, Production Still Remains at High Levels





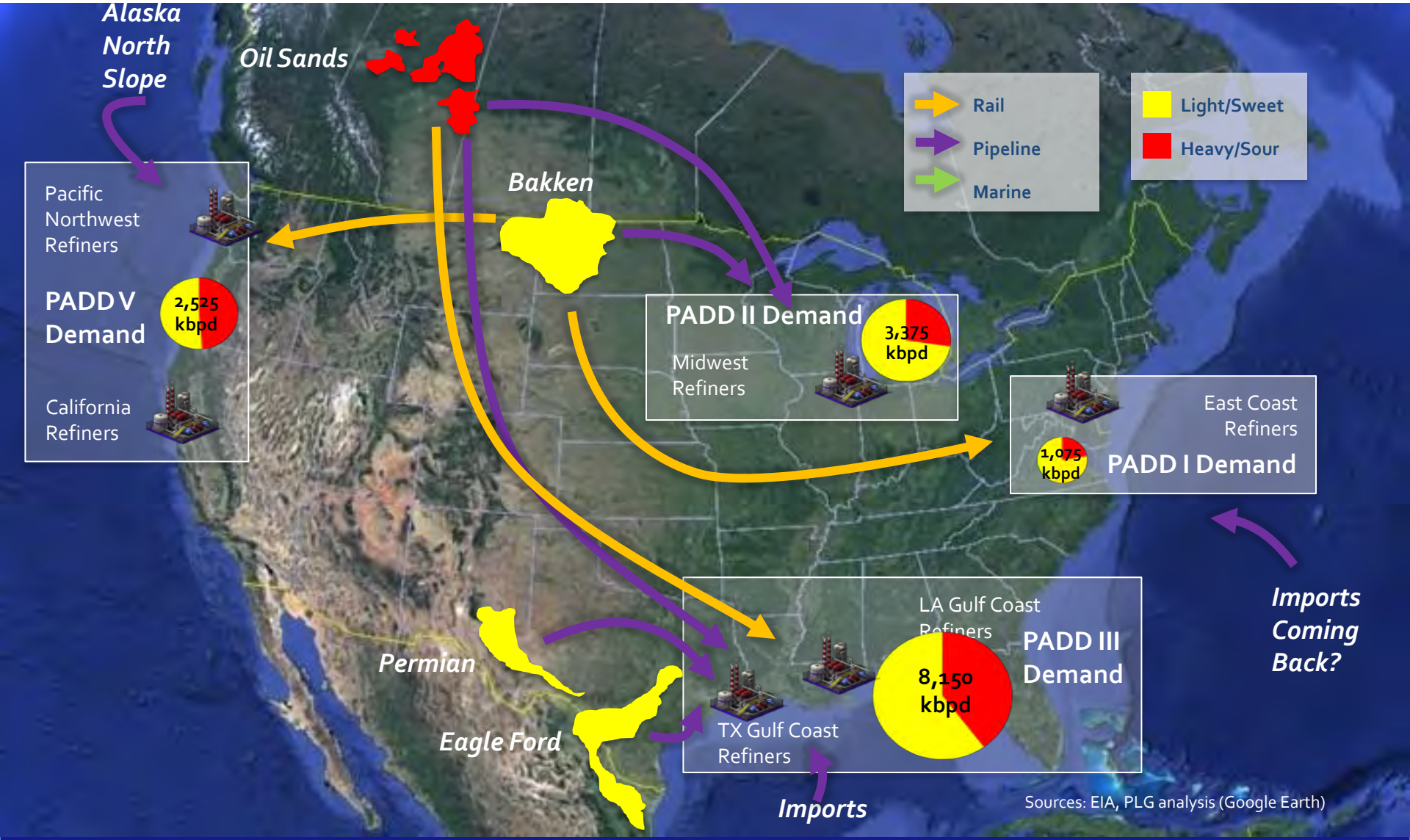




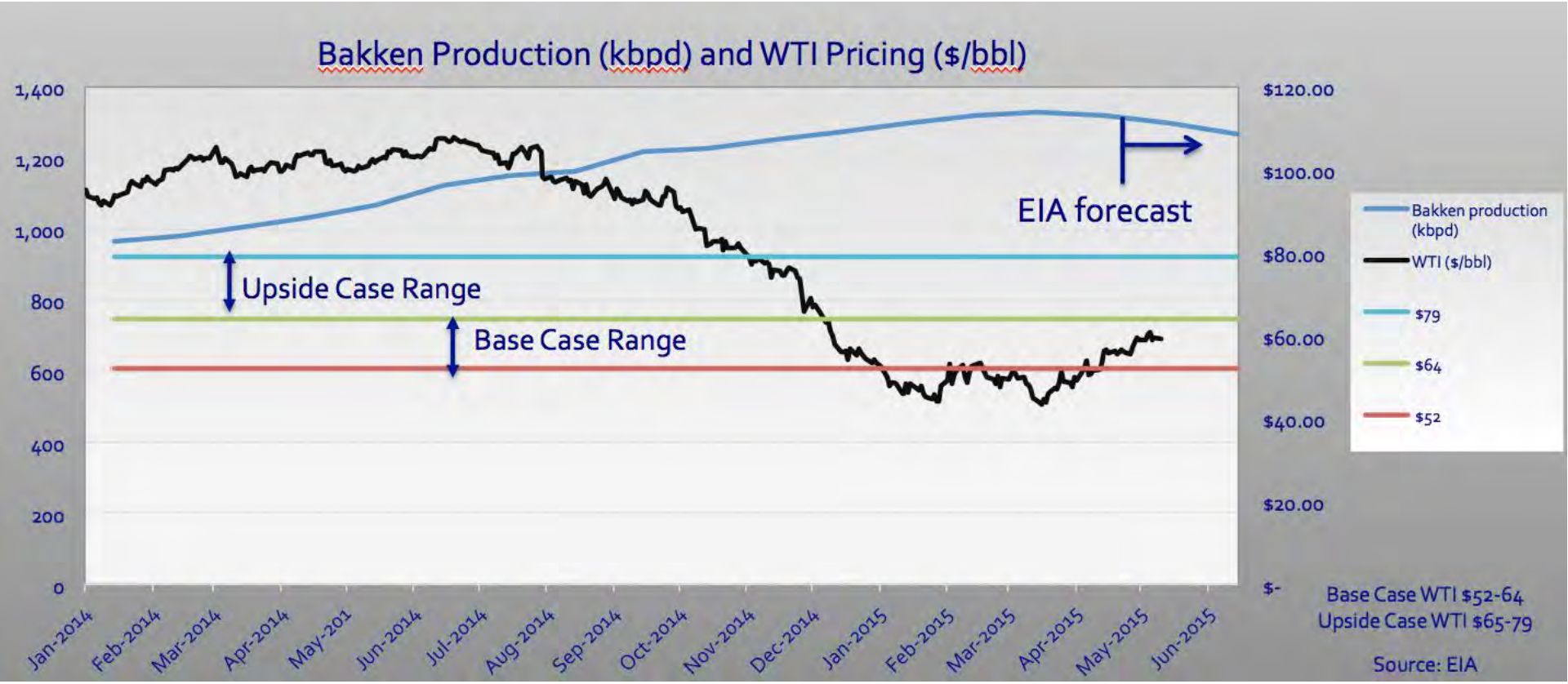
Source: EIA Drilling Productivity Report, June 2015

Three of four largest plays have seen recent production volume decreases – a first for the shale boom

NA Crude Logistics Today



Bakken Production History



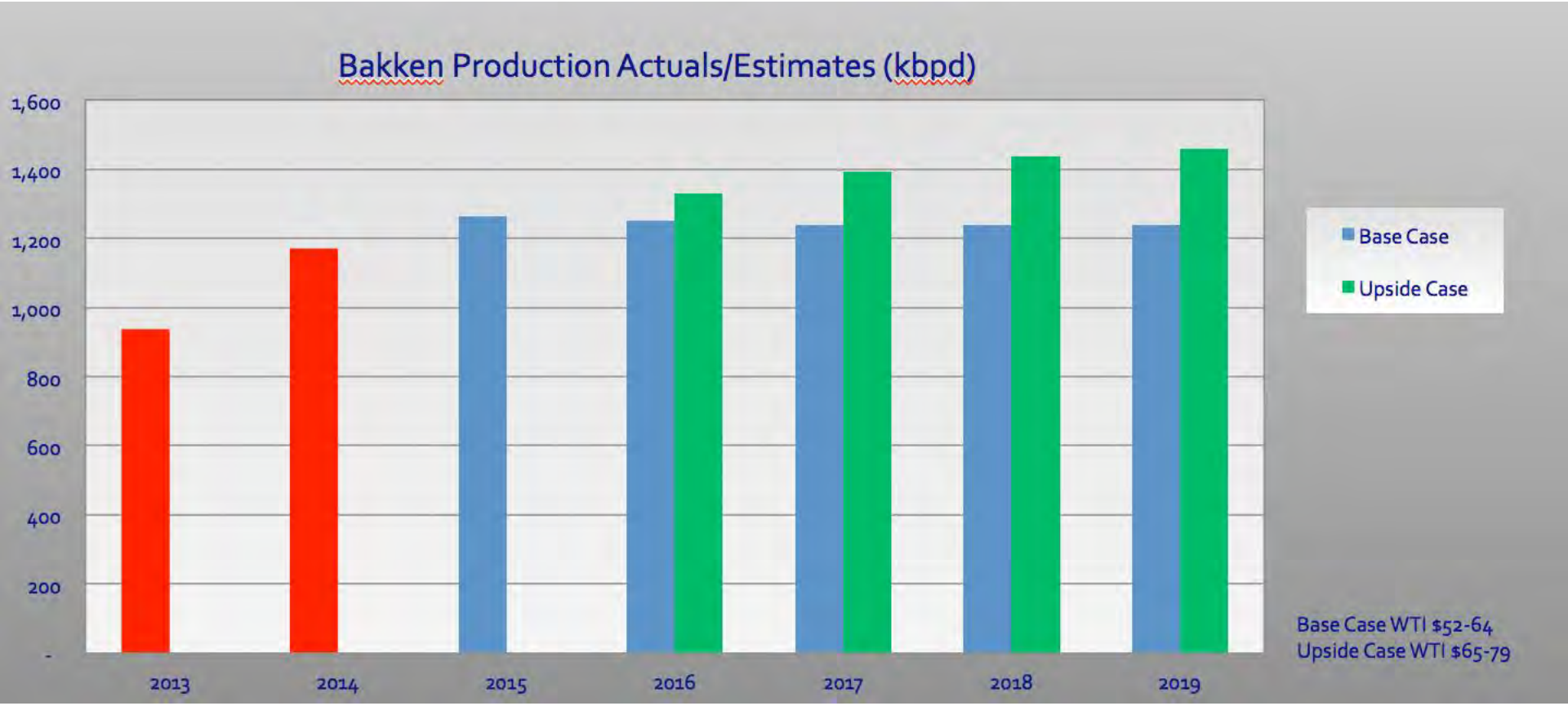
Note: Base Case = WTI $52 – $64/barrel

Upside Case = WTI 65 - $79/barrel

Bakken production flat to slightly down in Base Case

Bakken production up by 10% from 2016 to 2019 in Upside Case

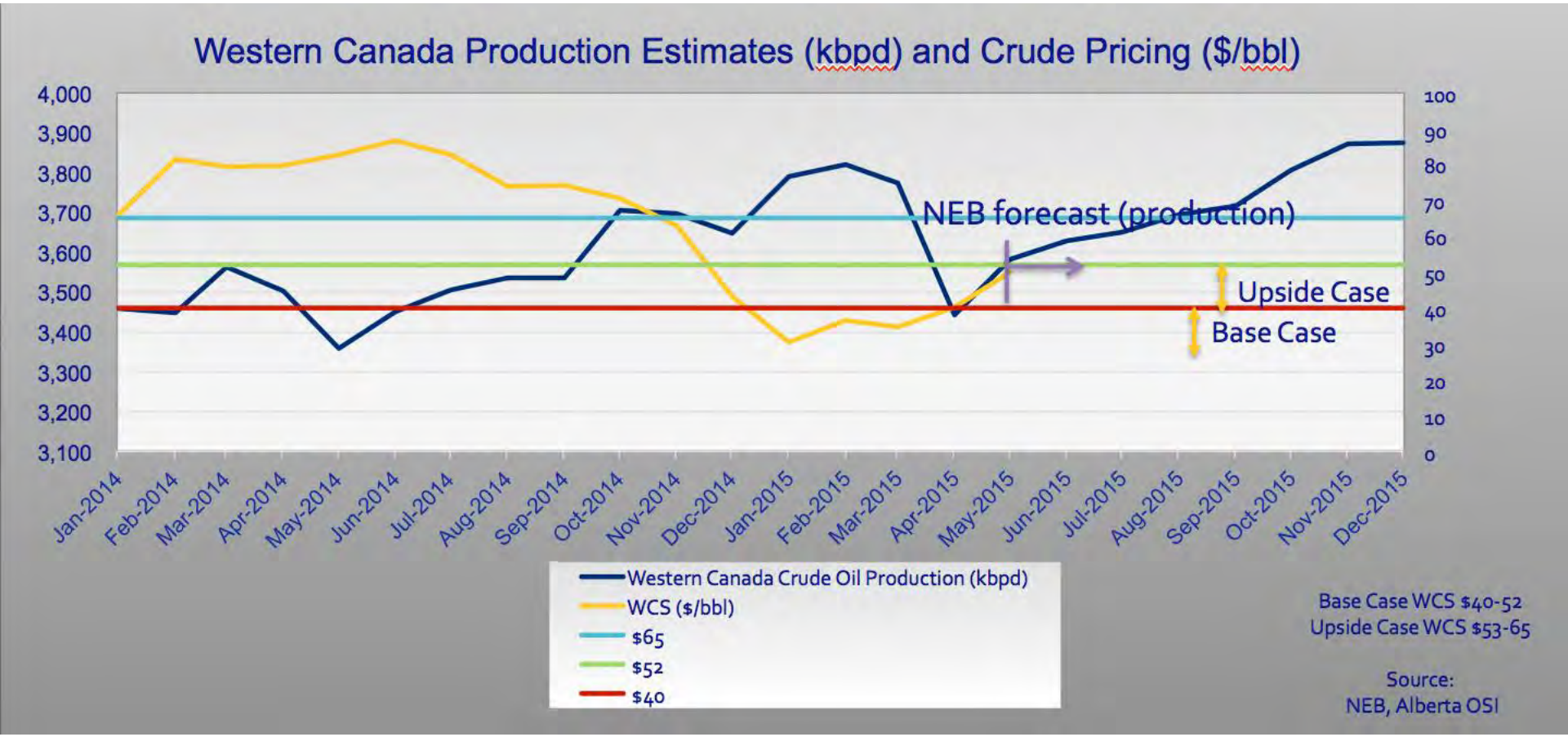
Bakken Production Forecast



Bakken production forecast in 2017 vs. 2015 is forecasted 2% lower for Base Case and 10% higher for Upside Case

Inflection point for further investments to drive increased production - $65~$70 per barrel

Western Canada Production



Western Canada production forecast holding steady due to long term nature of projects (30-50 years)

- Western Canada production dropped in April due to typical seasonality impacts but more pronounced due to dramatic reduction in WCS pricing
- Mexican Maya at USGC differential to WCS has decreased which puts downward pressure on CBR demand

Western Canada Pipeline Overview

Current pipelines are at capacity driving 5 separate new pipeline proposals largely aimed at getting to tidewater

These pipeline proposals are under intense scrutiny and subject to court challenges and protests in U.S. and Canada

- Regulatory process taking longer and approval subject to many more conditions
- Additional hurdle of requiring a Presidential Permit to cross border , but even issues arising crossing provincial boundaries within Canada

Innovation with existing pipeline network increasing capacity as companies seek to squeeze out more capacity

- Enbridge has temporarily switched the flows of Alberta Clipper and Line 3 on 17.5-mile segment across the U.S.-Canadian border to maximize flows under existing permits

Large Canadian oil producers and pipeline companies are strategically investing in CBR as largely a stop gap mechanism though it will have a long term niche

Likely Built Within Medium Term (~2018 - 2019)

- Trans Mountain Express (Kinder Morgan)
- Alberta Clipper (Enbridge)
- Keystone XL (TransCanada)

Likely Delayed Until 2020 or Later

- Northern Gateway (Enbridge)
- Energy East (TransCanada)

U.S. DOT Final Rules May 2015 – Highlights

New rules were issued by U.S. DOT on May 1st, and effective July 7, 2015, covering the areas of:

- Tank Car standards for both new and existing cars used in High Hazard Flammable trains (HHFTs: a continuous block of 20 or more tank cars loaded with a flammable liquid or 35 or more tank cars loaded with a Class 3 flammable liquid dispersed through a train)
- Enhanced braking systems requirements for HHFTs and a new class of train called a High Hazard Flammable Unit Train (HHFUTs: a train compromised of 70 or more tank cars loaded with a Class 3 flammable liquid and travelling at more than 30 MPH)
- Classification of unrefined petroleum based products
- Rail Routing in terms of Risk Assessments and Information
- Rail Network operating speeds

Implementation schedule by car type/commodity that feathers in need for new/retrofitted car by up to 10 years vs. NPRM of up to 3 years for PG I and PG II – largely focused on crude and ethanol

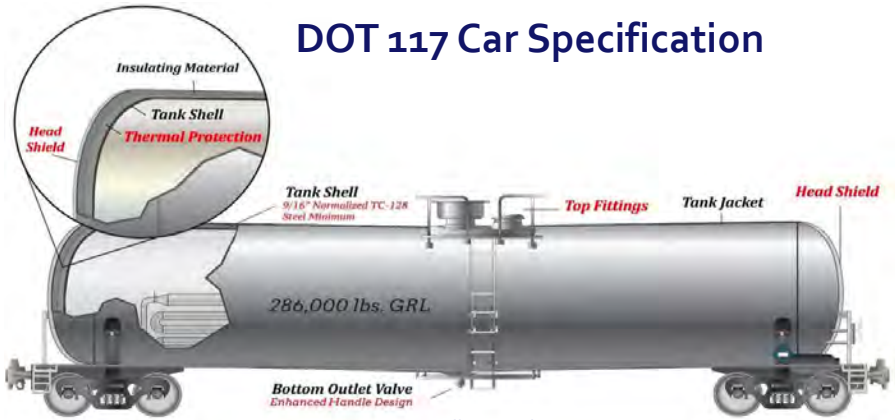
Electronically Controlled Pneumatic ("ECP") braking system requirement for HHFUTs is most contentious area of ruling

U.S. and Canada rules are largely harmonized

Retrofit standard is less than new standard (7/16" shell for retrofit vs. 9/16" shell for new)

Backlog will be built to 117 standard and will satisfy much of PG1 needs until ~2020 timeframe

DOT 117 Car Specification



Source: AllTranstek LLC

Frac Sand Industry Has Been a Rollercoaster Ride

2010 - 2014

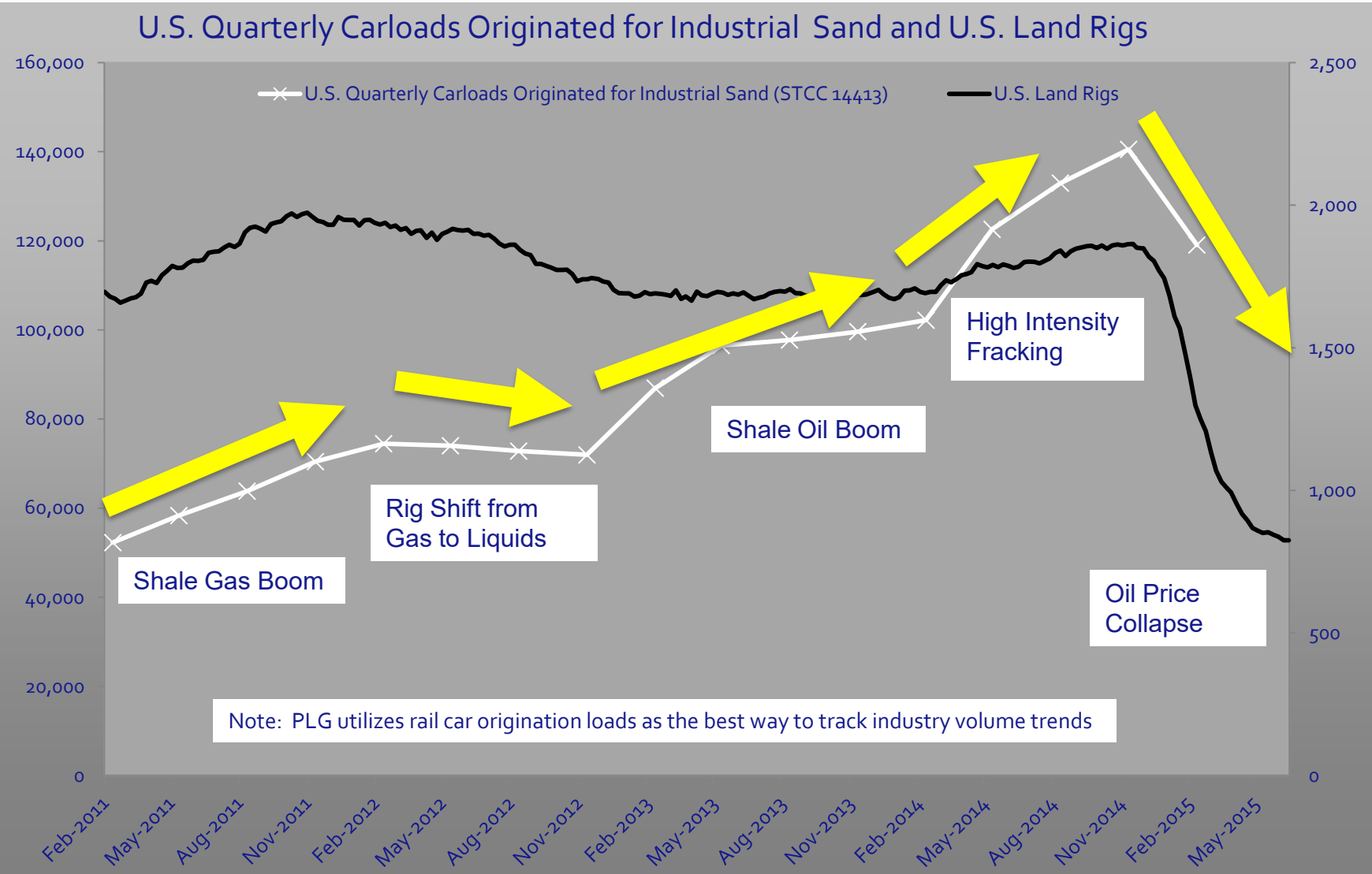
2015 and beyond??

Still a maturing industry with few barriers to entry…supply chain is evolving…never had a steady state

Highly dependent on market conditions -> Oil & Gas market prices…# of rigs…fracking technology changes

Hard to predict as industry volume data availability is weak and delayed…volume obscured with other industrial sand…forecasting is quite difficult and rare

Five Historical Phases of Frac Sand Market



Frac Sand Supply Chain
Undergoing Significant Rationalization

Sand Capacity

- Industry in an over capacity state based on current volume requirements ~55% of capacity
- New market entrants are now challenged to find funding

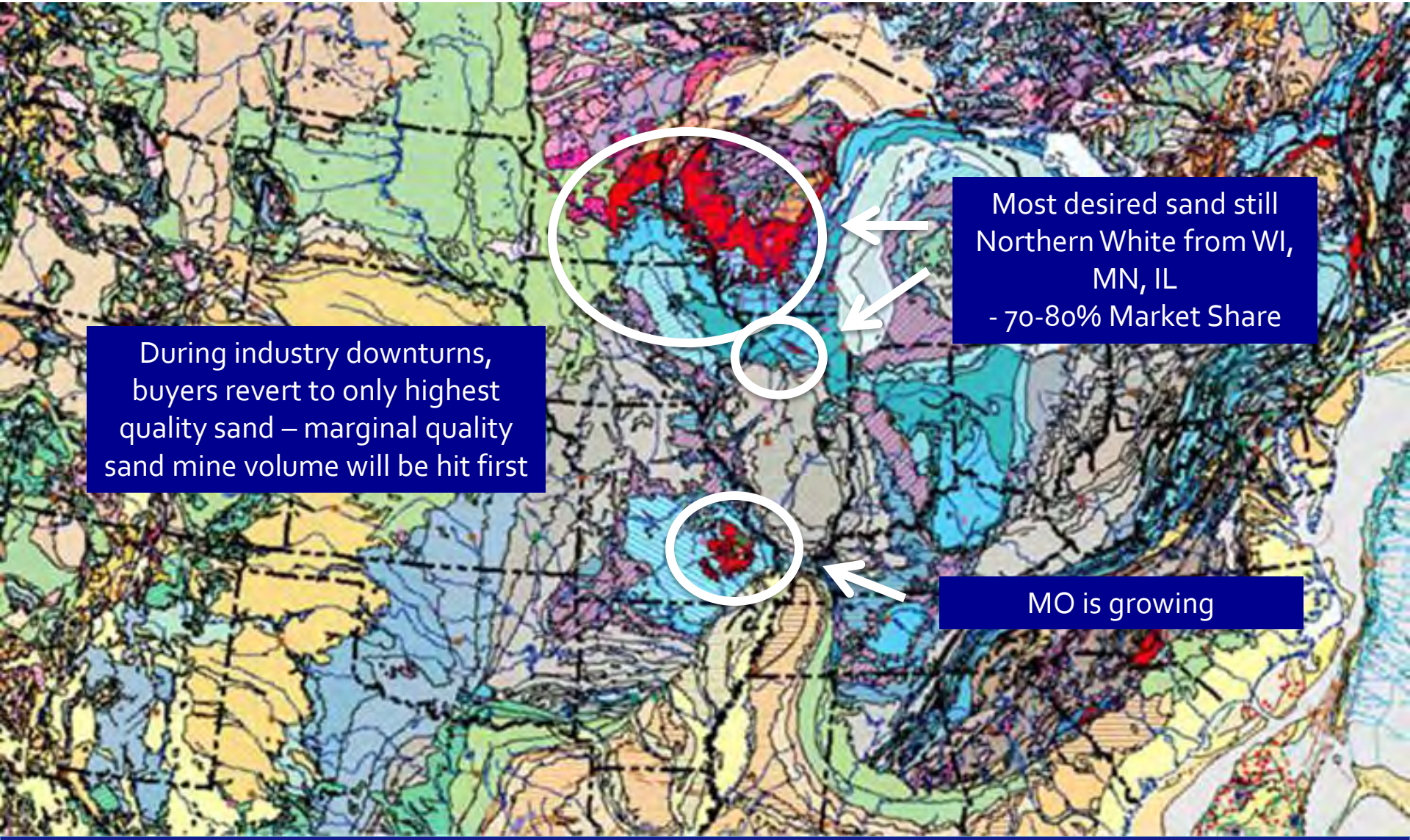
Sand Pricing

- Sand companies have already given 20%+ price reductions in exchange for lengthening contracts
- Huge variation in sand pricing based on size of sand buyer

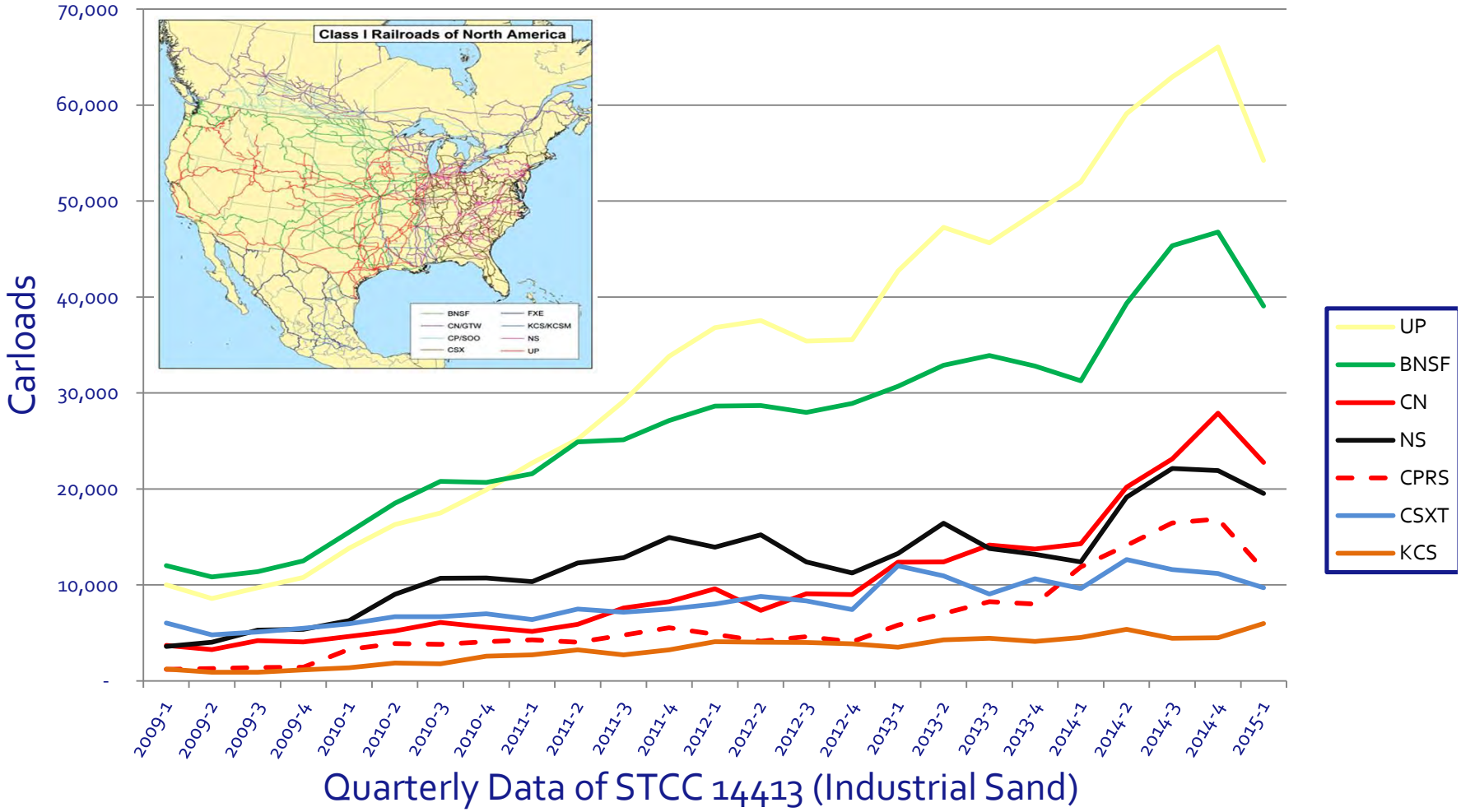
Rail Portion

- Largest single cost component of logistics cost
- Railroads have given back some of last year's rate increases to help producers with cost reduction
- Unit train improves cycle time by 2-3X in addition to lower rail rates (by 15%+) to manifest service
- Unit train loading/unloading capability will continue to grow in importance as long term differentiator

Premium Frac Sand Deposit Locations



Quarterly Frac Sand Handled by Railroad



Source: STB, June, 2015; Note that Industrial Sand category (STCC 14413) includes other commodities beside frac sand

Updated Processed Sand Total Delivered Cost per Ton

"Benchmark" unit train example – Illinois to South Texas

- Single-line haul (one rail carrier)
- Private railcars
- Railcar fleet achieving two round trips per month
- Origin sand facility has direct rail load-out
- Destination trucking is less than 100 miles

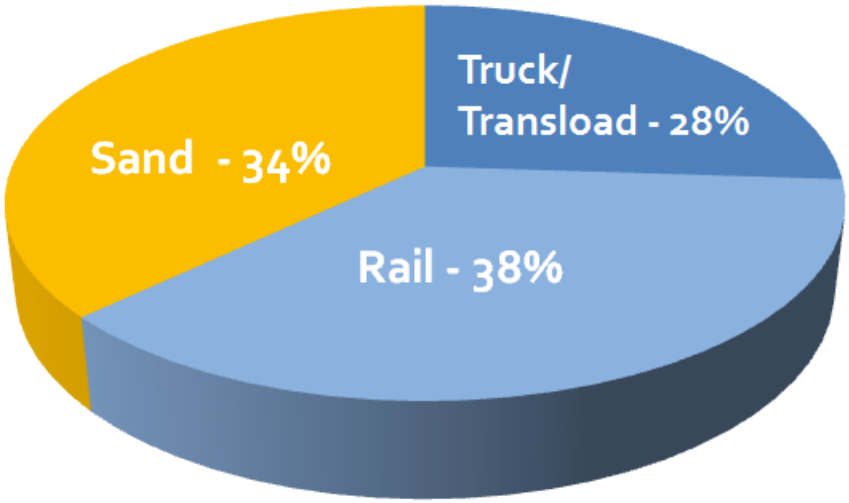
Unit train operations include efficient origin/destination handling

- 24 – 36 hours per train

Manifest service would increase rail-related costs by 17%

- Increased freight rate (12% higher)
- Railcar fleet only achieves one turn per month, on average
- Additional trackage required to accommodate larger fleet
- Delivery patterns are more variable, requiring additional destination storage and inventory

Total Delivered Cost per Ton ~ **$118**



Logistics costs drive ~66% of total delivered sand cost

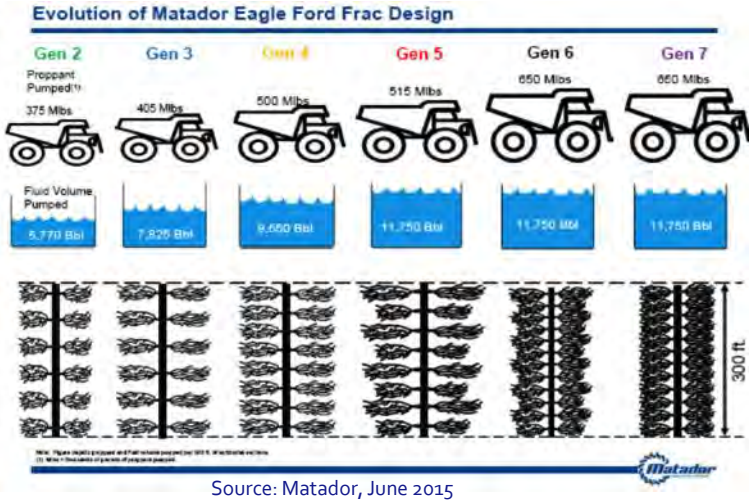
Source: PLG analysis using BNSF public pricing – does not include fixed assets at origin or destination
Current average sand price per ton = $40

High Intensity Fracking – Major Impact on Frac Sand Industry Now and the Future

Although overall frac sand volume decreased by 15% in Q1, sand mass per well increased dramatically – high intensity has blunted the industry volume drop

Will be the major driver of future volume recovery in the frac sand market

Leading edge experimental wells using up to one unit train of sand per well!



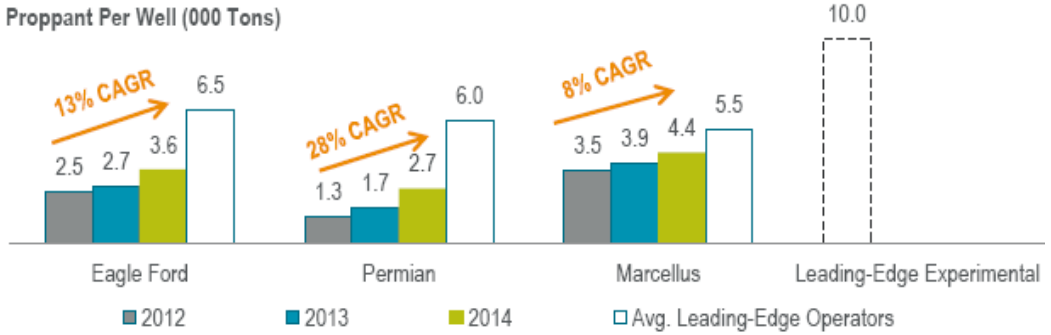
Source: Matador, June 2015

Frac sand mass per Hz Well

Play/Basin	%Δ (14Q2-15Q1)
Appalachia	+20%
Bakken	+7%
Eagle Ford	+25%
Permian	+10%
US Land Avg.	**+15%**

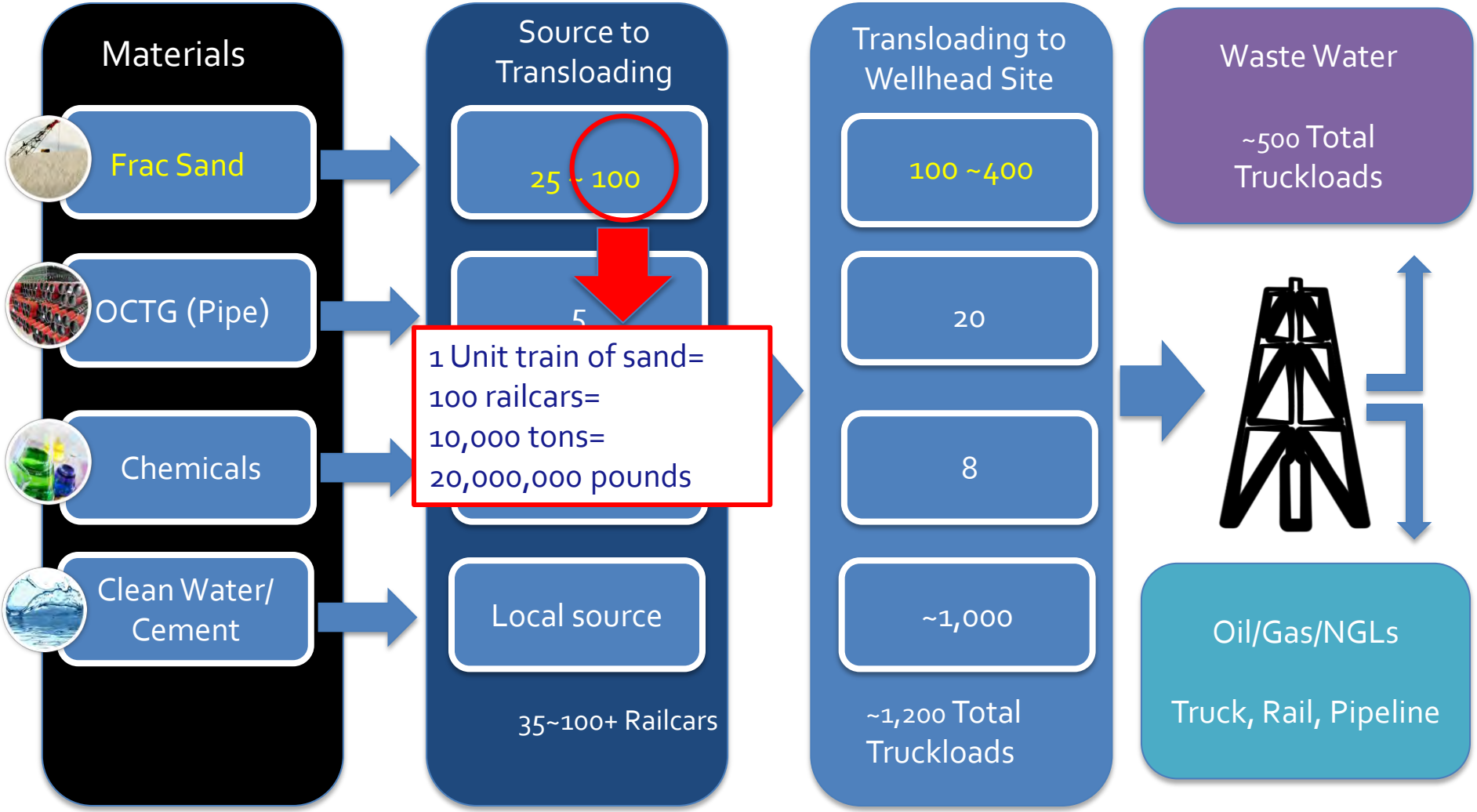
Source: PacWest

Robust Proppant Demand Driven by Multiplier Effect



Source: FairmontSantrol, March 2015

Hydraulic Fracturing Materials Inputs and Logistics Involved



Frac Sand Volume

Historically

2014 growth was 30% (vs. 2013) – seems like ancient history…..

Q1 2015 overall frac sand volume -15% vs. previous quarter

Future volume

Q2 expected further 20% volume decline – bottoming out over remainder of 2015?

2016/2017 volume growth expected to be 10-15% per year with some oil price recovery

Future volume key drivers

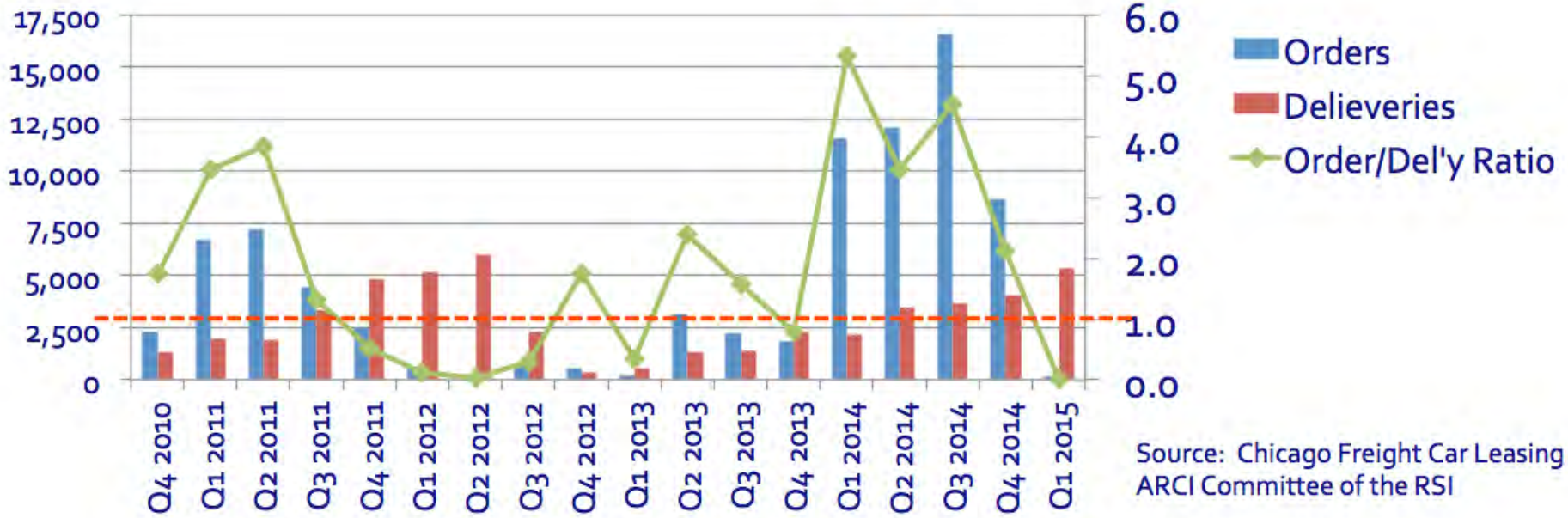
- Oil prices
- High intensity fracking
- Rig count
- Drilled, Uncompleted

Production Projections

$/BO at the wellhead	Rigs	New Wells	BOPD 7/1/15	BOPD 7/1/16	BOPD 7/1/17
$30	40	1,100	1,000,000	800,000	700,000
$40	90	2,400	1,030,000	875,000	720,000
$50	120	3,200	1,100,000	1,050,000	975,000
$60	140	3,800	1,200,000	1,200,000	1,150,000
$70	155	4,200	1,200,000	1,225,000	1,250,000
$80	170	4,600	1,200,000	1,300,000	1,400,000
$90	190	5,000	1,250,000	1,400,000	1,550,000

Source: North Dakota Industrial Commission, May 2015

Small Cube Covered Hoppers -- Likewise a Roller Coaster Market



Wild swings in order/delivery ratio over last 5 years with market changes

During 2014 frenzied market, "double ordering" took place by OFS and Sand companies for same volume - ~40k orders placed

2015 Q1 orders were only 131 cars!.....While 2015 car production will shatter delivery records

Current backlog (34K Cars), if filled, will take production through 2016 – where will they be used?

Small Covered Hoppers Market in a Correction State

Current market conditions

- Lots of cars in storage starting in Q4 2014
- Market is very quiet except for some interest from cement
- Minimal outright cancellations of car orders
- Some shifting of new-build delivery schedules
- New-build production schedules are full through 2016

Cement consumption is expected to grow by 8%+ in 2015

- Cement also utilizes small covered hoppers; small help to the market
- May be build/lease opportunities for cement cars with frac sand downturn

Plastic pellet cars market growing and will help builders to utilize some capacity

Major questions on small covered hopper market after backlog build out in 2016

- Gas market growth slowed by low gas prices resulting in low gas rig count
- Oil price level will be key driver on future oil rig counts and sand usage
- Frac sand industry consolidation will further rationalize the car market
- Industry will continue to move to unit trains – improved cycle time reduces car volume requirement
- How long until the "double buying" of rail car phenomena of 2014 will be worked out?

US Shale Gas Is/Will Have a Bigger Impact on U.S. Industrial Economy Than Shale Oil

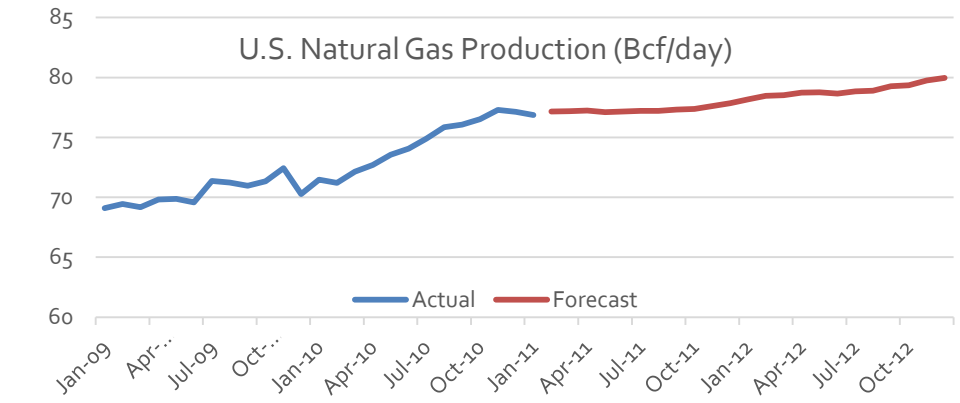
US gas demand will grow due to:

- Coal-fired generation plant converting to gas
- More industrial use – steel, fertilizer, methanol
- Mexican export via pipeline and LNG export overseas
- Increasing use as transportation fuel

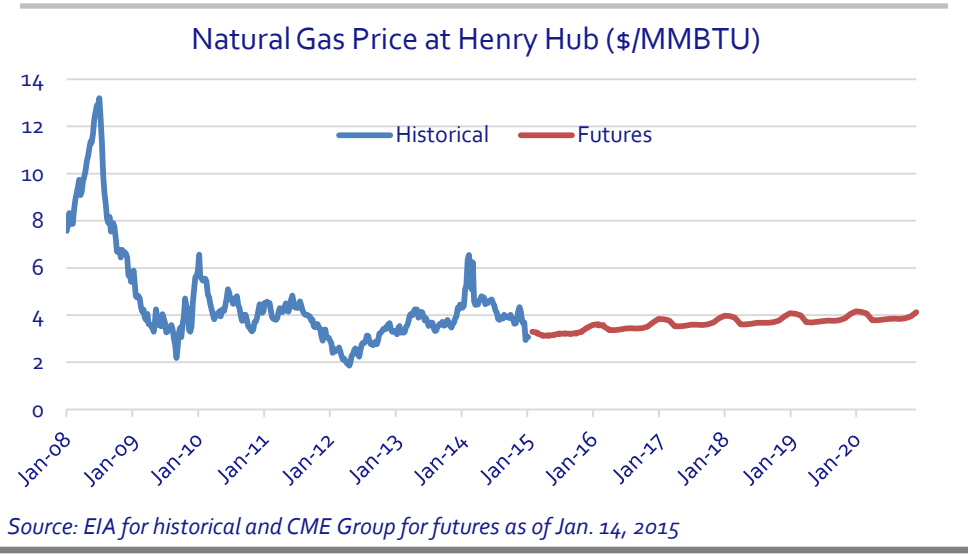
US gas cost competitiveness is sustainable

- 30+ year supply at ~$4 mm/btu; cost of production decreasing
- Supply will overwhelm demand as prices approach $5/mm/btu
- US government will likely limit LNG export to protect US from world gas market price

Low-cost gas and NGLs driving US industrial "renaissance" with globally competitive power supply and downstream materials



Source: EIA, Feb 2015

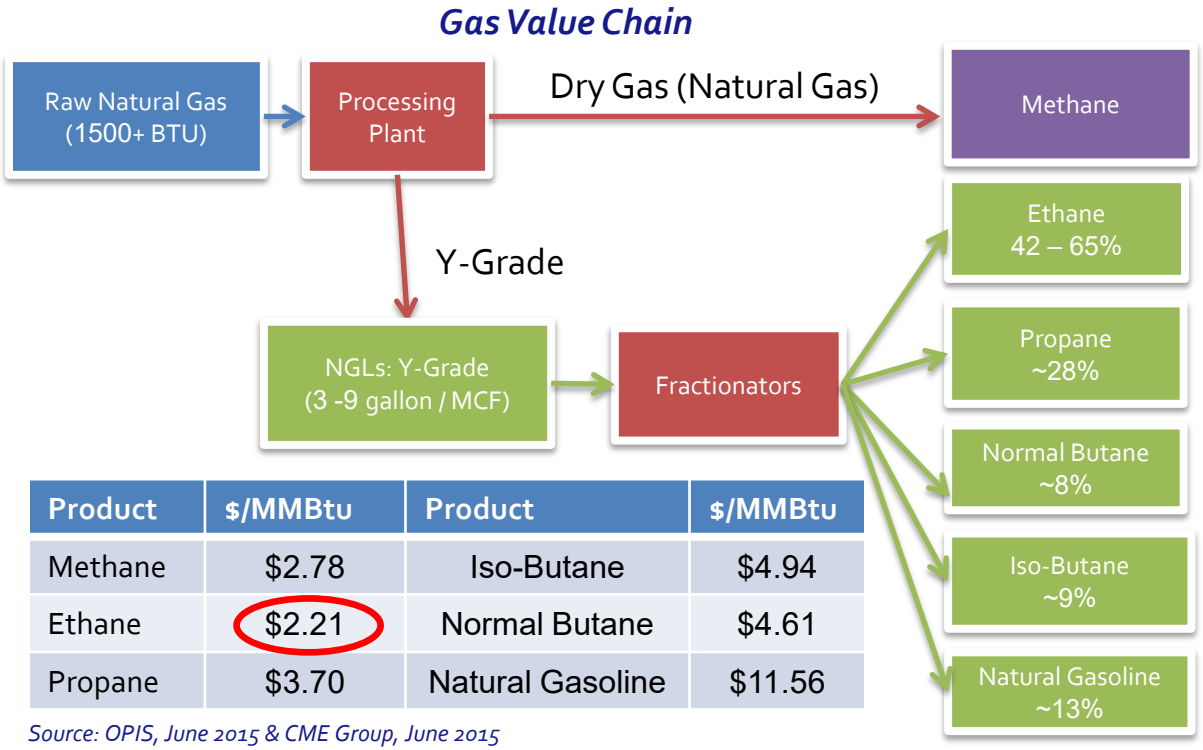


Source: EIA for historical and CME Group for futures as of Jan. 14, 2015

Shale Gas, NGLs, and Downstream Chemical Processing

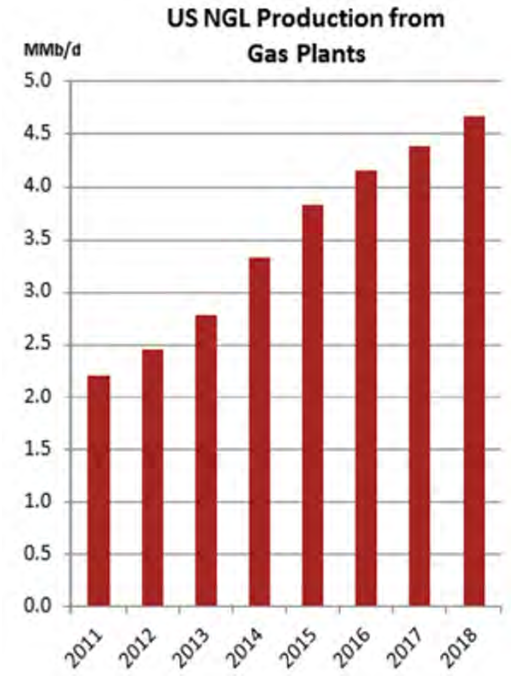
Ethane and propane production growth with shale gas

- Raw NGLs (y-grade) are extracted creating dry gas and y-grade streams; dry gas primarily used as a fuel for heat and power
- Y-grade is sent to a fractionator where it is made into "purity" NGLs – ethane, propane, butane, iso-butane, natural gasoline
- Ethane and propane are the largest components of the y-grade and are therefore seeing large growth in the U.S.
- U.S. infrastructure build-out continues to process the huge low cost production volume increase in ethane and propane



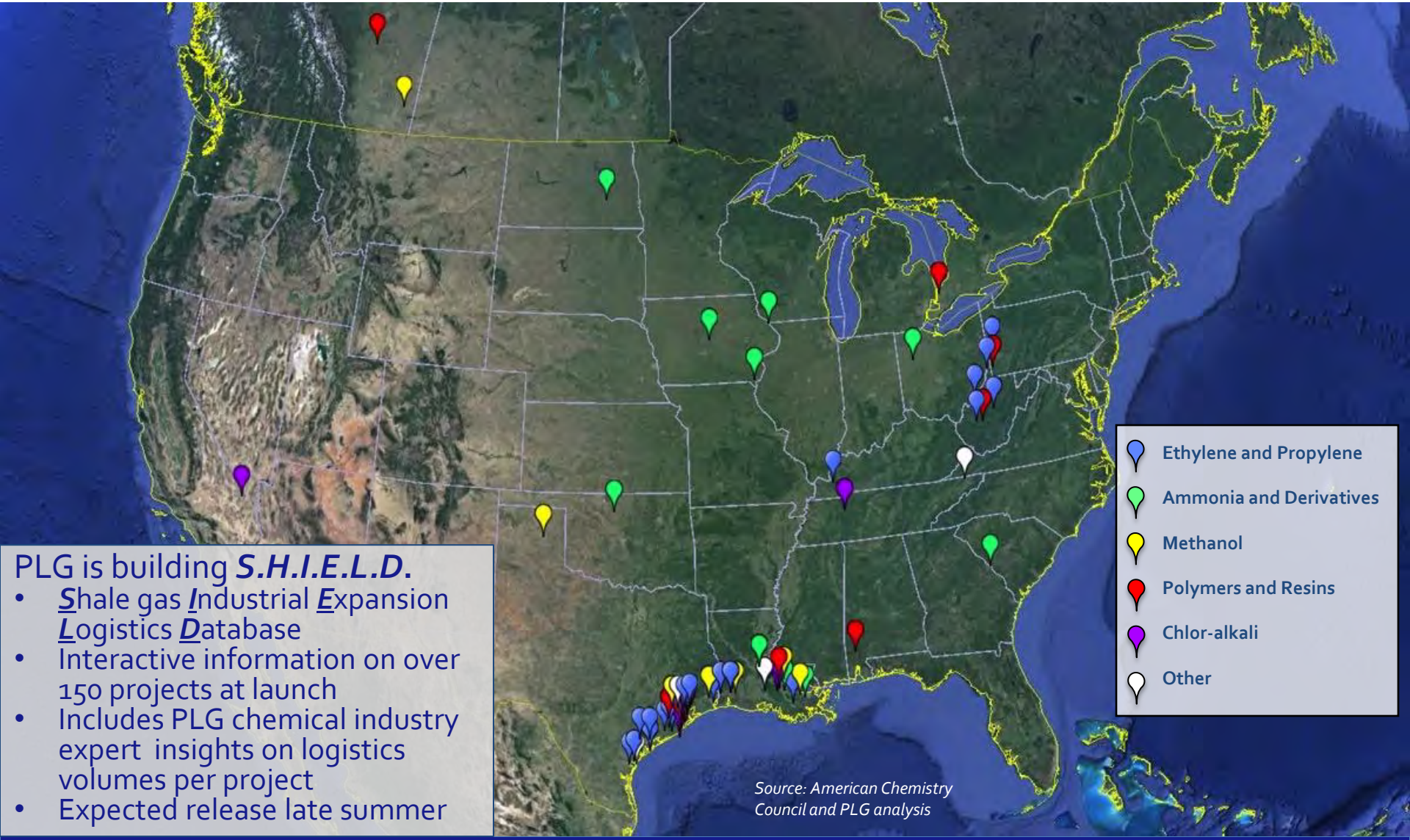
Product	$/MMBtu	Product	$/MMBtu
Methane	$2.78	Iso-Butane	$4.94
Ethane	$2.21	Normal Butane	$4.61
Propane	$3.70	Natural Gasoline	$11.56

Source: OPIS, June 2015 & CME Group, June 2015



Source: Bentek: North American NGLs 4Q2014

Over $140B of New Shale-Related CAPEX Investments Have Been Announced



PLG is building ***S.H.I.E.L.D.***

- ***S***hale gas ***I***ndustrial ***E***xpansion ***L***ogistics ***D***atabase
- Interactive information on over 150 projects at launch
- Includes PLG chemical industry expert insights on logistics volumes per project
- Expected release late summer

US Chemical Industry Build-Out

Abundant feedstock, structural cost advantages, and domestic market growth driving US petrochemical industry expansion

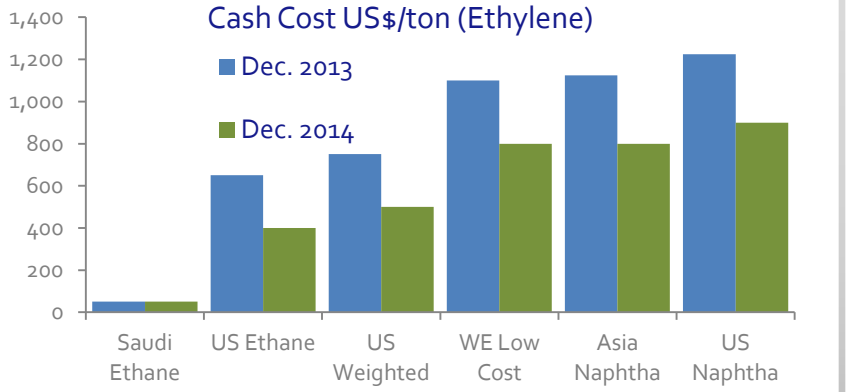
Rate of expansion growth will be slowed by

- Volatility of market prices – some based on oil prices
- Lack of EPC capacity
- Shortage of craft labor resources in the U.S. Gulf Coast
- Increasing regulatory hurdles and delays

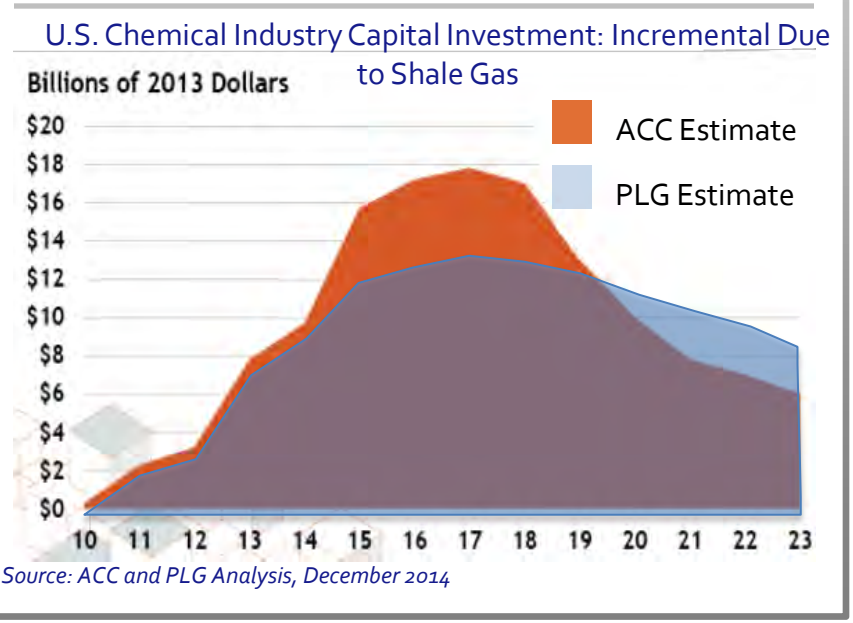
Expansion peak will be dampened and overall build-out will take longer than announced schedules

- 2nd wave possible early next decade

U.S. chemical industry is entering a historic growth period with incredible growth opportunities and challenges



Source: Townsend Solutions, December 2014



Source: ACC and PLG Analysis, December 2014

Presentation Summary

Expect hydrocarbon price challenges to persist for the near future due to oversupply

- All three products are becoming more global
- U.S. has become the global swing producer of crude
- The most agile, innovative players in the industry will survive and thrive long term

CBR challenged in the near term on the east coast due to differentials

- Long term, CBR is the "pipeline" to the coasts

Frac sand market volume is in the middle of a free fall

- Volume recovery dependent on oil prices and high intensity
- Small covered hopper market is in a state of disarray – when will it be sorted out?

U.S. downstream industries will be advantaged for the foreseeable future

- U.S. Shale gas provides long term supply capacity
- Ethane-based feedstock provides structural cost advantage
- U.S. manufacturing will have low cost material and electricity to be globally competitive

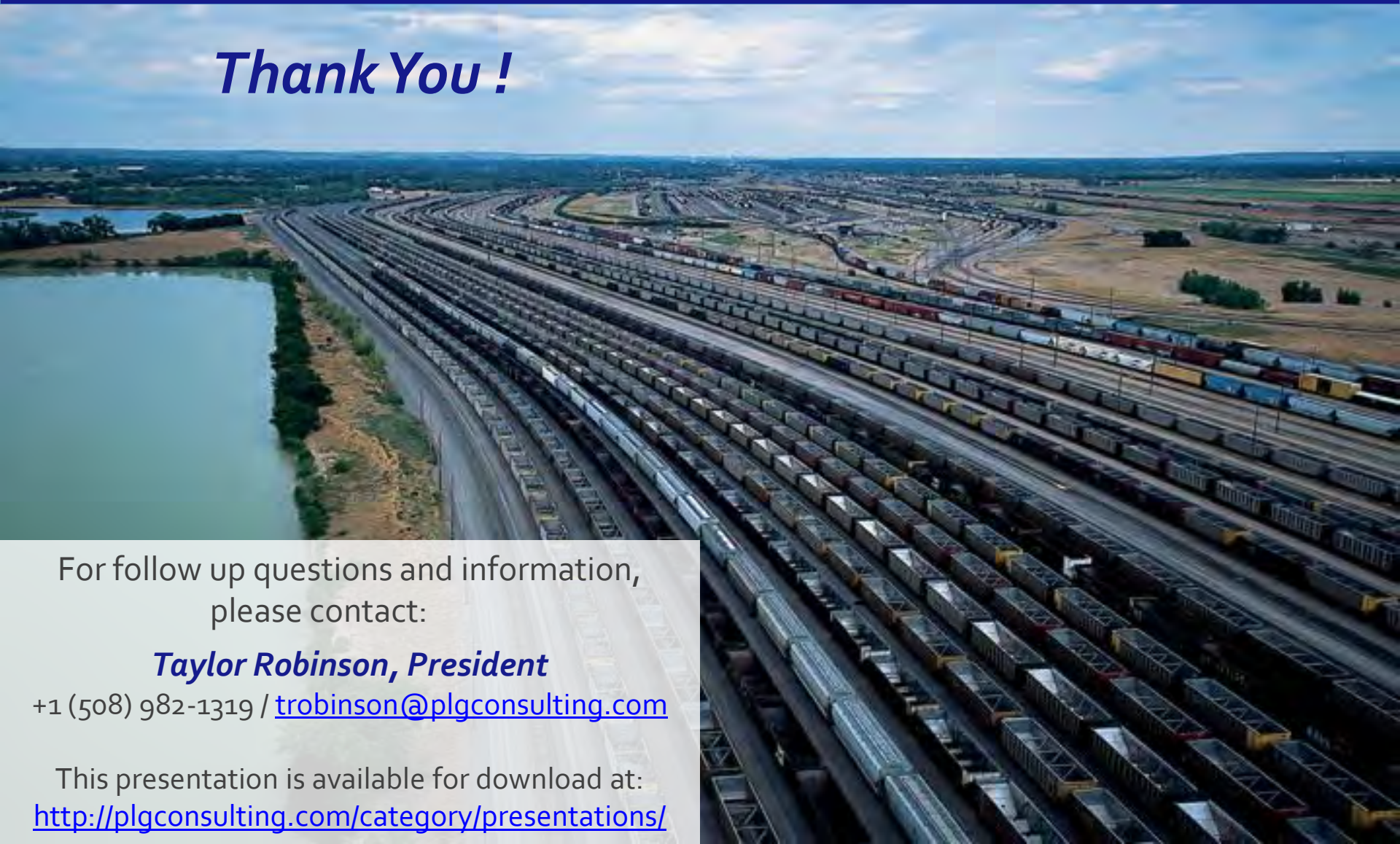
We are in the early innings of the North American energy revolution

Net positive for rail industry; long term growth opportunities for wide variety of railcar types

PLG Consulting

Logistics Engineering Supply Chain

Thank You !



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