Natural Gas Liquids Fundamentals

SEPTEMBER 2019

Key Takeaways

1 Demand for NGL products across sectors is expected to grow 23% from 2018-2022 driven by petrochemical buildout and export demand.

- Rising living standards in developing countries, particularly Asian, create an inelastic demand pull for LPG and NGL derivate products
- New U.S. steam crackers already under construction will increase domestic ethane demand by 831 MBbl/d, or 80%, above 2016

2 U.S. LPG exports are expected to remain robust while Middle East growth slows

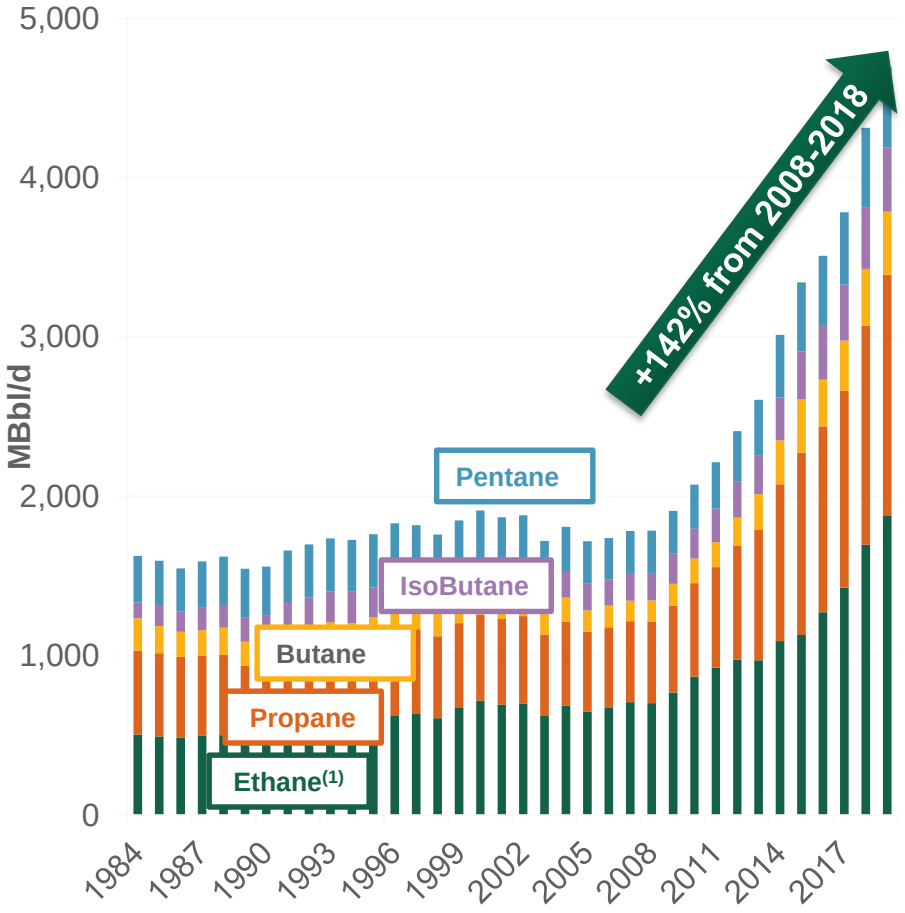
- High utilization rates from 2013-2016 prompted significant buildout of LPG export capacity, resulting in unconstrained exports beginning in 2H19 through 2022
- Middle East Export growth slows due to OPEC production cuts and more LPG kept at home in the Middle East to support growing petrochemical industry
- U.S. LPG exports displacing Middle East LPG supply to global markets

3 Appalachian producers will remain advantaged vs. other regions

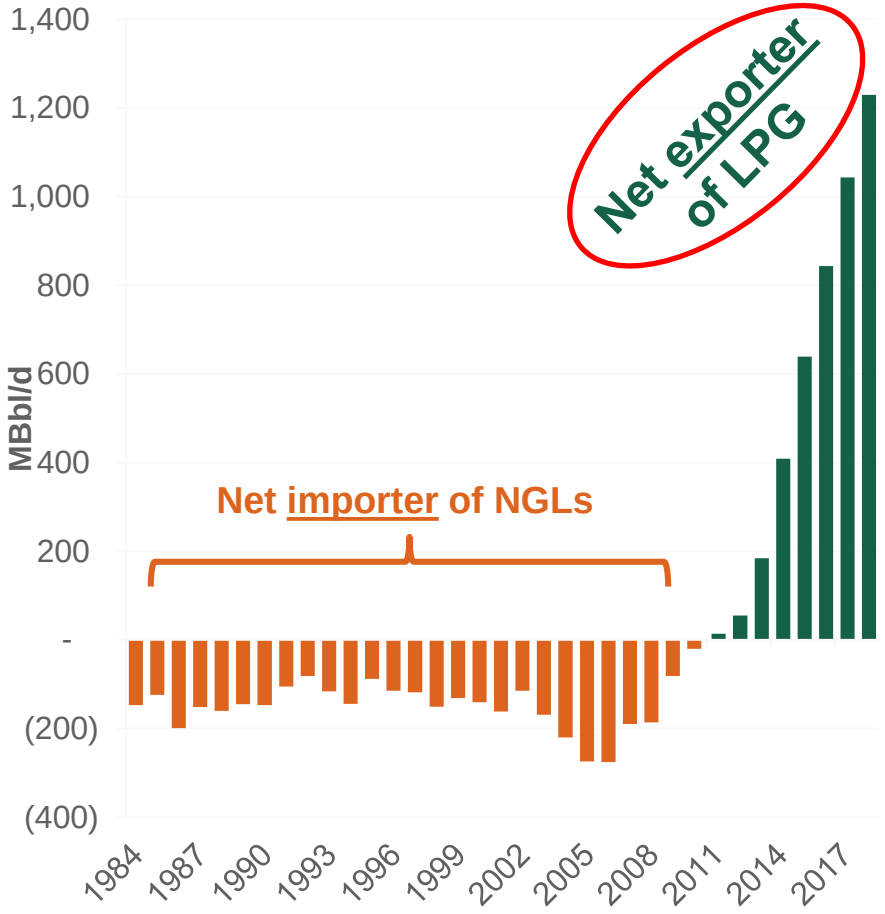
- Geographically advantaged LPG shipping rates to Europe compared to U.S. Gulf Coast cargoes; at parity for Asia destination cargoes
- Appalachian producers maintain control of product pricing through export dock and directly benefit from pricing uplift vs. typical midstream capture on the US Gulf Coast
- Start-up of Mariner East 2 ("ME2") at YE 2018 allows direct access to international markets and premium pricing, expected to translate into >$2.00/Bbl uplift
- ME2 has the initial capacity to clear ~40% of the projected Appalachia 2019 LPG supply of ~395 MBbl/d, which is improving northeast differentials

The Shale Revolution dramatically changed the NGL landscape, turning the U.S. into a net exporter after decades of importing NGL products

U.S. NGL Production (MBbl/d)



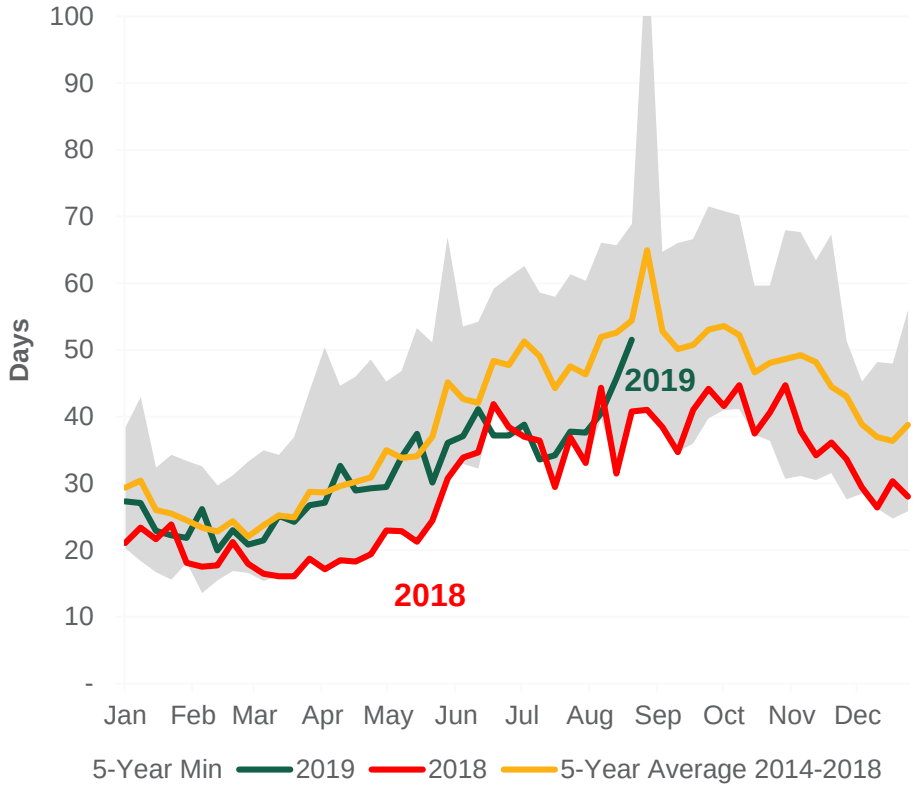
U.S. NGL Exports / (Imports) (MBbl/d)



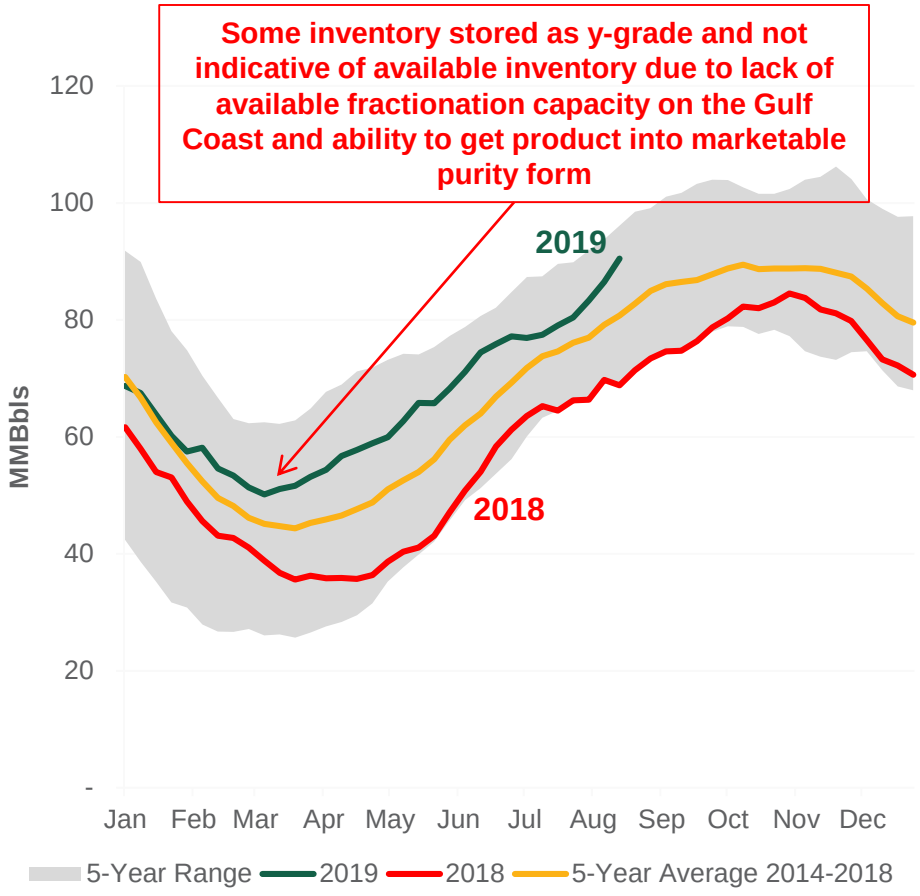
(1) Recovered ethane volumes only.

Current propane days of supply are still 5% below the 5-year average despite the recent increase due to continued strength in exports and domestic demand

Propane Days of Supply (Days)



U.S. Propane Inventories (MMBbls)



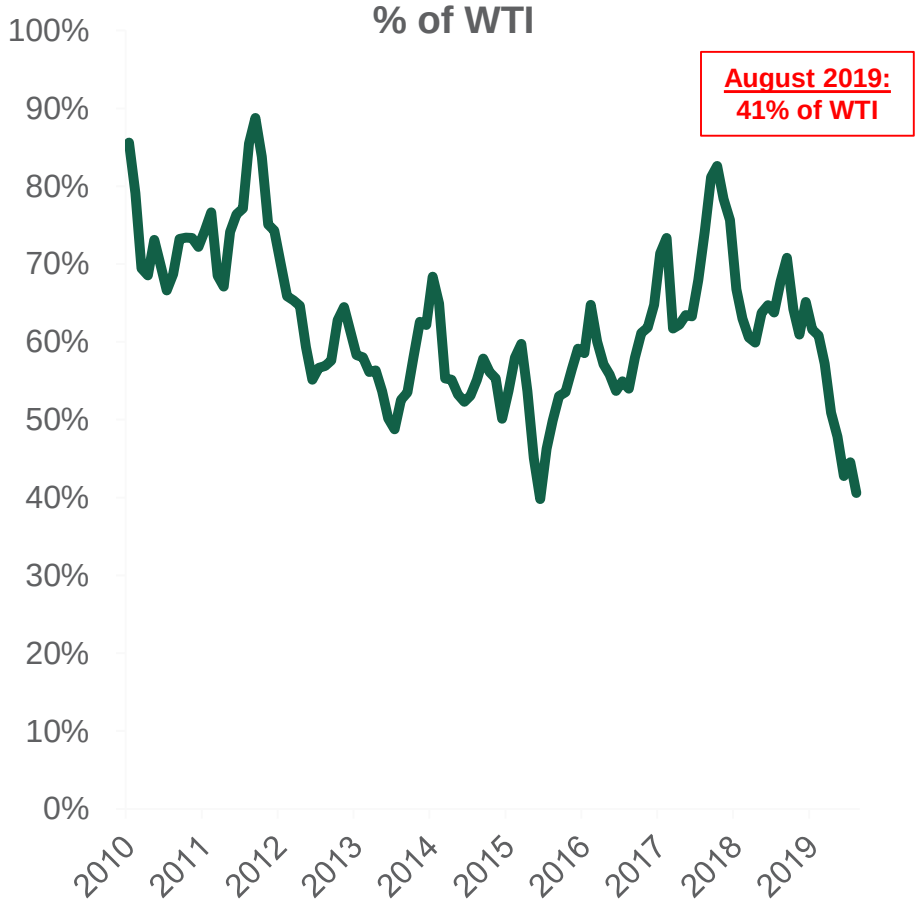
Source: EnVantage Inc. and Energy Information Administration (EIA) as of 8/23/19.

C3+ NGLs: Absolute & Relative Price Improvement

A lack of sufficient export capacity has driven down Mont Belvieu prices on an absolute price and relative to WTI basis. This is expected to improve as new export expansion capacity comes online during the 2H19.

Mont Belvieu C3+ Price ($/Bbl and $/Gal)

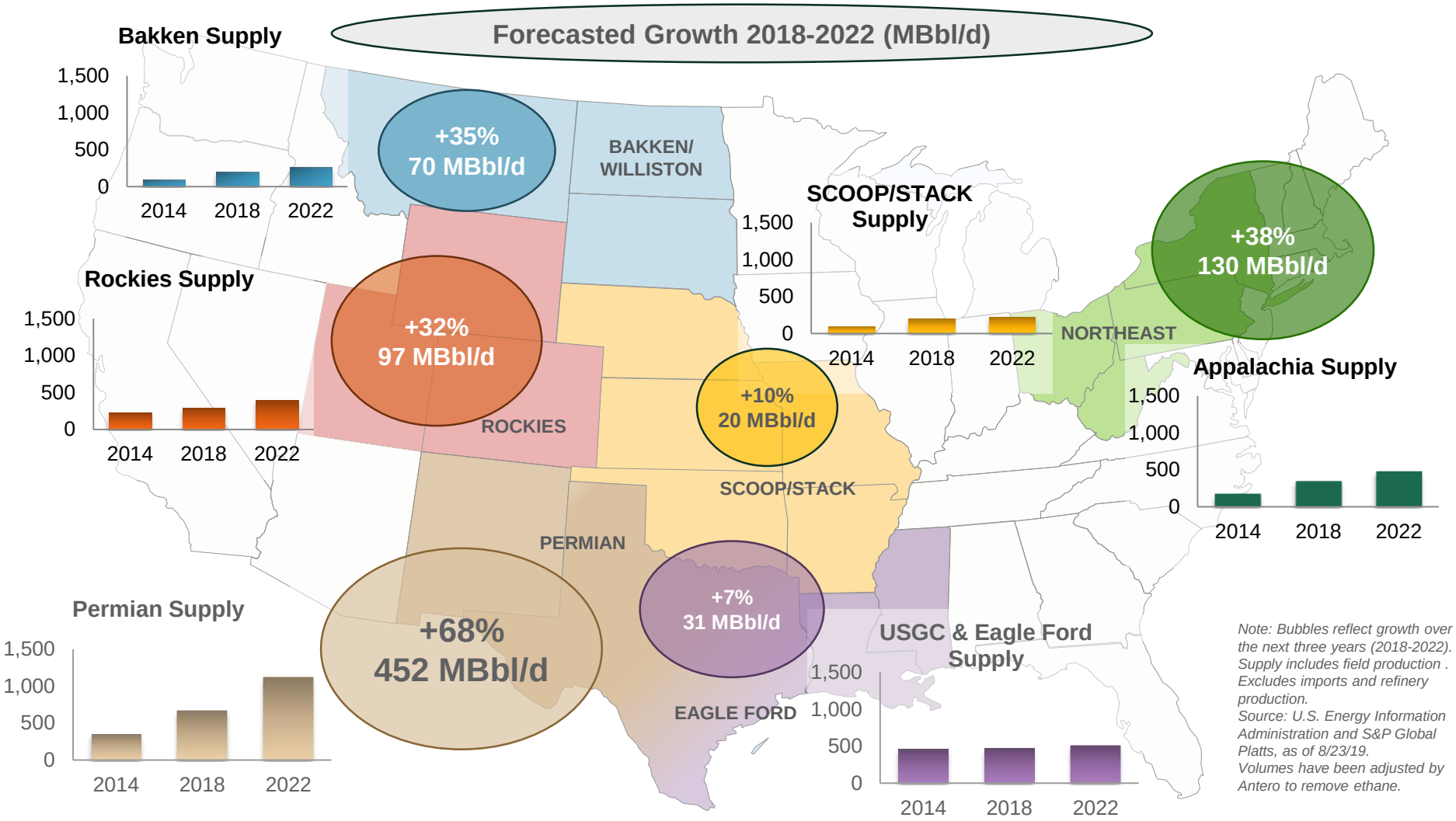
Mont Belvieu C3+ to WTI Price Ratio



Source: Intercontinental Exchange (ICE) pricing data as of 8/27/19. Assumes C3+ barrel weightings of: propane 56%, normal butane 16%, Isobutane 9%, pentanes 19%.

U.S. NGL Supply Growth by Region (C3+)

C3+ NGL supply growth driven by low cost basins such as the Permian and Appalachia

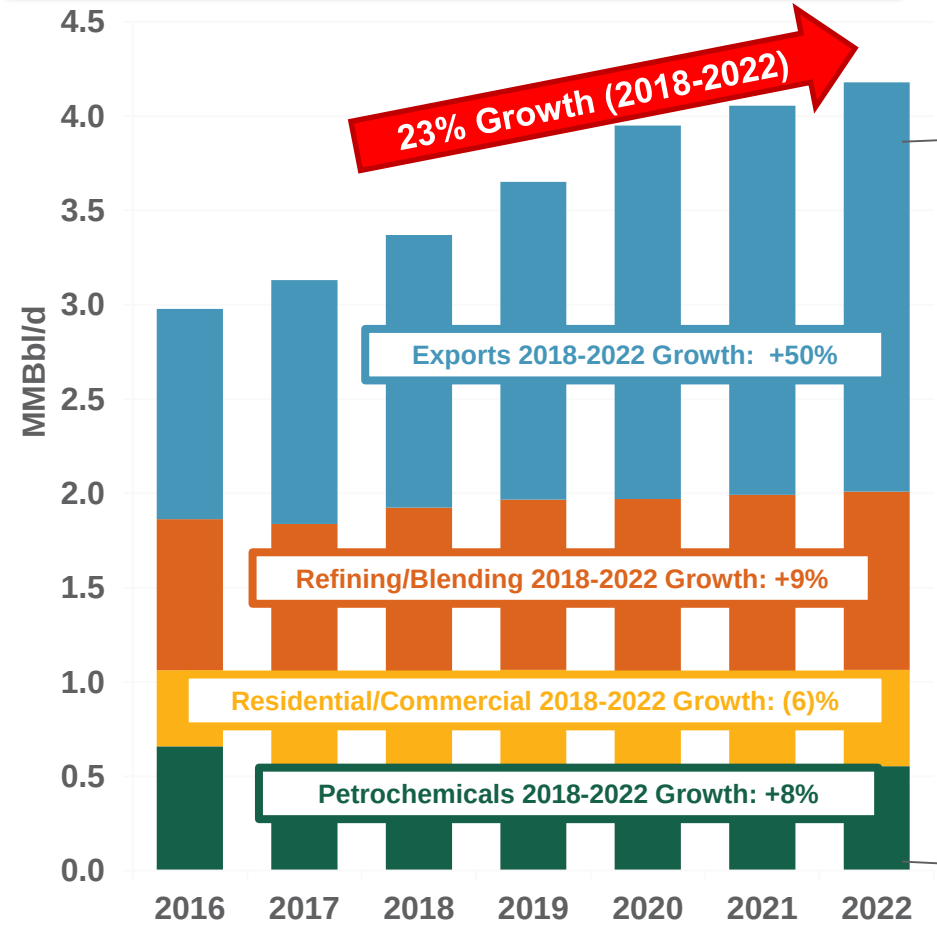


Note: Bubbles reflect growth over the next three years (2018-2022). Supply includes field production . Excludes imports and refinery production.
Source: U.S. Energy Information Administration and S&P Global Platts, as of 8/23/19.
Volumes have been adjusted by Antero to remove ethane.

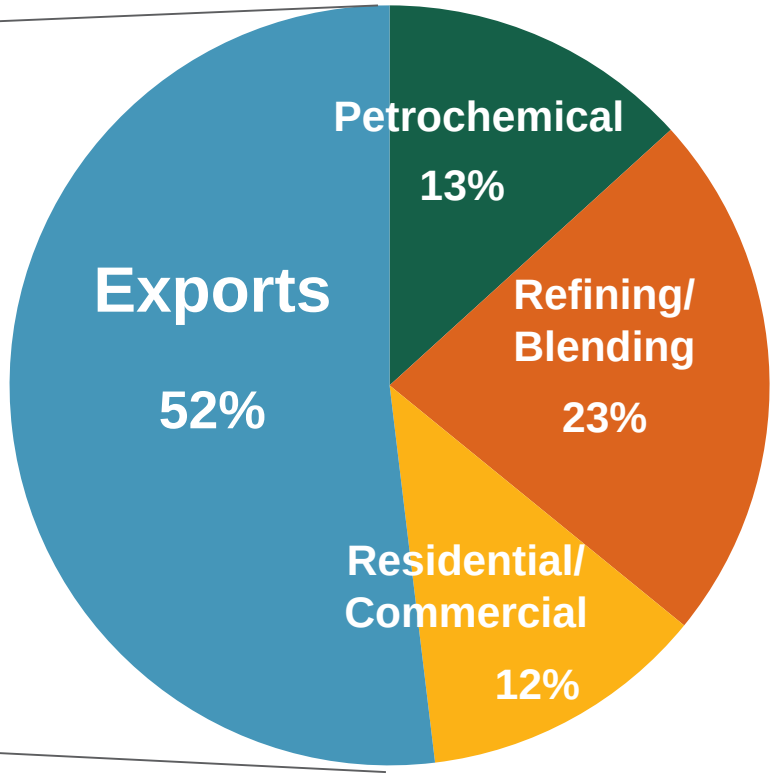
U.S. NGL Demand Growth

NGL demand growth driven primarily by increased exports of LPG (propane/butane)

C3+ Demand Growth by Sector (MMBbl/d)



U.S. C3+ Demand - 2022

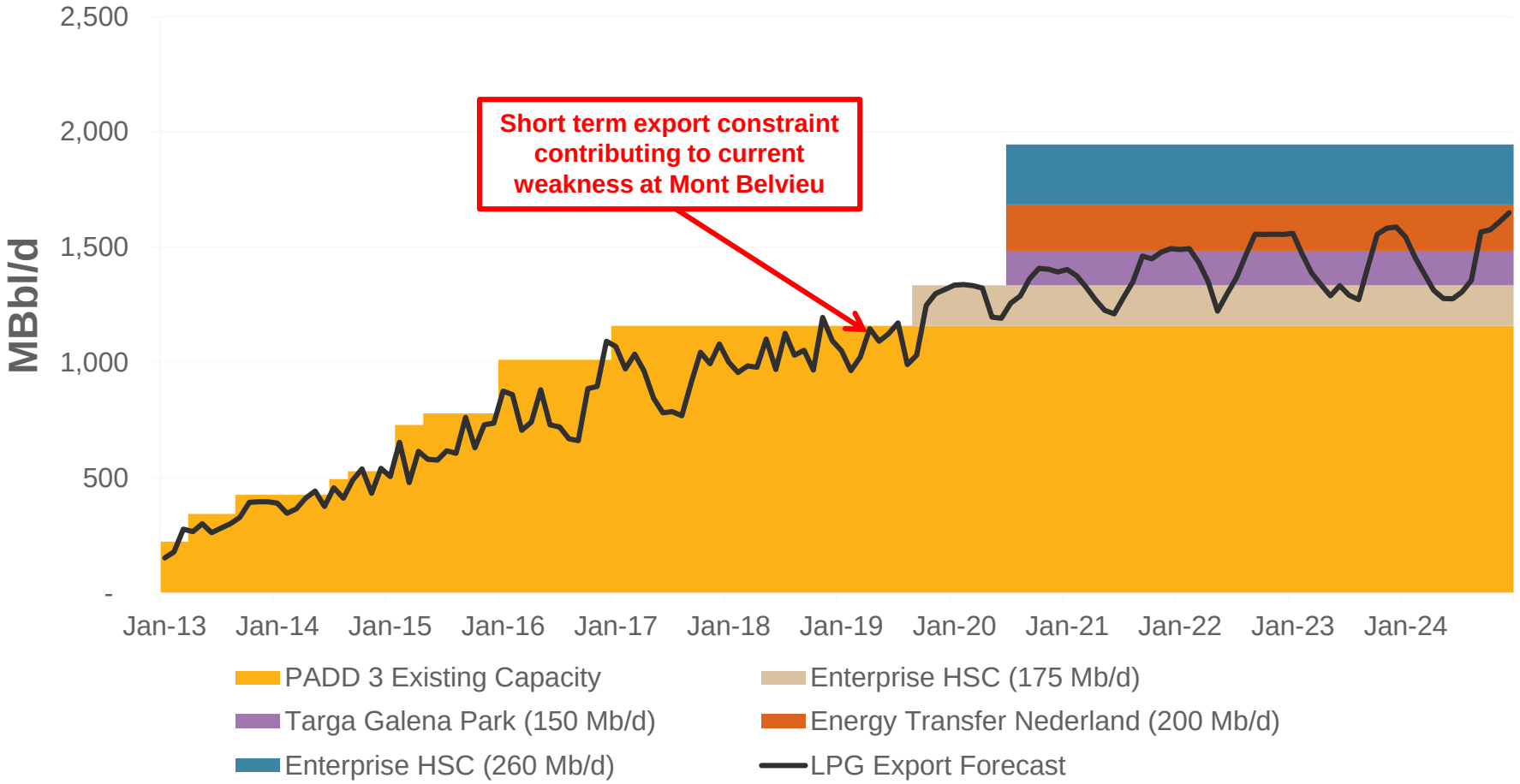


Source: S&P Global Platts as of 8/30/19

LPG Export Capacity: Unconstrained Outlook

Current high utilization rates prompted next round of buildout of LPG export capacity, resulting in unconstrained exports after 4Q19

U.S. Gulf Coast LPG Exports vs. Capacity (MBbl/d)

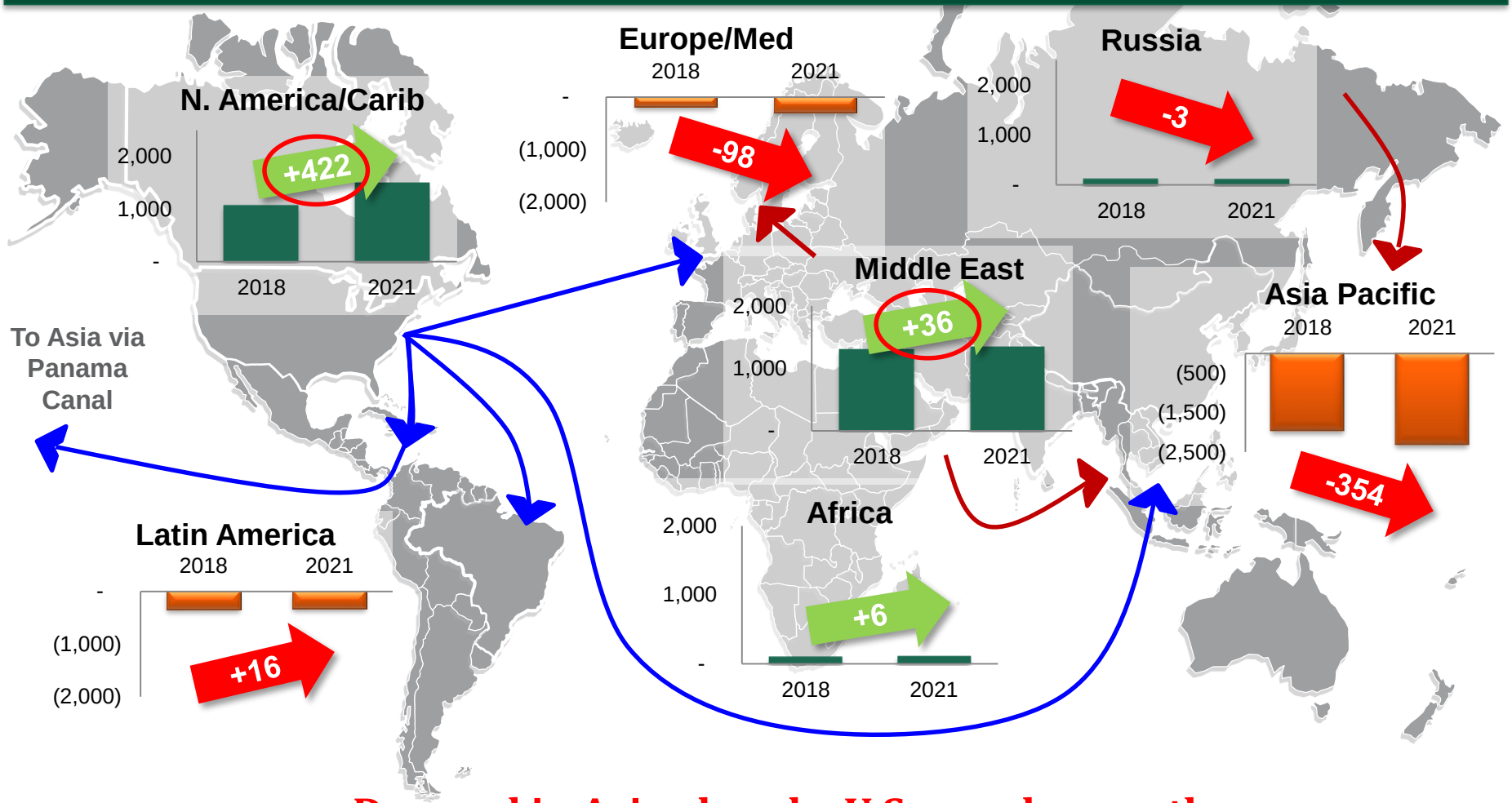


Source: S&P Global Platts as of 8/30/19

Global LPG Demand Growth Absorbs Supply Growth

U.S. LPG export growth expected to be ~12x Middle East LPG export growth from 2018- 2021 due to OPEC cuts and LPG products kept in the Middle East

LPG Import/Export Growth by Region (MBbl/d)



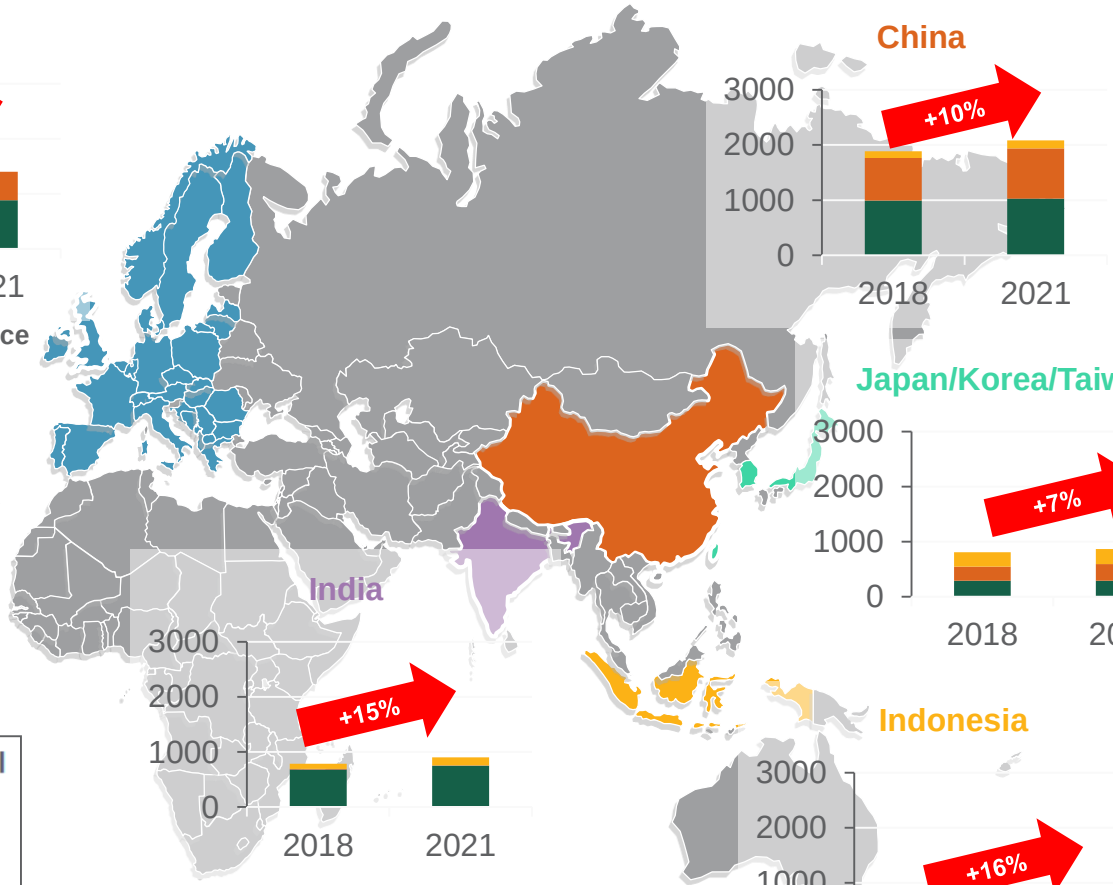
Demand in Asia absorbs U.S. supply growth

Source: Poten and Partners.

Global LPG Demand Growth Absorbs Supply Growth

Res/comm demand drives growth in developing nations while petrochemical demand continues to increase in more developed countries.

LPG Total Demand Growth by Region (MBbl/d)



- Higher freight rates enhance Antero's transportation advantage to Europe via Marcus Hook.
- Further European demand growth in 2022 with 3 new build PDH units (INEOS, Borealis, PDH Polska)

- Up to 6 new Chinese PDH units coming online in 2019.

- Japan/Korea/Taiwan increasing LPG flex capabilities at existing naphtha crackers.

- Residential/Commercial
- Petrochemical
- Other Demand*

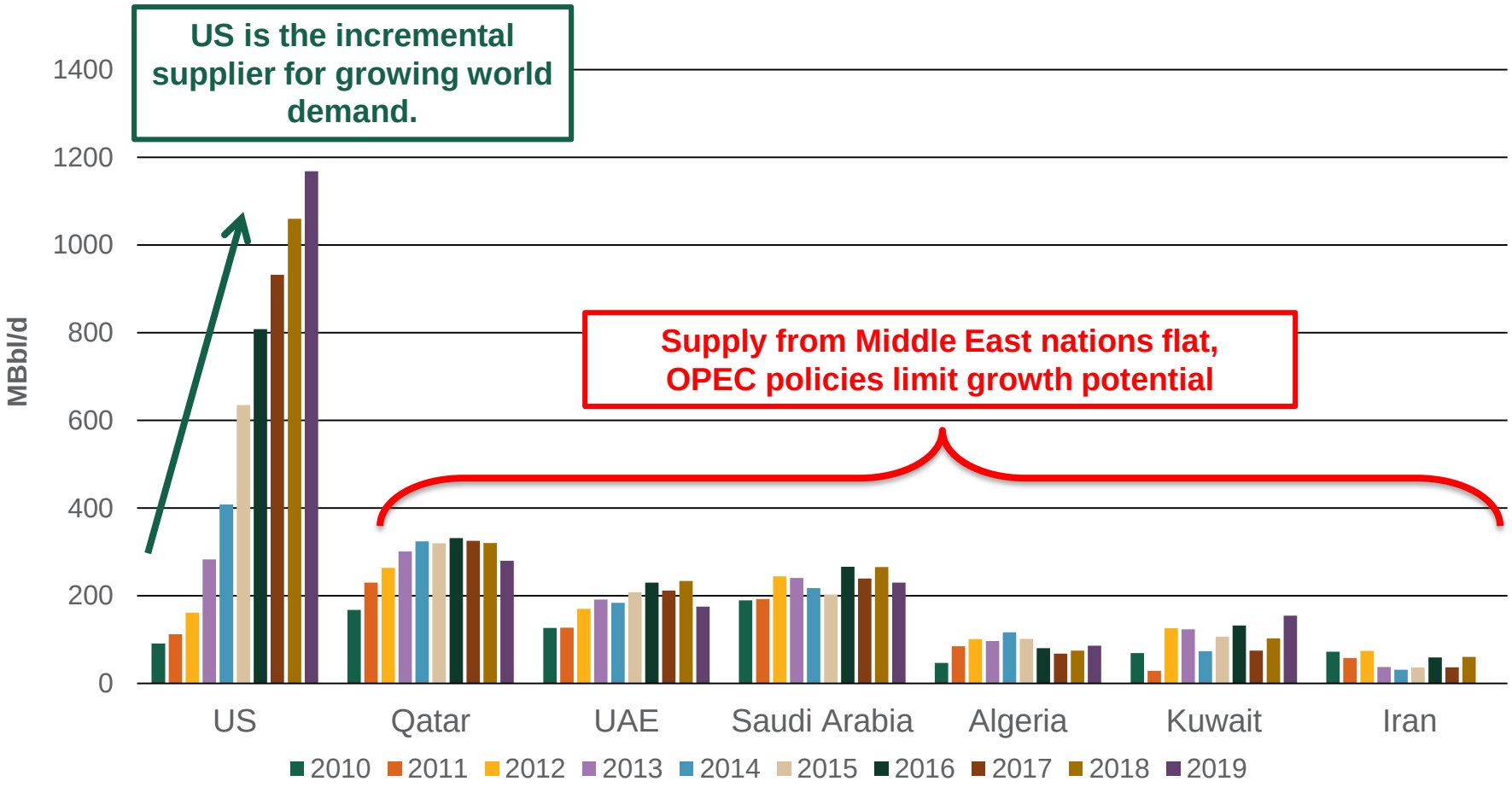
PM Narendra Modi's May 2019 election victory is constructive for Indian LPG demand.

- Government programs & subsidies encourage LPG adoption in India, Indonesia, and others.
- Many users are switching from dirtier wood and biofuels.

Source: Poten and Partners.
**Other Demand includes Industrial, Autogas, Exports, Agriculture, and Others.*

US exports are projected to surpass the entire Middle East region in 2019

LPG Exports: US versus Middle East

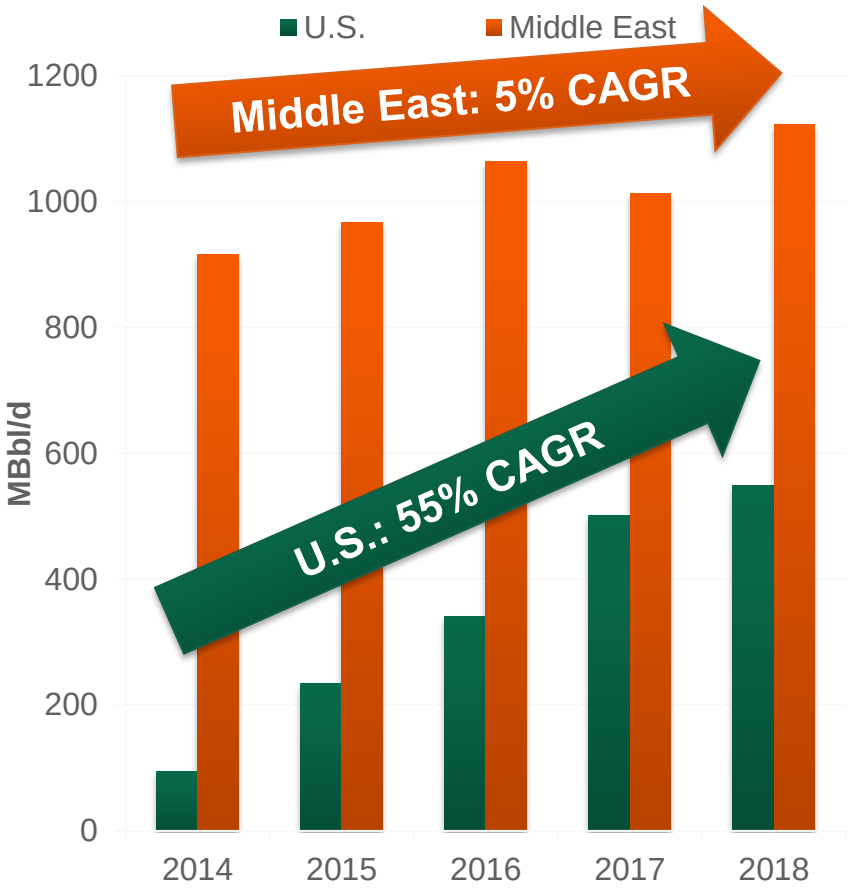


Source: Platts

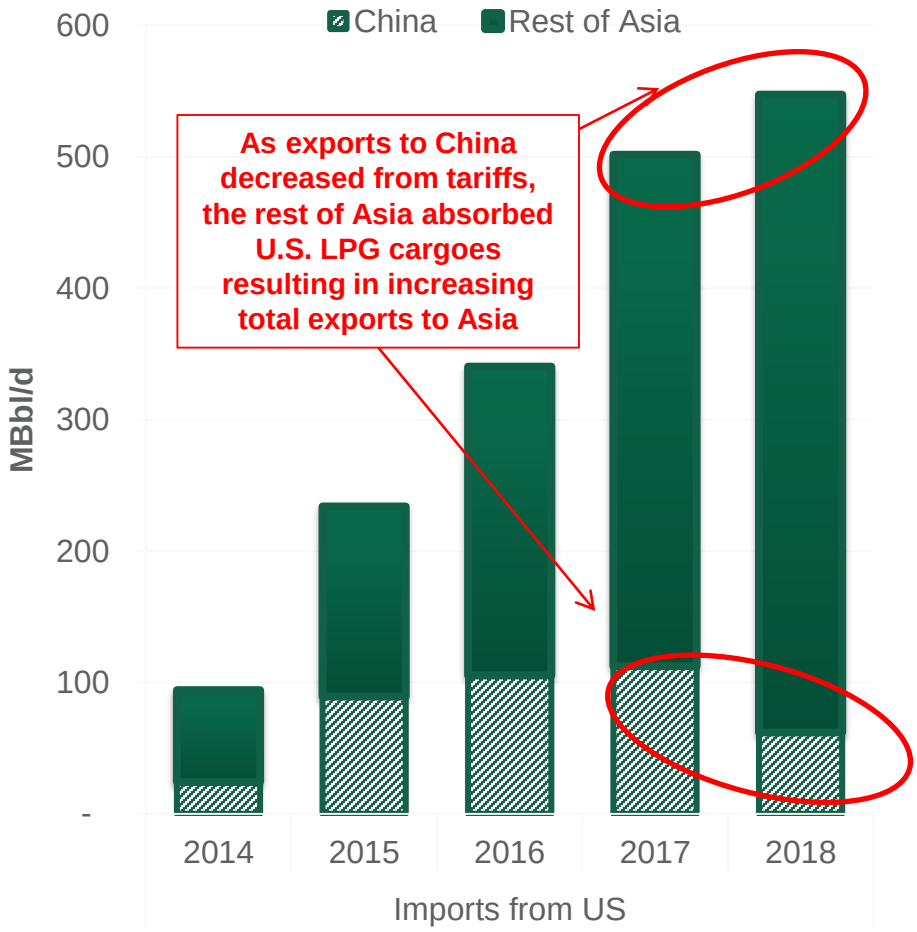
U.S. Exports Adjusting to Trade Flow Changes

The U.S. continues to play an integral role along with the Middle East of supplying the increasing demand from China and other Asian countries

LPG Exports to Asia



U.S. Only LPG Exports to Asia



Source: Poten and Partners.

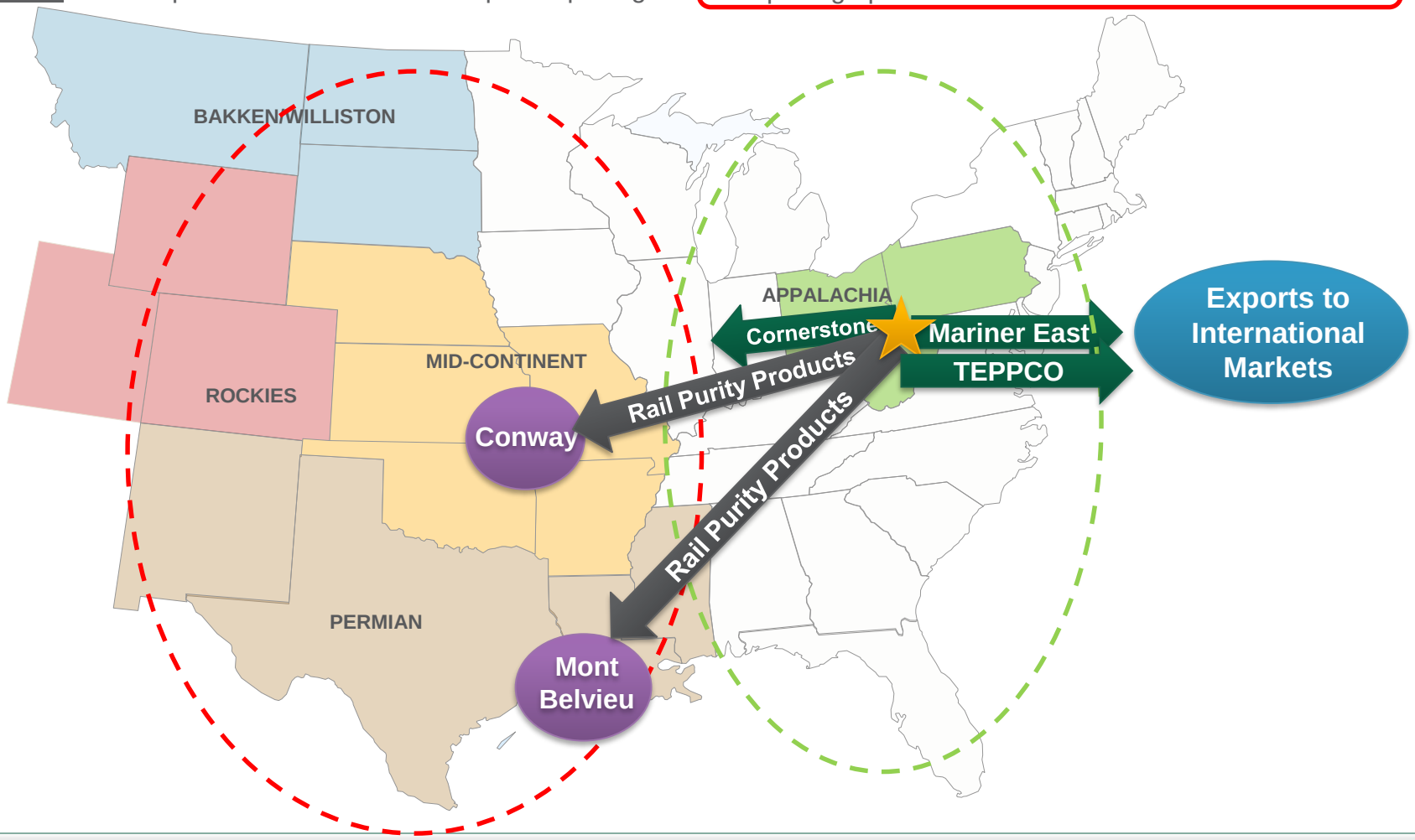
Appalachia: Geographic & Infrastructure NGL Advantaged

Permian, Rockies, Mid-Continent & Bakken

- Transport Y-grade for out-of-basin fractionation at Mont Belvieu and Conway
- Severely constrained fractionation, Y-grade transportation and NGL storage capacity
- Rapidly rising fractionation fees
- Midstream controls product destination and captures pricing uplift

Appalachia

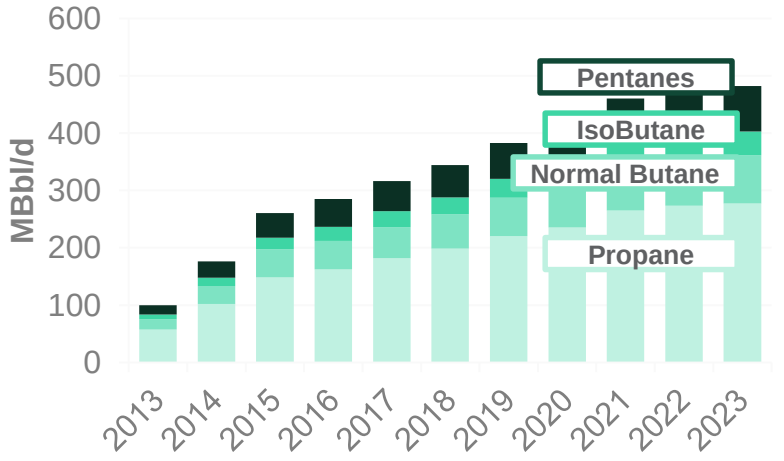
- In-basin fractionation
- Transport marketable purity products out-of-basin
- Sufficient fractionation capacity
- Fixed fractionation fees
- Producer controls product destination and captures pricing uplift



C3+ NGLs: Northeast Market Dynamics and Supply

Antero's C3+ differential to Mont Belvieu is expected to improve with the Mariner East 2 export takeaway and ability to access international markets

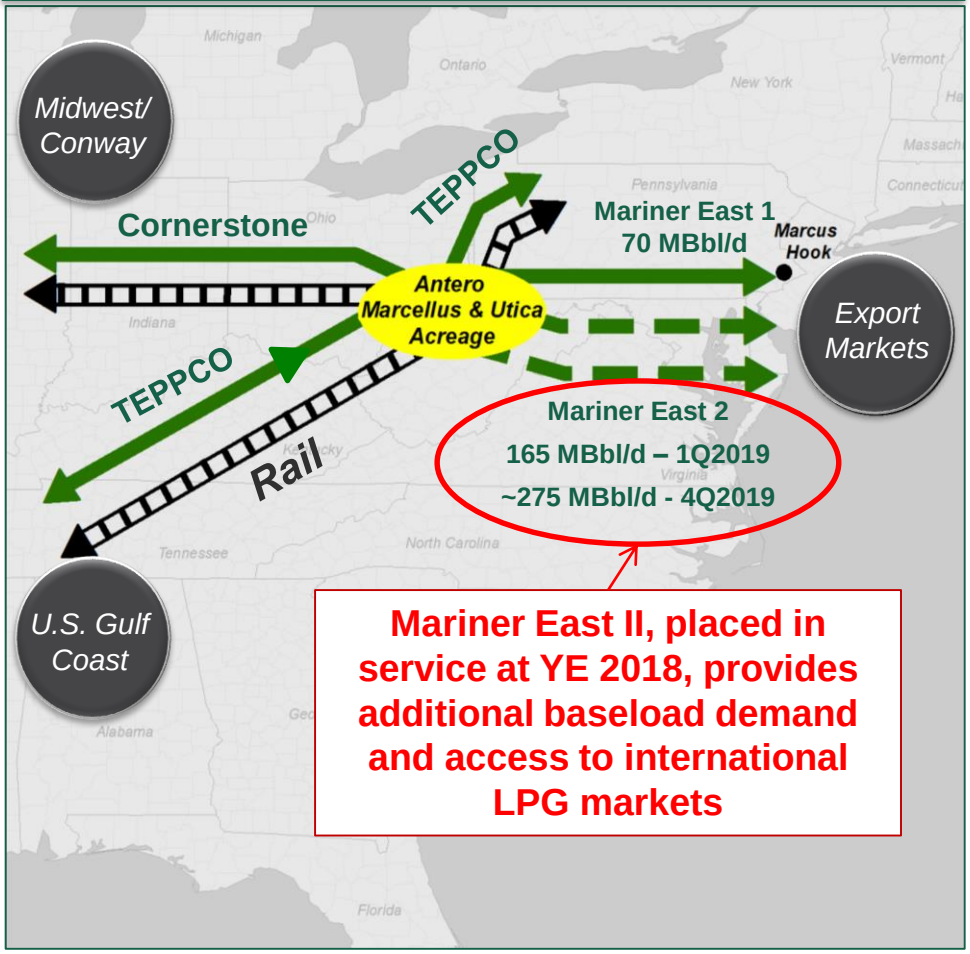
Northeast C3+ NGL Supply



~220 MBbl/d of Northeast C3+ **demand** vs.
~395 MBbl/d of Northeast **supply** in 2019
- Resulted in **56%** of production consumed locally
- Remainder moved primarily by rail and exported

Expect tighter differentials to Mont Belvieu in 2019 as ~150 MBbl/d of LPG exported via Mariner East 2

Northeast C3+ NGL Takeaway

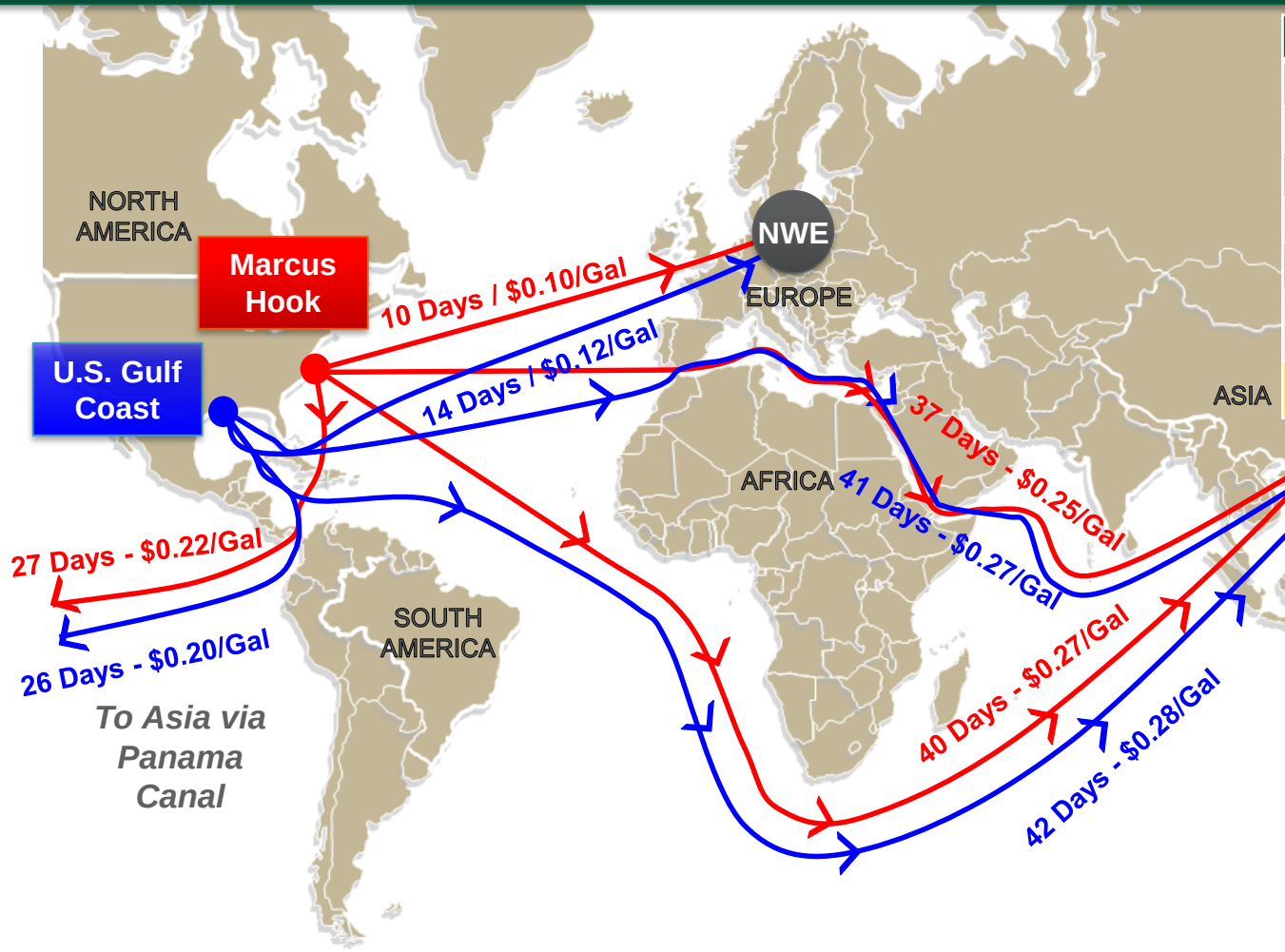


Source: S&P Global Platts as of 8/30/2019

LPG: Marcus Hook vs. U.S. Gulf Coast Shipping

Marcus Hook export facility in Appalachia is geographically advantaged for Northwest Europe cargos and at parity with Gulf Coast for Asia cargos

LPG Shipping Routes and 2019 Propane Netbacks ($/Gallon)



Antero Netback	2H2019
FEI Price ($/Gal)	$0.73
Pipeline & Terminal (1)	$(0.17)
Shipping	$(0.22)
Netback	$0.34
Mont Belvieu Price ($/gal)	$0.45
Mont Belvieu Netback at $0.25/gal Rail Cost	$0.20
Antero Uplift	**$0.14**

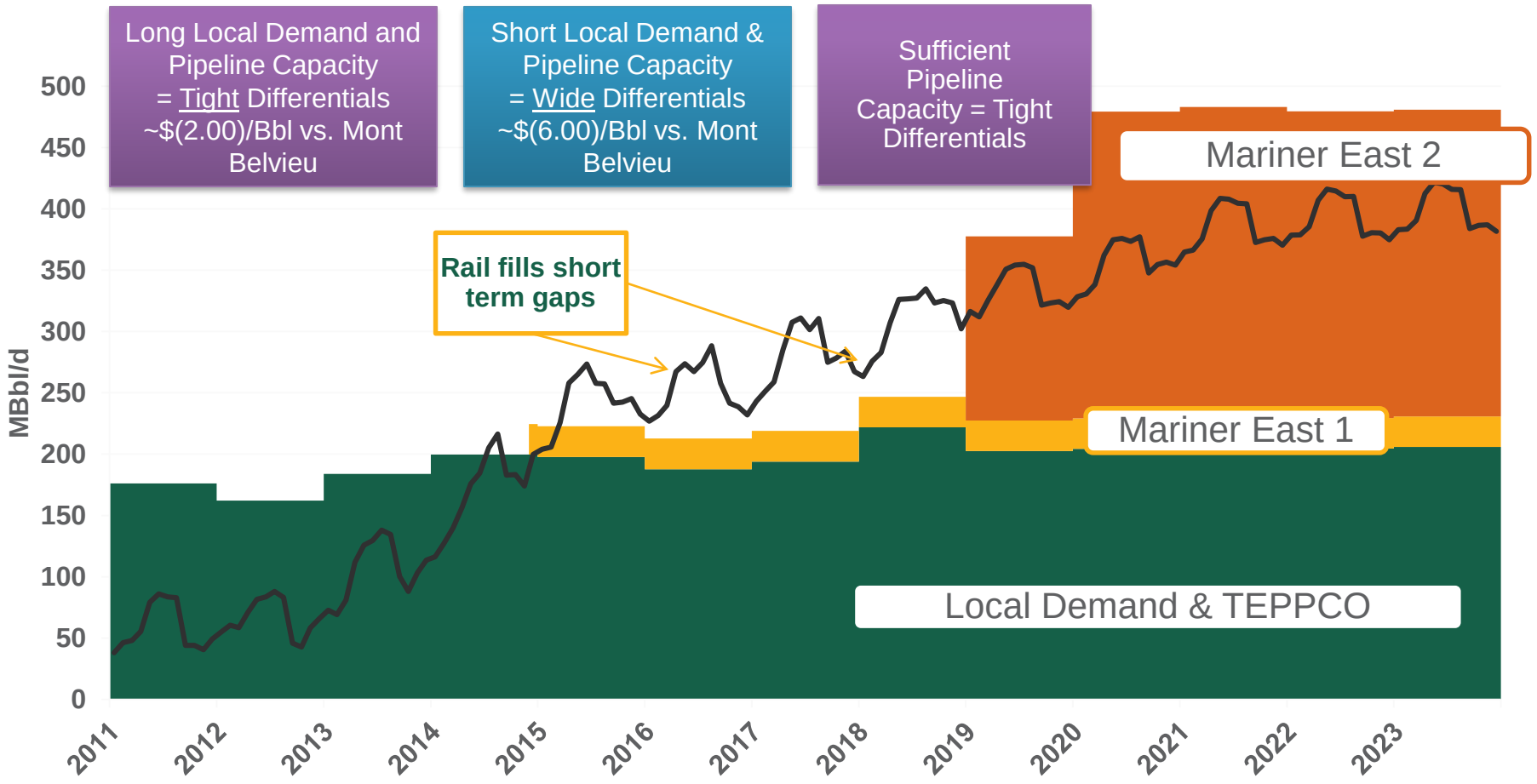
Antero Netback	2H2019
NWE Price ($/Gal)	$0.61
Pipeline & Terminal (1)	$(0.17)
Shipping	$(0.10)
Netback	$0.34
Mont Belvieu Price ($/gal)	$0.45
Mont Belvieu Netback at $0.25/gal Rail Cost	$0.20
Antero Uplift	**$0.14**

Source: Poten Partners. Prices reflect blended price of propane and butane based on Antero's ME2 volume commitment.
Note: Based on Baltic forward shipping rates and propane strip prices as of 8/29/19. Includes associated port and canal fees and charges.
(1) Based on Wall Street research. Antero cost may be lower.

LPG: Northeast Supply & Demand

Northeast LPG markets became oversupplied in 2015 and were forced to transport via rail, which was relieved by Mariner East 2

Northeast LPG NGL Supply vs. Demand & Takeaway Capacity (Excluding Rail)



Source: S&P Global Platts, Antero Company Estimates.

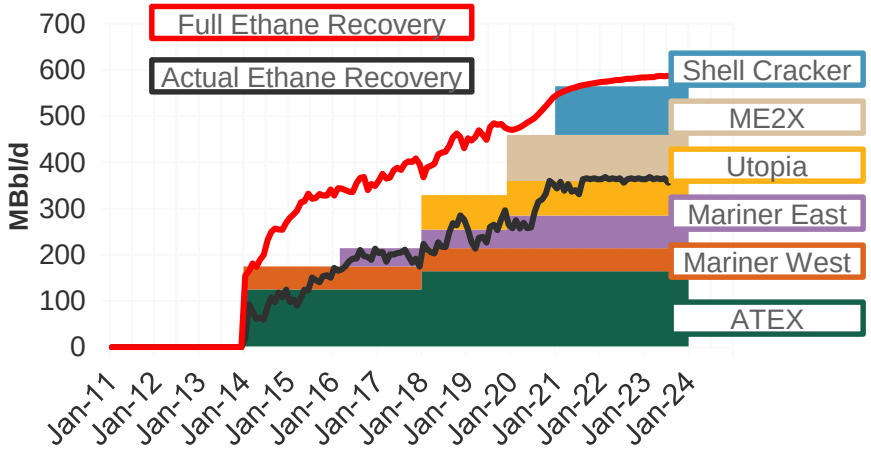
Antero's ethane has a natural gas value pricing floor; pricing improvements from additional petrochemical and takeaway demand is all "Upside"

~200 MBbl/d of ethane current rejected in Northeast (~45% of potentially recoverable ethane)

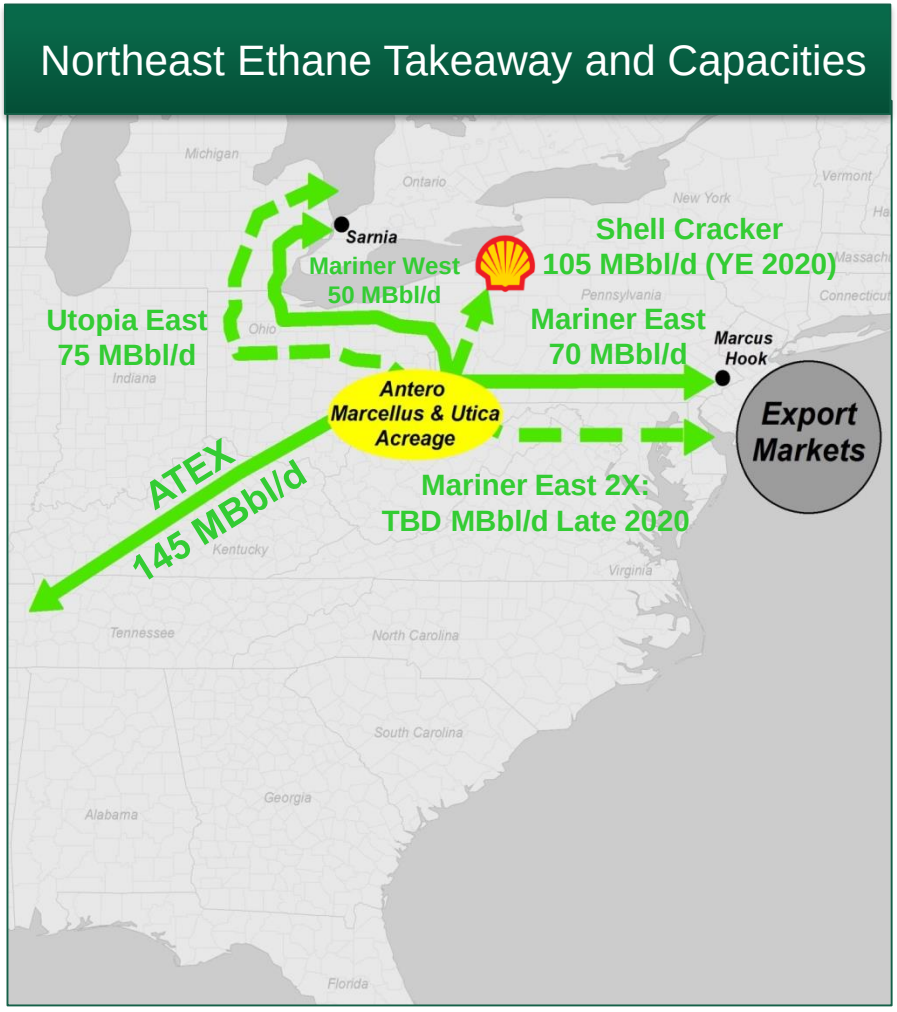
Antero is an anchor supplier to Shell's cracker expected by 2021

Antero ethane firm sales contracts ~50% gas-linked and ~50% Mont Belvieu-linked.

Northeast Ethane Supply (MBbl/d)



Northeast Ethane Takeaway and Capacities



Source: S&P Global Platts

Antero's First Ethane Export – November 2018

- **Antero's 11,500 Bpd C2 sales contract with Borealis commenced on November 1, 2018**
- **First ship departed Marcus Hook on November 26th with 337,000 barrels of ethane bound for Borealis' steam cracker in Stenungsund, Sweden**
- **Expect to load ~1 ship per month for duration of 10-year contract**

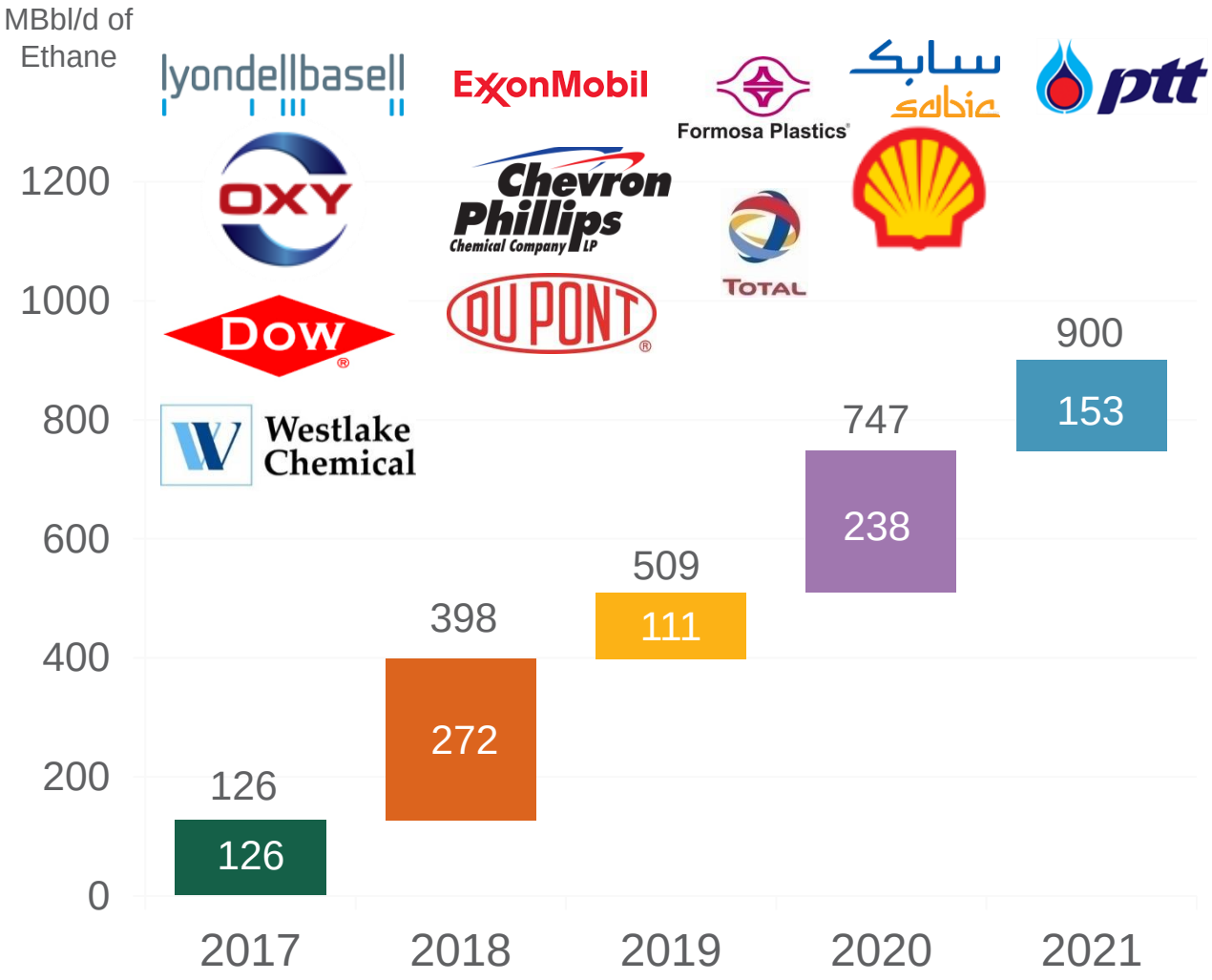
Ethane: Significant Demand Growth On Horizon

900 MBbl/d
of incremental ethane demand from 2016 to 2021

"First Wave"
Ethylene crackers under construction, some already complete

"Second Wave"
Next round of world scale crackers at or near FID (Exxon/SABIC, CP Chem/QP) will add demand in 2022+

Incremental U.S. Ethylene Plant Demand

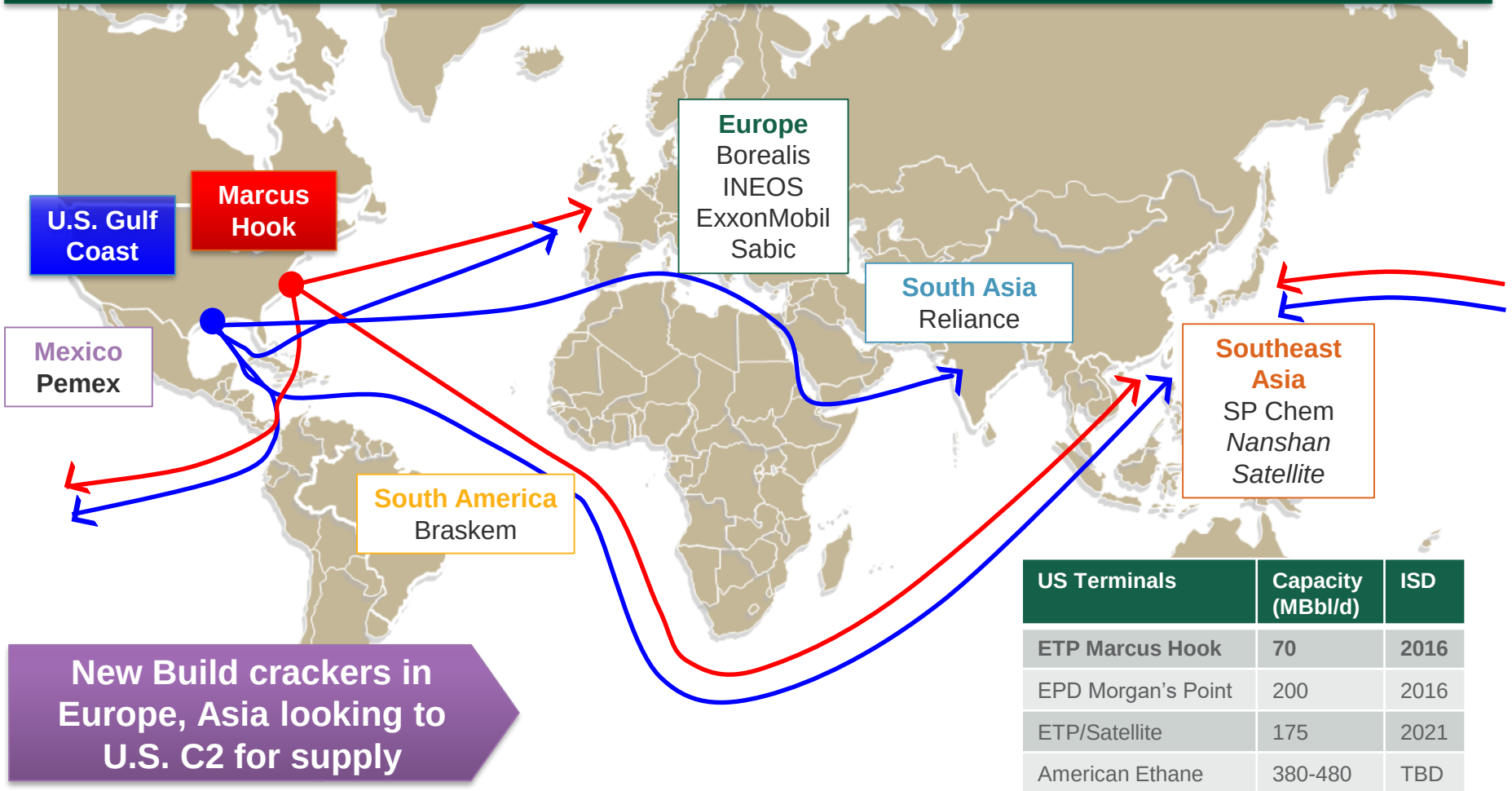


Source: S&P Global Platts , Company Reports

Ethane: Export Market Pulls Barrels Overseas

The ethane market continues to develop and creates opportunities for ethane sales outside of the domestic cracker pool

Ethane Export Suppliers and Customers



US Terminals	Capacity (MBbl/d)	ISD
ETP Marcus Hook	70	2016
EPD Morgan's Point	200	2016
ETP/Satellite	175	2021
American Ethane	380-480	TBD

New Build crackers in Europe, Asia looking to U.S. C2 for supply

Source: S&P Global Platts , Company Reports

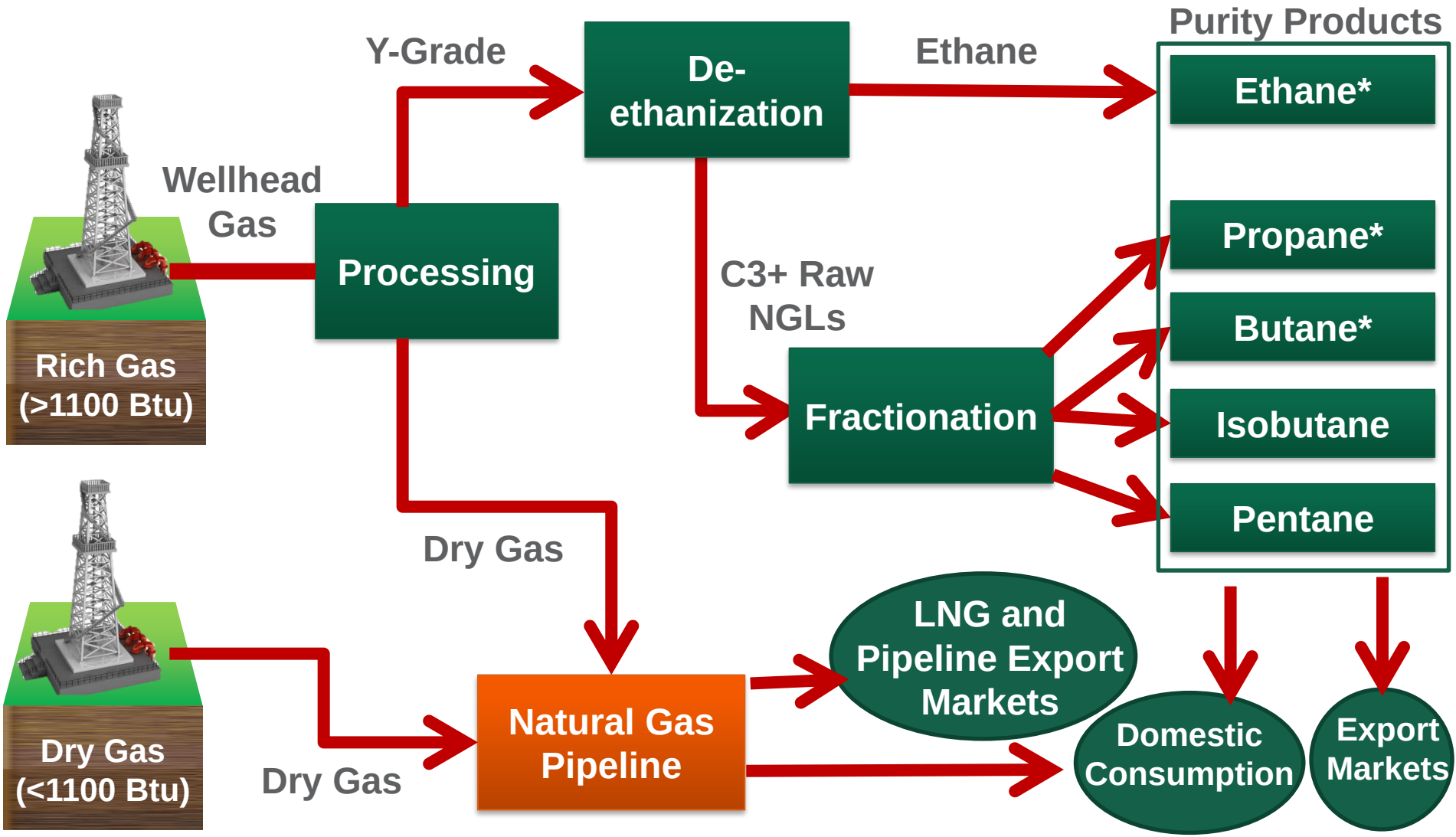
Appalachian producer advantage and "inelastic" international LPG demand underappreciated by the market

- ~130% increase in LPG export capacity from 2015-2020 allows U.S. domestic supply to reach global markets
- U.S. NGL differentials vs. global prices has shrunk by ~80% and benefits from premium Brent-linked pricing
- Inelastic global NGL demand growth from improvements in living standards and subsidies
- U.S. becoming a major global supplier as demand grows and export supply growth from the middle east slows
- Appalachian producer geographically advantaged vs. U.S. Gulf Coast and producers captures the uplift by selling at the export dock

Appendix

Natural Gas Liquids Primer

Natural Gas Liquids "NGLs" are contained in the rich natural gas stream, but after processing, condense into liquid form for storage, shipping and consumption



**Primary NGL export products are propane, butane, and ethane*

NGLs play an essential role in the domestic and international industrial, residential, commercial and transportation industries

Gas Linked Pricing → **Crude Linked Pricing**

	Methane	Ethane	Propane	Butane	Iso-Butane	Pentane
	Natural Gas	C2	C3	C4	IC4	C5
Primary Sectors	All	Chemical Industrial	Industrial Residential Commercial, Chemical	Industrial Transportation	Industrial	Transportation
Primary Uses	Power	Ethylene Production (For plastics)	Heating, Crop drying, Commercial, Propylene	Winter Gasoline Blending	Alkylate feed to produce gasoline	Gasoline blend and diluent

Higher Heating Value

1000 Btu → **4000 Btu**

Global PDH Buildouts

China New Build PDH plants	Est. Propane Demand (Mb/d)	In-Service Date
Zhejiang Satellite	18	In-service
Shenzhen Juzhengyuan, Guandong (South)	24	In-service
Hengli Petrochemical, Dalian (East)	10	3Q2019
Fujian Meide Petrochemical (PDH)	27	2H 2019
Oriental Ningbo Zhejiang (East)	27	2H 2019
Zhejiang Petrochemical	24	2H 2019
Oriental Lianyungang, Jiangsu	27	TBD
Jiangsu Weiming (East)	27	TBD

European New Build PDH plants	Est. Propane Demand (Mb/d)	In-Service Date
Borealis - Kallo, Belgium	31	2022
INEOS - ARA Area	31	2022
PDH Polska - Police, Poland	16	1H2022

Source: Poten and Partners