

STRATAS
ADVISORS
A HART ENERGY COMPANY



Appalachian Petrochemical Demand– The 5 W's

Pittsburgh, PA

Wednesday 01/25/2016

Greg Haas, Director of Integrated Energy, Stratas Advisors

UPSTREAM | MIDSTREAM | DOWNSTREAM | FUEL & TRANSPORT

DISCLAIMER

This Presentation contains forward-looking statements, including, but not limited to, statements regarding the value and effectiveness of Stratas Advisors' services, that involve risks, uncertainties, assumptions and other factors which, if they do not materialize or prove correct, could cause Stratas Advisors results to differ materially from those expressed or implied by such forward-looking statements. All statements, other than statements of historical fact, are statements that could be deemed forward-looking statements, including statements containing the words "predicts," "plan," "expects," "anticipates," "believes," "goal," "target," "estimate," "potential," "may," "will," "might," "could" and similar words. Stratas Advisors intends all such forward-looking statements to be covered by the safe harbor provisions for forward-looking statements contained in Section 21E of the Exchange Act and the Private Securities Litigation Reform Act of 1995. Actual results may differ materially from those projected in such statements due to various factors, including but not limited to: risks and uncertainties inherent in our business; our ability to attract new customers and retain existing customers; our ability to effectively sell, service and support our products; our ability to manage our international operations; our ability to compete effectively; our ability to develop and introduce new products and services or enhancements to existing products; our ability to continue to promote and maintain our brand in a cost-effective manner; our ability to manage growth; our ability to attract and retain key personnel; the scope and validity of intellectual property rights applicable to our products; adverse economic conditions in general and adverse economic conditions specifically affecting the markets in which we operate.

Past performance is not necessarily indicative of future results. The forward-looking statements included in this presentation represent Stratas Advisors' views as of the date of this presentation. Stratas Advisors anticipates that subsequent events and developments will cause its views to change. Stratas Advisors undertakes no intention or obligation to update or revise any forward-looking statements, whether as a result of new information, future events or otherwise. These forward-looking statements should not be relied upon as representing Stratas Advisors' views as of any date subsequent to the date of this presentation.

© 2016 Stratas Advisors. All rights reserved. Stratas Advisors is a trademark or registered trademark of Hart Energy Publications, LLLP in the U.S. and other countries. Other company names, product names and company logos mentioned herein are the trademarks, or registered trademarks of their owners. This material may not be published, broadcast or distributed in whole or part without express written permission of Stratas Advisors.

Agenda – 5 W's of Appalachian NGL Demand

What

Who

Where

Why

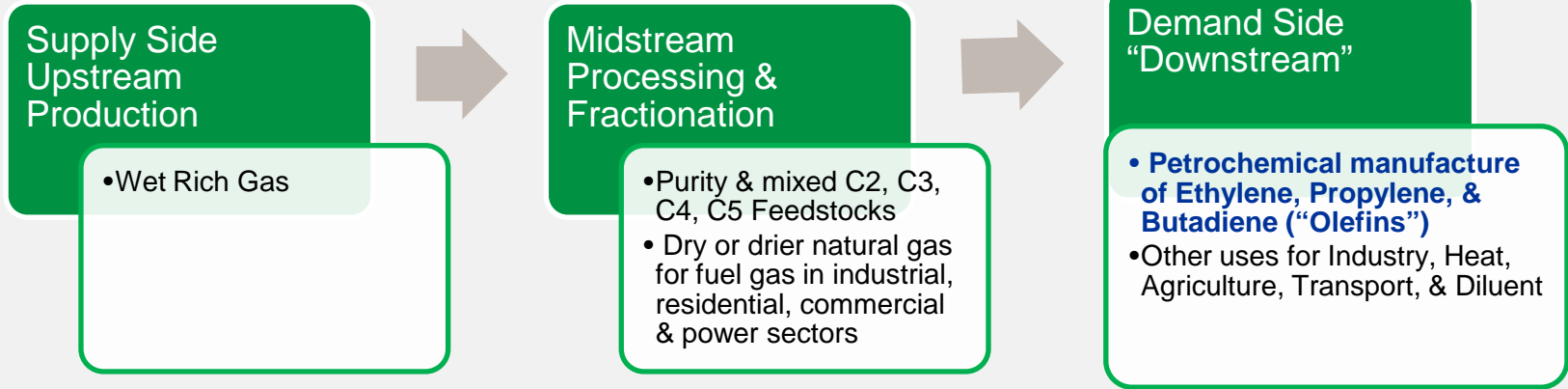
When



What

Petrochemicals Join NGLs within the Energy “Fullstream”

Gas/NGL



Oil



Source: *Stratas Advisors North American NGL Service*

© Stratas Advisors. All rights reserved.

N. Am. Ethylene Producers Shifting to Light NGL Feedstock



Source: Nova Chemicals Corp.

- The Nova Chemical's Corunna plant is newly reconfigured to convert ethane sourced from Appalachia to ethylene.
- In prior decades, the plant was integrated with a former NOVA crude oil refinery onsite (now shuttered) which yielded naphtha that was consumed as feedstock at its ethylene cracker.
- This facility, about 180 miles southwest of Toronto, supplies between 30% and 40% of Canada's total requirements for primary petrochemicals.

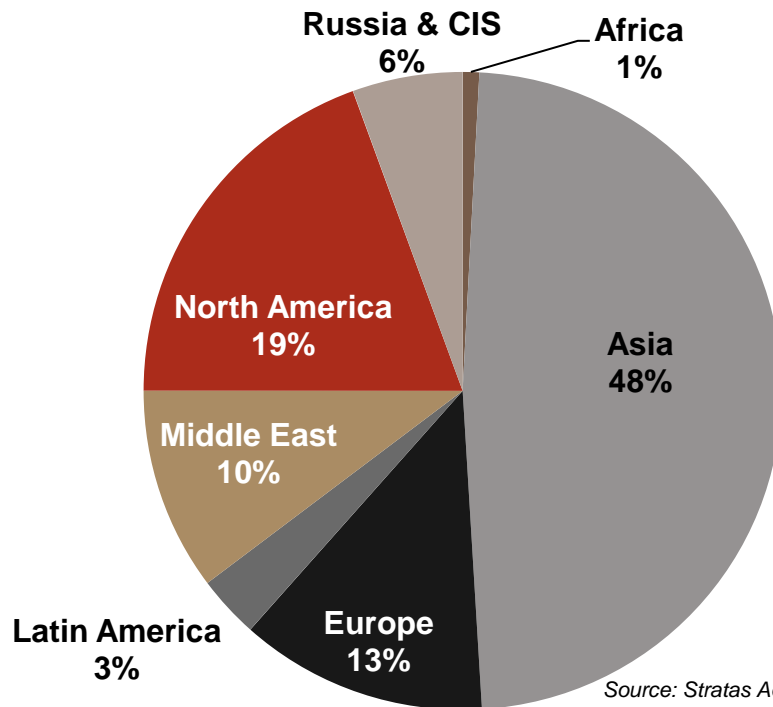


Who

Modern Society Needs Petrochemicals and Plastics

Olefins like Ethylene & Propylene are the world's number one highest volume traded chemical

2015 Demand for Ethylene/Propylene: 204 MMtpa



Source: *Stratas Advisors North American NGL Service*

North America's Ethylene Cracker Operators



The U.S. olefins manufacturing industry is presently comprised of 16 independent chemical manufacturers or 'integrated' oil/gas/petchem firms

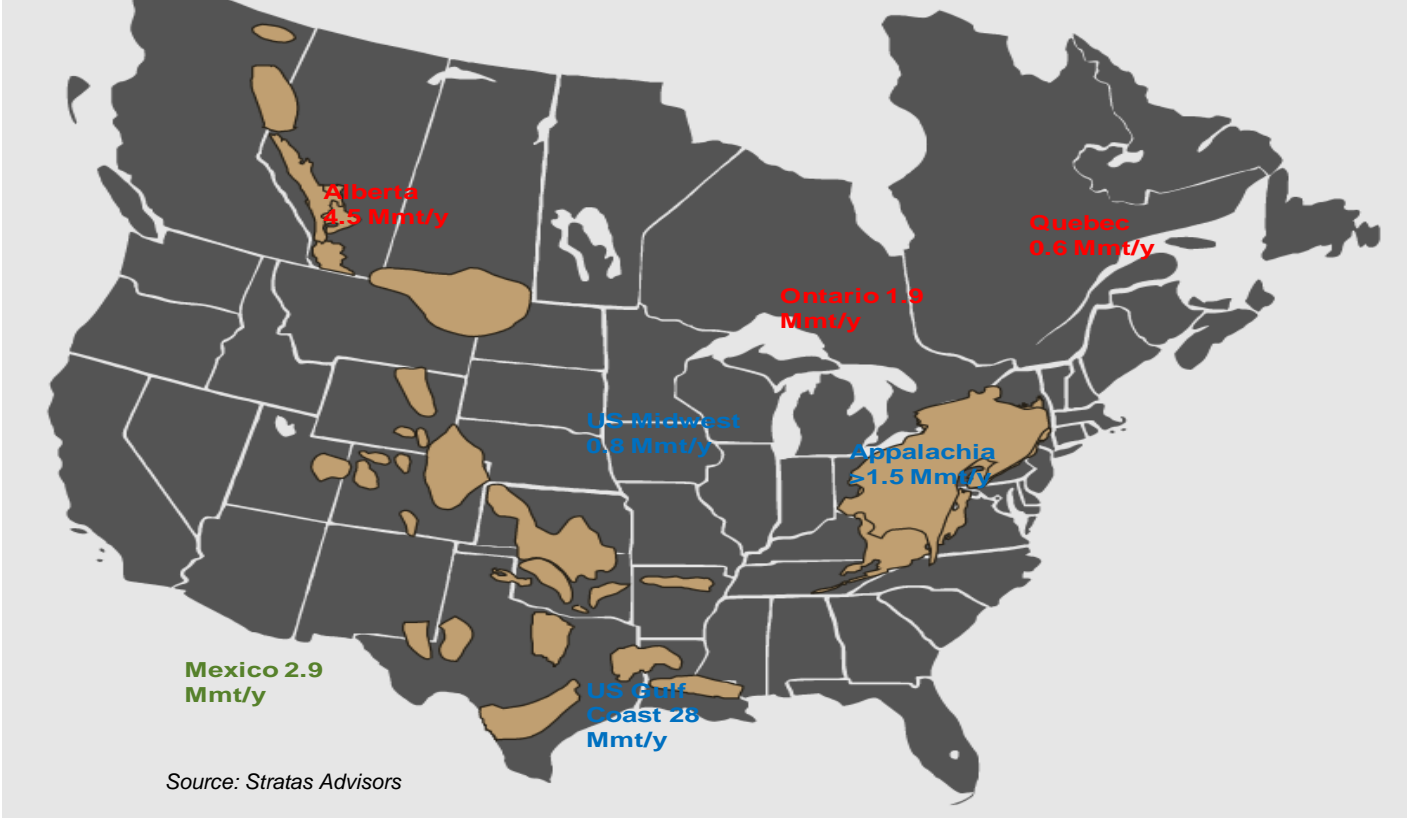
Canada's olefins industry presently consists of 1 integrated energy and 2 independent chemicals manufacturers

Source: U.S. Energy Information Administration, *Notations by Stratas Advisors*

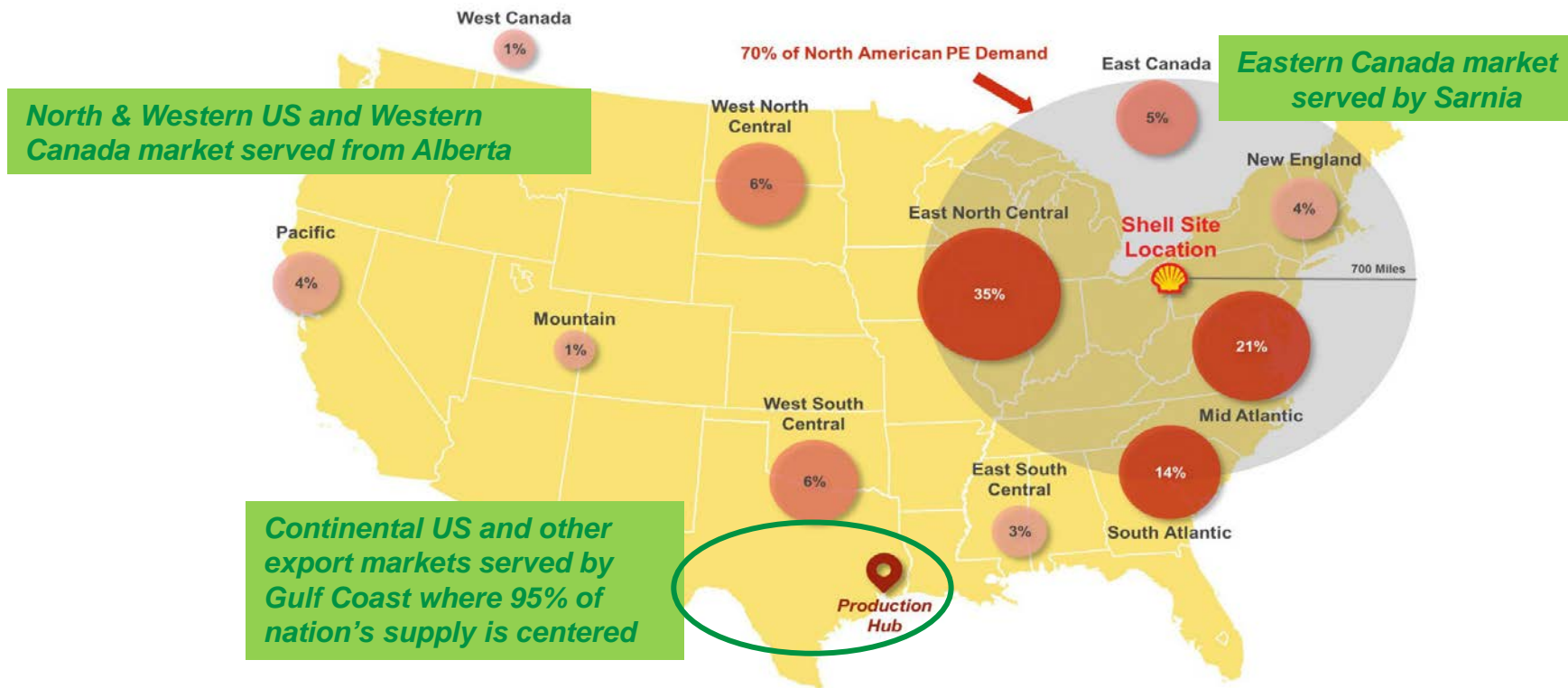


Where

Existing North American Ethylene Manufacturing Hubs



Feedstock & Fuel Supply Matters More than Demand

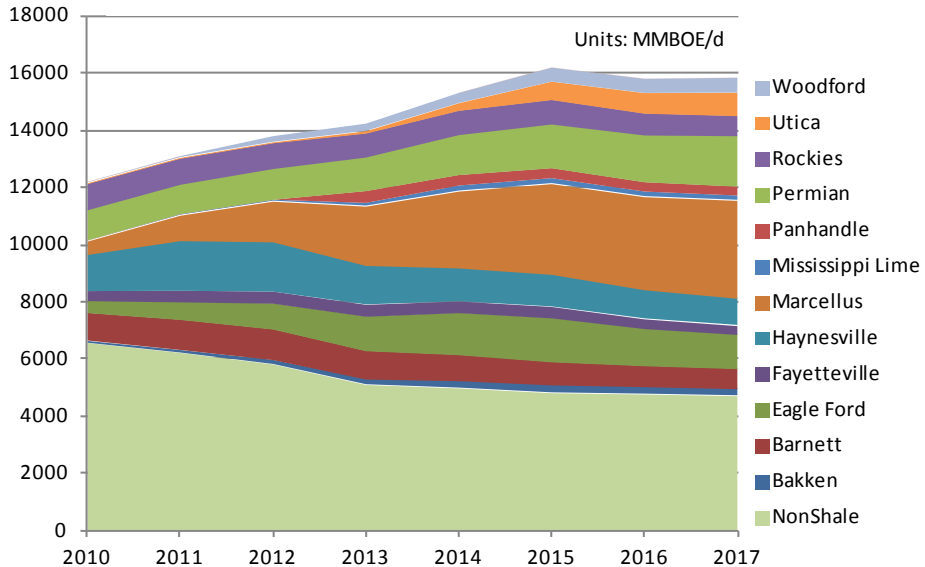


Source: Base image by Shell . Further Annotation by Stratas Advisors

Appalachia Supply Growth Boosted De-Ethimizer Recovery

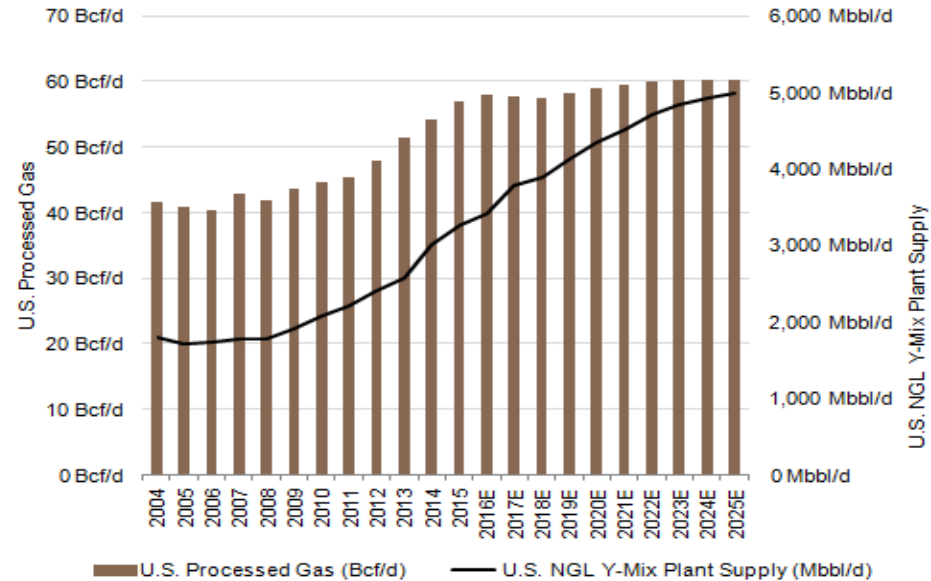
Lower drilling drives lower wet gas supply - only C2 recovery keeps NGL supply on a growth trajectory.

US Wet Gas



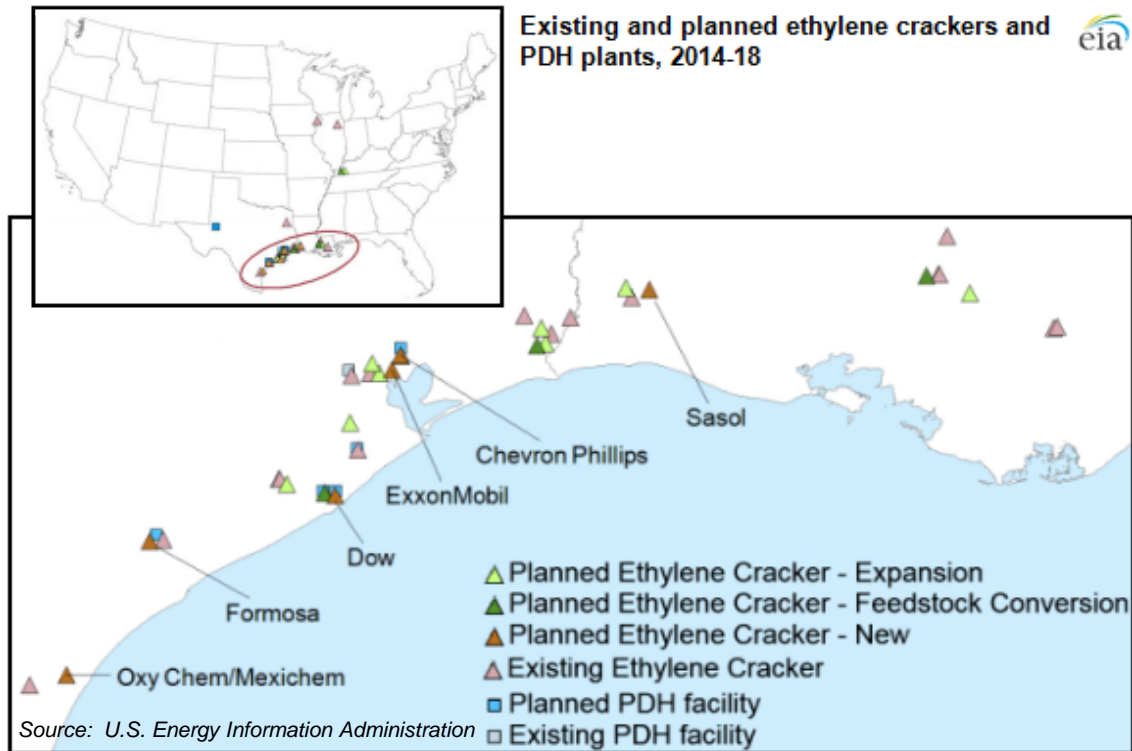
Source: Stratas Advisors North American NGL Service

Processed Gas & Recovered NGL



Cracker Expansion Ongoing in Supply Regions

The Gulf Coast hosts the most



Cracker Expansion Ongoing in Supply Regions

The Gulf Coast hosts the most

ANNOUNCED ETHYLENE CRACKERS UNDER PREPARATION/CONSTRUCTION				CAPACITY MTPY	ONLINE YEAR	C2 FEED MBBL/D
Westlake Chemicals Corp.	Lake Charles Expansion	Lake Charles	LA	114	2016	7.0
Dow Plaquemine	Plaquemine	Plaquemine	LA	250	2016	15.3
LyondellBasell Industries NV	Corpus Christi	Corpus Christi	TX	364	2017	22.2
Indorama Corp. & Ventures	Carlyss	Calcasieu Parish	LA	400	2017	23
Chevron Phillips Chemical Co. LLC	Cedar Bayou Plant	Baytown	TX	1501	2017	91.6
Exxon Mobil Corp.	ExxonMobil Baytown	Baytown	TX	1500	2017	91.5
Dow Chemical Co.		Freeport	TX	1501	2017	91.6
Oxychem -Mexichem		Ingleside	TX	545	2017	33.2
Formosa Plastics Corp. America	Point Comfort	Point Comfort	TX	1590	2017	97.0
Westlake Chemicals Corp.	OpCo	Calvert City	KY	32	2017	2.0
Shintech Inc.	Iberville Parish	Plaquemine	LA	500	2018	30.5
Nova Chemicals	Corunna Plant	Ontario	Canada	4	2018	0.2
Sasol Ltd.	Sasol Lake Charles	Lake Charles	LA	1500	2019	91.5
Axiall Corp. / Lotte Chemical Corp.	LACC LLC	Lake Charles	LA	1000	2019	60.5
Royal Dutch Shell	Beaver County	Monaca	PA	1500	2021	91.5

Source: Company disclosures with estimates and forecasts by Stratias Advisors North American NGL Service

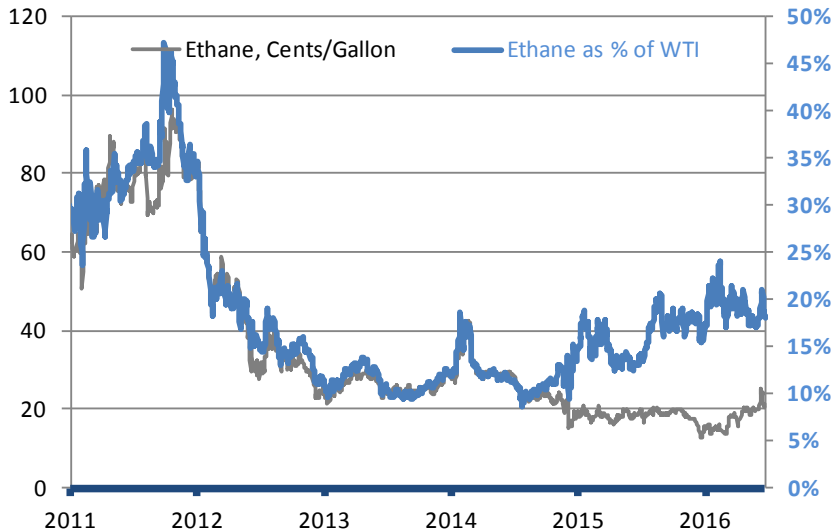


Why

Ethane More Economical for Ethylene Production

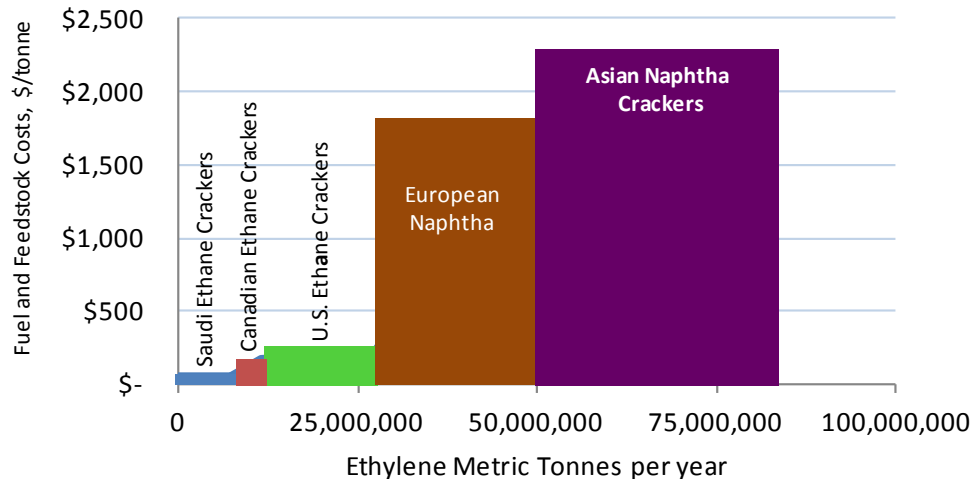
Ethylene from ethane uses less feedstock which can be bought at lower price and cracked with less fuel use

Relative Hydrocarbon Benchmark Prices



Source: Stratas Advisors, Bloomberg, EIA

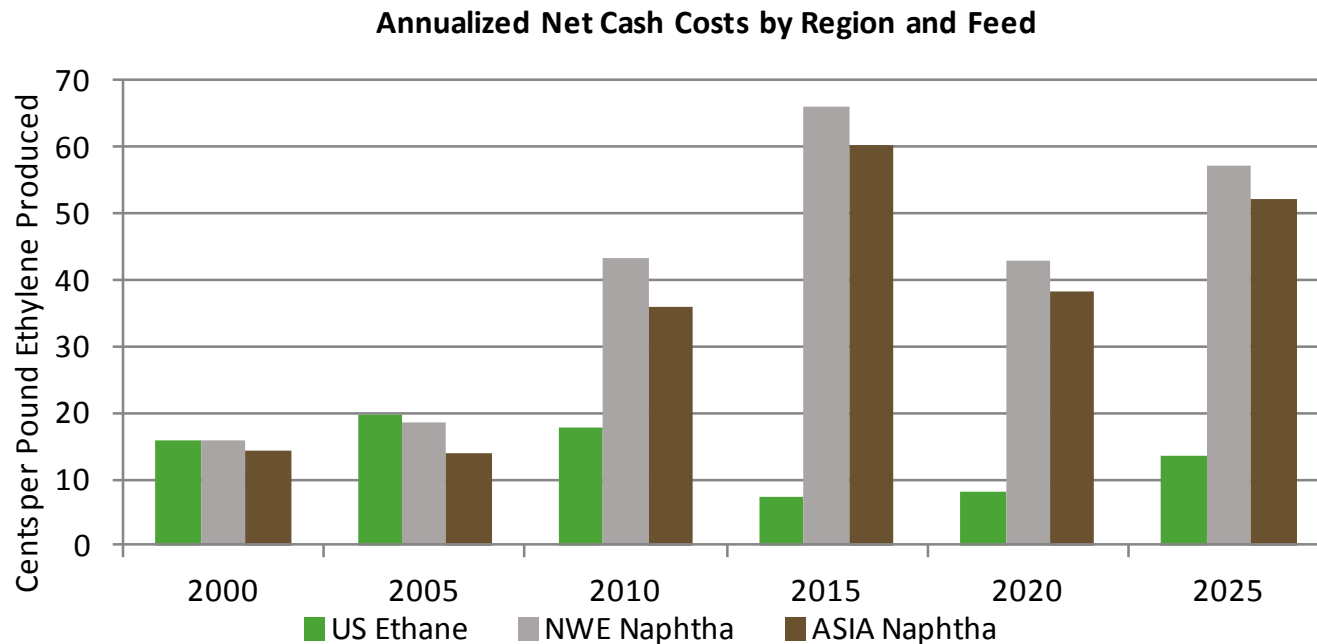
Global Ethylene Gross Cash Costs in 2015



Source: Stratas Advisors North American NGL Service

Ethane's 5x Advantage: Making ethylene with naphtha requires more feedstock (0.6 gal vs 0.4 gal of C₂) bought at higher oil-linked price, pyrolyzed with higher use of costlier fuel oil in a complex plant costing 50% more to construct.

We Forecast Lower Ethane Cash Costs vs. Globe



Low cost ethane and fuel as a result of shale oil and gas resources enables N. Am. ethylene producers to have significant and enduring competitive advantage versus global competitors



When

Shell is the First in Appalachia

Who will be first to be second?



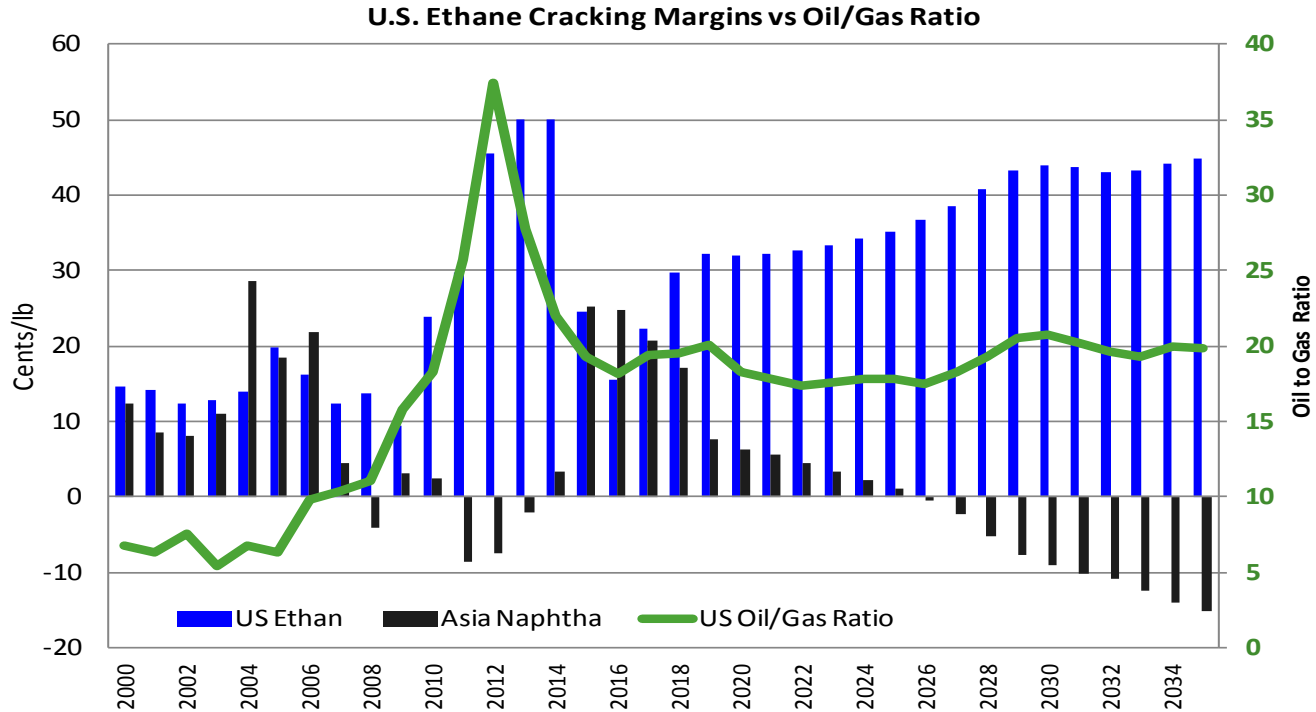
Using our estimate of ~100 Mbbbl/d ethane, we believe Appalachia has room for another.

Global petchem competitors like PTT know it too.

Source: Base image by Shell. Further annotations by Stratas Advisors

US Ethane Advantages Persist Through Recovery

As oil prices rebound , US ethane crackers likely to rake it in while global naphtha crackers feel impacts



Source: *Stratas Advisors North American NGL Service*

Pending(?) Expansions in Supply Regions

'2nd Wave' of petchem expansion shows more diverse site selections across producing areas

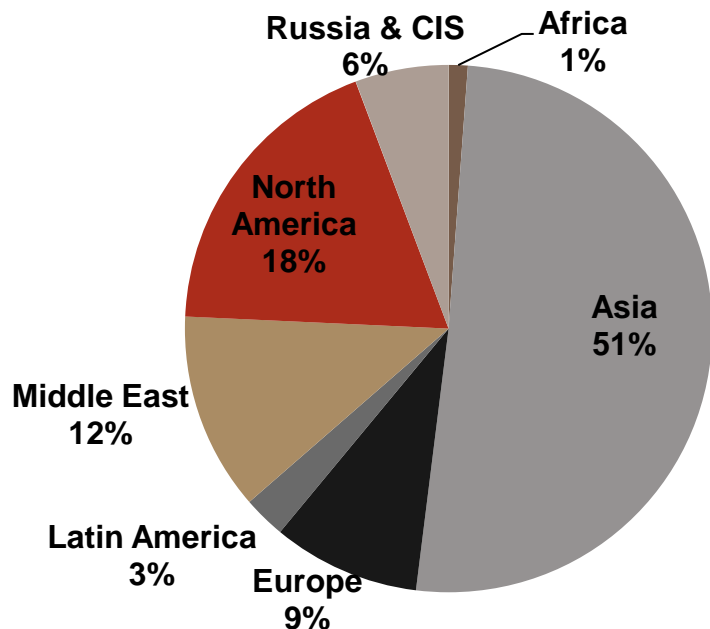
PROPOSED AND PRE-FID				CAPACITY		C2 FEED
ETHYLENE CRACKERS				MTPY	ONLINE YEAR	MBBL/D
Total	Port Arthur	Port Arthur	TX	1000	2023E	61.0
ExxonMobil / Sabic		Corpus Christi	TX	1800	2023E	110
Ineos Group Ltd.	Chocolate Bayou Plant	Houston Area	TX	450	2023E	27.45
PTT Global Chemical/Marubeni	Mead Township	Belmont Co.	OH	1000	2023E	61
Nova Chemicals	Corunna	Corunna	Ontario	500E	2023E	30
Braskem Americas	ASCENT (Appalachian Shale Cracker Enterprise)	Parkersburg, Wood County	WV	1000	2025E	61
Badlands NGLs LLC		Williston	ND	2000	2021E	122
POSTPONED INDEFINITELY OR CANCELLED						
Aither Chemicals		Charleston	WV	270	2024E	55
Appalachian Resins Inc.		Monroe Co.	OH	231	2022E	47.1

Source: Company disclosures, estimates & forecasts by Stratas Advisors

Future Ethylene Demand Outlook vs. N. Am Capacity Growth

Could the shale oil and gas glut flow downstream all the way to petrochemicals?

**2030 Demand for Ethylene/Propylene:
253 MMtpa**



Source: *Stratas Advisors North American NGL Service*

- 12.4 MMtpa of new ethylene capacity in 1st wave by 2021
- 7.8 MMtpa in 2nd wave announced and possible by 2025
- N. Am. petchem manufacturers must capture share since they are likely to expand well beyond our N. Am. petchem demand growth forecast of 7.3 MMtpa or 19% up by 2030 (representing a 1.1% CAGR from 2015)
- If all announced/possible 1st and 2nd wave plants are built, these will represent 41% of our conservative global growth forecast of 49 MMtpa over the next 15 years (1.4% CAGR from 2015).



Key Points

Key Points from the 5 W's:

Thanks to shale, the petchem industry is a key link in the North American “fullstream” energy industry

Petchem & plastic firms choose NGL/Oil supply regions to manufacture for local or export markets. New hubs need critical mass, access to workforce, land & logistics, supportive local authorities/communities

“1st Wave” of US crackers to tighten ethane supply while “2nd Wave” will pull up ethane prices & monetize the recovery of rejected ethane for use as cracker feedstock.

Bulk ethane export growth should stagnate amid tight US ethane supply & price ramp up. But we expect c5+/condensate to lead Appalachian NGL export growth for new Canadian pipeline diluent .

Further expansion in N. Am. cracker fleet must see higher oil prices and field production growth in the upstream amid plastics demand growth & closure of naphtha-based downstream competitors

N. Am. ethane cracker advantages persist through price recovery cycle. Further, “If Trump does cut business tax from 35% to 15%, that would help our U.S. affiliate a lot to report better profits and to further boost the U.S. economy,” - Jason Lin, chairman of Formosa Plastics



Questions & Answers in Adjacent Room

Greg Haas, Director, Stratas Advisors, ghaas@stratasadvisors.com 713-260-5201



UPSTREAM | MIDSTREAM | DOWNSTREAM | FUEL & TRANSPORT
Strategic Insights Across The Energy Value Chain

1616 S. Voss Road | Suite 675 | Houston, TX 77057 | +1.713.260.5201
Bogotá | Brussels | Denver | Houston | London | Melbourne | Mexico City
New Delhi | New York | San Diego | São Paulo | Singapore | Washington, DC