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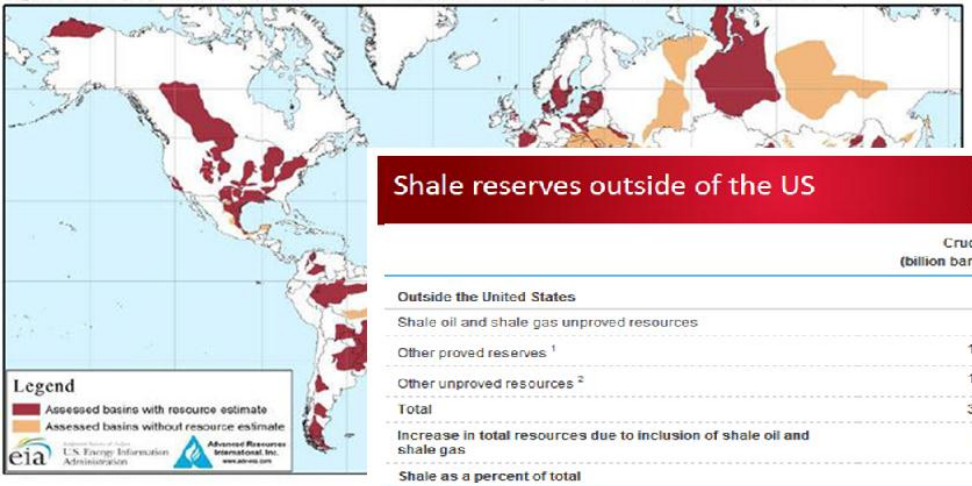
Shale gas, crude and the impact on petrochemical production



Shale reserves outside of the US

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	Crude oil (billion barrels)	Wet natural gas (trillion cubic feet)
Outside the United States		
Shale oil and shale gas unproved resources	287	6,634
Other proved reserves [1]	1,617	6,521
Other unproved resources [2]	1,230	7,296
Total	3,134	20,451
Increase in total resources due to inclusion of shale oil and shale gas	10%	48%
Shale as a percent of total	9%	32%

Countries with technically recoverable shale oil resources:

1. Russia – 75 billion barrels
2. US – 58 billion barrels
3. China – 32 billion barrels
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7. Venezuela and Mexico – 13 million barrels

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Kevin Allen – Sr. Managing Editor

Platts Petrochemical Forum 2013

Agenda

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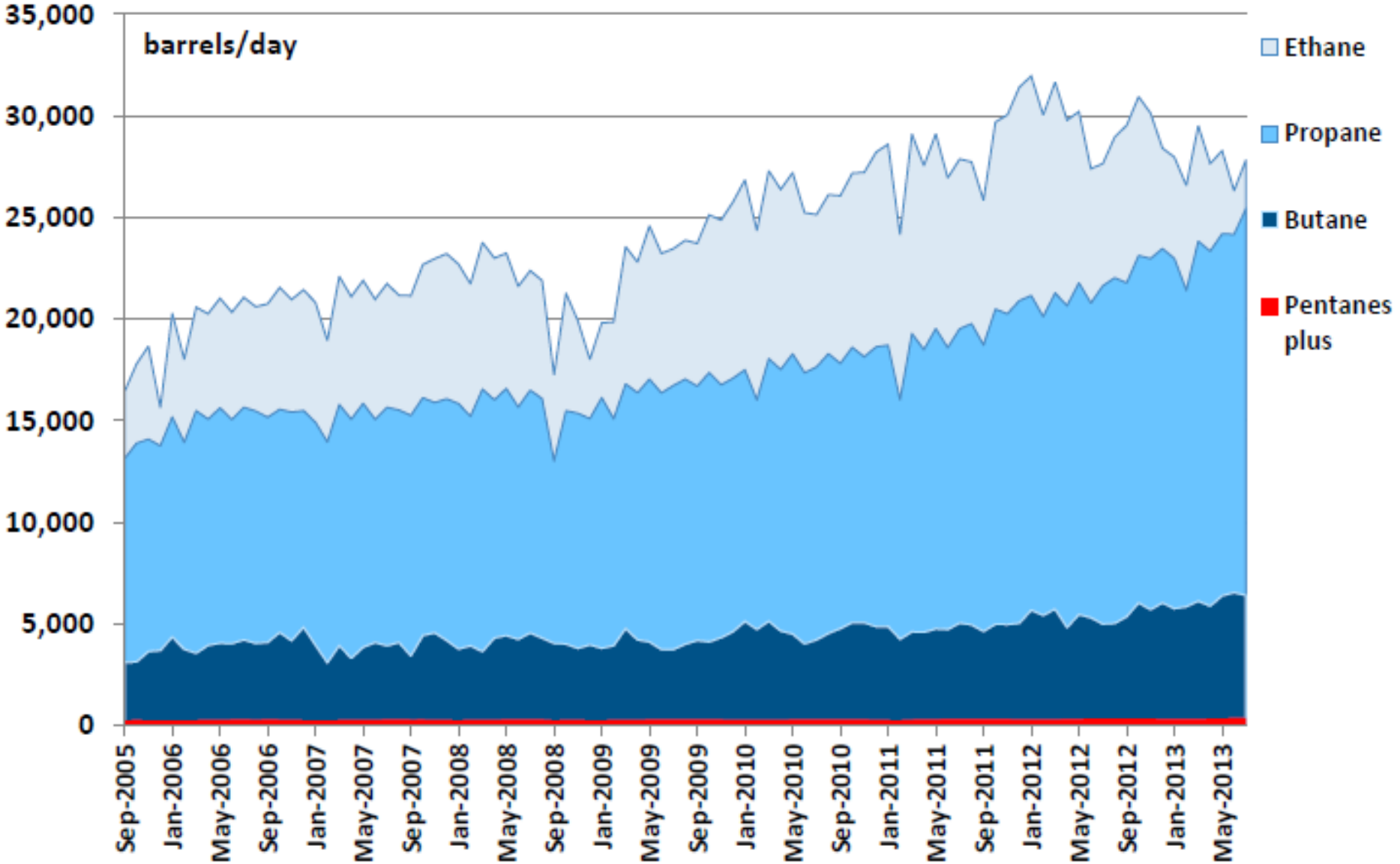
- NGL production growth and impact on petrochemicals in the US
- Cheap gas spurs expansions and new products across the industry
- Potential hurdles to new steam cracker projects
- Negative impact of cracking lighter feeds: the case of propylene
- Shale not a US phenomenon
- Growth in US crude and naphtha production
- Why timing matters
- Conclusions

NGL production continues to surge



Source: EIA

Crude to gas ratio still quite favorable

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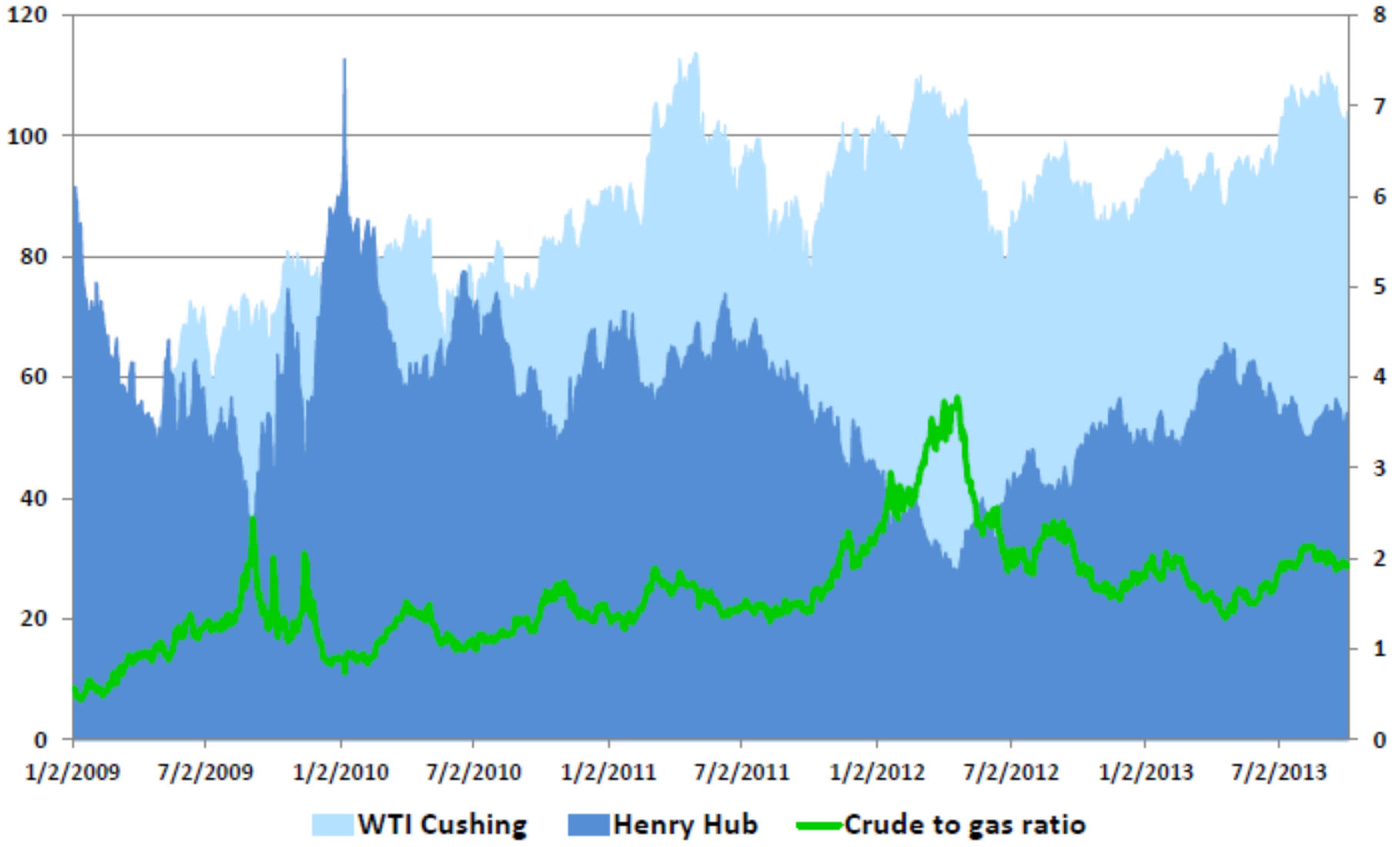

A Wave of New Cracker Projects And Expansions

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New builds

Company	Location	MM mt/yr	ETA
Braskem/Idesa	Veracruz, Mexico	1.05	2015
Aither Chemical/RMG	TBD/USNE	0.20-0.30	2016
ExxonMobil Chemical	Texas	1.5	2016
Formosa Plastics USA	Texas	0.8	2016
ChevronPhillips Chemical	Texas	1.5	2017
Dow Chemical	Texas	1.5	2017
Sasol	Louisiana	1.5	2017
Occidental/Mexichem	Texas	0.55	2017
Shell Chemical	Pennsylvania	1-1.50	2017

Expansions

Company	Location	MM mt/yr	ETA
BASF-Total	Texas	0.06	2012
Dow Chemical (restart)	Louisiana	0.40	2012
Westlake Chemical	Louisiana	0.11	2013
Williams	Louisiana	0.23	2013
Ineos	Texas	0.12	2013
Westlake Chemical	Kentucky	0.08	2014
BASF-Total	Texas	0.10	2014
Westlake Chemical	Louisiana	0.11	2015
LyondellBasell	Texas (3)	0.83	2014-16
Dow Chemical	TX/LA (2)	0.40	2014-16

Platts Petrochemicals Analytics: Shale Gas to Polyethylene

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Launched Nov 14, 2013

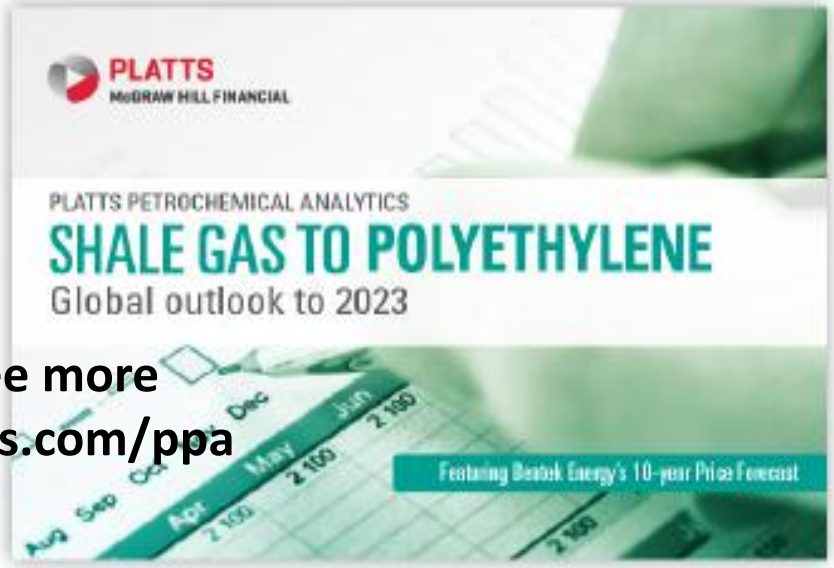
Contents:

1. Modeled Data

Quarterly refreshed, 30 Excel worksheets

2. Analysis Report

Quarterly refreshed, PDF of 48 pages



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Purpose:

Explains how and when cheap US NGLs from Shale Gas will be turned into new PE exports and disrupt global PE trade flows

Features:

10 year PE supply / demand forecasts

10 year global cracker capacity & future projects

10 year NGL price forecast for the US

Integrated upstream to downstream analysis

Surplus/deficit & trade flow analysis

Transparent modeling formulas & methodology

Shale gas and the methanol comeback

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Company	Location	Capacity kt/yr	Date SU expected
OCI Beaumont	Beaumont, TX	750	2012 (completed)
Methanex (debottleneck)	Medicine Hat, Alberta	90	Q3 2013 (completed)
LyondellBasell	Channelview, TX	780	Q4 2013
Methanex I (relocation)	Geismar, LA	1000	H2 2014
G2X Energy	Pampa, TX	65	Q2 2014
OCI Beaumont (debottleneck)	Beaumont, TX	125	Q4 2014
Celanese/Mitsui	Clear Lake, TX	1300	Q2 2015
Methanex II (relocation)	Geismar, LA	1000	2016
Valero	St. Charles, LA	1600	Q1 2016
South Louisiana Methanol	St. James, LA	1800	Q1 2016
Lake Charles CE/BP	Lake Charles, LA	1000	2017

Other projects and expansions

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- Westlake announced expansion of its 1.1 billion lbs/year PVC facility at Calvert City, Kentucky. The project is slated to be complete in late 2014 and should add an additional 200 million lbs/year of new capacity.

- Shintech announced in June that it would expand its vinyls capacities in Louisiana by 2015. The company will increase its caustic production by about 200,000 mt/year, VCM by 300,000 mt/year and PVC by 300,000 mt/year.

- Huntsman is slated to increase its ethylene oxyde capacity at Port Neches, Texas by Q2, 2015. The expansion will increase the companies current one billion lbs/year capacity by 25%.

Not all that glitters is gold: Hurdles for new cracker projects

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Costs: New steam cracker and derivative units can cost anywhere between $1-5 billion. Brownfield projects are substantially cheaper at under $500 million.

Timing: Those late to the game could miss out on the cost advantage. Brownfield projects advantaged in this area.

Permitting: Environmental groups likely to protest new projects and that could delay progress. Time is money.

Craft Availability: If all announced projects in the US are realized, there will not be enough skilled labor to build and operate these plants. Engineering firm Fluor anticipates that 40,000-50,000 skilled resources will be needed at the building peak in 2014-2015.

Overbuilding: Overbuilding supplies to lengthen and depresses prices.

What is all means.

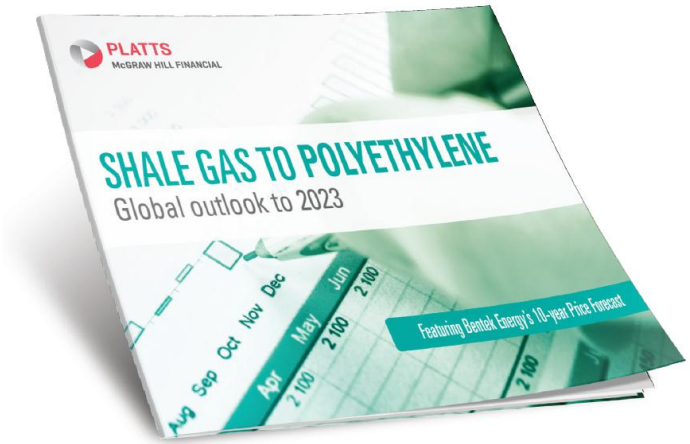
Click here to watch.

How will US shale gas affect the future of global polyethylene supply?

Featuring Shahrin Ismaiyatim, Jim Foster, and Max Yong

November 7, 2013 17:00:00 EST (9:04 mins)

With petrochemicals markets in the US resurgent as a consequence of the shale gas boom, Shahrin Ismaiyatim, Jim Foster, and Max Yong discuss what this could mean for North American polyethylene production by 2021; whether China and its coal resources and new methanol-to-olefins (MTO) plants could be the real game changer for petrochemicals production; and how the US will compete for market share in Latin America, the Middle East, and Asia.



Cracking light creates also production imbalance

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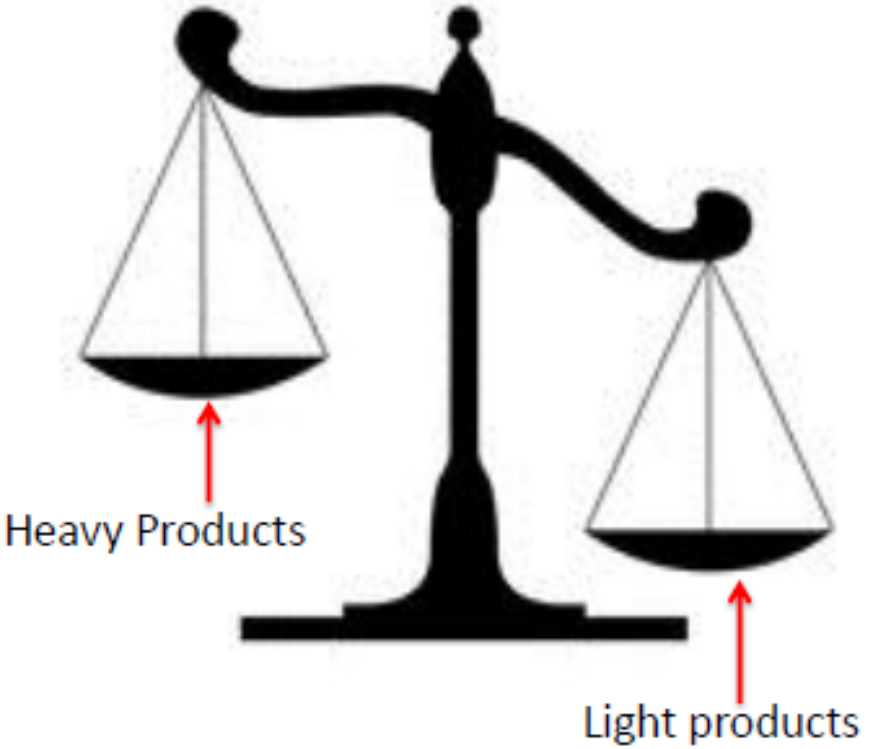
- Shifts in feedslate can create imbalance. For instance, prices for chemicals produced en masse are likely to face downward pressure.
- Ethylene and derivatives to fare well short term though will face pressure as supply increases.
- Heavy products such as propylene, C4, butadiene and aromatics will see pricing supported by a short market.



Shale gas and the case of propylene

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- Switching to NGLs as a feedslate, specifically ethane and E/P mix, cuts propylene output by well over 50%.
- Propylene output from the steam cracker has fallen sharply and the propylene to ethylene ratio was just over 19.5% to close out 2012.
- Shortage has prompted new PDH capacities which could total an additional 3.8 million mt/year by 2016, assuming all projects a realized.

Company	Location	Capacity (mt/year)	ETA
Dow Chemical	Freeport, TX	750,000	2015
Enterprise	Mont Belvieu, TX	750,000	Q3, 2015
C3 Petrochemicals	Alvin, TX	1,200,000	H2, 2015
Formosa	Point Comfort, TX	600,000	2016
Williams	Redwater, Alberta	500,000	2016
*Dow Chemical	TBD	TBD	2018
*Enterprise	Mont Belvieu, TX	TBD	TBD

The example of polypropylene

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- Total propylene output from steam crackers in the US in 2012 was just under 4.4 million mt. Output from new cracker projects expected to be about 392,500 mt.
- If all on purpose PDH units, not currently under study but including Williams Alberta unit, come to fruition, propylene supply in the US will increase 3.8 million mt.
- Adding it all up, propylene supply from crackers and PDH will total just under 8.6 million mt by 2016
- To meet anticipated polypropylene demand in the North America in 2015 (estimated at just over 8.5 million mt), monomer supplies would need to be just under 8.725 million mt.
- Factor in continued growth in PP consumption at 2.5% per year and North American demand for propylene in 2016 would be 8,942,161 mt meaning the monomer shortfall in 2016 would be over 200,000 mt/year.
- Presuming consumption levels hold steady, total propylene demand needed for PP would be just under 9.165 million mt in 2017.

Platts New Report & Modelled Analysis

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Request a free trial of: Shale Gas to Polyethylene Report: Global outlook to 2023

The shale gas revolution is rapidly changing the US ethane, ethylene and polyethylene supply equation, with direct implications for global trade flows of polyethylene between key production and consumption regions.

Platts Shale Gas to Polyethylene Report helps you understand how today's wide cracking margins are incentivizing a rush for new capacity and how this might erode the US feedstock advantage after 2017.

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Estimations do not account for other derivatives

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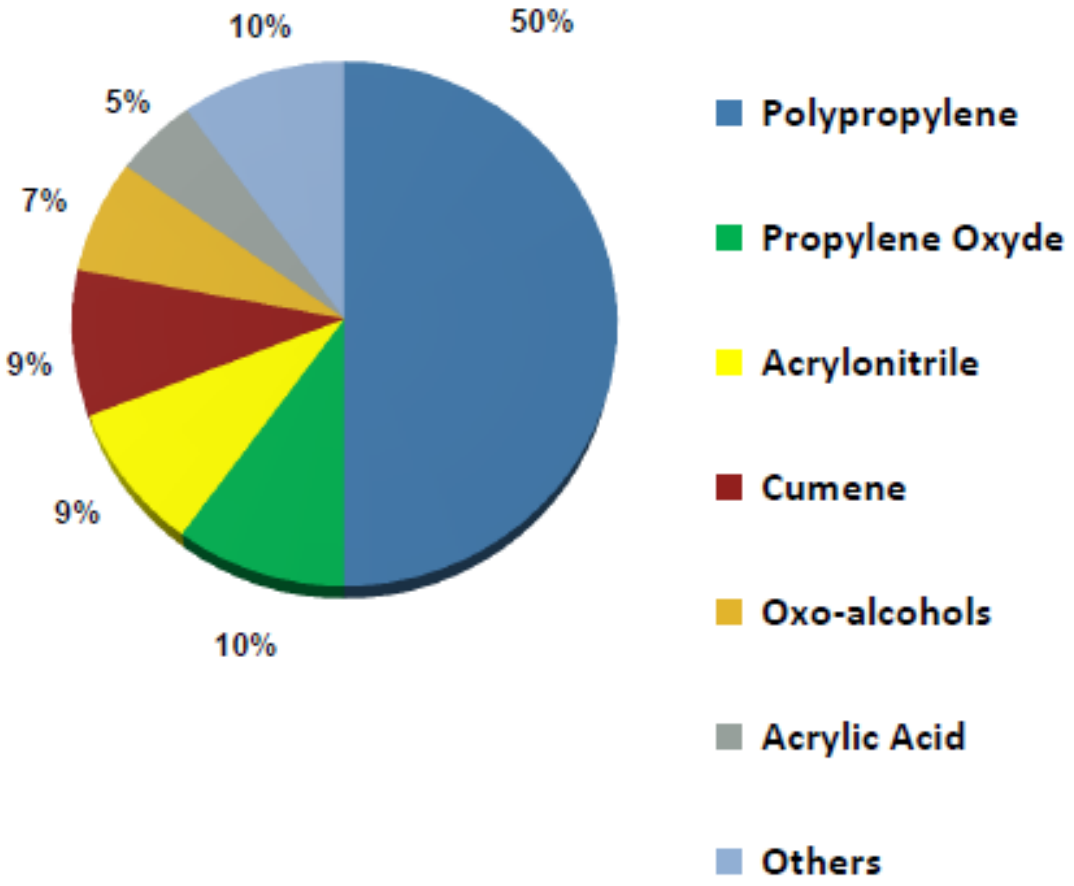
- Heavy focus on polypropylene as it accounts at least 50% of propylene demand however these estimations do not consider derivative demand from other sectors.
- Following polypropylene, propylene oxide and acrylonitrile are the two largest segments at accounting for a combined 19% of propylene demand.
- Cumene accounts for another 9% while the oxo-alcohols segment accounts for 5% of propylene demand.



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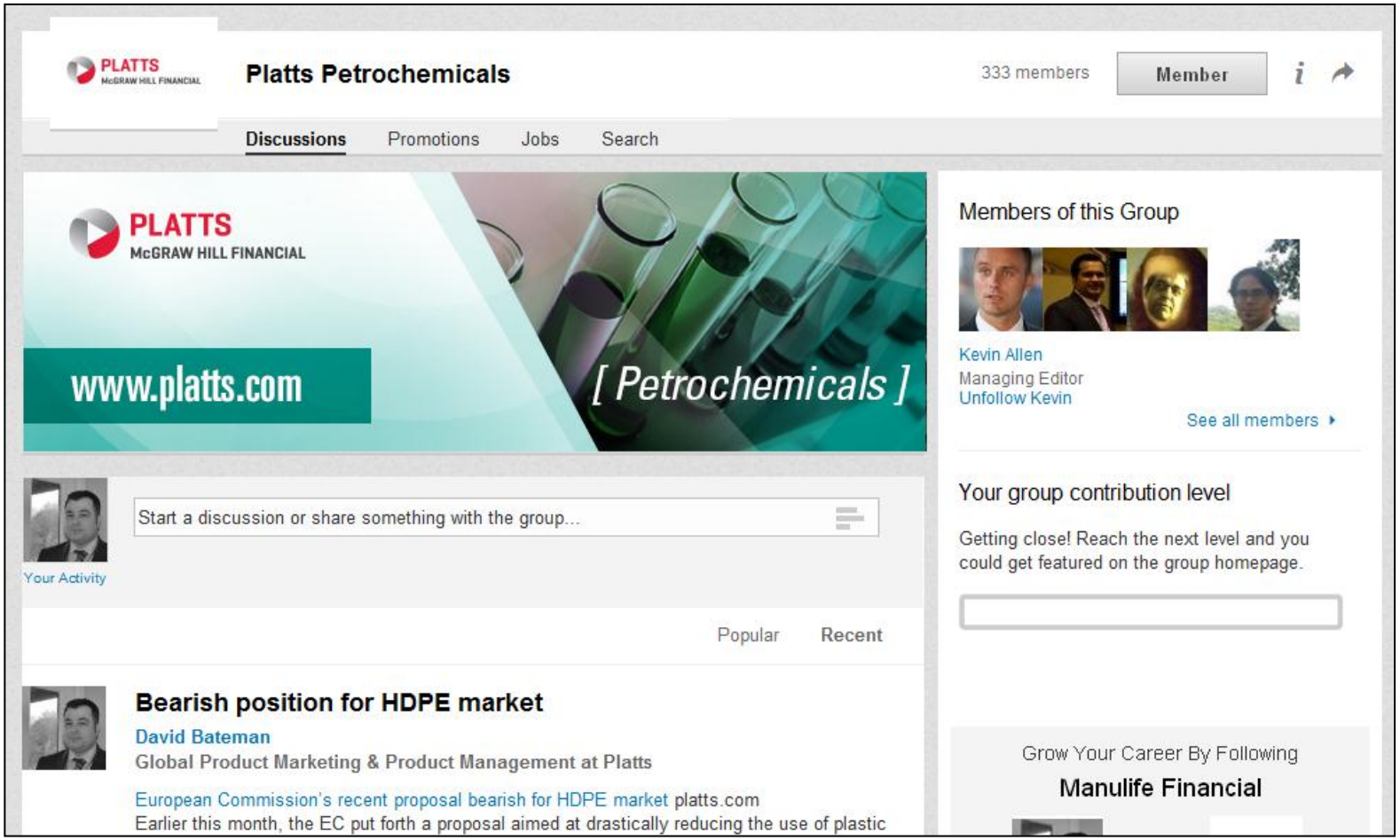

Why naphtha could remain a viable feedstock

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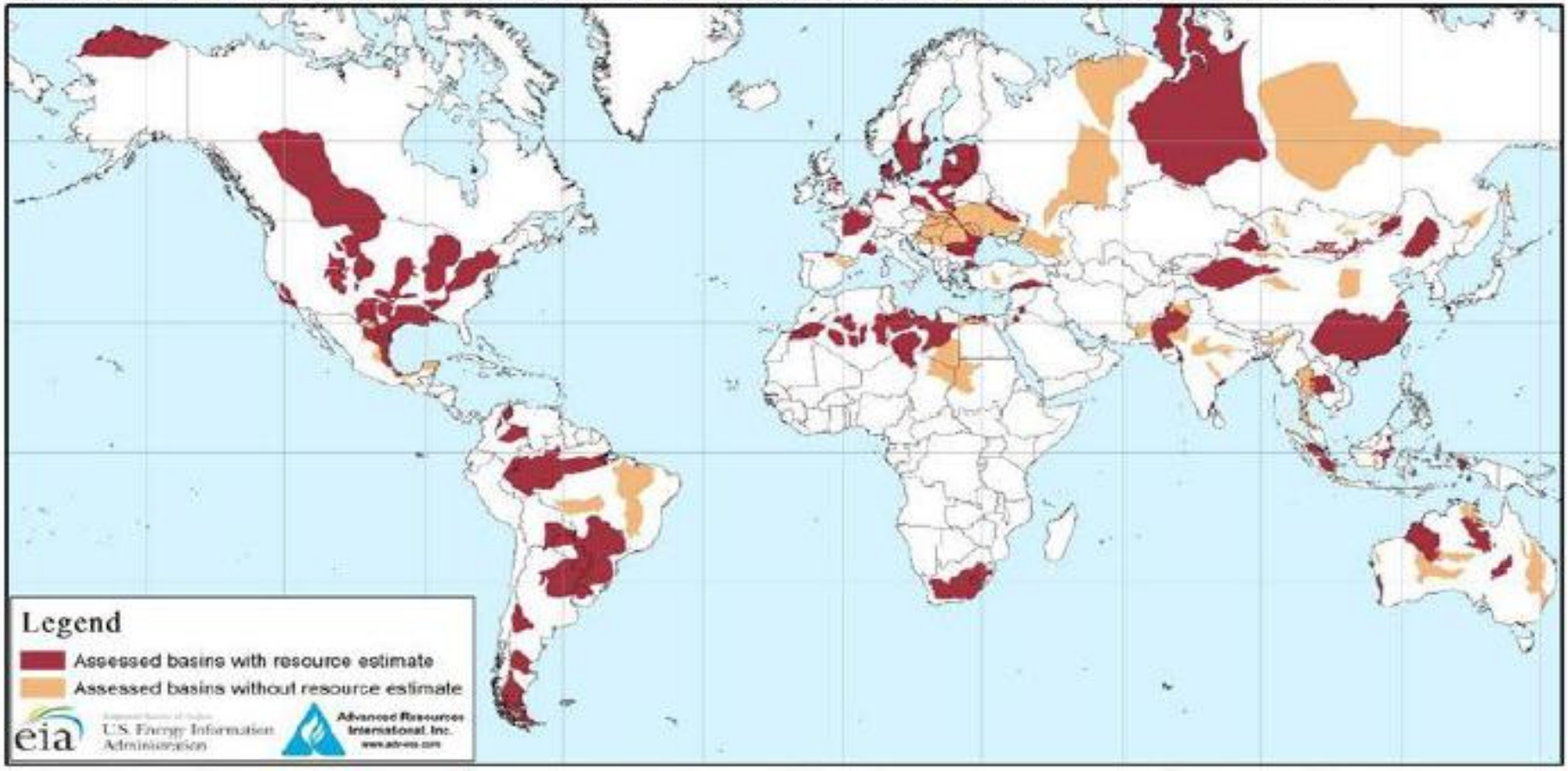
- Shale gas is not strictly a North American phenomenon and can be found in other regions. It is only a matter of time before others begin extracting shale gas and US producers lose their cost advantage.

Figure 1. Map of basins with assessed shale oil and shale gas formations, as of May 2013



Source: United States basins from U.S. Energy Information Administration and United States Geological Survey; other basins from ARI based on data from various published studies.

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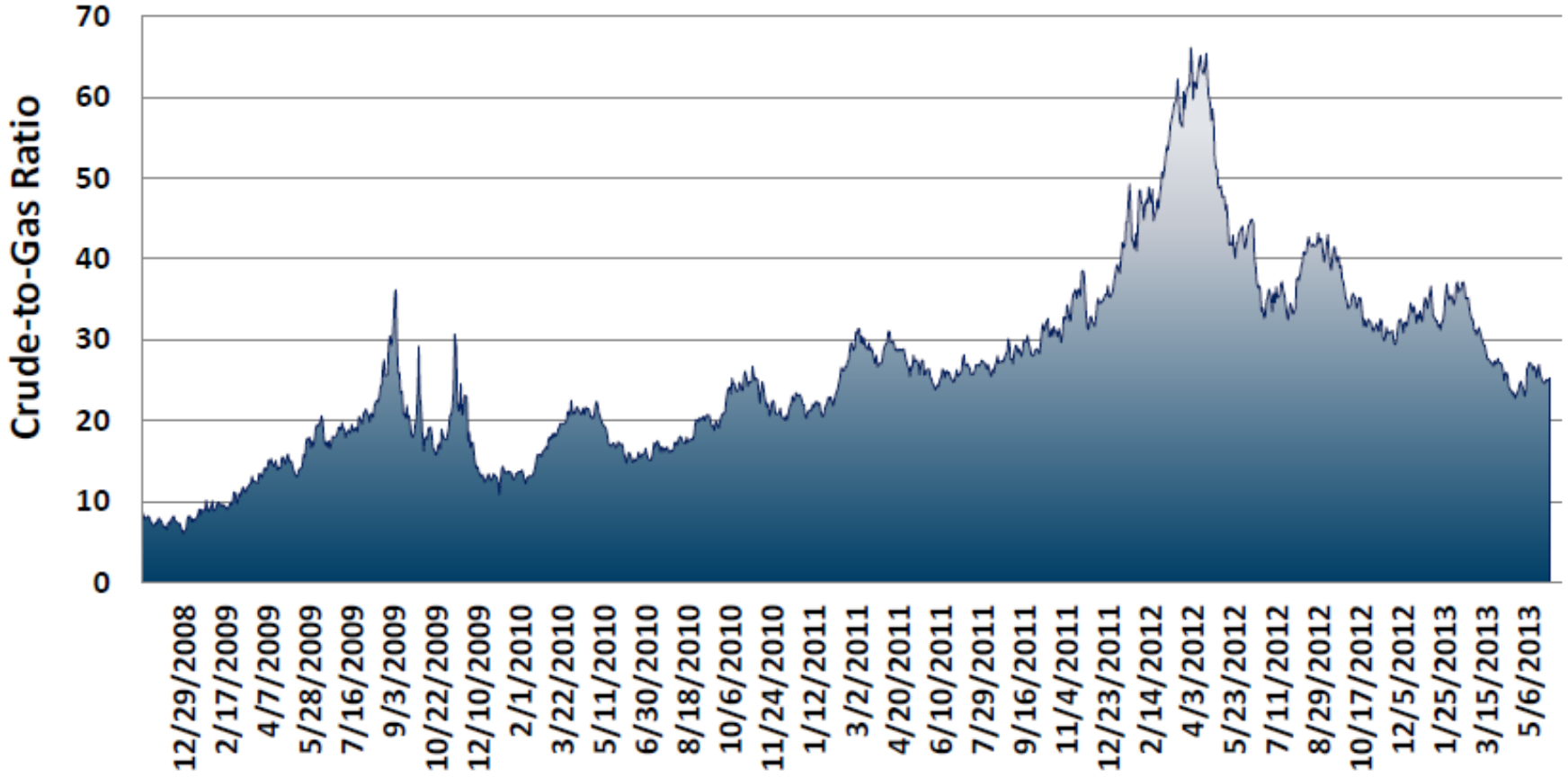
Revisiting the crude to gas ratio

- **A higher crude to gas ratio suggests operators should drill for oil in lieu of natural gas and makes NGL developments more commercially attractive.** Higher ratios also encourage operators to place rigs in liquid rich areas of supply basins which contain both oil and gas.



*Source: EIA

Oil and gas rig counts in the US

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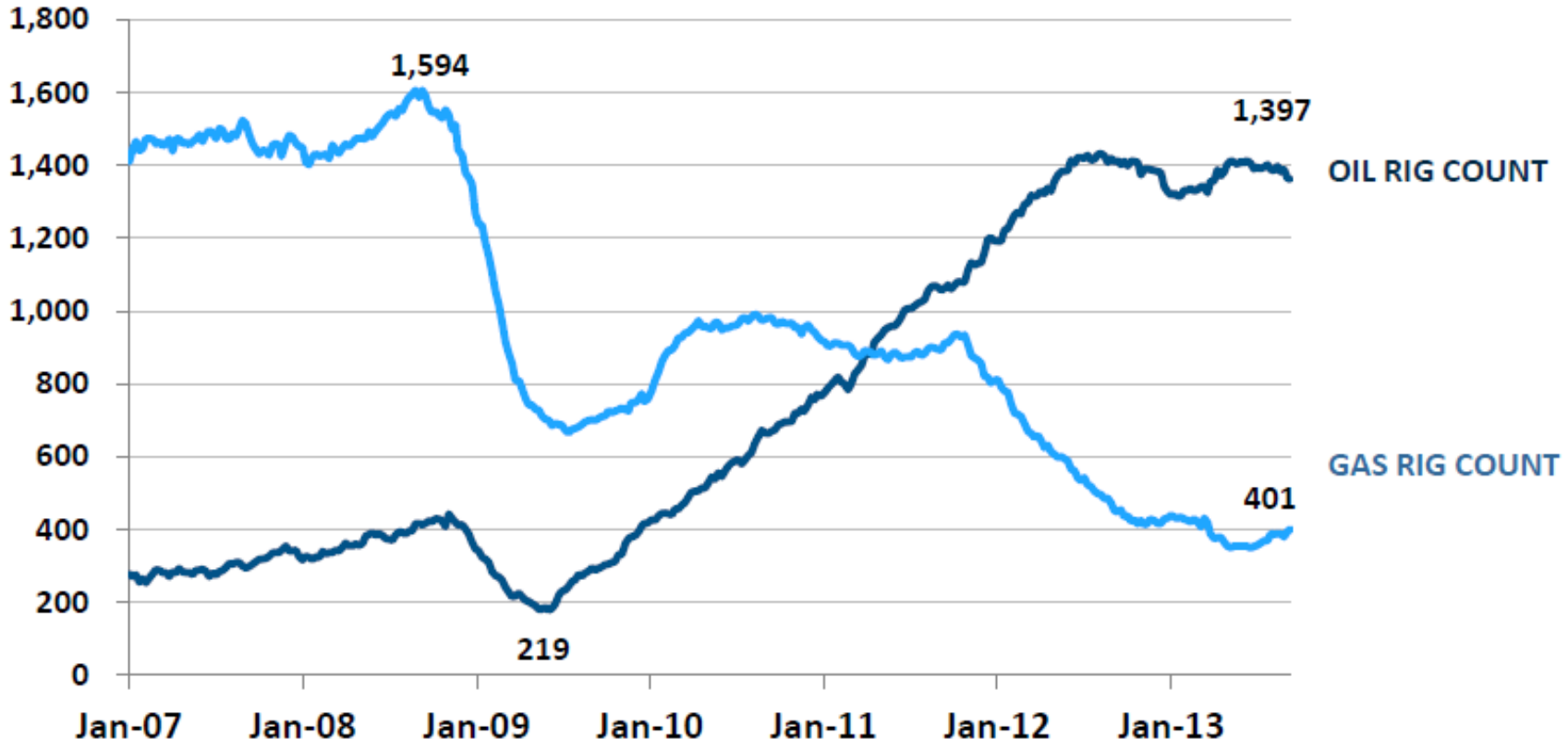

- Between 2007-2013, the North American gas rig count has fallen by roughly 71.5% while the oil rig count has risen nearly 500%. The narrowing of the gulf between the two and the intersection in 2011 also corresponds directly to a rising crude to gas ratio.

*Source: Baker Hughes

Naphtha to become more appealing

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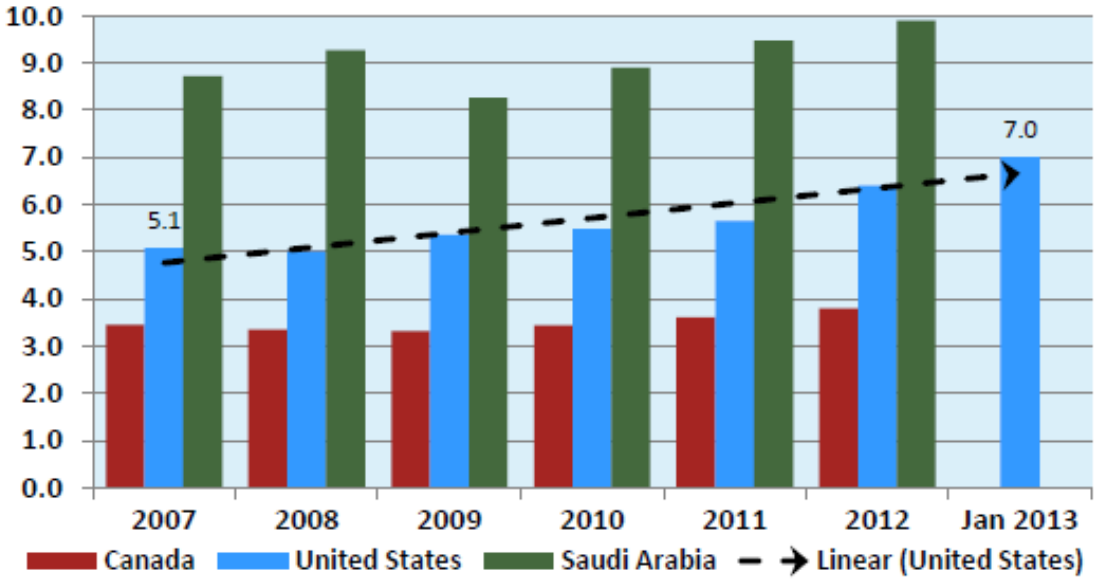
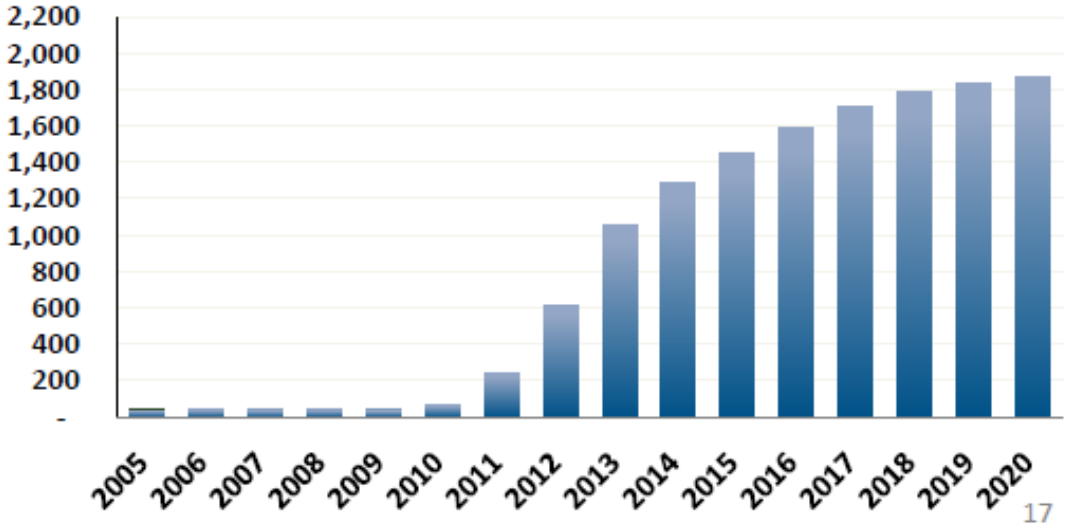
- Crude production grew almost 2 million b/d between 2007-2013. Output from Eagle Ford (graph below) is expected to triple by between 2012-2020.

- Output from Eagle Ford and Bakken may increase US crude production by almost 4 million b/d by 2020.

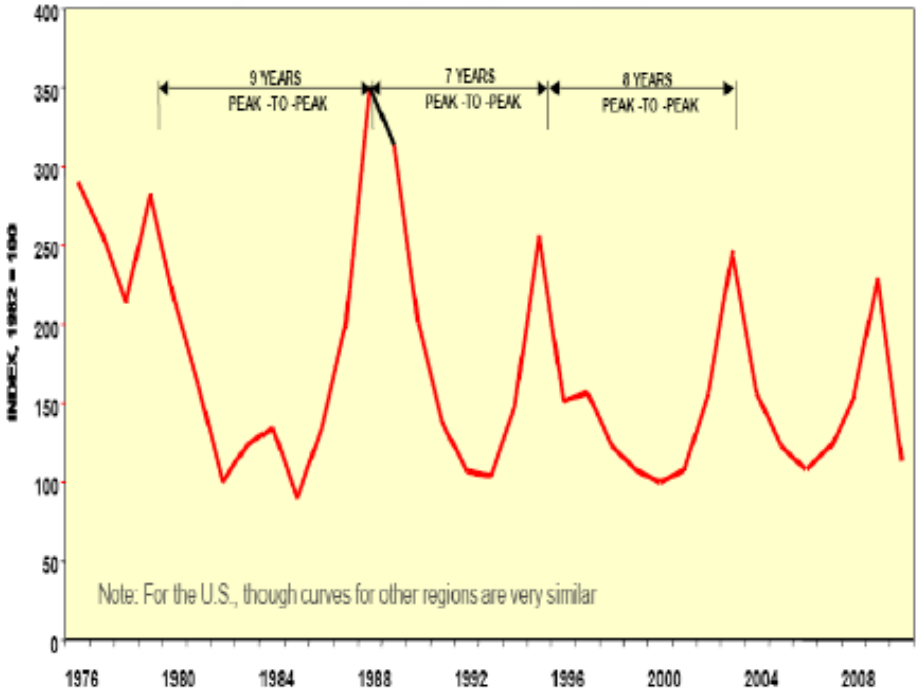
- Considering that naphtha constitutes between 15-30% of a barrel of crude, depending on the weight, the US could theoretically see an additional 600,000 b/d of naphtha production by 2020 and likely more than that.



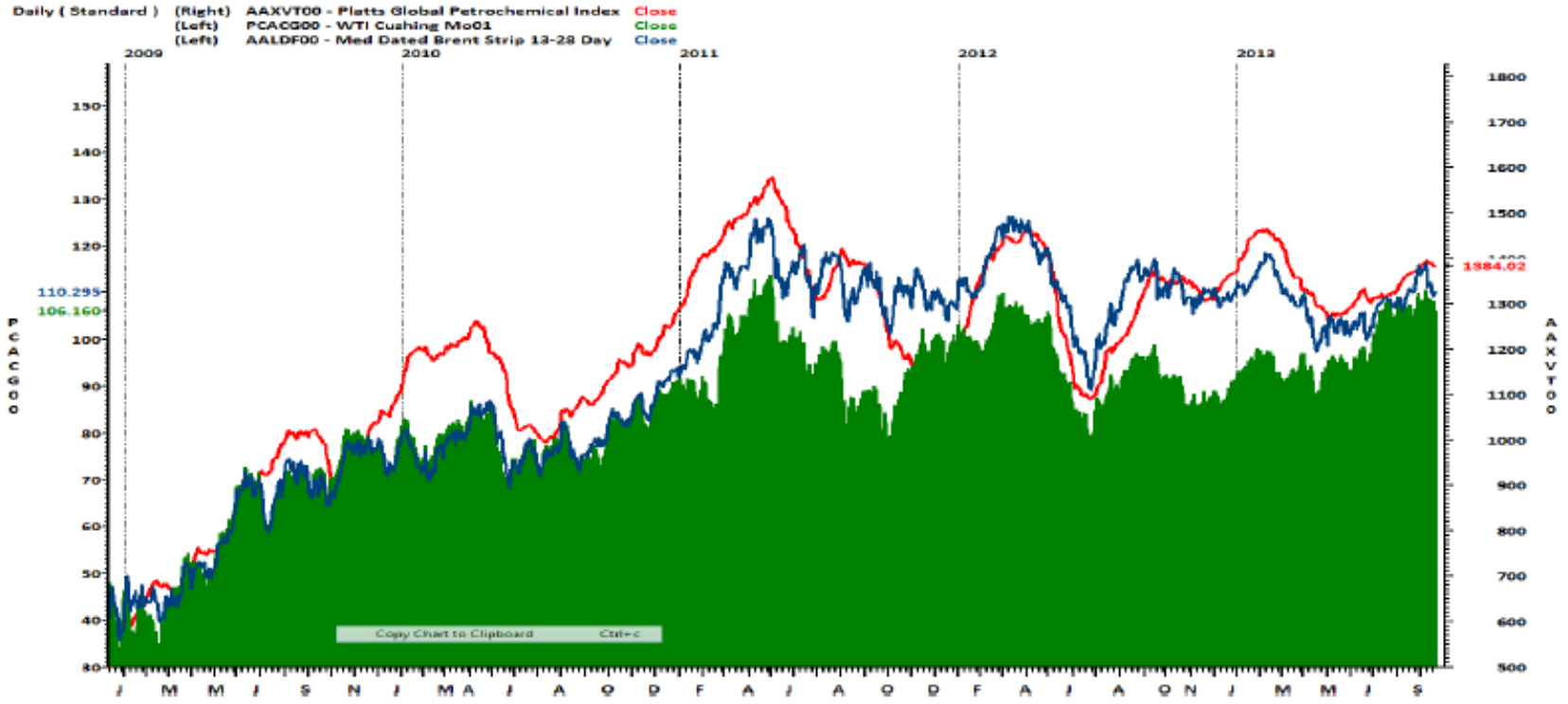


Timing is everything

- The petrochemical industry tends to follow an approximate 7-8 year cycle of profitability with the most recent cycle bottoming out in 2010.
- If we expect the industry to continue following this trend, we can expect the next bottom around 2017-2018.
- This will be about the same time the last new cracker projects will be completed.
- When the cycle next begins to move upward, the US will be one of, if not, the worlds leading producer of crude oil.



Petrochemical prices tend to trace crude



- Petrochemical prices have historically traced movements in crude and there is little reason to suspect this to change, particularly given anticipated increases in production going forward.

- Petrochemical Index/Brent correlation coefficient = .8578

- Petrochemical Index/WTI correlation coefficient = .8353

Conclusions

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- A more forward looking approach might focus on crude. Production dynamics could shift by the end of this decade and the US expected to surpass Saudi Arabia as the worlds leading oil producer, pumping out an additional 3.8 million b/d of crude by 2020 from the Eagle Ford and Bakken plays alone.

- Increased crude production mean increases in naphtha supply. Given that naphtha constitutes 15-30% of a barrel of crude depending on the weight, the US should see an extra 600,000 b/d of naphtha by 2020 and possibly as much as 1.2 million b/d.

- On a global scale, oil production in 2020 is expected to be over 96.5 million b/d. Light naphtha production, at that production level, would be almost 14.5 million b/d. To put that into perspective, the US fresh feed input into reformers in 2012 was just over 2.6 million b/d with a total processing capacity of 3.25 million b/d.

- While producers could choose to focus their strategy strictly on ethylene derivatives, a more prudent approach for chemical makers who have access to shale reserves might be to build a flexi-cracker and have the option to capitalize on high-priced heavier products.

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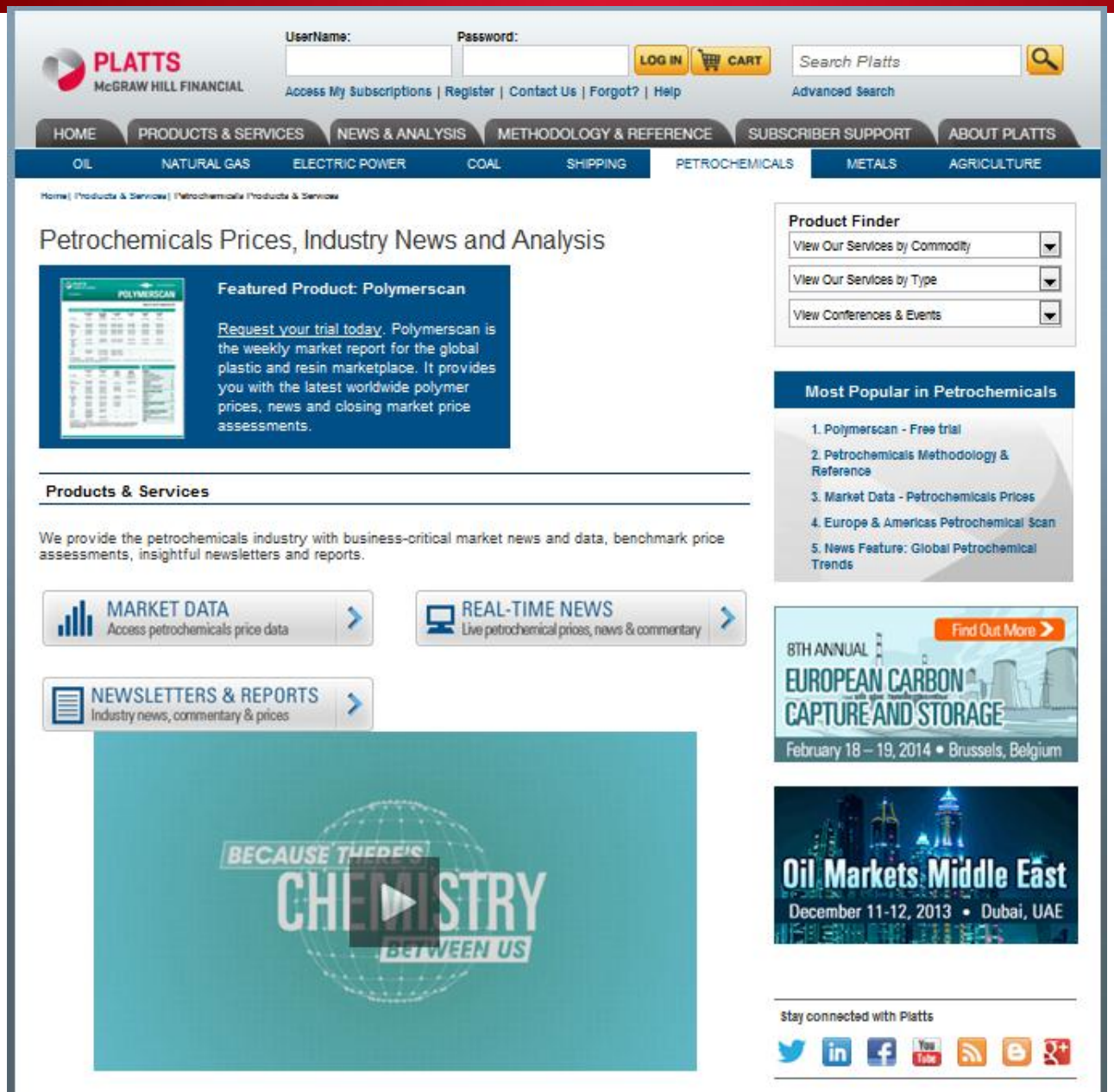

Thank you

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