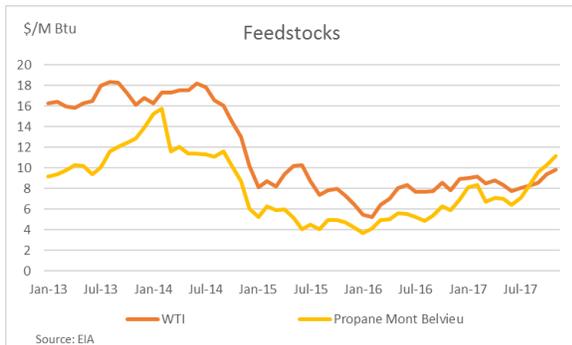


KEY THEMES – NOVEMBER 2017

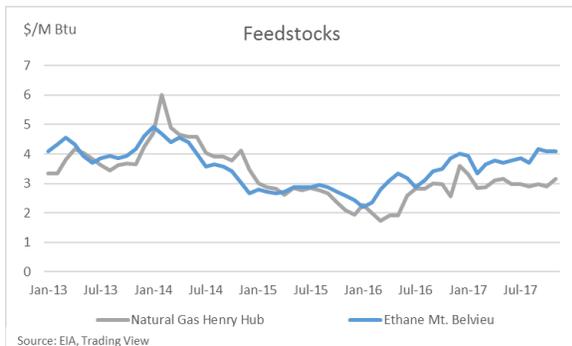
FEEDSTOCKS

PROPANE: US EXPORTS CAUSING PRICES TO RISE



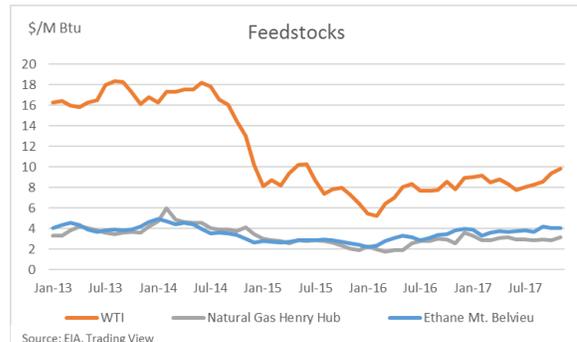
Propane more expensive than oil, on a \$/MMBTU basis. Why is this important? Impact on PDH costs (North America & Asia). Could it be a leading indicator of trends for ethane, as its exports increase?

ETHANE: PRICES SPLITTING FROM NATURAL GAS



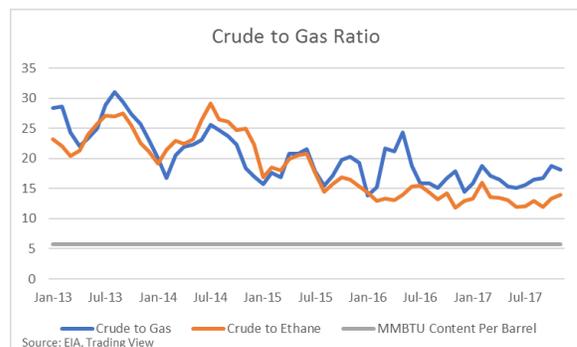
Driver: increased petrochemical demand. That said, rejection remains high and is expected to continue to be high.

ETHANE: STILL ADVANTAGED VERSUS HEAVIER FEEDSTOCKS



On a pure cost basis, ethane still competitive versus heavier feeds.

Feedstock indifference is achieved when oil prices (in \$/barrel) are about 6 times natural gas prices (in \$/MMBTU). As we can see, we are still far from that level.

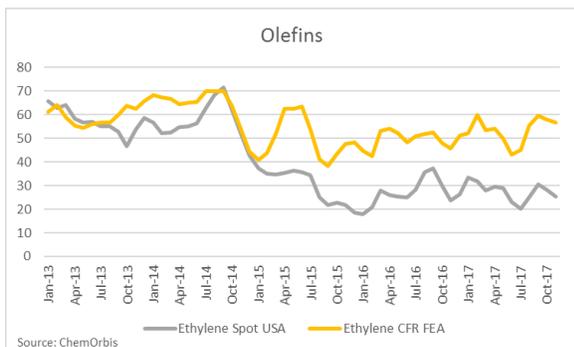


Parity is a bit “closer” for ethane, but to reach it ethane would need to be 65 cpg (at current oil prices), or oil be 24\$/barrel (at current ethane prices), to reach parity.

However, as we will see later, heavy crackers’ derivative prices (particularly in Asia) are helping those crackers’ economics remain competitive versus ethane cracking.

OLEFINS

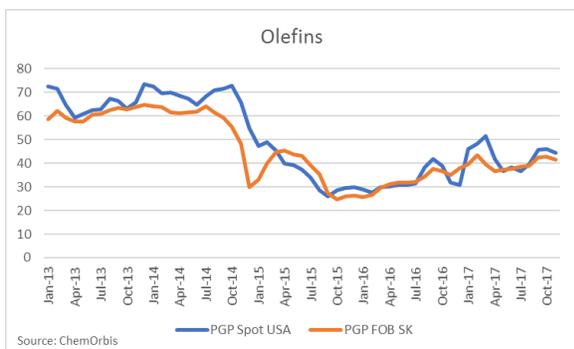
ETHYLENE IN ASIA > ETHYLENE IN NORTH AMERICA



Ethylene in Asia is expensive! Or, looking from the other end of the viewing glass – ethylene in North America is cheap!

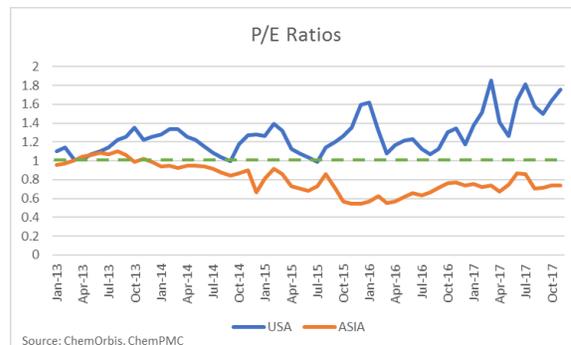
Excess supply driving down ethylene prices in the U.S. The result is that heavy cracking economics in Asia are attractive versus ethane cracking in North America.

GLOBAL PROPYLENE PRICES ALIGNED



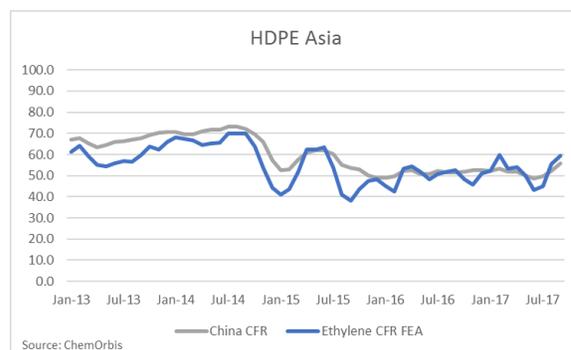
In the case of propylene, supply tightness (related to the lightening of crackers) and absence of an advantaged cost region results in well-aligned global propylene prices.

P/E RATIOS: LOOKS CAN BE DECEIVING



P/E ratios higher than parity in the U.S and lower than parity in Asia should, in theory, make propylene derivatives, and particularly PP, competitive in Asia and not competitive in the U.S.

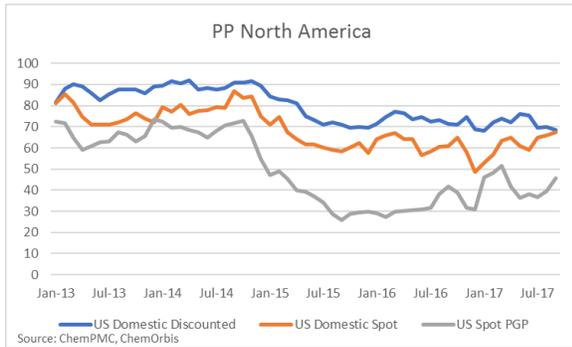
As we will see, the impact is much subtler in polyolefins. Ratios are being impacted by the very competitive ethylene prices in North America.



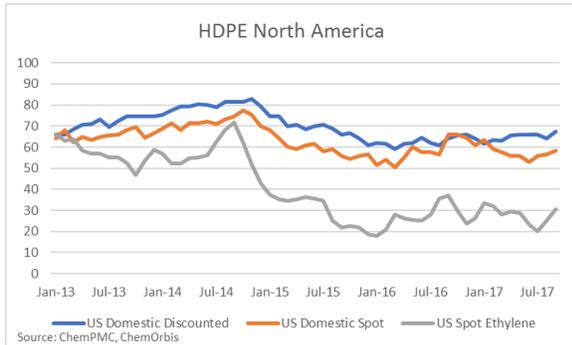
In the case of Asia, ethylene is being propped up by HDPE (or is it the other way around?).

POLYMERS

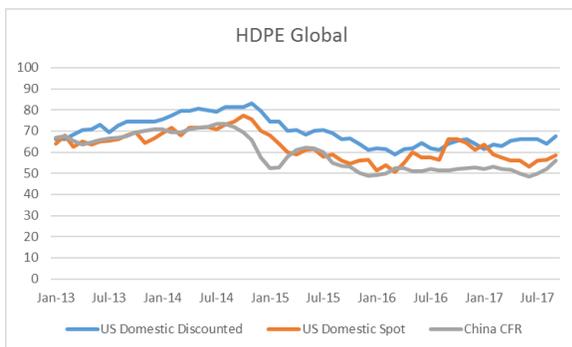
STRONG PROFITABILITY IN NORTH AMERICA



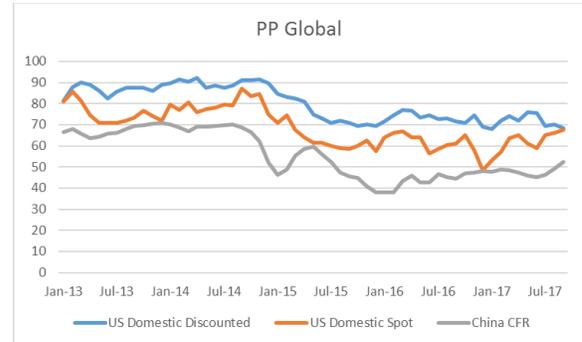
Non-integrated margins in North America continue to be very strong. For PP, lack of investments and an improvement in propylene's supply situation help.



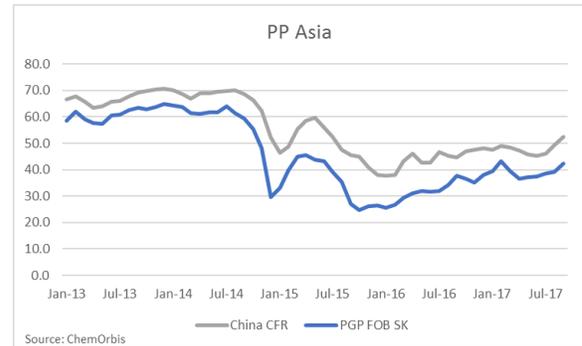
For PE, the excess supply of ethylene helps non-integrated polyethylene margins. Globalized (and high) PE prices also help.



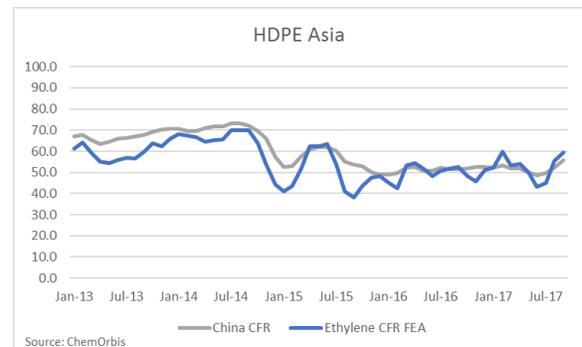
PP Prices are less globalized; oversupply in Asia and tightness in North America keep the spread open



A MIXED PROFITABILITY BAG IN ASIA



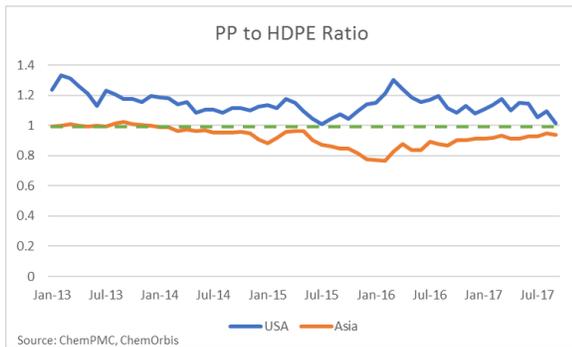
PP, despite being somewhat oversupplied due to China becoming self-sufficient, is seeing some non-integrated margins in the chain.



PE margins, on the other hand, are being kept tight by producers.

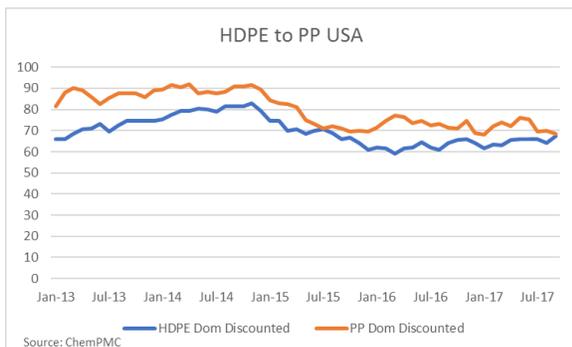
It's hard to tell what drives what, but what's sure is that producers are keeping PE and ethylene prices close. The concept: try to avoid losing margins to over-eager sales managers (can't drop a price if the margin is zero, can you?)

**PP/HDPE RATIOS: NOT AS BAD AS WHAT OLEFINS SEEMED TO INDICATE**

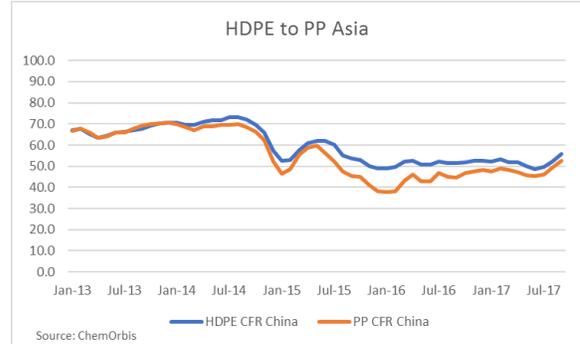


Polyethylene and Polypropylene much closer to parity than would have been expected, based on the P/E ratios. And the polymer ratios are converging to 1.

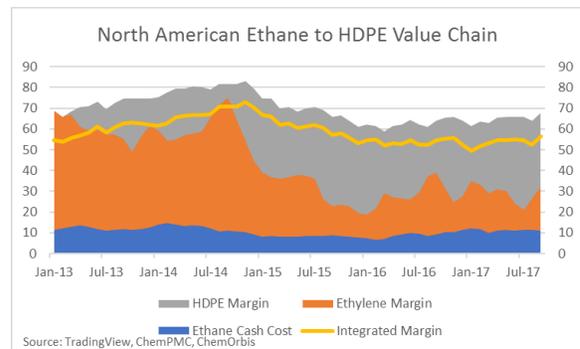
PP in North America moving higher (tight), PE stable to lower.



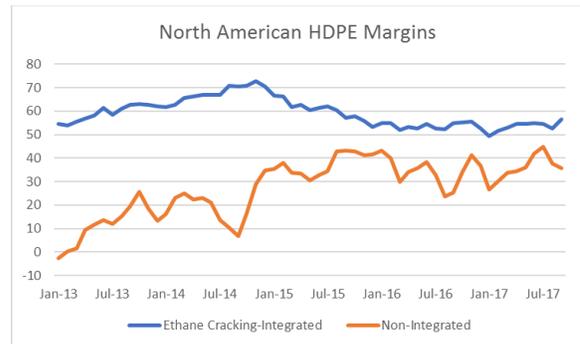
PP in Asia had moved lower than PE (oversupply) but the spread is tightening in recent months.



**NORTH AMERICA PE KEEPING MOST OF THE MONEY IN THE VALUE CHAIN**



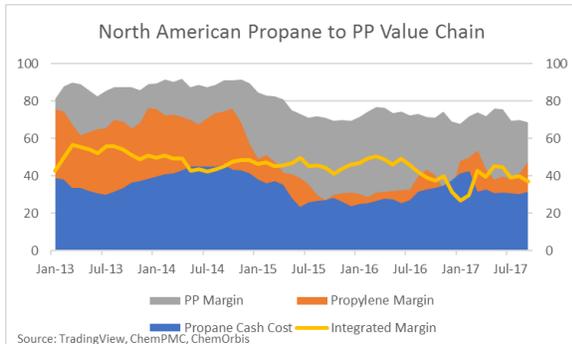
Margins for ethane integrated HDPE sales remain extraordinary. Low ethane prices and high domestic PE prices in North America make for a killer combination. PE enjoys the larger share of margin.



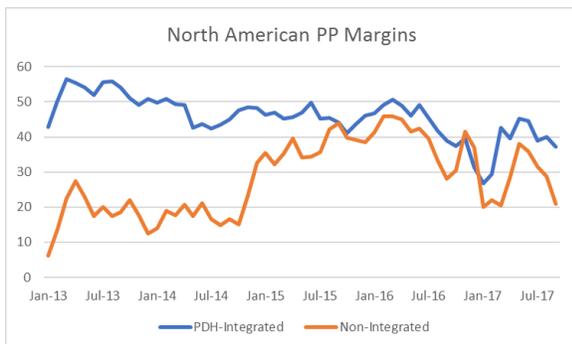
That said, non-integrated margins are not too shabby. There are no non-integrated PE producers in North America, but, if there were, their margins would be approaching

those of non-integrated producers. This is a change for the industry, that traditionally kept most of its margin on the olefin side of the fence.

PDH IN NORTH AMERICA: STILL ATTRACTIVE, BUT LESS SO...



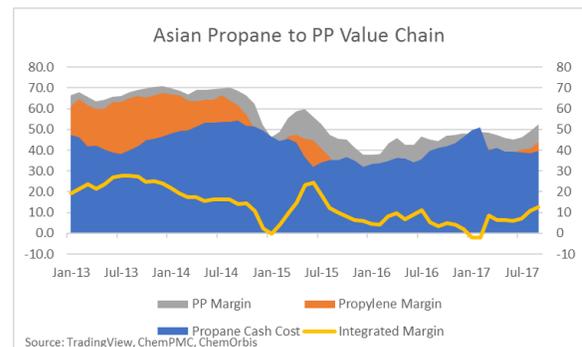
Improved propylene supplies (which resulted in lower propylene prices) and higher propane prices have reduced the attractiveness of PDH-integrated PP production. Most of the margin is being kept in the polymer side of the equation.



What's more, margins for non-integrated PP producers are aligned with PDH-integrated margins. This makes hard to justify PDH-integrated PP investments in the US Gulf Coast. Canadian projects are different, as those see significantly lower propane price than the price in the U.S. Gulf

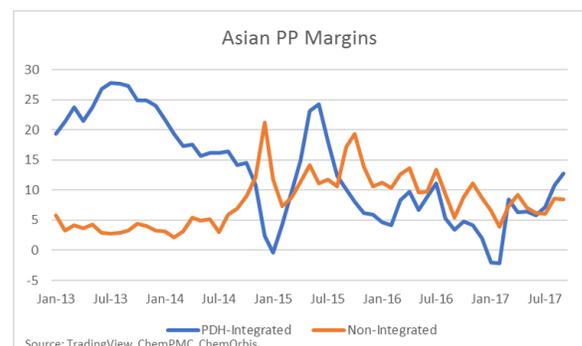
Coast. But... what if propane exports out of Canada take flight? They would require investments in logistical infrastructure, but that does not mean they won't happen. Long-term contracts for propane supply are "de rigueur" in those cases.

ASIA PDH WITH IMPORTED PROPANE – DOES IT MAKE SENSE?



Looking at PDH-integrated units in Asia using North American imported propylene, the economics of those projects don't seem to make sense. Rising propane prices together with lower PP prices are not boding well for these investments.

A comparison of the margin for PDH-integrated versus non-integrated facilities shows that since mid-2015 it has made more sense to buy propylene than to run a PDH unit using imported propane.

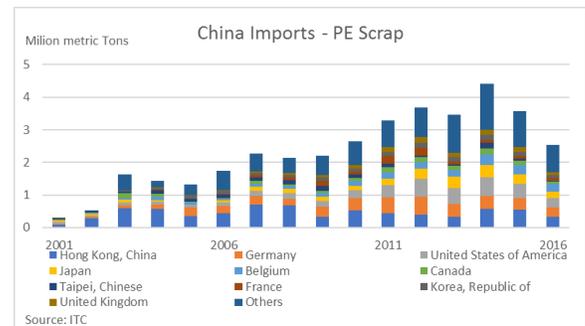


## EVERYTHING ELSE...

- Braskem/Lyondell?
- After delays (and Harvey), now U.S. plants are going to start pumping out polyethylene. In the next three to six months we will see how well has the industry prepared, particularly from a logistical standpoint, to move all the additional material that will be produced in North America. Expect disruptions due to insufficient capacity to move product, with the potential of increased availability of resins domestically in North America. Price outlook – lower.
  - However... what's going to be produced? Specialty/high-performance strategy? Opening new markets?
  - New players versus existing players... Only Sasol new to the game. Discipline? But... high current margins too tempting!
- Logistics are not only relevant for polymers. Ethane may be oversupplied in North America, but that oversupply is taking place away from consumption areas. Ability (of lack thereof) to move ethane from production areas to consumption areas may impact ethane prices more than other factors like increasing demand or exports. ATEX (Marcellus to USGC) expansion needs to be followed closely. Lack of ability to move ethane could result in oversupply in producing areas (Marcellus or Utica) and balanced to tight situation in the USGC. Bringing ethane from the Bakken and other further away regions would require a much higher premium to get it

to move to the USGC. Ethane price outlook – higher.

- Weather: something to worry much about. Production of ethylene and derivatives will concentrate even further in the USGC. Expect volatility (ethane, ethylene, derivatives) to increase dramatically with any weather event.
- China to the rescue? Scrap imports going away. Could this result in higher virgin demand?



## METHODOLOGY NOTES

- Margins estimates only include raw material variable costs; packaging, delivery & fixed costs omitted for this exercise
- Unless otherwise specified, North American polymer prices are domestic discounted prices and olefins prices are spot prices. Global polymer and olefin prices are spot.
- Sources are listed in each chart. Special thanks to [ChemOrbis](#) for providing access to its superb global price & market database and trading platform!
- Questions? Comments? Send us an email – [contact@chempmc.com](mailto:contact@chempmc.com)