US Propane – will it cause pain?

Arkema & BASF most exposed

- **Propane price weakness** — Propane prices in the US are down 26% YTD and 20% in the last 2 weeks. According to our US colleague, John Tysseland, maximum propane storage capacity of 75mm bbls could be reached as early as August or September as supply continues to increase and propane exports are also running at capacity (Propane: How Low Can It Go? - Reducing NGL Price Deck). High propane inventories were driven by rising production (+20% YoY), which is expected to continue, and the recent warm winter reducing heating demand.

- **Shift to propane cracking?** — Our US colleagues believe that the US petrochemical industry will be able to harness this now cheap propane. CMAI data already reported an increase in propane cracking (Propane to Keep a Lid on Ethane? - Another "Shale Supremacy" Ramification. According to their findings**, at current levels, cracker margins from ethane and propane are now comparable**. They estimate that the petrochemical market would have to consume an extra 50-60k bbl/d (on top of the existing 350k) to reduce excess propane inventories. As propane cracking generates over 5x more propylene than ethane-based cracking, we analyze the potential impact of this shift on the global propylene supply/demand balance.

- **Implications for BASF and Arkema** — if the shift is limited to the current excess propane production (c. 55k bbl/d) then the impact on the global C3 chain will be very limited. We estimate **global propylene supply would rise by c. 0.4%** due to this shift. In Europe, Arkema and BASF are most exposed to the C3 chain with about 42% and 13% of group EBIT respectively driven by propylene-chain businesses. Acrylics margin for instance are off their 1H11 peak levels and we expect mid-cycle conditions in 2012. This limited impact from the propane shift currently underway is not large enough to justify a cut to our EPS forecasts at this point. **In the longer-term** assuming all of the future incremental propane output is used as cracking feedstock, **the increase in propylene supply would be c. 1%,** still not enough to materially change the competitive landscape. The key wild card is the potential for propane dehydrogenation (PDH) projects, which become more cost competitive in a low propane price environment. The steady growth in propane output suggests the risk of an adverse impact on European C3 chain profitability is now possible in the medium-term.

- **Implications for US chemicals** – Our US colleagues found that LYB is the biggest beneficiary of falling propane prices, followed by DOW. They estimate a $0.10/share increase in annual EPS for every $0.10/gal decline in propane prices. For Dow, they calculate a $0.04/share impact mainly due to less US ethylene capacity.

- Industry Overview

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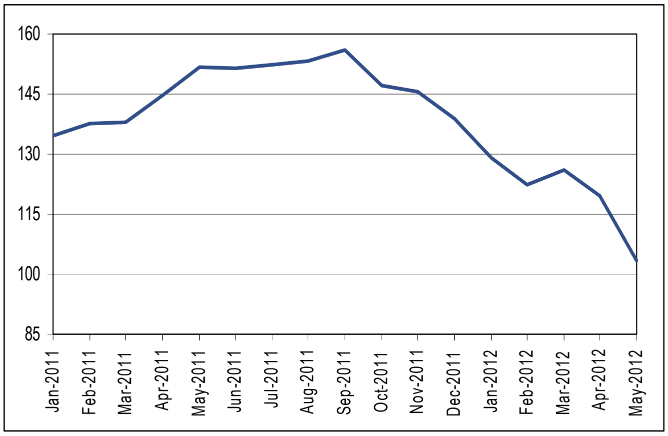
Propane or ProPAIN?

Propane prices are down 18% over the last two weeks. This comes on the back of most recent inventory data (up 64% YoY at 43.4m barrels) that was released by the EIA in late April, which was the highest since 1999. Is this the start of a new price trend for this chemical raw material? Might this price development be a harbinger of a more competitive propylene (C3) chain environment?

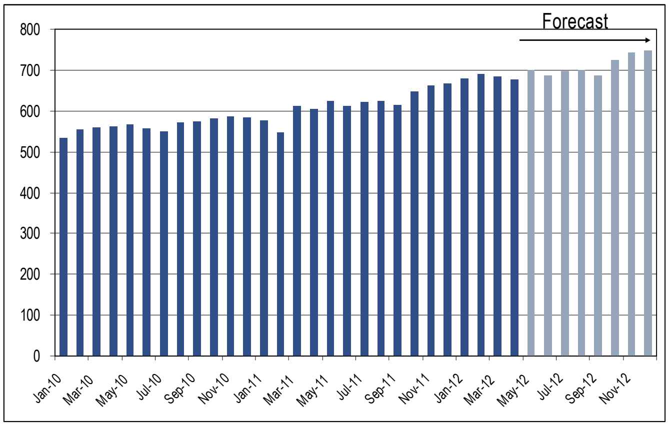
Our US colleague, John Tysseland, believes propane inventories are likely to surpass the maximum available level of c. 75m bbl by August or September. The sharp increase in inventories is believed to be driven by four factors: 1) mild winter; 2) petrochemical plant turnarounds; 3) surging production growth; 4) limited export capacity.

Figure 1. US Propane Price ($ct/gallon)



Source: CMAI

Figure 2. US Propane Production (in thousands of Bbls/d)



Source: Citi Investment Research and Analysis; EIA

Exports up 22% YoY and close to maximum levels

So far exports, which are up 22% YoY have helped to keep the market in balance. However, the near-term issue is that propane export capacity is now operating at/or near maximum levels of 150-160k Bbls/d and can no longer relieve the market of excess supplies.

Petchem market to clear out excess supply

Hence, Citi believes the petrochemical market will act as the main "clearing house" to reduce propane inventories. They estimate a shift of 50-60k bbls/d (c.1.6-1.9mt/year) is needed to reduce the excess supply, which at current propane pricing levels seems achievable. Propane is now competitive with ethane as a base petrochemical feedstock. Clearly, the extent to which the shift from ethane to cheap propane can continue will be a function of the further increase in supply.

Figure 3. Commodity Prices

Revised Commodities Price-deck (May 2012)	Q1-A	Q2-E	Q3-E	Q4-E	2012 E	2013 E	2014 E	2015 E	2016 +
Brent Crude($/Bbl)	**$118**	**$115**	**$115**	**$115**	**$116**	**$120**	**$95**	**$98**	**$100**
WTI Crude($/Bbl)	$103	$95	$100	$95	$98	$113	$90	$95	$98
Natural Gas ($/MMbtu)	**$2.52**	**$2.00**	**$2.25**	**$3.00**	**$2.44**	**$3.85**	**$4.45**	**$5.00**	**$5.25**
NGLs ($/gal)									
Ethane	$0.57	$0.40	$0.42	$0.47	$0.46	$0.48	$0.53	$0.57	$0.59
Propane	$1.26	$0.96	$0.96	$1.07	$1.06	$1.29	$1.24	$1.40	$1.43
N-Butane	$1.92	$1.89	$1.89	$1.89	$1.90	$2.00	$1.58	$1.63	$1.67
I-Butane	$2.04	$1.94	$1.94	$1.94	$1.97	$2.06	$1.70	$1.75	$1.79
Natural Gasoline	$2.39	$2.25	$2.25	$2.25	$2.28	$2.40	$1.92	$1.98	$2.02
Comp NGL ($/gal)	**$1.21**	**$1.02**	**$1.03**	**$1.09**	**$1.09**	**$1.19**	**$1.08**	**$1.16**	**$1.18**
NGL (% of Brent)	43%	37%	38%	40%	39%	42%	48%	50%	50%

Source: Citi Investment Research and Analysis; Bloomberg

Propane prices close to near-term low; upside risk going forward

Overall, ethane and propane prices are expected to remain depressed for the remainder of 2012 but with little downside from current levels. There are several near-term events that could actually lead to a tightening of the market: 1) heavy maintenance season in petchem industry coming to close by end of May; 2) at least 2 NGL fractionators coming off-line for maintenance which will reduce supply.

However, to put this into context, the increase in average daily production now versus 2011 (noting that production is on a clearly rising trend still), represents c. 83,000bl/d. This increase is 2.6m tonnes of propane a year, enough for 10% of total US cracking capacity (assuming 100% use of propane as petrochemical feedstock; total light feedstock cracking capacity c. 25m t) – and this material delivers a similar profit to ethane for US cracker capacity.

Will there be a shift to propane cracking?

Propane cracking is competitive at current price levels

Our US team estimates that propane cracking economics are roughly comparable to ethane at current levels, supporting their view that the petchem market will act as a "clearing house" to reduce excess propane supply and lead to a more balanced market.

Figure 4. Ethylene Economics – Ethane and Propane-Based Margins are comparable

Ethylene Cracker Economics	Ethane	Propane
Raw Material Price - cents per gallon	45.75	102.50
Ethylene Cash Costs - cents per pound		
Raw Material Cost	19.22	57.66
Co-product Credit	(7.72)	(45.30)
Variable Operating Cost	3.25	3.83
Incremental Cash Cost	**14.75**	**16.18**
Fixed Cost	2.71	3.16
Production Cash Cost	**17.46**	**19.34**
Contract Ethylene Price - cents per pound	55.25	55.25
Ethylene Margin - cents per pound	**37.79**	**35.91**
Ethane Margin Advantage (Disadvantage) vs. Propane (c/lb)		**1.88**

Source: Citi Investment Research and Analysis; CMAI

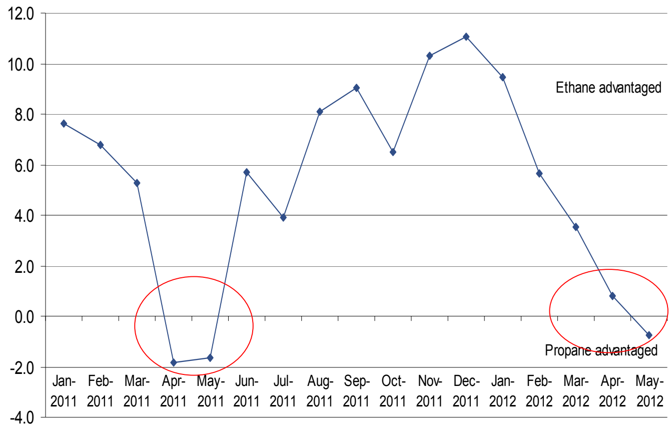
Based on current spot prices, propane seems to have a slight advantage

We have done a similar analysis but used current spot prices for input costs and selling prices (see Figure 5), which shows propane to be slightly more cost competitive than ethane. The picture demonstrates that in the past few weeks the steady increase in propane availability has created a new low-cost resource for the US petrochemicals industry.

Seasonality plays a role

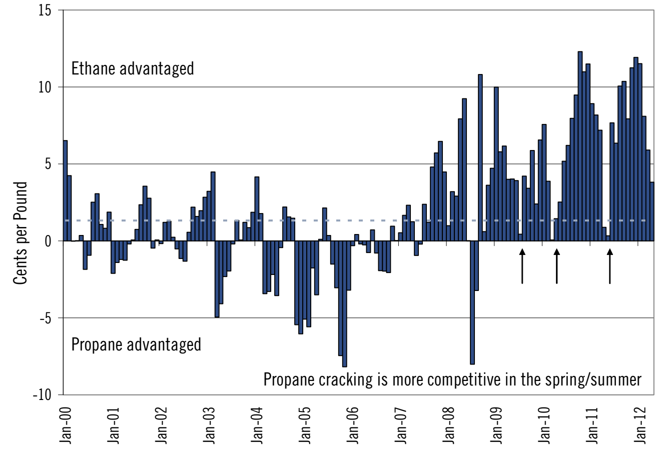
Since 2009, ethane cracking has been advantaged compared to propane. Over the last several years, however, propane economics have improved during the spring/summer months given the seasonal demand weakness for heating during this period of the year. However, given the current state of the market (in addition to seasonally weak heating demand, high production levels, maximum exports, close to peak inventory), the effect could more pronounced this year. Furthermore, historically propane's use as a heating fuel has led to limited availability as a petrochemical raw material; rising supply may be changing this situation.

Figure 5. Ethylene Production Cost Comparison: Ethane vs. Propane



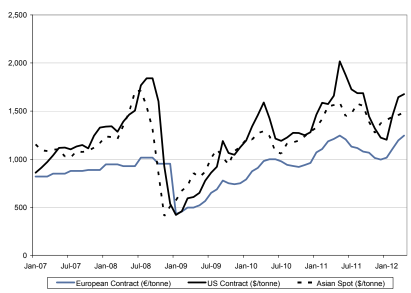
Source: Citi Investment Research and Analysis; CMAI

Figure 6. Long-Term Production Cost Comparison, Ethane vs. Propane



Source: Citi Investment Research and Analysis, CMAI

Figure 7. Propylene Prices



Source: CMAI

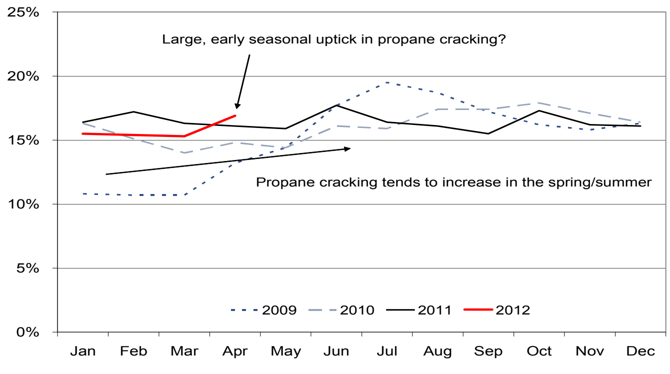
According to CMAI, the US ethylene cracker feed-slate has shifted towards propane and currently c. 16-17% of US ethylene is based on propane cracking, just slightly above the level we saw at the same time last year (Figure 6). Latest May data highlights a modest shift to propane as a feedstock; the US industry appears to be highly sensitized to exploit raw material cost changes and will switch if the economics permit.

The key swing factors are the co-products, notably propylene and butadiene. In particular, propylene prices impact the relative production economics of ethane and propane cracking given that propane cracking generates over 5x more propylene than ethane per unit of input raw material. Recent spot prices in the US point towards a continued decline in contract for propylene prices which would lower the netbacks from propane cracking. **But the price erosion of propylene highlights the potential for a more competitive C3 product chain due to improved propylene building block availability**.

Butadiene tightness to persist

The same situation is not true for butadiene, as the production of this building block per unit of raw material is comparable and about half of the level of production from naphtha-cracking.

Figure 8. Percent of US Ethylene Industry Output from Propane



Source: Citi Investment Research and Analysis; CMAI

Figure 9. Feedstocks and Output (per unit feedstock in %)

	Ethane	Propane	Naphtha	Gas oil
Ethylene	78%	42%	31%	21%
Propylene	3%	17%	16%	15%
Butadiene	2%	3%	5%	4%
Butylenes	1%	1%	4%	5%
Others/Fuel	17%	37%	44%	55%

Source: Citi Investment Research and Analysis

Limited implications for EU chemicals

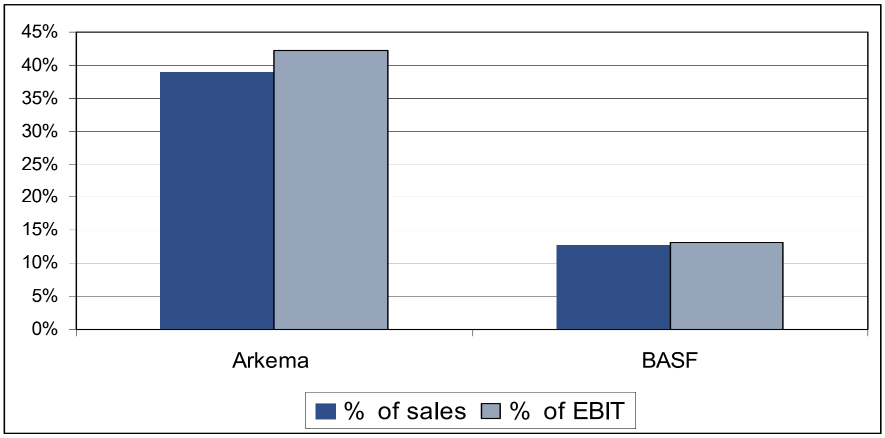
Arkema and BASF most exposed to C3 chemistry

In Europe, Arkema and BASF are most exposed to propylene with about 42% and 13% of group EBIT respectively related to C3 chemistry. Arkema confirmed recently that acrylics margins have come off 1H11 peak levels and are currently around mid-cycle levels. The company does not expect further margin erosion going forward.

The question is if the shift towards propane cracking continues could it lead to an increase in propylene availability that might have a discernable impact on the supply/demand balance and therefore lead to margin pressure in the C3 chain.

Is the propylene co-product benefit for Europe that has arisen from the shift to low cost ethane in the US running out of steam because of low cost propane?

Figure 10. Estimated propylene related sales and EBIT (% of total group sales and EBIT (2011))



Source: Citi Investment Research and Analysis; company reports

Shift towards propane only to increase global propylene supply by about 0.4% on annual basis

Assuming the US petrochemicals industry worked off the excess inventory by shifting the cracker feed-slate towards propane and consumed the c. 55,000bbl/day (midpoint between the expected 50k-60k bbl/day) or about 1.7mt/year of additional propane, we estimate propylene supply to increase by about 294kt/year. **This is about 2% of annual North American supply or about 0.4% of annual global supply.** This surplus is not of sufficient magnitude to have a material impact on the supply/demand balance, we think.

Figure 11. Implications of Propane Shift

Incremental Propane Use in Petrochemical Market	Metrics
55,000	bbl/d
365	# days
20,075,000	bbl/year
1,730,465	**mt/year**
Incremental Propylene Production	
294,179	**mt/year**
North America Propylene Supply (2011)	
14,360,000	Mt/year
2.0%	**% increase**
Global Propylene Supply (2011)	
82,073,000	Mt/year
0.4%	**% increase**

Source: Citi Investment Research and Analysis; CMAI

Realistic increase only about 0.2%

Further, the scenario above assumes the shift to last for an entire year. However, potentially it may only last for about 6 months given increasing heating demand towards the end of the year and an expansion of propane export capacity (e.g. EPD to double its capacity at the Gulf Cost) in the coming months. Hence, additional demand sources are likely to come to the market towards the end of the year. Assuming the propane shift lasts for 6 months, total propylene supply would increase by about 1% in North America and 0.2% on a global basis.

In conclusion, we believe the impact of the propane shift on the global propylene supply/demand balance to be marginal at present and the impact on C3 margins on likely to be limited. Hence, our assumption of mid-cycle C3 margins in 2012 remains unchanged at this point.

Longer-term view

US propane supply to increase by about 6.4m t in the next 4 years

The trend in propane production at present is clearly rising sharply. As outlined in Citi's Energy 2020 report US NGL supply is expected to increase from 2.3m bbls/d in 2011 to c. 3.0 bbls/d by 2015. Hence the total implied incremental increase in propane production is about 6.4m t over this time period (CAGR11-15E of about 7%). Currently the US petrochemical industry consumes about 1/3 of total propane output (380k bbl/d). However, given that other uses, like heating, are unlikely to see a significant increase going forward, we expect the majority of propane used as petrochemical feedstock to increase somewhat in the coming years – although there is likely to be further expansion of export capability as well.

Worst case scenario suggests only c. 1% increase in global propylene supply

A worst case scenario for the propylene market would be if 100% of incremental propane availability is used as cracking feedstock in the petrochemical industry. In this scenario, propylene supply would increase by about 1.1mt. **This represents about 1.3% of current global supply**. **This would probably be enough to have a discernable impact on margins.**

Figure 12. Scenario Analysis: Potential impact of propane cracking on propylene supply

	2011	2015E	Delta
NGL supply ('000 bbl/d)	2300	3000	700
Propane ('000 bbl/d)	667	870	203
Propane (m mt p.a.)	21.0	27.4	6.4
% of Propane used as petchem feedstock	100%	100%	
Propane used as Petchem feedstock (in m mt p.a)	21.0	27.4	6.4
Propylene Output (in m t)	**3.57**	**4.65**	**1.09**
Global Propylene Supply (2011, in m mt)	82.07		
Assumed increase in Propylene Supply (in m mt)	1.09		
as % of global supply	**1.32%**		

Source: Citi Investment Research and Analysis; CMAI

PDH wild card

However, given the generally improved availability of cheap feedstock propane, the key wild card going forward is the expansion of dedicated propylene production facilities based on **propane dehydrogenation (PDH**) as they become more economical. For instance, Dow Chemical plans to build two PDH plants on the Gulf Coast for start up in 2015 and 2018. In addition, low cost NGL exports to Asia could make PDH projects in the region more cost competitive. At the moment, there are about 6 major PDH projects in China with a total propylene capacity of 3.6m t. Our Chinese colleague, Oscar Yee, however thinks that most of them are unlikely to materialize given the current cost economics in the region (Shale Gas Implications on Global Chemicals - Europe and Asia React to US Shale Supremacy). His basis for that assertion was the limited availability of cheap propane. Clearly, if this changes so too might the pace of PDH capacity.

Propylene tightness seems to be over with downside risk for the outlook of Arkema and BASF

In conclusion, we think the trends in propane and propylene are something to watch. Low cost propane is likely to remain a feature of the petrochemical market going forward. At this point neither the short-term nor the longer-term trends suggest any meaningful destruction of C3 profitability. However, the times of tight propylene availability seem to be over and with the advent of designated production technology (PDG), the risks remain more towards the downside which has the potential to put downward pressure on the outlook for both BASF and Arkema.

Appendix A-1

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