

Liquids Questions

Condensate, which can account for up to 15% of the liquids barrel poses its own challenges:

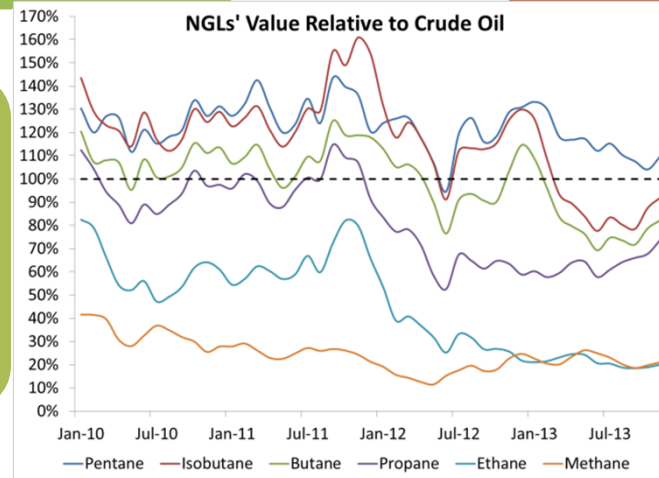
- Cannot blend all with crude oil due to refinery specs
- Need to export but current U.S. law does not allow the export of “lease” condensate although “plant” condensate can be exported.

NGLs (C2-C5) have provided uplift to upstream economics

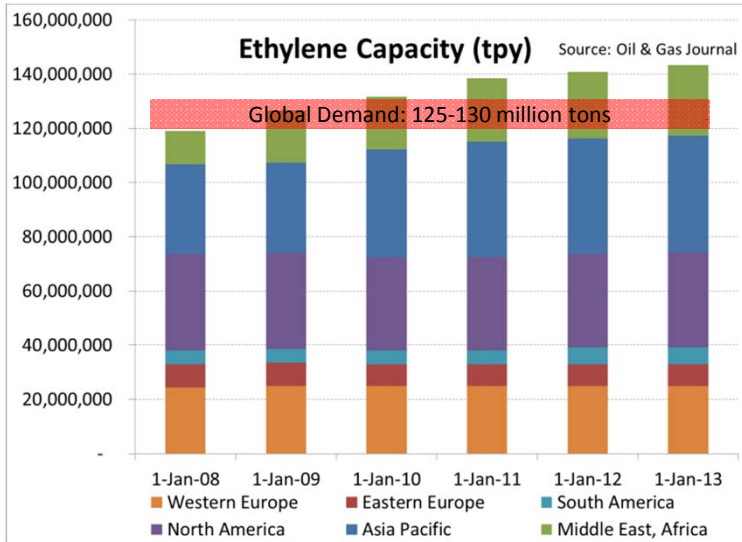
Without C2 & other NGL uplift, higher gas prices will be necessary to induce drilling for more gas.

But, demand for liquids can be constrained from time to time; ethane (C2), 40-50% of the NGL barrel, is the prime example.

US ethylene is very competitive given current C2 prices (see next page) but those prices do not provide much uplift to producers.



NGL uplift was strong through early 2012, after which prices collapsed, especially that of C2 (see chart). 300-350 MBPD of C2 is rejected.



Global capacity has been growing, surpassing demand (see chart). More facilities planned especially in the Middle East and Asia.

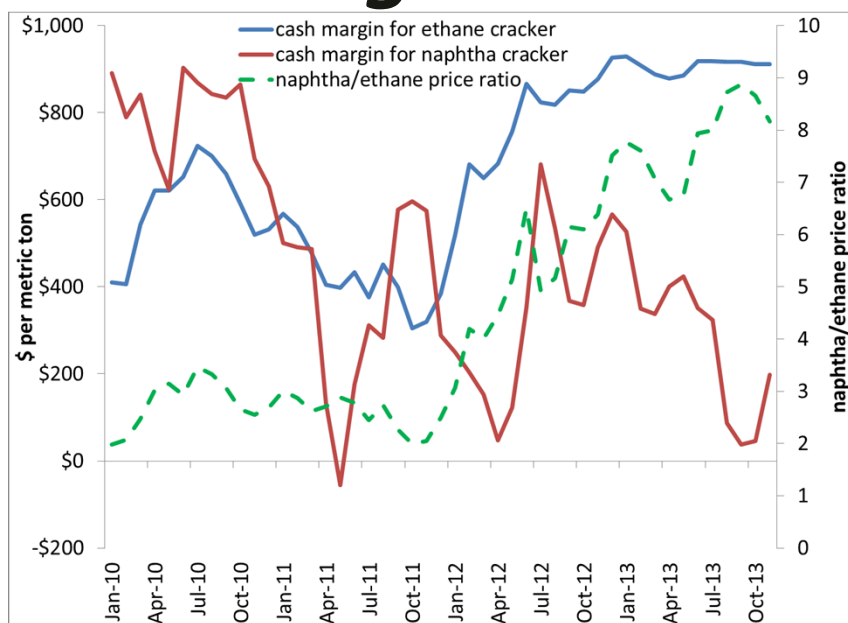
However, ethylene also needs export markets.

LPG exports helped with C3 & C4 but C2 needs ethylene crackers although there is also one C2 export project.

Implications for the U.S. energy industry

- *Is there a fundamental difference today in how production streams are considered and, if so, what are the implications for: producers, midstream, downstream, customers?*
- *Is there more market exposure for production streams that once were embedded in integrated business models?*

Cracking Economics



- Generally speaking, as long as oil price is \$90/bbl or more, which translates into a naphtha price of roughly \$1.90 per gallon or more, C2 crackers are more profitable even if C2 is 80 cents/gallon; conversely, if oil price is \$75/bbl or less (naphtha price of \$1.5 per gallon, naphtha crackers will be more profitable unless ethane costs less than \$0.25 (see table below).
- Globally, naphtha pricing is not always linked to the oil price in this way; resource owners in the Middle East, some of which are developing new crackers, may offer more favorable prices for naphtha from their own refineries to develop and sustain an integrated refining & petrochemicals industry. China may also support its petrochemicals industry in a similar fashion.
- Accordingly, growing excess ethylene cracker capacity is likely to push naphtha crackers without such price support to shut down.

ethane cracker cash margin / naphtha cracker cash margin

Since early 2012, C2 crackers have been significantly more profitable than naphtha crackers. During this period naphtha to C2 price ratio (both prices in cents/gallon) has been greater than 4, averaging 6.5. In 2010 & 2011, the ratio stayed below 3, averaging 2.7. Even then, there were periods (e.g., early 2011) when a C2 cracker was more profitable than a naphtha cracker because the impact of feedstock cost on cash margins is not linear; the level of prices also matter.

| Ethane Price (¢/gallon) | Naphtha Price (¢/gallon) | | | | | | | | | | |
|-------------------------|--------------------------|------|------|------|------|------|------|------|------|------|------|
| | 1.50 | 1.55 | 1.60 | 1.65 | 1.70 | 1.75 | 1.80 | 1.85 | 1.90 | 1.95 | 2.00 |
| 0.20 | 1.02 | 1.09 | 1.18 | 1.28 | 1.40 | 1.54 | 1.72 | 1.94 | 2.23 | 2.61 | 3.17 |
| 0.25 | 0.97 | 1.04 | 1.12 | 1.21 | 1.33 | 1.46 | 1.63 | 1.84 | 2.12 | 2.48 | 3.01 |
| 0.30 | 0.91 | 0.98 | 1.06 | 1.15 | 1.26 | 1.38 | 1.54 | 1.74 | 2.00 | 2.35 | 2.86 |
| 0.35 | 0.86 | 0.93 | 1.00 | 1.08 | 1.19 | 1.31 | 1.46 | 1.65 | 1.89 | 2.22 | 2.70 |
| 0.40 | 0.81 | 0.87 | 0.94 | 1.02 | 1.12 | 1.23 | 1.38 | 1.55 | 1.79 | 2.09 | 2.54 |
| 0.45 | 0.76 | 0.82 | 0.88 | 0.96 | 1.05 | 1.16 | 1.29 | 1.46 | 1.67 | 1.96 | 2.38 |
| 0.50 | 0.71 | 0.77 | 0.83 | 0.90 | 0.98 | 1.08 | 1.20 | 1.36 | 1.56 | 1.83 | 2.23 |
| 0.55 | 0.66 | 0.71 | 0.77 | 0.83 | 0.91 | 1.00 | 1.12 | 1.26 | 1.45 | 1.70 | 2.07 |
| 0.60 | 0.61 | 0.66 | 0.71 | 0.77 | 0.84 | 0.93 | 1.03 | 1.17 | 1.34 | 1.57 | 1.91 |
| 0.65 | 0.56 | 0.60 | 0.65 | 0.71 | 0.77 | 0.85 | 0.95 | 1.07 | 1.23 | 1.45 | 1.76 |
| 0.70 | 0.51 | 0.55 | 0.59 | 0.64 | 0.70 | 0.78 | 0.86 | 0.98 | 1.12 | 1.32 | 1.60 |
| 0.75 | 0.46 | 0.50 | 0.53 | 0.58 | 0.63 | 0.70 | 0.78 | 0.88 | 1.01 | 1.19 | 1.44 |
| 0.80 | 0.41 | 0.44 | 0.48 | 0.52 | 0.56 | 0.62 | 0.69 | 0.78 | 0.90 | 1.06 | 1.28 |
| 0.85 | 0.36 | 0.39 | 0.42 | 0.45 | 0.49 | 0.55 | 0.61 | 0.69 | 0.79 | 0.93 | 1.13 |