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## Energy and commodity price benchmarking and market insights

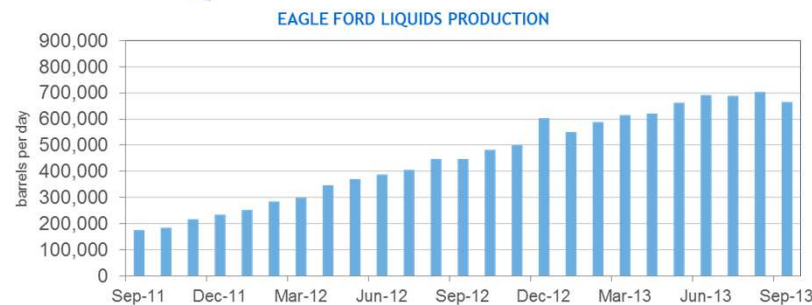
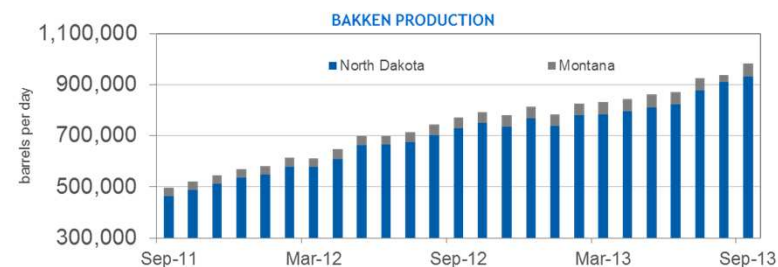
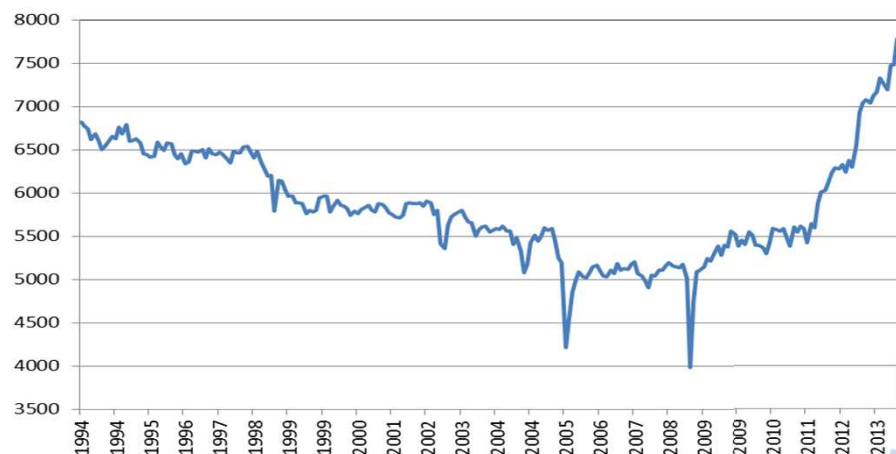
London, Houston, Washington, New York, Portland, Calgary, Santiago, Bogota, Rio de Janeiro, Singapore, Beijing, Tokyo, Sydney, Dubai, Moscow, Astana, Kiev, Porto and Johannesburg

illuminating the markets

Is shale gas creating a short term length in naphtha or a longer term bonanza for petrochemicals?

Joe Duffy  
IEA-IEF-OPEC Forum  
Riyadh January 2014

# US oil production is up 54% in 60 months as a result of increased shale oil production

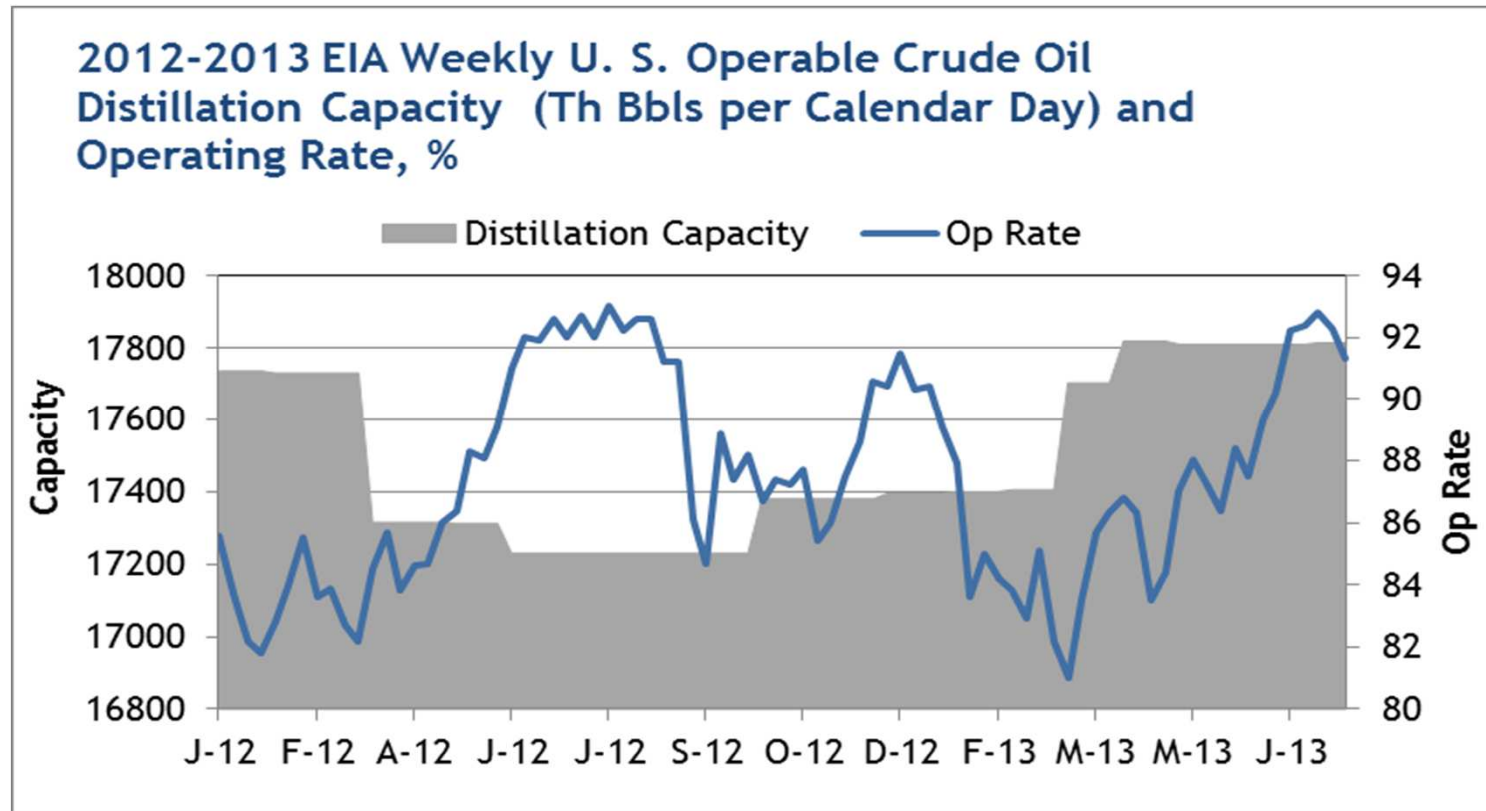


Source: EIA Data

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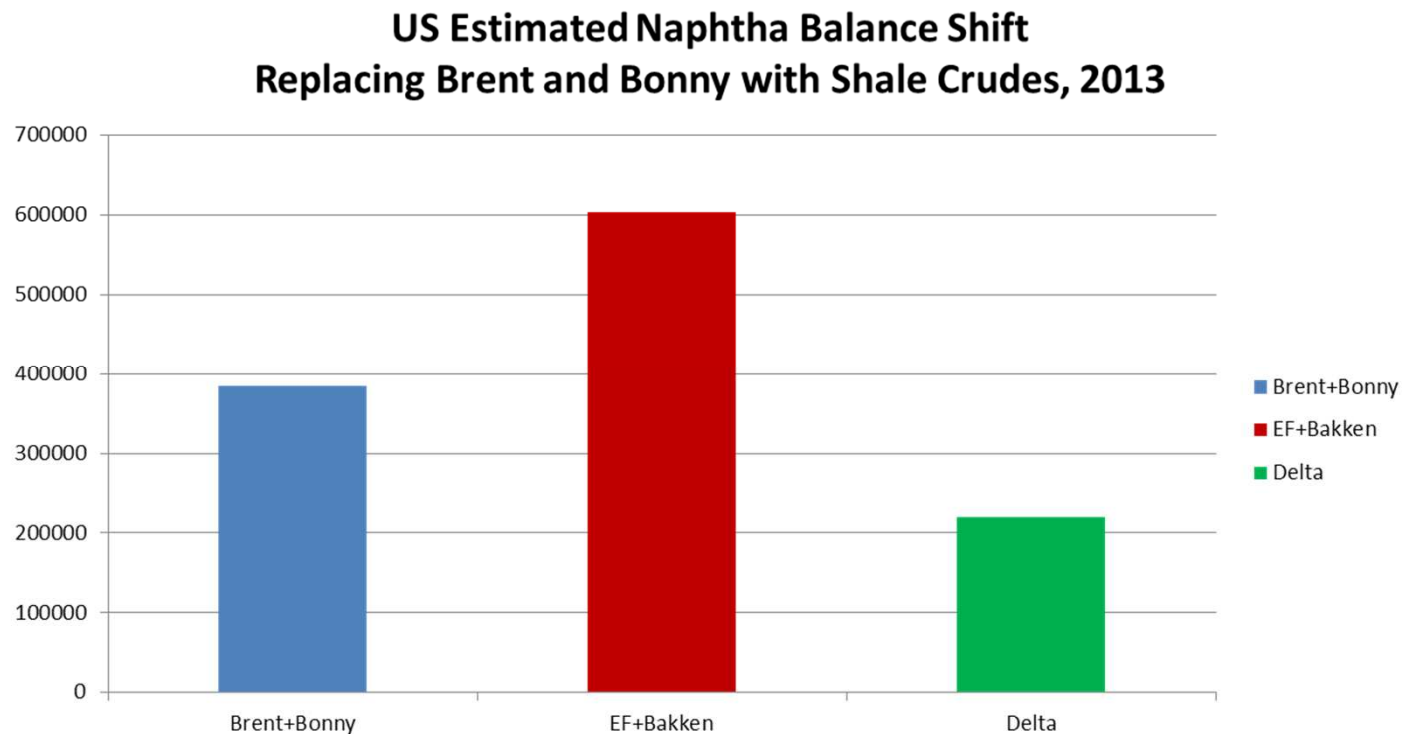
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..leading to the reinvestment and growth in US refining capacity



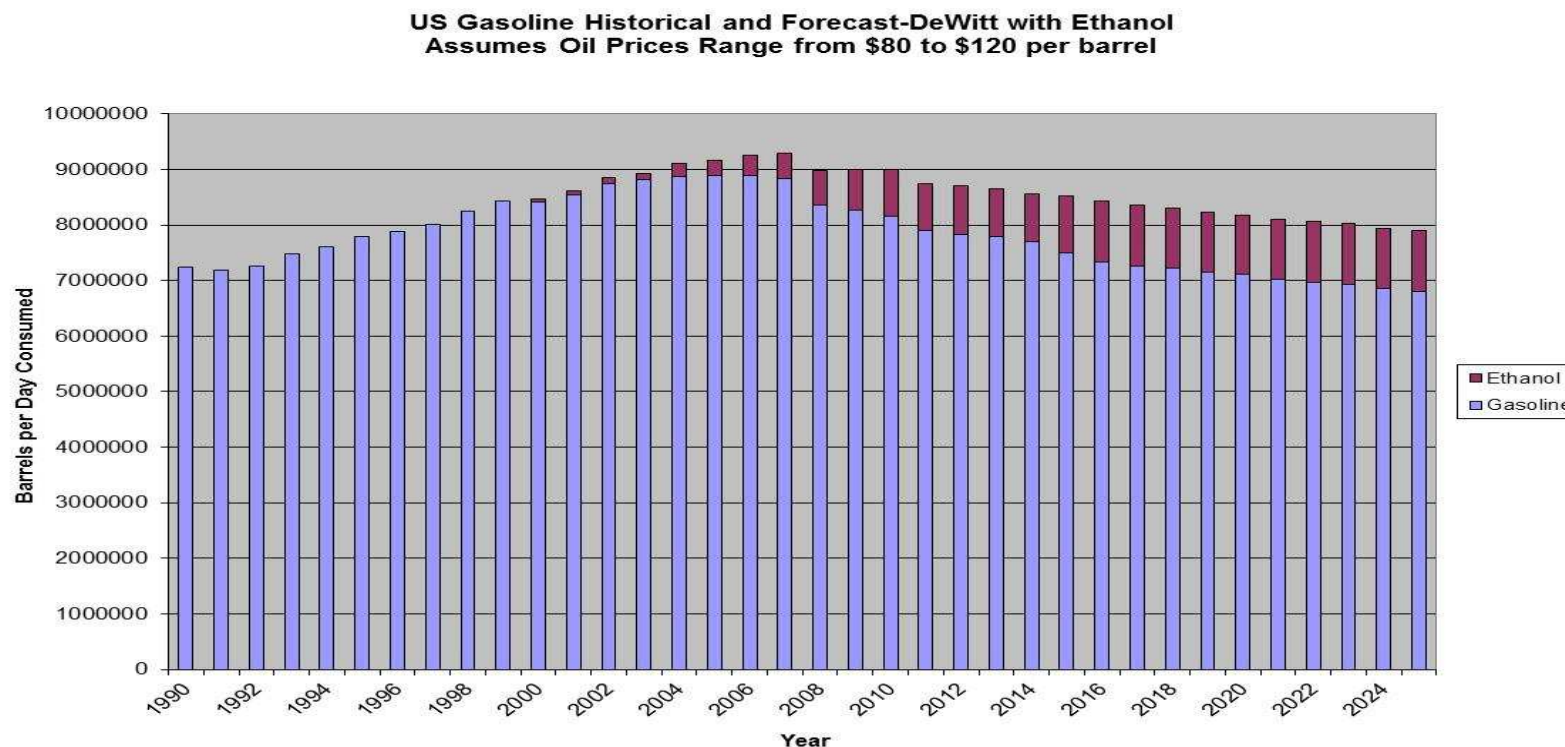
- Valero and Marathon are adding distillation capacity to process more shale crudes

... and a significant boost in US naphtha production



- Based on replacing 1.6mn bbls per day of Brent/Bonny with Eagle Ford and Bakken
- With forecast production growth of shale crudes (up to 4.0mn bbls per day by 2020)

## But in the US, demand for naphtha into gasoline blending is falling



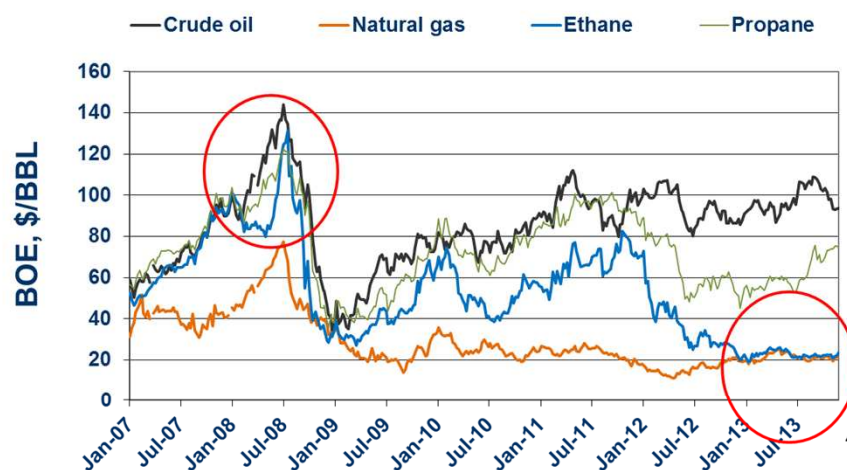
- Slow economic growth; does not include exports
- Renewable fuel standard-target is 36 B gallons of ETOH by 2023(not achievable)
- CAFE standard with targets of 35.5 MPG by 2016 and 54.5 MPG by 2025

Source: EIA and Argus DeWitt forecast

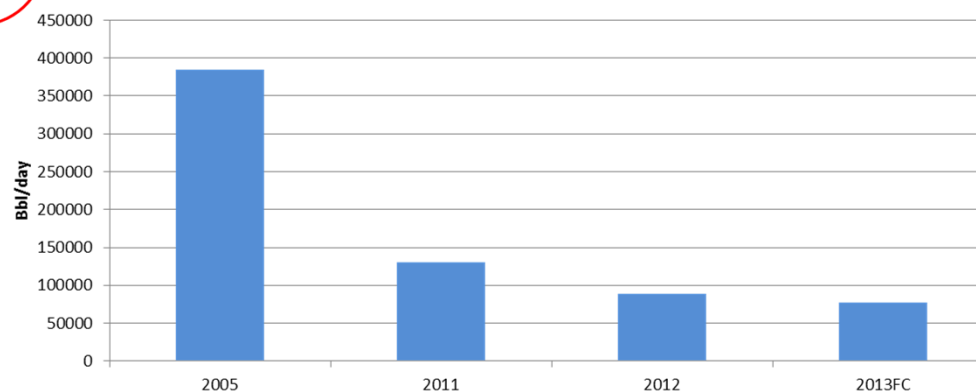
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## While olefins crackers have moved feedstock slates away from naphtha to ethane/LPG



**US Steam Cracker Feed Evolution**  
Feeds Heavier than Butane, Adjusted for VGO



- Drop of nearly 300kbbbls per day of naphtha/natural gasoline feeds
- Naphtha length could exceed 500kbbbl per day

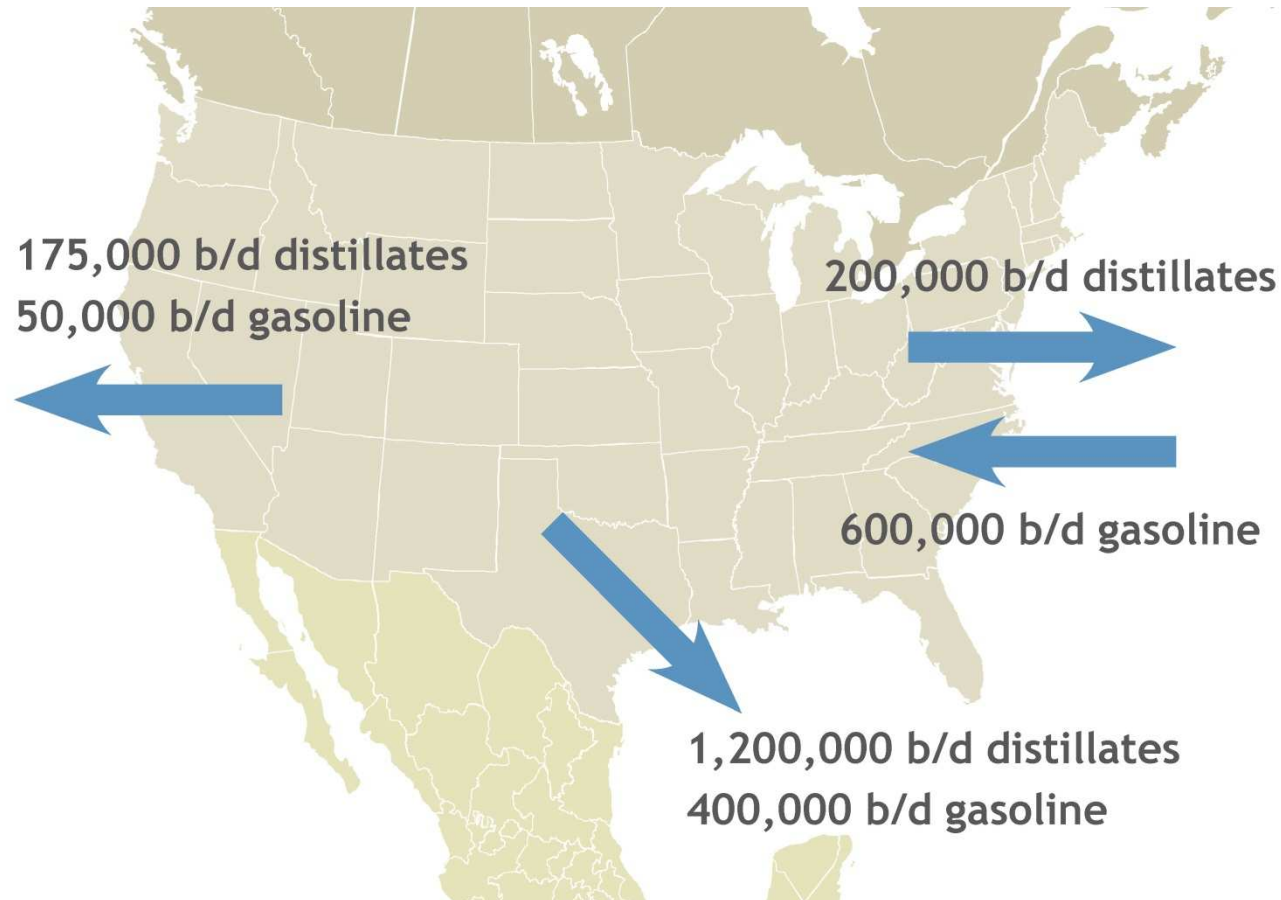
Source: AFPM & Argus DeWitt adjustments

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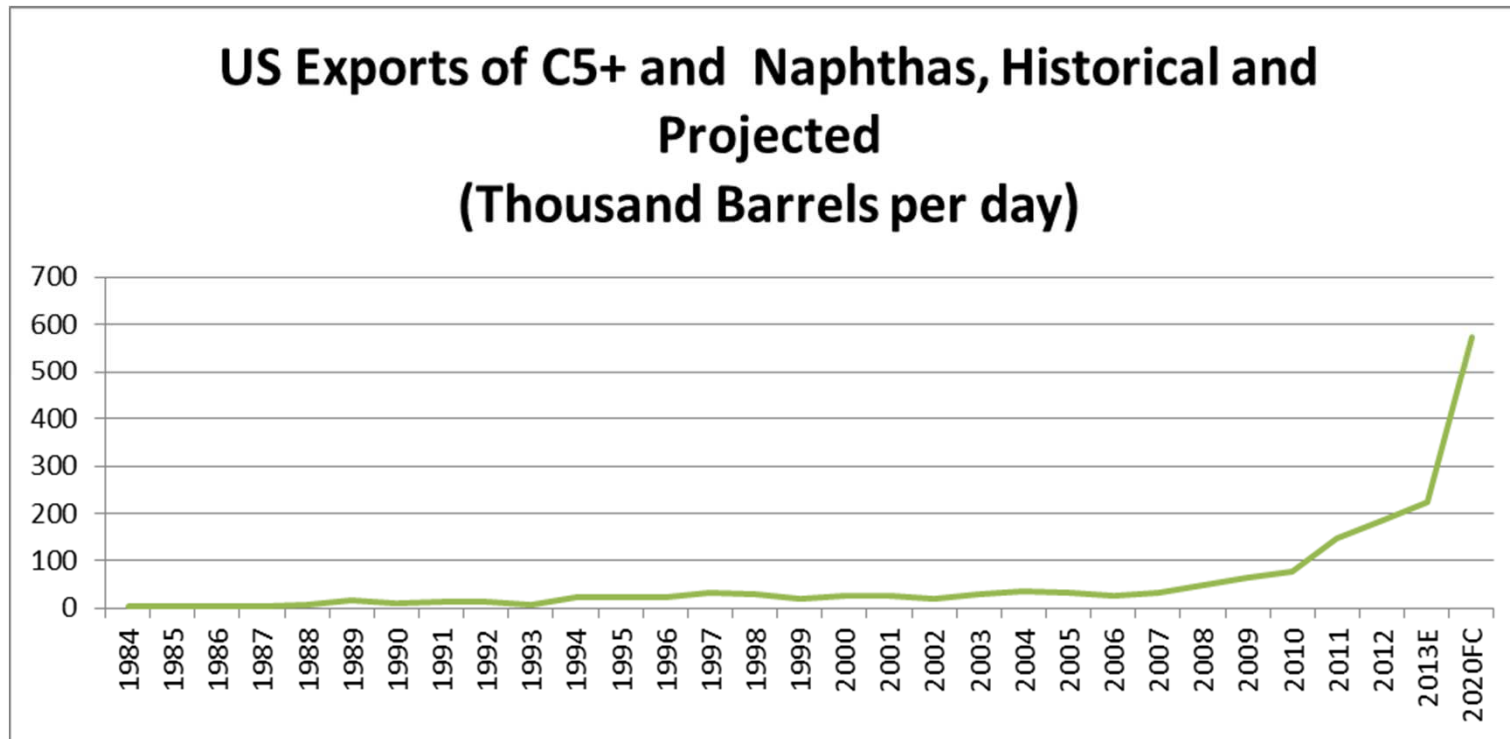


The US has sought to mitigate part of this naphtha length by increasing its exports of gasoline





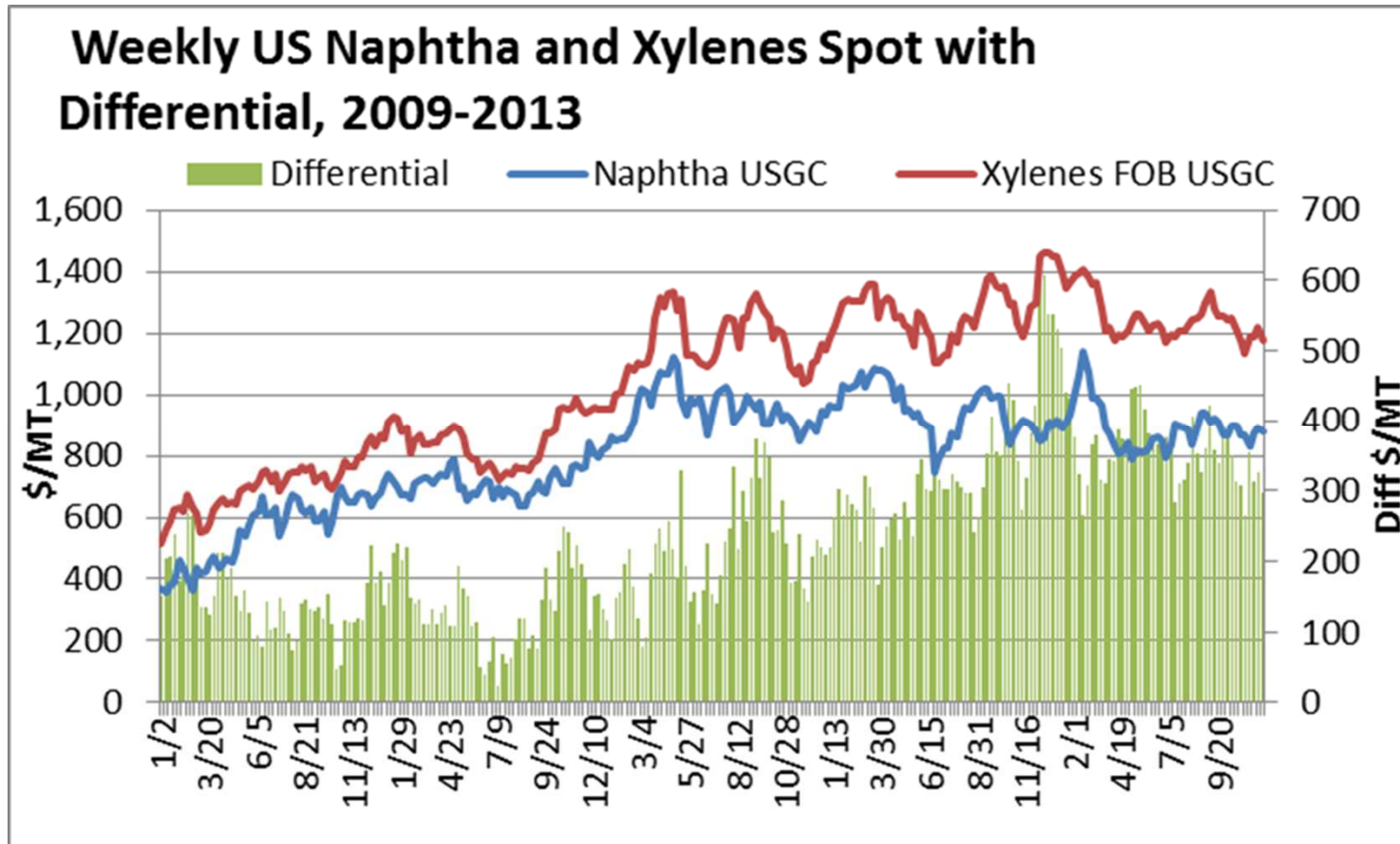
... while US exports of C5+ and naphtha are also rising rapidly



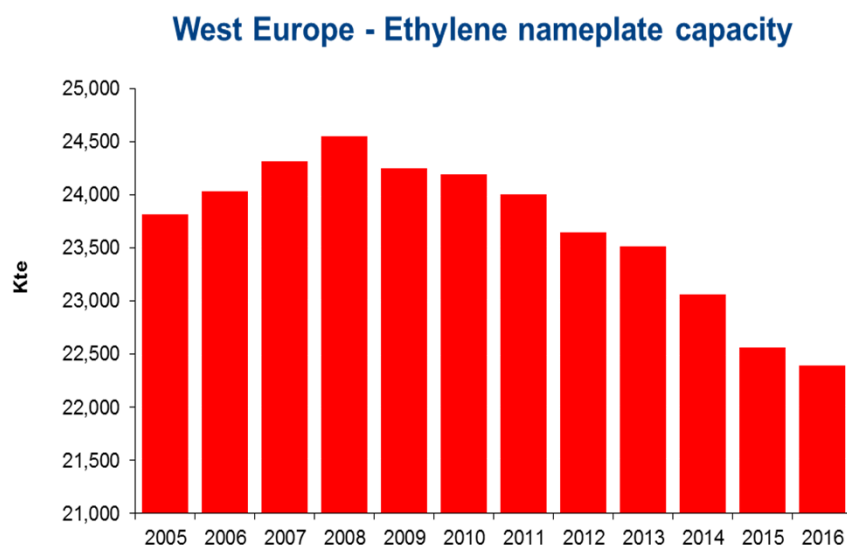
- C5+ condensate going to Canada as diluent for heavy crude production
- More cargoes are leaving the USGC for Asia
- Forecast for 2020 is based on forecast of increased production of light crude

Source: EIA and Argus DeWitt forecast

In the meantime, ample availability of low cost naphtha has led to a recovery in US reformer and aromatics margins

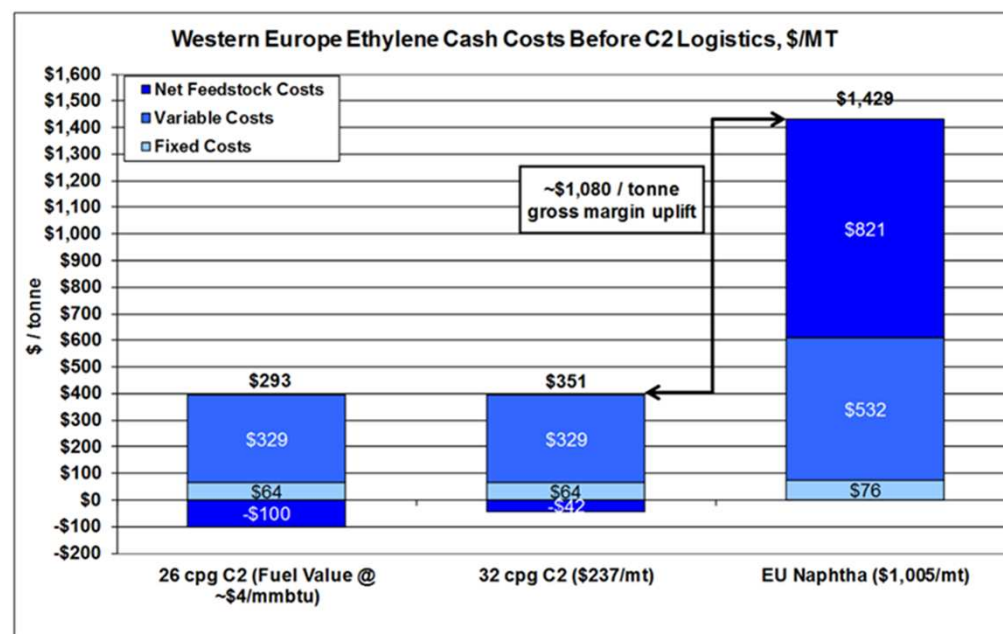
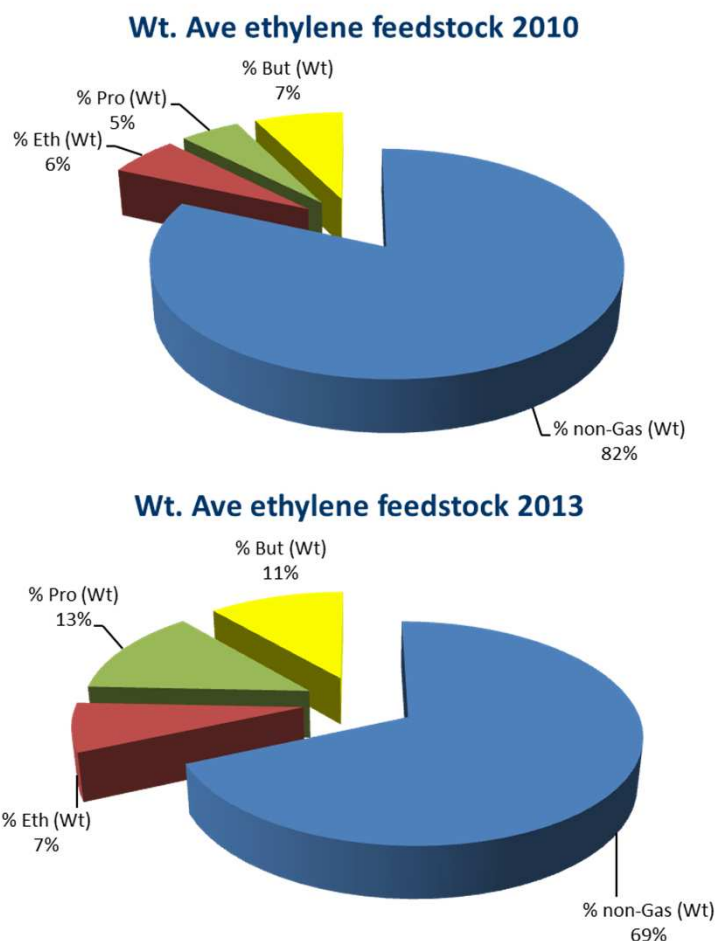


Looking to Europe - shale gas developments in the US have also contributed to rationalisation of cracking capacity, leading to lower naphtha consumption.

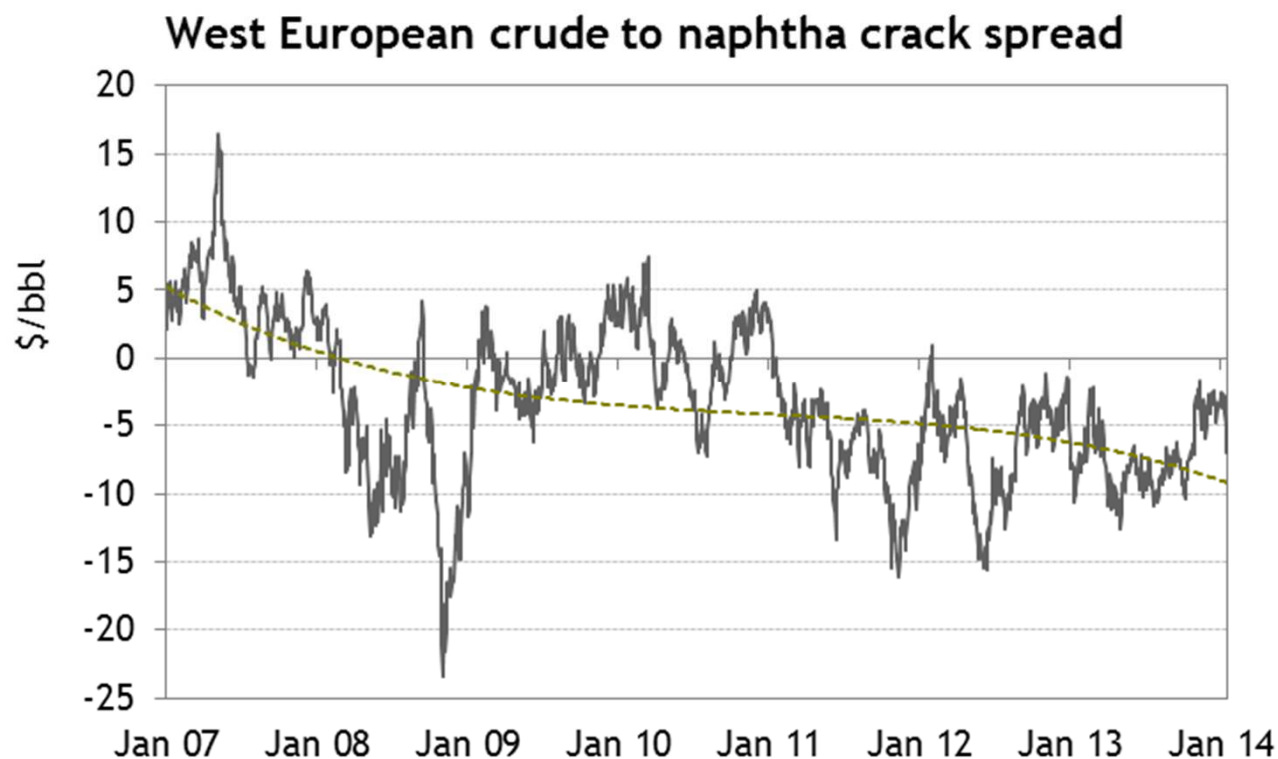


- Over 2.0mn tons of announced cracker closures in West Europe (further ~1.0m in N. Africa and EE).
- The majority of closures involve old, small naphtha crackers resulting in the loss of 9.0mn tons of potential naphtha consumption

Competitively priced LPG is also displacing heavy naphtha feed at flexible crackers, while others are considering a more radical move to ethane.



... with feed substitution softened by a declining value of naphtha, despite the permanent closure of 1.7mn bbl/d of crude capacity since 2009.



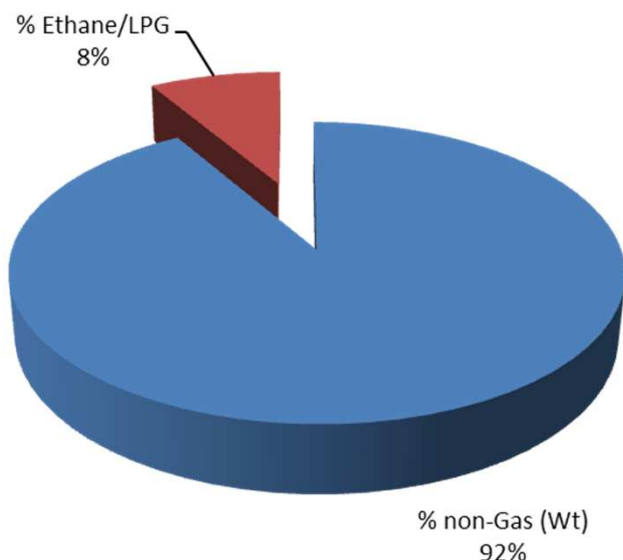
Source: Argus North Sea Dated crude (\$/t); Argus Naphtha CIF NWE (\$/t)

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In Asia, crackers have a strong and traditional dependency on naphtha/gasoil as feedstock.

**Wt. Ave ethylene feedstock in Asia 2013**



- 53mn tons of ethylene production capacity. 4.5mn tons produced from ethane/LPG.
- Co-product streams - propylene and C4 - have higher values in Asia than in Europe.
- The hurdle for LPG is higher

However in China PDH units fed by low cost propane from the US, are challenging the traditional naphtha cracking route to propylene and PP.





With future CTO/MTO developments adding to the challenge on naphtha cracking across the whole of Asia.



## So how will naphtha remain as a competitive feedstock for petrochemicals and what will this mean for refinery operations

- Will PDH/CTO production in China force major cracker rationalisation in Japan, Korea and Taiwan?
- If so, how low will naphtha pricing need to fall in order for ethylene/olefins to be cost competitive?
- Is this uneconomic for refineries?
- If growing naphtha length forces more refinery rationalisation in Europe and Asia,
  - where will the Xylenes come from to feed the 6% p.a. polyester growth?
  - Will propylene and C4 balances tighten?
  - Will on-purpose production become essential?

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