



*APIC ANNUAL MEETING,  
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# North American Shale Gas - Implications for Global Petrochemicals

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# Agenda

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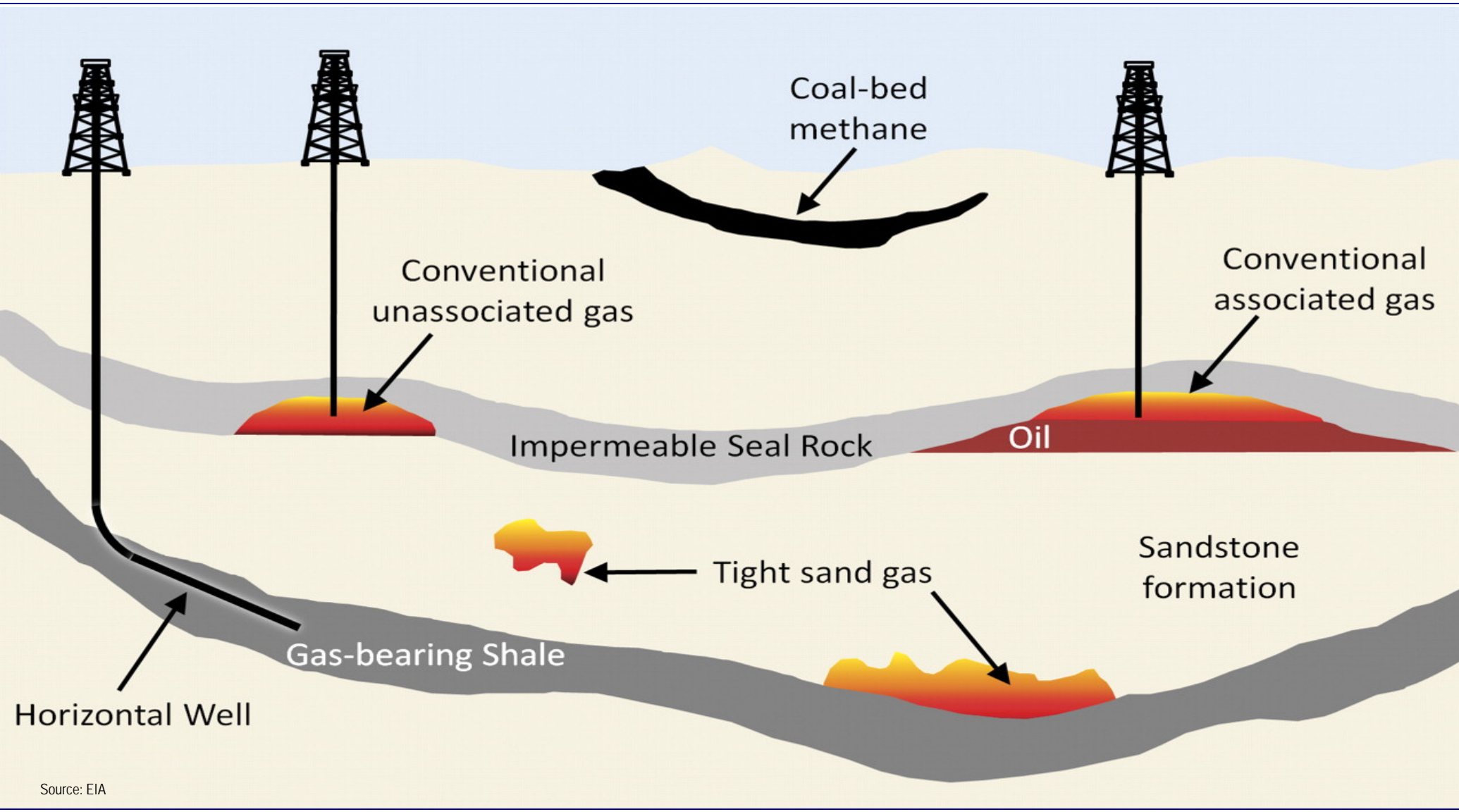
- Shale Gas Overview
- Opportunities and Developments in Chemicals
- Impact and Outlook on Global Markets

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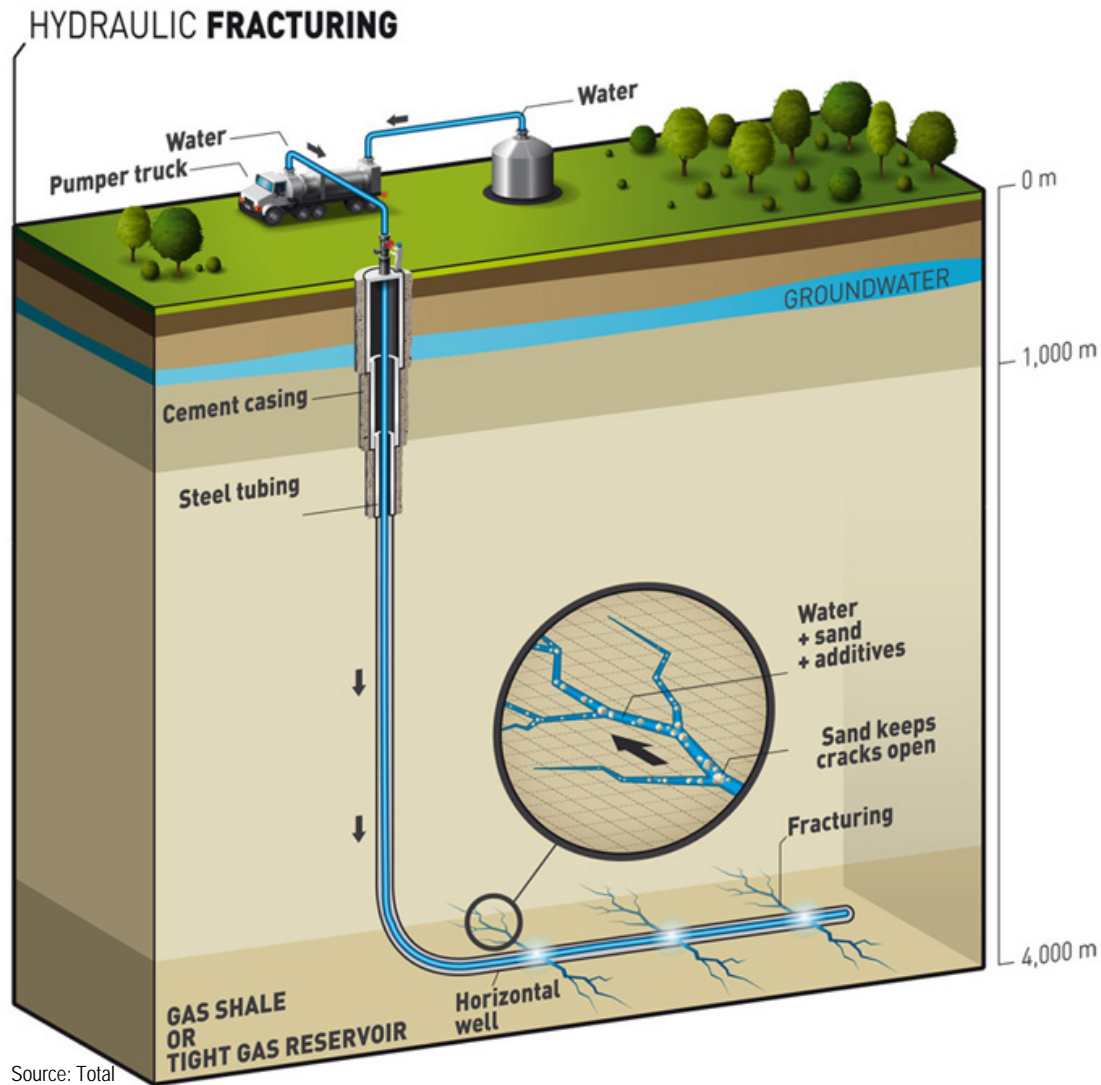
Shale Gas Overview

## Unconventional feedstocks – Is this the final chapter of the oil & gas age?



Source: EIA

## Hydraulic fracturing technology has enabled access to unprecedented oil and gas reserves in North America and potentially across all global regions longer term



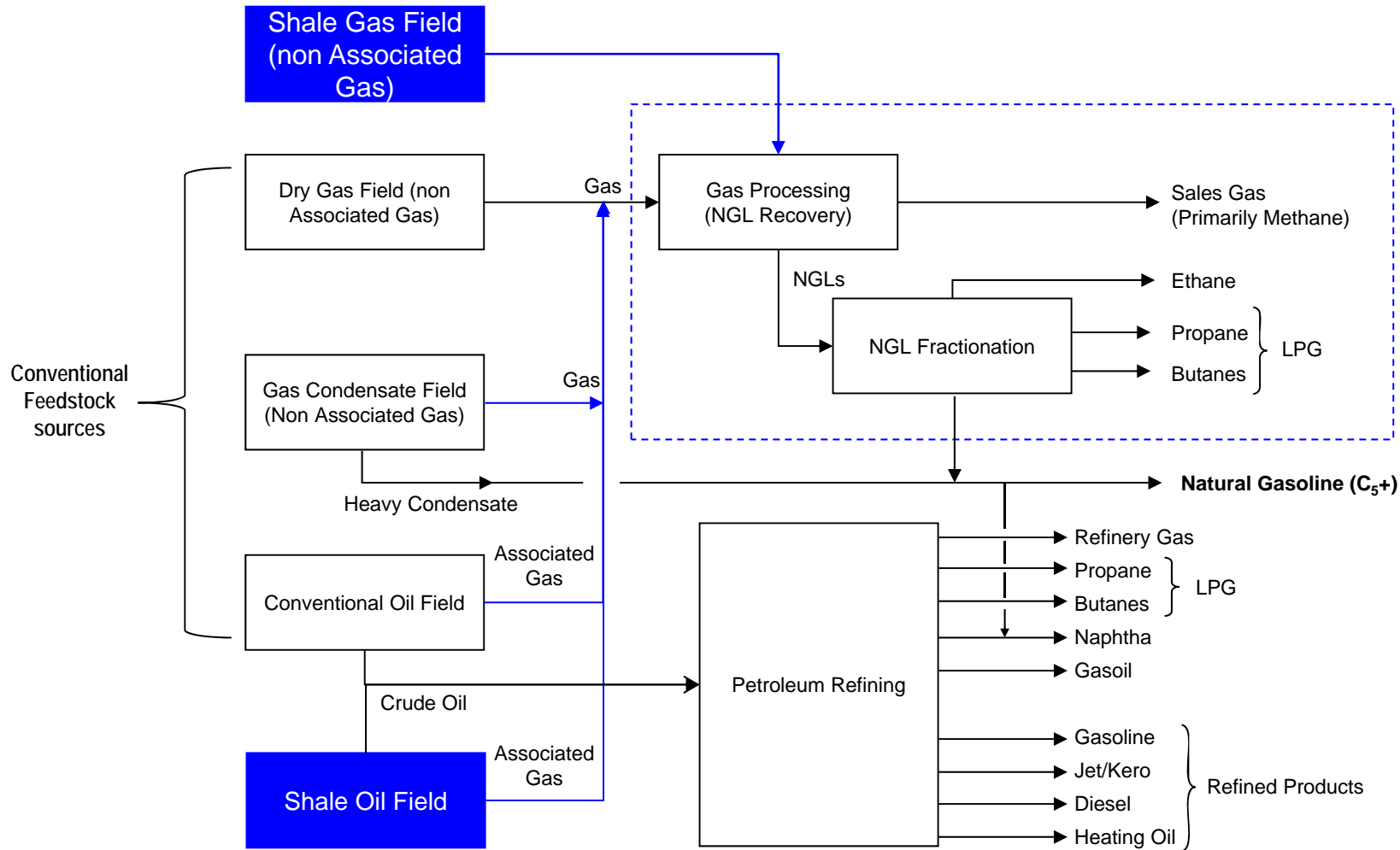
Source: Total

- Fracturing wrenches (fractures) open rock deep beneath the earth's surface, freeing up trapped natural gas.
- Fracturing process begins with small explosive charges deep in the well. Millions of gallons of fracking fluid (sand, chemicals and water) are then pumped into the well at high pressure creating the shale fracture and gas release.

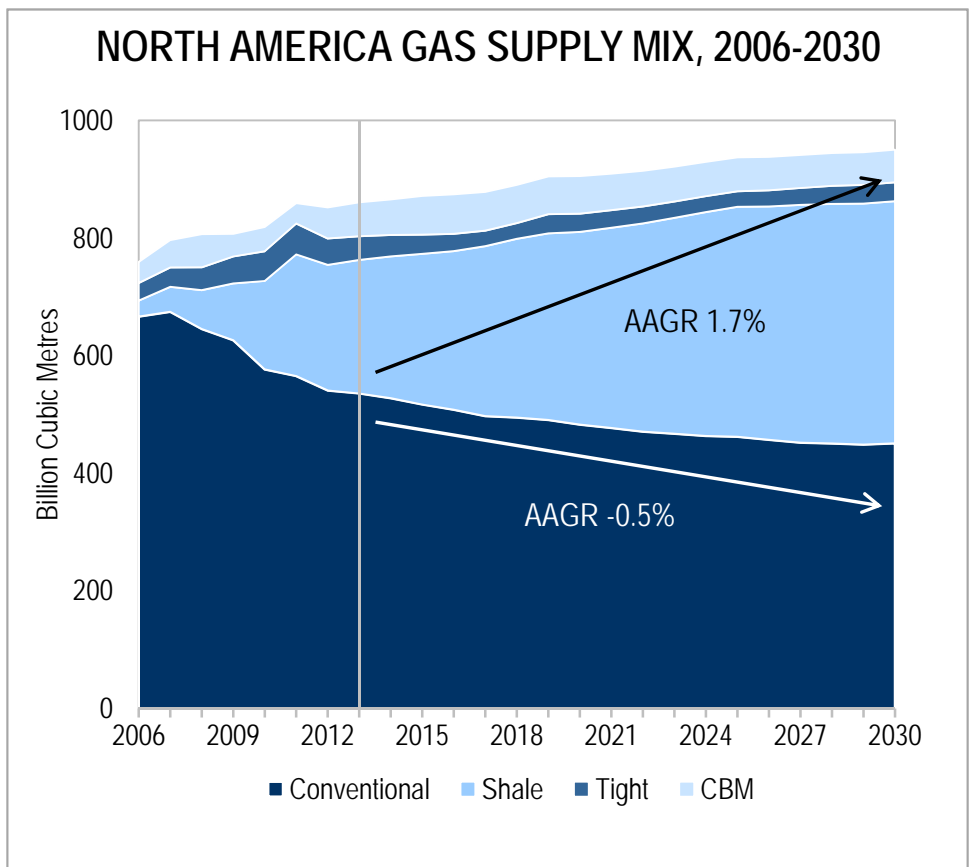
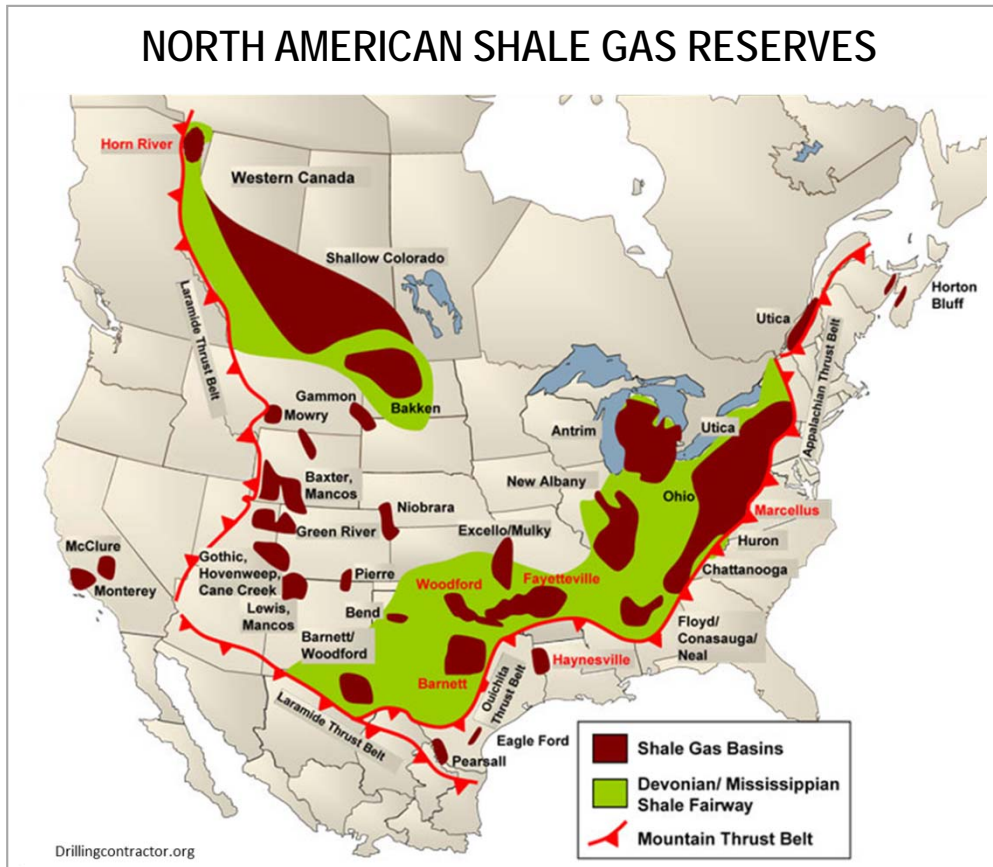
### Key Issues

- Ground water and air contamination.
- Waste water storage & disposal
- Potentially a catalyst for earthquakes

Shale resources have resulted in increased availability of ethane and other NGLs therefore increasing the availability of petrochemical feedstocks

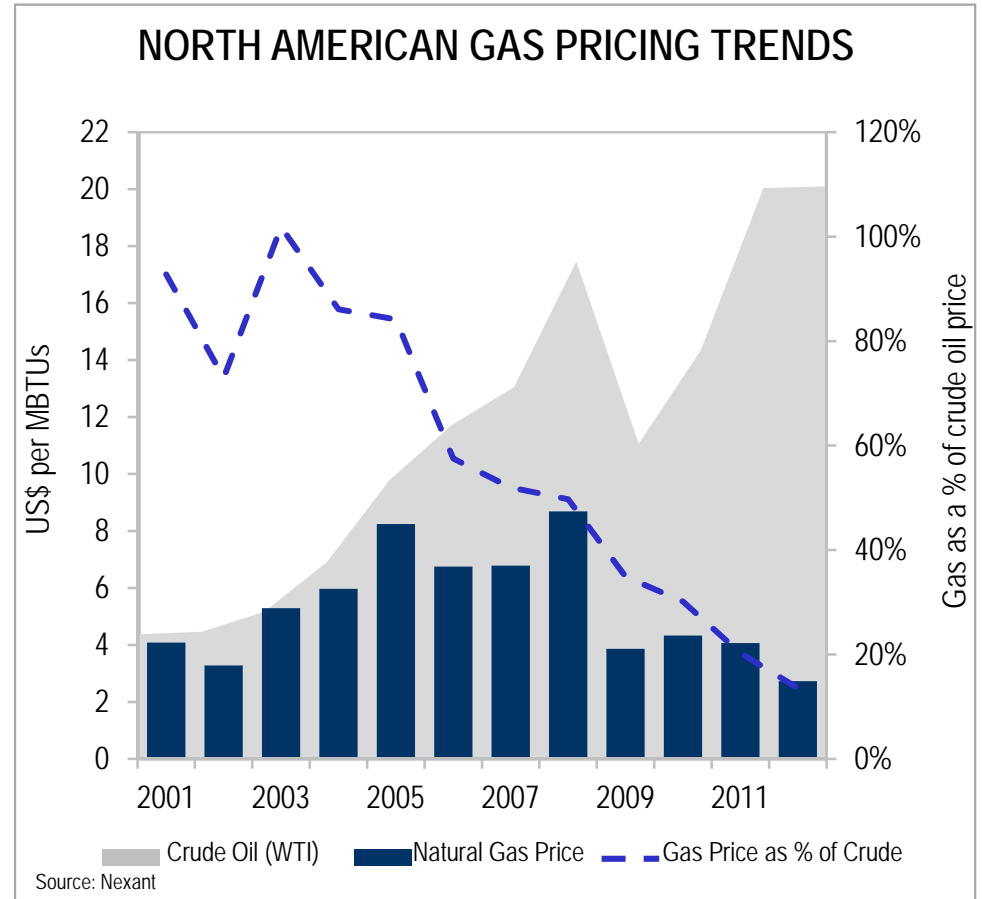
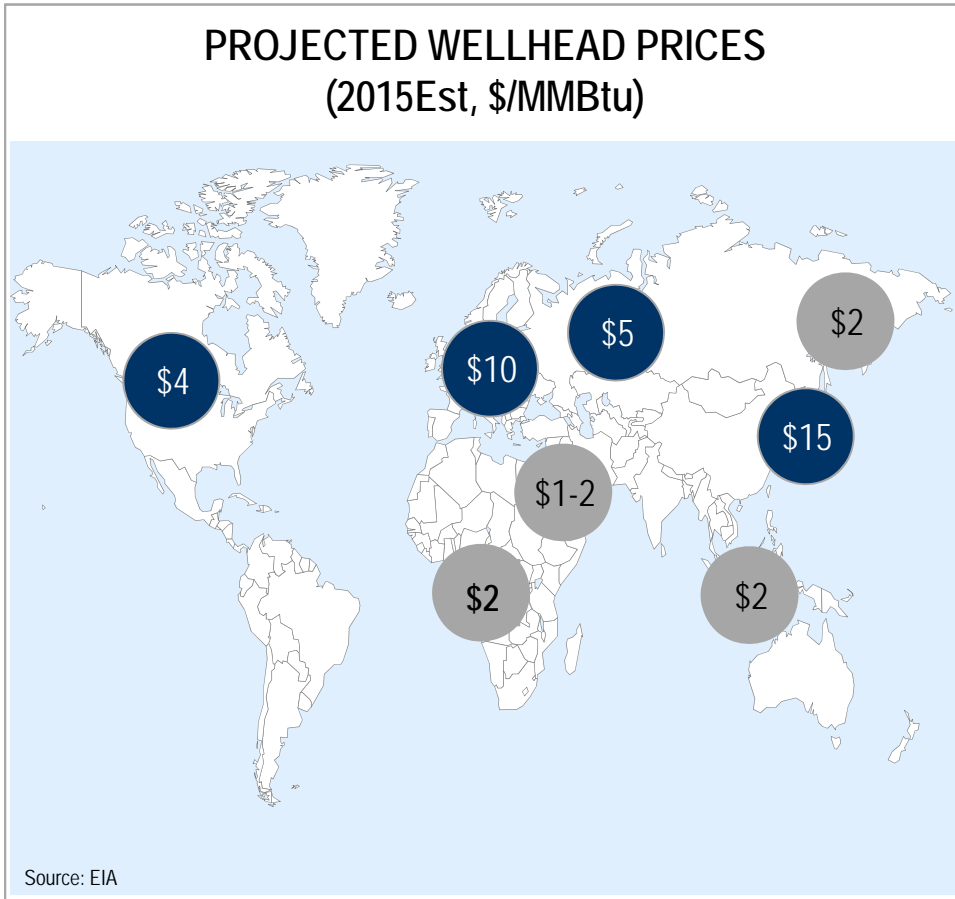


Overview of major shale gas basins in North America. Which span most of the continent. Today, the only significant shale gas producing region in the world.



- Production of shale gas, and other non-conventional gas sources, are more than sufficient to cover declining gas production from conventional sources.

Disparity in global gas pricing set to continue longer-term despite increasing connectivity enabled by LNG



- Shale gas has enabled a disconnect in North American gas prices relative to the wider energy market

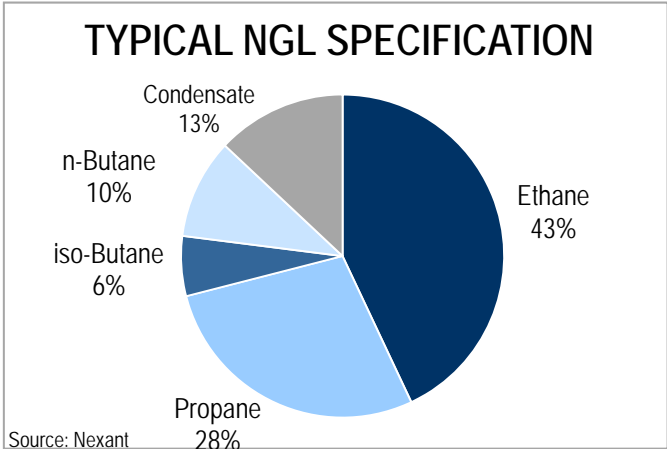
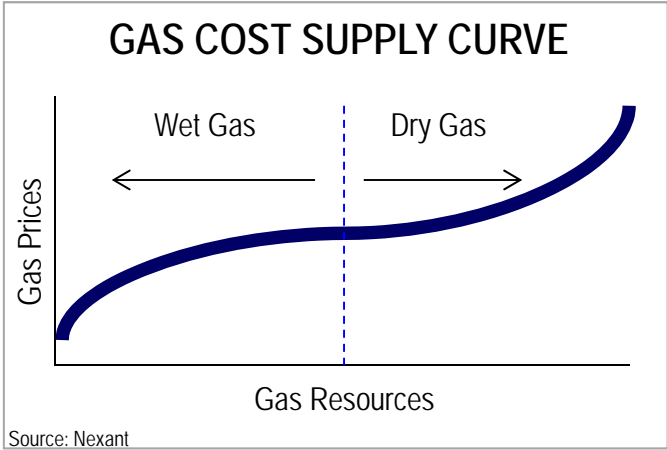
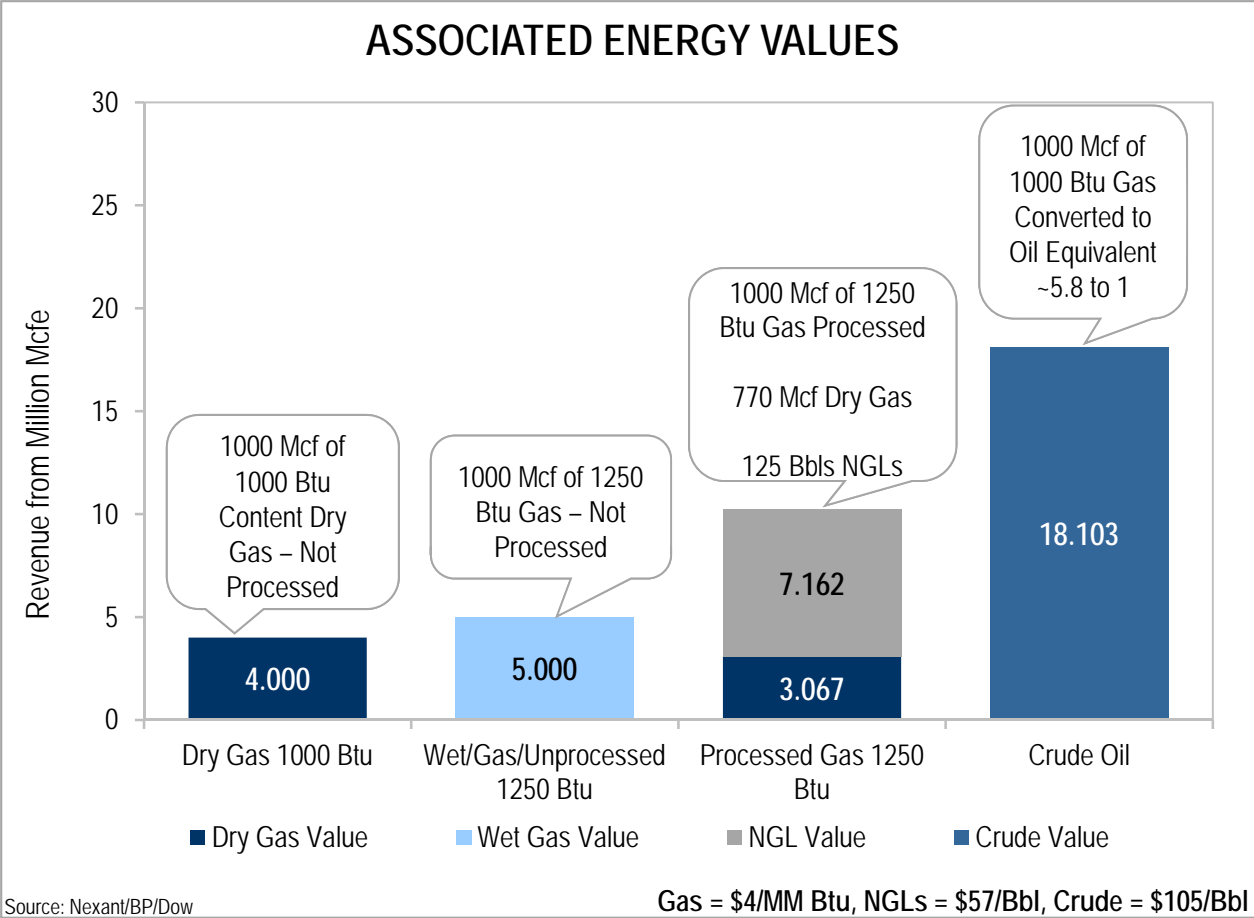


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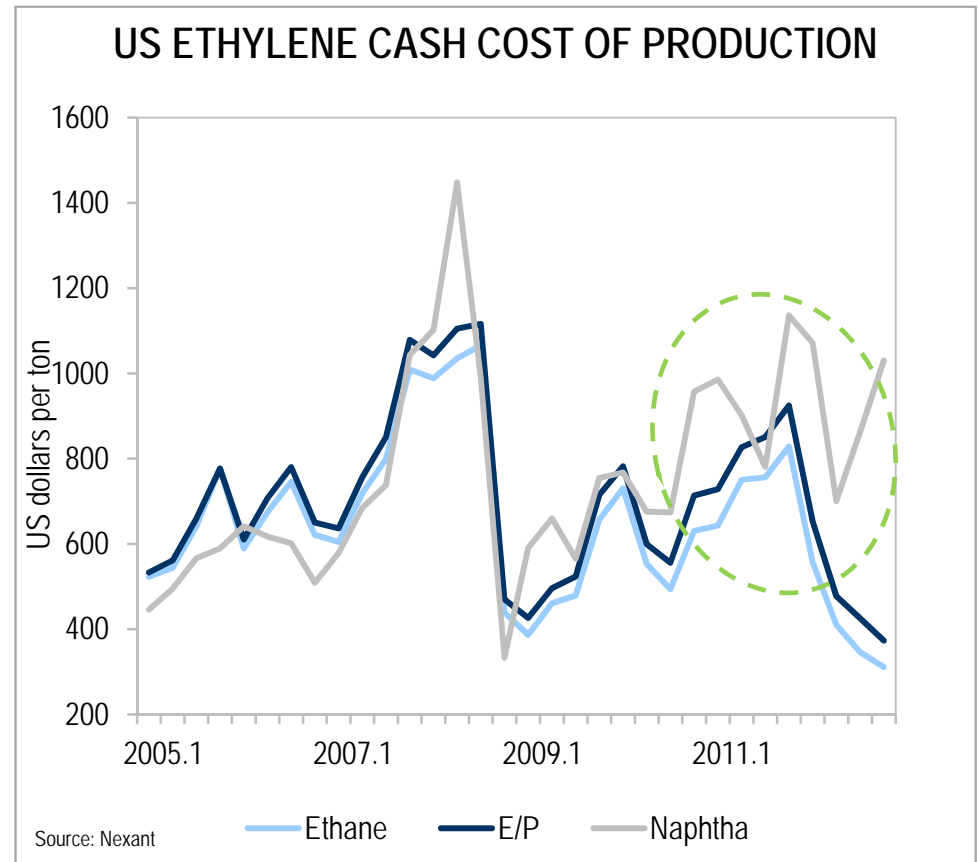
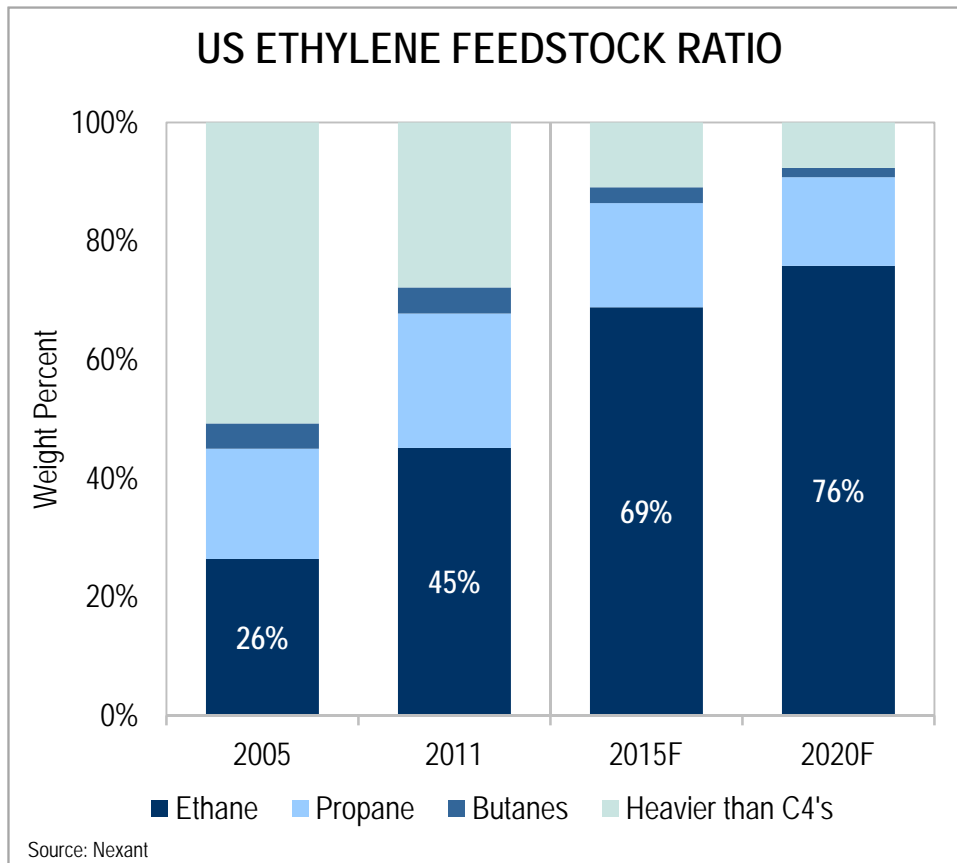
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Opportunities and Developments in Chemicals

Gas companies are targeting wet/heavy fields due to the attractive co-product values associated with 3<sup>rd</sup> party sales of NGLs. Thus increasing domestic availability of ethane and propane and pushing prices lower.

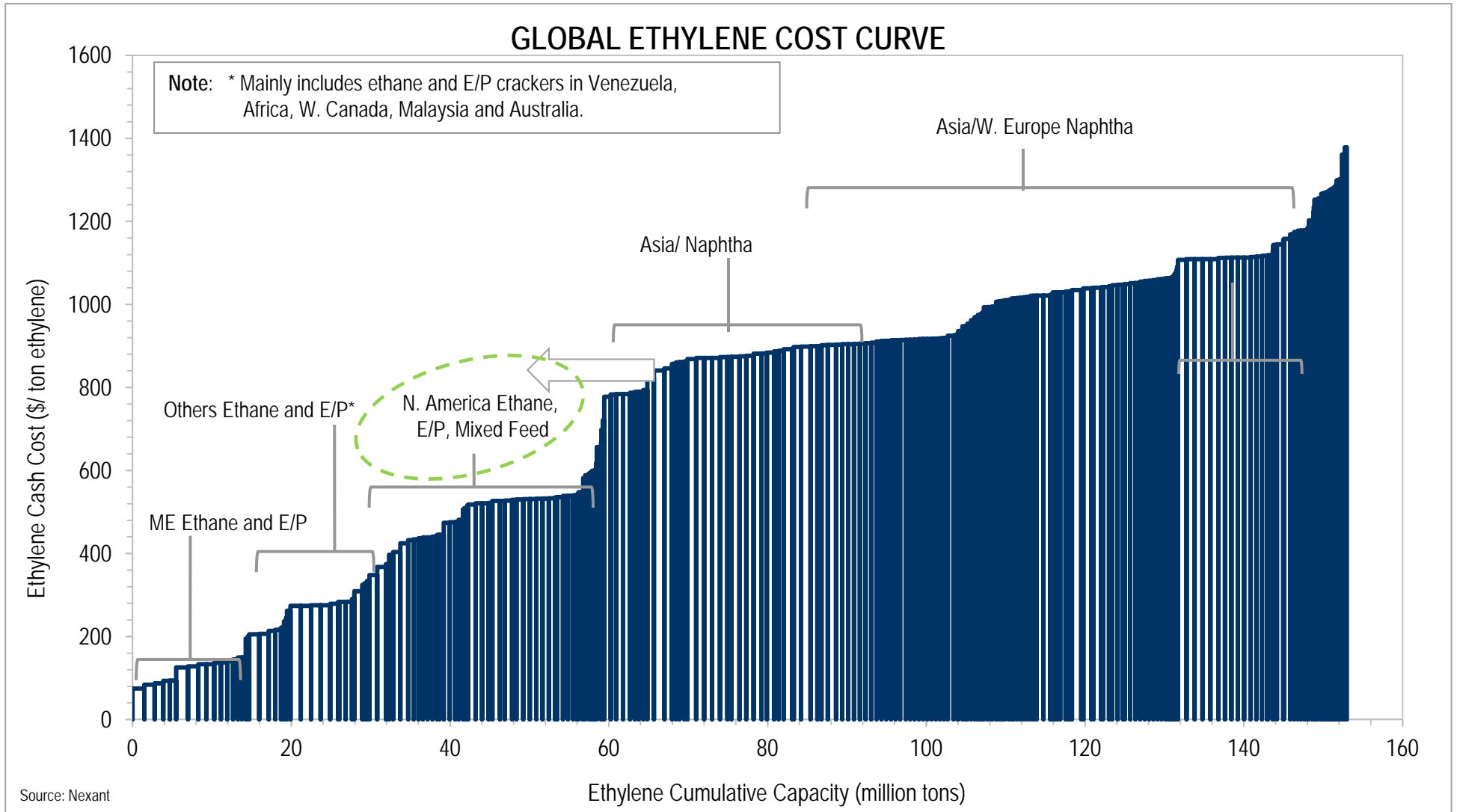


## Ethylene cracking feedstock slate has shifted predominantly into more ethane, therefore improving product margins and production competitiveness versus heavier feedstock slates



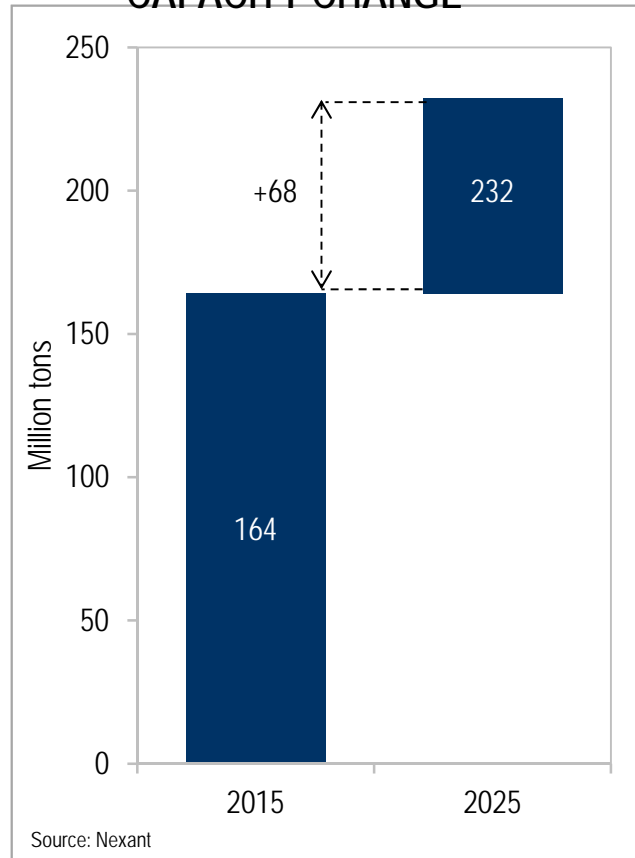
- Many of the regions existing crackers have undergone feedstock conversions/process optimisation investments to maximise ethane cracking potential

The shale gas effect has resulted in a structural change in global ethylene competitiveness. Despite this ethylene producers in the Middle East continue to hold a significant advantage



The key question is how much new production capacity will come from the US based on the availability of competitively priced ethane and other NGLs? The answer is tied to natural gas production.

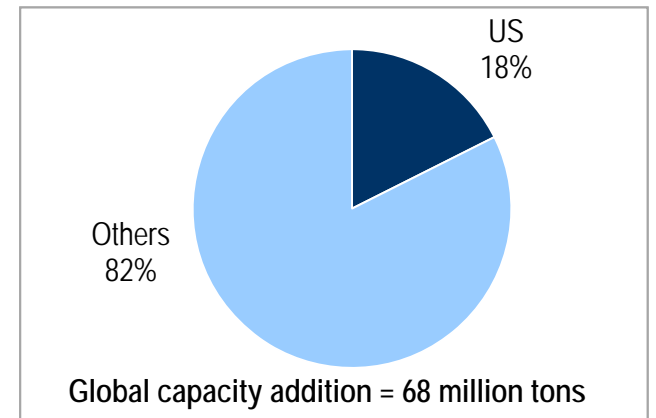
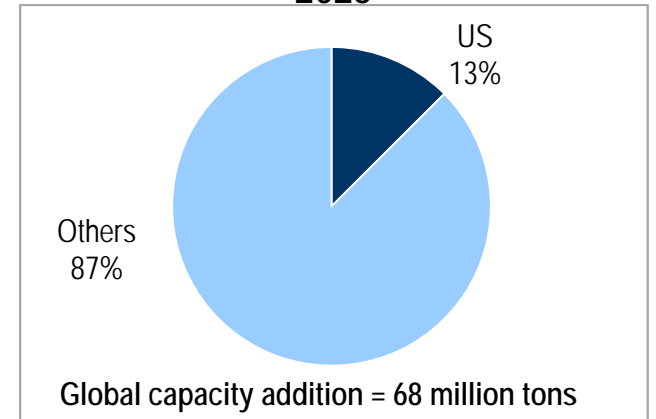
**PROJECTED ETHYLENE GLOBAL CAPACITY CHANGE**



Base Case  
1% Gas Production Growth

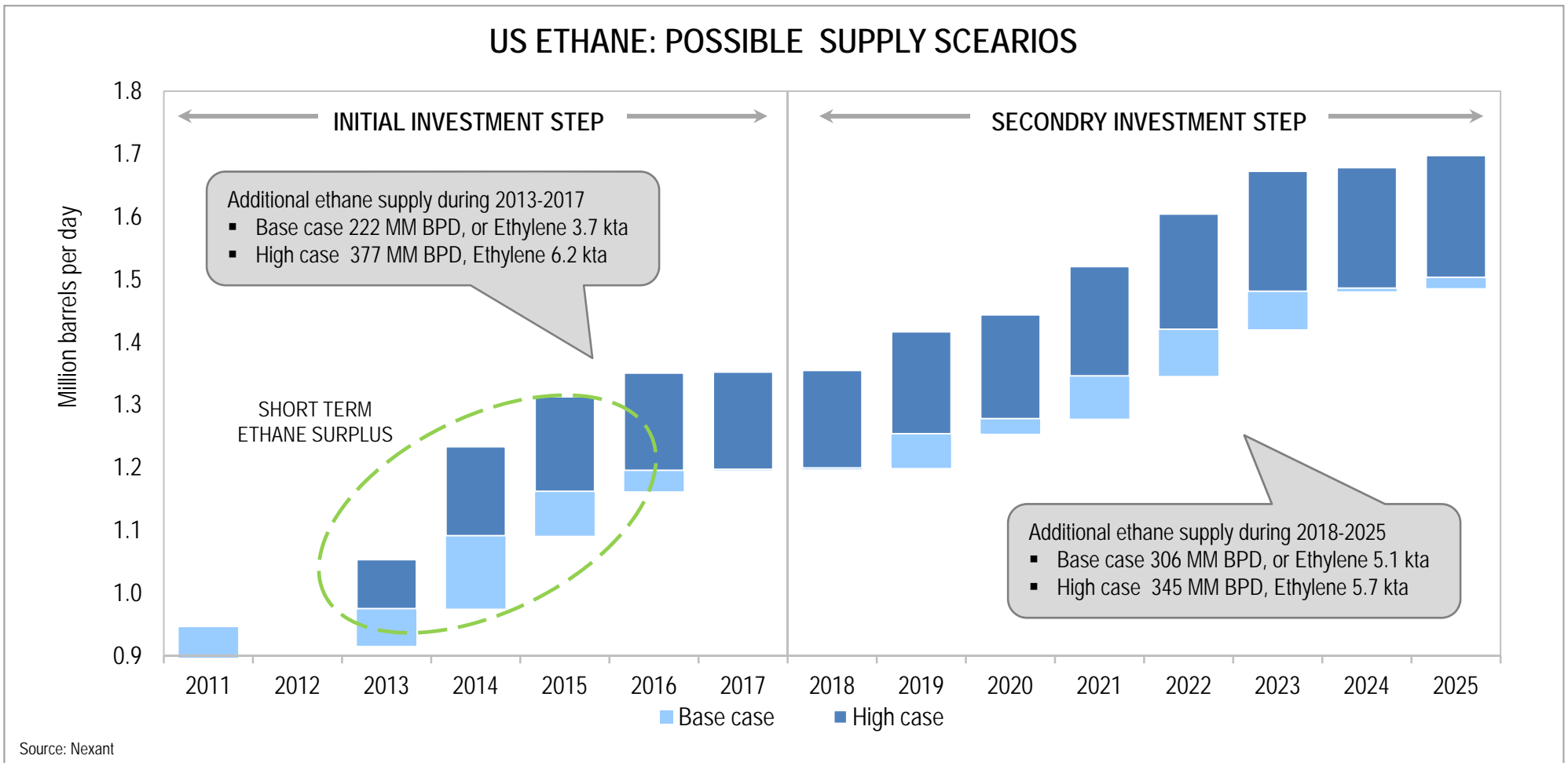
High Case  
2% Gas Production Growth

**ETHYLENE CAPACITY ADDITIONS, 2025**



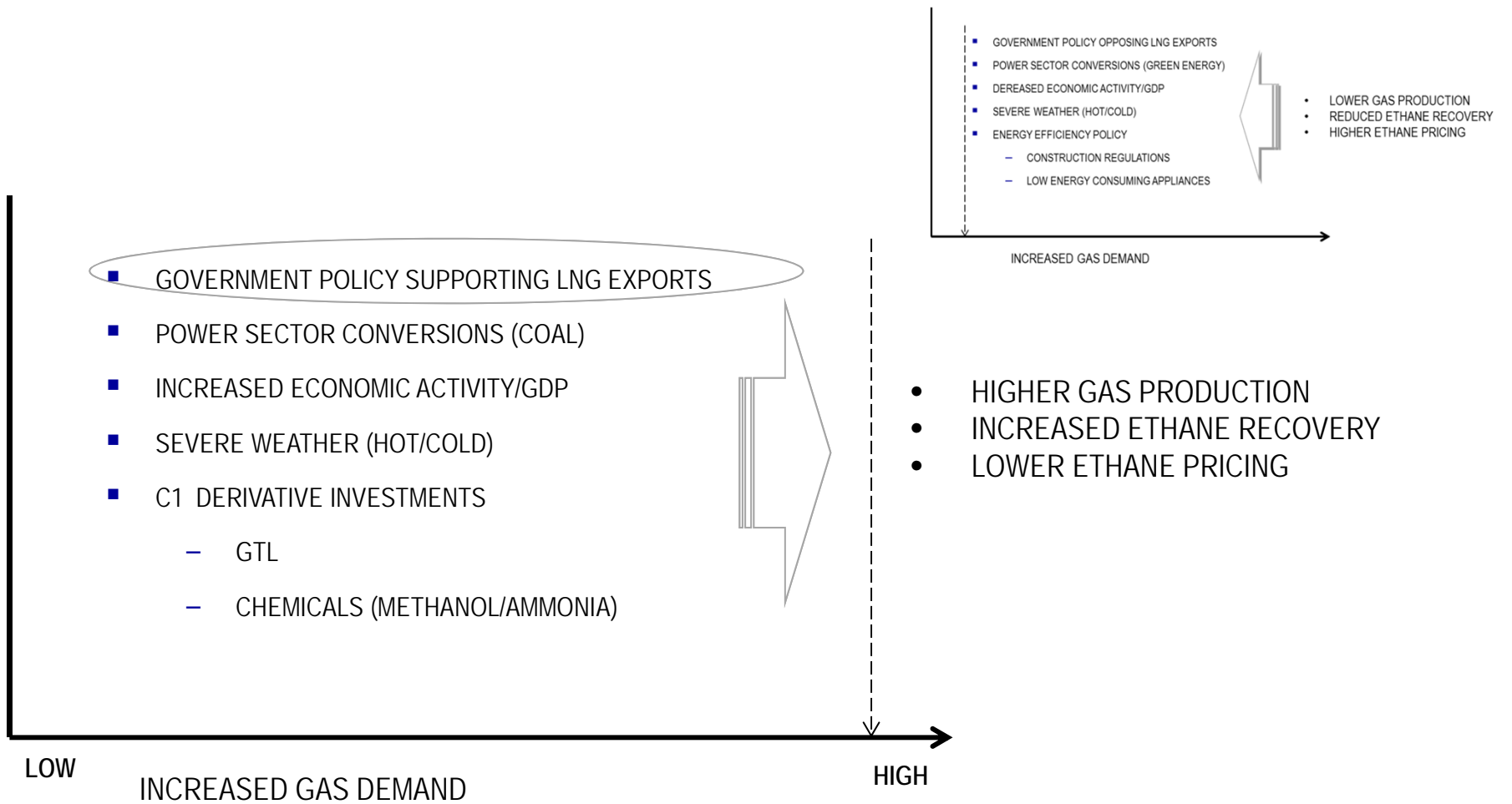
NB this analysis assumes a standardised gas specification across the forecast

The total additional supply of US ethylene based on ethane fall within a range of 8.5-12 million tons (6 – 9 steam crackers).

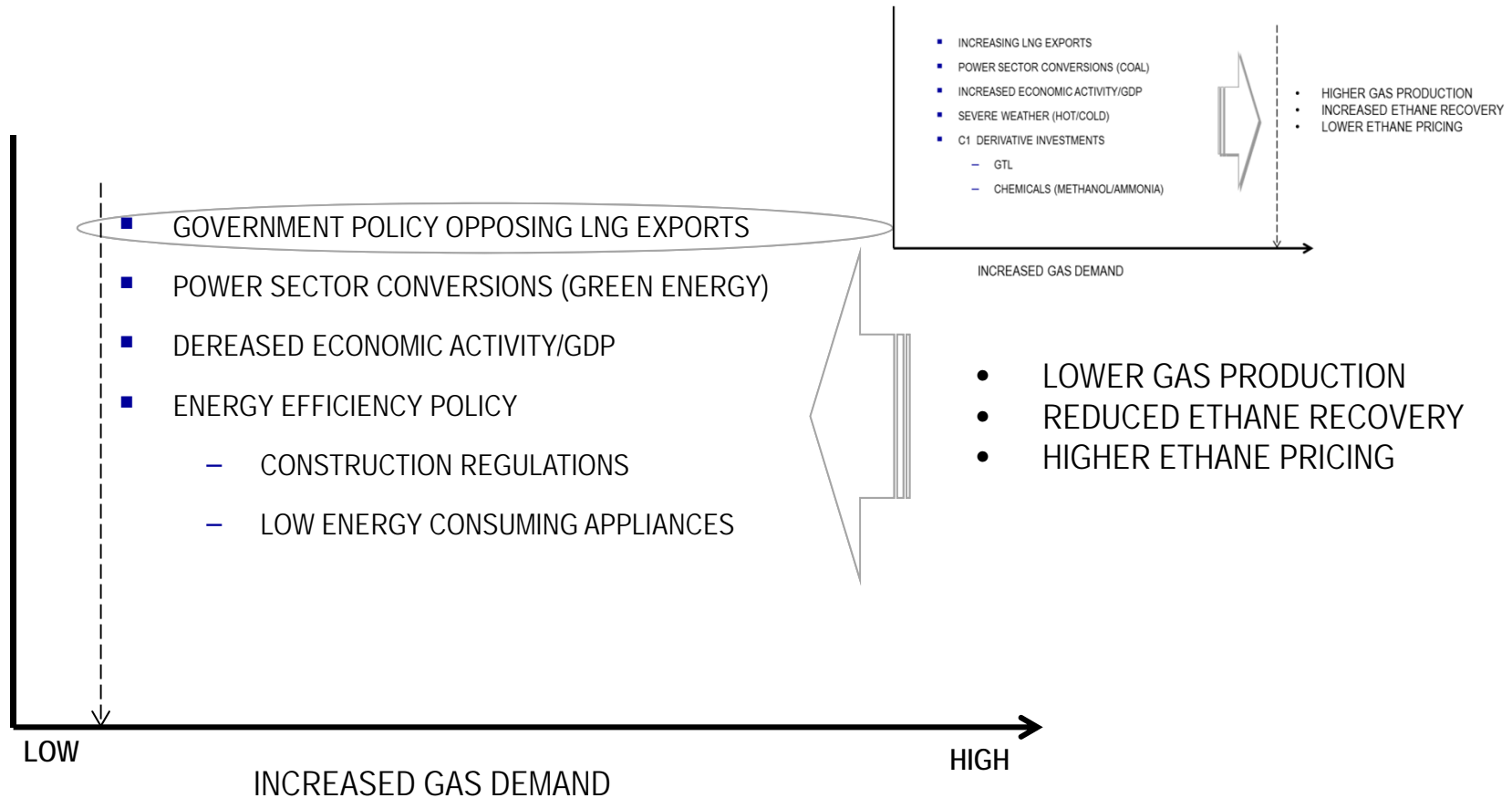


- Surplus ethane is keeping prices low. This will change as the market over invests in new ethane based ethylene capacity – thus changing the supply and demand dynamic.

Investment opportunities in new ethane crackers will primarily depend on total US gas production and the factors that support this.

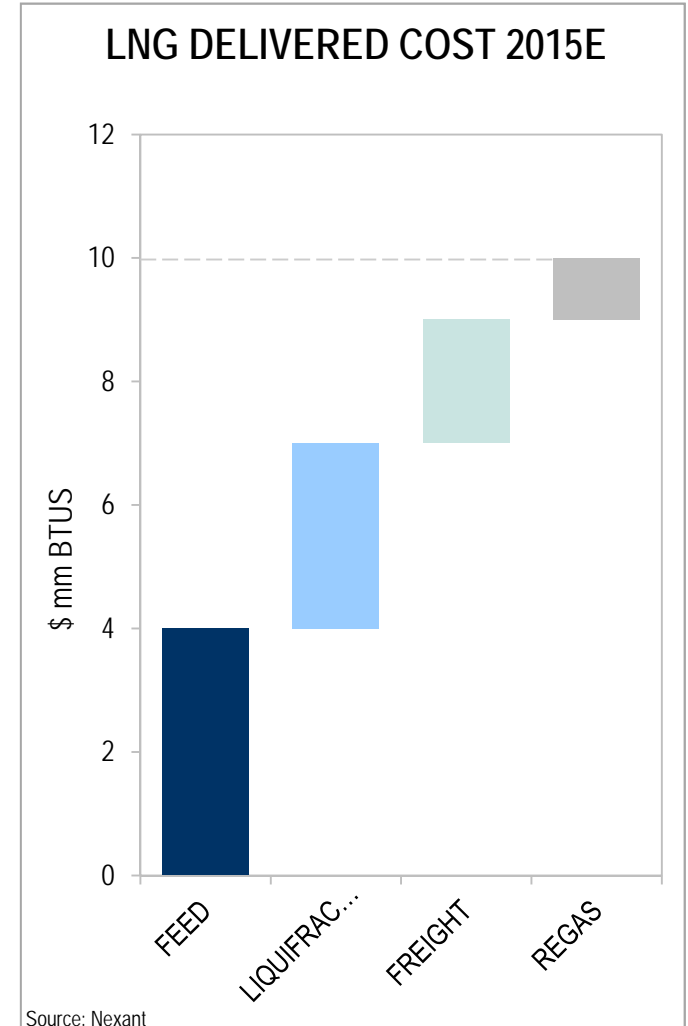
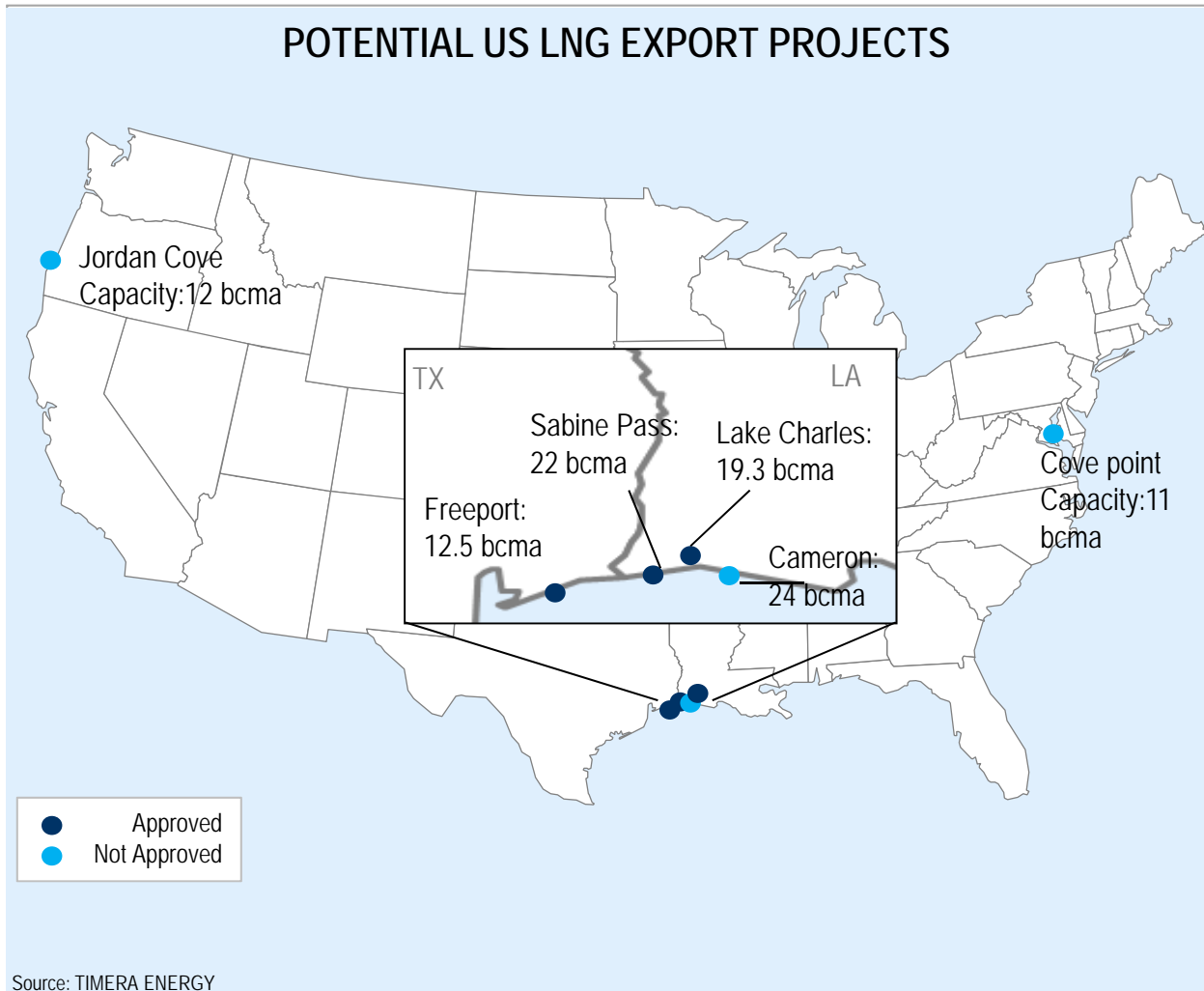


However in reality there is significant downward pressure on gas consumption principally due to energy efficiency /green policy. However the market may expand if proposed LNG projects are approved.





Approximately 100 bcma of additional LNG export capacity is under review. However to date the Department of energy has only approved around half of these projects.

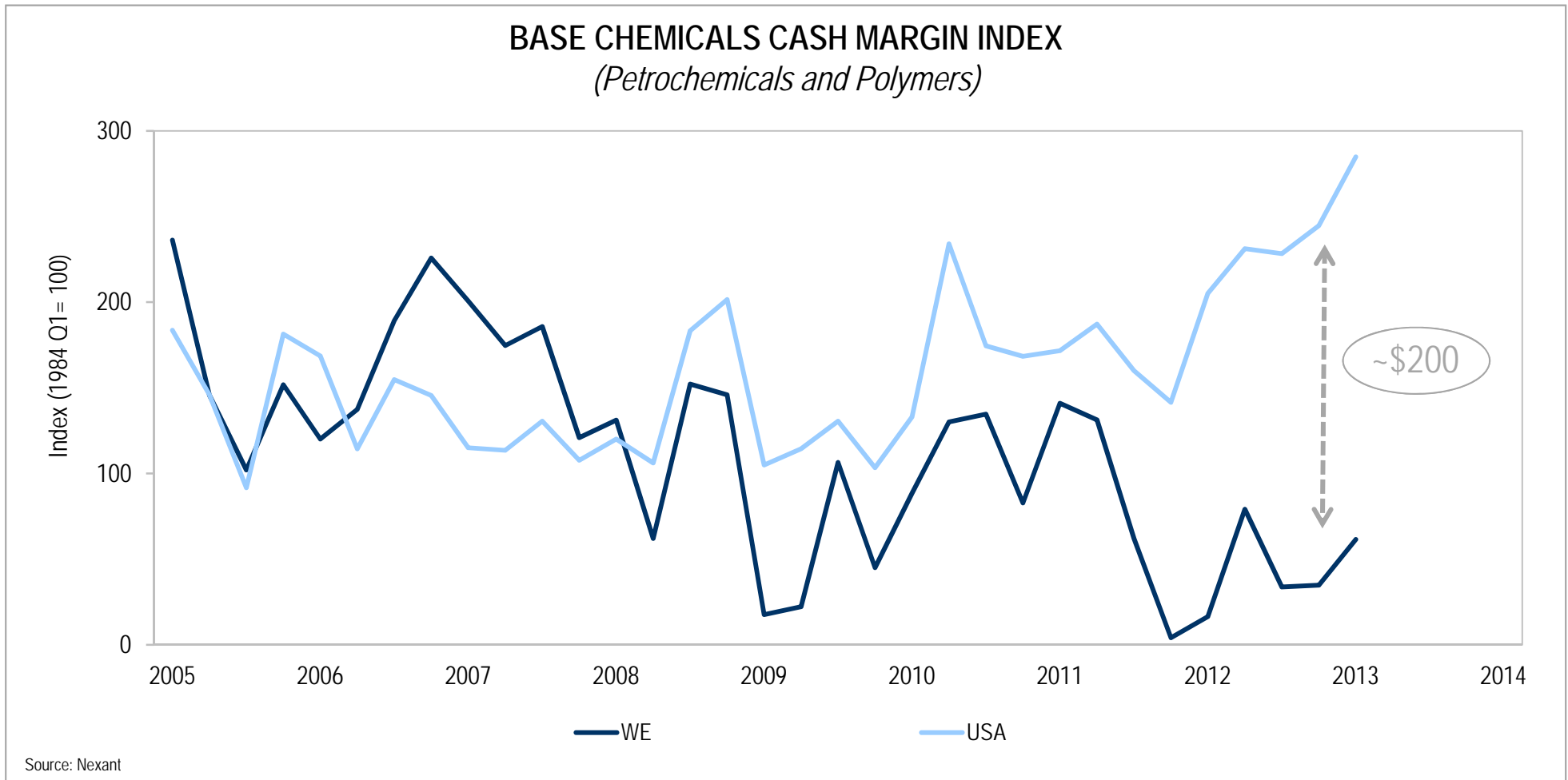


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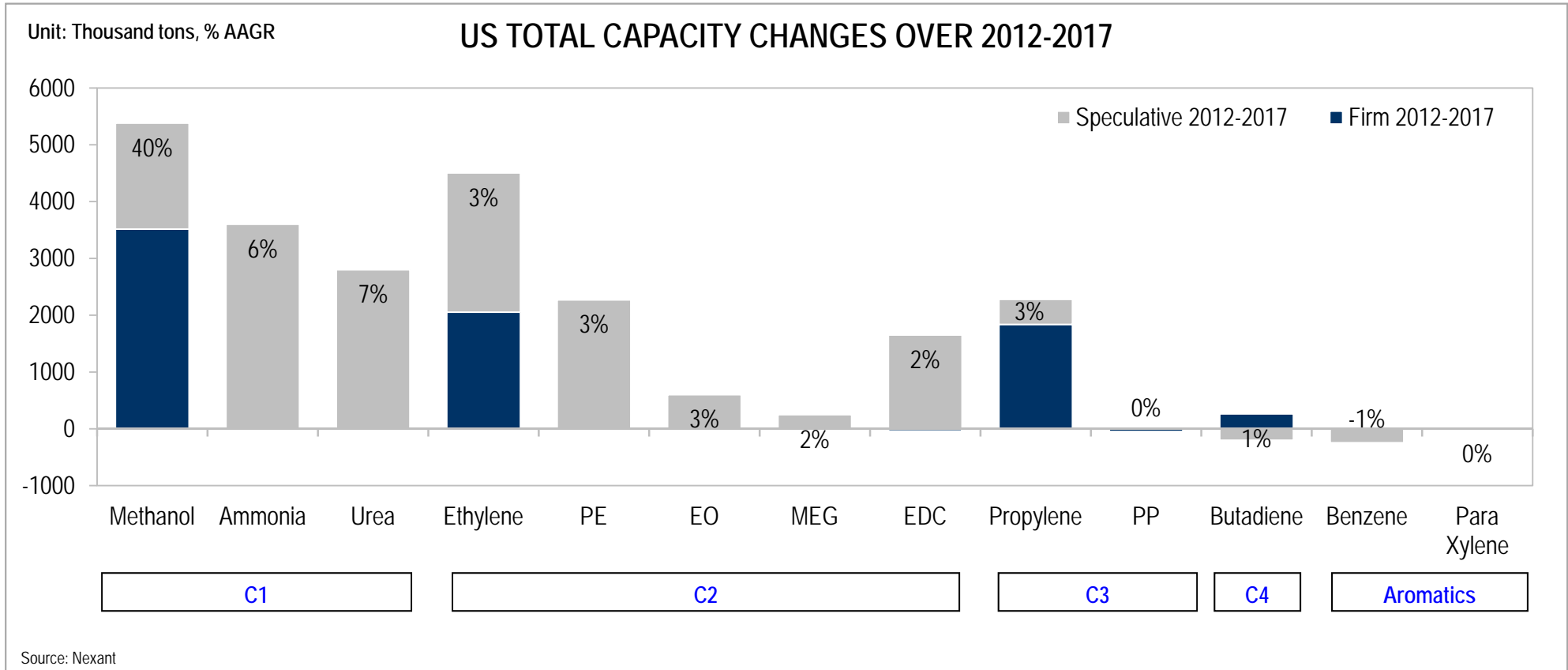
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Impact and Outlook

Average cash margins in the US have been considerably higher versus European and other conventional naphtha based producers in Asia – despite weaker market conditions

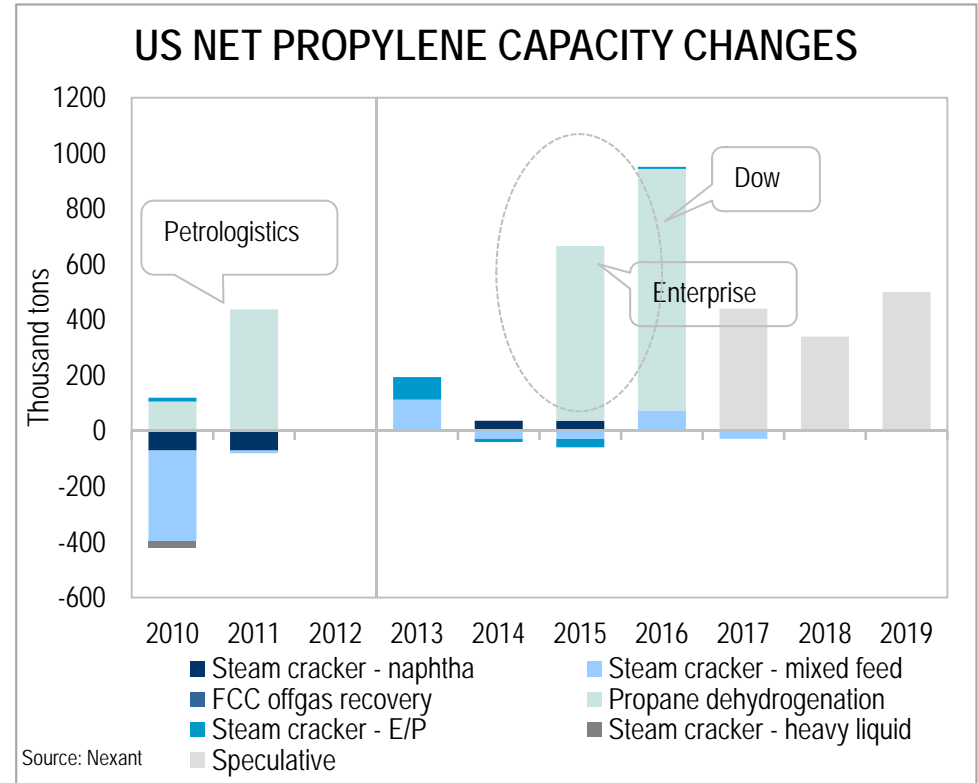
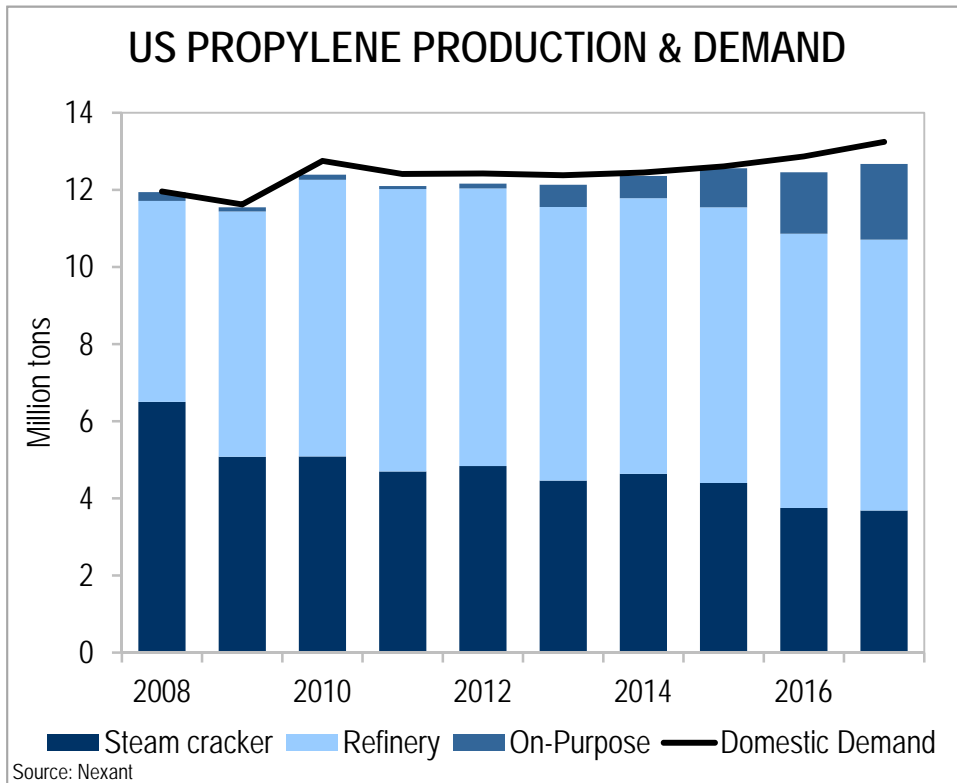


The prospect of higher returns is promoting significant interest in new petrochemical investments. These are primarily focused across C1 and C2 product value chains.



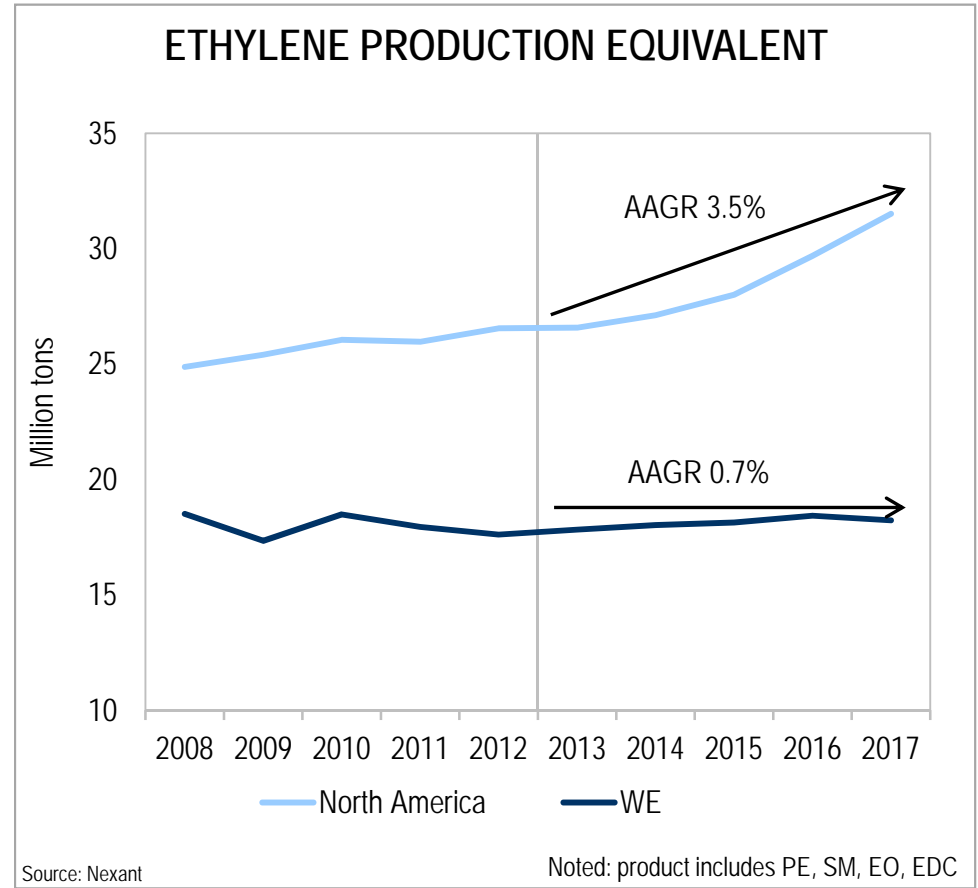
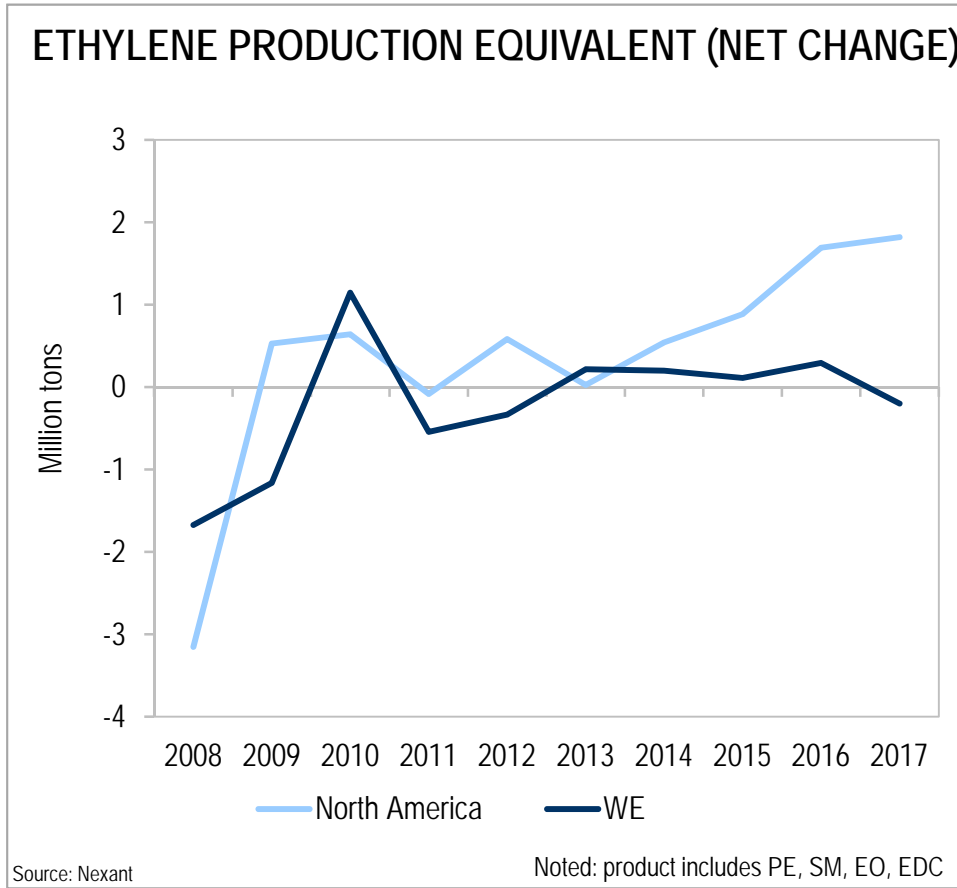
- Interest in propylene production via PDH is also forecast due to increased availability of propane.

Propylene output from stream crackers has declined as US olefin producers optimise to crack more ethane. PDH projects are expected to cover the shortfall created from ethylene crackers

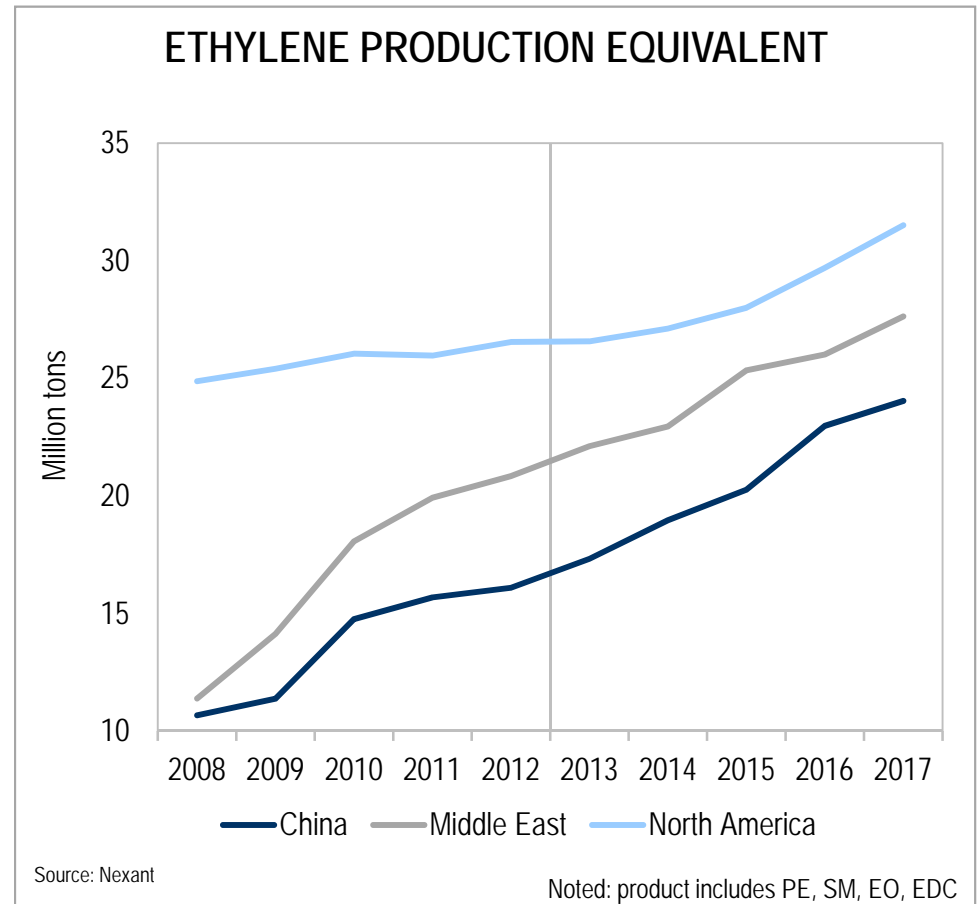
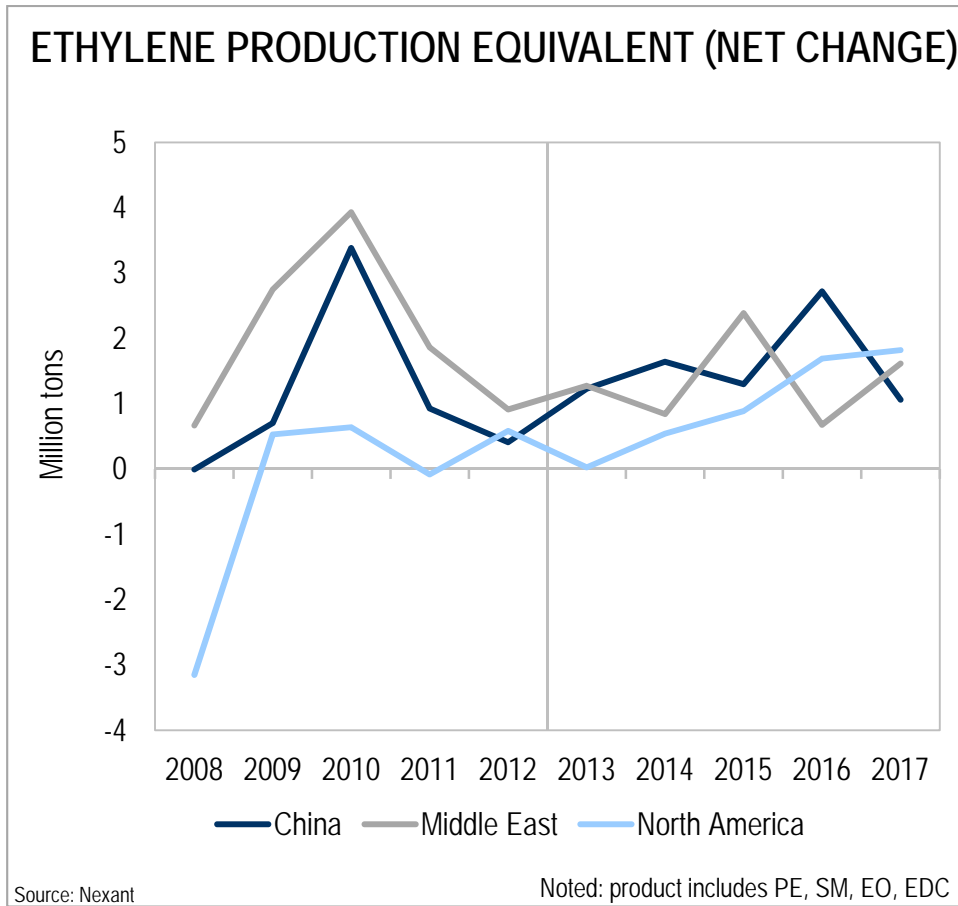


- Refinery output of propylene is expected to remain largely unchanged with most operators running at high rates and benefitting from the impact of both shale gas and shale oil.

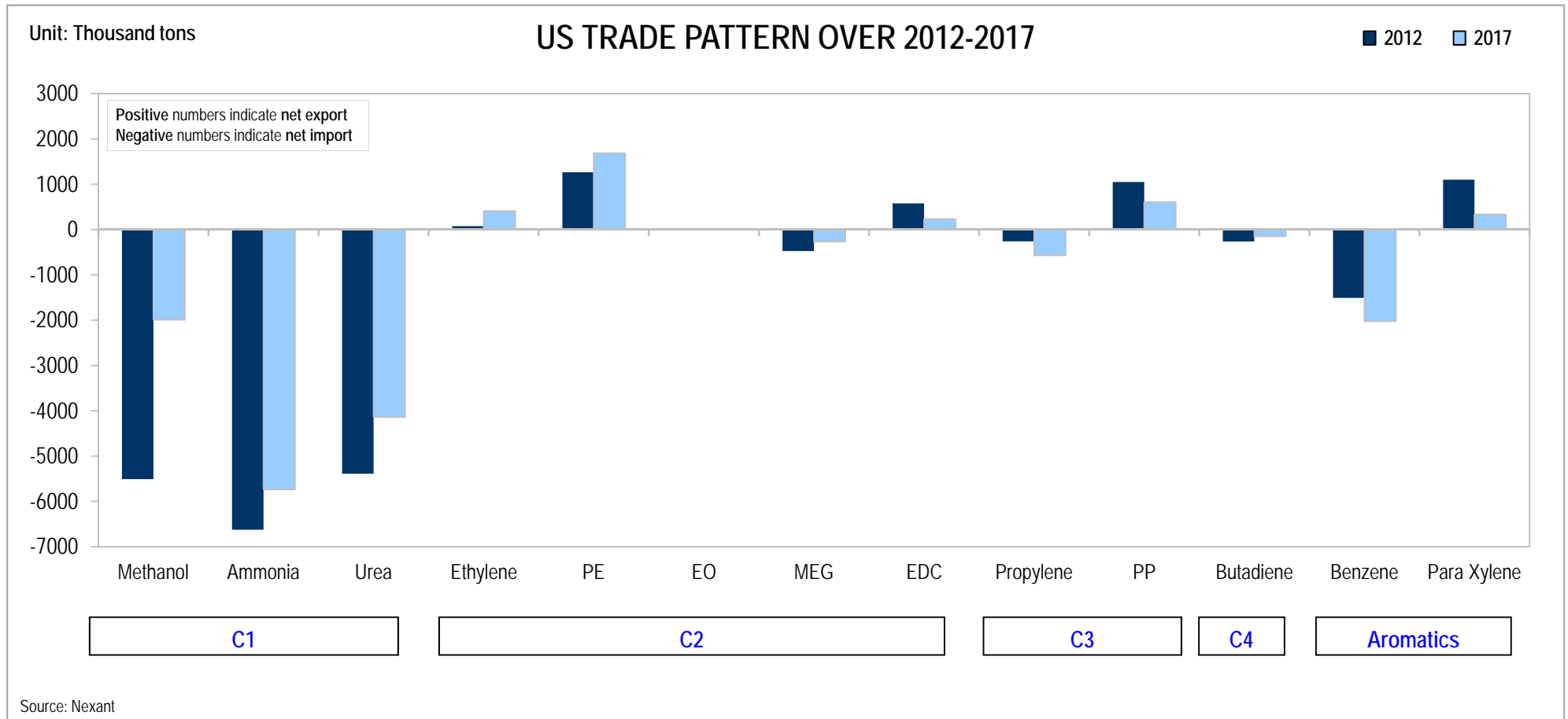
North American production is forecast to show reasonable trend growth over the next few years as new investments in ethylene and derivatives capacity are realised and global markets recover



Global chemicals production growth is now clearly concentrated in 3 regions.



The impact of shale gas on US trade is not expected to be too significant in the short-term as the main investment wave is not anticipated until post 2017.



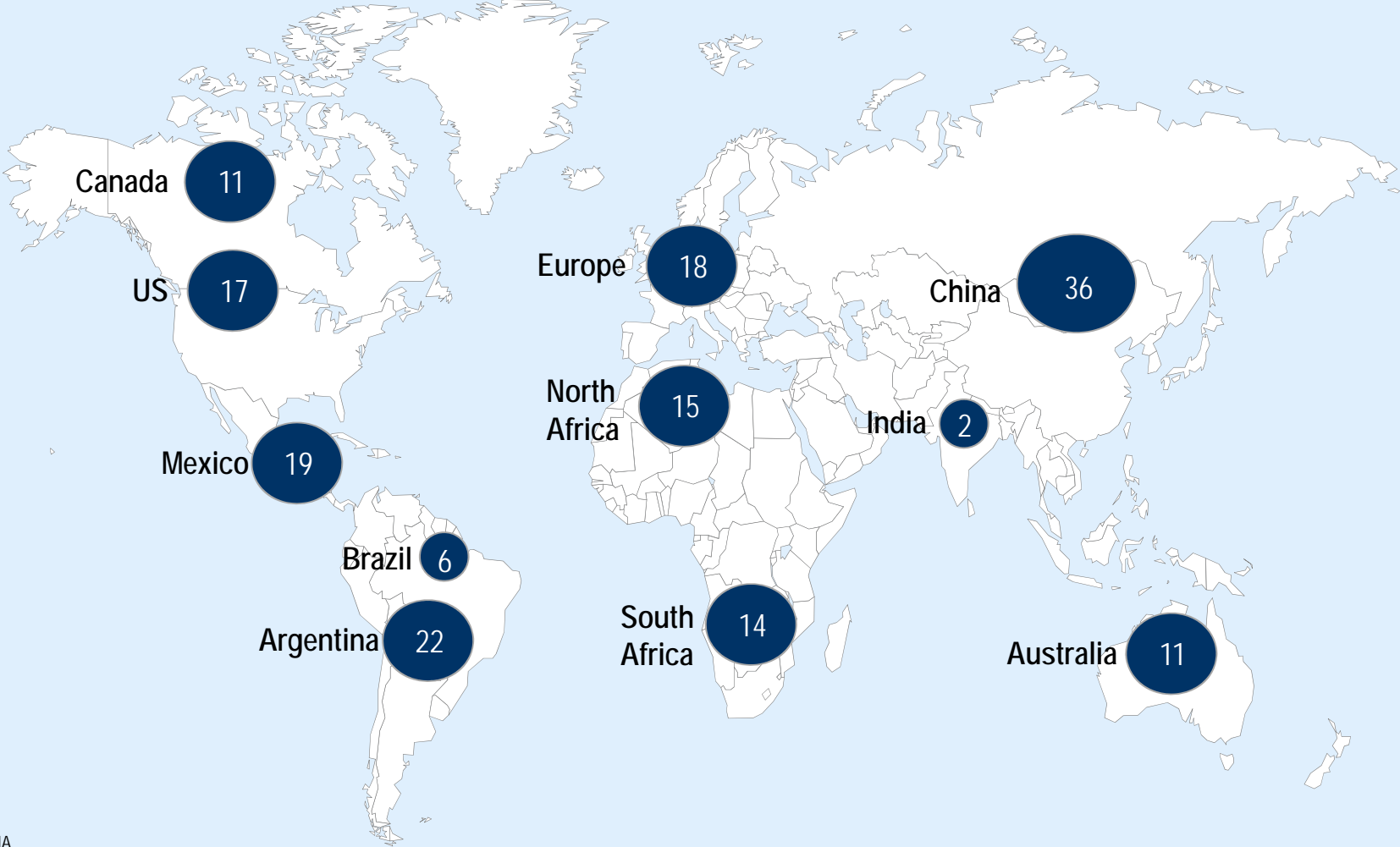


## Some final thoughts

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- US energy boom expected to result in a sustained gas surplus and lower average prices relative to crude oil markets
- Associated supply of ethane and other NGLs will also increase and support significant investment opportunities across North America.
- Short-term impact of additional capacity in the region will not have a significant impact on global markets or global trade of ethylene derivatives.
- A more substantial investment wave will commence post 2016/2017. However the full potential of this will depend on overall gas demand & production in the region
- Ultimately shale resources present new opportunities across all regions, and are not unique to North America, and will support future expansions of the petrochemical sector for the longer-term.

# GLOBAL ESTIMATE OF SHALE GAS RESOURCES (TRILLION M<sup>3</sup>)



Source: EIA

## Nexant Contacts

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