A Changing Global Feedstock Picture and Polypropylene Production

World Flexible Intermediate Bulk Container
2 May 2017
Amsterdam, The Netherlands

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Key Agenda Items

1. Crude oil prices and their impact on petrochemicals

2. The US ethane cracking boom and PP production

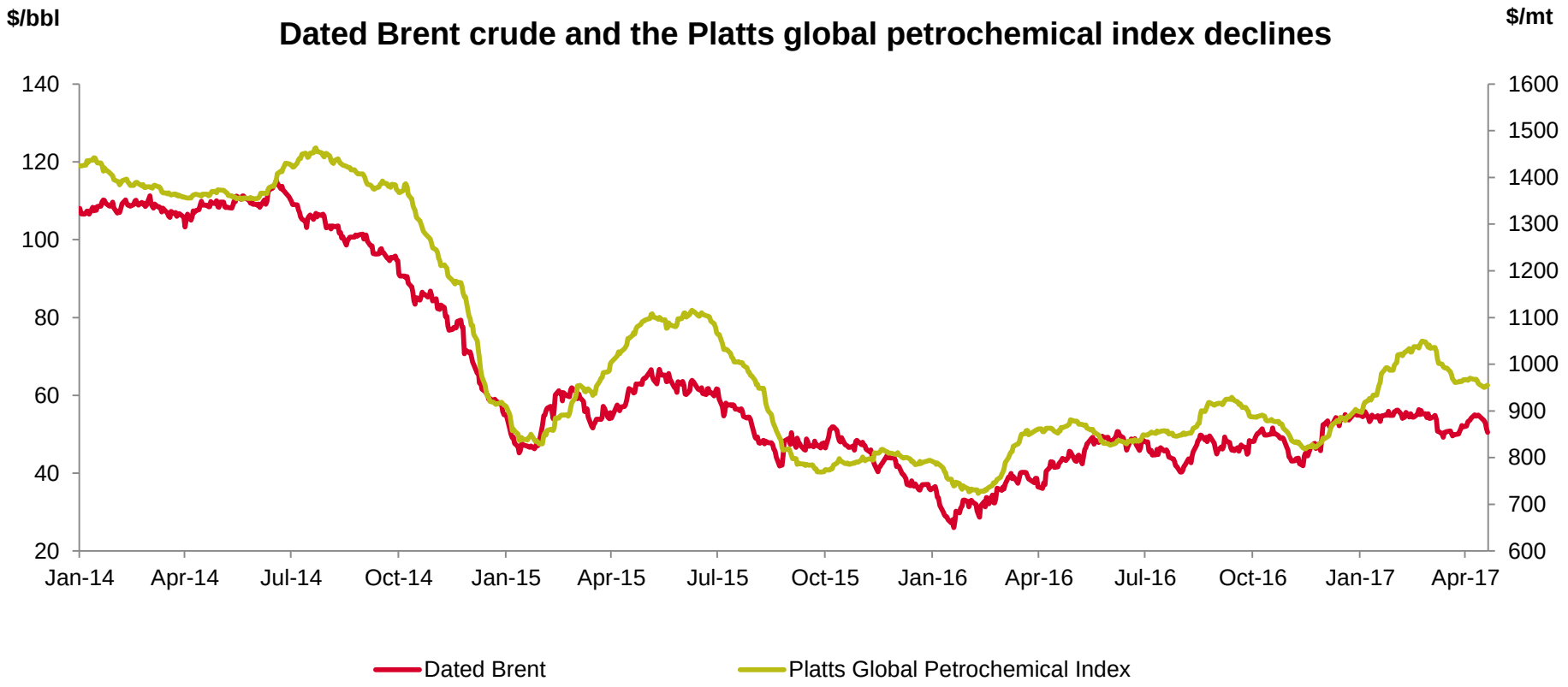
3. The rise of on purpose propylene production and PP production in Asia

4. Changes to the European and Middle Eastern PP markets

5. The global polypropylene picture in years to come

Crude oil prices and their impact on petrochemicals

A lower crude oil price and the Platts global petrochemical index



Ethylene, propylene, benzene, toluene, paraxylene, low-density polyethylene and polypropylene prices as published by Platts weighted by the three regions of Asia, Europe and the United States.

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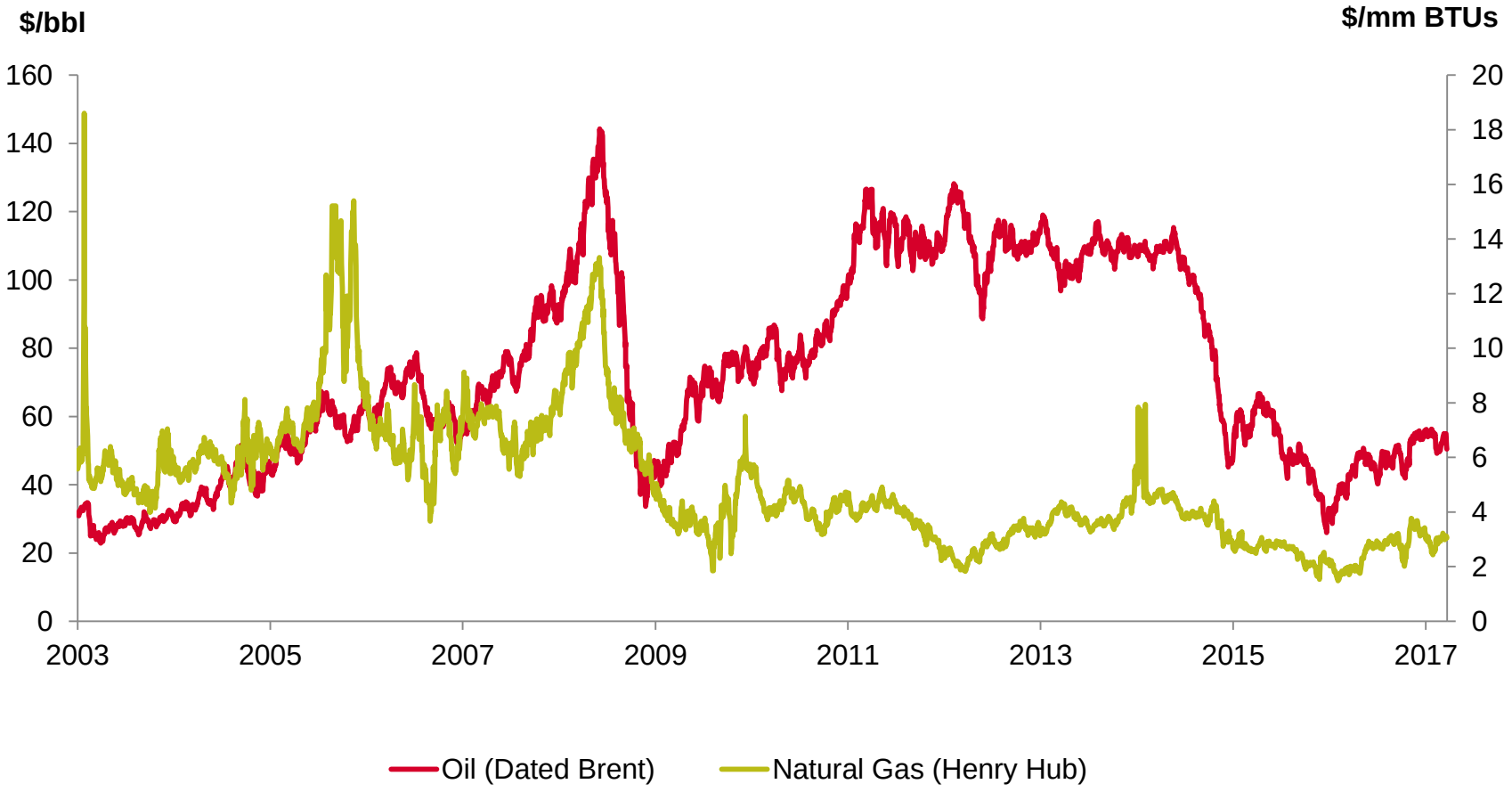
Source: Platts

Crude oil and natural gas prices converge



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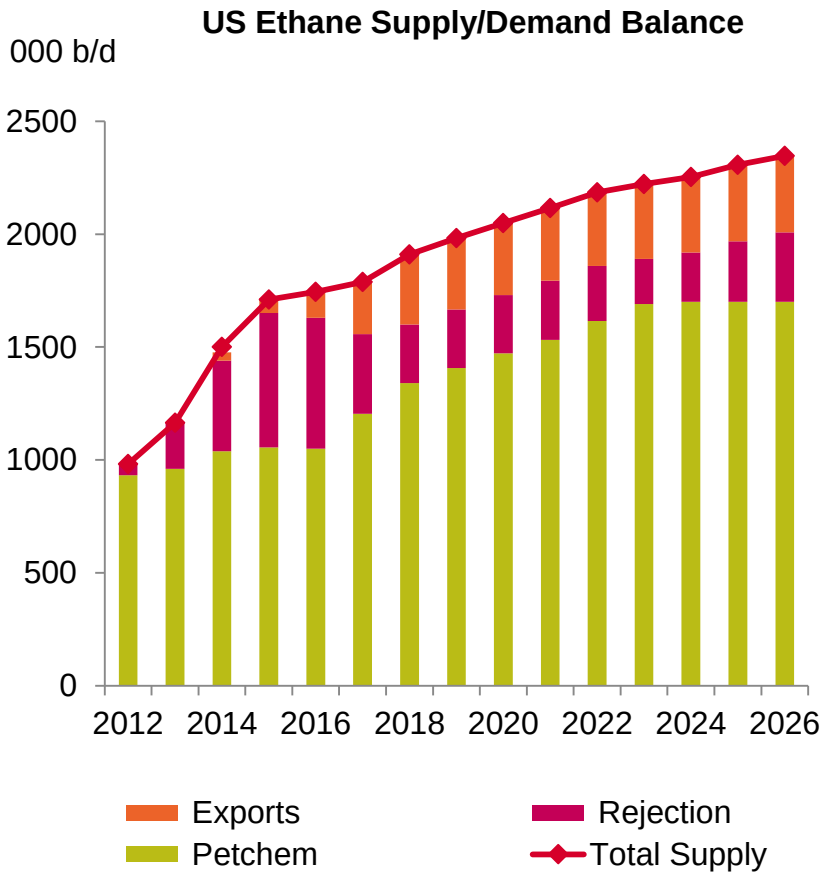
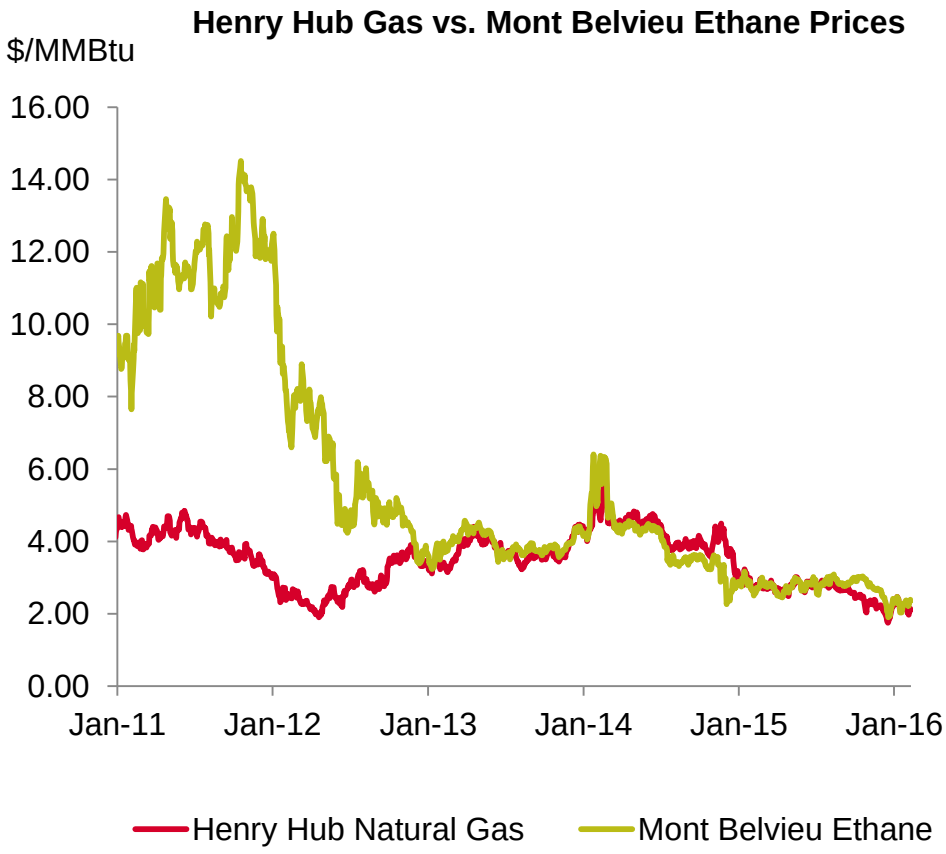
Source: Platts

The connection between petrochemical feedstock, natural gas liquids, and natural gas prices

Naphtha sees around an $8 rise for every $1 rise of Brent crude.





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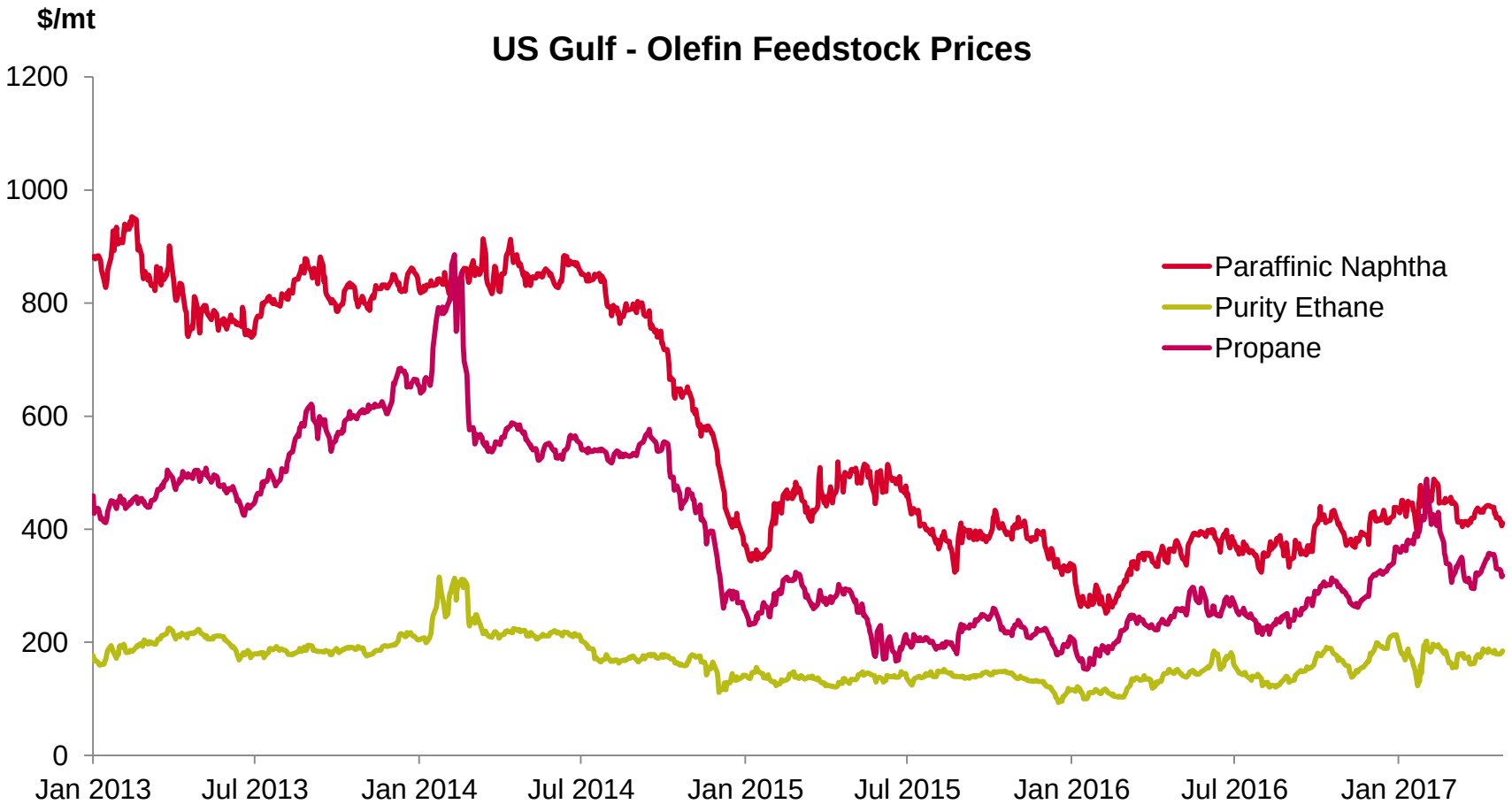
Source: Platts Analytics

Crude oil decline has eroded the premium of naphtha over gas based olefin feedstocks



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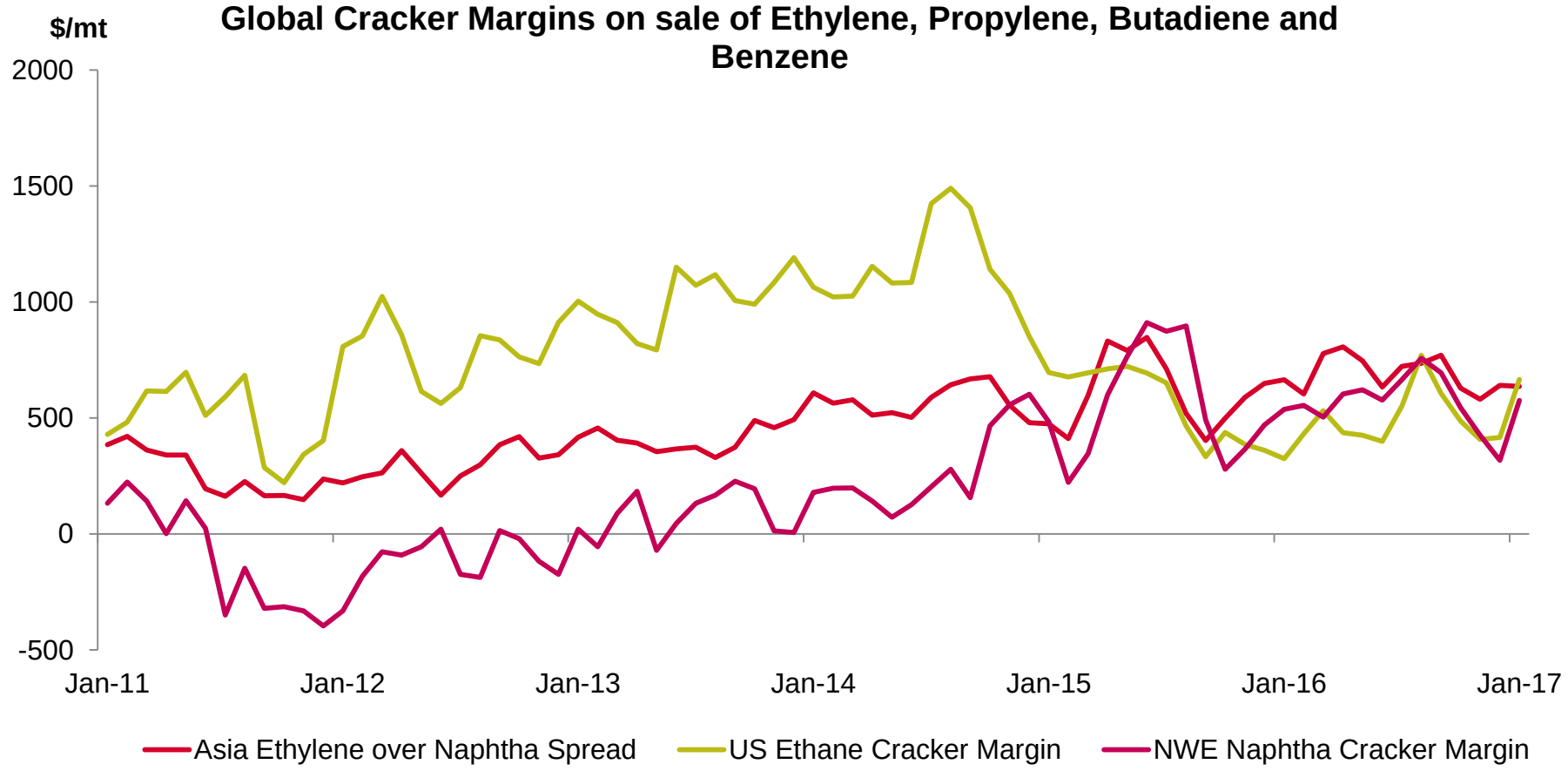
Source: Platts

Lower oil prices have levelled petrochemical production costs globally



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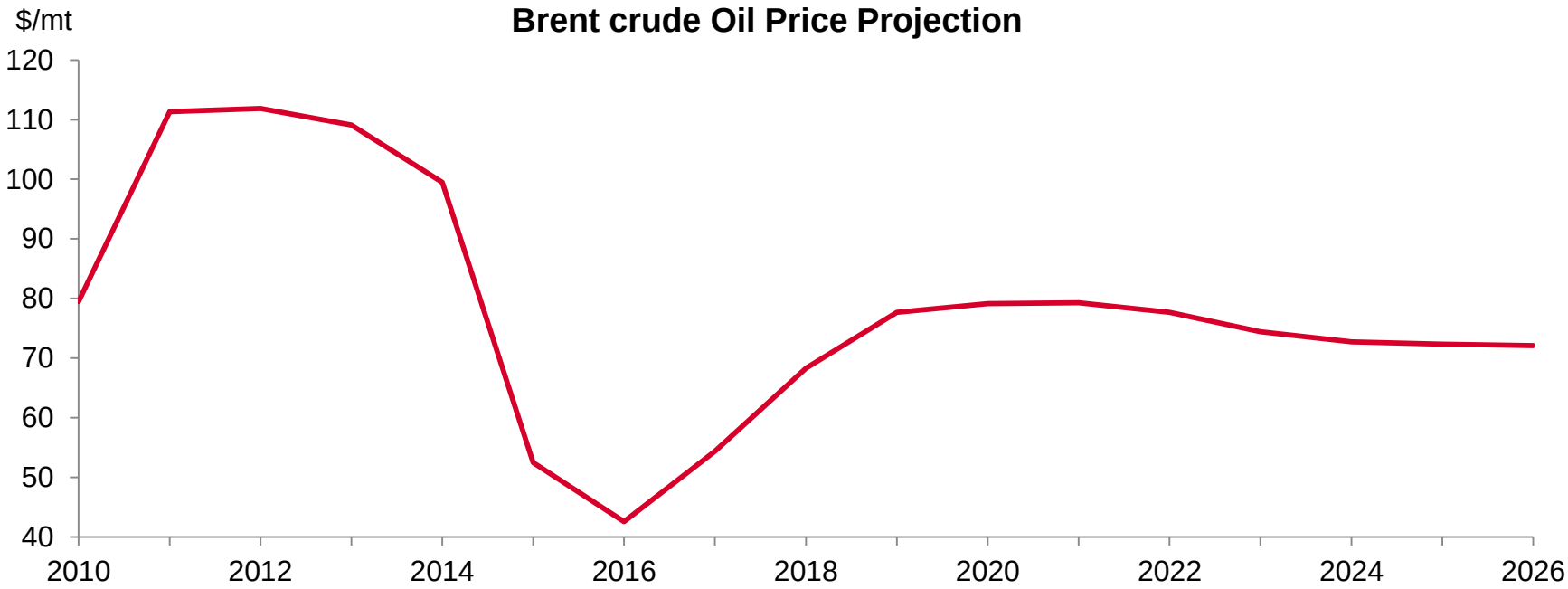
Using naphtha yields more propylene than ethane.

Source: Platts Analytics

Will this olefin feedstock price situation remain?



- Brent crude oil prices to surpass $60 by 2018 and breach $75/bbl in 2019.
- Thereafter crude prices will remain in a $70/bbl -$80/bbl range.

- **The result: Cracker margins will fall for those using naphtha but alternative feedstock petrochemicals producers will regain dominance. This may subdue propylene and polypropylene supply.**

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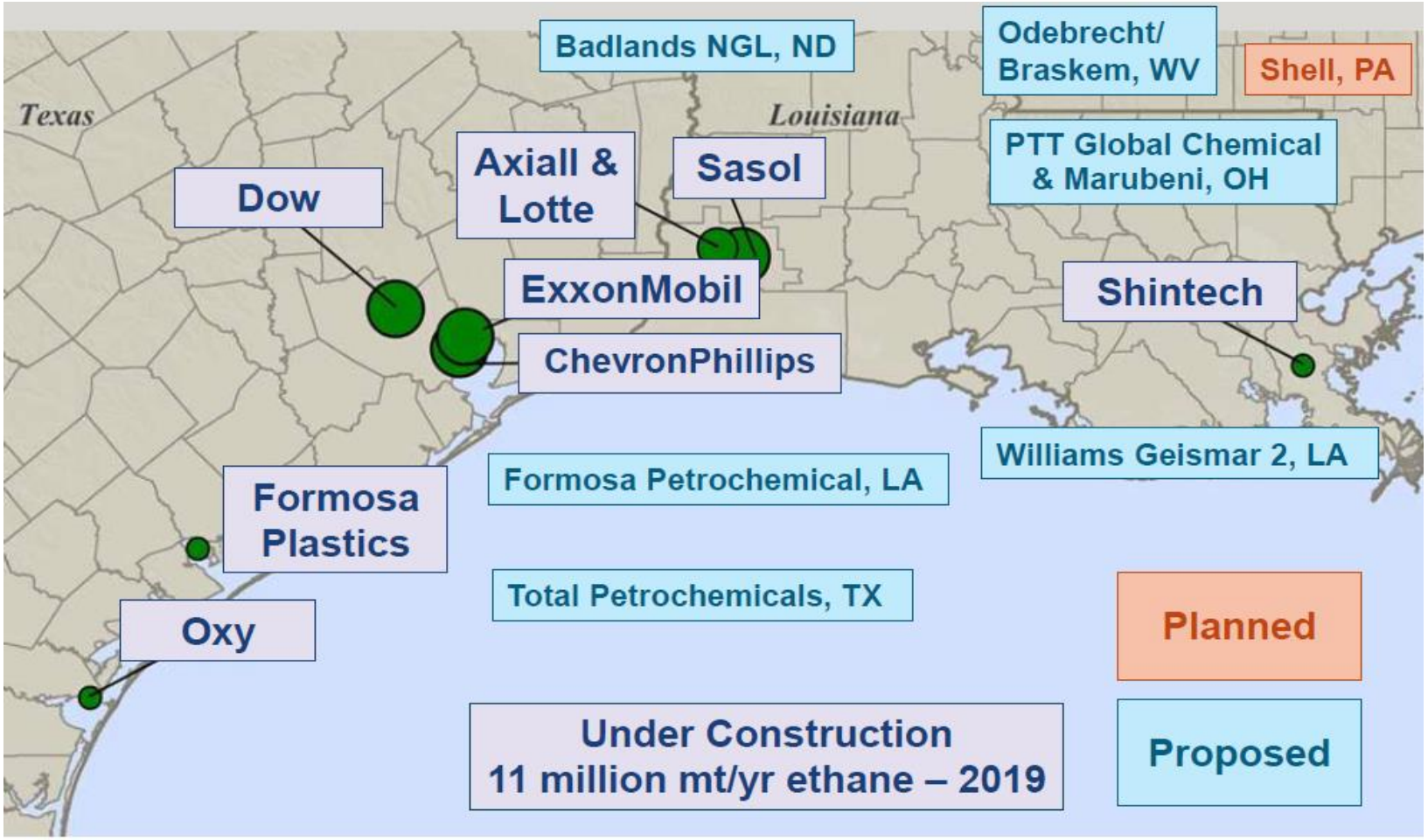
Source: Platts Analytics' Bentek Energy

The US ethane cracking boom and polypropylene production

First major wave of US shale crackers come online this year



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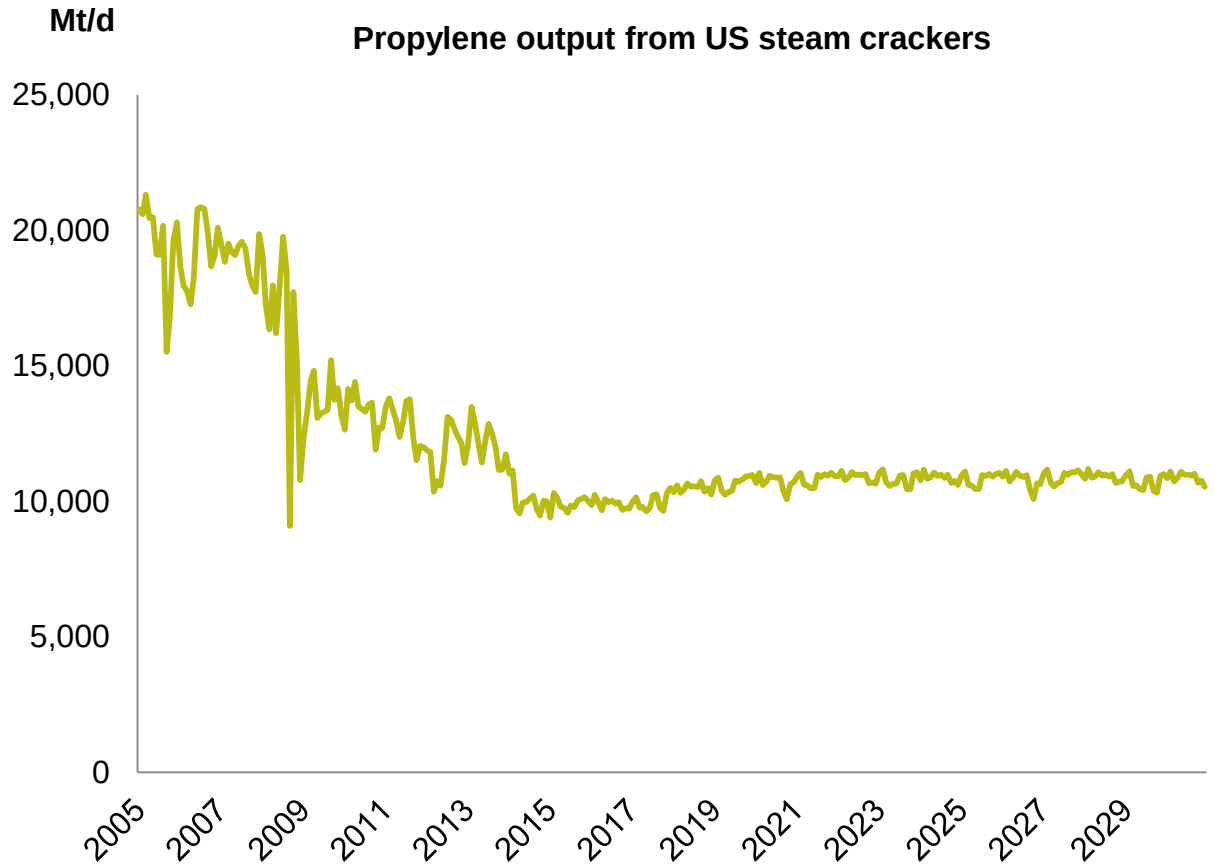
Source: Platts Analytics

No increase in propylene yields from US crackers

Ethane is expected to account for 76% of US cracker feedstock by 2024

Typical stream cracker yields from feedstock

	Ethylene	Propylene
Naphtha	34%	16%
Ethane	79%	3%
Propane	43%	17%



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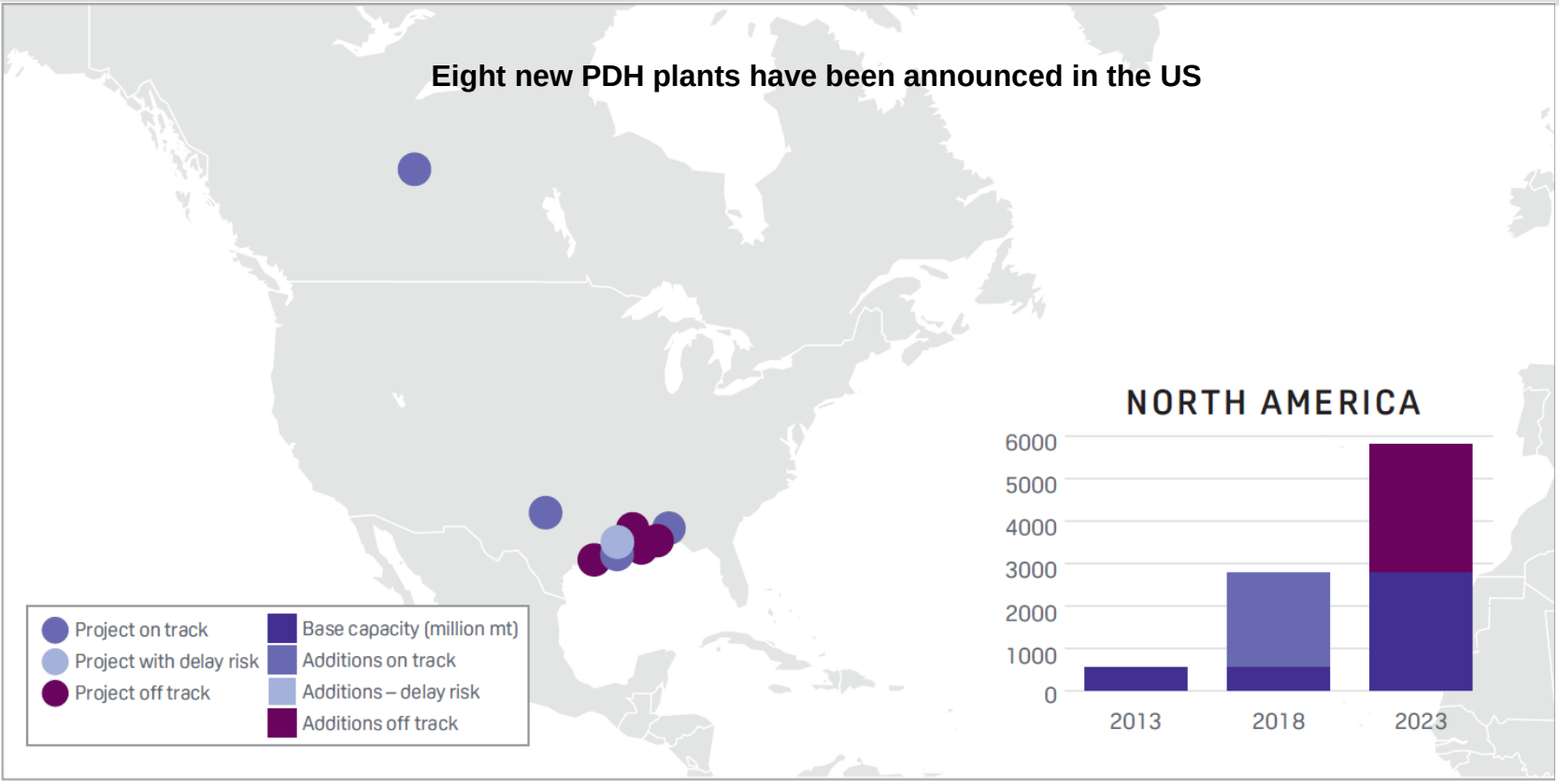
Source: Platts Analytics

The US PDH builds mean little for PP supply



Source: Platts Analytics

PP Plant Additions (000 mt)

Company	Location	Capacity	Start up
Rextac	Odessa	100	2017
Rextac	Odessa	100	2017
Formosa	Point Comfort	380	2018
Debottlenecking Projects	Various	300	2016

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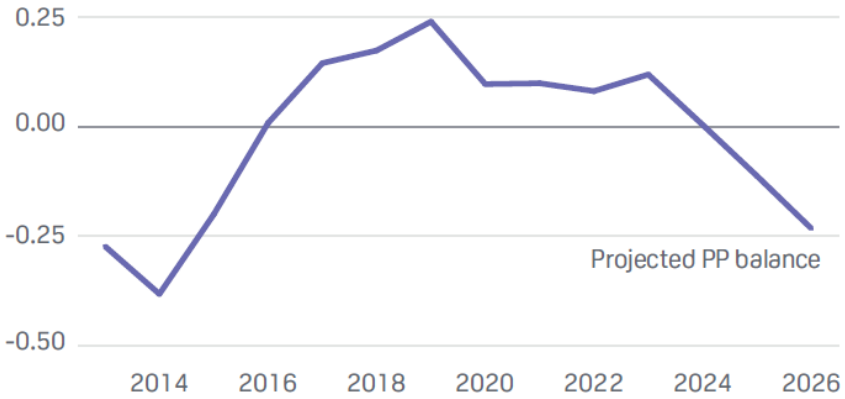
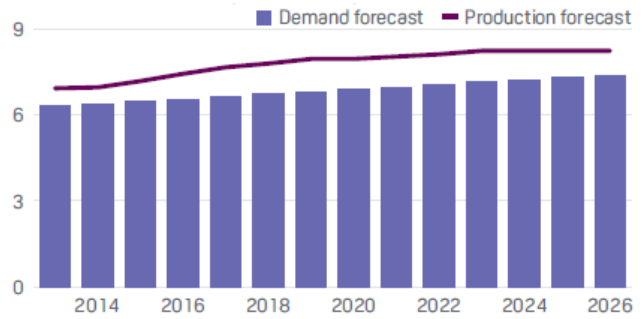
Only two PDH plants have integrated PP lines

North American PP supply deficit to return

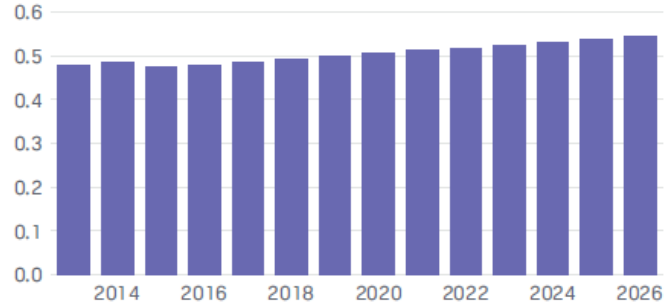
North American PP supply/demand balance [million mt]



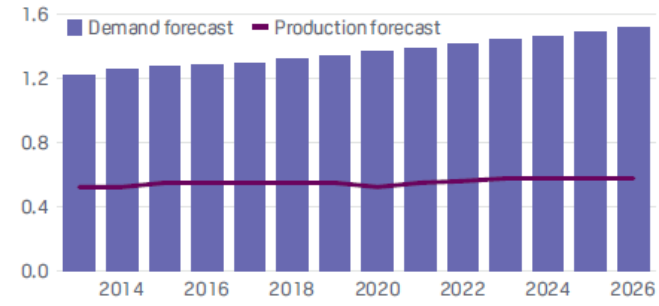
US PP supply/demand balance [million mt]



Canadian PP supply/demand balance [million mt]



Mexican PP supply/demand balance [million mt]



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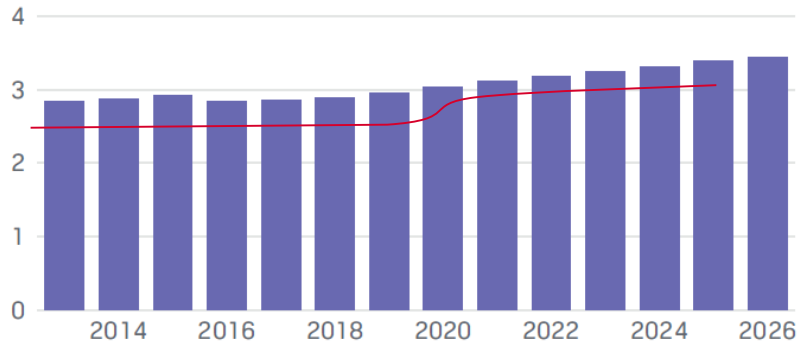
Source: Platts Analytics

Total Americas will continue to be reliant on imports

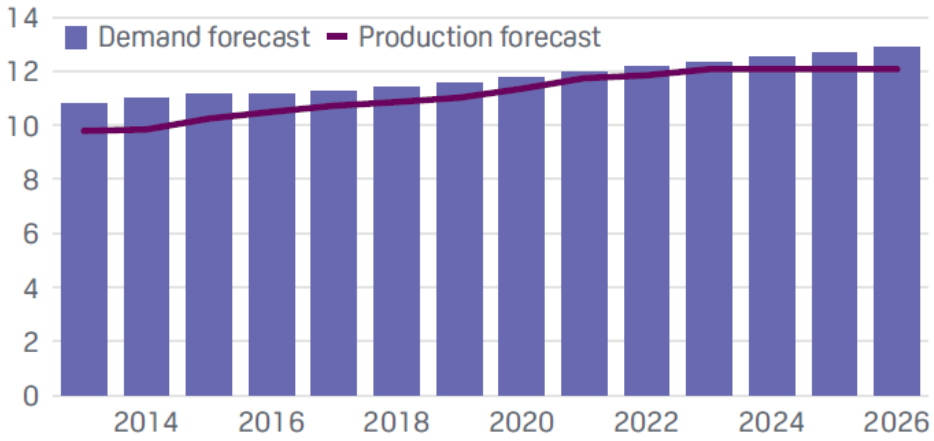
Central and South America n PP Additions (000 mt)

Company	Location	Capacity	Start up
Propilco/Ecopetrol	Cartagena	430	2020
YPFB	Tajira	250	2021

Central American demand outweighs production [million mt]



Total American demand outweighs supply [million mt]



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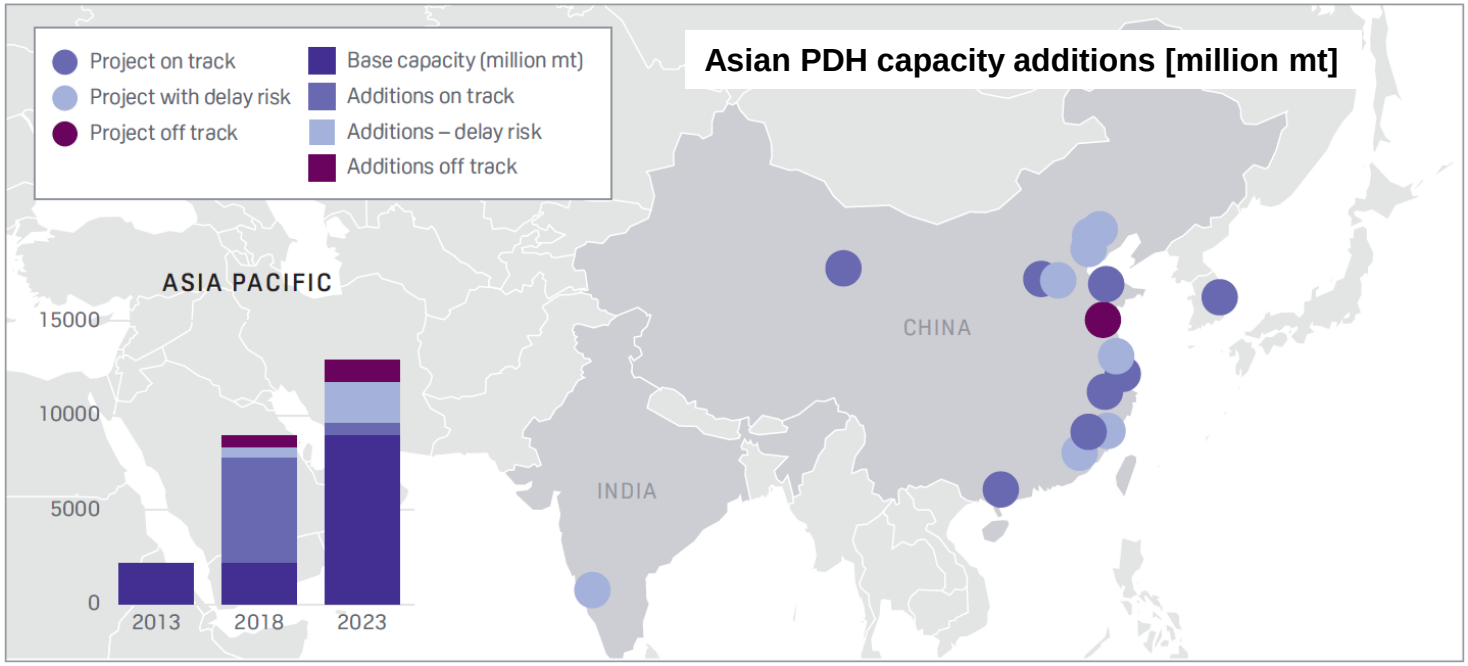
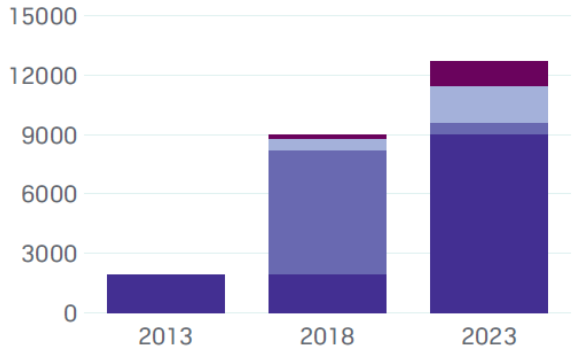
The rise of on purpose propylene production and polypropylene production in Asia

Asia fuels PP production with on purpose propylene production



Chinese coal to propylene additions [million mt]



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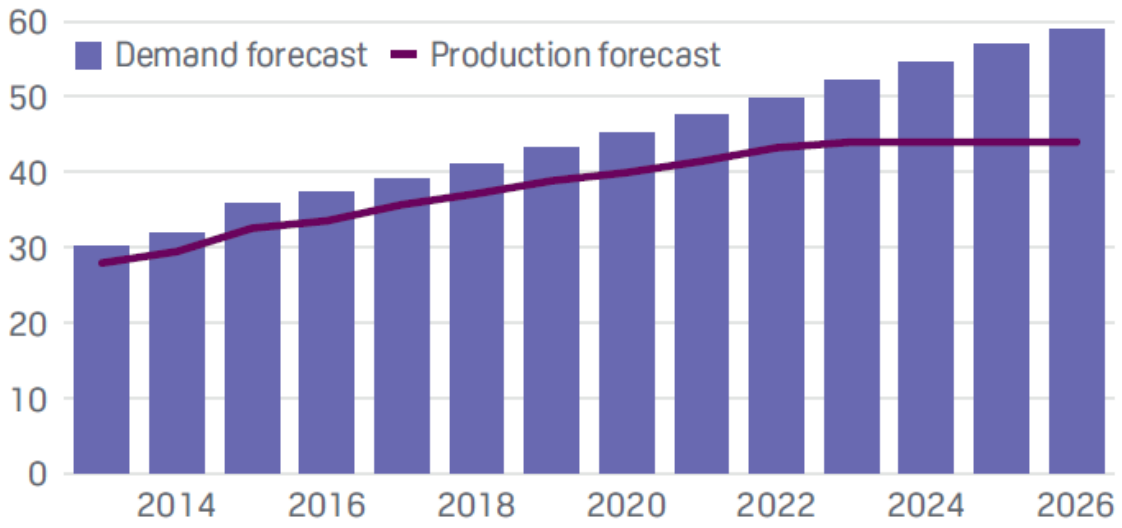
Source: Platts Analytics

Asian PP plant additions will not cover demand

Country	Producer	Location	Capacity (000 mt)	Start Up
China	China Coal Mengda	Ordos	300	2016
China	Fujian Meide	Fujian	700	2016
China	Fund Energy	Changzhou	300	2016
China	Ningbo Fortune	Ningbo	400	2016
China	Sinopec Zhong Tian He Chaung	Ordos	350	2016
China	Jiutai Energy	Ordos	350	2017
China	Sinopec Wanbei Coal	Huainan	300	2019
China	Oriental Energy	Caofedien	600	2019
China	Shenhua Group	Turpan	450	2016
China	Shenhua Group	Yulin	300	2016
China	Shenhua Group	Ningdong	600	2018
India	Indian Oil Corporation	Paradip	700	2017

Total Asia PP supply/demand balance [million mt]



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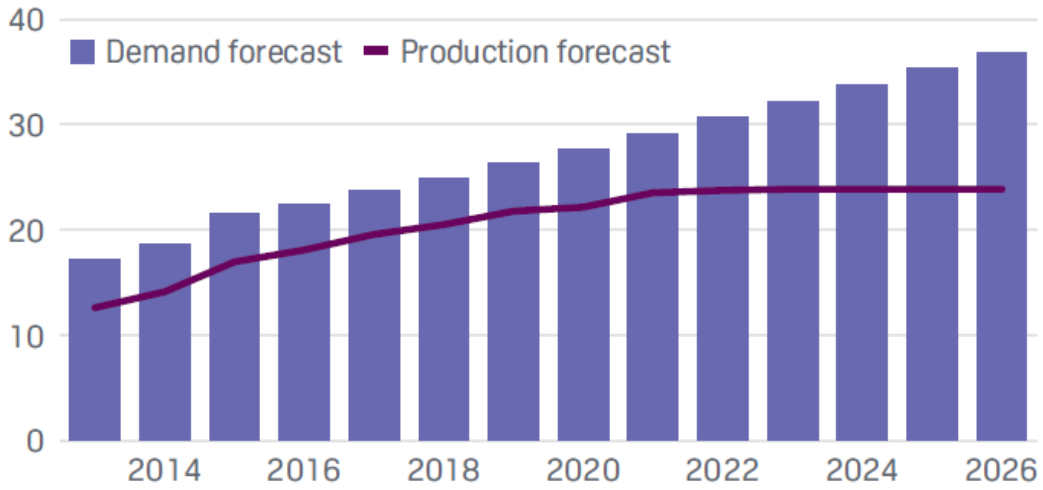
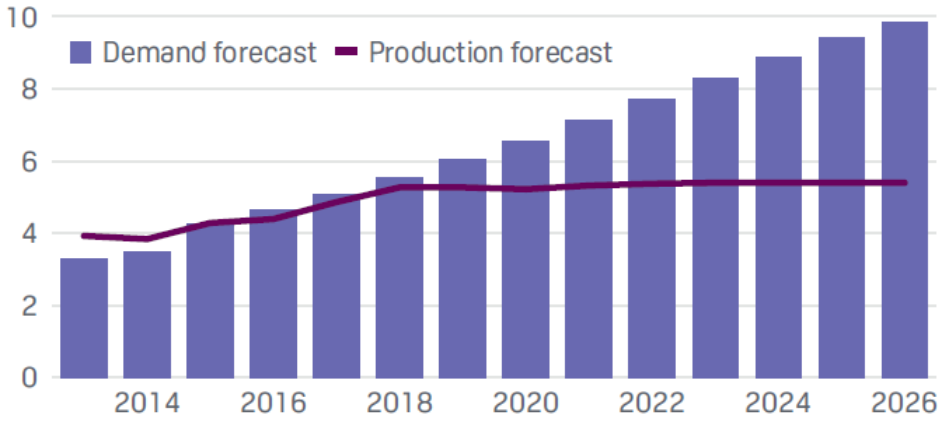
Source: Platts

Asia’s PP deficit to grow towards 2025

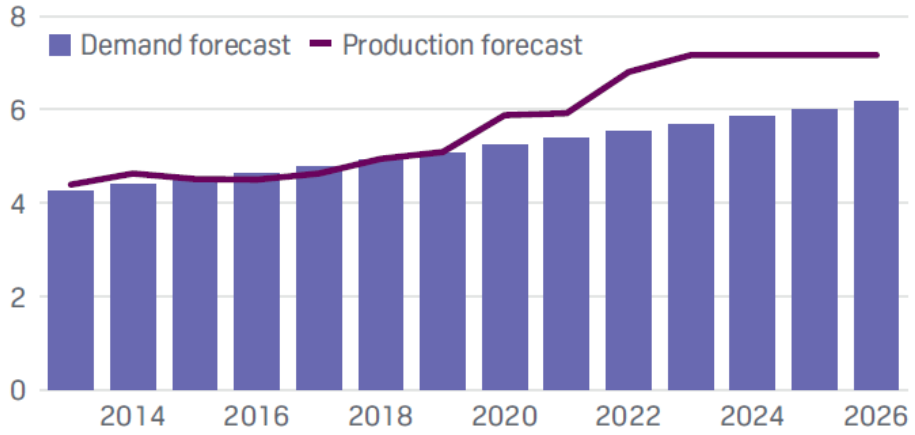
China PP supply/demand balance [million mt]



Indian PP supply/demand balance [million mt]

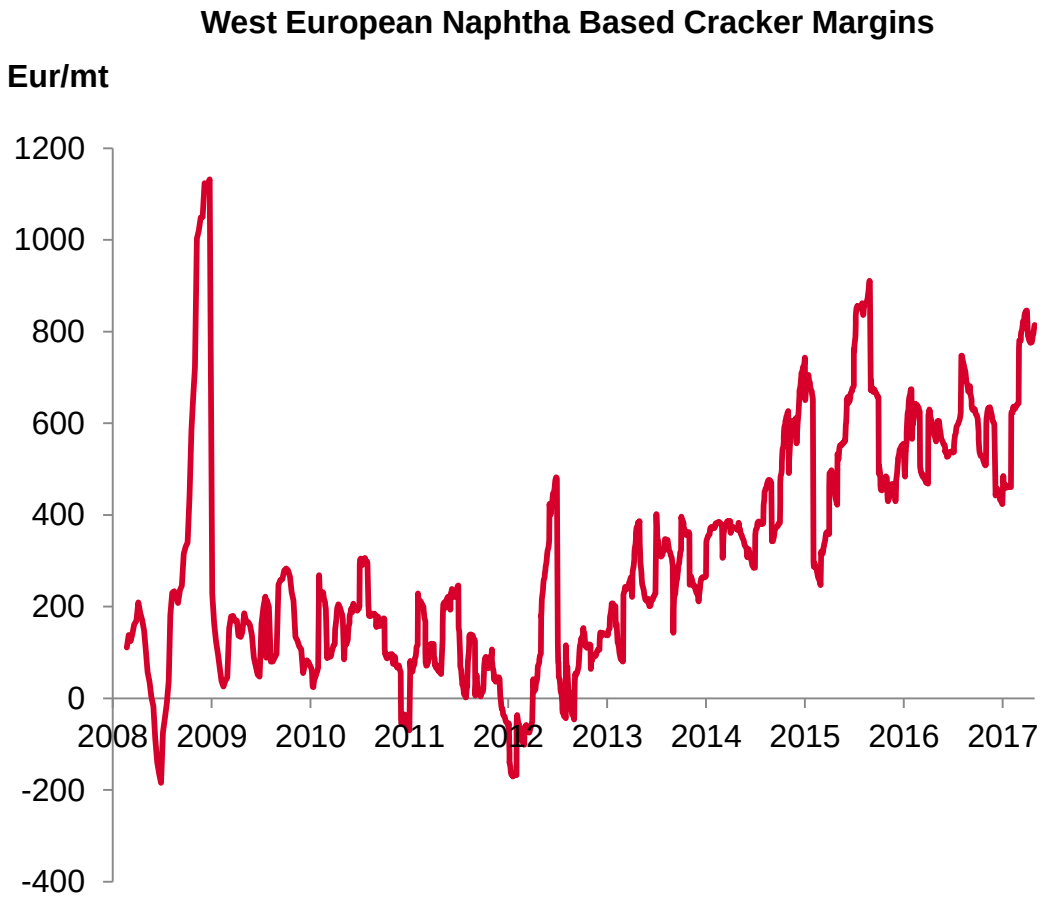


Southeast Asia PP supply/demand balance [million mt]



Changes to the European and Middle Eastern Polypropylene Markets

West Europe's strong margins on naphtha cracking may be short lived



West European PP Production Disadvantages

- Old production assets, smaller and more inefficient to run
- High feedstock and energy costs
- Lower demand growth than that of emerging market countries
- Under threat from derivative imports

	EU PP Imports (mt)	
2015	1,138,706	16% Increase YoY
2016	1,322,354	

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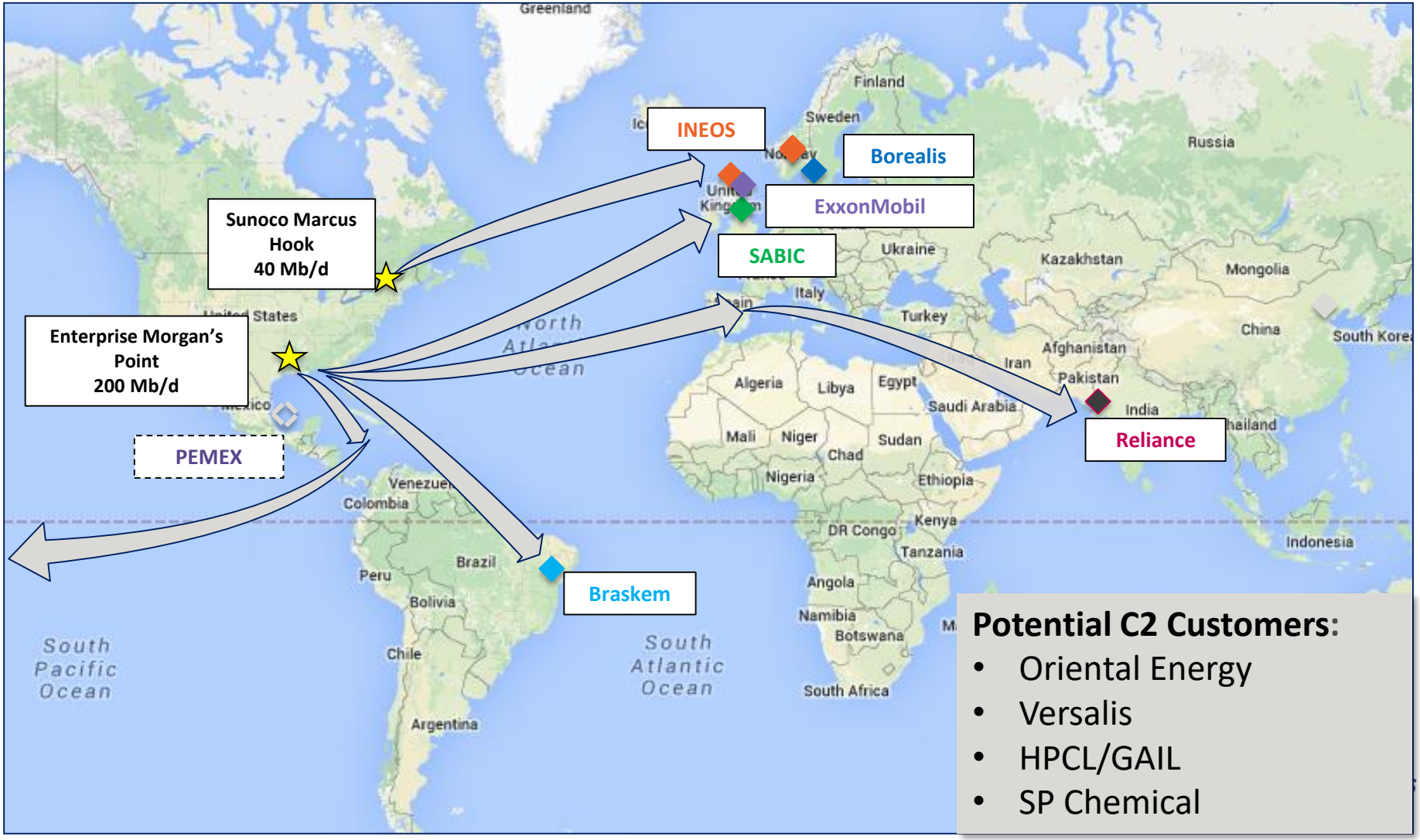
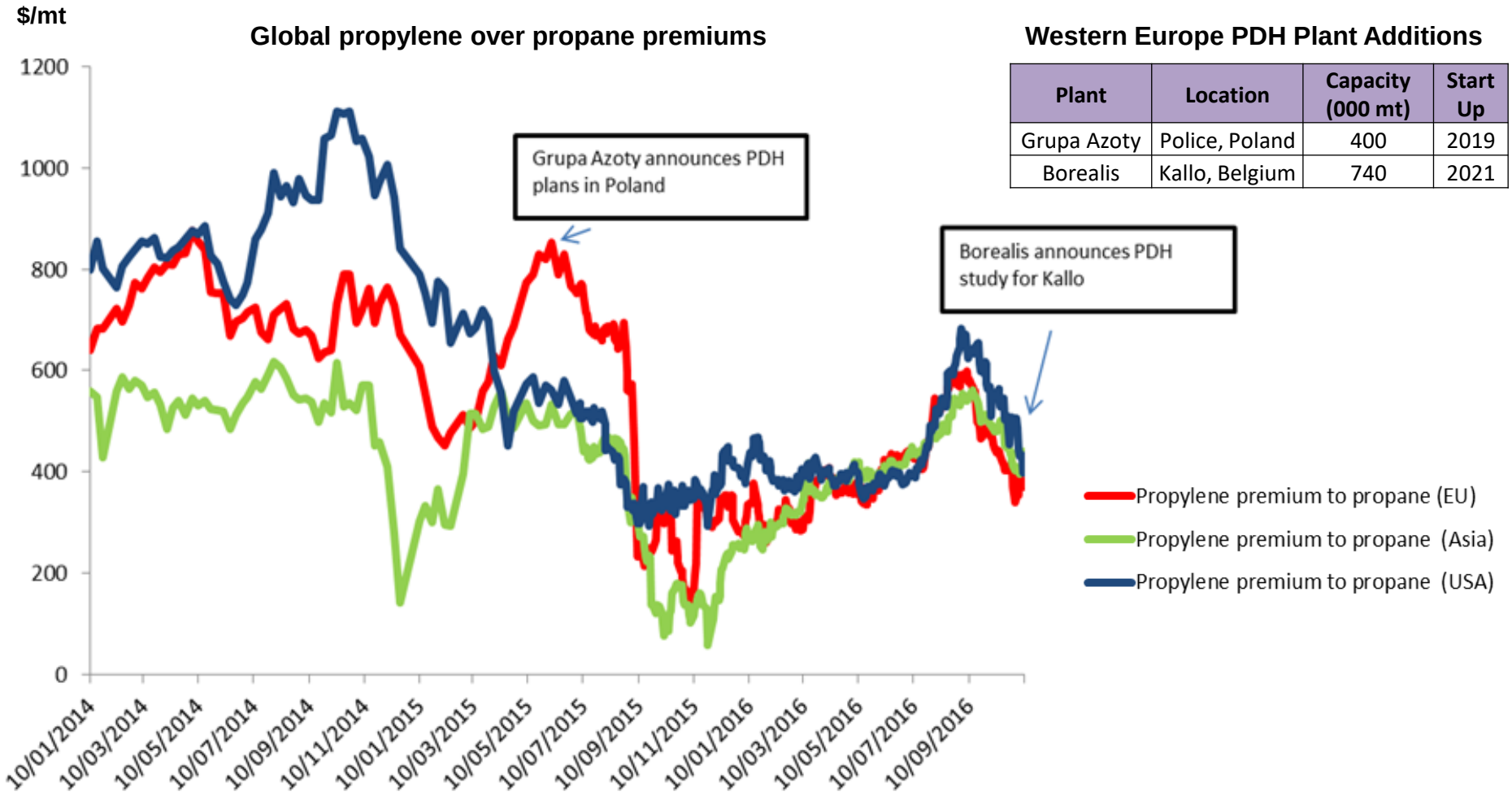
Source: Platts

US ethane made its way to West Europe last year



Source: Platts Analytics

Europe sees investment in PDH but not for PP production



Western Europe PDH Plant Additions

Plant	Location	Capacity (000 mt)	Start Up
Grupa Azoty	Police, Poland	400	2019
Borealis	Kallo, Belgium	740	2021

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Source: Platts

Eastern Europe shows greater advantage for petrochemical investment (As does Africa)

East European PP builds

Nizhnekamskneftekhim	Tatarstan	180	2020
Rosneft-VNHK	Nadhodka	800	2023
Sibur-ZapSibNeftekhim	Tyumenskaya	500	2020
SOCAR	Sumgait	180	2017
Uz-Kor	Nukus	100	2016

East European Advantages

- Lesser feedstock disadvantage than WE with a nearby naphtha source in Russia.
- As well as a good source of natural gas liquids captured from oil feeds.

African PP builds

Company	Location	Capacity	Start up
Carbon Holdings	Ain Skhna	350	2020+

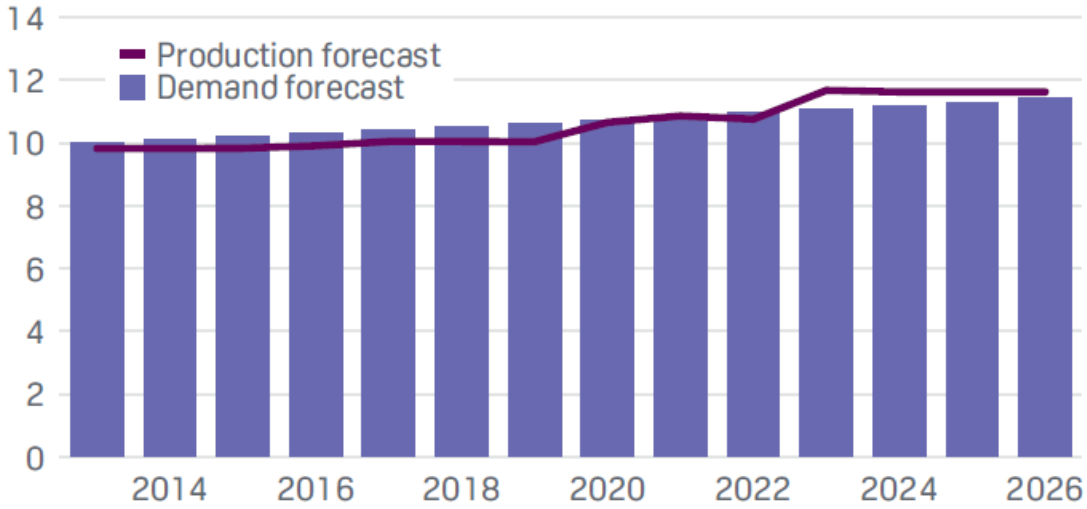
African Advantages

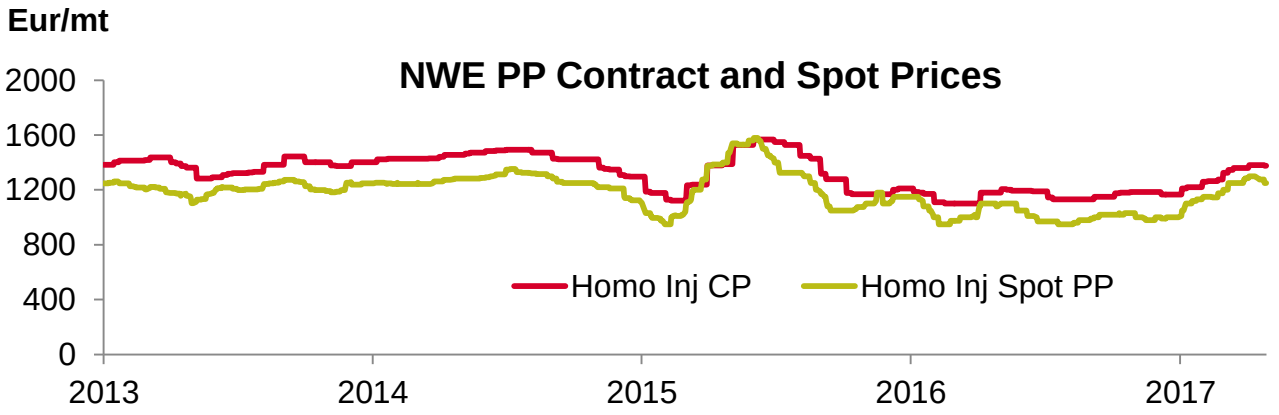
- The region is at a current deficit of 486,000 mt
- The addition of a new plant but demand growth will mean a deficit of 376,000 mt by 2026.
- Vast feedstock advantage, yet no further polypropylene units have been announced in the region.

Source: Platts Analytics

Europe as a whole to see PP supply creep towards a surplus

European supply/demand balance [million mt]





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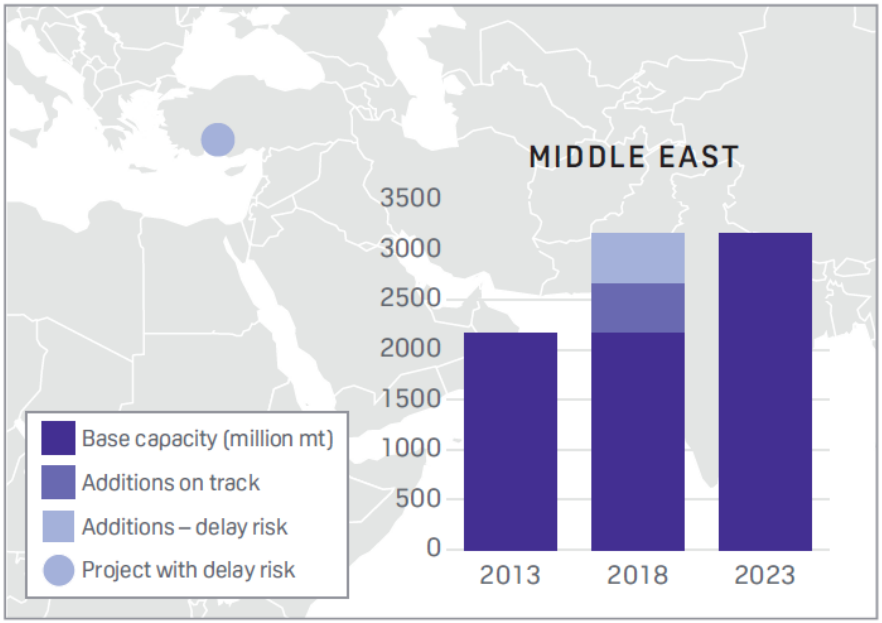
Source: Platts Analytics

Middle Eastern PP additions brought by Iran

Middle East PDH plant additions



Middle East PP additions [mt/year]

Company	Location	Capacity	Start up
Khomein PC	Khomein	175	2018
Mehr PetroKimia	Asalouyeh	450	2018
ORPIC	Sohar	205	2020
Borouge	Ruwais	960	2015

Country	Producer/Location	Capacity	Start up
UAE	Takreer Ruiwais Refinery	500.000	Q4 2015
Turkey	Bayeagen	500,000	2018

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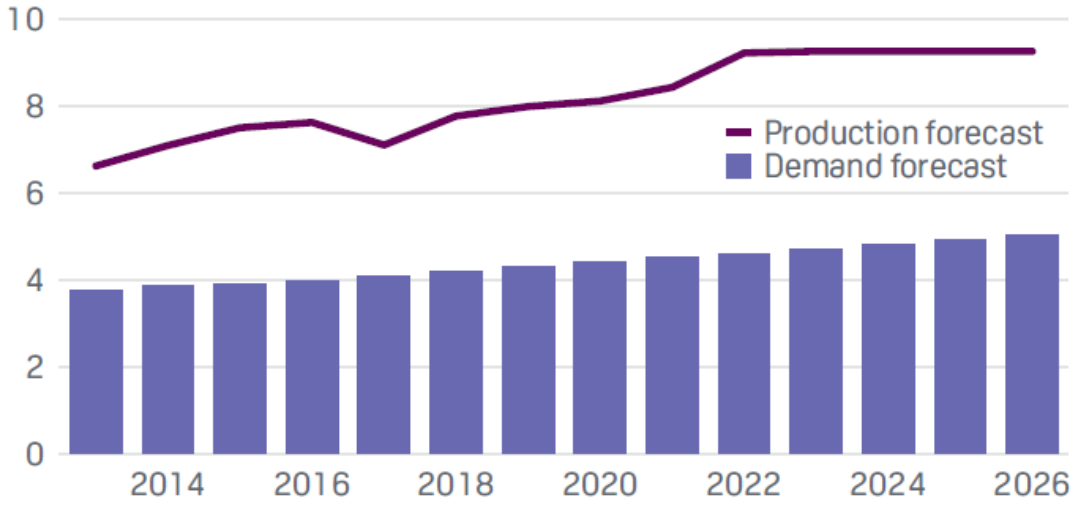
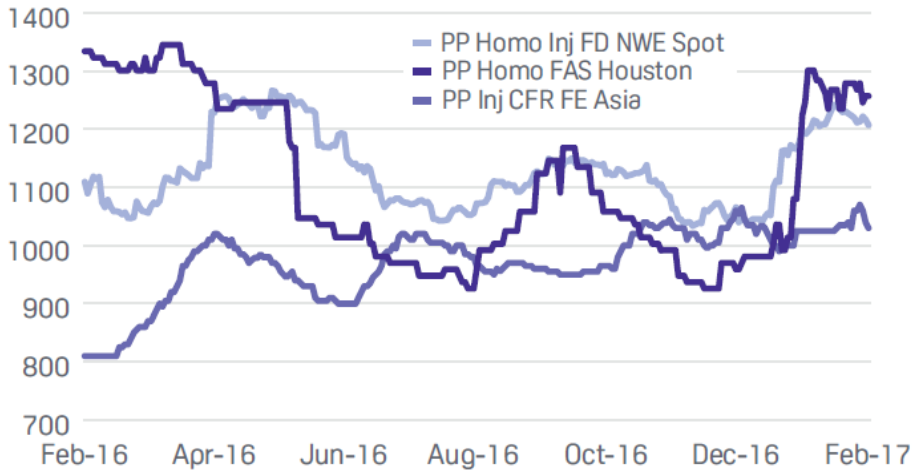
Source: Platts Analytics

Middle East to remain a dominant PP exporter

Middle East supply/demand balance [million mt]



Global PP Spot Prices



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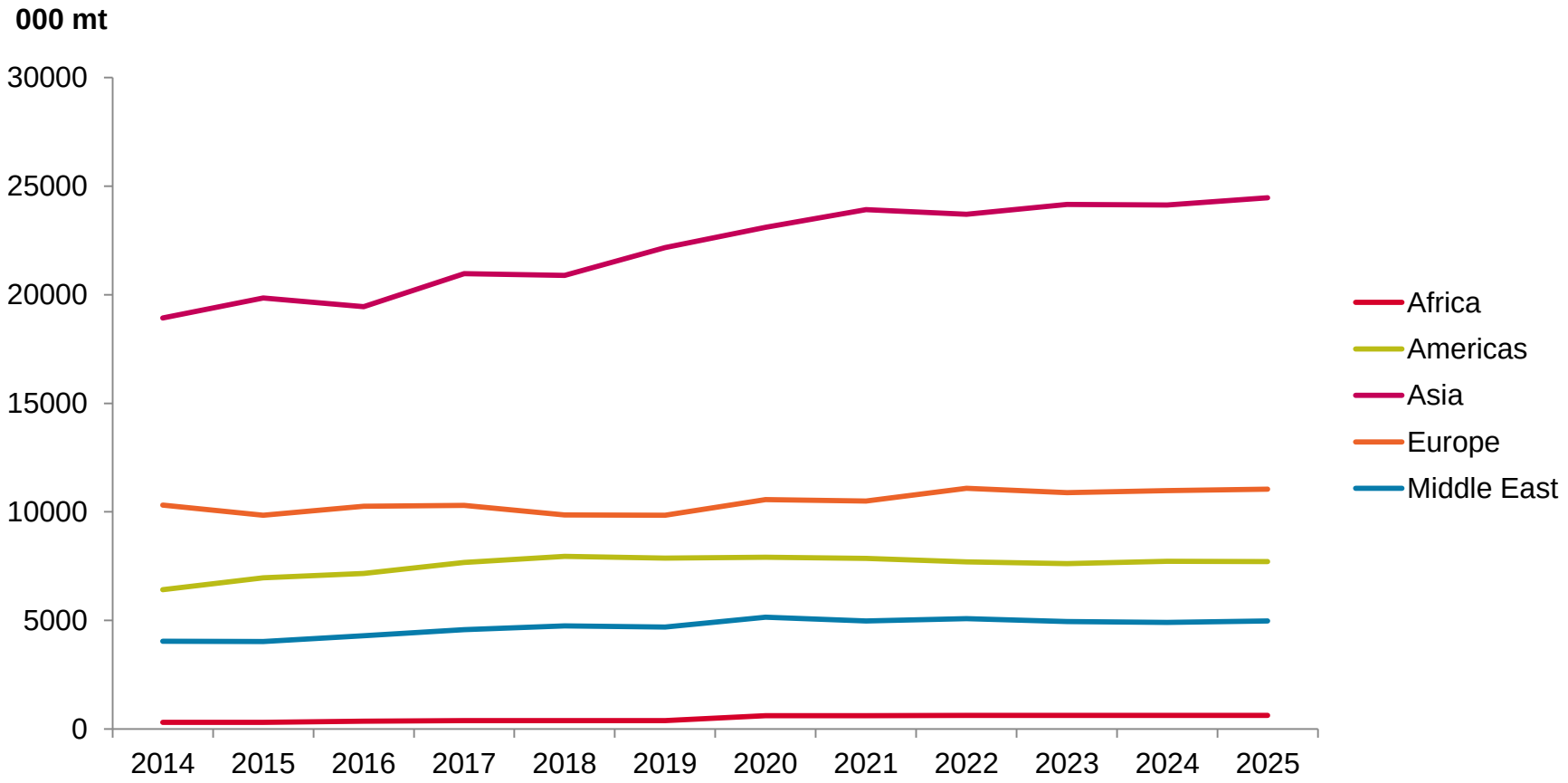
Source: Platts Analytics

The global polypropylene picture in years to come

Global production of propylene from stream crackers



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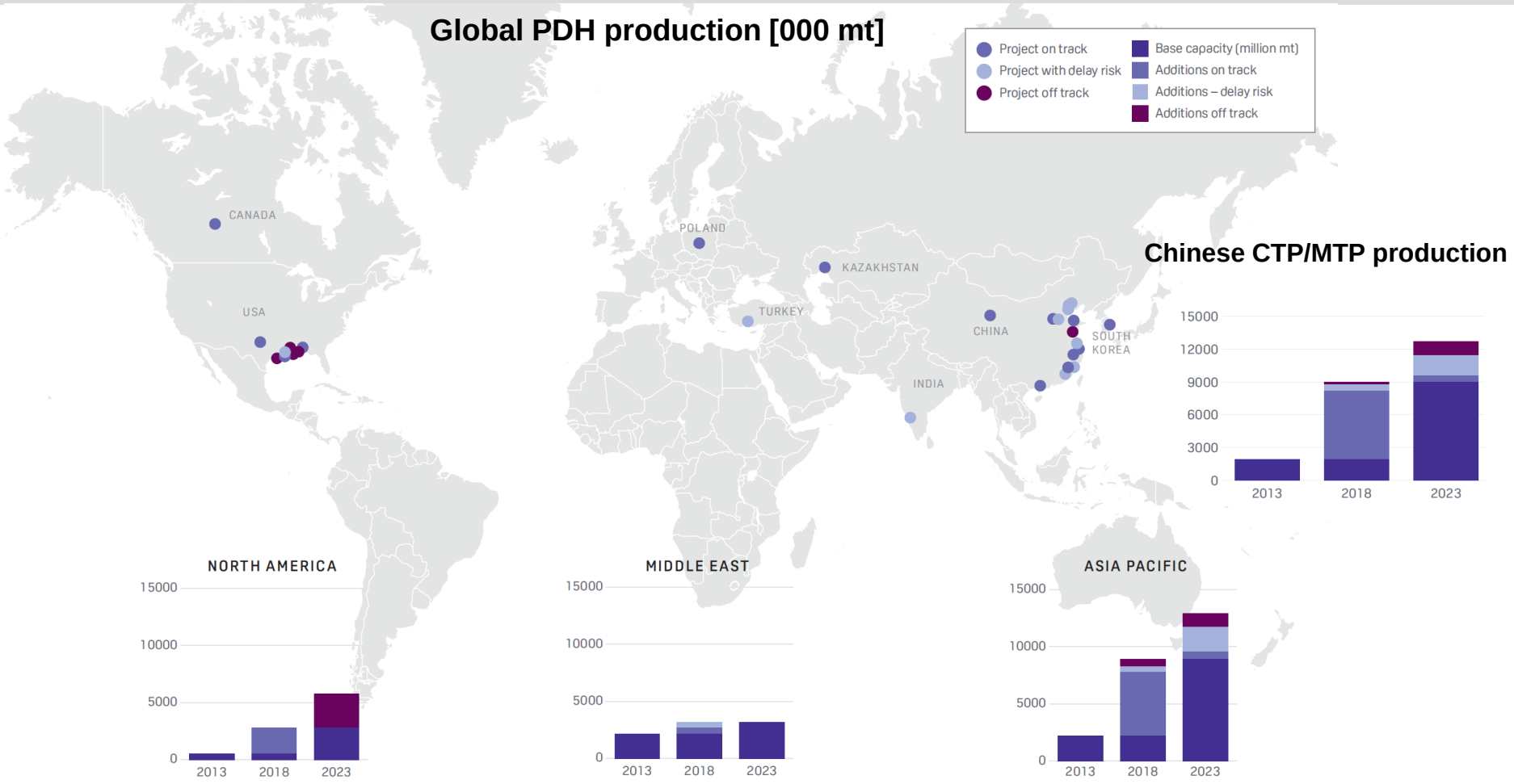
Source: Platts Analytics

Global on purpose propylene production



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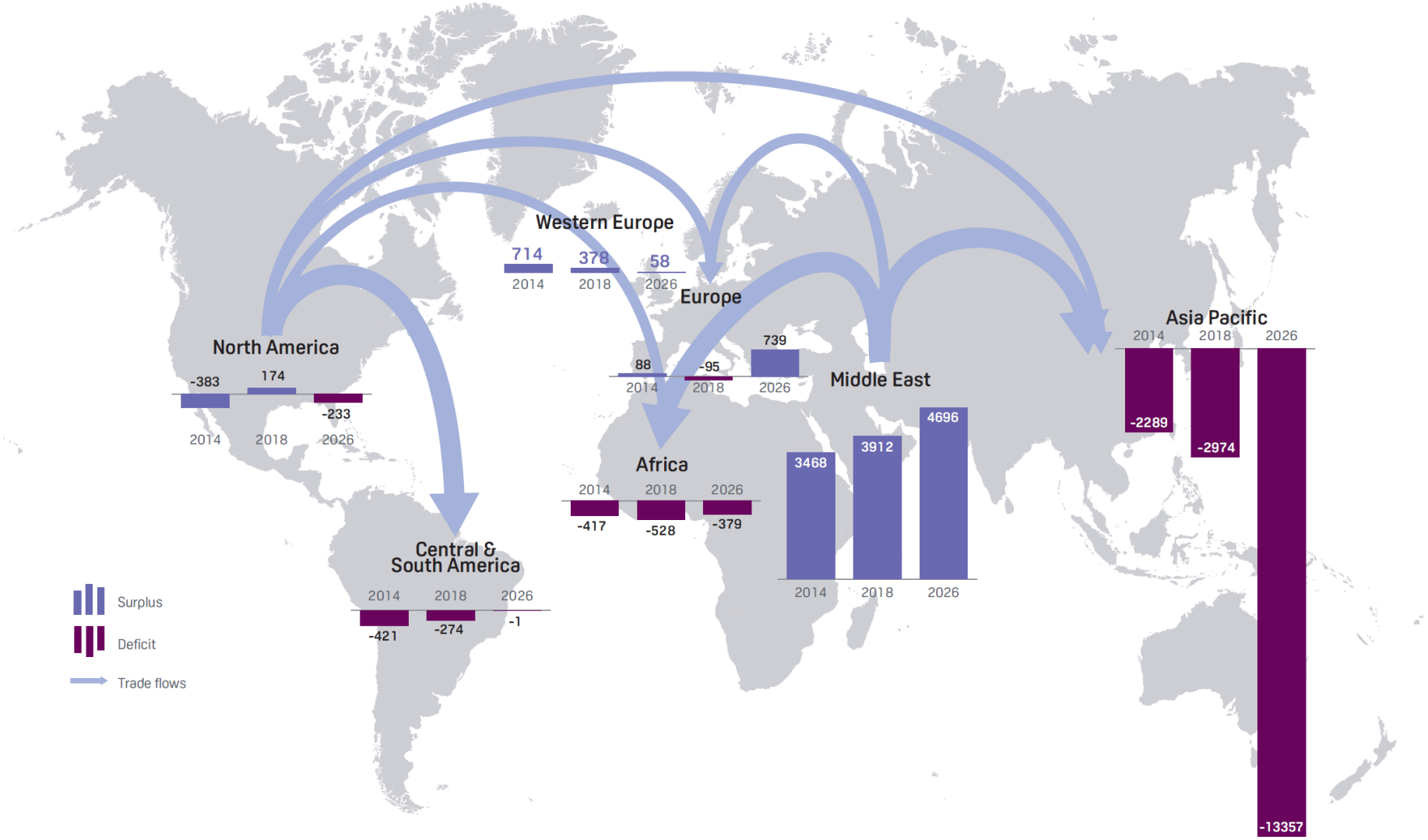
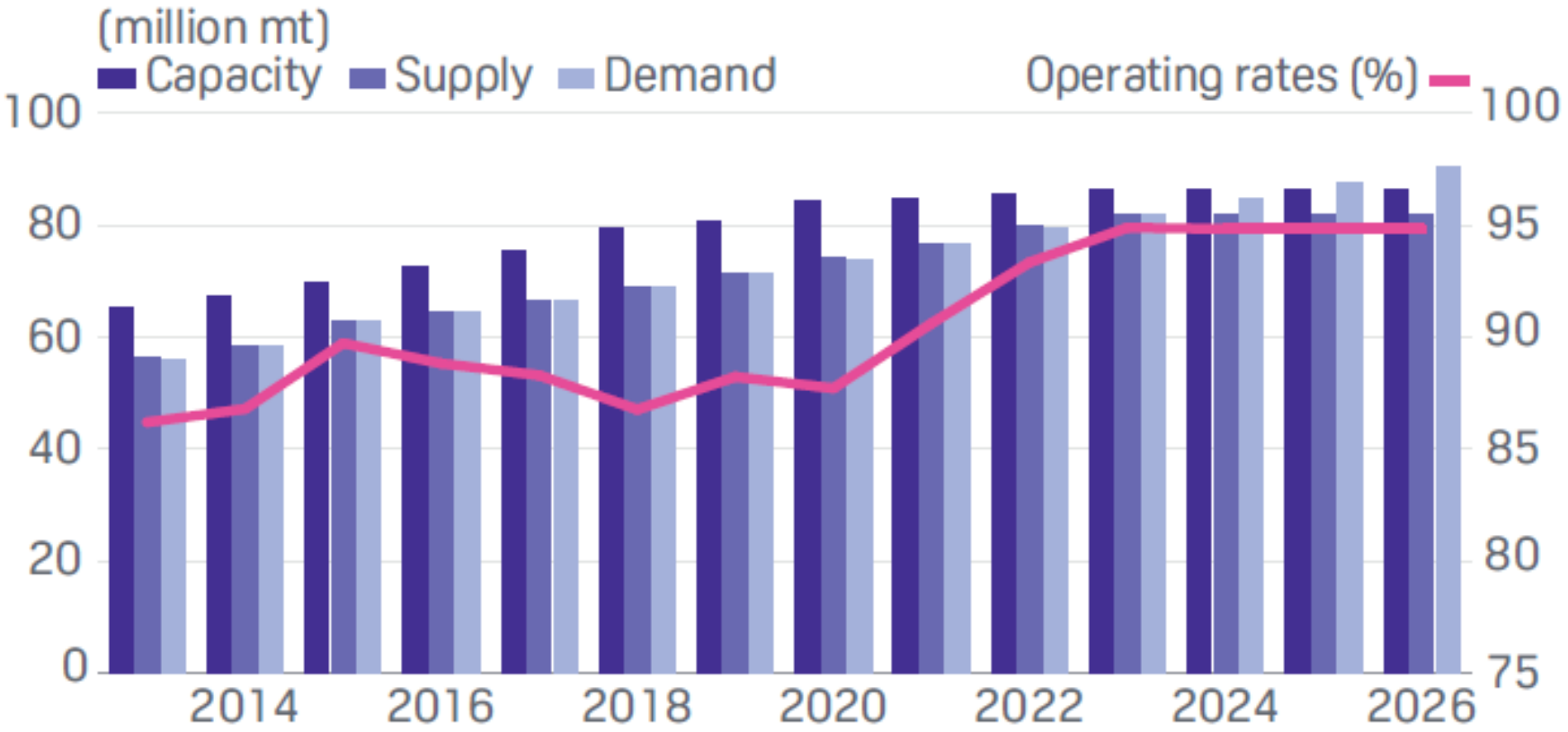
Source: Platts Analytics

Regional PP net trade in the next decade (000 mt)



Source: Platts Analytics

The global PP supply and demand balance



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Source: Platts Analytics

Key takeaways

1. **Crude oil prices and their impact on petrochemicals**
   - Lower oil prices has meant the difference between liquid and gas feedstocks has narrowed
   - Expected increases in crude will return advantage to gas based olefin feedstocks discouraging naphtha use
2. **The US ethane cracking boom and PP production**
   - The US will continue to push ahead with ethane based cracker projects, which does not favour propylene supply
   - US PDH plants not going towards PP Production
   - North American PP supply balance to remain tight
3. **The rise of on purpose propylene production and PP production in Asia**
   - Asia to see a dramatic rise in number of PDH and CTP plants
   - New PP plants keep pace with growing demand in near term but not longer
   - China will continue to see a growing reliance on imports
4. **Changes to the European and Middle Eastern PP markets**
   - Western Europe sees no new PP additions on profitability risk
   - Eastern Europe sees some PP expansion helping to keep Europe as a whole balanced
   - The Middle East continues to strengthen itself as a global exporter, growth led by Iran
5. **The global polypropylene picture in years to come**
   - Ethane use in new crackers means minimal growth in co-product propylene in regions bar Asia
   - Global on purpose propylene production comes up to meet demand from polypropylene production
   - Polypropylene to see shortage globally post 2023 where yet more propylene will be needed
   - Capacity will ahead of 2023 to ease pressure on operating rates

Thank you

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