

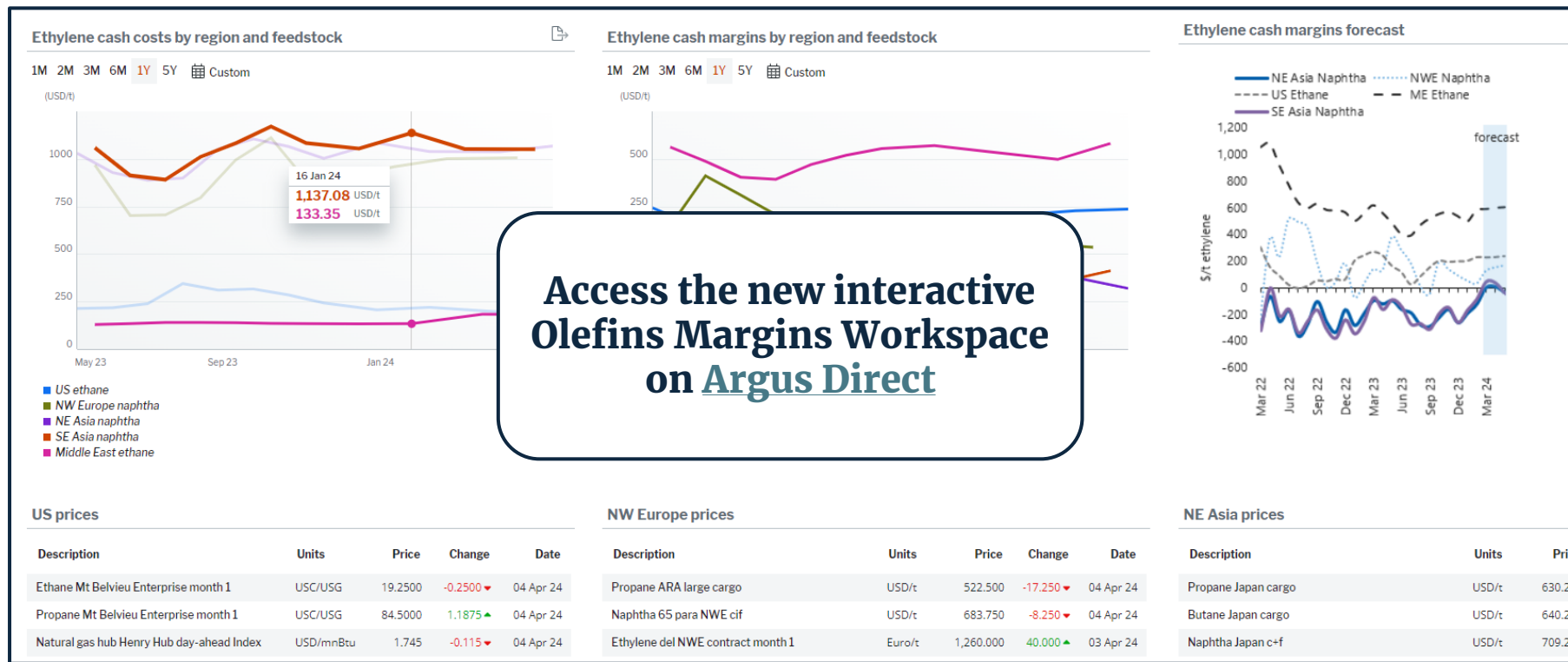
Argus Olefins Margins

16 April 2024

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- 1. Executive Summary**
 - 2. Steam cracker margins**
 - 3. PDH cash costs**
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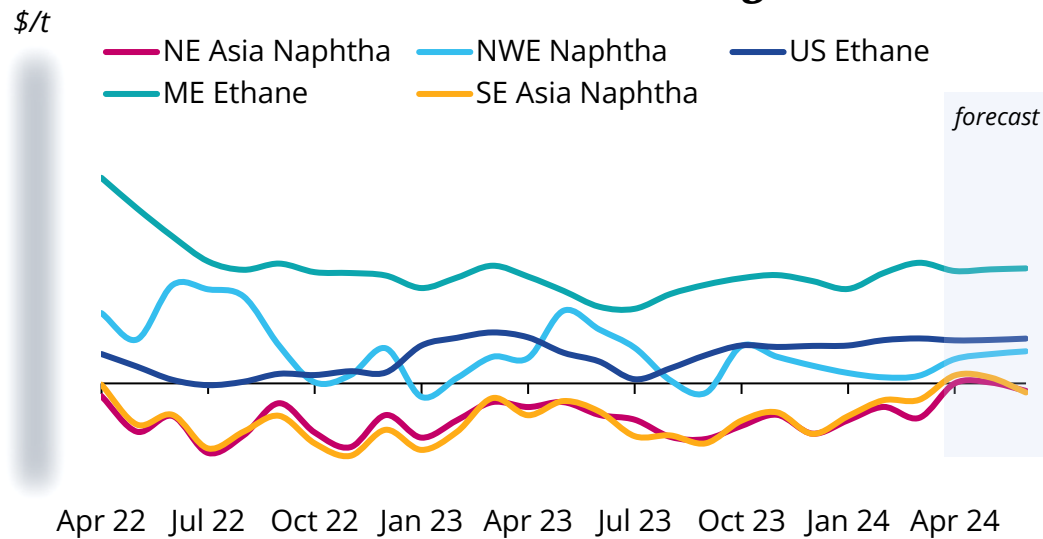
Executive Summary

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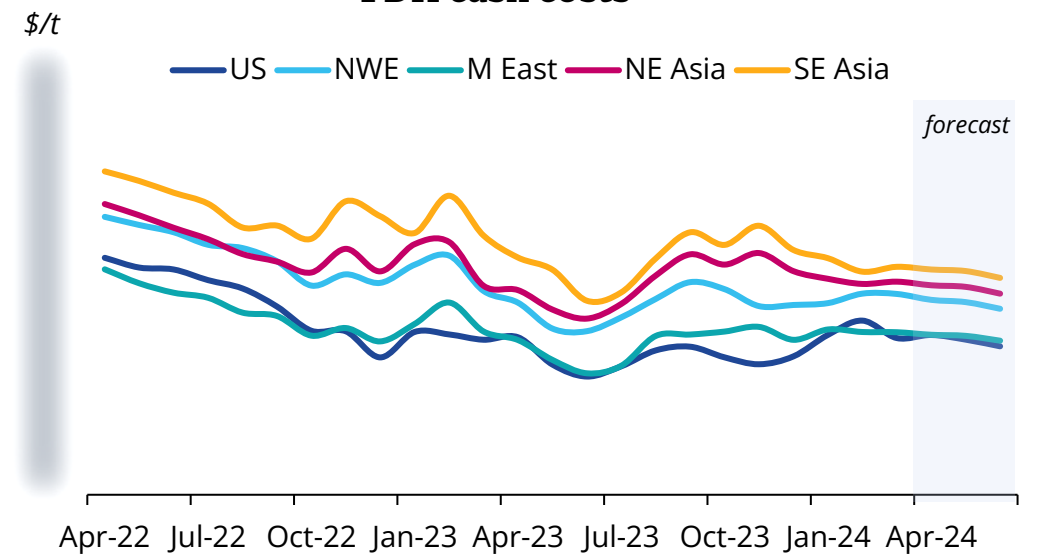
LPG prices expected to drop, supporting propane and butane cracking margins in the coming months

- **US:** Propane and butane cracking margins rose in March and are expected to continue rising. Propylene weakened on conclusion of Dow's PDH maintenance; PDH margins are expected to remain moderate after the recent spike.
- **NW Europe:** Cracker and PDH margins are improving on increased price rises across the cracker products.
- **Middle East:** Cash costs remain low and steady on a global basis for both ethylene and propylene.
- **Asia:** Margins remain squeezed across the region for both steam crackers and PDH units.

Steam cracker cash margin



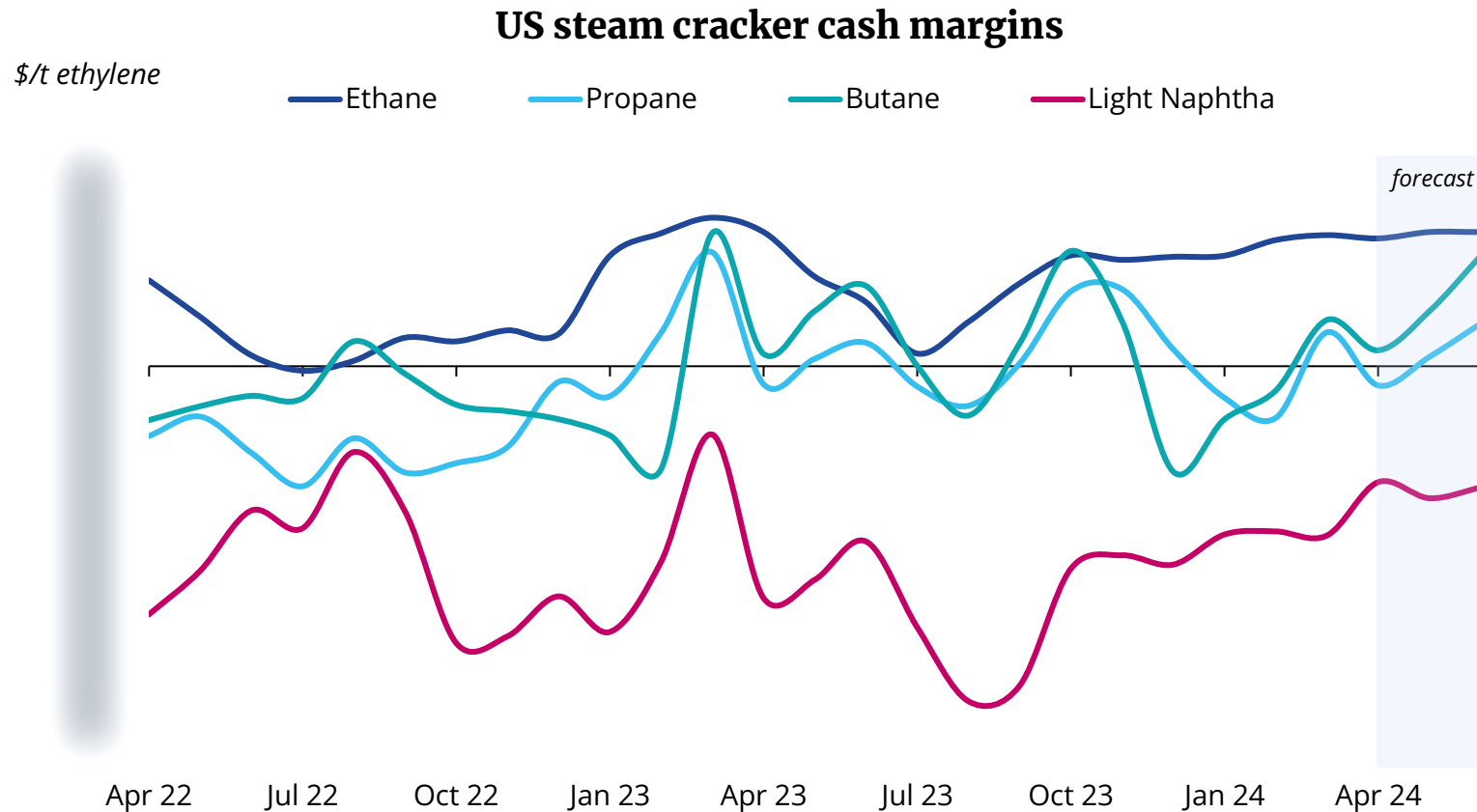
PDH cash costs



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US: Steam Cracker

LPG margins increasing on weak feedstock prices

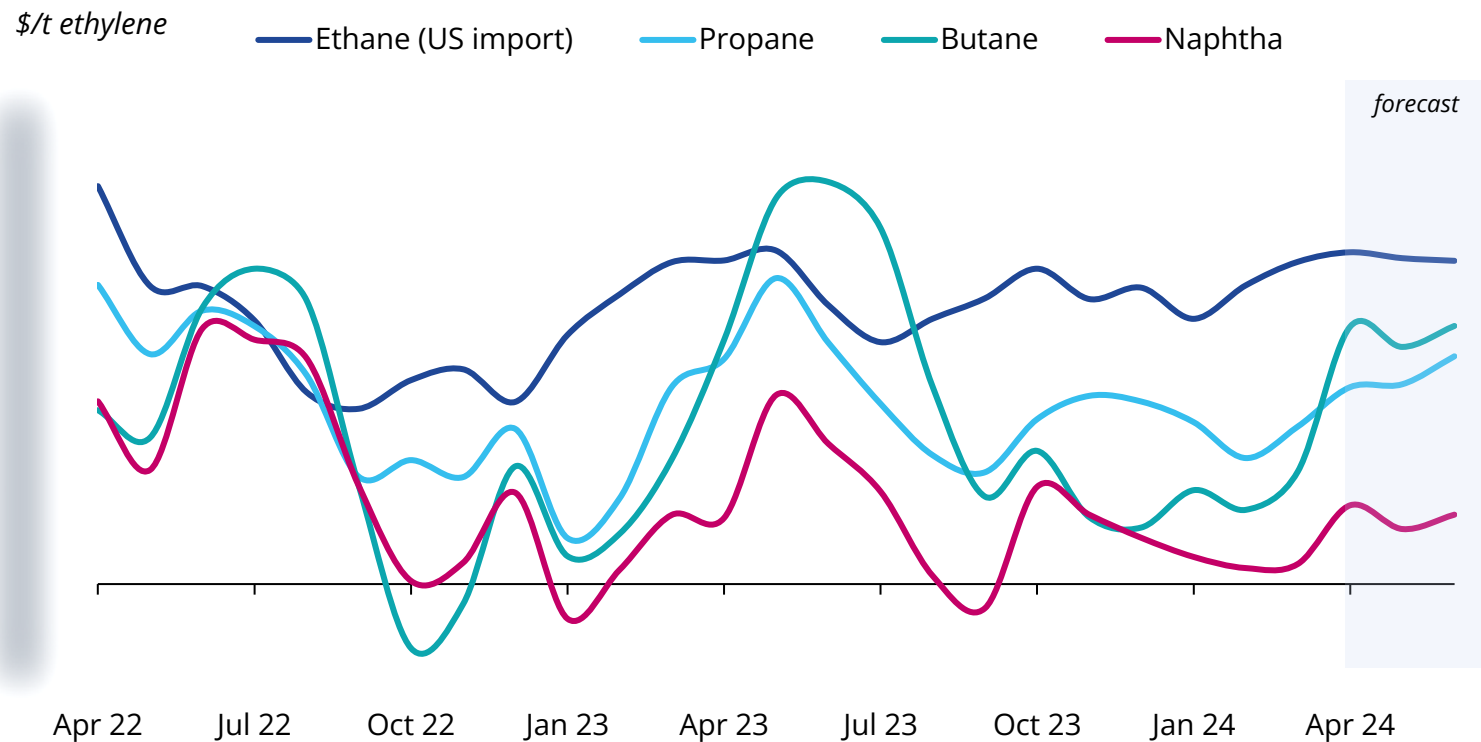


- US natural gas prices remain low, supporting lower ethane prices. Ethane costs and margins are set to remain stable throughout the forecast period, with ethane retaining a cost advantage over other feedstocks.
- US LPG production is nearing record highs, causing prices to fall, turning margins positive in March.
- US propane had the weakest March on record relative to WTI Houston crude, owing to increased production and weak heating demand.
- Propylene spot prices tumbled in March with the quicker than expected restart of Dow's PDH unit in Freeport, Texas.
- Butadiene (BD) prices are to remain elevated in the short term because of snug supply and firm demand, which will support butane margins in the forecast period.

Northwest Europe: Steam Cracker

Increased margins across all feedstocks owing to increased cracker product prices

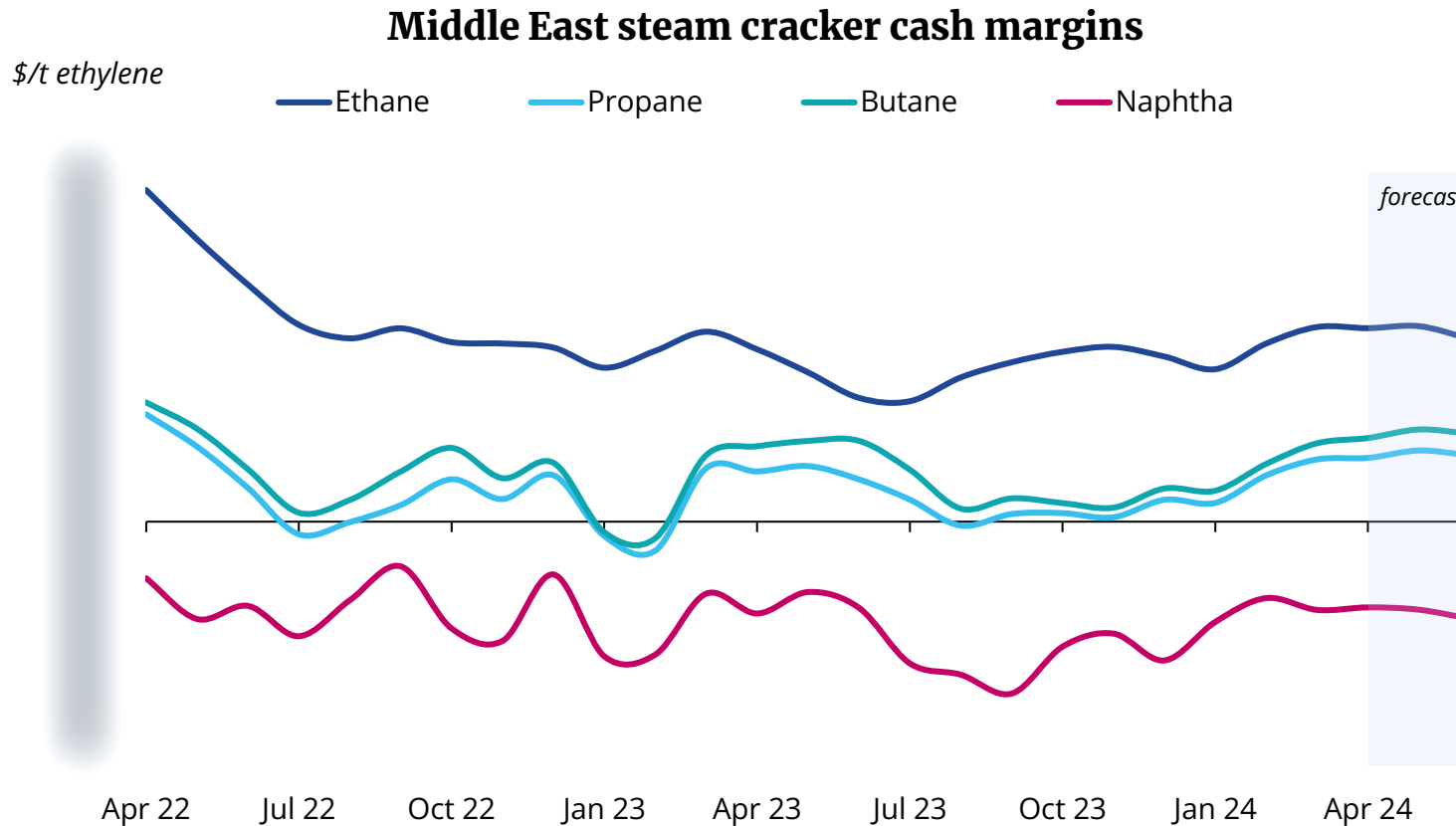
Northwest Europe steam cracker cash margins



- Margins in March increased across all feedstocks driven by product prices rising further than naphtha prices. Higher benzene and butadiene prices were a significant contributor to the margin increases.
- Steam cracker operating rates increased with firmer downstream demand. Producers integrated downstream into PE and PP will have healthier margins.
- We anticipate a rise in product prices and mostly lower feedstock costs. Forwards expectations are for naphtha and LPG costs to reduce, driven by lower demand. US imported ethane remains the highest margin feedstock in Europe but is only accessible to a limited number of crackers.
- Producers with the flexibility to switch their cracker feedstock to propane or butane will enjoy higher margins, as will those that have ethane on their feed-slate.

Middle East: Steam Cracker

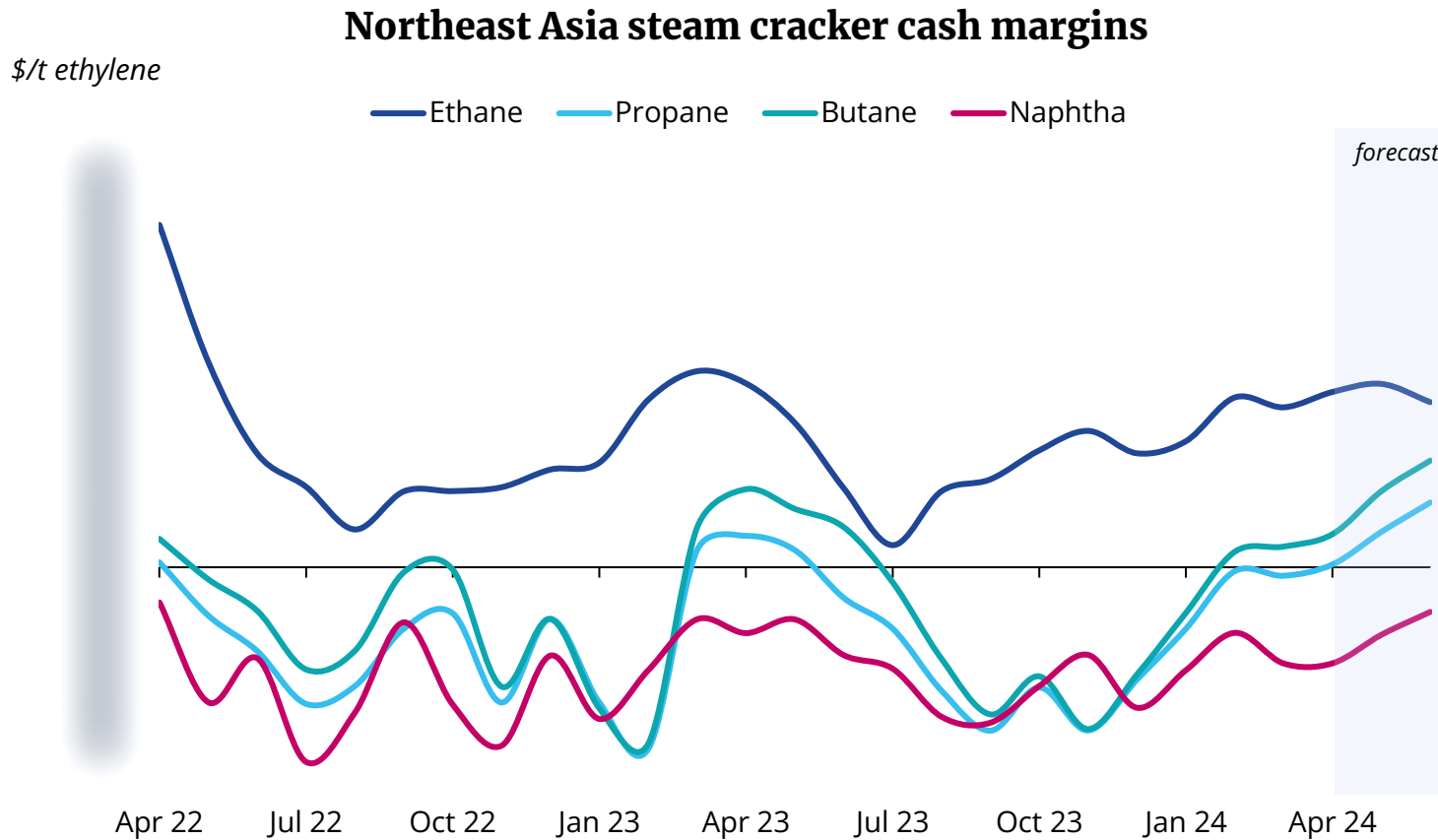
Ethylene prices increased further in March; margins are expected to remain high across all major feedstocks in the region



- Ethane margins are strong while propane and butane have strengthened since the fourth quarter, and we forecast margins to rise further.
- Ethylene prices are expected to remain around /t through May.
- Saudi Aramco increased ethane prices on 1 January to \$2.50/mm Btu from \$1.75/mm Btu, pushing up ethane cash costs to \$180/t, according to Argus Consulting modelling. Further price increases are expected over time, but ethane cracking margins remain strong.
- Propane and butane cash margins are expected to increase as feedstocks fall seasonally. Naphtha cash margins will remain negative, although this feedstock is not widely used.

Northeast Asia: Steam Cracker

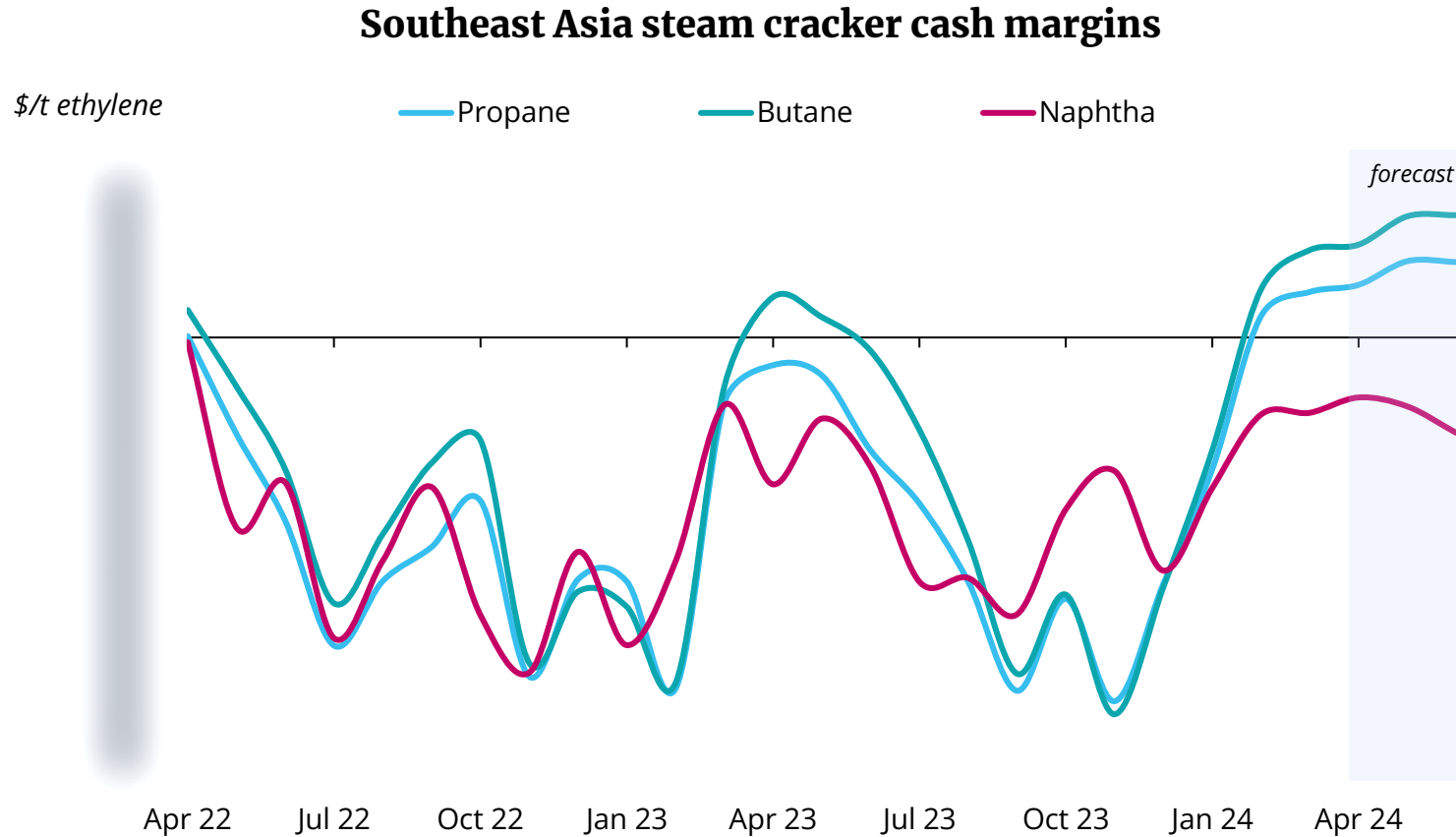
Naphtha margins weakened in March on rising feedstock costs and falling ethylene values



- Naphtha margins remain negative, falling $\text{\$/t}$ in March owing to lower ethylene prices and higher naphtha feedstock cost. Margins are forecast to improve in April on expectations of higher product prices and stable costs during turnarounds – but remain negative in our models.
- Ethylene prices are under pressure from exports from South Korea, but the market remain tight, with sporadic long-haul arrivals.
- Butane cash margins have reached their highest since June 2023. Propane cash margins edged slightly lower in March. LPG cash margins are expected to break even in April owing to anticipated lower feedstock costs.
- Ethane costs will increase slightly over the next three months. Only a limited number of crackers in northeast Asia use imported US ethane.

Southeast Asia: Steam Cracker

Propane and butane margins strengthening as feedstock costs fall

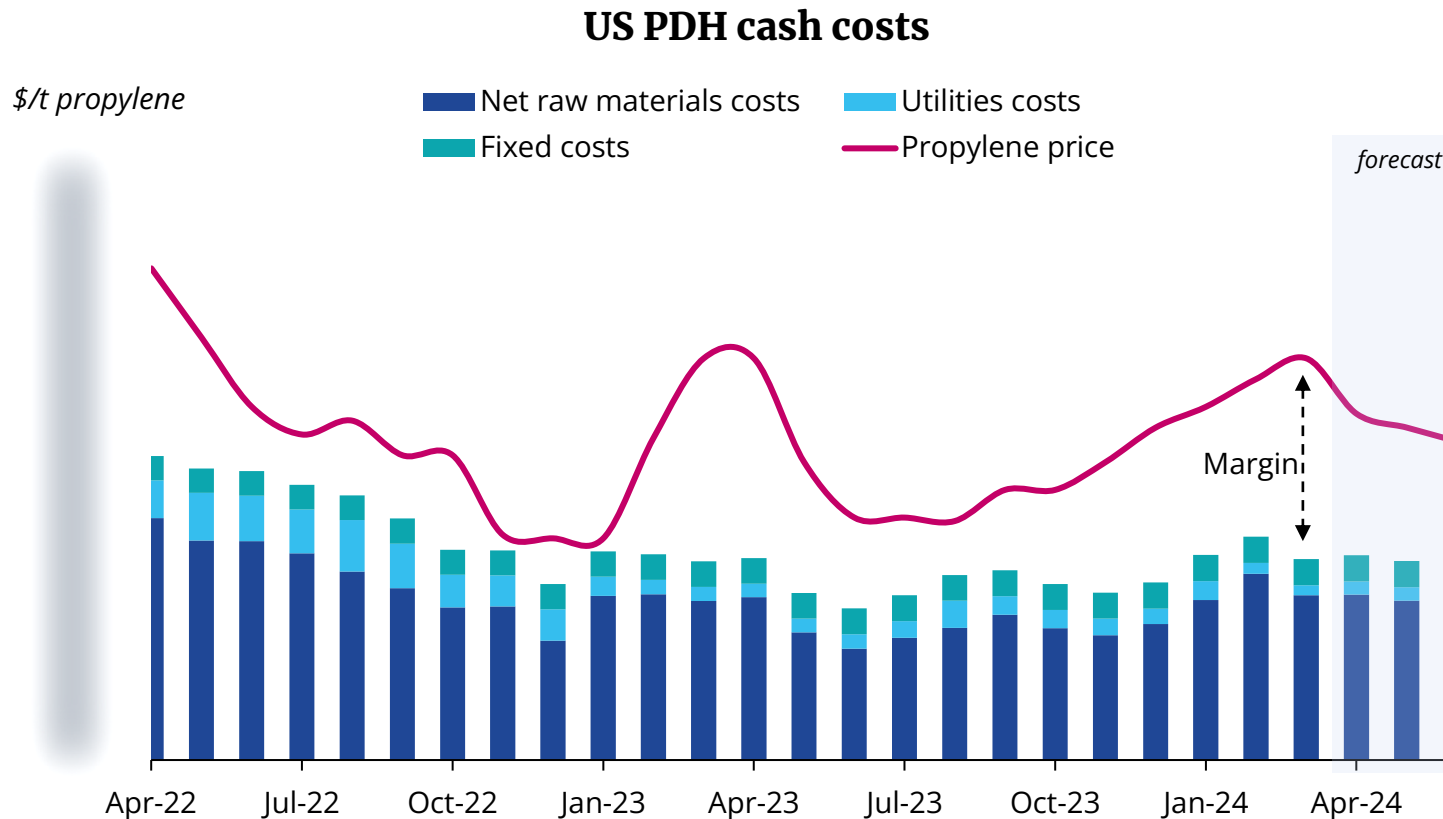


- Naphtha is the most widely used feedstock in the region and modelled margins remain negative – although producers integrated into refineries will be operating on a different economic model.
- Propane and butane margins turned positive in February owing to falling LPG prices.
- The southeast Asia ethylene cfr price rose above ██████ in March, the highest monthly average since June 2022.
- Previously shut-in crackers in southeast Asia are expected to restart in May and June, renewing pressure on ethylene prices.

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US: PDH

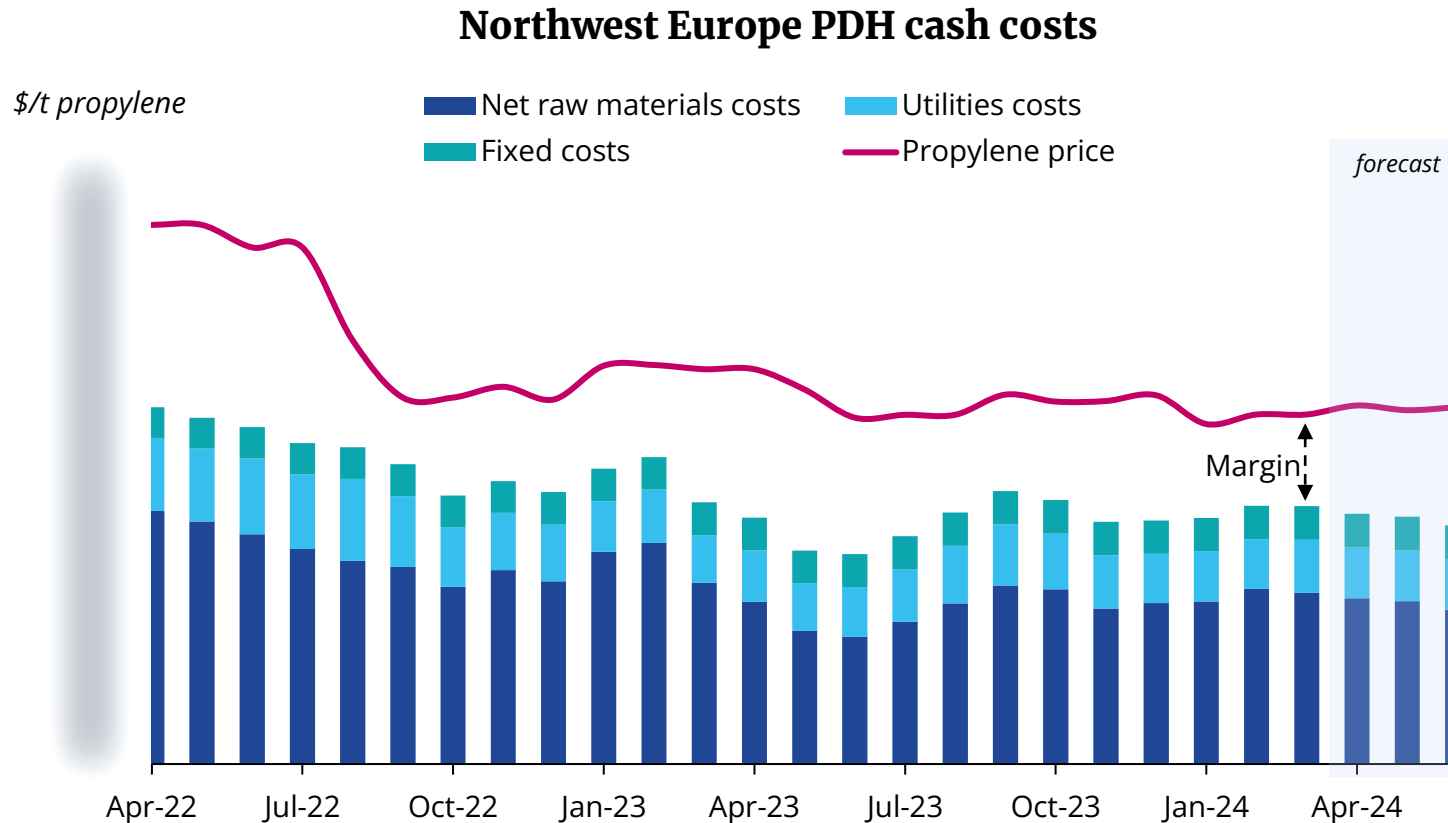
Propylene prices expected to continue declining from recent highs



- PDH margins averaged over [redacted] in March, significantly higher than the historical average of [redacted] since 2018.
- Margins are expected to moderate in April and May as propylene prices continue to fall.
- Dow restarted its 750,000 t/yr PDH unit in Freeport, Texas, in March, several weeks earlier than expected. This contributed to a sharp decline in spot propylene prices. The planned shutdown of Enterprise's 750,000 t/yr unit in Mont Belvieu, Texas, on 10 March failed to sway the market and spot prices tumbled by more than 20pc over the following two weeks.
- Propane prices are expected to fall seasonally in the coming months.

Northwest Europe: PDH

The European propylene balance is tight and modelled PDH margins stable



- PDH margins are estimated at \$ [redacted] /t in April. The 20pc rise from March is attributed to seasonally weaker propane and rising propylene prices.
- LPG prices are forecast to fall further in the forecast, supporting PDH margins.
- The net contract propylene price is expected to be stable in the coming months.
- Western Europe's third PDH unit is expected to start up in 2025. In central and eastern Europe, Poland's Grupa Azoty unit is expected online later this year.

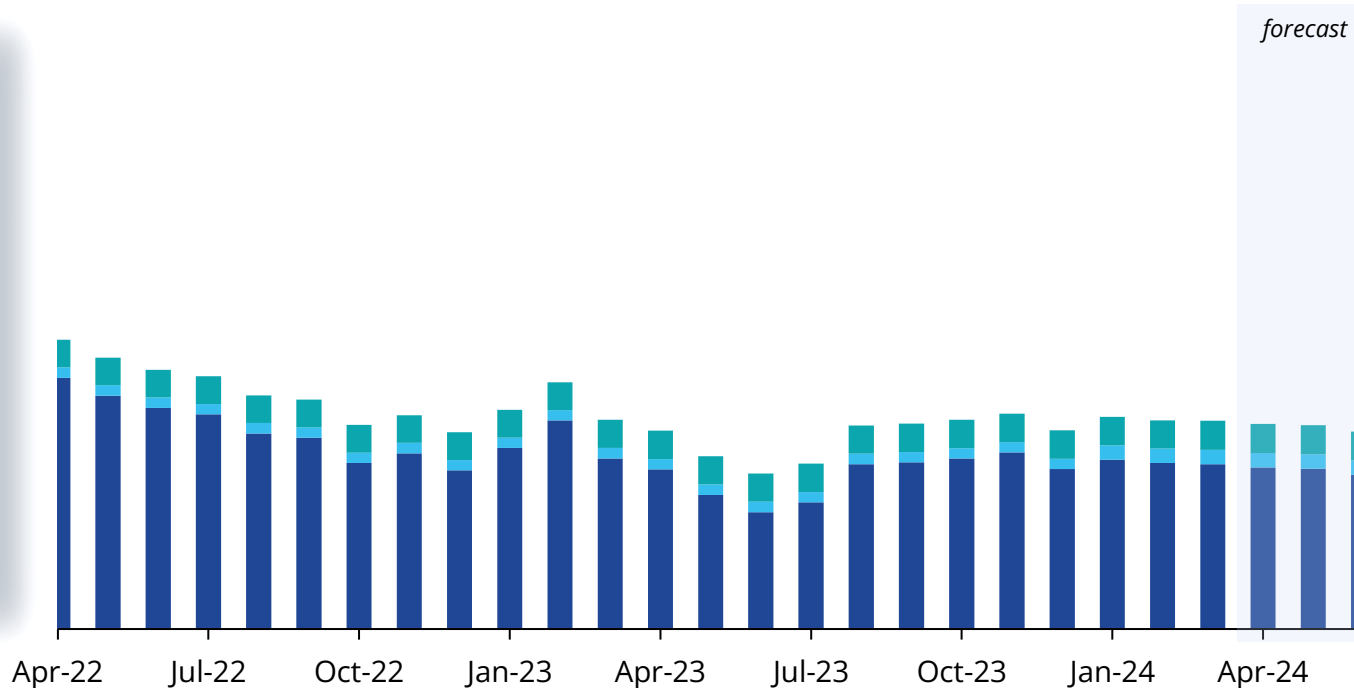
Middle East: PDH

Cash costs are steady and remain in a healthy range for integrated producers

Middle East PDH cash costs

\$/t propylene

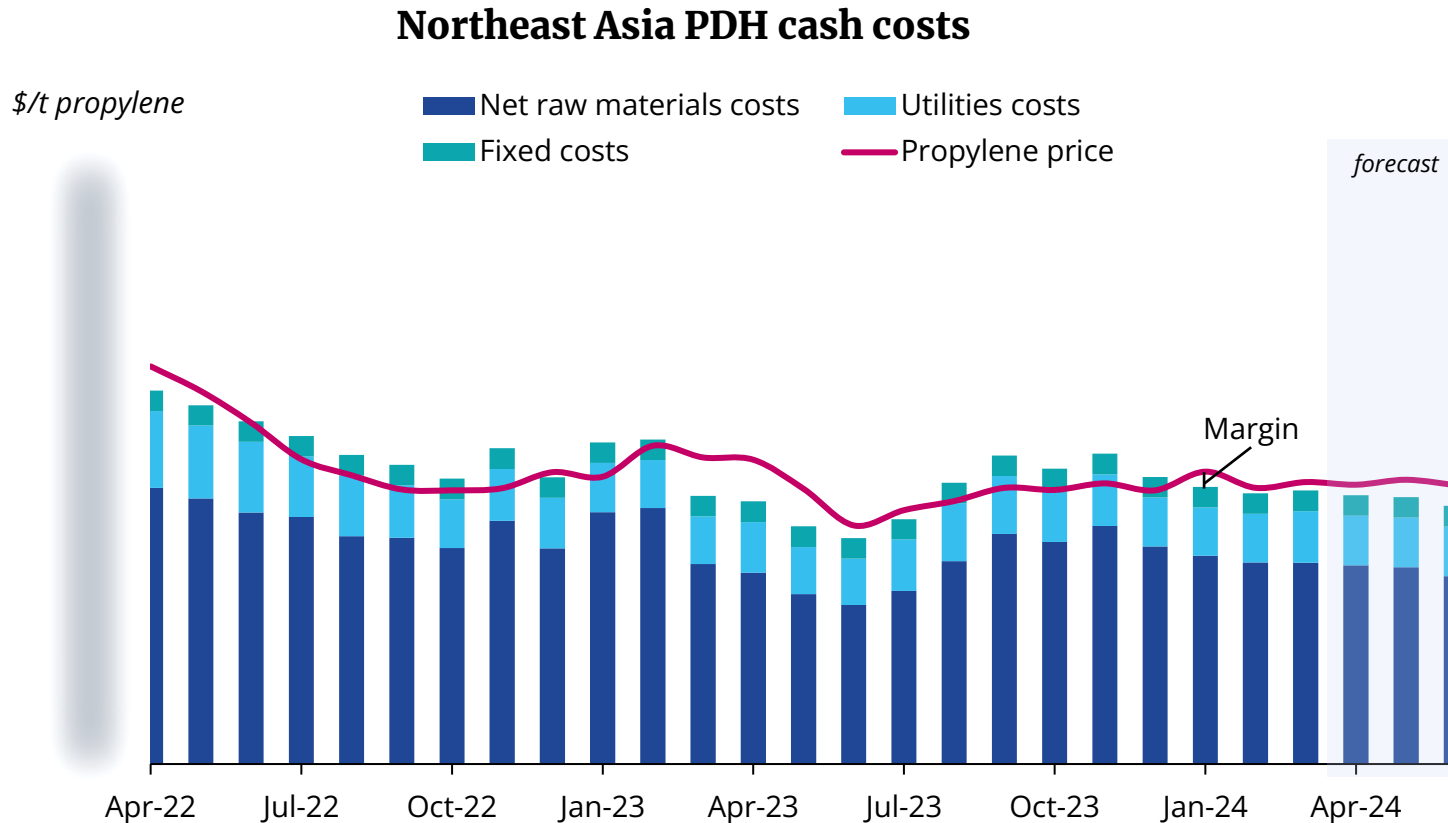
■ Net raw materials costs ■ Utilities costs ■ Fixed costs



- Middle East propylene cash costs remained steady in March at [redacted], 4pc higher than US PDH cash costs. These figures are close to historical averages for the past five years.
- Middle East spot propane prices are expected to decline seasonally through June to [redacted]. Prices are driven by Asian markets, as most Middle East propane is exported.
- Essentially all Middle East PDH operators are integrated downstream with polypropylene. Integrated PP margins via PDH are healthy.

Northeast Asia: PDH

Propylene oversupply will keep margins weak for an extended period



- PDH margins are bordering on positive since the beginning of the year and forecast to improve slightly through the summer months because of falling propane prices.
- Previously shut-in PDH units are expected to restart from this month, keeping pressure on propylene prices.
- Propylene is expected to experience a longer downturn than ethylene because of the greater oversupply. Argus forecasts lower operating rates and weak margins throughout 2025-26.

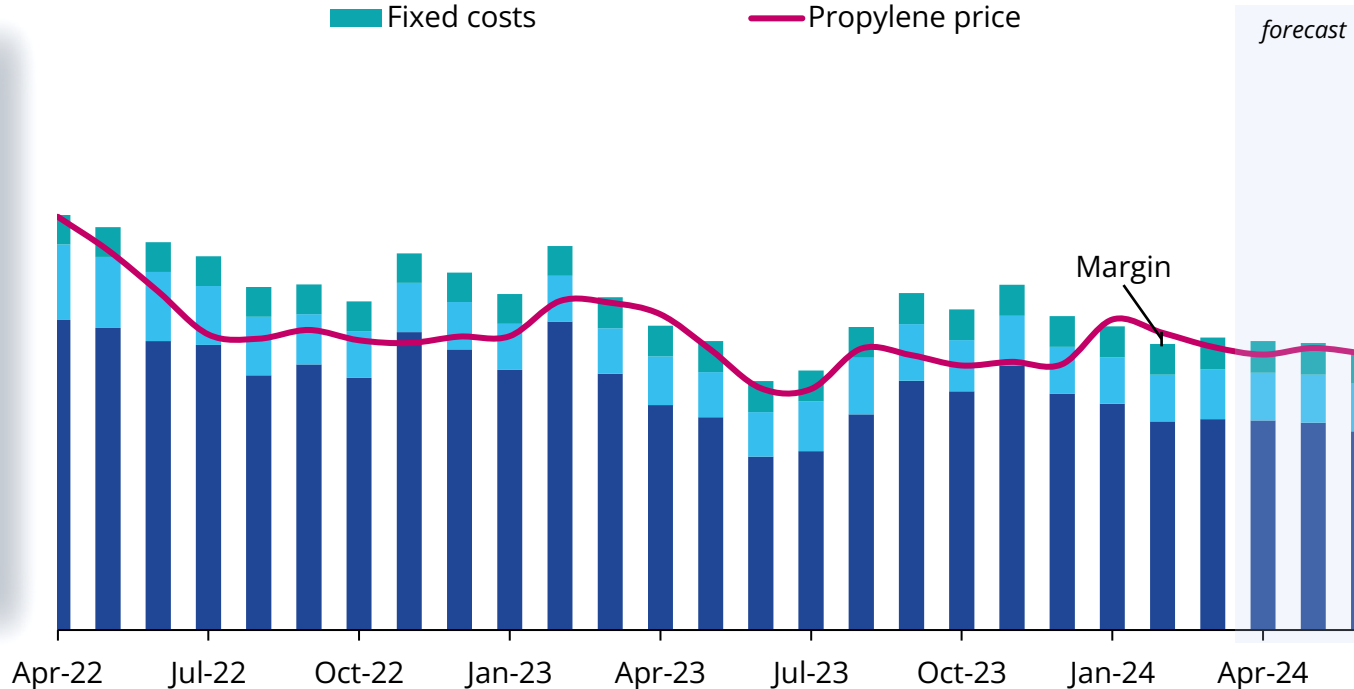
Southeast Asia: PDH

Margins remain negative owing to propylene oversupply

Southeast Asia PDH cash costs

\$/t propylene

■ Net raw materials costs ■ Utilities costs
■ Fixed costs ■ Propylene price



- Propylene price weakened relative to northeast Asia in March. Oversupply is less severe in the region, but prices are vulnerable to imports of propylene and derivatives from China.
- Propane prices are expected to fall seasonally through July, but propylene prices will not be high enough to result in positive margins for PDH units.
- PDH capacity is not expected to increase in southeast Asia in the Argus forecast period to 2034. Existing units are in Malaysia, Thailand and Vietnam.

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Assumptions

Argus Western Europe Steam Cracker Model is based on a fully flexible mixed-feed cracker located on the ARG pipeline with a nameplate capacity of 500,000 t/yr and fully integrated downstream.

Net product prices are based on monthly contract prices; average discounts are based on market consultation. Pygas modelled as equivalent to 35pc benzene cif NWE contract/65pc naphtha 65 para NWE minus \$84/t. Raffinate-1 is taken as 1.1*naphtha 65 para NWE.

Argus US Steam Cracker Model is based on a fully flexible mixed-feed cracker with capacity of 700,000 t/yr located on the Texas grid, fully integrated downstream.

Product prices are based on spot values. US Pygas = (0.35 x benzene US Gulf coast \$/t) + (0.65 x gasoline 87 conv USGC waterborne fob lowest RVP not 7.8 or 7.0) - \$84/t (the \$84/t is a discount). Raffinate-1 is taken as 1.1*naphtha full-range USGC waterborne del.

Argus Northeast Asia Steam Cracker Model is based on a fully flexible mixed-feed coastal Chinese cracker with a nameplate capacity of 600,000 t/yr and fully integrated downstream.

Product prices are based on spot values. Pygas modelled as equivalent to 35pc benzene fob South Korea/65pc naphtha Japan c+f minus \$70/t. Raffinate-1 is taken as 1.1*naphtha Japan c+f.

Argus Middle East Steam Cracker Model is based on a fully flexible mixed-feed cracker with capacity of 1,000,000 t/yr.

Product prices are assumptions calculated based on spot values for Europe and Asia. Pygas modelled as equivalent to 35pc benzene /65pc naphtha minus \$70/t. Raffinate-1 is taken as 1.1*naphtha LR1 Mideast Gulf fob.

Argus Southeast Asia Steam Cracker Model is based on a fully flexible mixed-feed cracker with capacity of 800,000 t/yr.

Product prices are based on spot values. Pygas modelled as equivalent to 35pc benzene /65pc naphtha minus \$70/t. Raffinate-1 is taken as 1.1*naphtha Singapore fob.

Argus Western Europe PDH Model is based on a 450,000 t/yr PDH unit.

Propane price assumption is ARA large cargo.

Propylene price assumption is PGP contract; average discount is based on market consultation.

Argus US PDH Model is based on a 750,000 t/yr PDH unit.

Propane price assumption is Mt Belvieu Enterprise.

Propylene price assumption is PGP contract; average discount is based on market consultation.

Argus Northeast Asia PDH Model is based on a 450,000 t/yr PDH unit.

Propane price assumption is AFEI price.

Propylene price assumption is PGP fob.

Argus Middle East PDH Model is based on a 450,000 t/yr PDH unit.

Propane price assumption is based on discounted AFEI.

Argus Southeast Asia PDH Model is based on a 600,000 t/yr PDH unit.

Propane price assumption is based on AFEI.

Propylene price assumption is PGP cfr.

For full details download:
[Reference and Modelling Approach](#)

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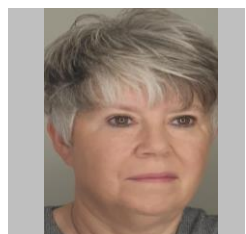
Craig leads the global ethylene team focused on integrated global forecasts. He has over 30 years experience in the olefins industry including with Dow Chemical and ExxonMobil. Throughout his career Craig has worked across the world with major olefins and derivative producers. His experience also includes olefins feedstocks and refinery integration with the petrochemical industry. He holds a chemical engineering degree from The Ohio State University and an MBA from Rice University.



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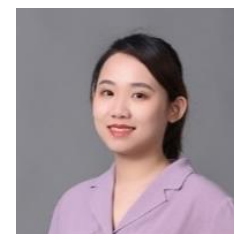
Dhanish is a deputy analyst manager in Argus' London consulting team, focusing mainly on olefins, polyolefins and chlor-alkali. His experience includes roles working in power generation, project management, agriculture and analytics. He also spent time at an edible oil refinery in operations and managed projects with high-pressure biomass boilers, steam turbines, water treatment and fuel management. He holds a degree in chemical engineering and a masters in finance analytics.



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Sarah Rae is Argus' propylene consultant focusing primarily on Europe and the Middle East. For 17 years prior to joining Argus, Sarah held senior strategic purchasing management positions at Ineos, Tessenlo Chemie and Rhodia, responsible for a wide range of materials including olefins, fertilizers and commodity raw materials. Before this, Sarah held various management and project roles covering most aspects of the chemical business, including business management, sales, planning and logistics. She graduated with a degree in geology from Leicester University.



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Josie is an analyst in Shanghai focused on olefins and polyolefins markets. Her experience includes working at Pacific Gas as a market analyst in the strategic department, focusing on LPG, ethane, shipping and financial markets. Josie is a chartered financial analyst and holds a bachelor's degree in economics, and a master's in finance and investment from the University of Bristol.



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Craig is a member of the Argus Media olefins team focusing on propylene and associated derivatives. He contributes to the monthly Olefins Outlook report, the biannual Propylene Analytics report, and provides support to both internal stakeholders and external clients. Craig has nearly 25 years' experience in the petrochemical industry including roles with producers and consultants. The variety of products covered in his career include polymers, olefins, aromatics, asphalt, methanol, inorganics, oxo alcohols and electricity.



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