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Asia olefins – Are we out of the woods? The way forward for crackers in the face of supply overhang

**Olefin Market Update
May 2024 – APIC Seoul**

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Fertilizers



Metals



Oil Products



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Emissions



Chemicals

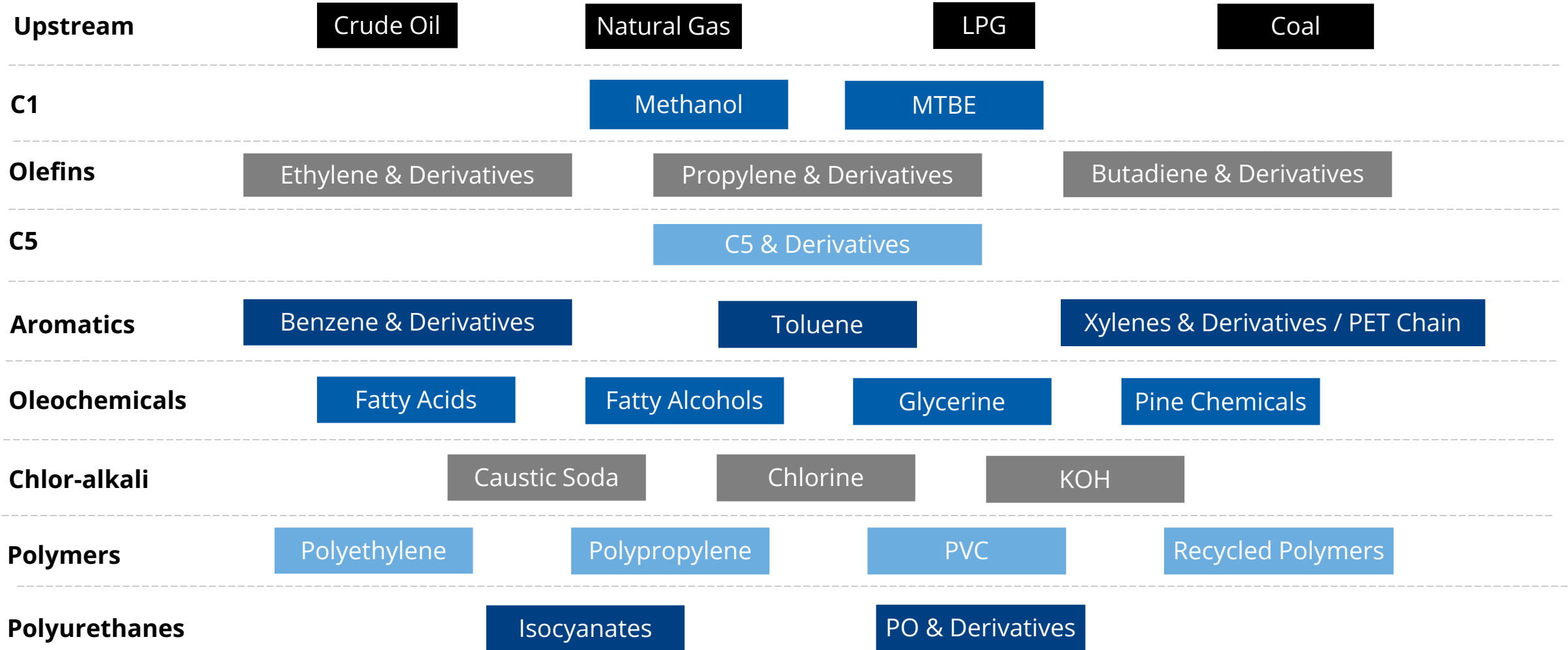


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Asia olefins – Are we out of the woods? The way forward for crackers in the face of supply overhang.

Global Olefin markets – scope for optimism?

- **Over-view on global supply/demand dynamics**
- **Challenges and opportunities of circularity and lower carbon**

Key market dynamics –

Over-view on global supply/demand dynamics



Global: Economy

Central banks appear to have tamed inflation for now. Global GDP forecast continues to be revised lower for longer as growth in China remains lower than previous estimates.

GDP Forecast Assumptions

Inflation

Inflation to be more volatile than before the pandemic. Central banks likely to keep inflation close to target in the medium and long term.

Monetary policy

Central banks to cut rates this year. They will move cautiously to bring rates down slowly.

War in Ukraine

Russia sanctions stay in place long after any cease-fire. Europe avoids any future energy problems during winter months.

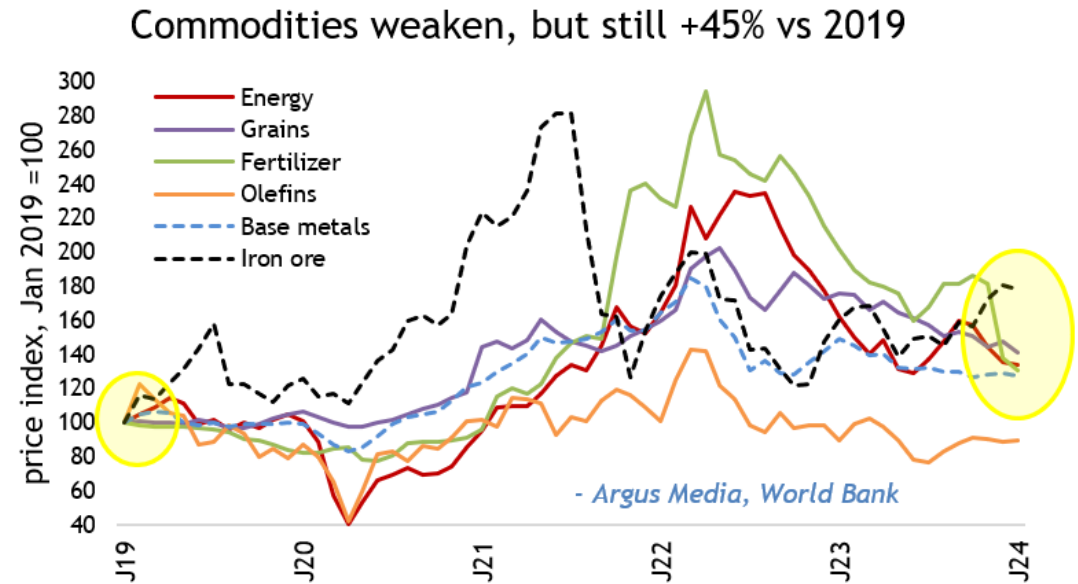
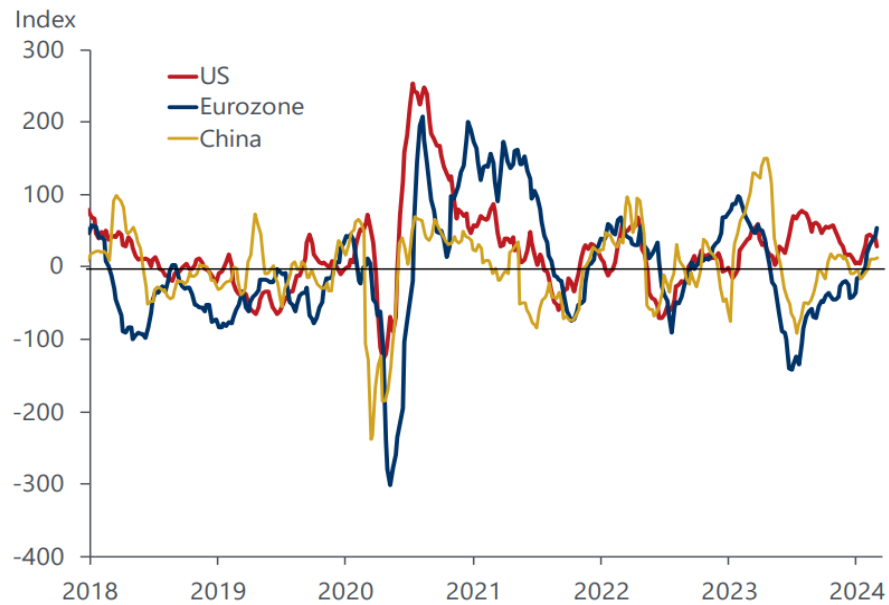
Globalisation

No meaningful change in the global trading system or US/China relationship. Recent tariffs and other trade barriers stay in place.

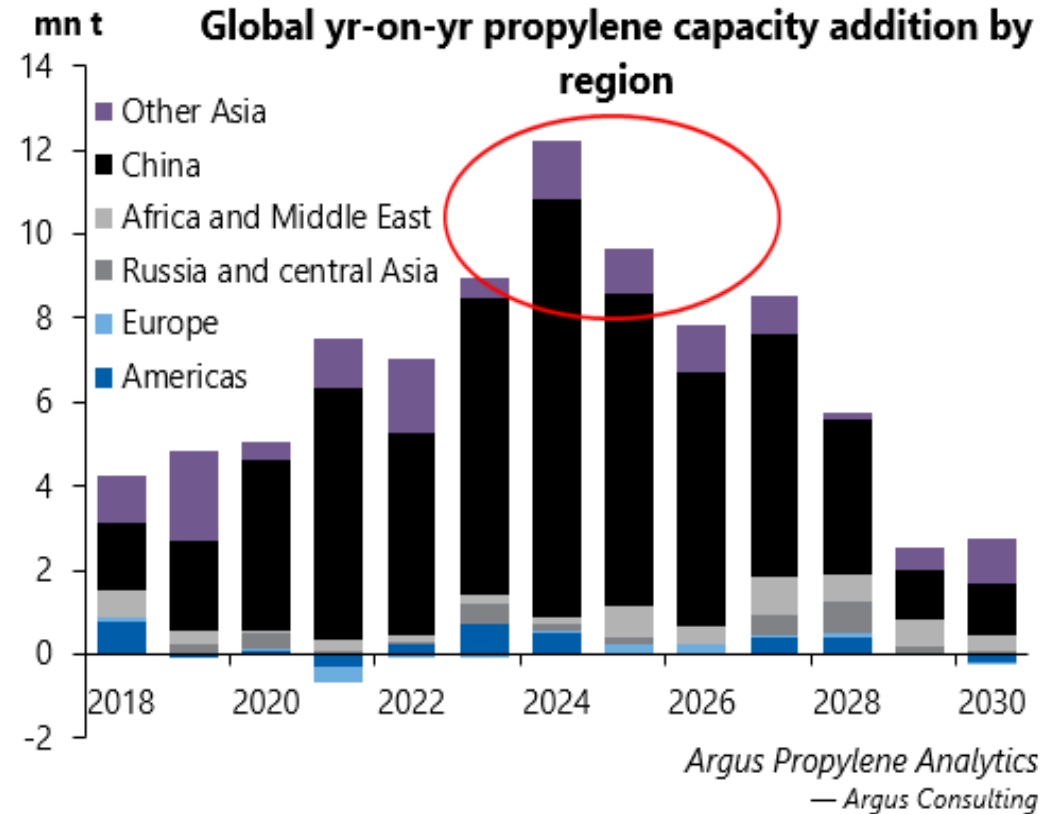
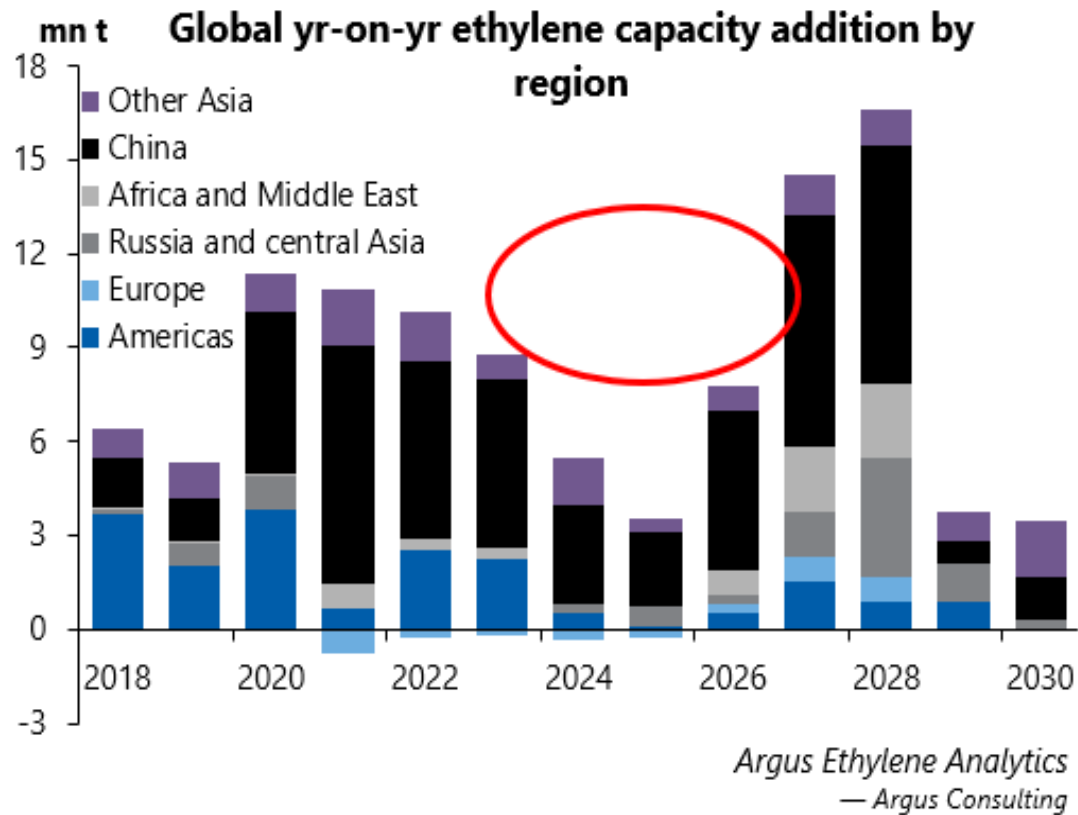
Global GDP growth rate forecast, Oxford Economics (OE)



Economic growth is a key driver for olefin consumption



The ethylene and propylene markets have very different dynamics



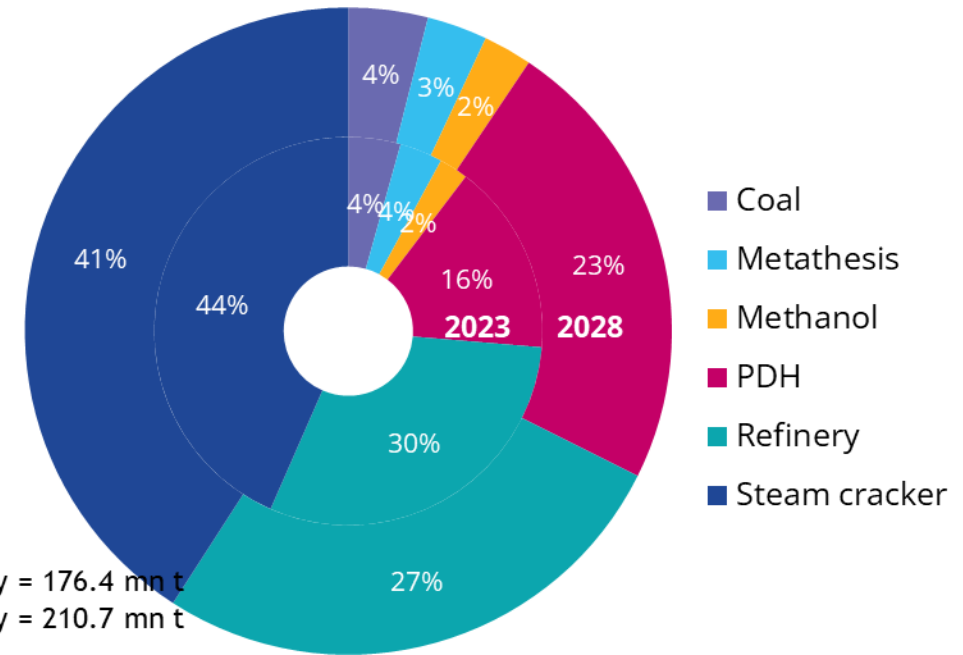
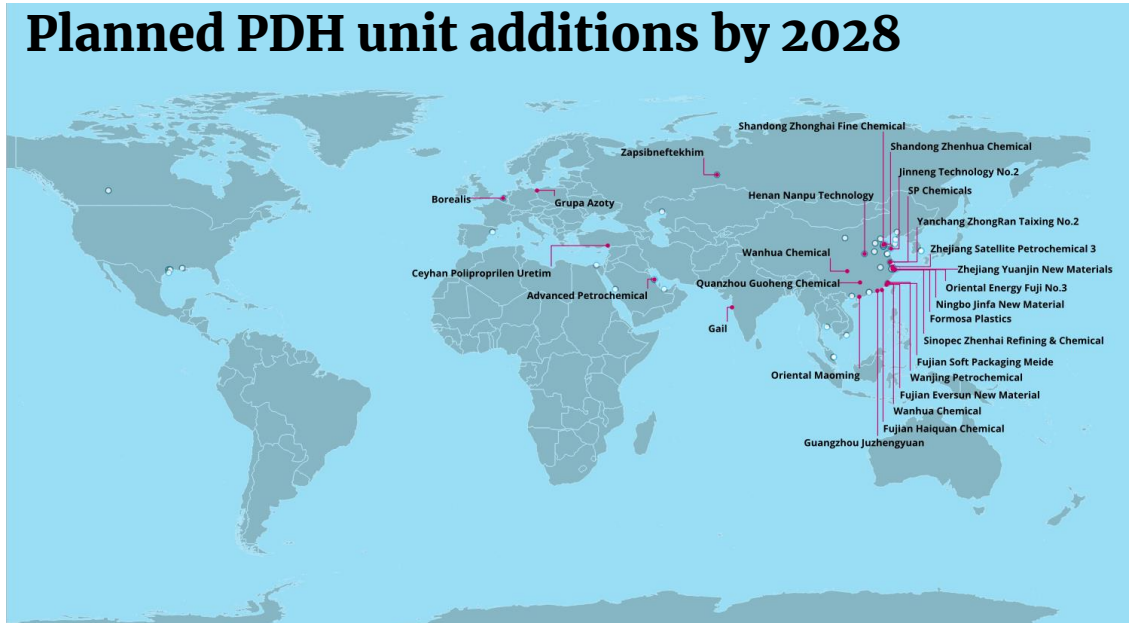
With a new wave of investment in 2026-27 - China started building 8 new crackers with 9mn t/yr. of ethylene capacity in 2026 and 2027

Company	Country Subdiv	Source	2023	2024	2025	2026	2027	2028	2029+
PetroChina Jieyang	Guangdong								
Sinopec Hainan Refinery	Hainan								
Jinghai Petrochemical	Shandong								
Sanjiang Chemical	Zhejiang								
Sinopec Anqing Petrochemical	Anhui								
Jincheng Petrochemical	Shandong								
Huatai Shengfu	Zhejiang								
Yulongdao Refining & Petchem N	Shandong								
Ineos Sinopec Tianjin Nangang	Tianjin								
Zhejiang Petrochemical	Zhejiang								
Chambroad	Shandong								
Wanhua Chemical	Shandong								
PetroChina Jilin Petrochemical	Jilin								
Yulongdao Refining & Petchem N	Shandong								
CNOOC Daxie	Zhejiang								
Shenghong No.2	Lianyungang								
ExxonMobil	Guangdong								
SABIC Zhangzhou Gulei	Fujian								
CNOOC Shell No 3	Guangdong								
Sinopec Luoyang Petrochemical	Henan								
BASF Zhanjiang	Guangdong								
PetroChina Dushanzi Tarim Oilfie	Xinjiang								
Huajin Aramco Petrochemical	Liaoning								
PetroChina Guangxi Petrochemic	Guangxi								
Sinopec Maoming Petrochemical	Guangdong								
Rongsheng New Materials	Zhejiang								
Sinopec Zhenhai No.3	Zhejiang								
Satellite Lianyungang	Jiangsu								
Sinopec Zhongke Zhanjiang No.2	Guangdong								
Sinopec Yangzi Petrochemical	Jiangsu								
Sinopec Yueyang	Hunan								
Lanzhou Petrochemical	Lanzhou								
Sinopec Tahe Refining	Xinjiang								
Gulei Refinery No.2	Fujian								
Subtotals			3,800	4,330	3,973	9,200	9,250	3,200	3,700

PDH capacity growth

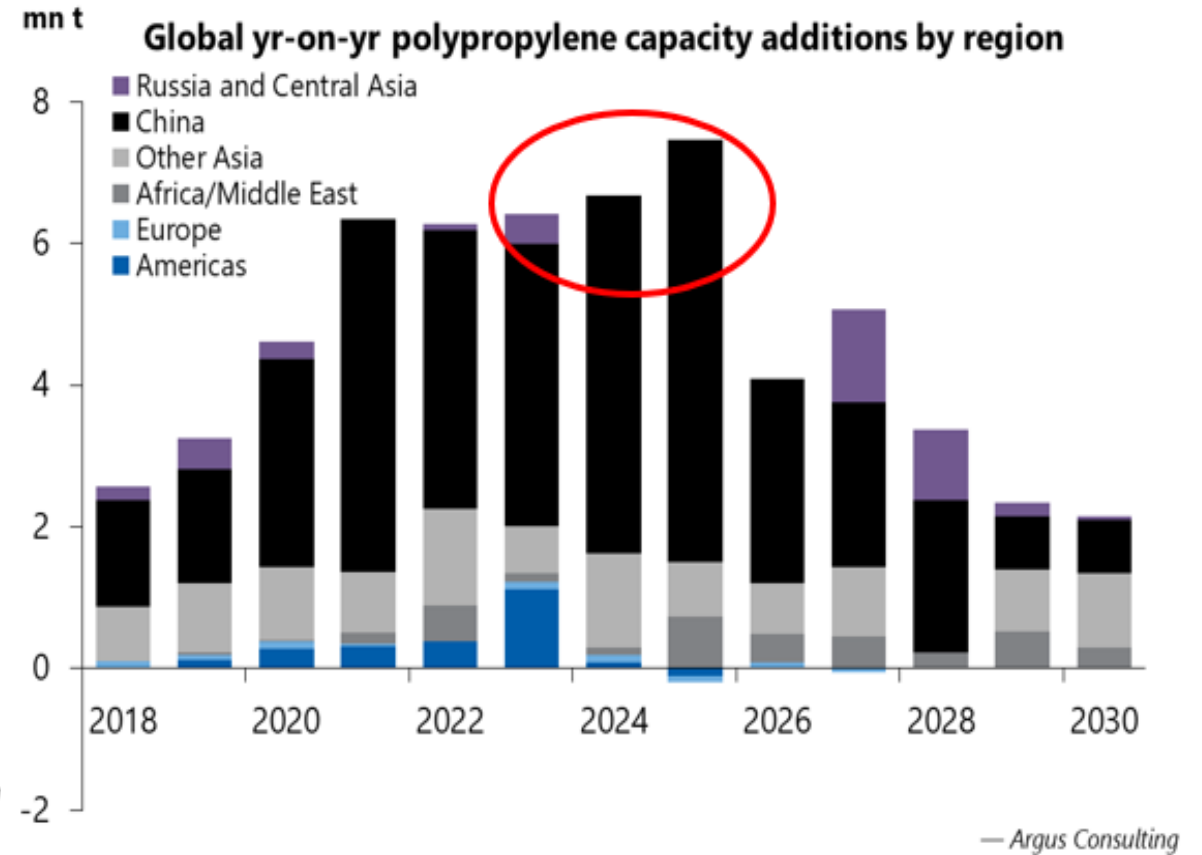
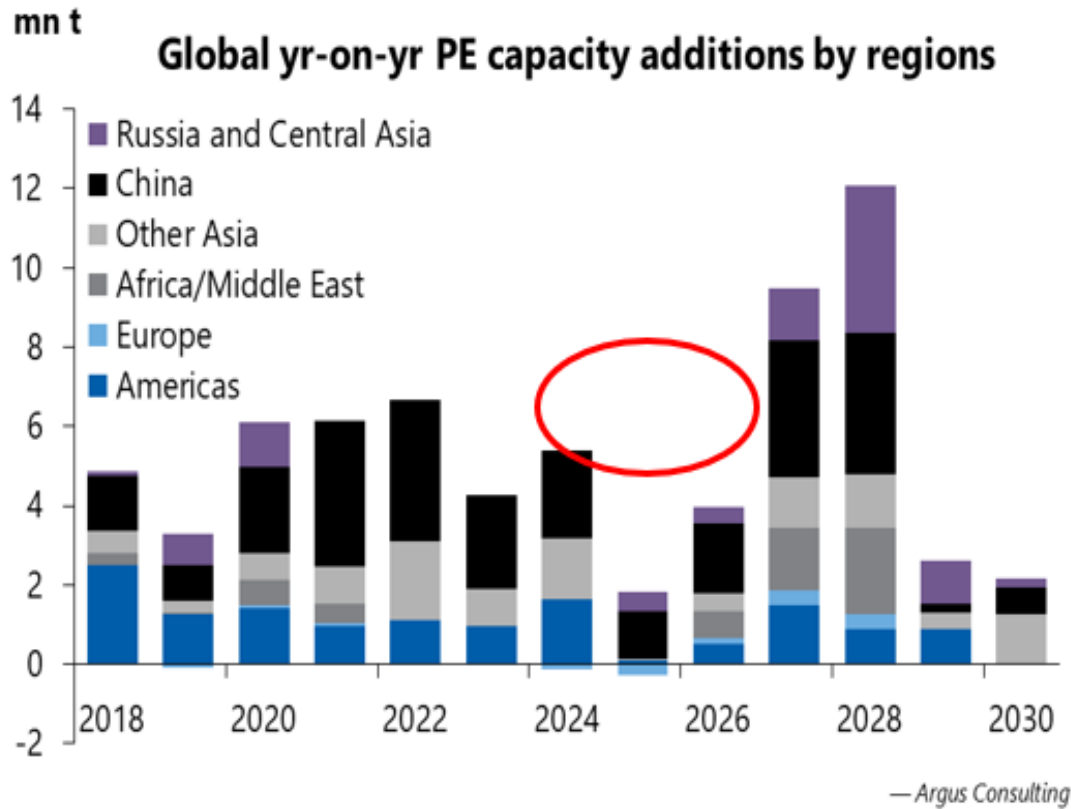
Globally there are 64 PDH plants operating, 16pc of global capacity. A further 28 are in the pipeline and will represent 23pc of global capacity by 2028.

Planned PDH unit additions by 2028



- Most of the investment is in China - 38 units already built and another 21 planned.
- Much of this investment is taking place against the assumed tightening of planning rules from 2030 and likely closure of older, smaller more polluting sources. But this over investment means that plant profitability is highly dependent on integration up/down-stream and we anticipate some industry consolidation or even closures.
- Elsewhere – PDH investments are replacing propylene production lost to lighter feeds and refinery/steam cracker closure
- With the growing reliance on PDH as a source, propane is likely to become the price setter for regions reliant of PDH sourced propylene.

...and this translates directly into polyethylene / polypropylene

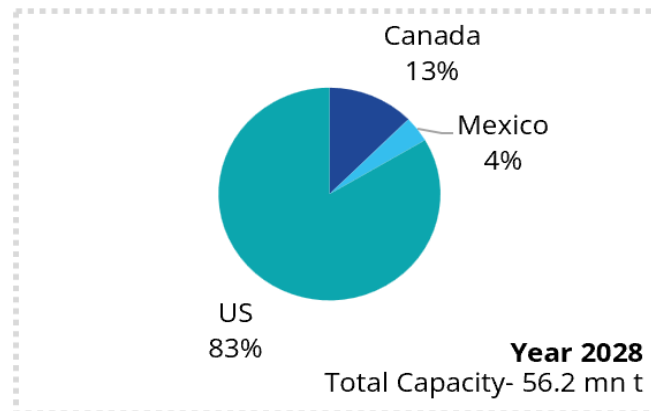
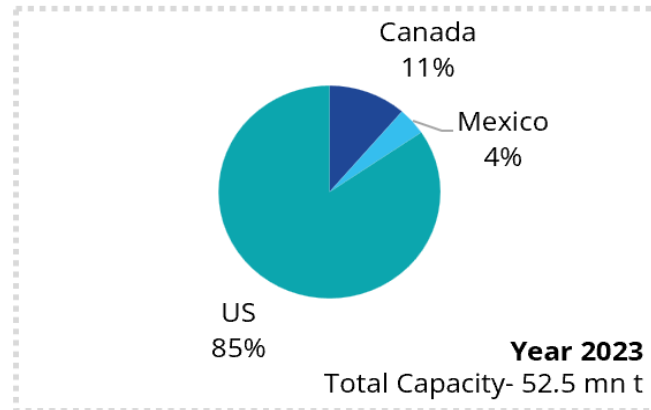


North America: Supply

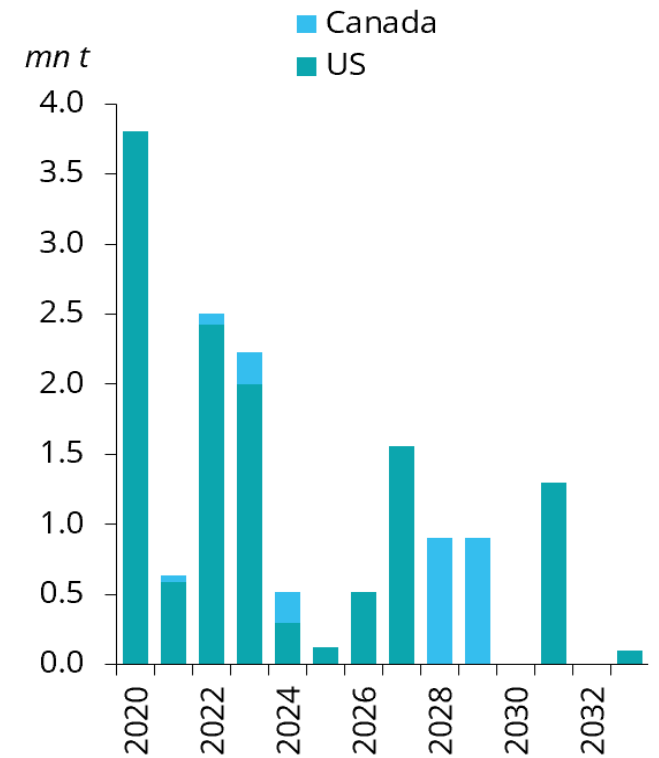
Pace of new ethylene capacity slows, but growth will likely come from the integration of existing ethylene supply into derivatives later this decade.

- The pace of capacity additions slows, with only two producers — CPChem / Qatar joint venture and Dow Chemical — are moving forward with expansion projects during the forecast period.
- At least two other cracker projects are under development, but the timing of FID is unclear. Higher capital cost and the uncertainty of attractive export markets, especially for PVC producers.
- By 2031, high operating rates and a sustained ethane cost advantage will likely lead to at least one additional cracker project. Over time, new projects will need to closely evaluate future ethane prices as exports continue to grow and the region’s supply and demand for ethane narrows.

Capacity by country



Capacity year-on-year changes



US ethane supply

Is there enough US ethane to support a second wave of low-cost crackers? How will planned exports impact the US ethane supply and demand balance?

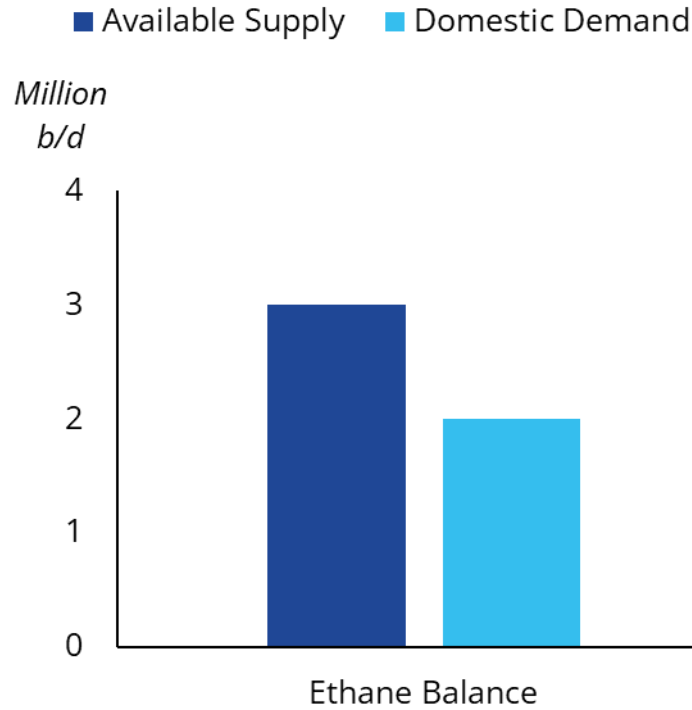
Today, US ethane is a “distressed” product, produced from associated gas production and therefore priced closely to natural gas. There is sufficient ethane supply to support current and announced crackers in the long term.

However, a large second wave of cost-advantaged ethane crackers is unlikely unless oil price and domestic oil production exceed today's levels.

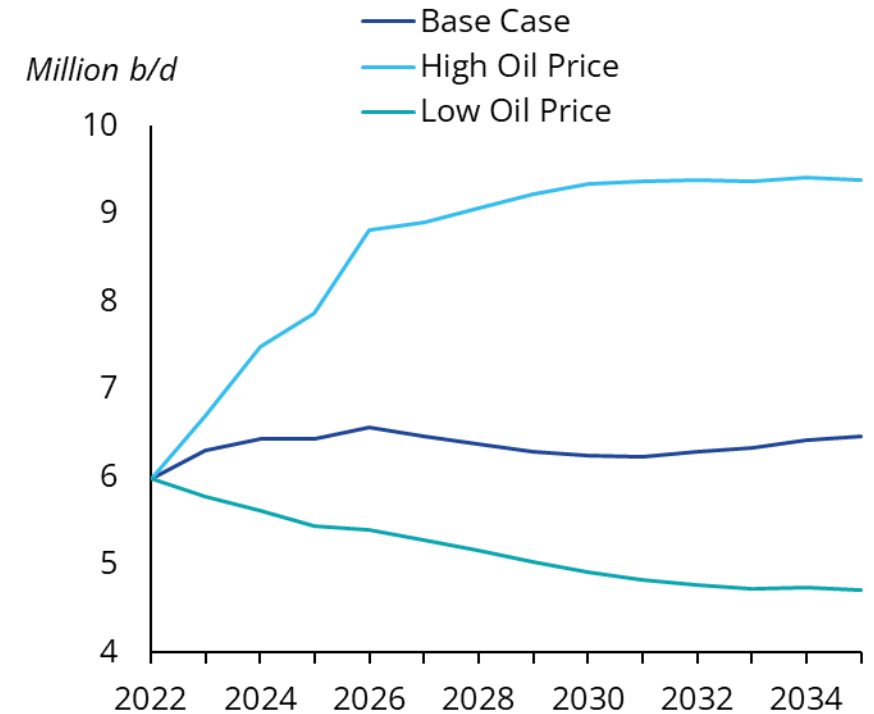
New ethane export facilities will narrow the gap between supply and demand by 2030. Mexico, Europe, China and India will increase ethane imports.

Ethane prices will move higher on a tighter supply and demand balance and higher natural gas prices.

Current US ethane production



US natural gas liquid production outlook

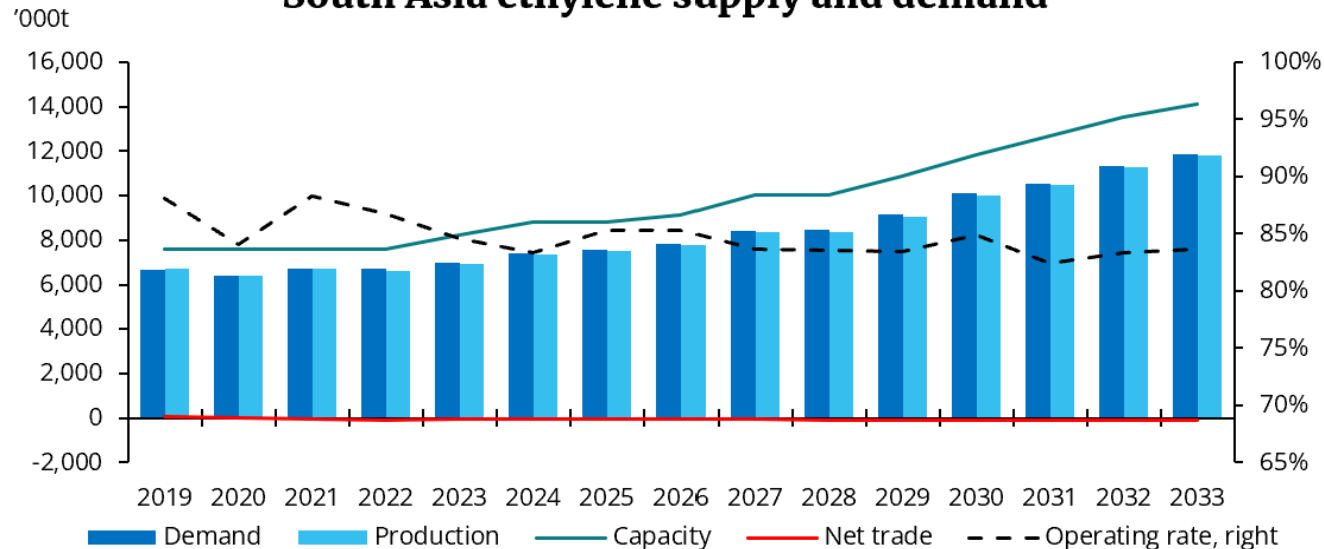


South Asia: Key Updates

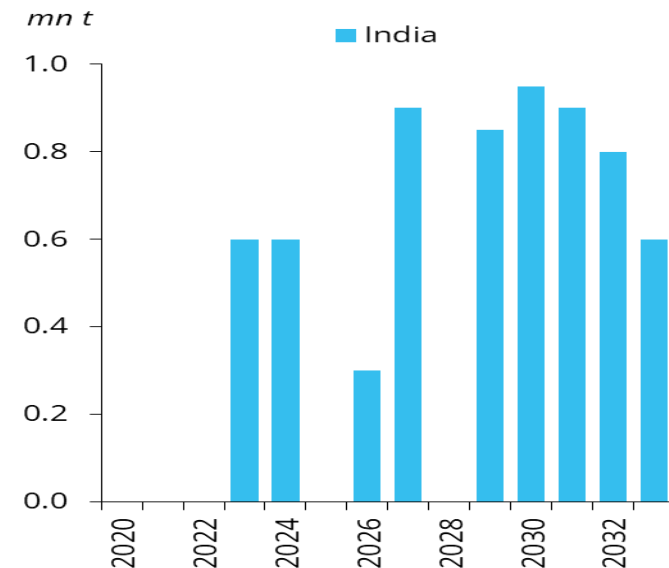
Steam crackers to lead way in ethylene production; booming supply and downstream start-ups expected in the latter five years of the forecast.

Key Market Changes					
Supply	India has ambitious plans to improve self-sufficiency by the end of the forecast period and reduce dependence on derivative imports.	Demand	Consumption for pipes for sanitation and rural water projects underpin downstream demand growth.	Trade	The country is a net importer of ethylene since 2022 due to bullish downstream demand. Most imports come from the Middle East and southeast Asia.

South Asia ethylene supply and demand

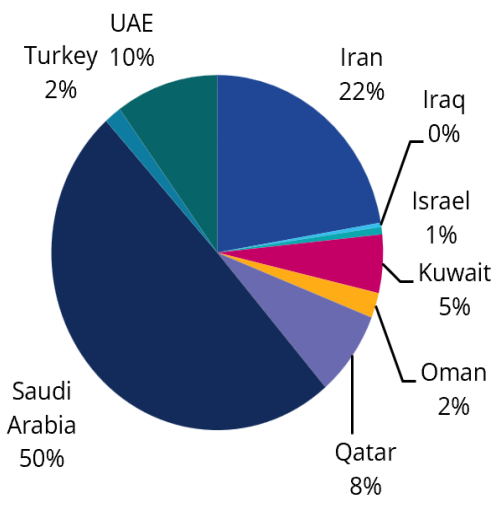


South Asia yr.-on-yr. changes 000t

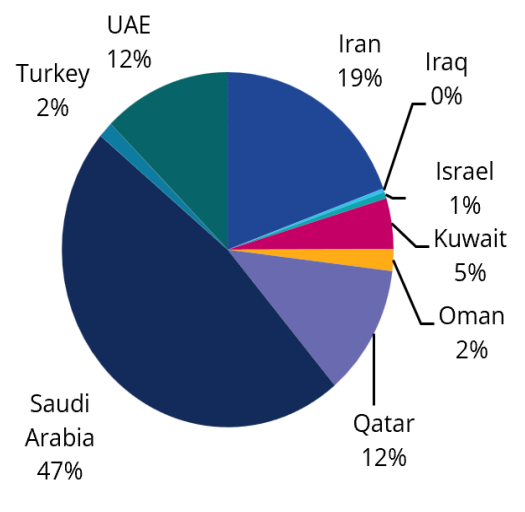


Projects in the ME will add 4.4mnt of PE capacity 2026-28

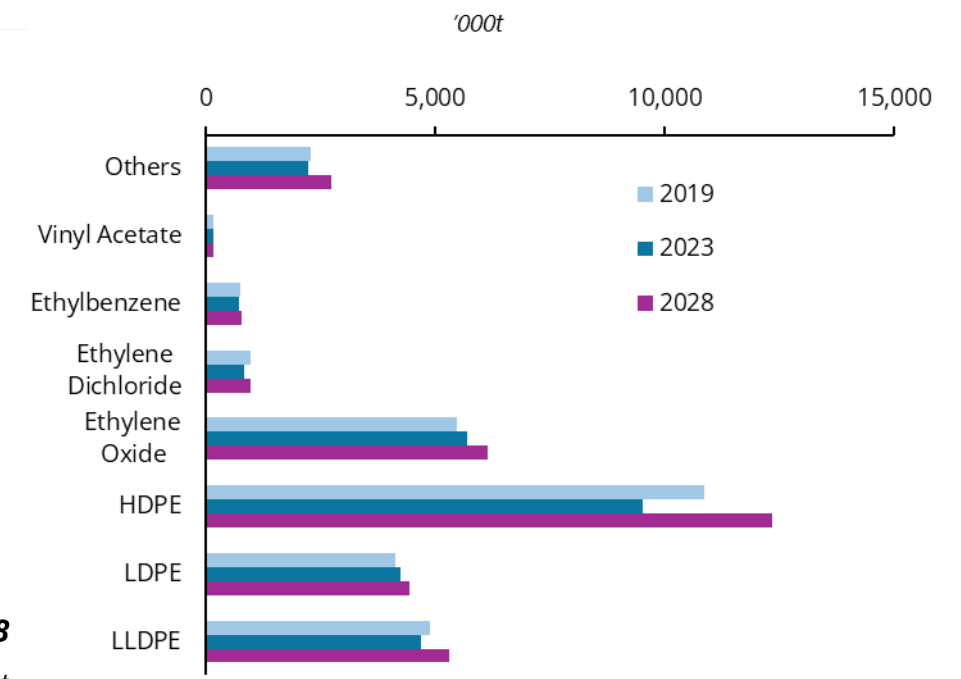
Qatar - CP Chem/Qatar energy - 2mnt HDPE / Saudi - Satorp 500,000t – HDPE + 500,000 HD/LL /UEA Borouge 700,000t HDPE + 700,000 HD/LL



Year 2023
Total Capacity- 34.9 mn t

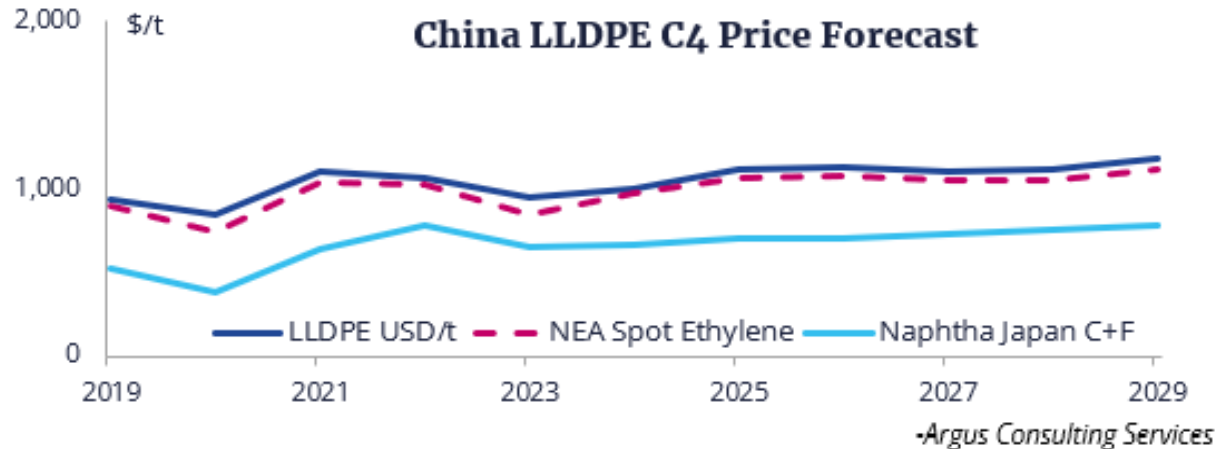


Year 2028
Total Capacity- 40.2 mn t

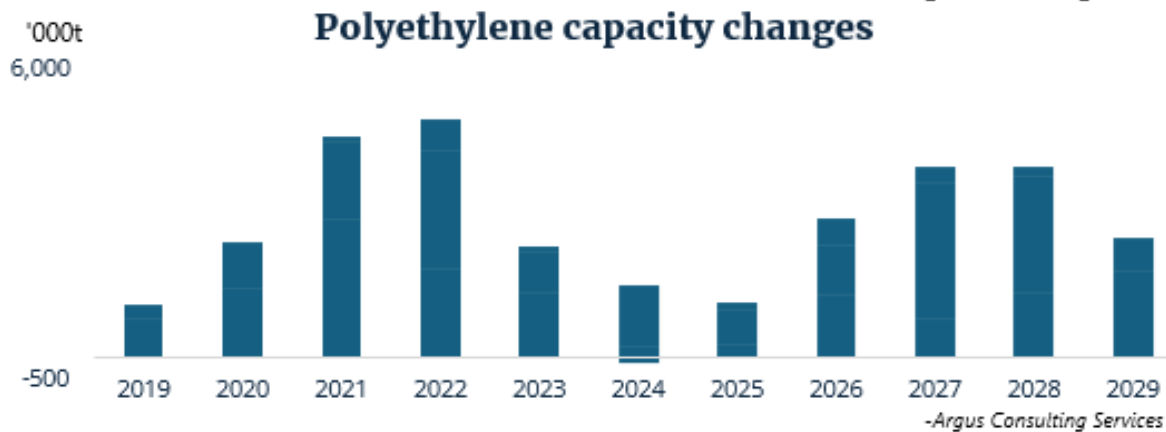


Asia-Pacific Prices vs. Capacity Increases

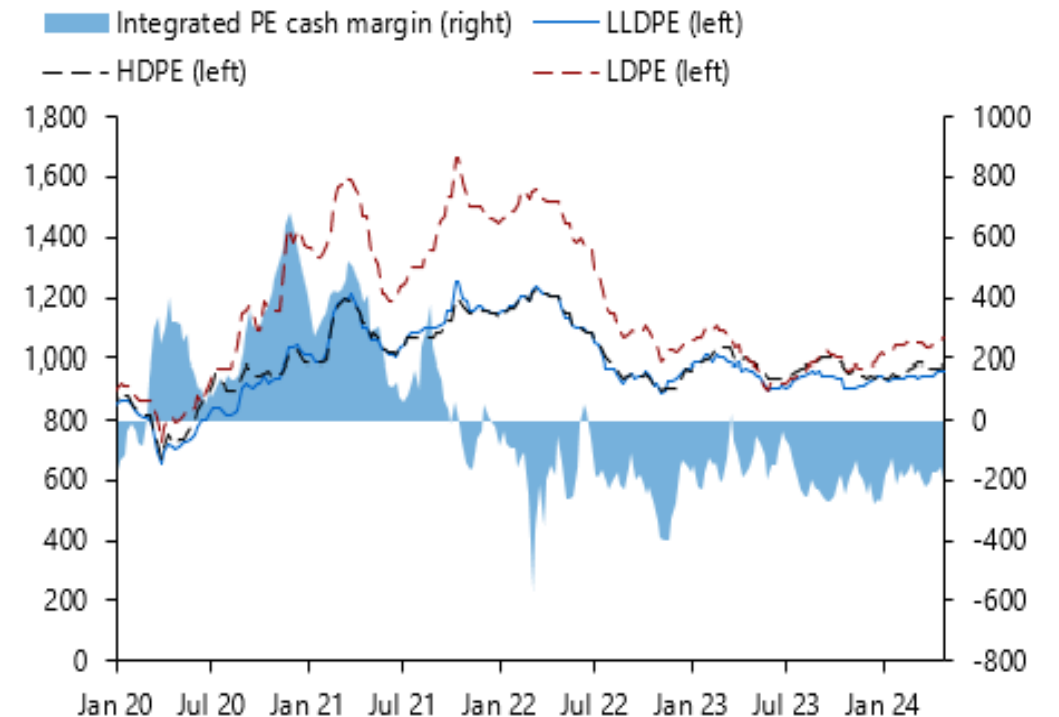
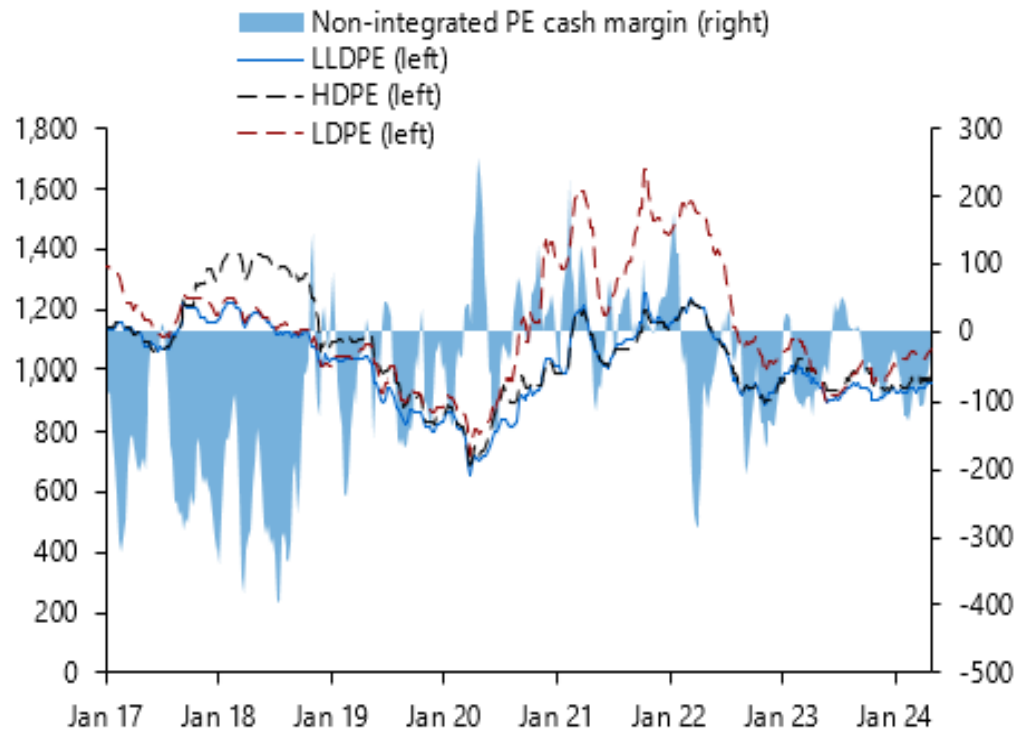
The PE market will face pressure from another expansion wave in 2026-2028



- The expanding PE supplies continue to outweigh regional demand, weighing on prices and margins. In the longer term, the market is expected to rebalance again after 2028 as demand catches up and new project investments slowdown in the region.
- The slower cracker expansions in 2024-25 may drive up Asia's demand for import ethylene from low-cost regions such as the US and the Middle East. But a gradual recovery of regional cracker margins will partially boost regional production and reduce supply shortage.
- Operating rates and margins should improve gradually from a trough in late-2023 through 2025 and 2026 but experience downward pressure with all the new capacity coming in 2027 and 2028
- The recovery speed of demand was slower than the expectations in previous publication. Slow retail sales and concerns on the property growth in China cast a gloomy outlook in the petrochemical sector. The situation might get prolonged over next few years.

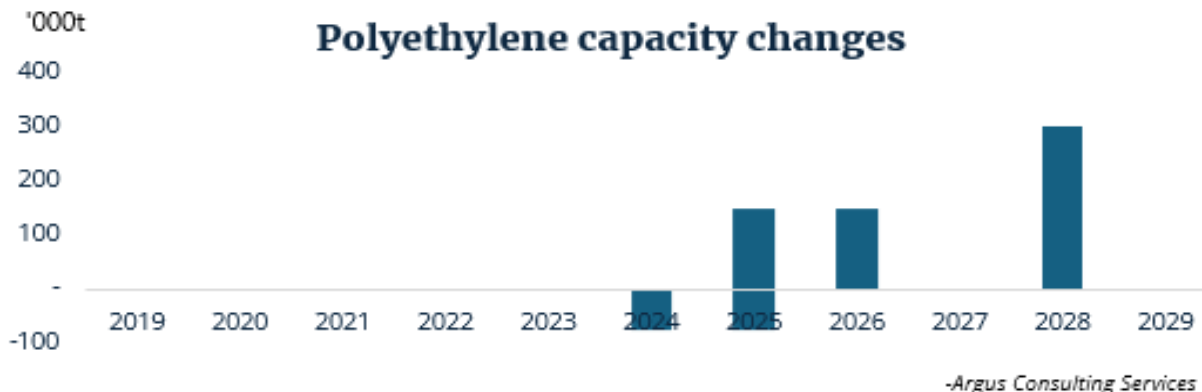
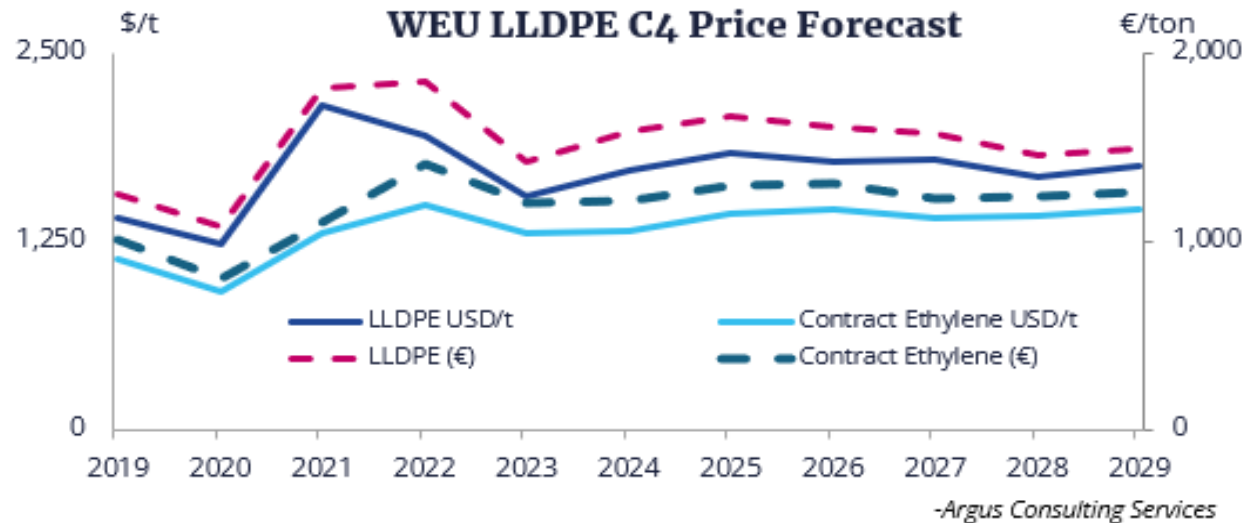


Asia PE margins - on a modelled basis - remain negative



Europe Prices vs. Capacity Increases

Energy and Feedstock costs will challenge domestic producers against imports

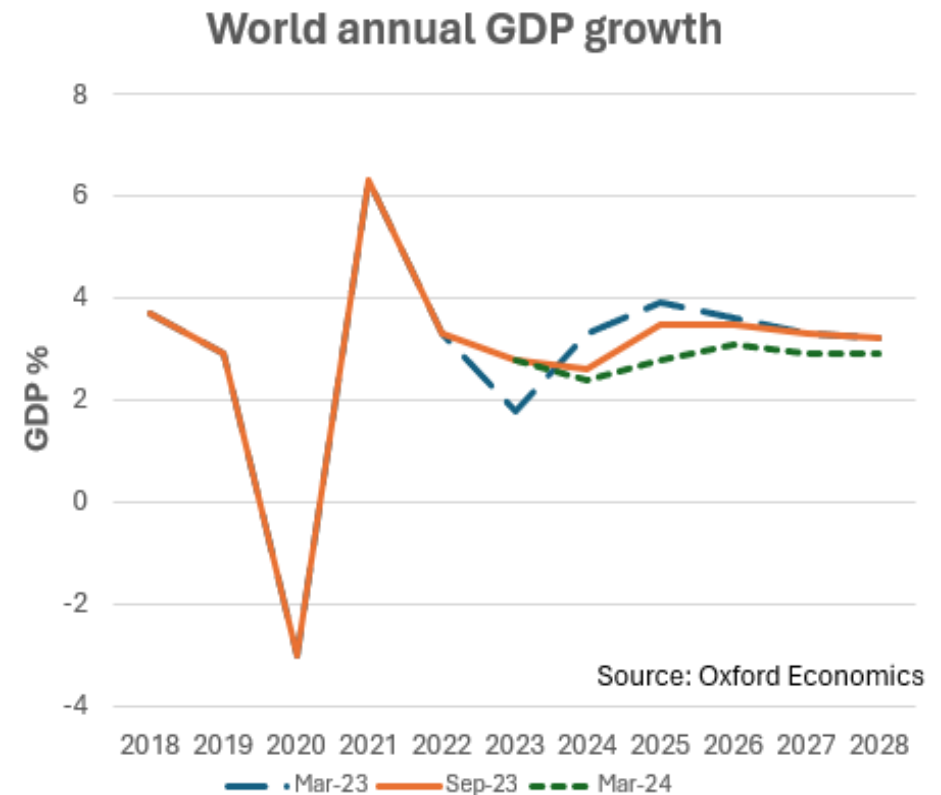
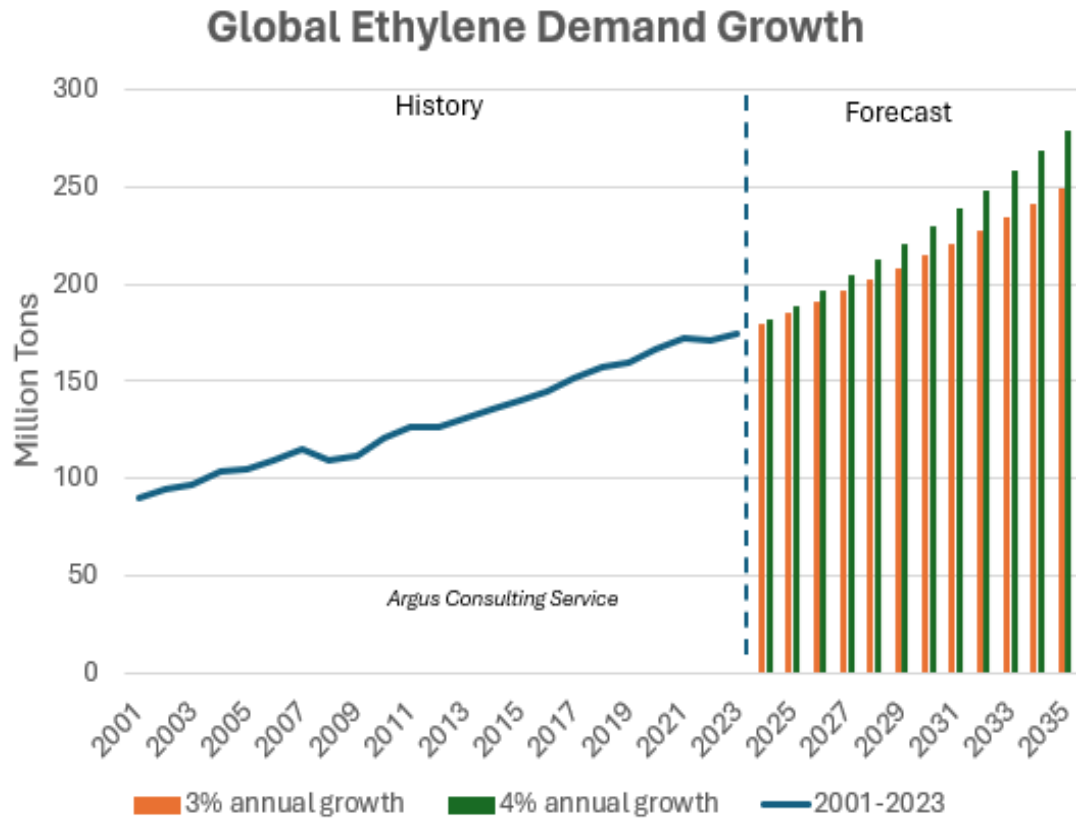


- Higher oil prices will push up naphtha integrated ethylene costs impacting Europe competitiveness versus the US and Middle East
- Energy costs could impact LDPE production more negatively vs. LLDPE or HDPE
- Increased risks for plant rationalizations will have producers cautious of operational continuity as this could affect the production and supply of specialty resins with good margins.
- Different strategies to optimize global supply chains may focus on Europe as an attractive destination to move length from other regions, and partly substitute domestic supplies with lower-priced imports to increase returns.

Key market dynamics – Challenges of sustainability



Macroeconomic drivers for ethylene demand remain in place: growing middle class, urbanization and now the material transition to a lower carbon world.



“Two” challenges face the industry

Finding a way to recycle waste polymer

- Poor control of waste polymer drives a poor public perception of polymers
- Globally the proportion of waste plastic collected and sorted is just 10pc and varies widely from region to region.
- Waste contamination is a challenge - food / dirt as well as non-compatible materials – e.g. PVC
- PET recycles well - most other polymers are more complex and deteriorate – limiting cycles.
- Non-recyclable or post recycled life?

Reducing the carbon foot-print of the industry

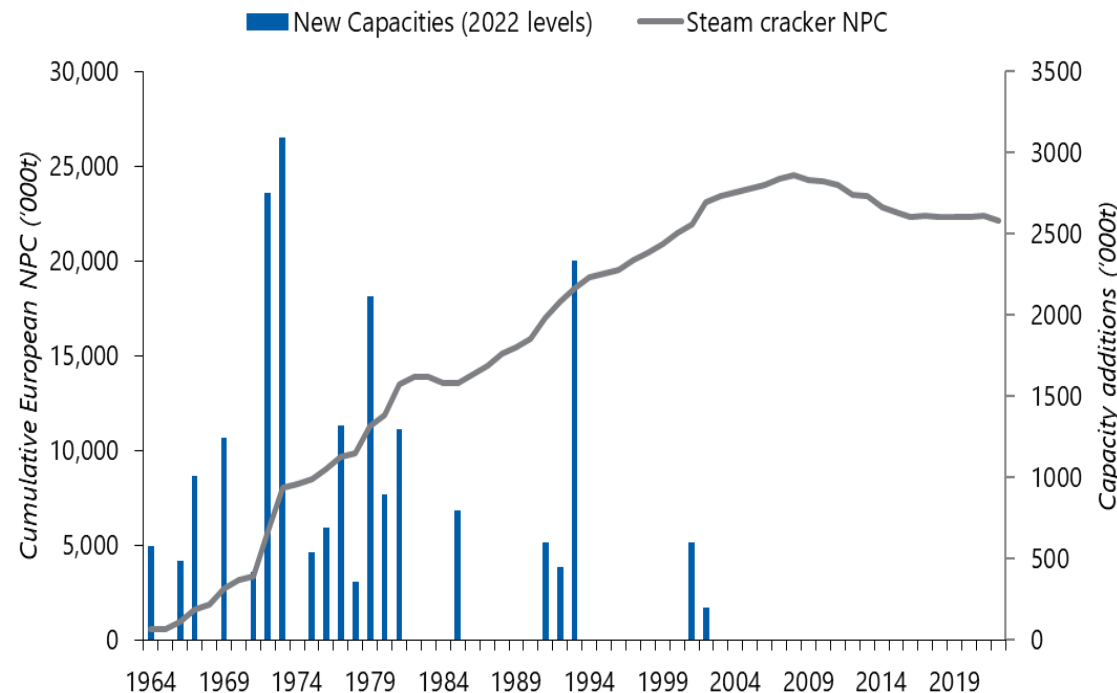
- Reducing CO2 emissions is a separate but linked challenge.
- Huge investment required in alternative feedstocks / fuels
 - Pyrolysis oil – from hard to recycle waste polymer
 - Bio-naphtha from SAF production
 - Ethylene from ethanol
 - Other – bio feedstocks
- Carbon capture and storage?
- Off-setting - wind / solar power

Public confidence and brand-owner confidence is key – mass-balance seen by some as “Green-washing”

European capacity rationalisation is driven by carbon reduction targets

– and not helped by the current market conditions

West European Ethylene Nameplate Capacity with start-up dates of current units



— Argus Consulting Services

- Europe has closed 1.6mn t of ethylene and 750,000 tons of propylene capacity over the last three/four years
- Japan is also likely to continue to rationalise
- Other regions - South America / SE Asia / N Africa - have shelved/postponed projects as economic uncertainty tested the appetite for investment
- Imports to these regions will grow
- But - particularly for Europe - carbon foot-print is likely to be a differentiating factor.
- Europe is likely to implement a carbon border tax for polymers as some point in the future - although the implementation will be complex.

Europe is a testing ground for some new technologies

– but the investment required to implement is huge

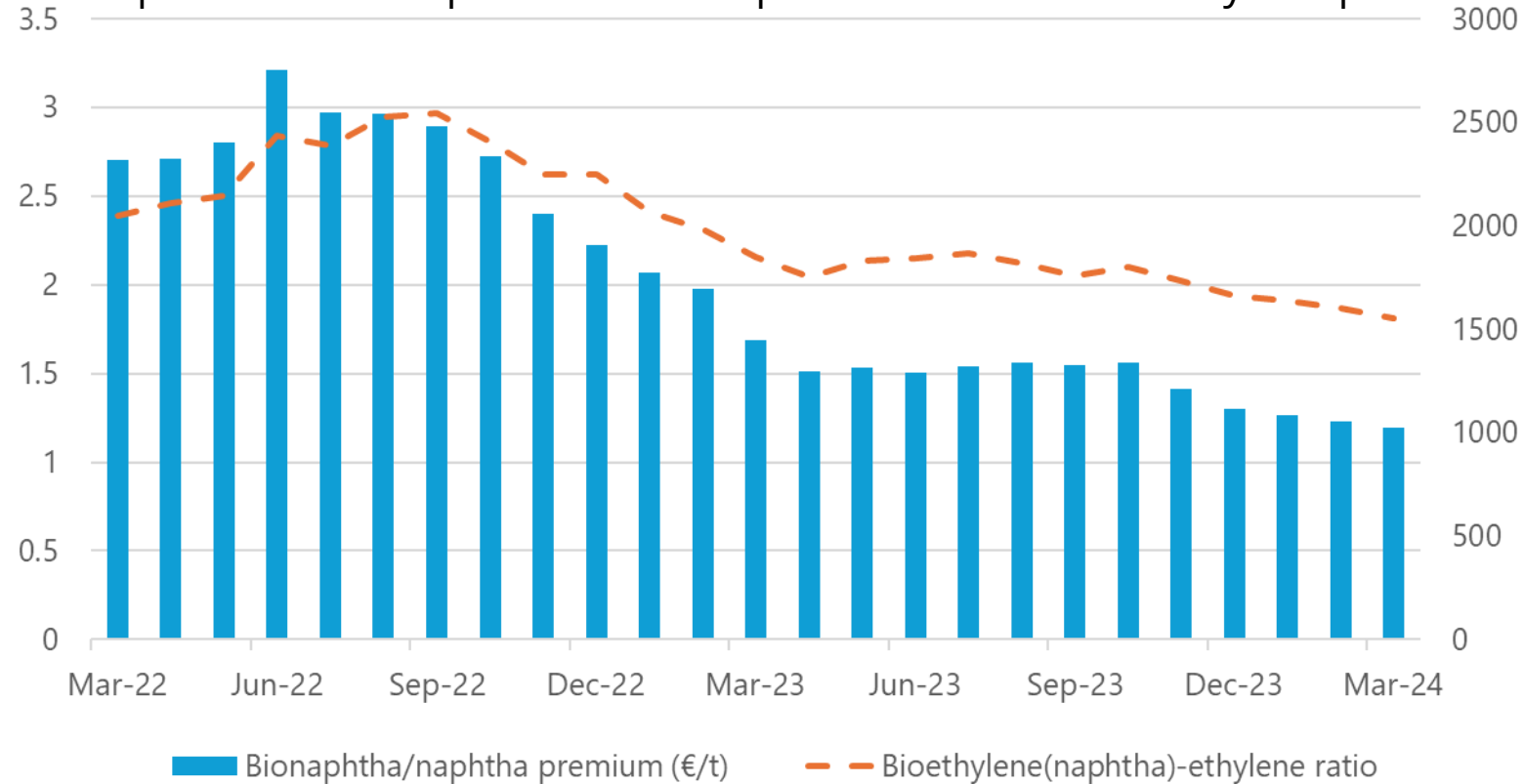


BASF / Sabic /Linde

- Cracker fleet remains “of an age”
- New legislation coming – EU Green Deal; “Fit for 55”; CBAM
- Consumer demands for “green content”
- Electric furnaces
- Alternative feedstocks – pyrolysis oils; bio-naphtha; HVO; ethanol etc...
- Integrating chemical recycling into steam cracking
- Wind energy; Hydrogen energy
- Geleen 3 (1972); Porta Marghera (1972); NDG (1967):

The higher cost of bio-ethylene is a barrier to consumers

Bio-naphtha and HVO premiums to naphtha and modelled ethylene price



- Although the premiums have reduced there is a significant cost difference between bio-ethylene and hydro-carbon based
- There is competition for the feed-stock from the mandated fuels market.
- In the medium term as more green-feed becomes available those mandates into fuel are likely to be increased.
- Consumers will face higher prices for a green product.

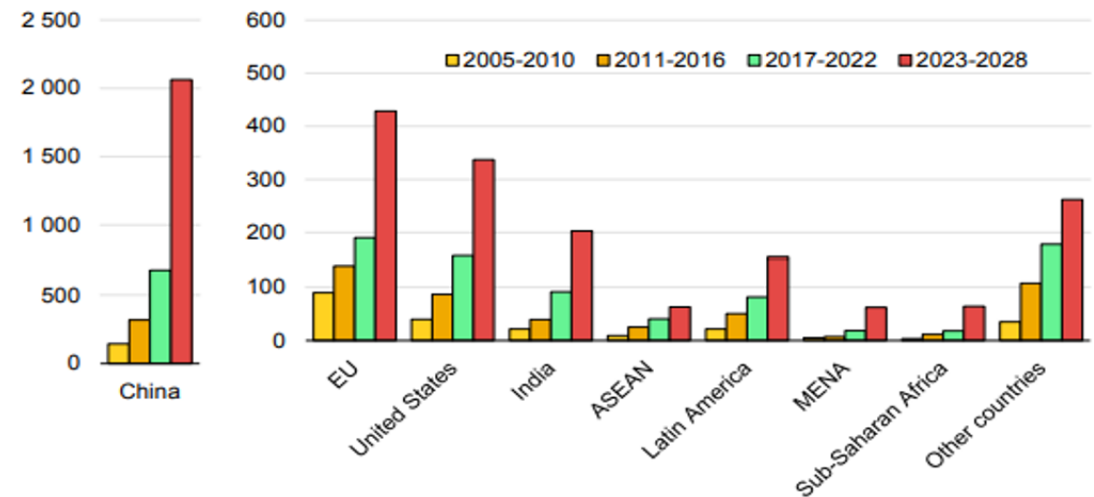
Other regions are beginning the process of carbon reduction

Europe has been following a path of energy transition since 1991 when Germany introduced the first feed-in tariff for renewables

- 2019 – EU Power generation from wind and solar surpass coal for the first time
- IEA - in 2023 China commissioned as much solar PV as the whole world did in 2022.
- IEA forecast that 42% of global electricity generation will be from renewable sources by 2028
- EV Cars – forecast to reach 46mn unit sales by 2034 and Europe will ban sales of new diesel/petrol cars from 2035
- ME starts trial waste sorting initiatives
- Japan trials Bio-naphtha on crackers
- Dow – 2023 – FID's a cracker project in Canada that will be fully offset

Renewable electricity capacity growth by country/region

– IEA



But – for all the initiatives the process will be slow, and most olefins will continue to be produced from conventional routes

Major challenges of both capacity addition and the drive to lower carbon emissions

- But polymers will remain an integral part of human life, it has played a part in extended life spans bringing food, clean water and medicine to millions.
- Polymers are playing a key role in better insulated secure construction as well as the growth of renewable energy
- The facilitate the growth of EV's - allowing cars to be lighter while maintaining strength and safety
- And food production in a warmer, wetter world
- But – the volumes used in disposable packaging will fall.
- Consumers and brand-owners will demand a consistency of offer around the world
- Polymer producers will have to invest in lower carbon technologies / feedstocks
- Recyclability will become increasingly important.
- Legislators are becoming increasingly sophisticated in their approach with initial targets for reduce usage – leading to less recyclable alternatives in some cases – being replaced with rules for producers to ensure materials are recyclable.

Some polymers are likely to grow faster than others – PET / EVA / PVC are examples where a stronger growth trajectory is likely – polymers are part of the problem but also a part of the solution

Thank you

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