

Global Butadiene Market : Looking for Direction

APIC Korea, May 2024

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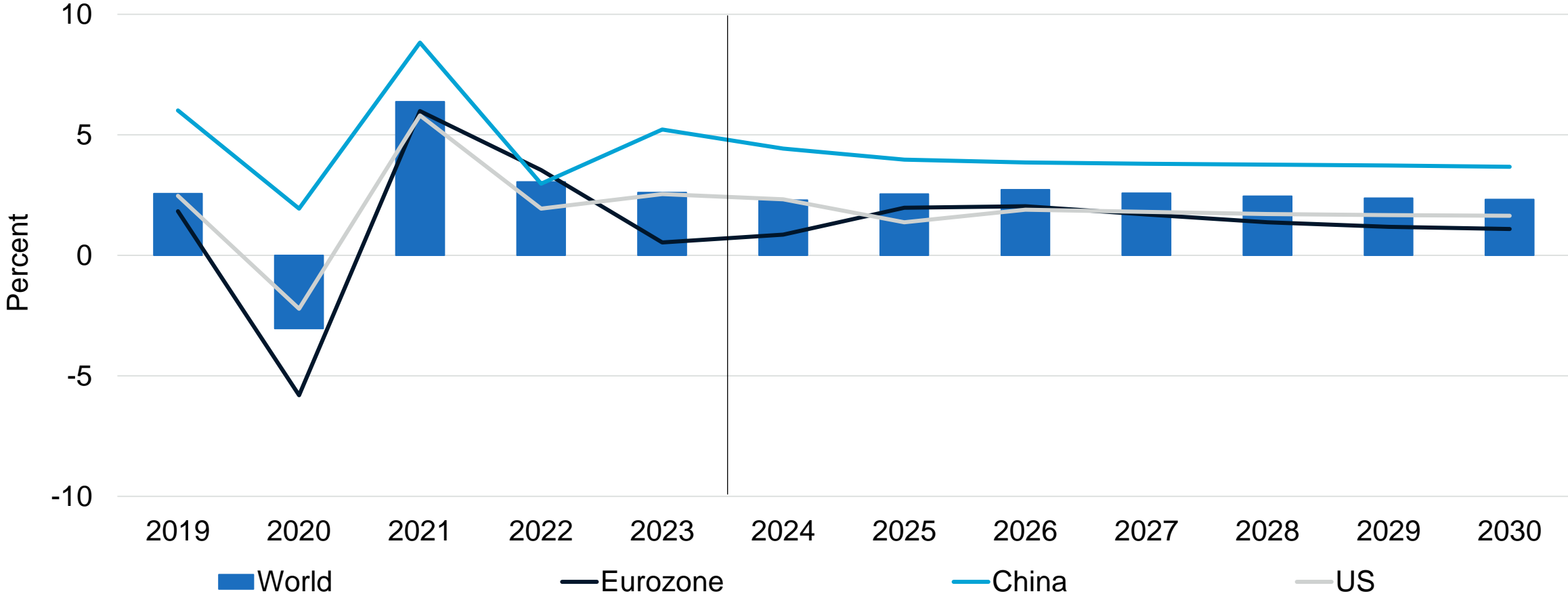
Agenda



- Automotive & Tire Trends
 - Economy
 - Light Vehicle Production
 - About Tires
- Crude C4 (Ethylene)
- Butadiene
 - Global View
 - Regional Balance
 - Derivatives
- Price Outlook

Longer Term Global Growth Rates Ease In Key Geographies

GDP Growth Outlook for Key Geographies



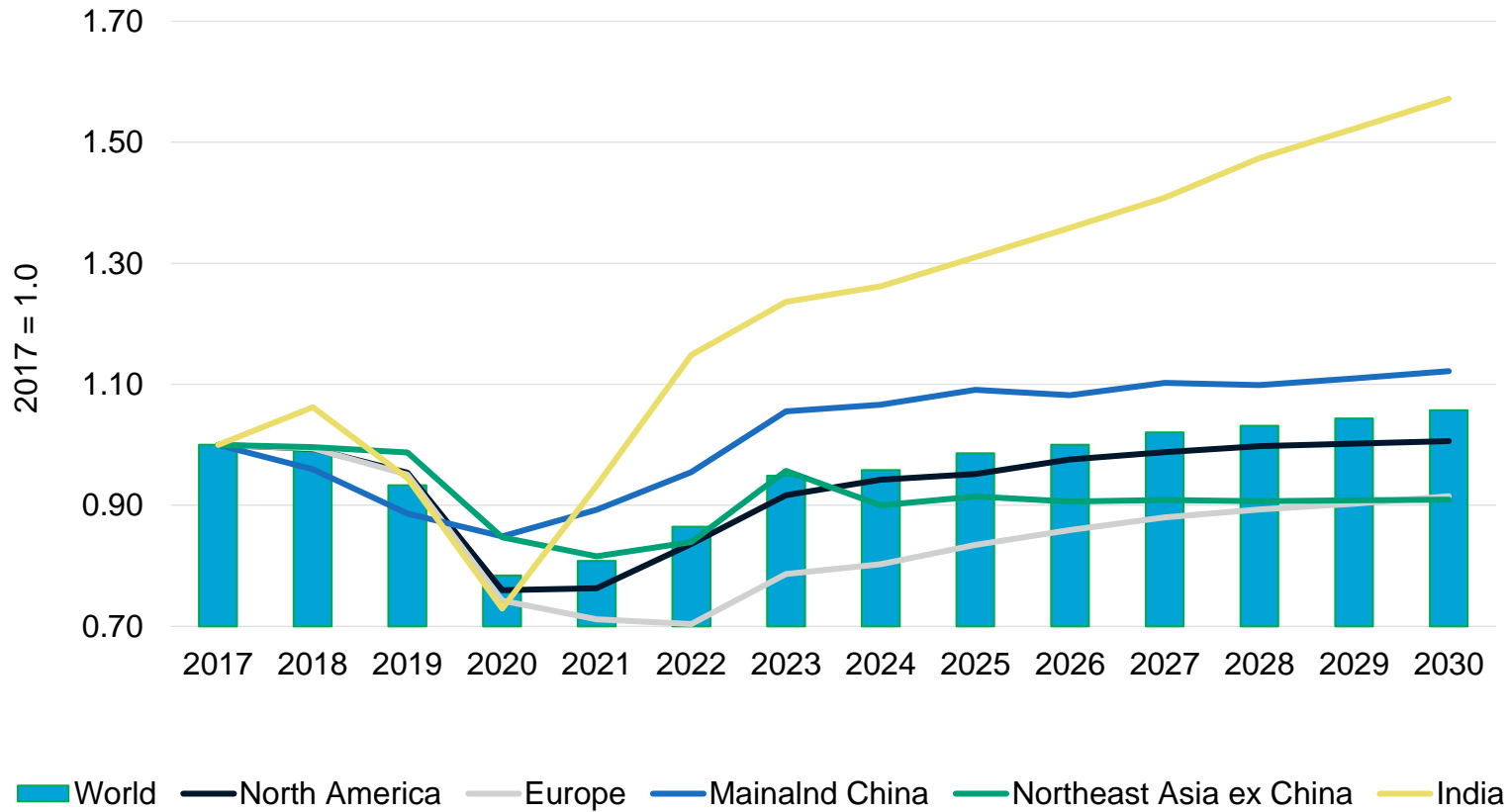
Source: Oxford Economics

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Light Vehicle Production Slowly Recovers To Previous Peak, But Not Everywhere

- Global motor vehicle production growth accelerated in 2023; however, there is a growing risk that the market becomes demand constrained. Headwinds from high inflation/interest rate and escalation in MDE
- US EV production supported by IRA.
- Weak demand conditions in Europe will continue to weigh on the near-term outlook.
- Chinese automotive demand has been increasingly supported by export growth while domestic demand has been sluggish amid weakening economic conditions.
- India is the fastest growing country, but production share is still small

Light Vehicle Production Trends



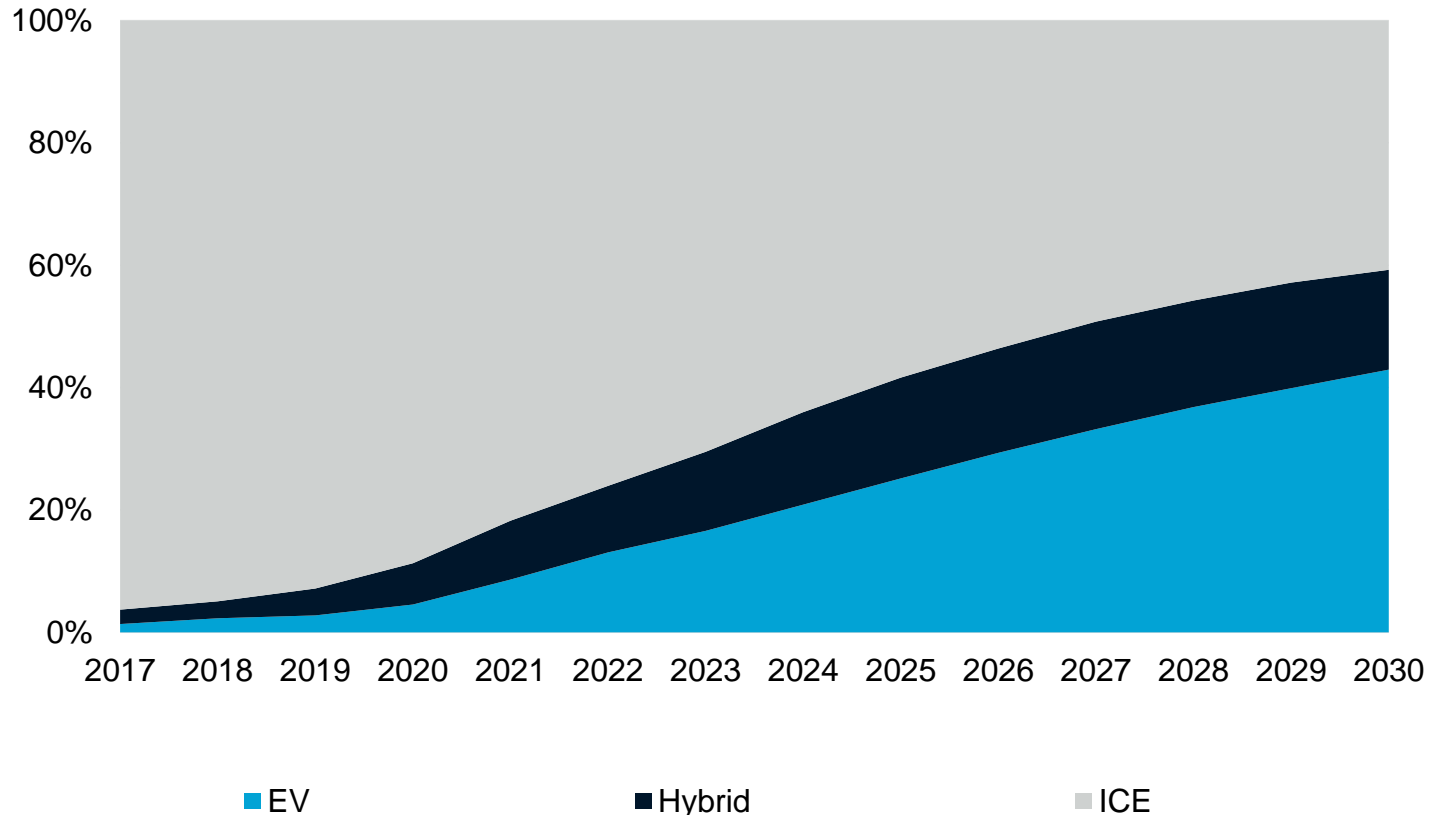
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Electric And Hybrid Vehicle Production Growth To Remain Strong

- Global hybrid and electric vehicle sales to represent nearly 60% of global light vehicle sales by 2030.
- Mainland China is increasingly looking at increasing their EV exports
- The US Inflation Reduction Act will support US EV prospects.
- EU ban of ICE sales extended post-2035 (only allowed for e-fuel)
- Vehicle manufacturers outside of mainland China slowing shifting fully from ICE to EV production
- Challenges
 - Infrastructure (charging stations)
 - Source of electricity
 - Battery recycling

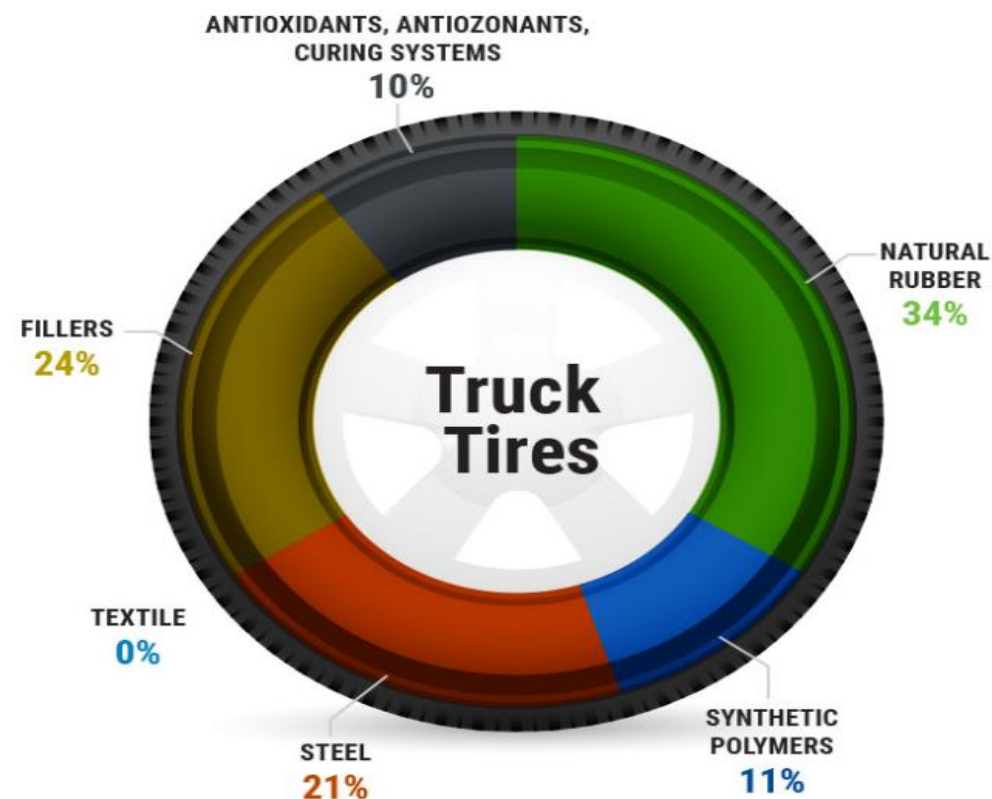
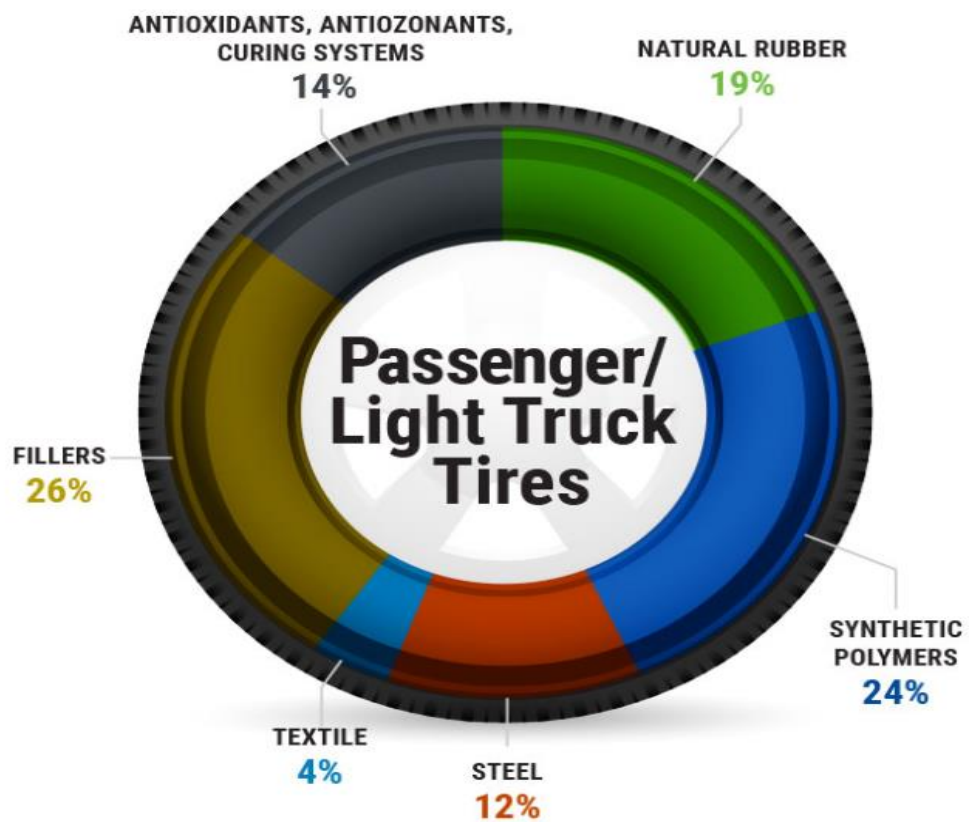
EV, Hybrid, ICE Production Share



Source: Oxford Economics

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Typical Tire Compositions

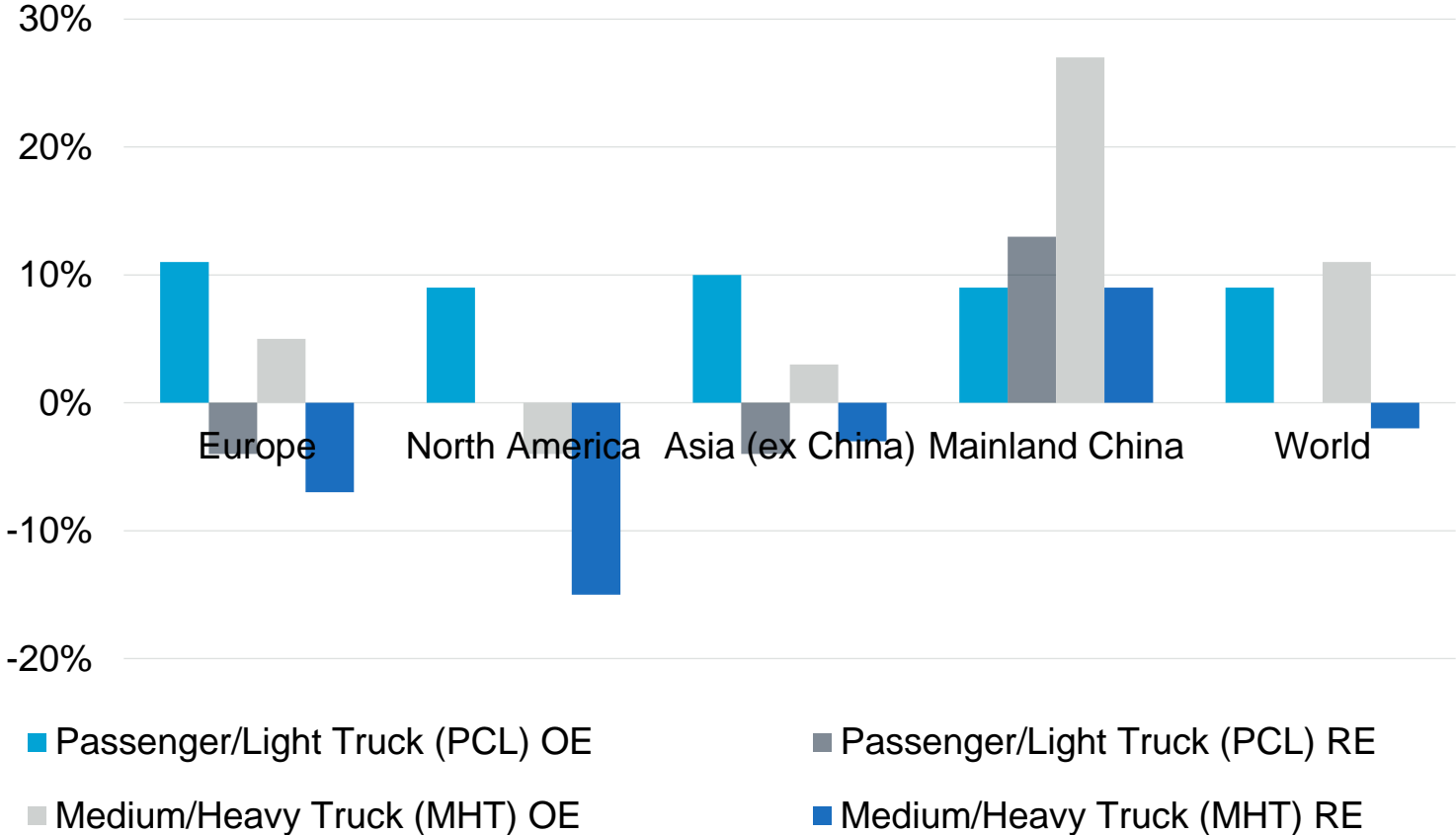


Source : US Tire Manufacturer Association

Steady OE Market Growth While Slow RE Market Recovery

- Global tire demand
 - OE 25% / RE 75%
 - PCL 60% / MHT 30% / Others 10%
- PCL OE market growth driven by robust EV sales, particularly in mainland China
- Strong PCL RE sales in mainland China offset decline in other regions
- MHT OE market growth driven by strong demand from mainland China
- Overall production was down due to extensive destocking in RE market

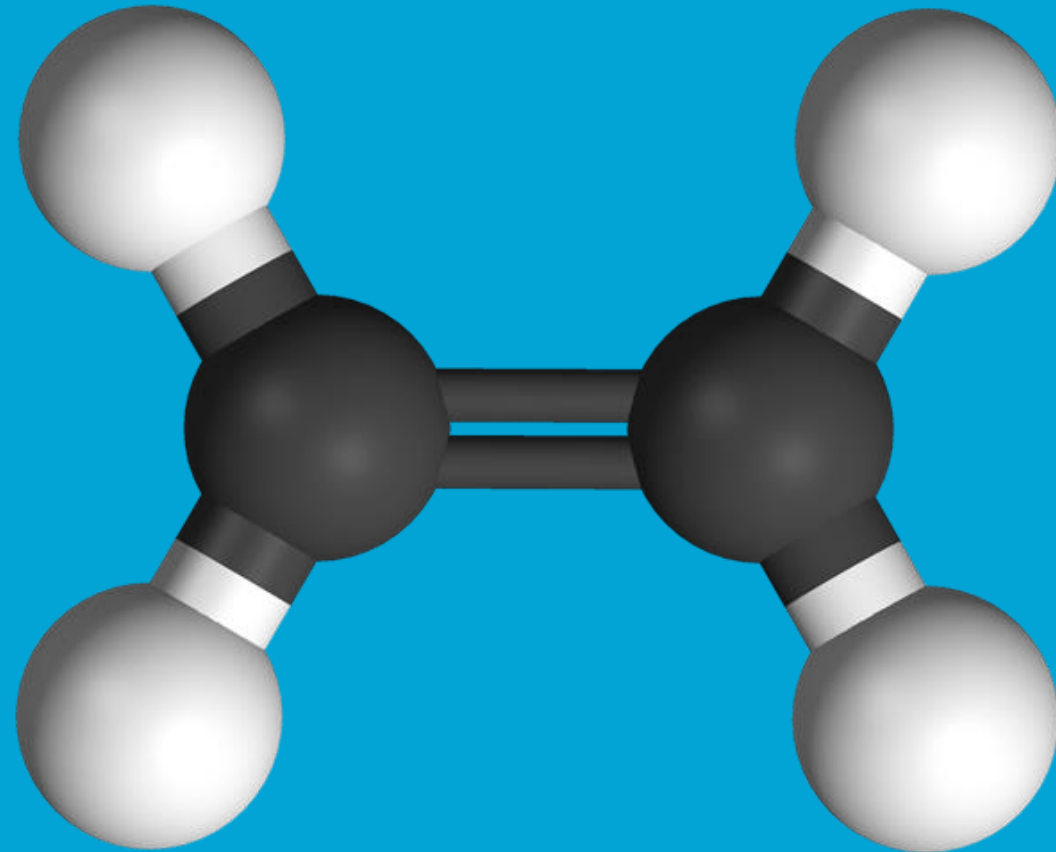
Estimated Global Tire Sales (2023 vs 2022)



Source: Michelin

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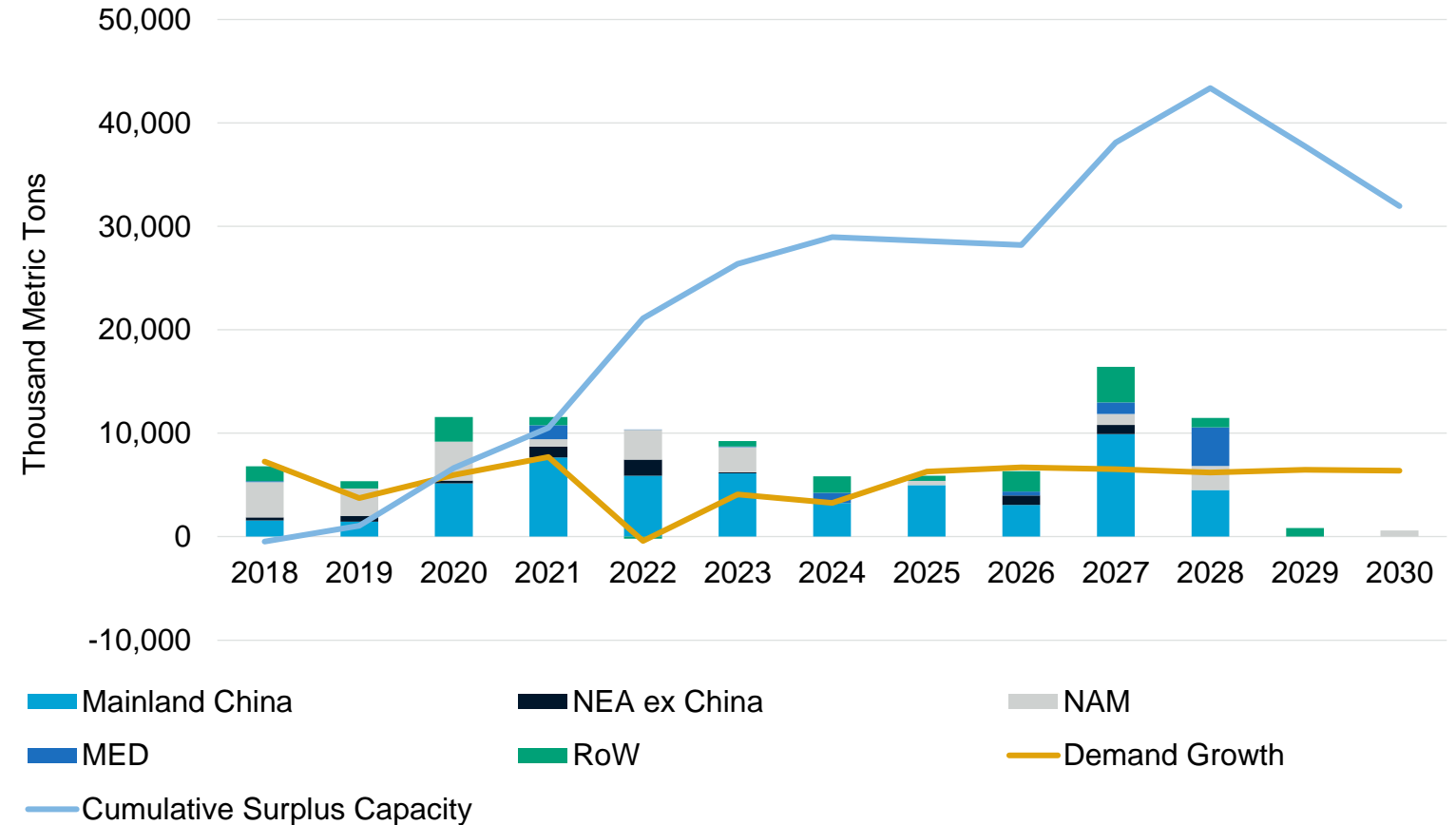
Crude C4 (Ethylene)



Global Ethylene Capacity Surplus Not Absorbed

- Capacity addition “First Wave” in Mainland China (‘18 ~ ‘25)
 - Completed : 23 projects (24 Mmtons)
 - Upcoming : 5 projects (6 Mmtons)
- Capacity addition “Second Wave” in Mainland China (‘26 ~ ‘30)
 - Confirmed : 13 projects (16 Mmtons)
 - Preliminary : 16 projects (17 Mmtons)
- Small additions in other NEA and SEA (Korea and Indonesia)
- Possible big mega projects
 - Saudi Aramco announced to invest on COTC (crude oil to chemicals)
 - From current 1M barrels/day to 4M barrels/day around 2030

Global Ethylene Capacity vs Demand Growth



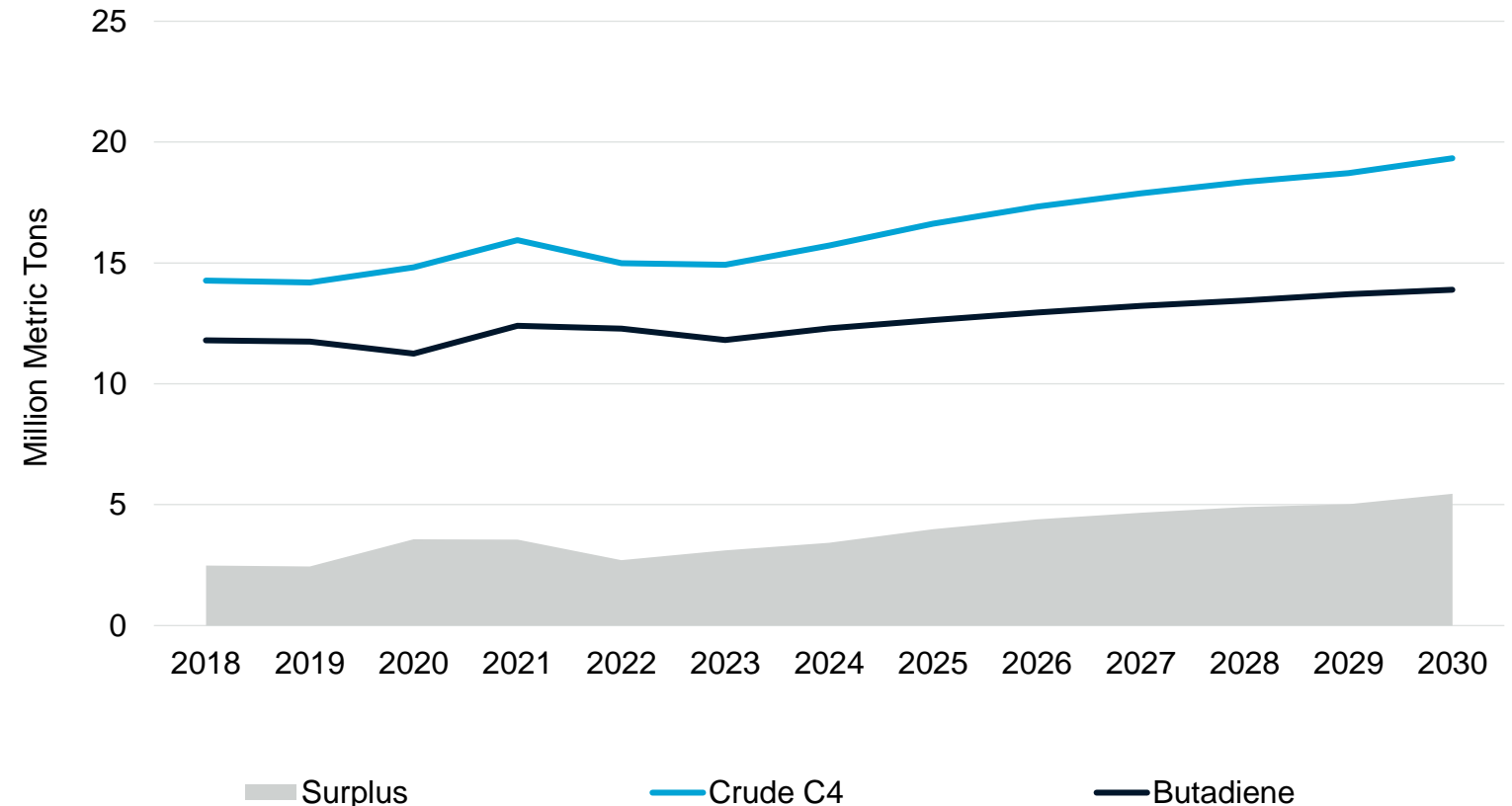
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Crude C4 (Contained Butadiene) Balance Increasingly Long

- Ethylene demand grows faster than butadiene demand
 - Ethylene 3.5 ~ 4% vs butadiene 2%
- Cracker feedslate trending heavier
 - Trended lighter till 2022 with shale revolution in U.S.
 - Ethanes are mostly committed
 - With cracker investments in Mainland China, feedslate trending heavier
 - Mostly Naphtha + LPG

Crude C4 and Butadiene Production

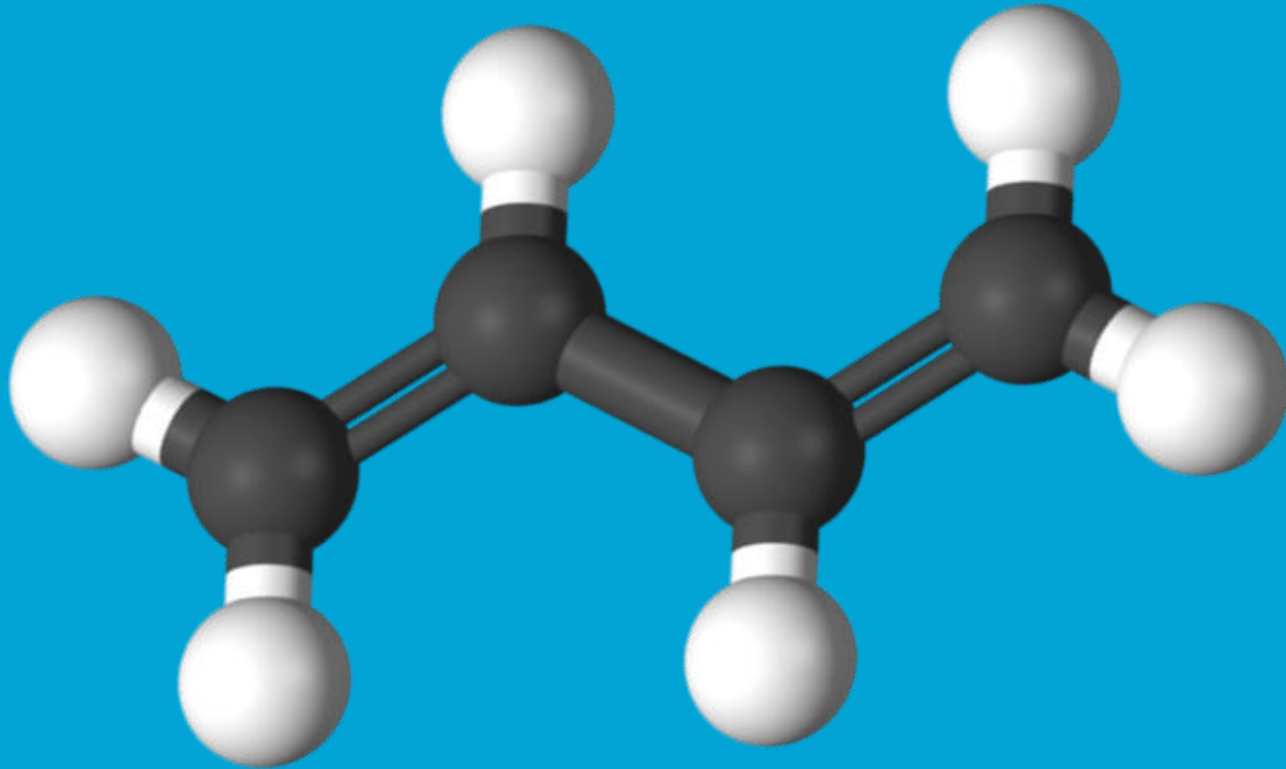


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Olefins Yield Factors (Ton / Ton of Ethylene)

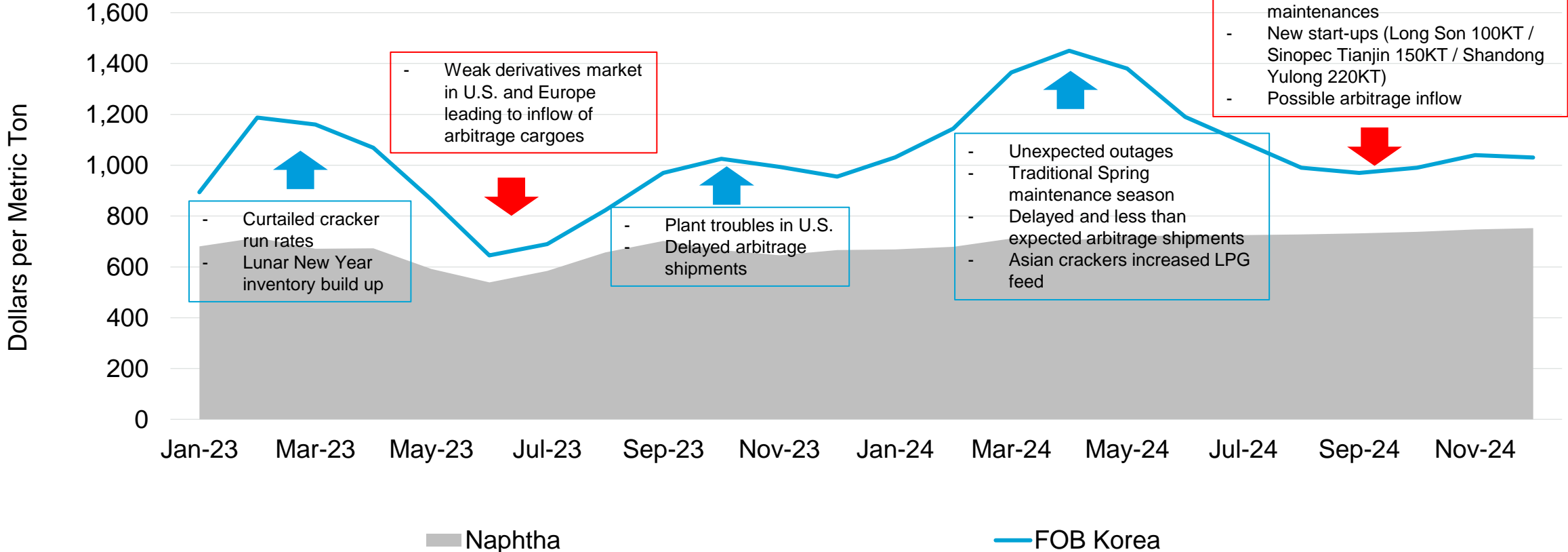
	Ethane	Propane	Butane	Light Naphtha
Crude C4s	0.036	0.103	0.255	0.297
Contained Butadiene	0.025	0.072	0.087	0.155
Contained Butylenes	0.011	0.031	0.168	0.142
Feedstock Required	1.289	2.381	2.504	3.247



Butadiene

Current Market Price Is Driven By Tight Supply Not Demand

Asia Butadiene and Naphtha Prices



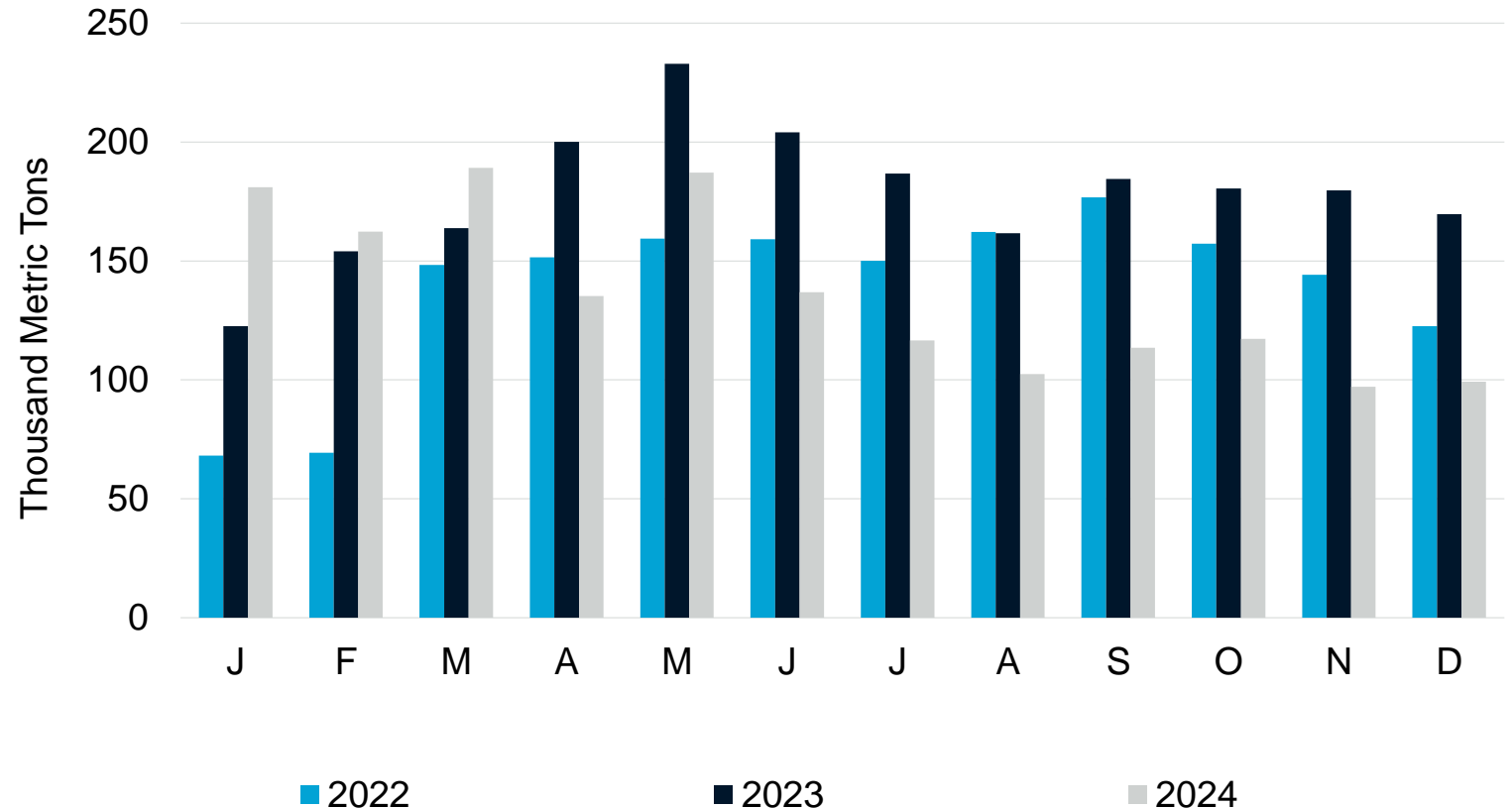
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Crude C4 Production Loss In Asia

- Voluntary cracker run cuts continuing
 - Running between 70% ~ 80% depending on the sites
- Unexpected outages
 - Qilu (end 2023) Chandra Asri (Jan '24)
BASF-YPC (Jan '24) Long Son (Feb '24)
CPC No.3 (Mar '24) JG Summit (May '24)
- Spring scheduled maintenances
 - Jan : CPC No.3
 - Feb : FPCC No.2
 - Mar : ENEOS, Tosoh, Zhongke, Sinopec
Maoming, Pref Chem
 - Apr : Zhejiang No.2, Sinopec Zhongyuan,
Keiyo, Lotte Malaysia
 - May : Maruzen, Mitsubishi, Chandra Asri,
Zhejiang No.1

Asia Crude C4 Production Loss



Source: Chemical Market Analytics by OPIS

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Spot Arbitrage To Asia Becomes More Challenging

1 nautical mile = 1.852 km

Houston to NEA : about 14,200 nautical mi
Rotterdam to NEA : about 10,800 nautical mi

Houston to NEA (1) vs (2) : + 5,800 nautical mi
Houston to NEA (1) vs (3) : + 4,500 nautical mi
Europe to NEA (2) vs (3) : + 3,300 nautical mi

North America

Europe

Northeast Asia

MidEast

Africa

Houston to NEA : about 9700 nautical mi

Panama Canal daily transit reduced due to drought

Daily transit reduced to 24 (normal 36)

Escalating tension in Red Sea (Houthi attacks on foreign vessels)

Rotterdam to NEA : about 14,100 nautical mi

Houston to NEA : about 15,500 nautical mi

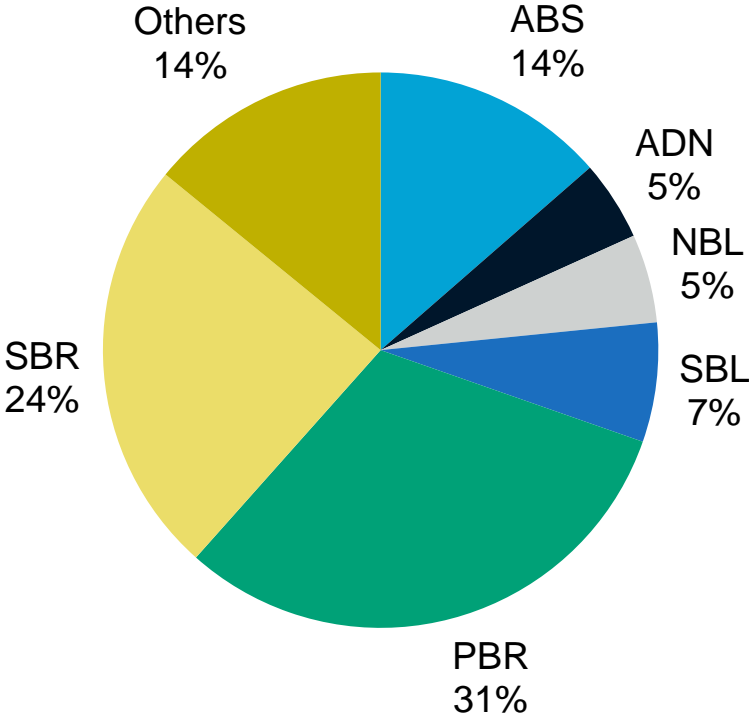
- Panama Canal Route (1)
- Cape of Good Hope Route (2)
- Suez Canal Route (3)

- The long hoped for demand recovery in 2023 never happened
- 2024 outlook is uncertain
 - Chain Restocking? Pausing? Interest rate cuts?
 - Recovery not likely before 2H24 – at risk due to interest rate uncertainty
- Trade driven by long supply not demand – but not Q124
 - Sell as much domestically as possible
 - Hydrogenate as much as possible
 - Export what's left
 - Improved extraction availability still likely to require exports from US



Synthetic Rubber Is The Global Butadiene Demand Driver And NEA Is The Key Region

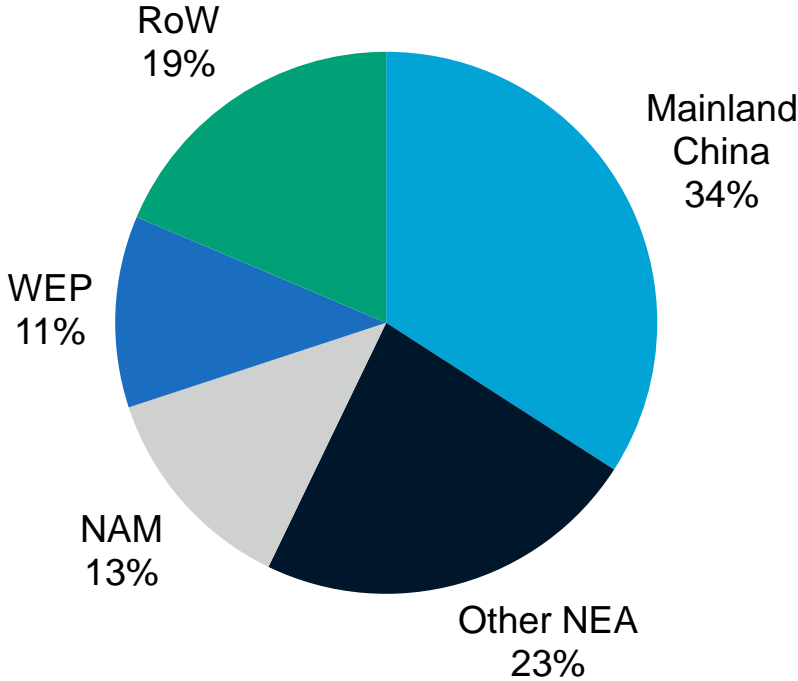
2023 Global Butadiene Demand



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2023 Butadiene Demand by Region

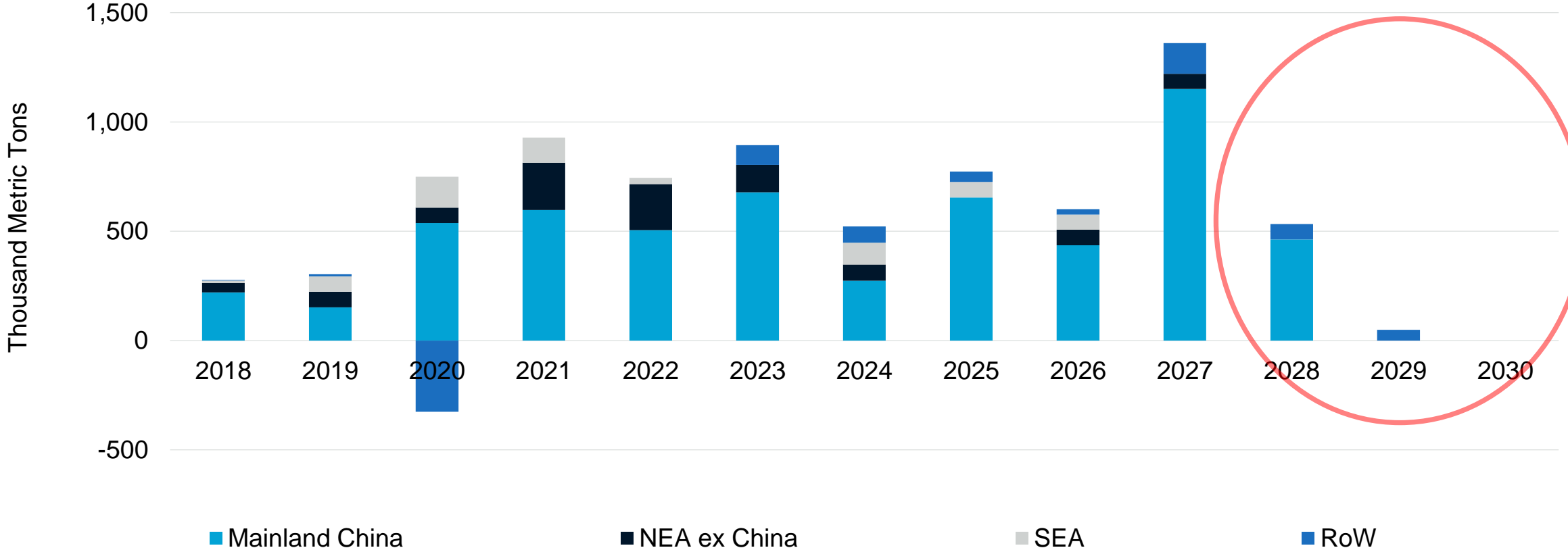


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Butadiene Capacity Additions Driven By Mainland China

Global Butadiene Capacity Additions

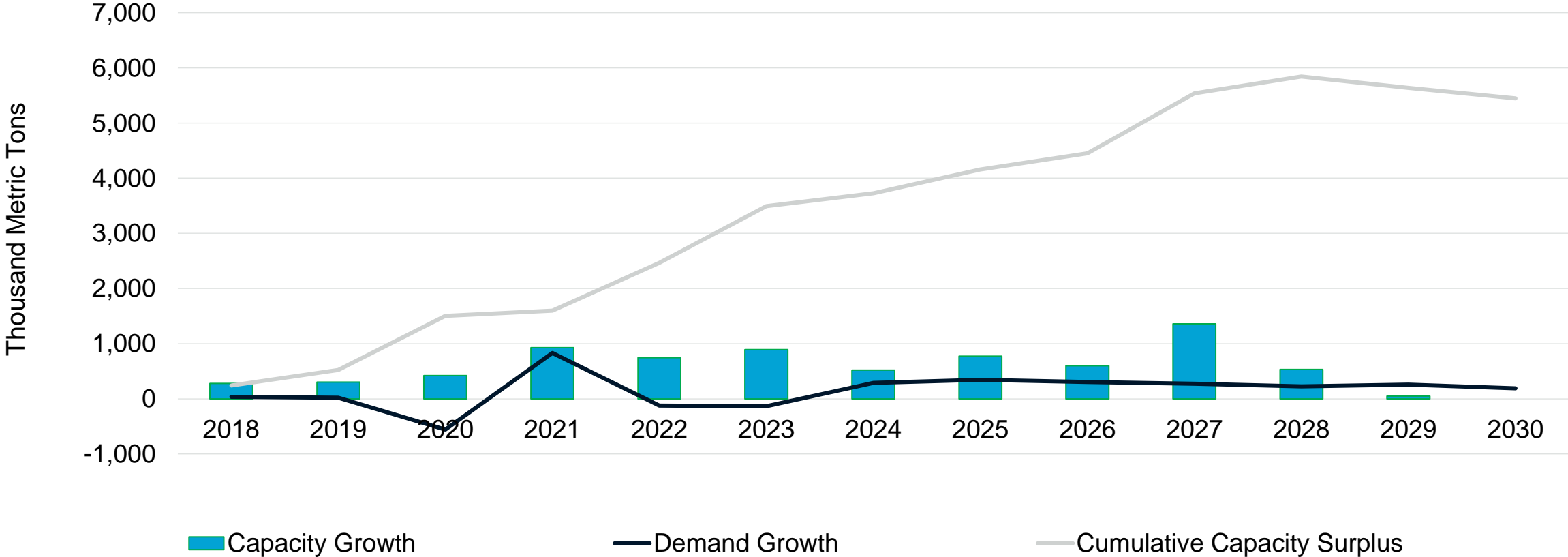


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Butadiene Capacity Surplus Will Require Significant Rationalization To Resolve

Global Butadiene Capacity vs Demand Growth



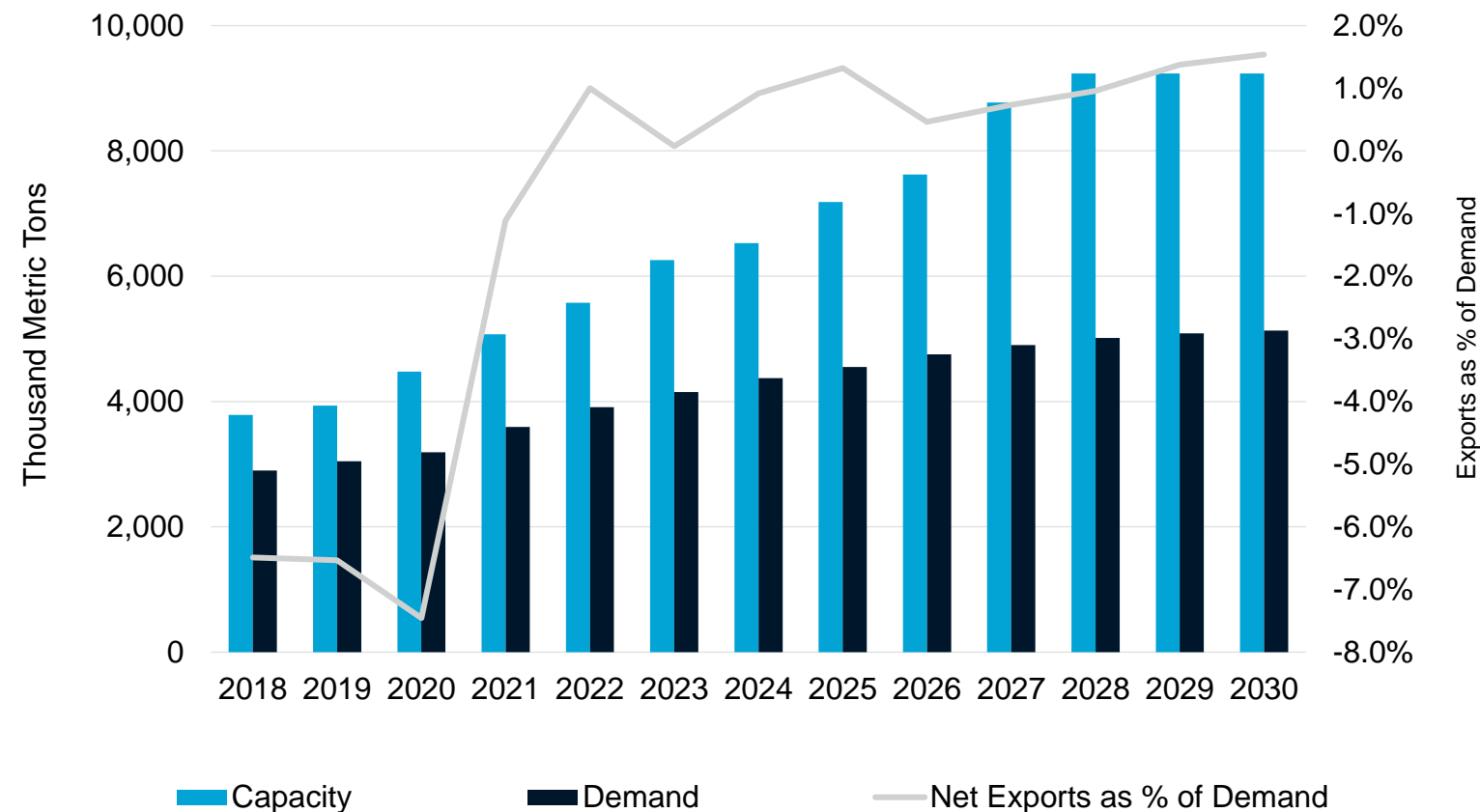
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Mainland China Remains Net Exporter

- < 4Mmtons of capacity added during 1st wave
- Capacity addition continues with 2nd wave
- Mainland China has shifted from net importer to net exporter
- Massive butadiene derivative capacities added (focused on ABS/NBL), but support on demand limited due to weak ABS/NBL market

Mainland China Butadiene Balance



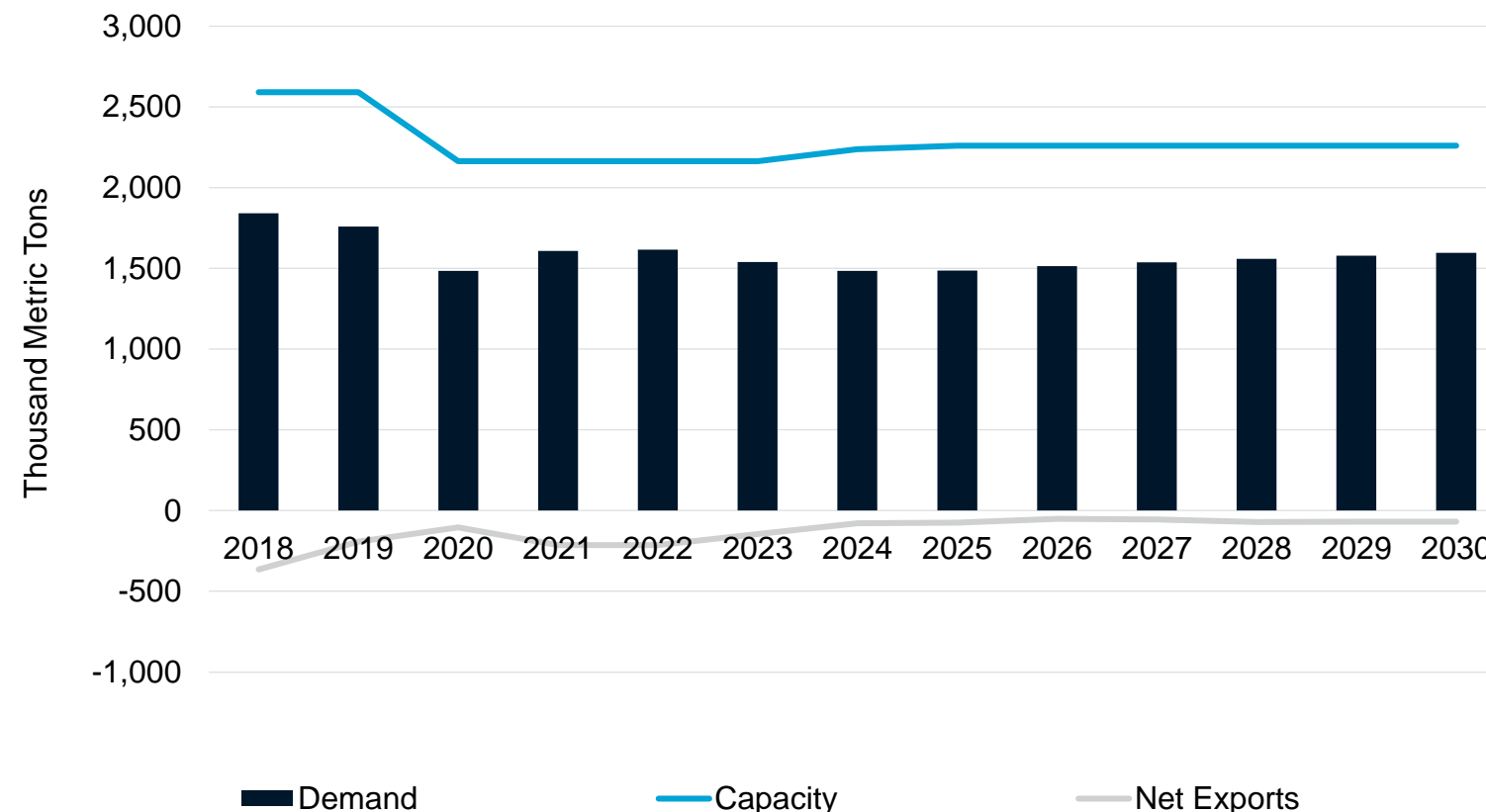
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NAM Requires Less Imports

- TPC will finish expansion by 3Q 2024 (100KT)
- Invista announced to shutdown ADN plant in Orange, TX (380KT)
 - ADN accounts for 20% of US butadiene demand
 - Victoria plant (460KT) will continue to run
 - Will increase production in newly started up ADN plant in Mainland China
- US butadiene supply/demand close to balance
 - US can become exporter depending on cracker run rates and feedslate

North America Butadiene Balance



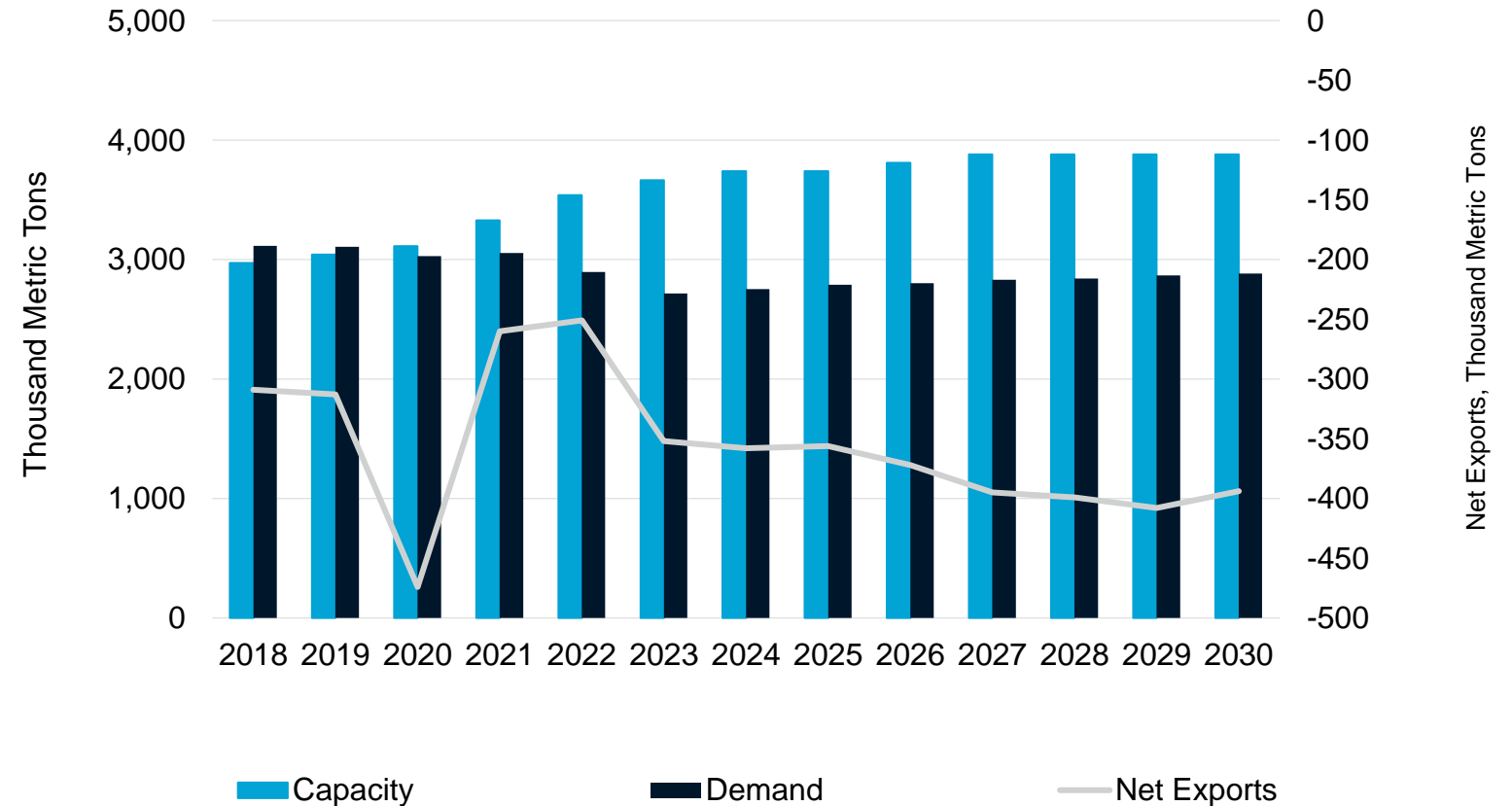
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Other NEA Continues To Import Despite Capacity Increase

- Capacity increased from South Korea (new & expansion)
 - Next new capacity S-Oil in 2026
- Butadiene production not maximized due to curtailed cracker run rates
- Imports continued to be required
- Small expansion of butadiene derivatives (NBL)
- Rubber capacities have been rationalized (PBR/SBR)

Other Northeast Asia Butadiene Balance



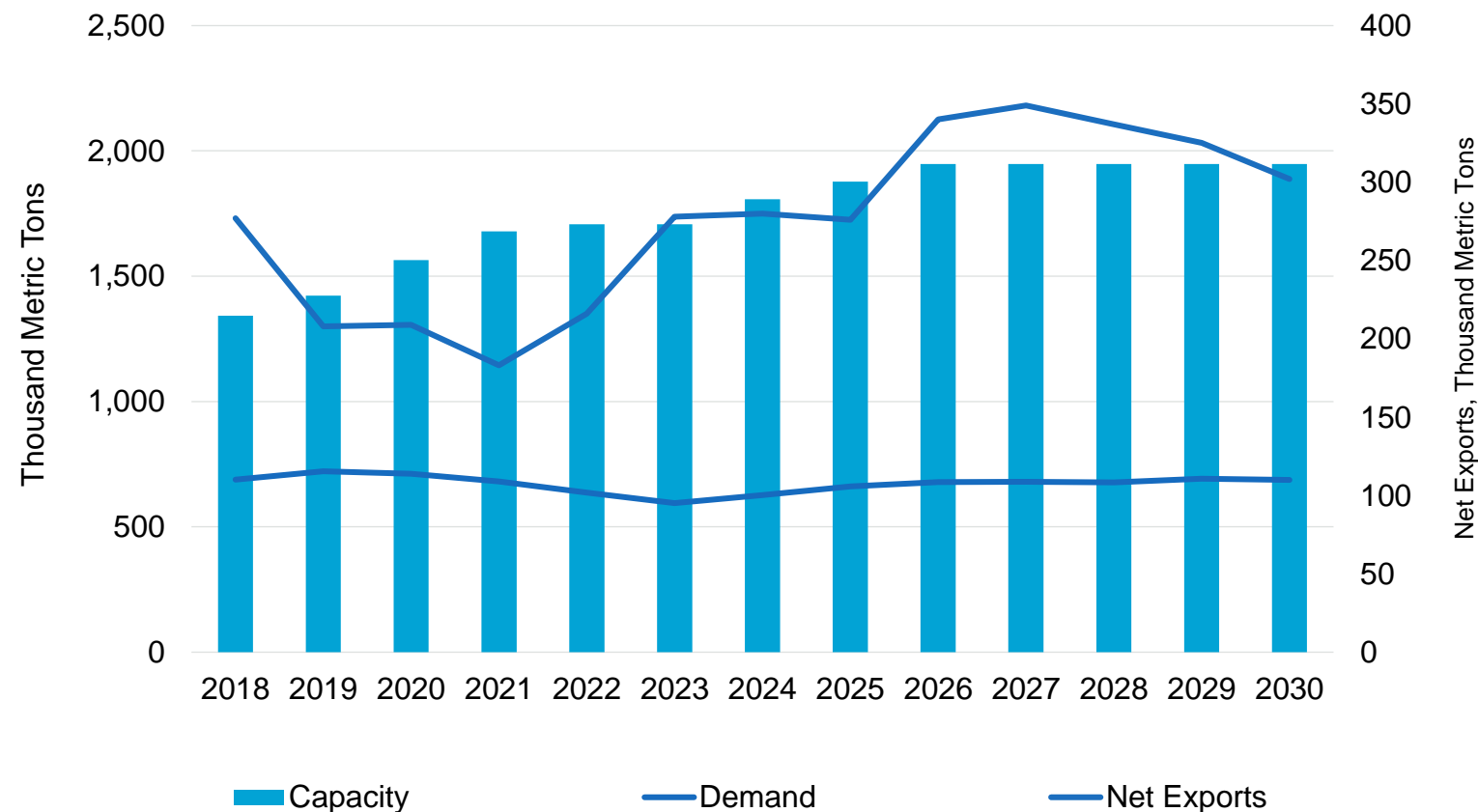
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SEA & ISC Increases Exports To NEA

- Capacity increased with expansion and new start-up
 - JG Summit / Long Son (new)
 - BST (expansion)
- One new plant expected in 2025 (PT. Lotte in Indonesia)
- Few rubber rationalization in Southeast Asia
 - Arlanxeo PBR in Singapore (2020)
 - Sumitomo SSBR in Singapore (2024 or 2025)
- Start-up of new NBL capacity in Malaysia (LG/Petronas JV)

SEA & ISC Butadiene Balance



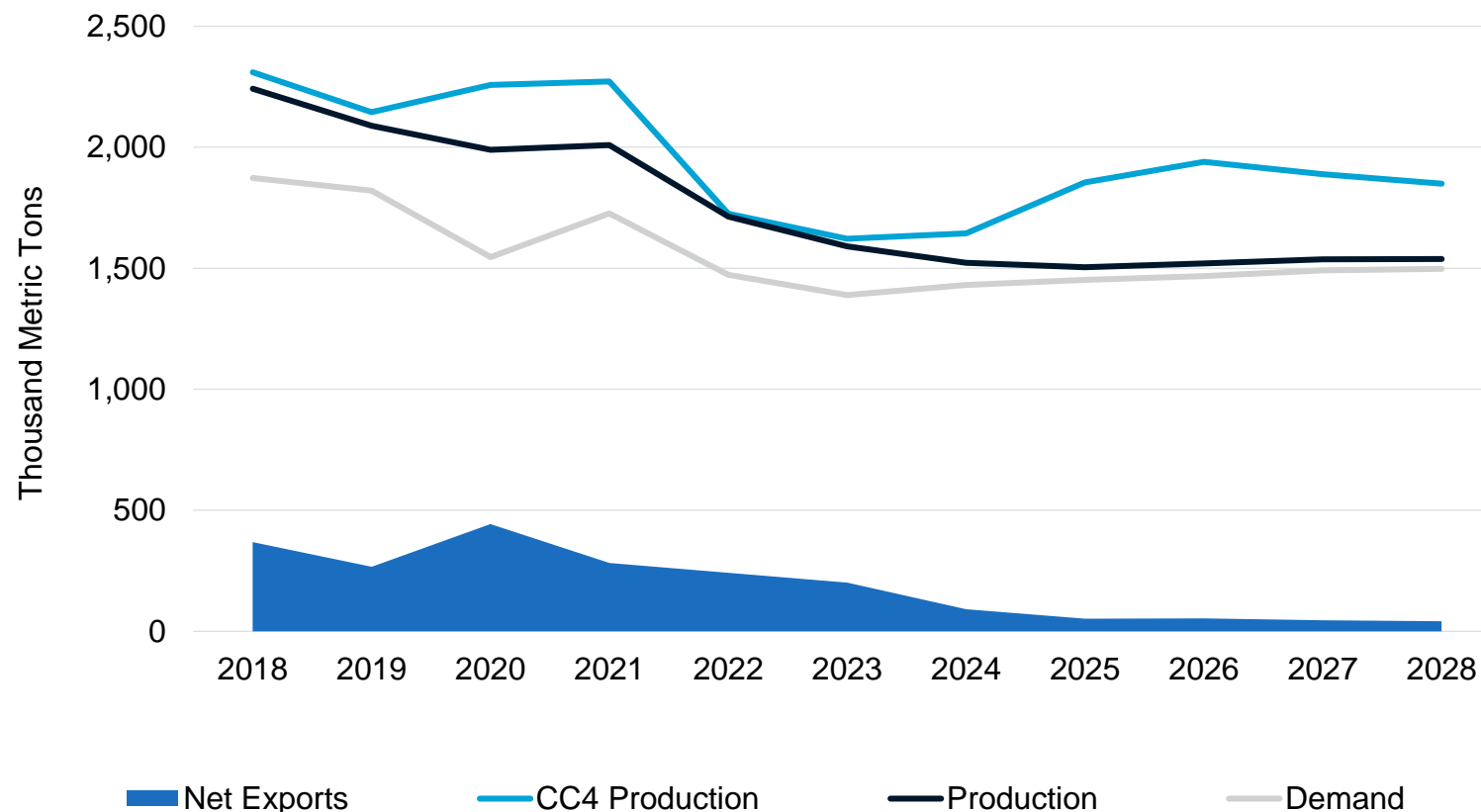
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West Europe Exports Plummet

- Traditional CC4 exporter, currently BD exporter
- Exports impacted by reduced import requirements by other regions
- Europe is high production cost region therefore they will not be able to reduce the price to increase the exports
- Alternative options required for CC4 or BD
 - Hydrogenation (Full / Selective)
 - Capacity rationalization

West Europe Butadiene Balance

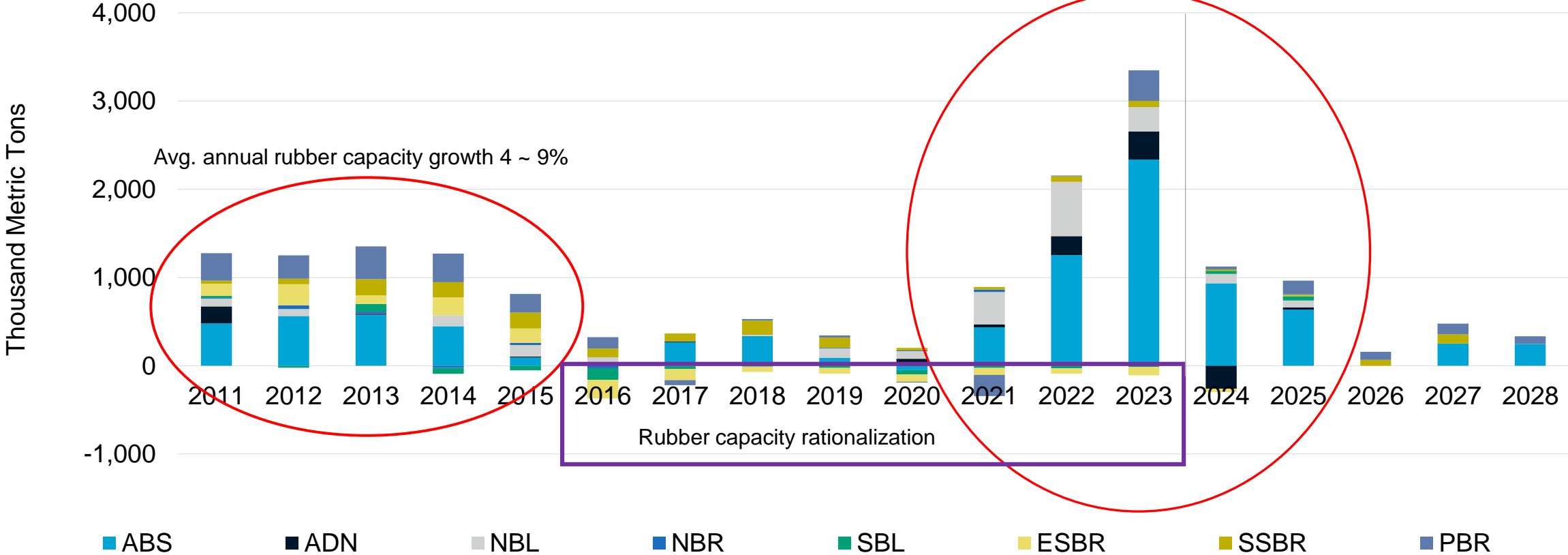


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Rubber Overcapacity Results In Rationalization And Derivative Investment Shifts To ABS & NBL

Global Butadiene Derivative Capacity Additions

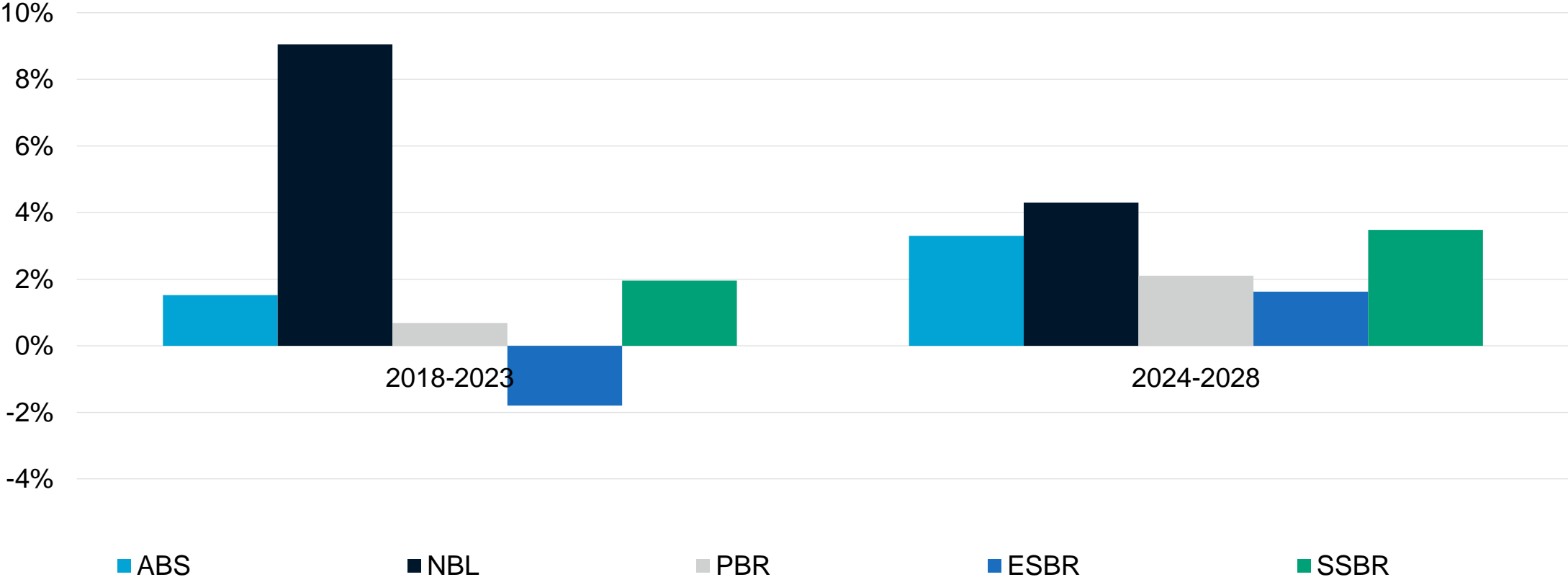


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Derivative Demand Growth Returning To Normal

Selected Butadiene Derivative Demand Growth



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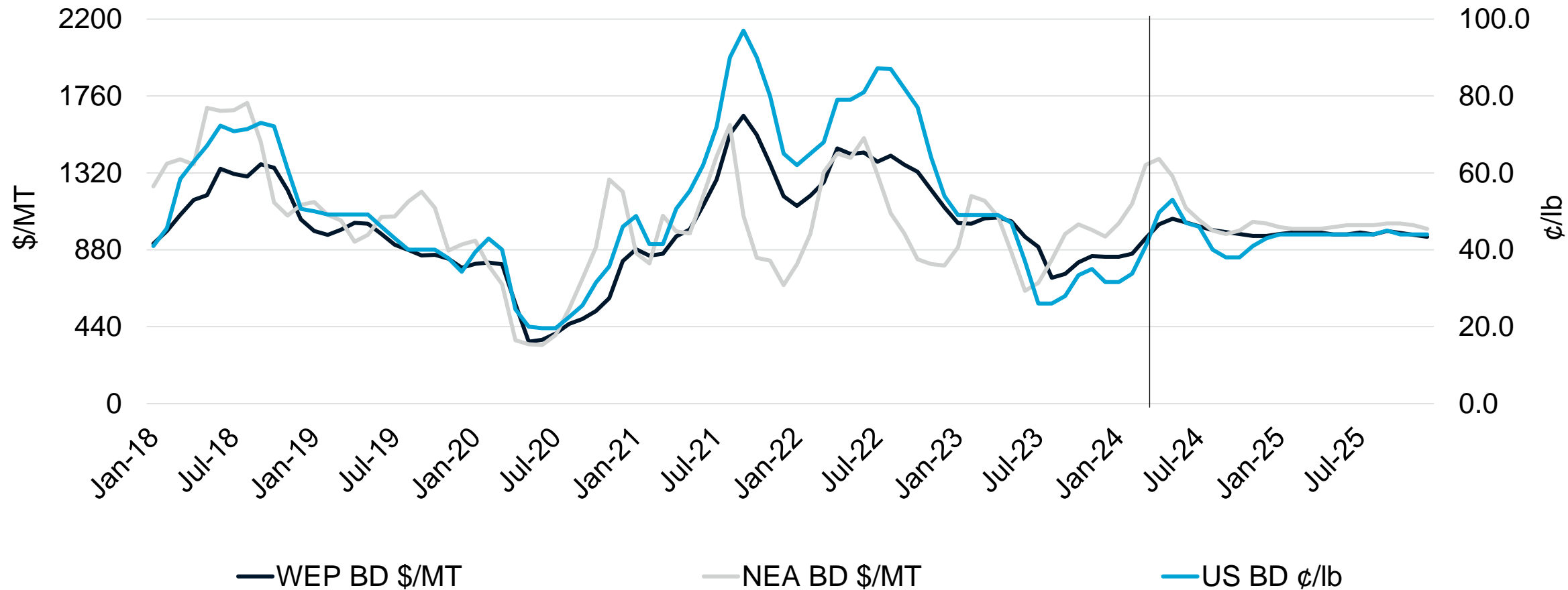
- Increasing self sufficiency of key BD importers: China, South Korea, and North America
- Weaker BD derivative demand outlook primarily driven by mobility trends
- Strong crude C4 supply growth as cracker feedslates trend heavier throughout the world, especially in Asia
- Increased recycling down ethylene chain potentially reducing ethylene production growth?
- Crude oil to chemicals projects with large crude C4 coproduct streams, likely a late 2020's or early 2030's dynamic
- Sustainability along the chain is technically complex but efforts are underway

Price Forecast



Near Term Butadiene Prices US Keeping The Rubber Import Arb Closed?

Short Term Butadiene Price Trends

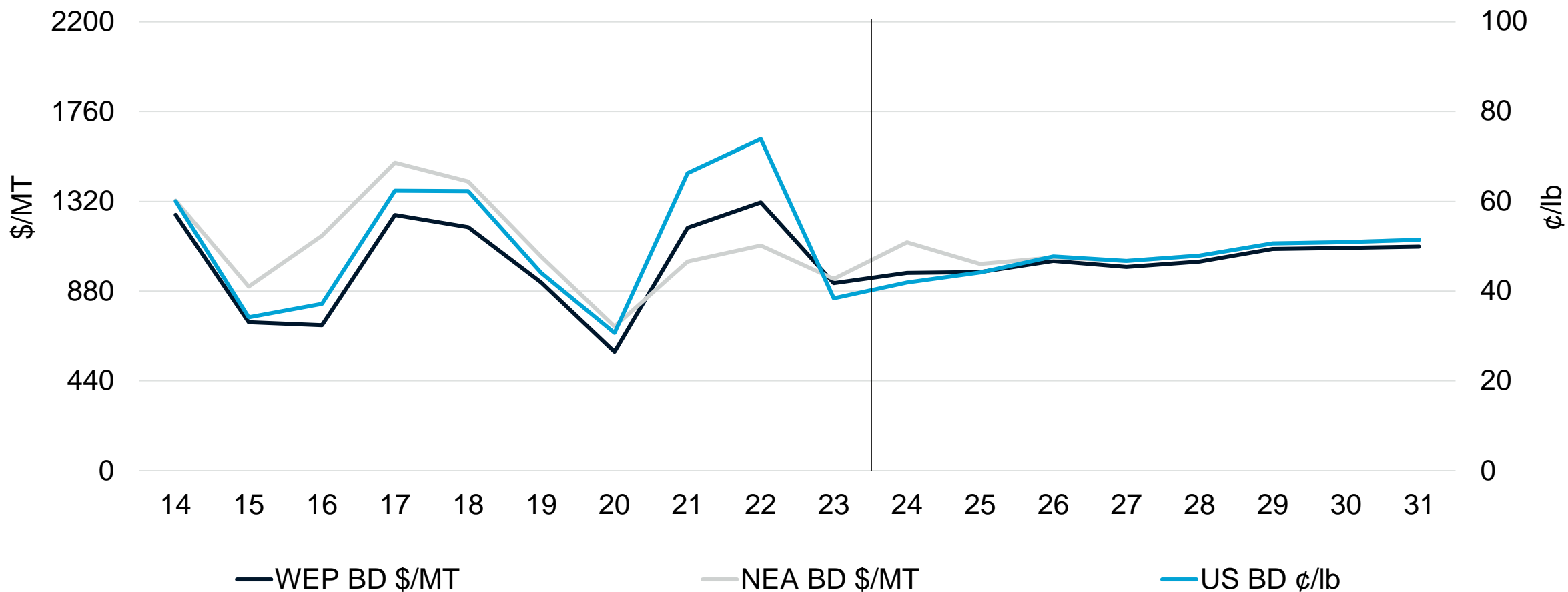


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Annual prices move with naphtha with tightening regional spreads eventually

Butadiene Price Markers



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Q&A

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