APIC

The Enduring Role of Petrochemicals in the Energy Transition

Chuck Venezia / Sarah Rae
Chuck.venezia@argusmedia.com / Sarah.rae@argusmedia.com
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A view of Argus

Headquartered in the UK, Argus has over 1,300 staff working in 29 offices in the world's principal commodity trading and production centres.

Argus publishes more than 42,000 daily and weekly spot and forward price assessments, along with commentary, news and analysis for global commodities and energy markets.

Coverage includes markets for:

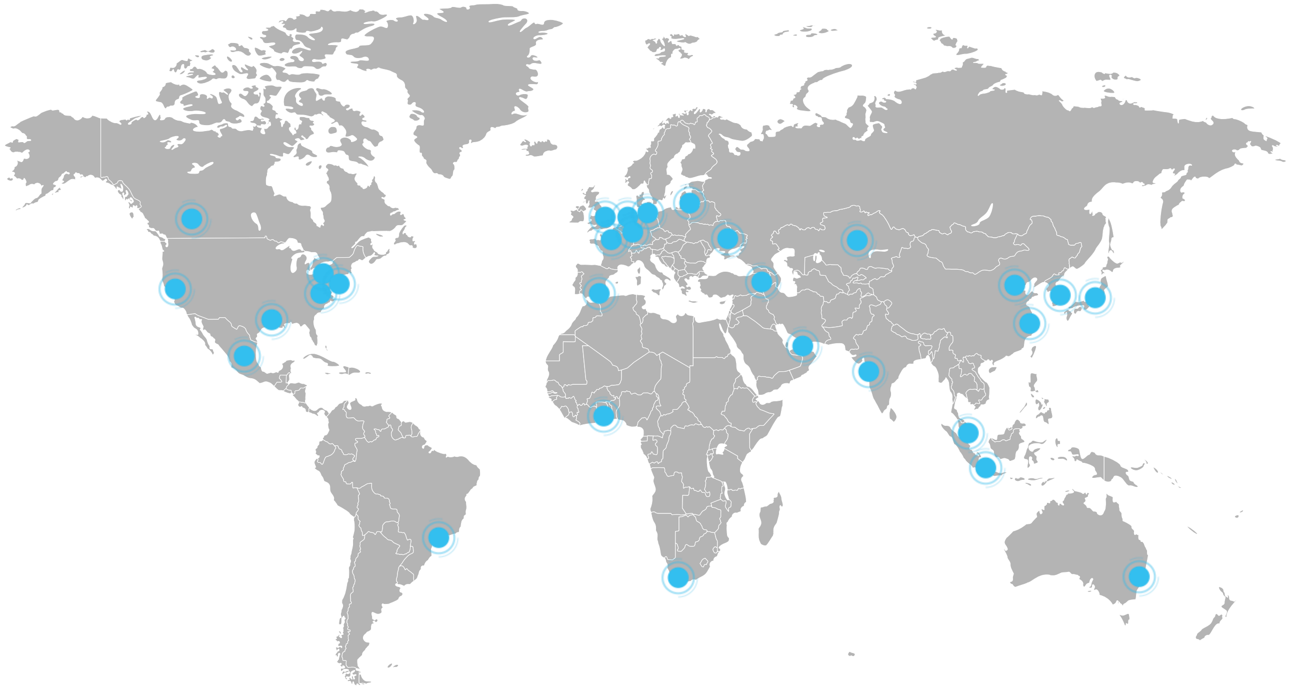
- Oil, natural gas, power, hydrogen, coal, biomass, asphalt, base oils, emissions and carbon
- Biofuels
- Fertilizers
- Agriculture
- Chemicals, including petrochemicals and oleochemicals
- Metals, ferrous, non-ferrous, battery materials, and scrap

Services:

- Market reporting, news, and analysis
- Consulting and forecasting
- Conferences

Argus prices are used as benchmarks worldwide, including for:

- US crude oil
- European gasoline and biofuels
- Asia-Pacific LPG
- Coal
- European steel
- US and European environmental markets



Expanding coverage of the chemical industry

Methanol & Octane	Methanol, MTBE
Light Olefins	Ethylene, Propylene
Heavy Olefins	Butadiene, C5 & Hydrocarbon Resins
Aromatics	Benzene, Styrene, Toluene, Xylenes
Oleochemicals	Fatty Acids, Fatty Alcohols, Glycerine, Pine Chemicals
Chlor-alkali	Caustic Soda, Chlorine, KOH
Polymers	Polyethylene, Polypropylene, PVC, PS, PET/Polyester, Recycled Polymers
Polyurethanes	Isocyanates, PO, Propylene Glycols, Polyols, EO

Bio Chemicals

The Enduring Role of Petrochemicals in the Energy Transition

State of the industry
Opportunities
Challenges / what's needed

State of the industry

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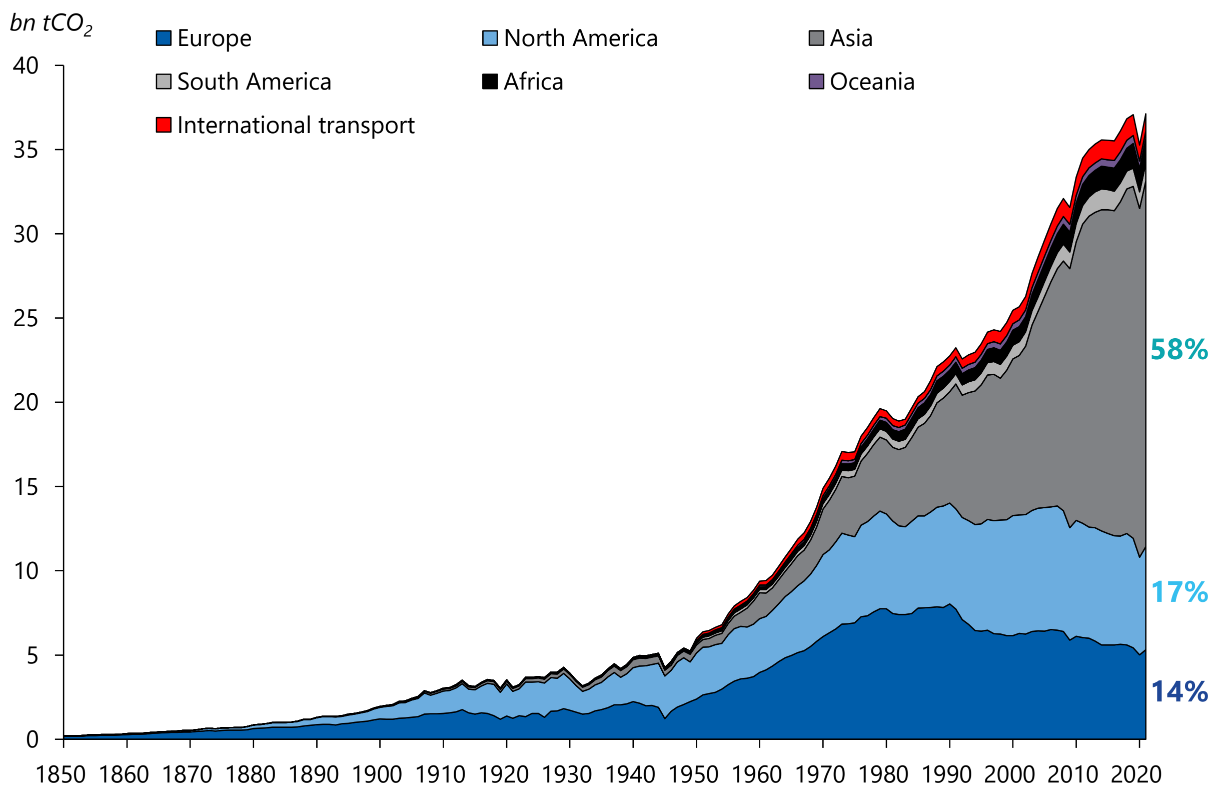
Historical Green House Gas (GHG) emissions

Europe and US are responsible for over half of accumulated emissions, but China will soon overtake as largest cumulative emitter

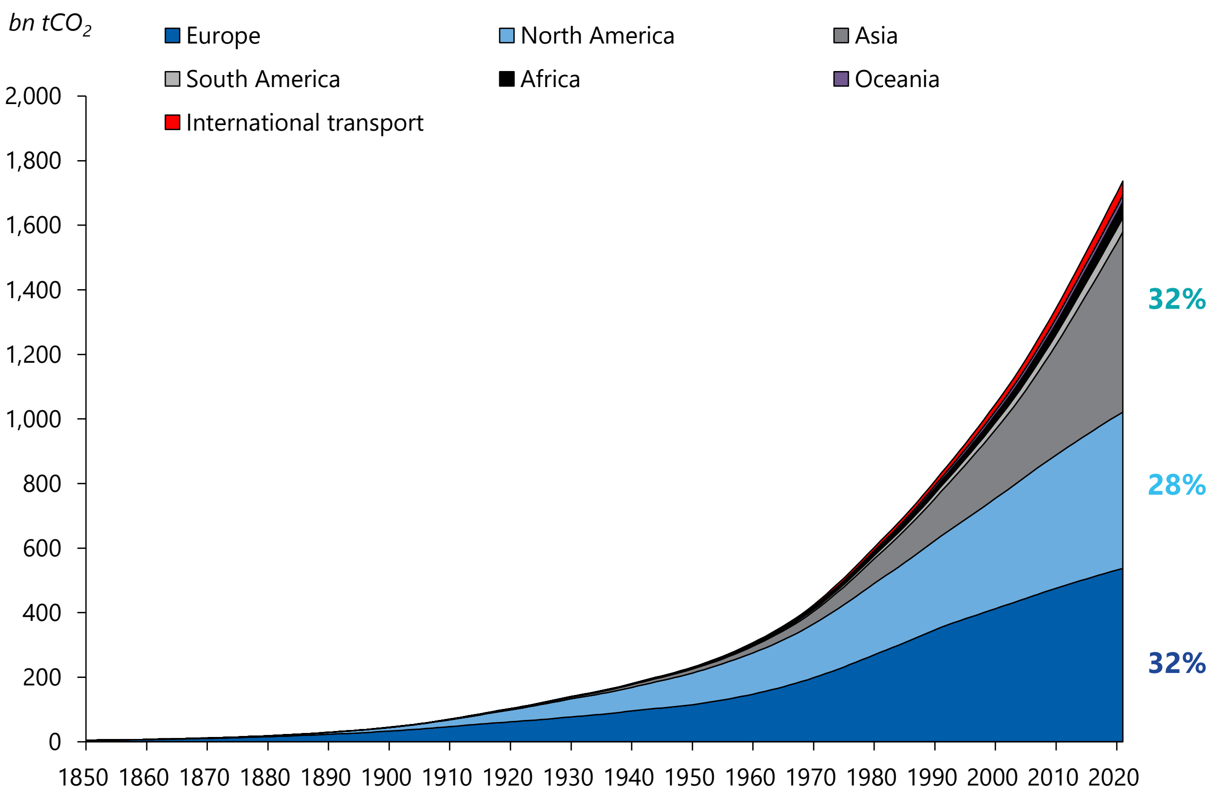
Annual global production of CO_2 emissions by geography, 1850-2021



CO_2 emissions only, excludes emissions from land-use change

— Argus Consulting, OWID

Cumulative global CO_2 emissions by geography, 1850-2021



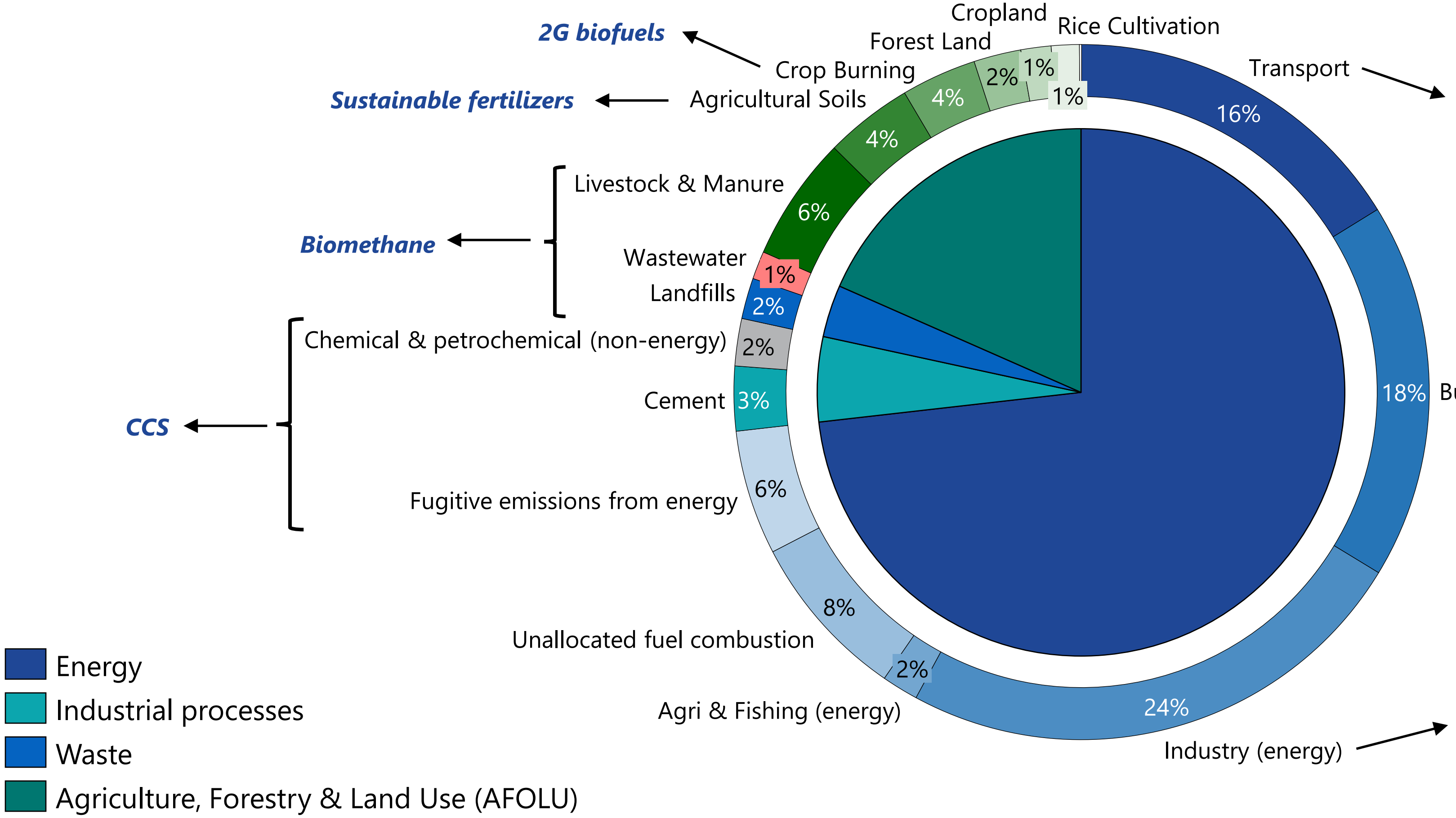
CO_2 emissions only, excludes emissions from land-use change

— Argus Consulting, OWID

Argus coverage of the Energy Transition

Sectors will look to electrify, with low-carbon fuels, in hard-to-abate sectors

= Energy transition solution covered by Argus



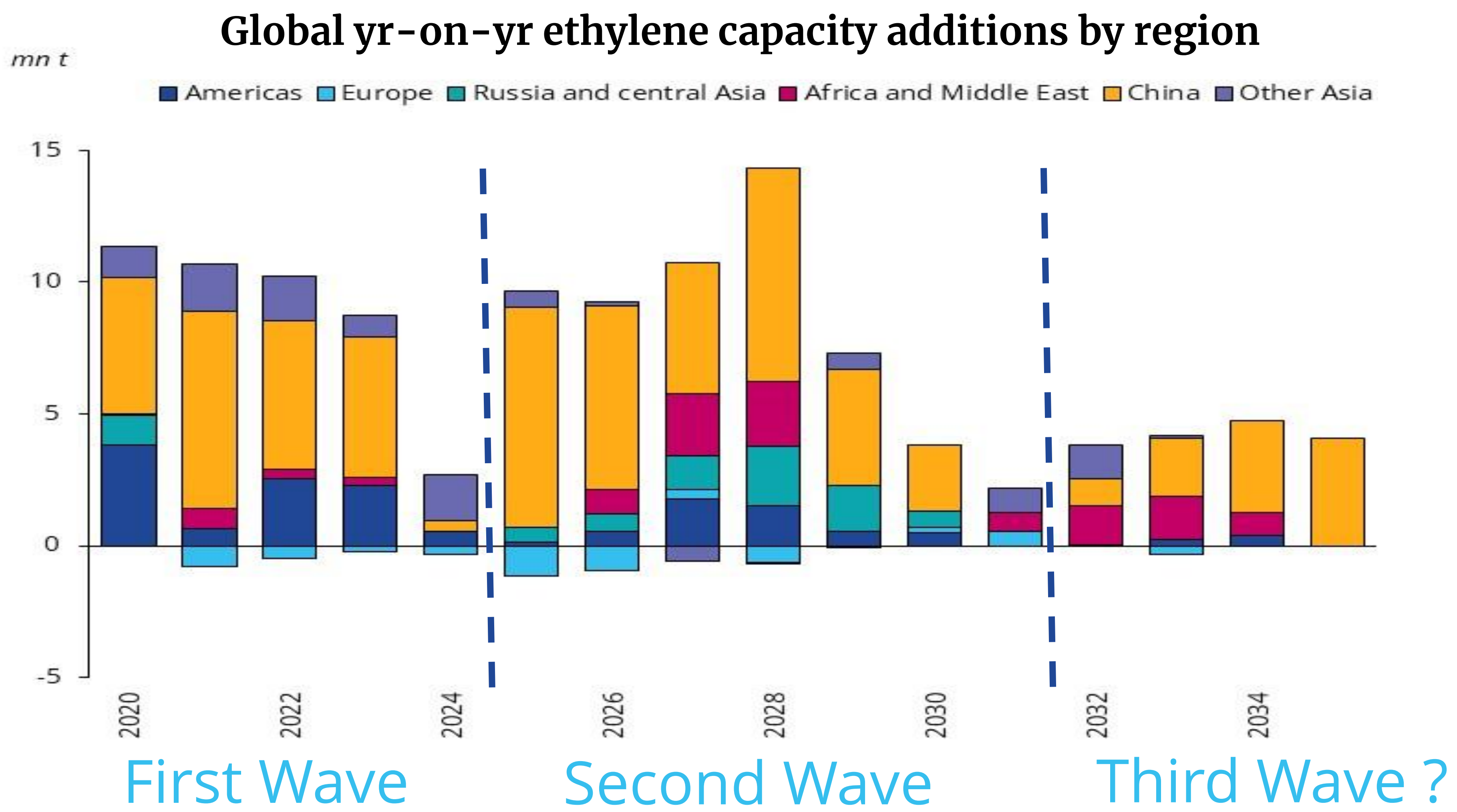
Transport:
- ***Biofuels***
- ***Hydrogen & low-carbon fuels (e-fuels, ammonia, methanol)***
- ***EVs (+ renewable electricity)***

Buildings:
- *Energy efficiency*
- *Heat pumps*
- ***Low-carbon fuels (hydrogen, biomass, biomethane, etc.)***

Industry (energy):
- *Energy efficiency*
- ***Electrification (+ renewable electricity)***
- ***Hydrogen***
- ***Low-carbon fuels***
- ***Bioenergy***
- ***CCS – Carbin capture & Storage***

Source – Climate Watch, World Resources Institute

Ethylene is into its second wave of global capacity additions which is 29% larger than the first



Opportunities – Within the industry

Reducing Carbon Footprint in Petrochemicals

Three pathways for the petrochemicals industry to achieve meaningful decarbonization

Change Feedstock

- Shift from fossil-based to bio-based and recycled raw materials
- Bio-naphtha and bio-propane as drop-in replacements for existing crackers
- Mechanical and chemical recycling to create circular supply chains
- Green methanol and bio-ethanol pathways for olefin production

Clean Power Sources

- **Renewable energy** – Wind and solar to electrify crackers and process heat
- **Hydrogen** – Green and blue hydrogen as both fuel and feedstock for ammonia, methanol, and refinery processes
- **Nuclear** – Small modular reactors to provide reliable, zero-carbon baseload for energy-intensive operations
- Electric furnaces replacing gas-fired steam crackers to cut direct process emissions

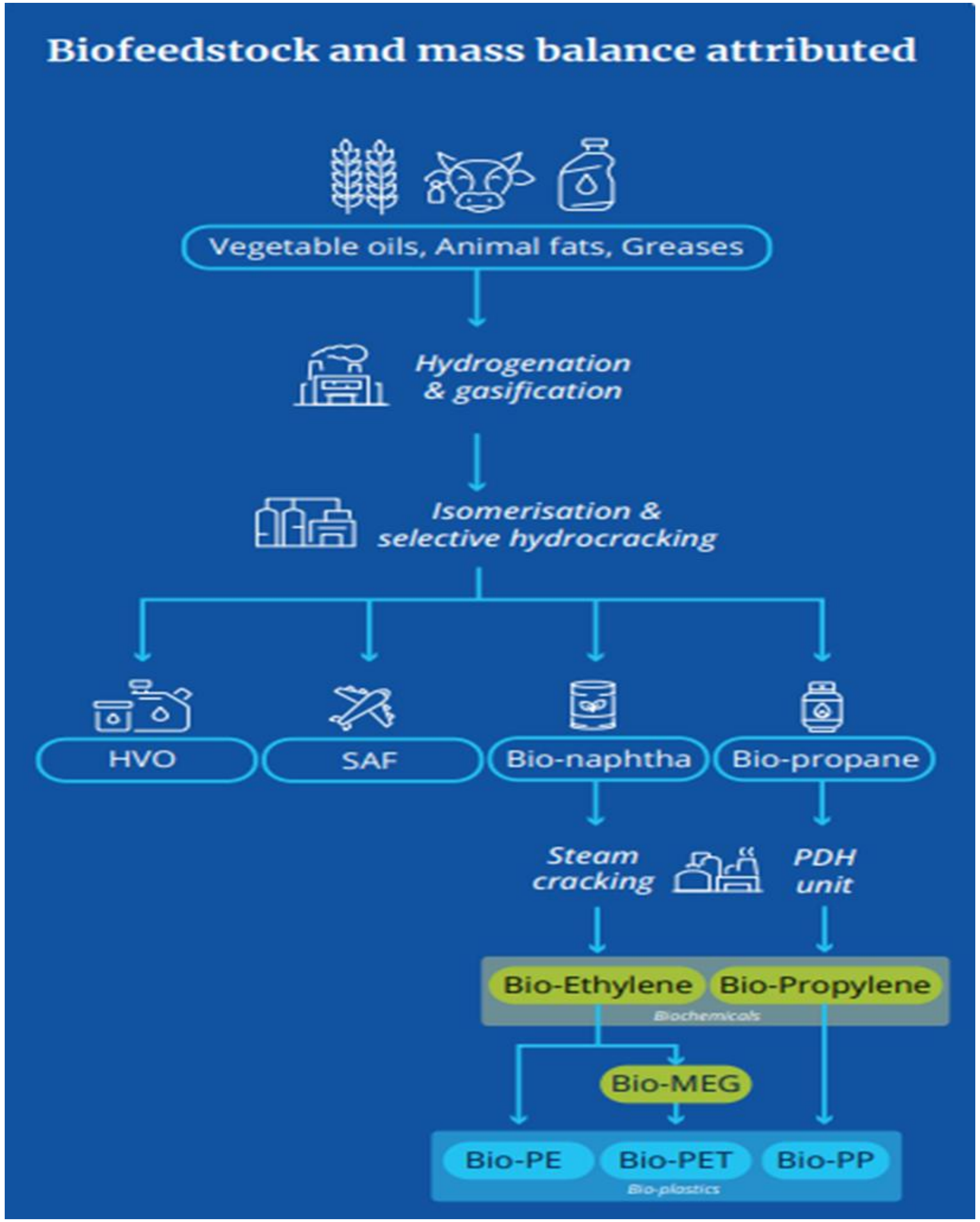
Carbon Capture (CCS)

- Capture CO2 at point-source from crackers, furnaces, and power plants
- Permanent geological sequestration in depleted reservoirs and saline aquifers
- CO2 utilization – converting captured carbon into building materials, fuels, and chemical feedstocks
- Industrial cluster hubs sharing CCS infrastructure to lower per-plant costs

Petrochemicals – what are the current options?

Bio-feedstock

- Food vs Plastics debate
- Competition with other sectors
    - Sustainable aviation fuel
    - Fuels
- But – bio-naphtha / bio-propane are "drop-in" replacements for their petrochemical equivalents on existing plants.
- Public perception – products from the same supply chain as 'legacy' products on a mass-balance basis struggle to gain public confidence



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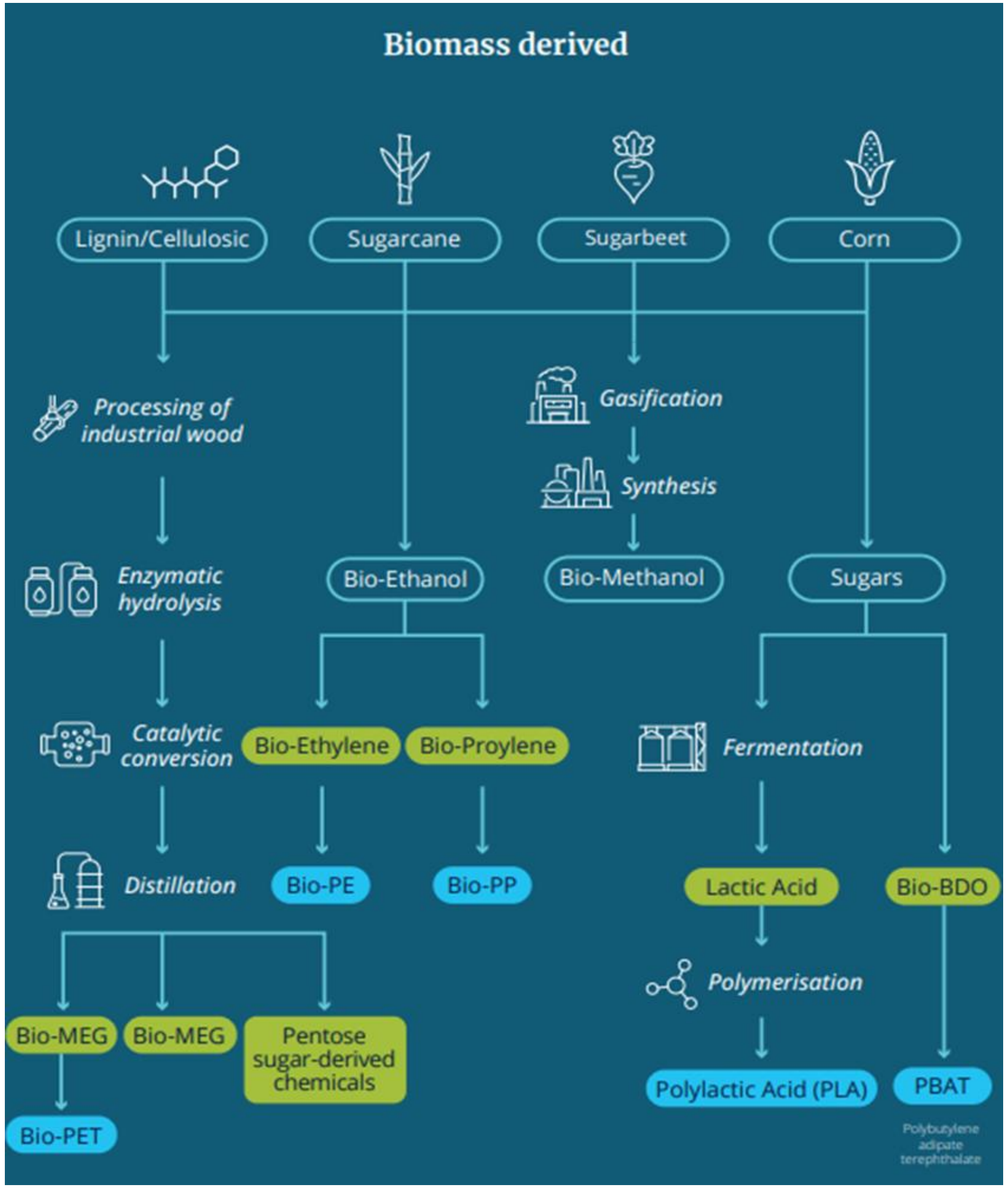


Petrochemicals – what are the current options?

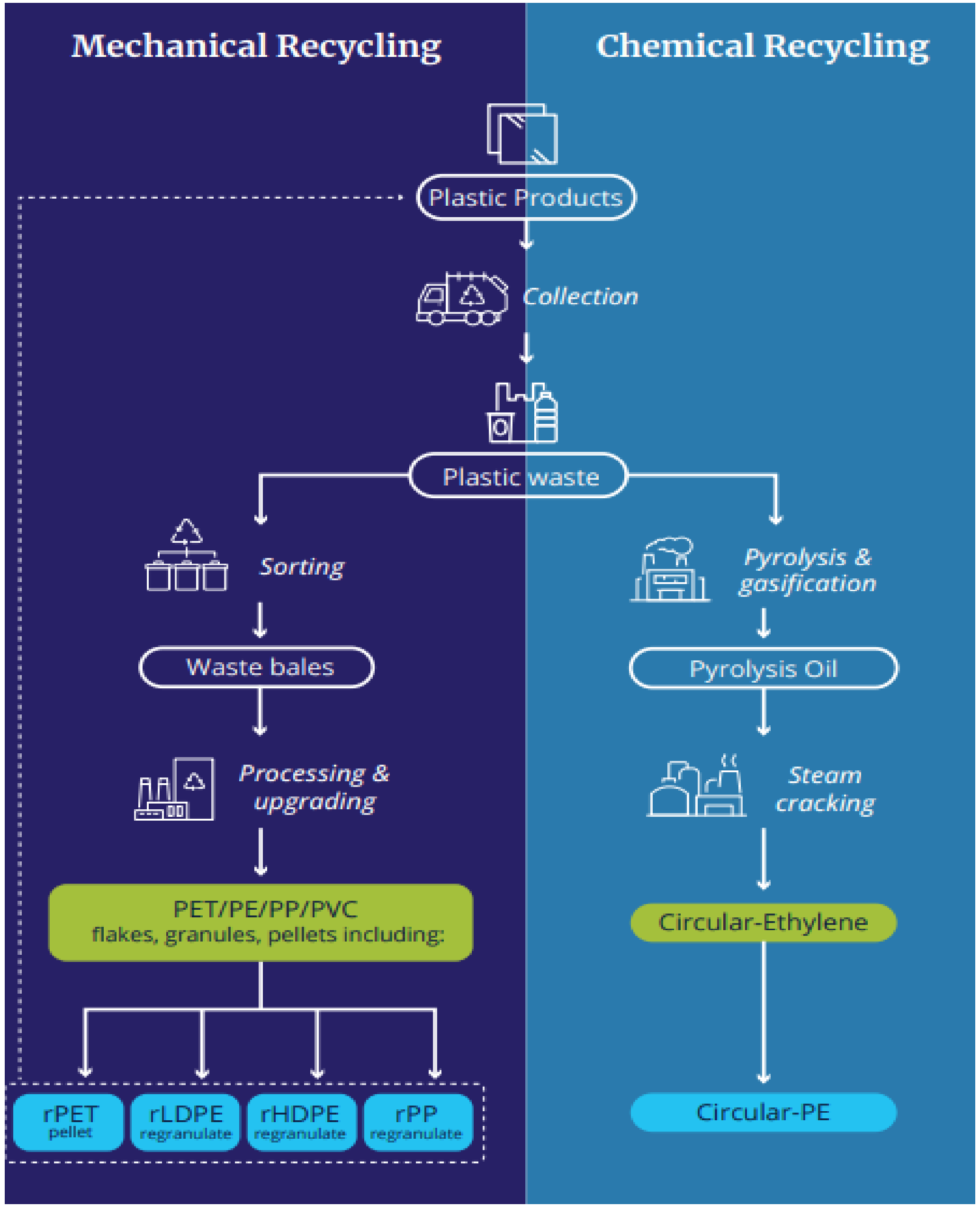
Biomass Derived

- Some of the same issues as bio-feedstock - Food vs Plastics debate
- Competition with other sectors for bio - based ethanol / methanol – e.g. gasoline
- Need investment in new technology and scale
- Public perception ?

Petrochemicals – what are the current options?

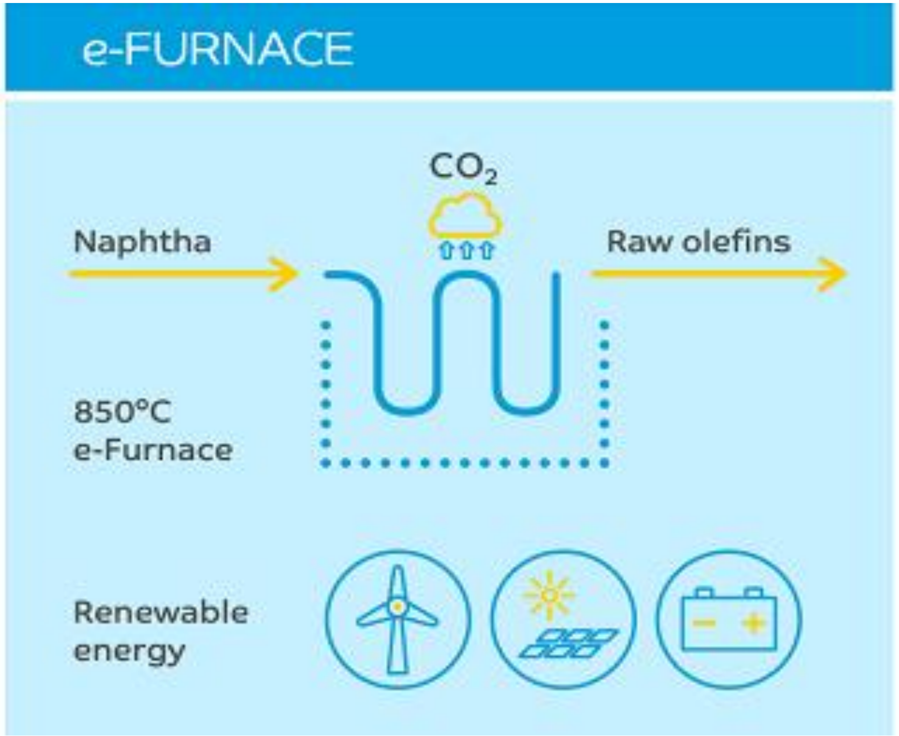
Mechanical & Chemical recycling

- No food vs Plastics debate
- Some competition with other sectors
- Mechanical recycling is a known entity but has limitations for some uses - e.g. food / medical
- Public perception – products from mechanical recycling have reasonable public confidence
  but
- Chemical recycling – Pyrolysis oil – has high costs and arguably a higher CO2 footprint than 'virgin' polymer production but does help to address the waste issue.
- Pyrolysis oil is a drop-in replacement for feedstock on some existing crackers but then you are back to the mass-balance issue



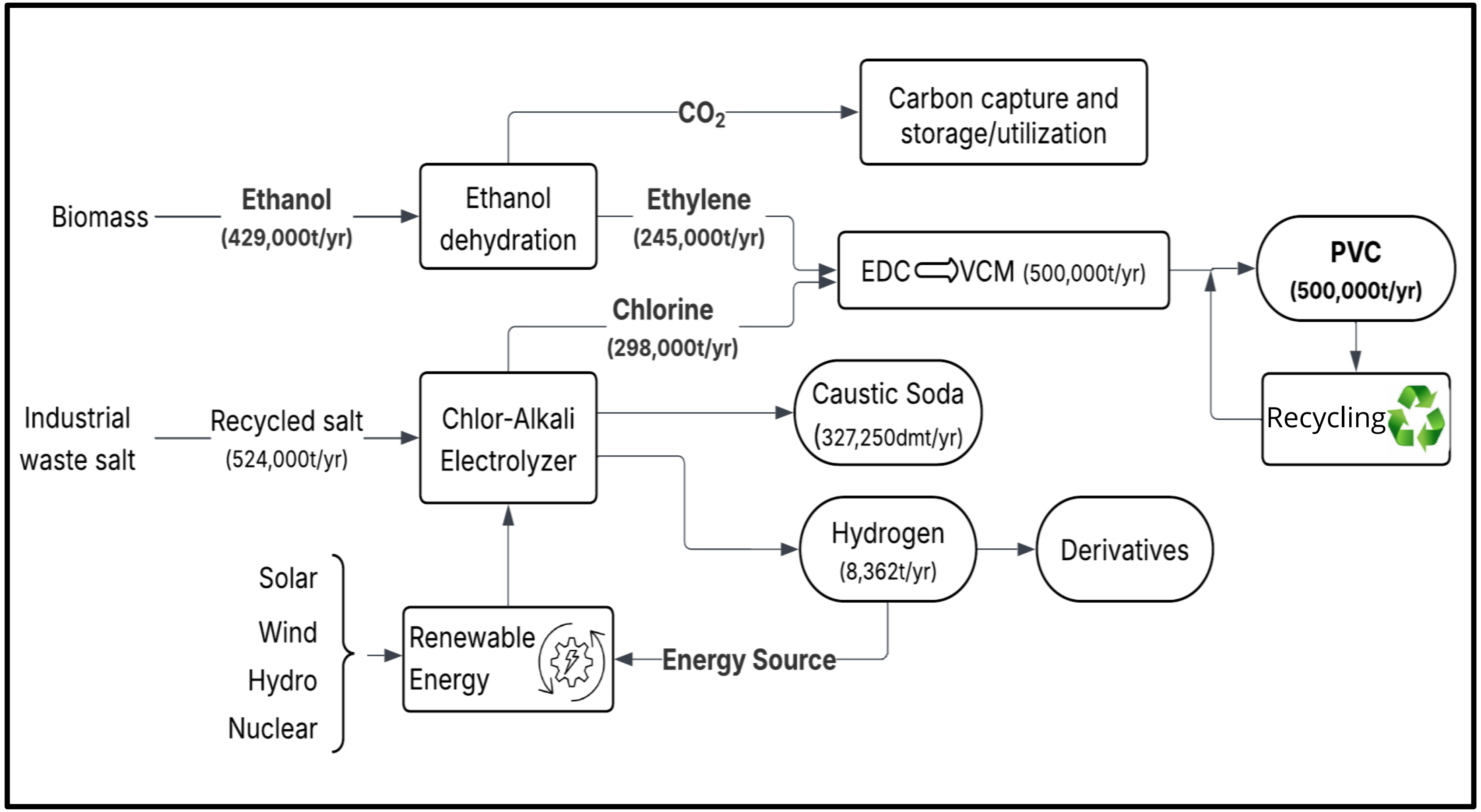
Technology to address the CO2 of the manufacturing process

Electric furnaces ?



Carbon Capture and storage?

PVC: Decarbonization is driven by feedstock and energy



Ethylene route:

- Low-carbon ethylene (bio / electrified cracking).
- Decarbonized power for chlor-alkali.

Carbide route:

- Power decarbonization (coal → renewables).
- Efficiency + CCUS.

Cross-cutting

- PVC Recycling.
- Process integration.

Route choice sets the decarbonization ceiling. The ethylene route offers greater flexibility for deeper emission reductions.

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Opportunities –

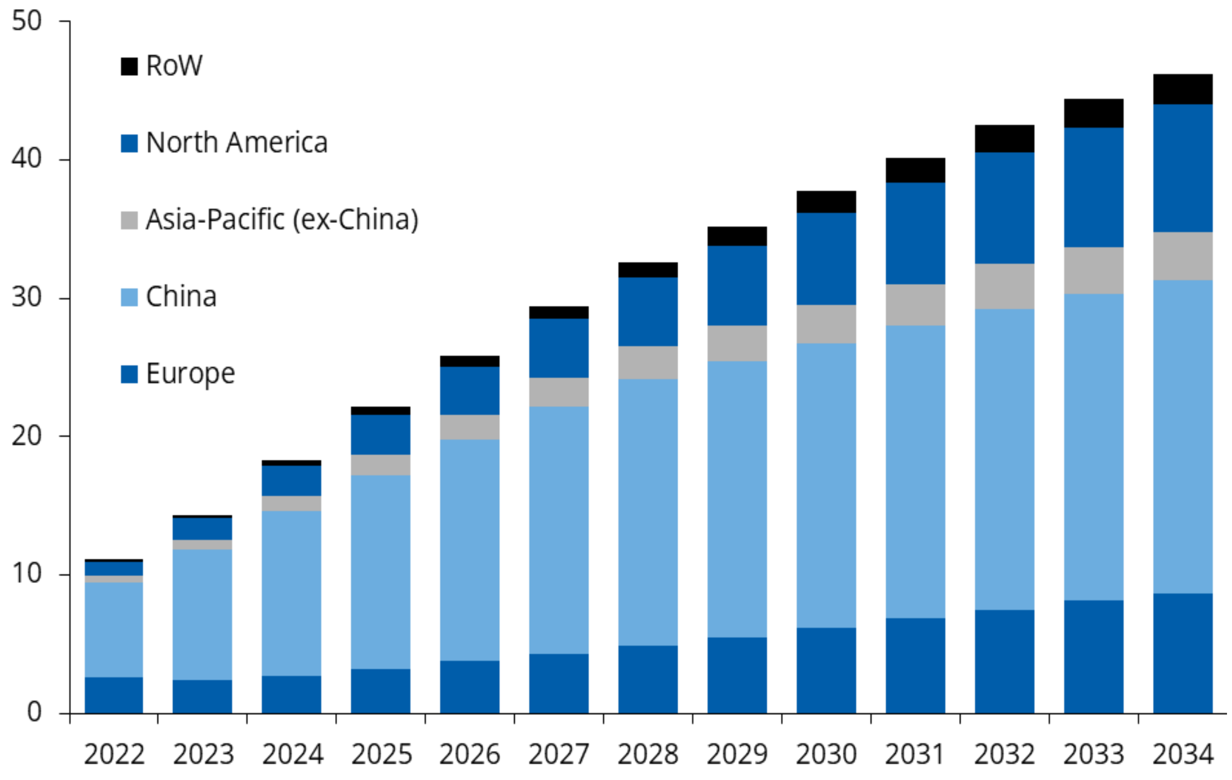
External

Enabling Energy Transition

- **Electric Vehicles** – Driving demand for lightweight polymers, battery materials, and advanced composites across the automotive supply chain
- **Windmills and Turbines** – Petrochemical-derived resins and adhesives are essential for manufacturing turbine blades and nacelle components
- **Solar Power** – Encapsulants, backsheets, and specialty coatings rely on petrochemical feedstocks to protect and optimize photovoltaic panels
- **Construction Materials** – High-performance insulation, PVC piping, and energy-efficient building materials support greener infrastructure
- **Electric Grid and Data Centers** – Cable insulation, coolants, and polymer housings are critical to expanding grid capacity and powering the digital economy

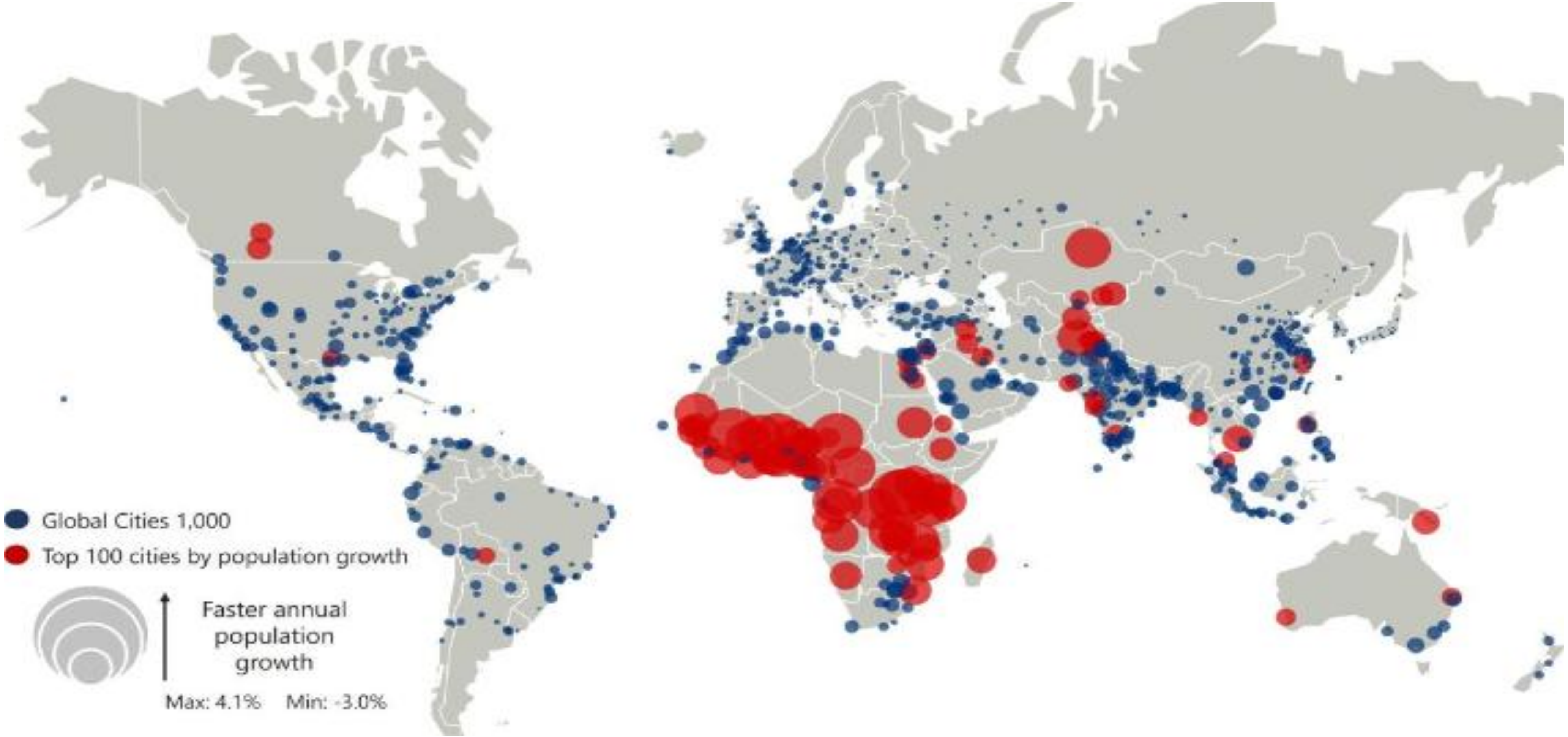
EV's need to be lighter, and modern cars tend to be larger – using more polyolefins

Global EV Sales by region, 2021-34 (mn units)



— *Argus*

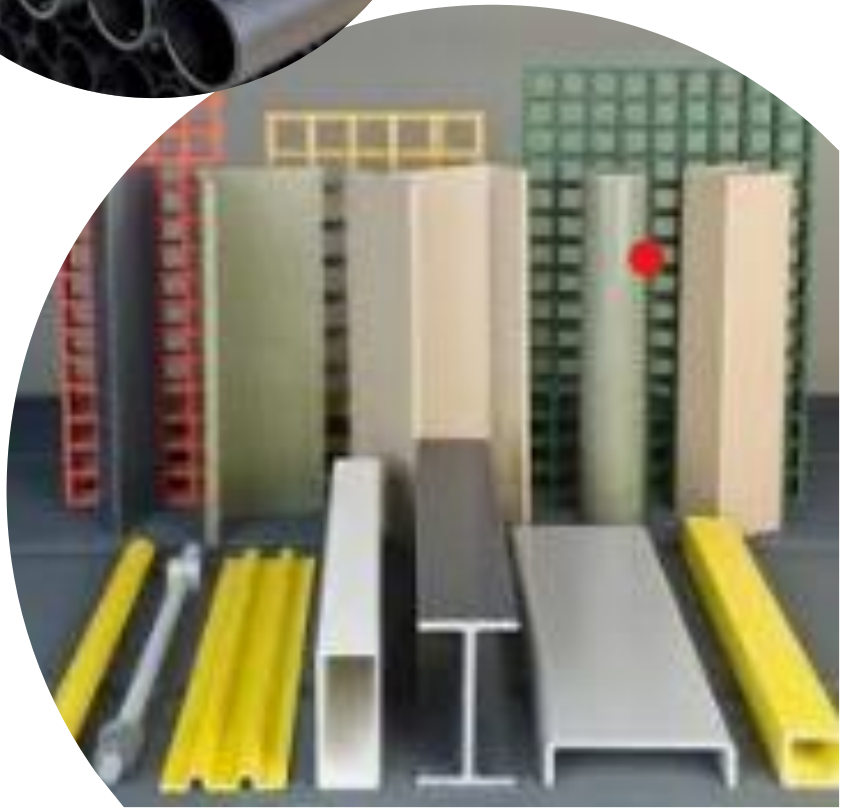
Urbanisation is a driver for petrochemical use



Oxford economics – Nov 2023

More people in urban environments drives infrastructure spending and construction

- Infrastructure – clean water / fuel distribution - PVC / HDPE
- Domestic - insulation against heat and cold – PVC
- Wall coverings / carpets / flooring / plumbing / heating / electrical wiring etc.
- Once people have houses/apartments they need furniture
- Medical – as populations become more urbanized and with growing wealth – medical services increase



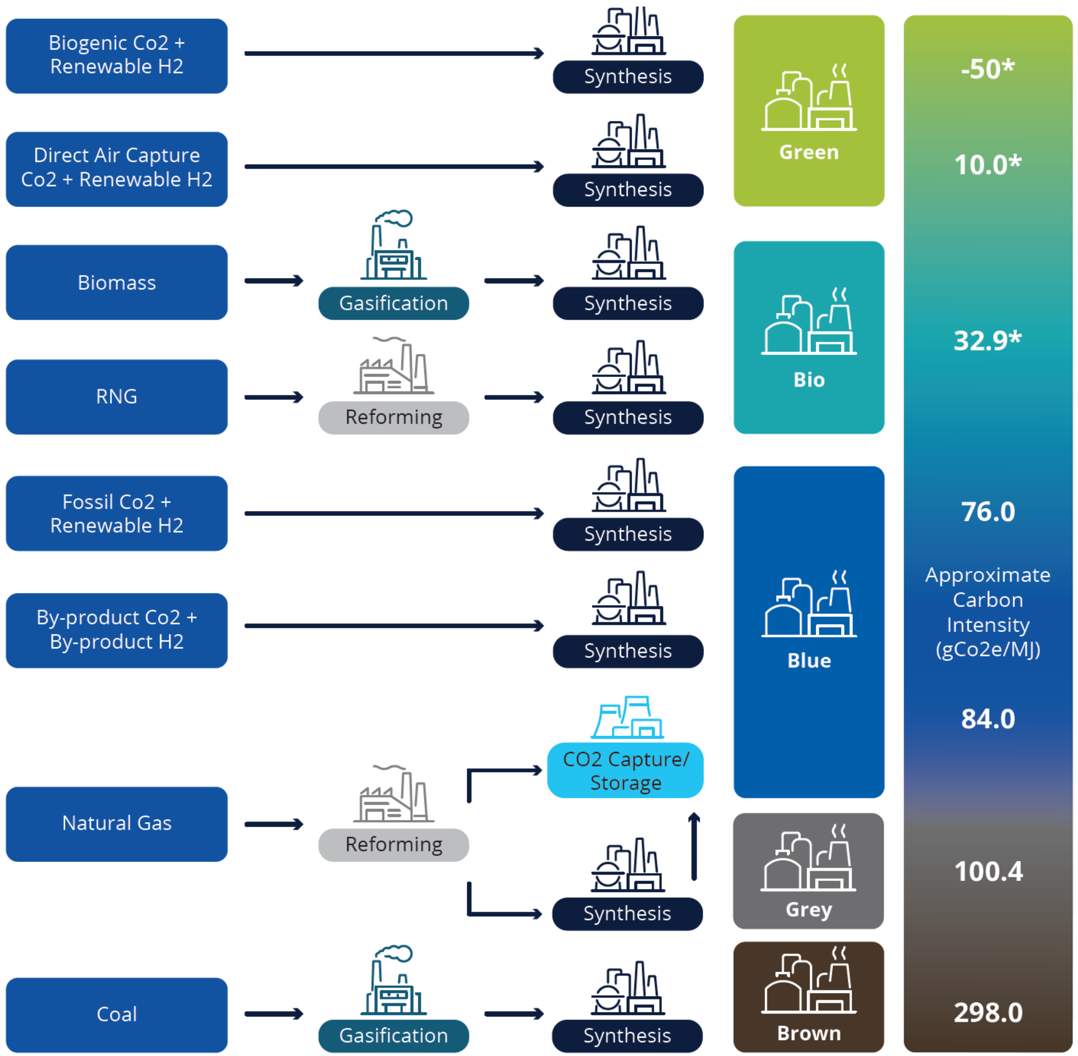
And in a warmer wetter world ….

- Agricultural use of polymers will increase
- Irrigation
- Tunnels to control growing conditions for more sensitive / fragile crops
- Ground cover / mulch
- Innovative use of polymers for water retention and yield improvement

- But – some of this market will be taken by bio-degradable polymers
- Use of polymers for tunnels / mulch-ground cover creates recycling challenges with already hard to re-process films contaminated with soil.

Low carbon methanol: reducing the footprint of the marine industry

Methanol definitions: Methanol production pathways



Path-ways	Carbon Intensity and GHG Savings	
	LCA Carbon Intensity CI, gCO2e/MJ	GHG Emissions against Fuel Oil 94 gCO2e/MJ
E-methanol (Green)	5-12	- (87-96)%
Biomethanol (Green)	-50-32	- (65-153)%
Coal-based methanol (Grey)	300	+ 219%
NG-based methanol (Grey)	95-105	+ (1-12)%
Blue methanol	45-75	- (20-52)%

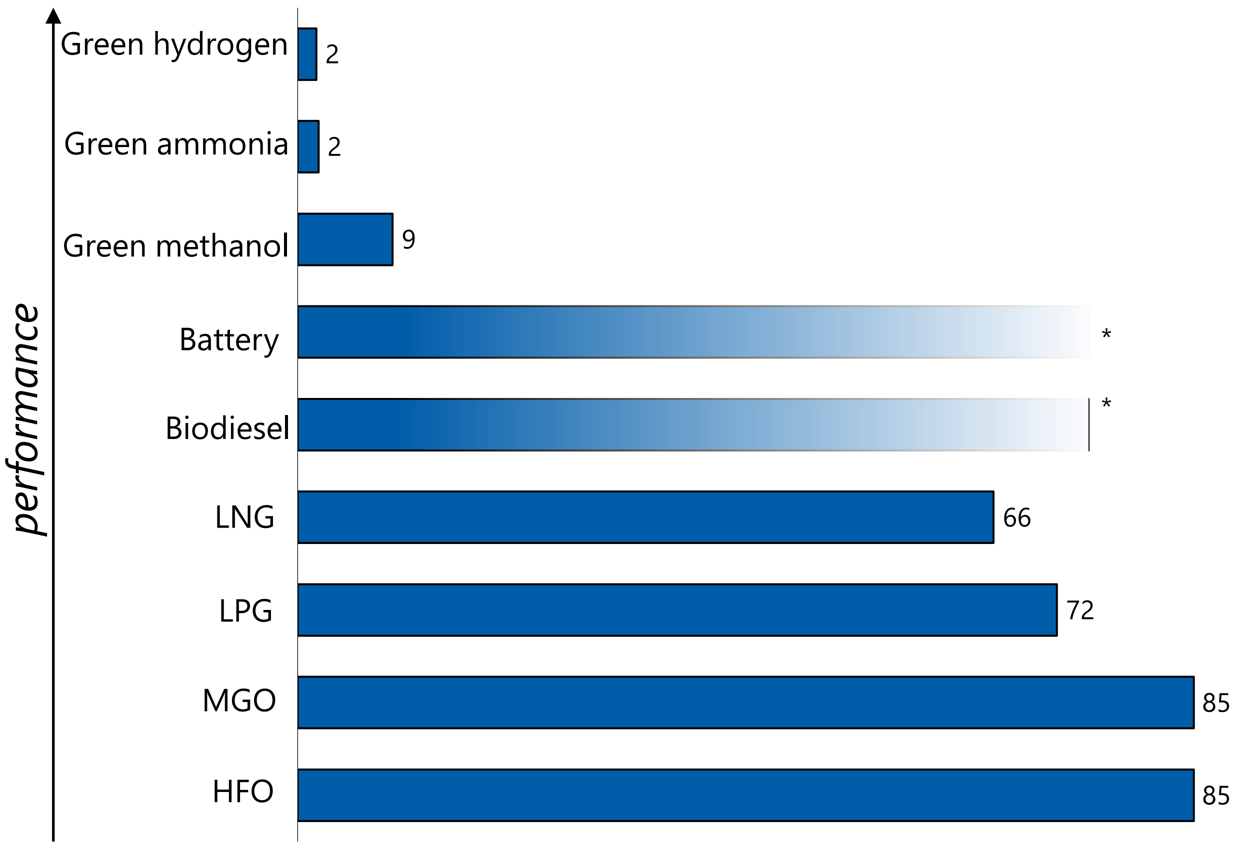
Note: Methanol's calorific value is 19.95 MJ/kg

- GHG savings are based on VLFSO 94gCO2 equivalent/MJ
- RED biomethanol: minimum 65pc GHG savings
- RED e-methanol: minimum 70pc GHG savings

Alternative Fuel Choices – Key Metrics

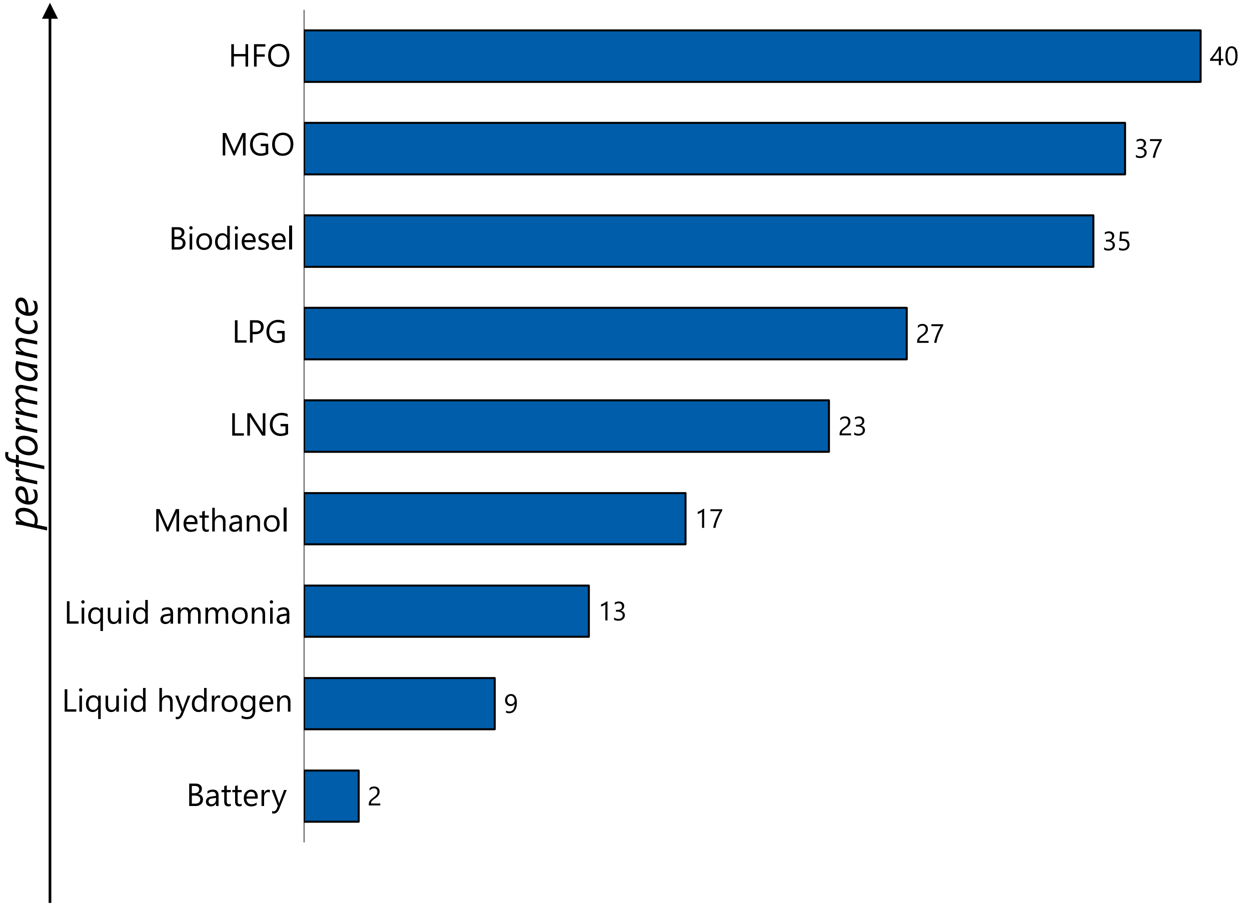
Synthetic fuels ammonia and e-methanol have low GHG emissions but also low volumetric energy density.

Well-to-Tank (WTT) GHG Emissions of Marine Fuels per Unit of Energy (gCO_2e/MJ)



*Notes: * dependent on grid electricity or feedstock*

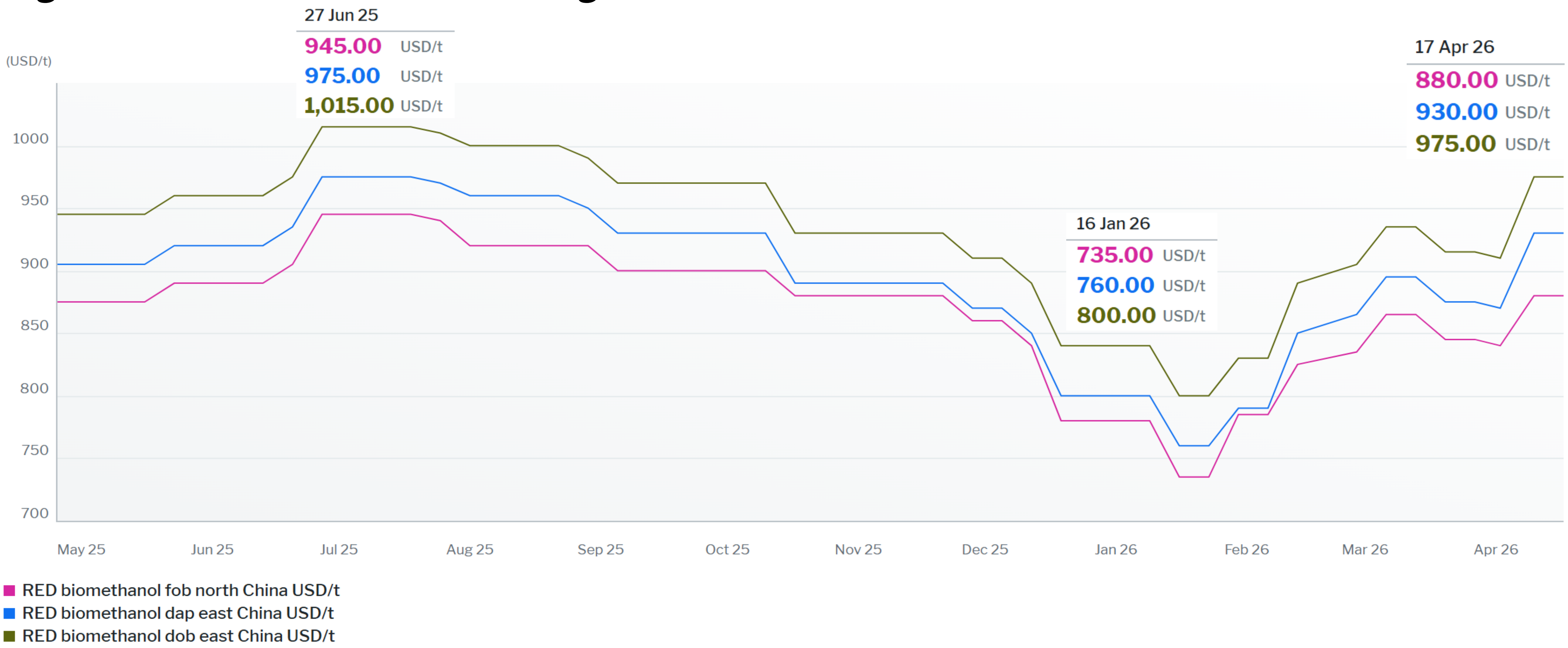
Volumetric Energy Density of Marine Fuels (MJ/l)



Source: DNV GL, Argus Consulting

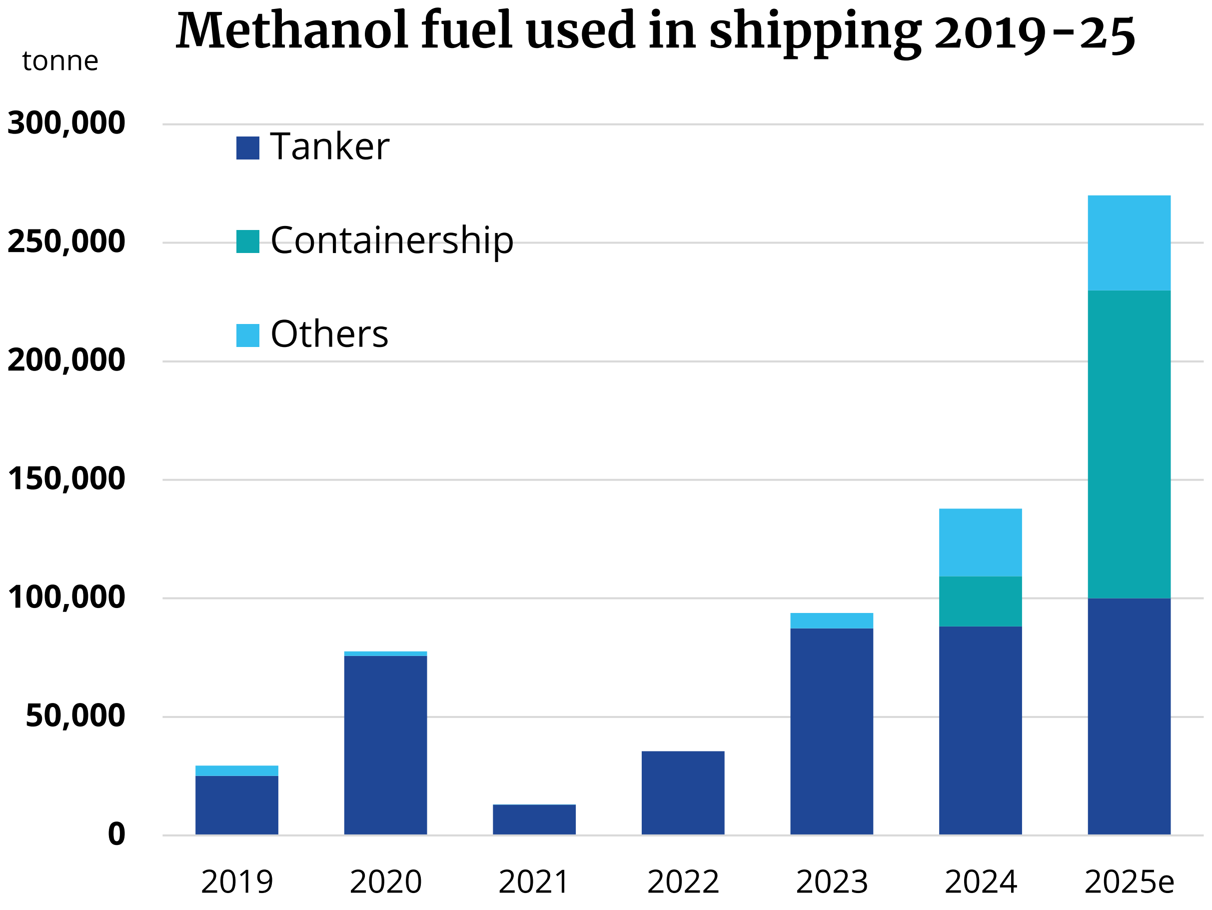
Argus China's biomethanol pricing: Spot prices driven by bunker tenders, new start-ups and policy shifts

Argus Asia RED Biomethanol Pricing



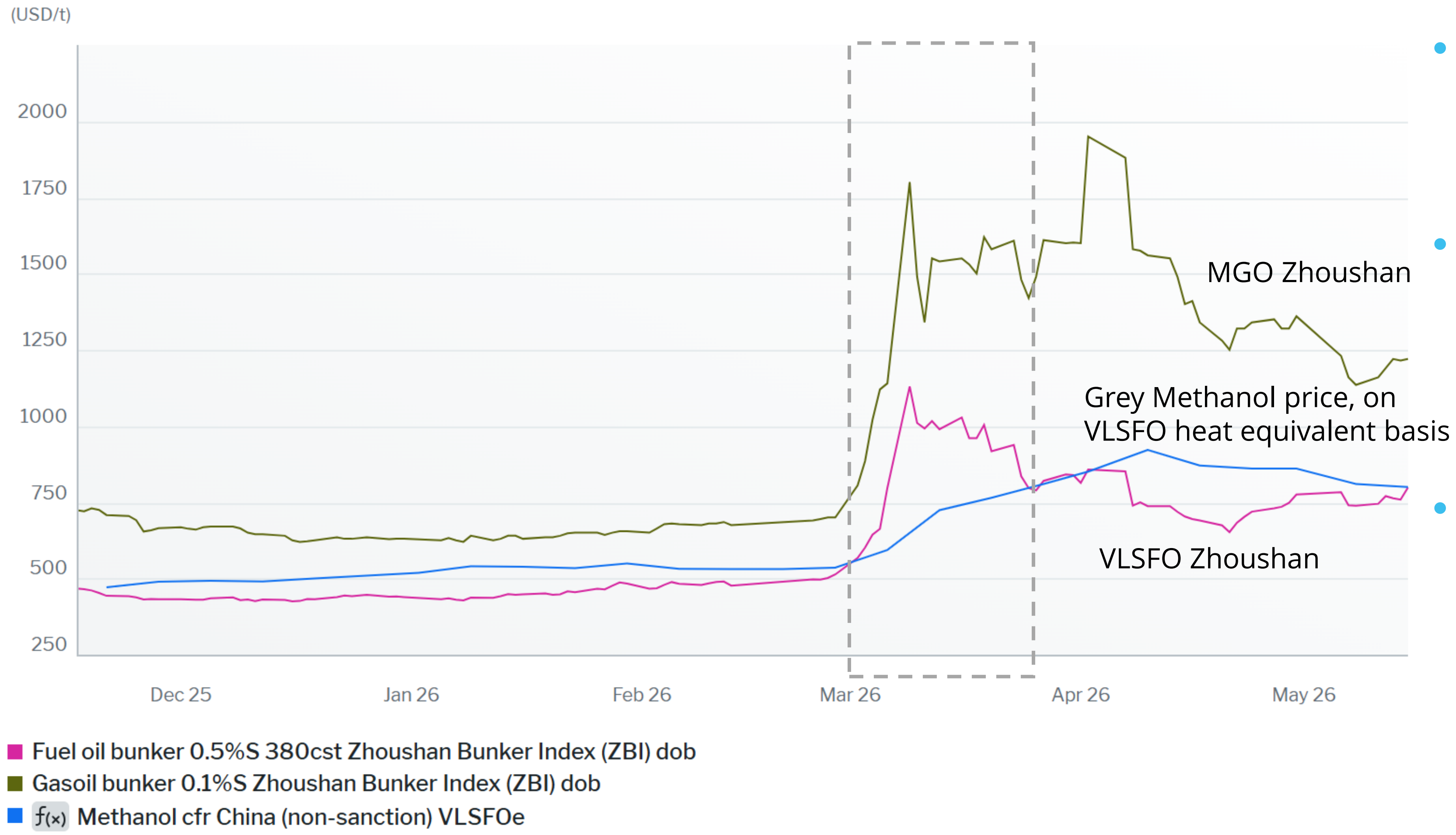
Emerging demand for grey methanol: Elevated crude prices boost methanol's value as marine fuel substitute

- Methanol's relatively lower price versus fuel oil is **driving interest as a substitute**
- Total consumption of methanol (including green) as a marine fuel **reached 138kt in 2024**, up by 47pc from 2023, and may hit ~250kta in 2025
  - Shanghai Port alone bunkered nearly **60kt** of conventional methanol in 2025
- Argus expects methanol bunker demand to remain supported, driven by:
  - More delivery of methanol dual-fueled vessels in 2026-27
  - Used for engine warranty test
  - Economically competitive versus fuel oil
  - 0.5ppm sulfur content, way below MARPOL's Sox Emission Control Area (ECA) policy: sulfur < 0.1pc fuel oil or 1000ppm)



Source: IMO, Argus consulting

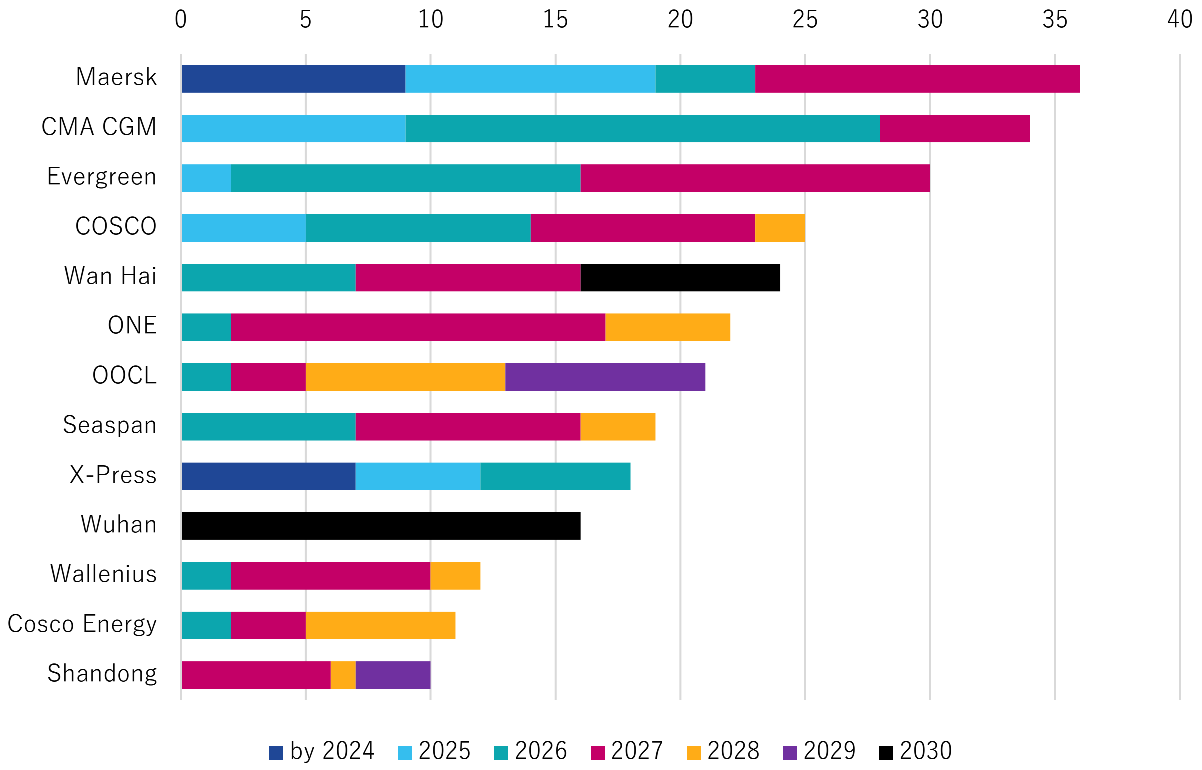
China grey methanol pricing: Attractive prices and super low sulfur content drive grey methanol bunkering demand



- Grey methanol VLSFOe price = grey methanol price * 2.02
- On VLSFOe basis, pre-war and after ceasefire:
  - Methanol > VLSFO
  - Methanol << MGO
- An excellent substitute for low sulfur fuel oil
  - Methanol (sulfur content 0.5ppm) << MGO (sulfur content 1000ppm)

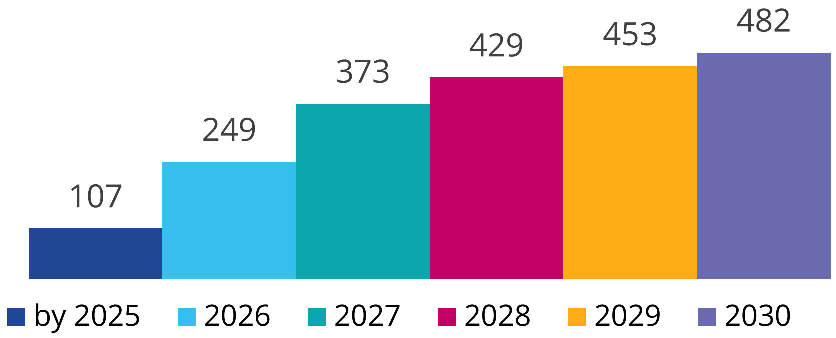
Methanol bunkering demand outlook: Increasing delivery of methanol dual-fuel fleets in 2026-27 drives demand

Top ship owners with methanol dual-fuel fleet orders



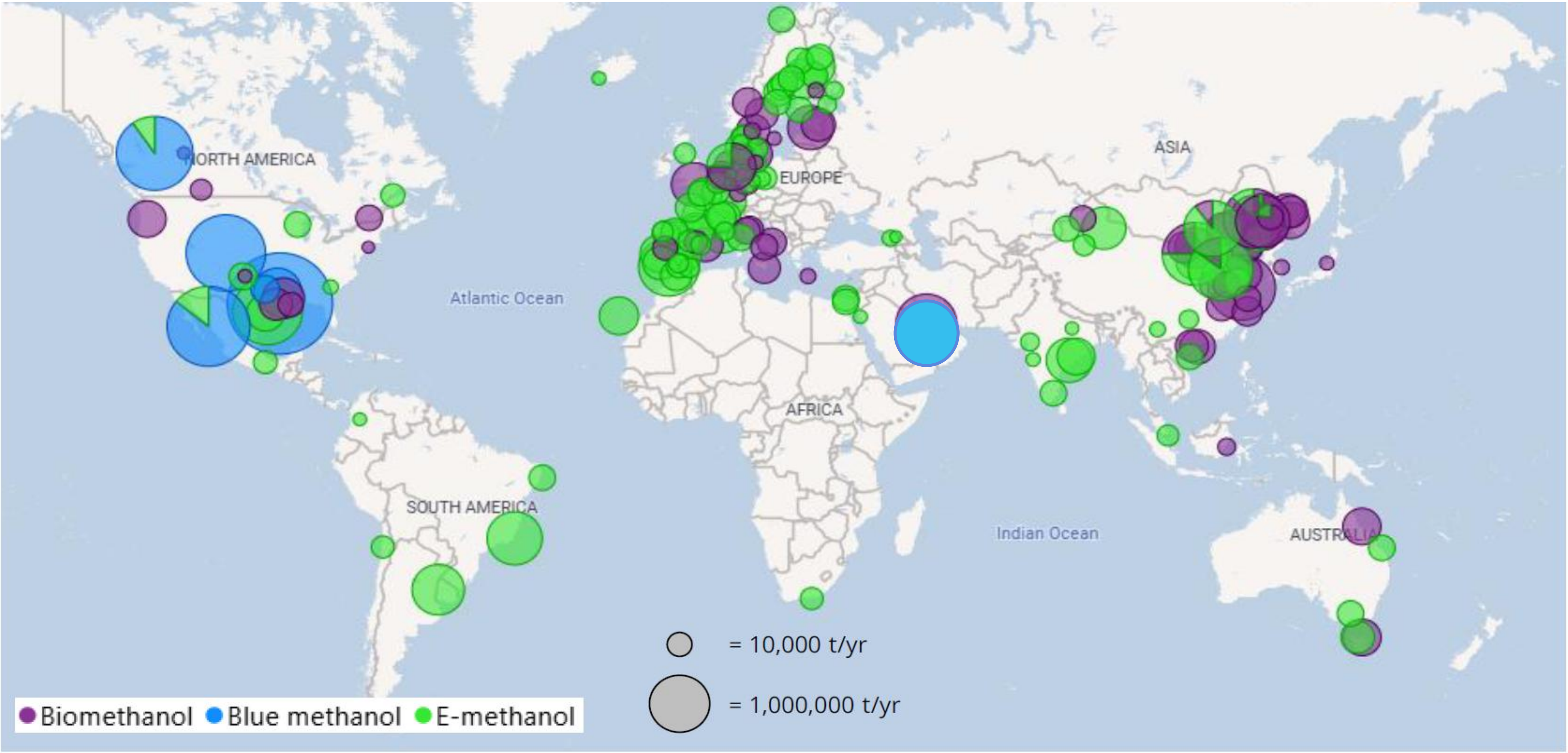
Source: DVN

Delivery schedule of methanol fleets



- **Over 100** methanol fleets are operational globally. This number will continue to grow and reach 482 by 2030.
- **Container ships account for 56%,** followed by bulk carriers 13%, and methanol/oil carriers 8%.
- **Top ship owners** who ordered the most methanol fleets are Maersk, CMA CGM, COSCO, Evergreen, Wan Hai, and ONE

Global low carbon methanol projects: China, Europe and the Americas lead the investments



Challenges to Energy Transition

Barriers to the Energy Transition

Currently low-emissions technologies and products are more expensive than conventional sources

Policy is the key driver of renewables

Governments role is to introduce policies to guide markets in a sustainable direction for consumers

Carrots (incentives)	Sticks (penalties)
▪ Subsidies (e.g. feed-in-tariffs/premiums, contract for differences) ▪ Tax advantages ▪ Consumption mandates ▪ GHG intensity targets	▪ Carbon pricing (e.g. ETS, carbon taxes) ▪ Tariffs/Carbon Border adjustment mechanisms ▪ Universal standards to measure and account for carbon intensity

Finding the right balance between Sticks and Carrots is the key challenge of environmental/energy policy to reach GHG emission reduction targets while protecting consumers and producers from high costs

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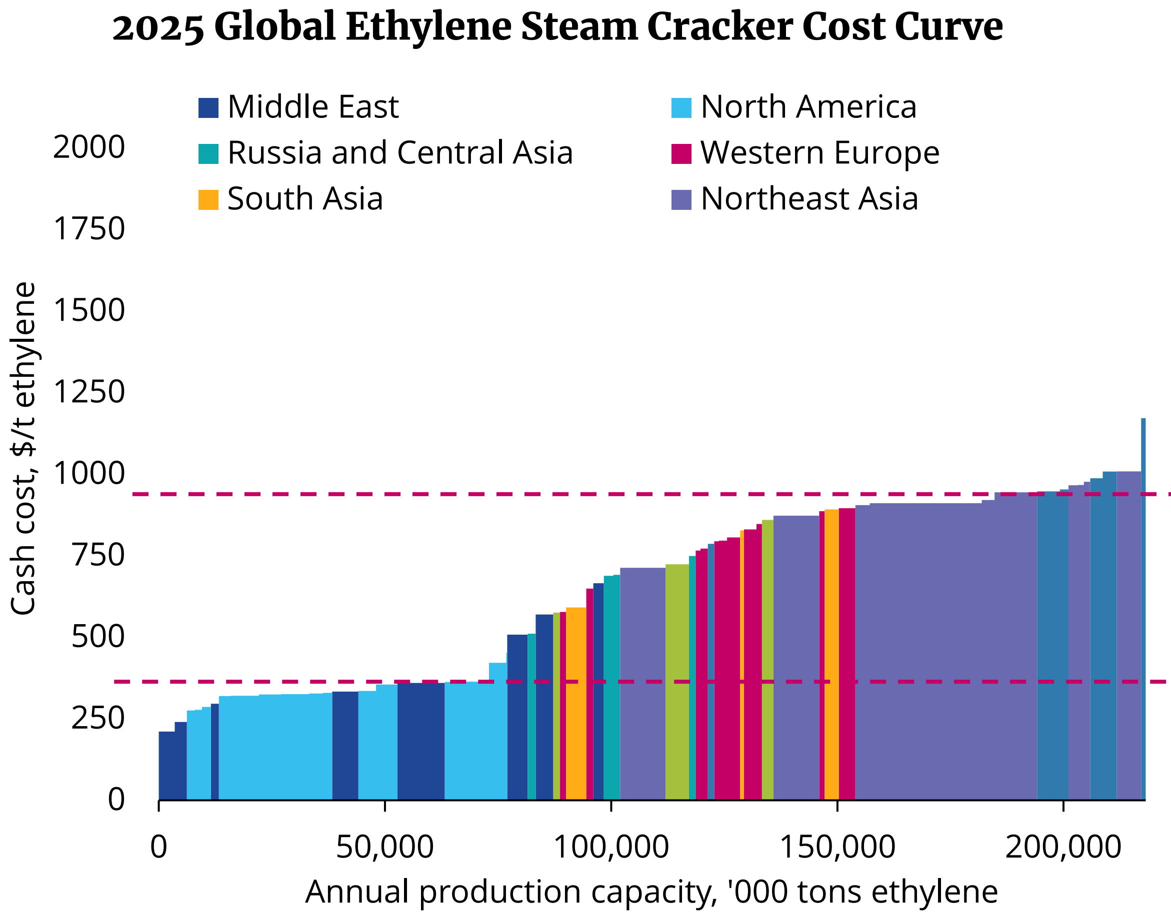
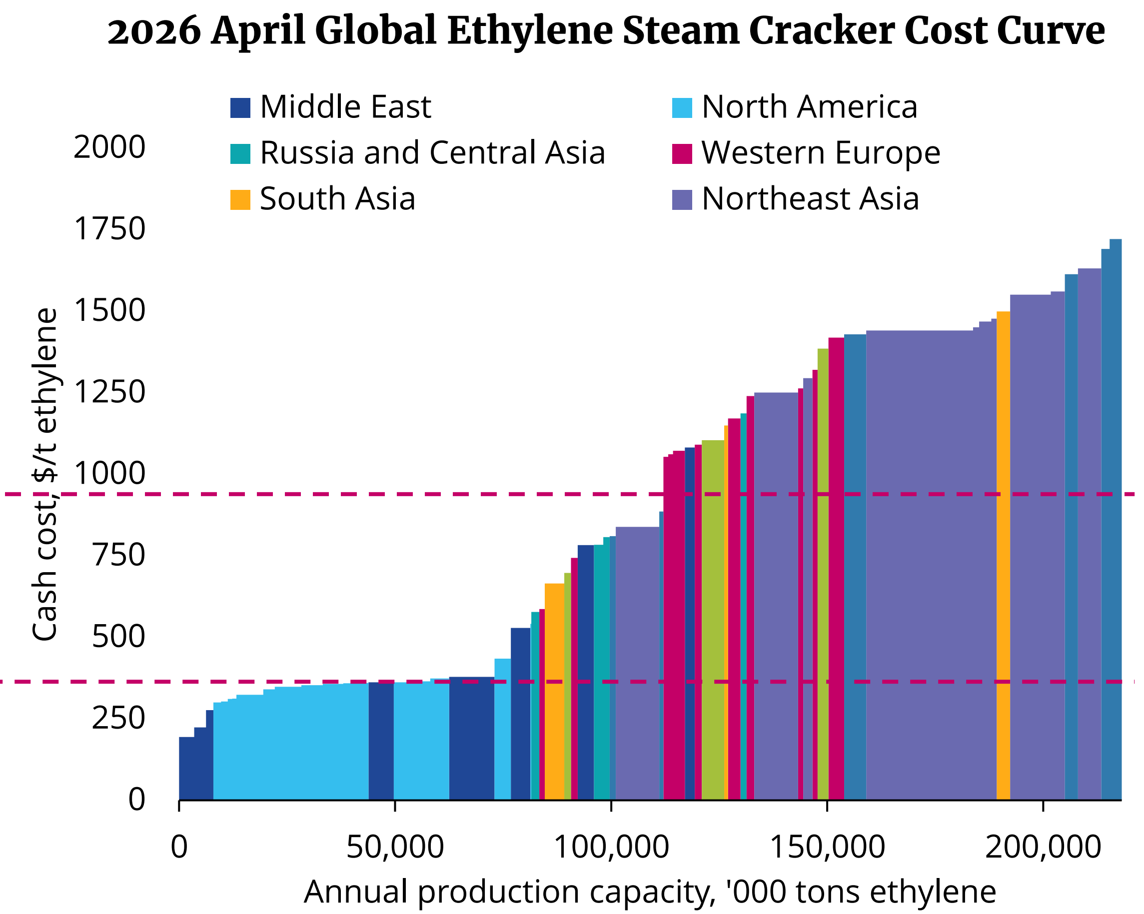
Cost and cost competitiveness is a major barrier

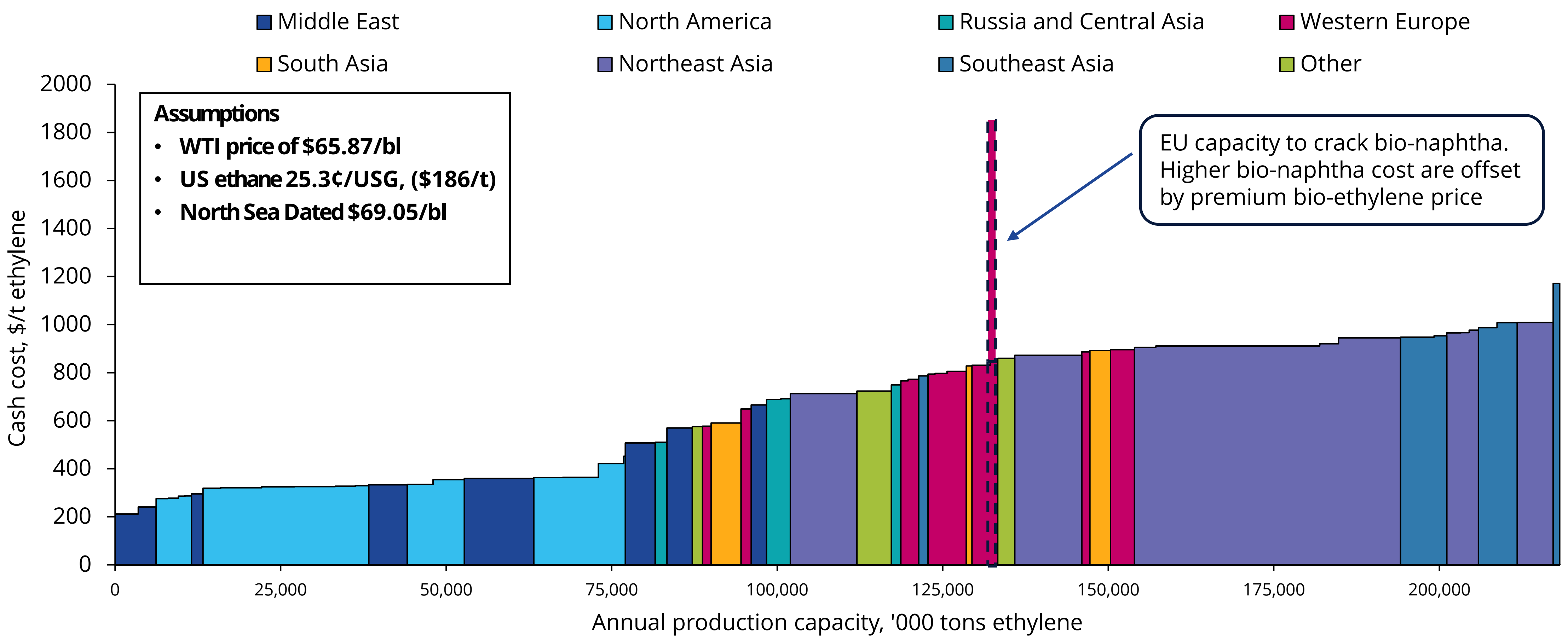




2025 (66 $/bl) vs 2026 April Cost Curve (100 $/bl, WTI)

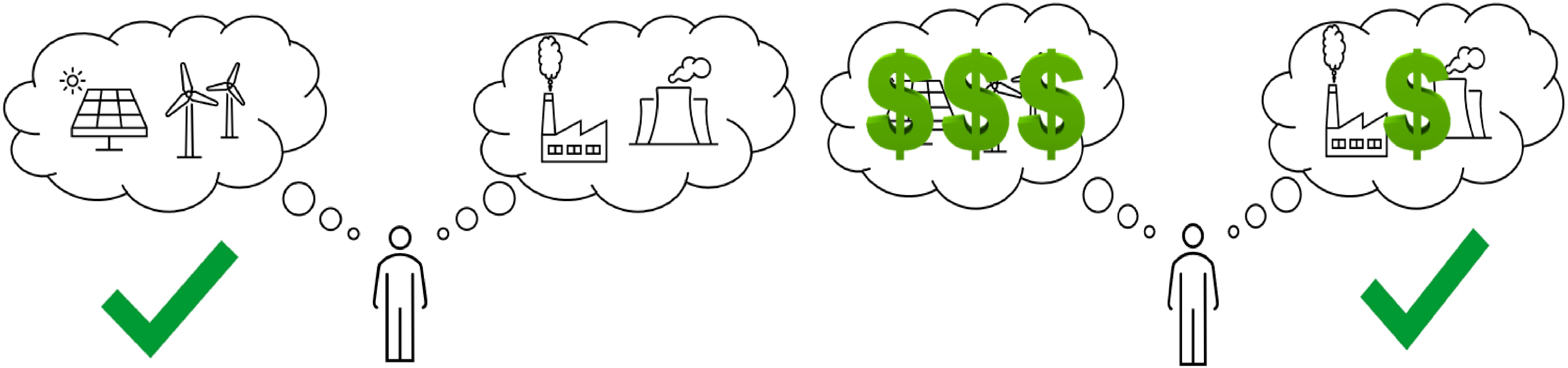
The cost of bio-naphtha more than doubles the cost of producing ethylene in Europe

2025 Global ethylene cost curve



Source: Argus Media – Consulting Services

Currently low-emissions technologies and products are more expensive than conventional sources

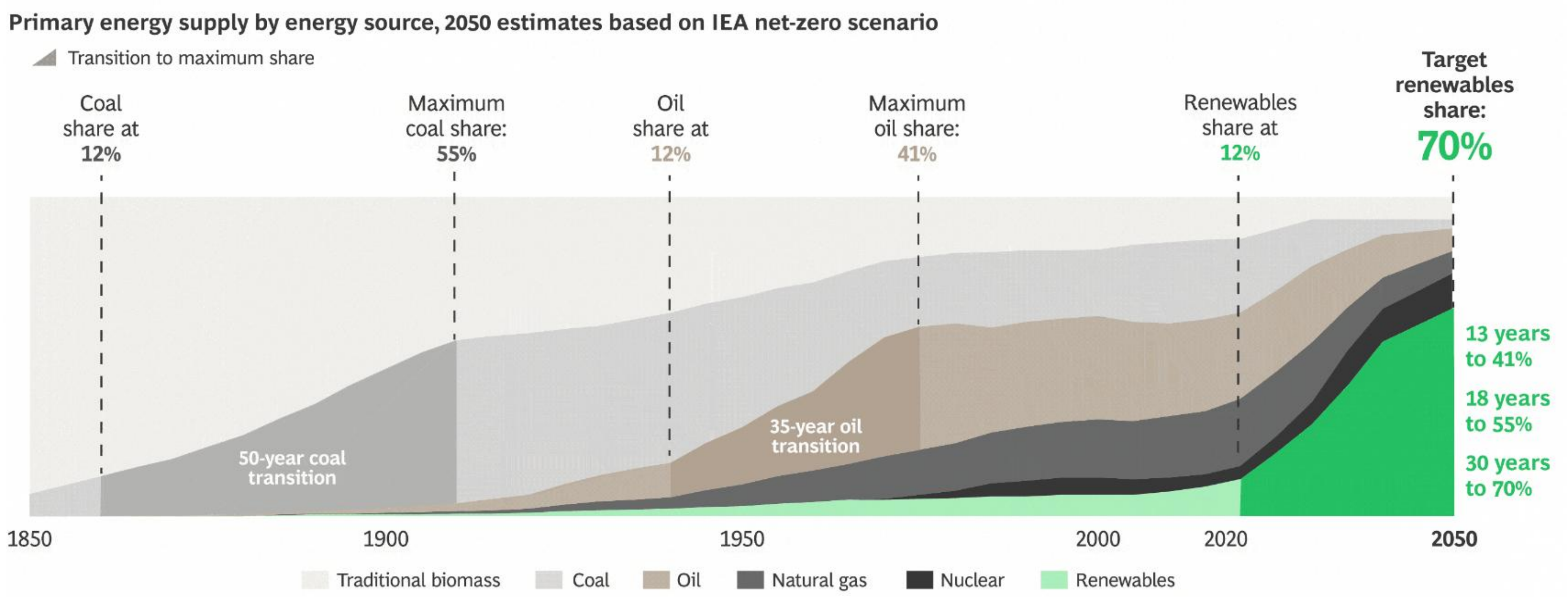


Climate conscious consumer, but a cost-conscious brand owner

Not enough to meet climate change goals –

Feedstock changes don’t reduce direct CO2 emissions

- Currently we are locked-into fossil fuels because they are cheap and highly compatible with our economies following significant optimisation over many decades
- For the world to transition to renewable energy sources they must become cost-competitive with/cheaper than fossil fuels, but currently they are more expensive, and consumers are not willing to pay a “green premium” for low-emissions and sustainable products
- Therefore, the energy transition is/will require support from governments to help scale up technologies and develop new markets – but there must be a careful balance between meeting climate targets, affordability for consumers and industrial competitiveness



“The transition to net-zero needs to happen roughly 3x faster than previous transition”

Source – BCG

So is this affordable – especially in the current climate ?

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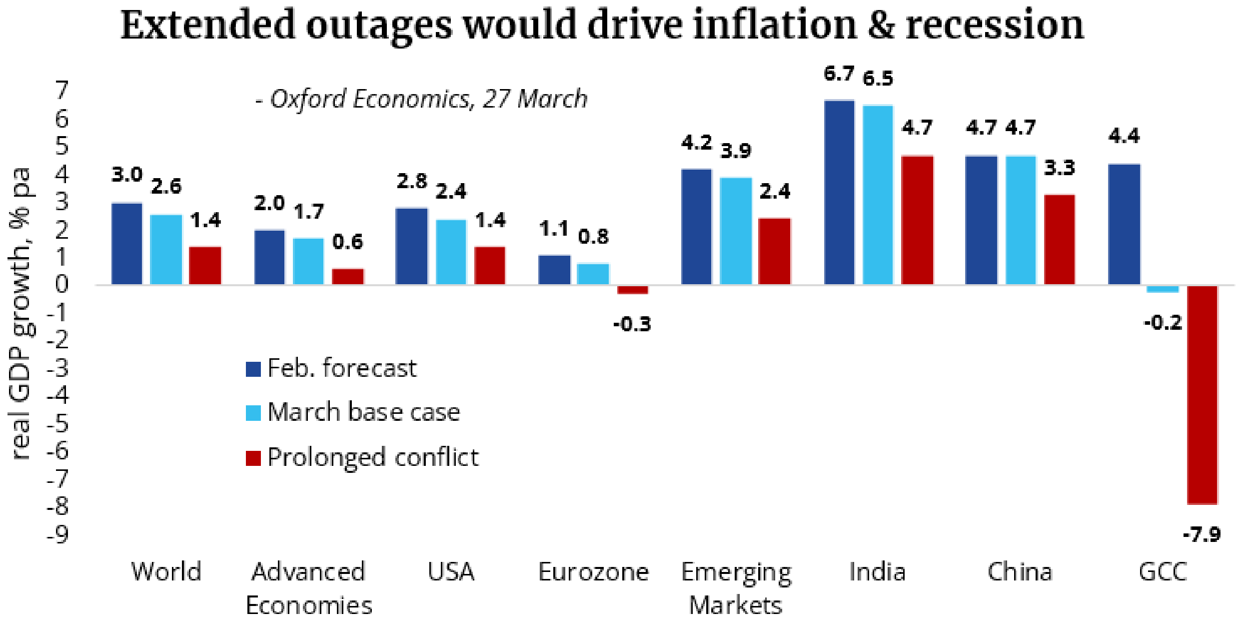
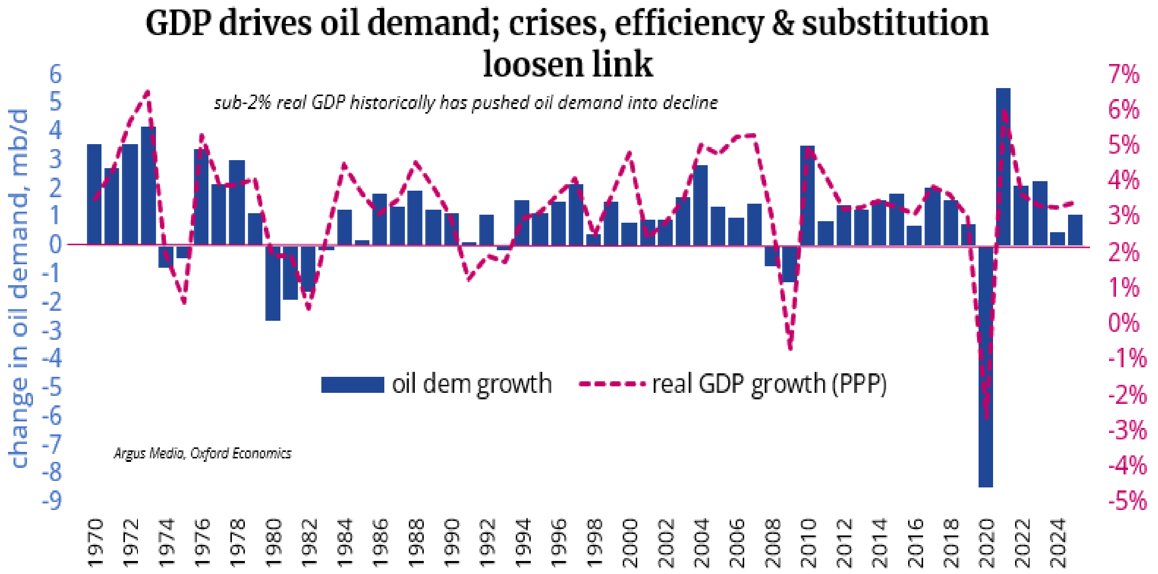
Macro scenarios highlight downside risks

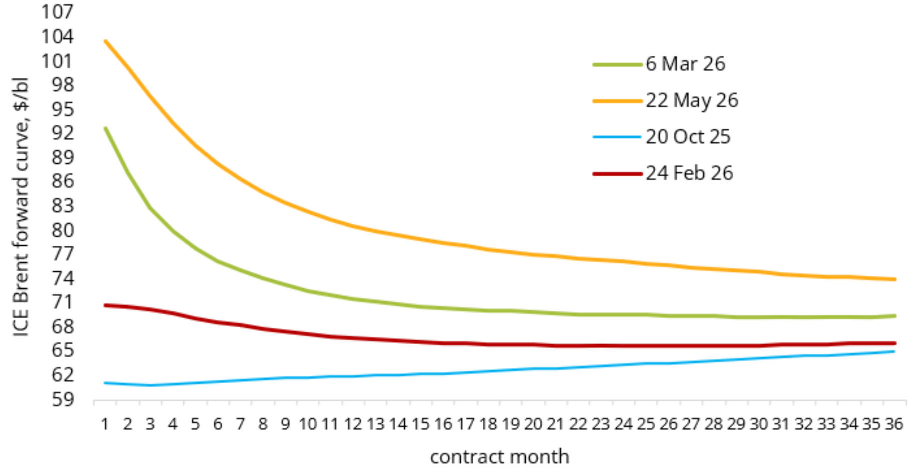




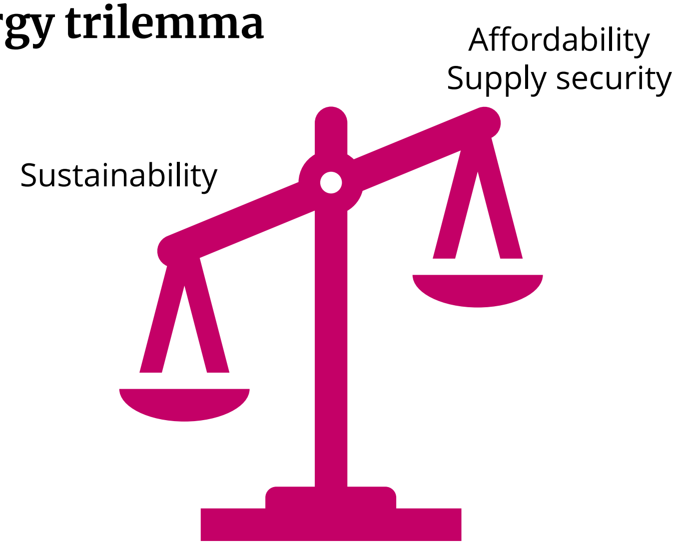
- Longer-term inflation consequences depend on conflict duration, Hormuz (& Red Sea) transit, supply chain resilience & damage to regional energy infrastructure.
  - 1-month disruption → limited inflation impact, CB policy unchanged.
  - 3-month disruption → delays CB rate cuts or limited rate hikes.
  - 6-month disruption → Widespread rate hikes to control inflation.
- All scenarios imply downgrades for 2026 GDP growth from negligible for 1-month stoppage to ~0.5pp downgrade or outright recession in prolonged conflict case.

Potential implications from the Hormuz crisis

Long-dated Brent shifts higher



The energy trilemma



1. Short term inflation, interest rate hikes & slower GDP growth.
2. Gulf exporters to expand pipeline alternatives to Hormuz Strait.
3. Waterway "nationalisation" is unlikely to prevail.
4. Importers to prioritise multiple supply sources: but is dependence on US & China for energy commodities & technologies more secure than trade with MidEast Gulf, Iran or Russia?
5. More long-haul trade, stretched delivery lead times → freight takes a higher share of delivered costs.
6. Inventory management – a greater role for strategic stockpiles and moving from "just in time" to "just in case" stock-holding.
7. European de-industrialisation rethink – refining, chemicals, fertilisers & metals?
8. 2020-2026 experience highlights energy policy trilemma – supply security & affordability to catch up with sustainability?
9. Do elevated debt, higher cost of capital & prioritisation of defence & security make de-carbonisation & electrification easier or harder?

Q&A

Do you have any questions?

Thank you for listening.

Chuck Venezia / Sarah Rae

Chuck.venezia@argusmedia.com/sarah.rae@argusmedia.com

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