ABS

BEYOND THE HORIZON

VISION MEETS REALITY

2025 SUSTAINABILITY OUTLOOK

EXECUTIVE SUMMARY

1.1 Well-to-Wake Emissions Fall Short: Net-Zero Ambition in Question

Although shipping has reduced carbon intensity per unit of transport work for almost two decades — initially by slowing vessel speeds and increasing ship sizes, and later through environmentally conscious operations and improved design — the total Well-to-Wake (WtW) greenhouse gas (GHG) emissions present a different narrative. After the 2008 financial crisis sharply reduced trade volumes, emissions have steadily increased in line with trade growth and rising tonnage on the water since 2010.

The shipping industry operates through self-regulating dynamics of supply and demand, influenced by macroeconomic indicators such as gross domestic product (GDP) and population growth, geopolitical disruptions including sanctions and security threats, and climatic factors such as droughts. Similarly, the improvements in carbon intensity observed so far — only partially attributable to environmental initiatives — have largely been shaped by market forces.

Today, shipping's WtW carbon dioxide (CO_2) emissions are approximately 121 percent of the 2008 baseline, highlighting the growing challenge of meeting industry targets.

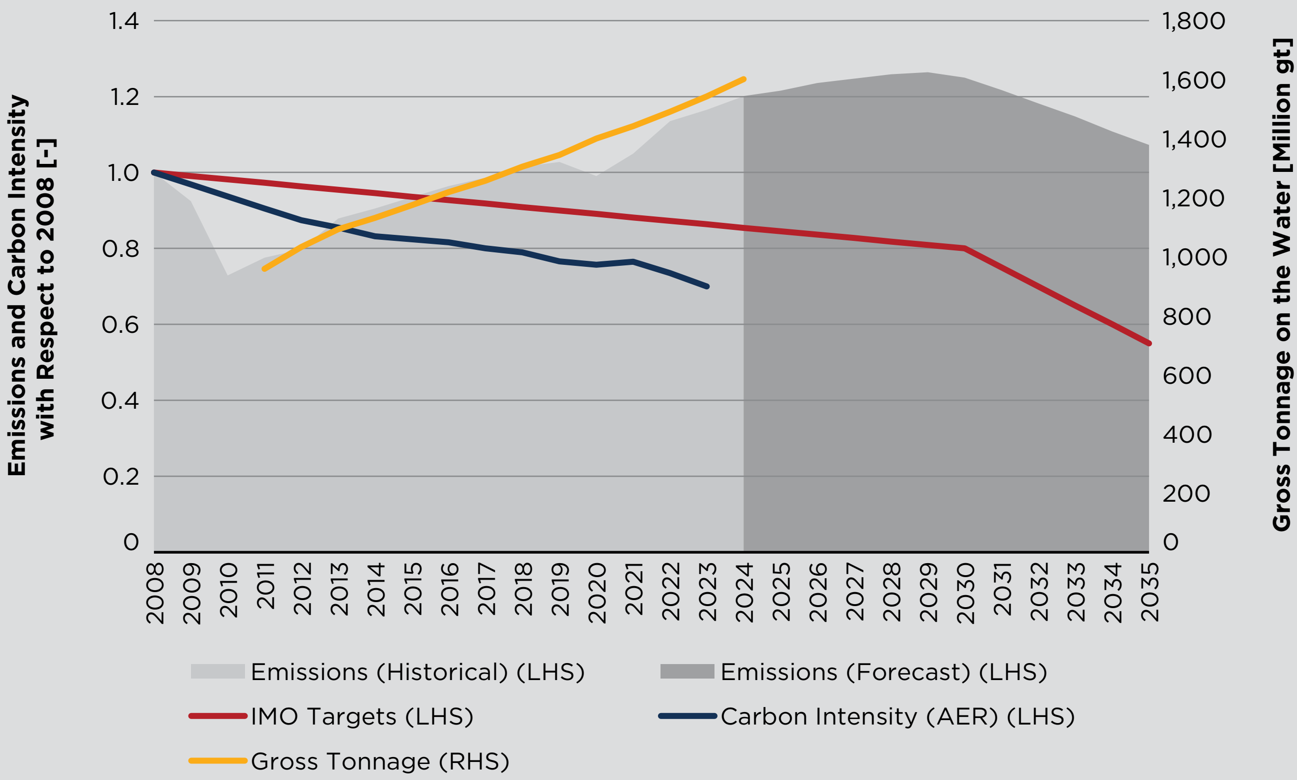


Figure 1: Evolution of shipping CO_2 equivalent emissions.

While the industry has yet to fully assess the true impact of regulatory measures on shipping decarbonization, it is evident that in highly regulated markets, end users will largely bear the cost of compliance, rather than shipowners or charterers. As a result, regulatory constraints function as additional variables within the system, rather than overriding the prevailing market dynamics. Given the relatively limited availability of low carbon solutions, compliance costs — whether from regulatory penalties or the procurement of high-cost green fuels — are expected to function as de facto trade tariffs. This dynamic carries significant implications for efficiency and competitiveness in global maritime trade.

1.2 LNG and Biofuel Availability and Affordability Outpace Green Fuel Readiness

Prevailing market dynamics reveal that, from a total cost of ownership perspective, clean fuels currently present a weak economic case due to their high costs and limited availability, even under optimistic assumptions for their adoption. At the same time, compliance costs are rising sharply. For example, vessels trading within the European Union (EU) could see daily operating costs increase from approximately $15,000 in 2028 to around $45,000 by 2035 for a ship consuming 30 tons of very low sulfur fuel oil equivalent (VLSFOe) per day.

Blue fuels heavily rely on carbon capture technologies, which are advancing slowly. Clean fuels, on the other hand, depend on electrolyzers and renewable electricity, both of which face escalating costs and significant investment risks. Green methanol is limited by its dependence on renewable hydrogen and scarce biogenic CO_2, with costs estimated to be two to four times higher than conventional fuels. Although ammonia is promoted as a zero-carbon alternative, it is corrosive and toxic. Additionally, most ammonia projects are driven by energy majors targeting energy markets rather than maritime applications. Hydrogen faces even steeper challenges: infrastructure remains nascent, safety risks are considerable and deep-sea readiness is not expected.

While these fuels may play a role later in the transition, they are unlikely to deliver meaningful decarbonization before 2040. They remain strategic wildcards that warrant monitoring, but they do not provide a reliable foundation for near-term fleet planning. Any regulatory intervention aimed at forcing their adoption would require such high compliance costs that it risks distorting competitive market behavior.

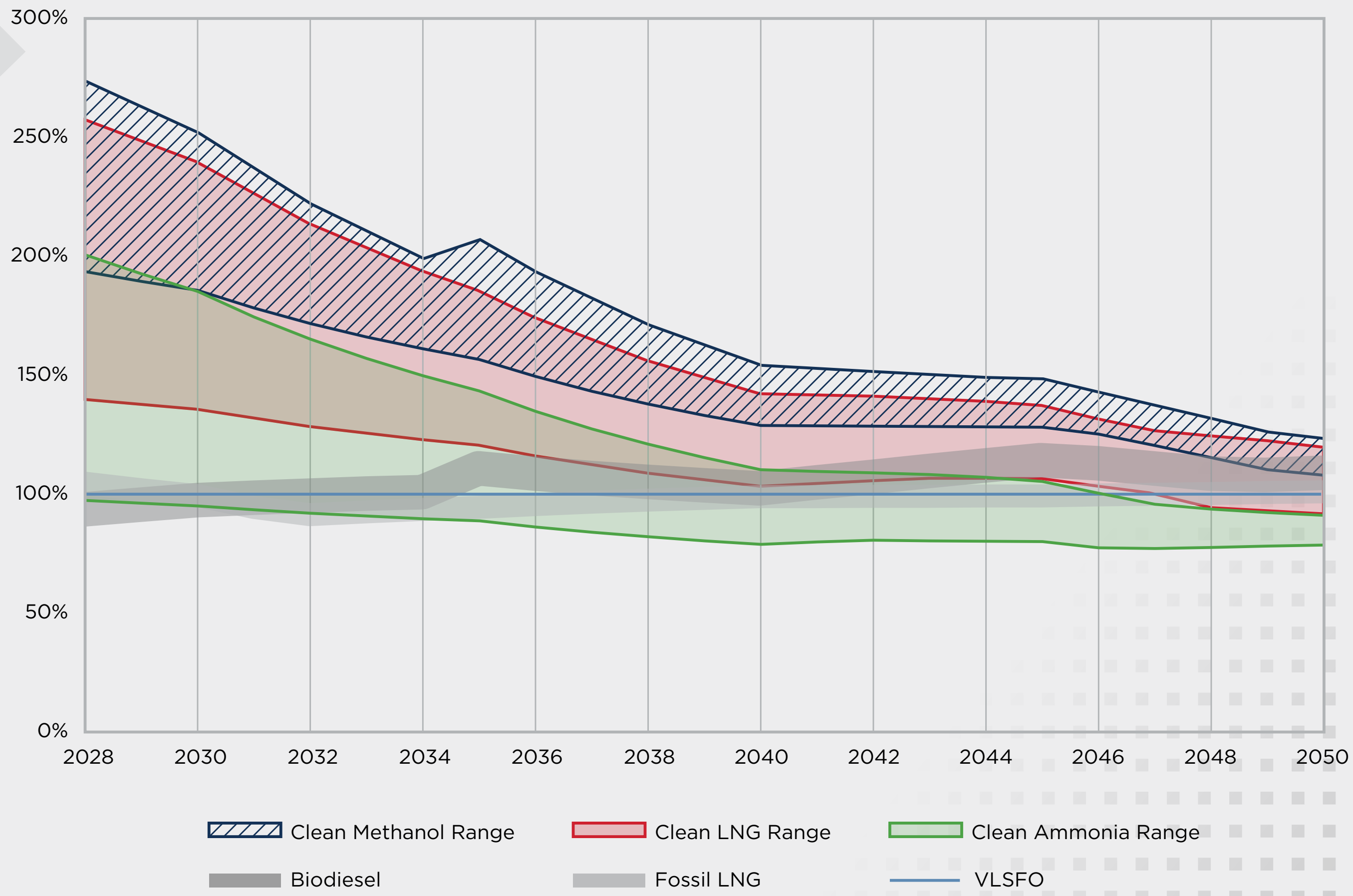
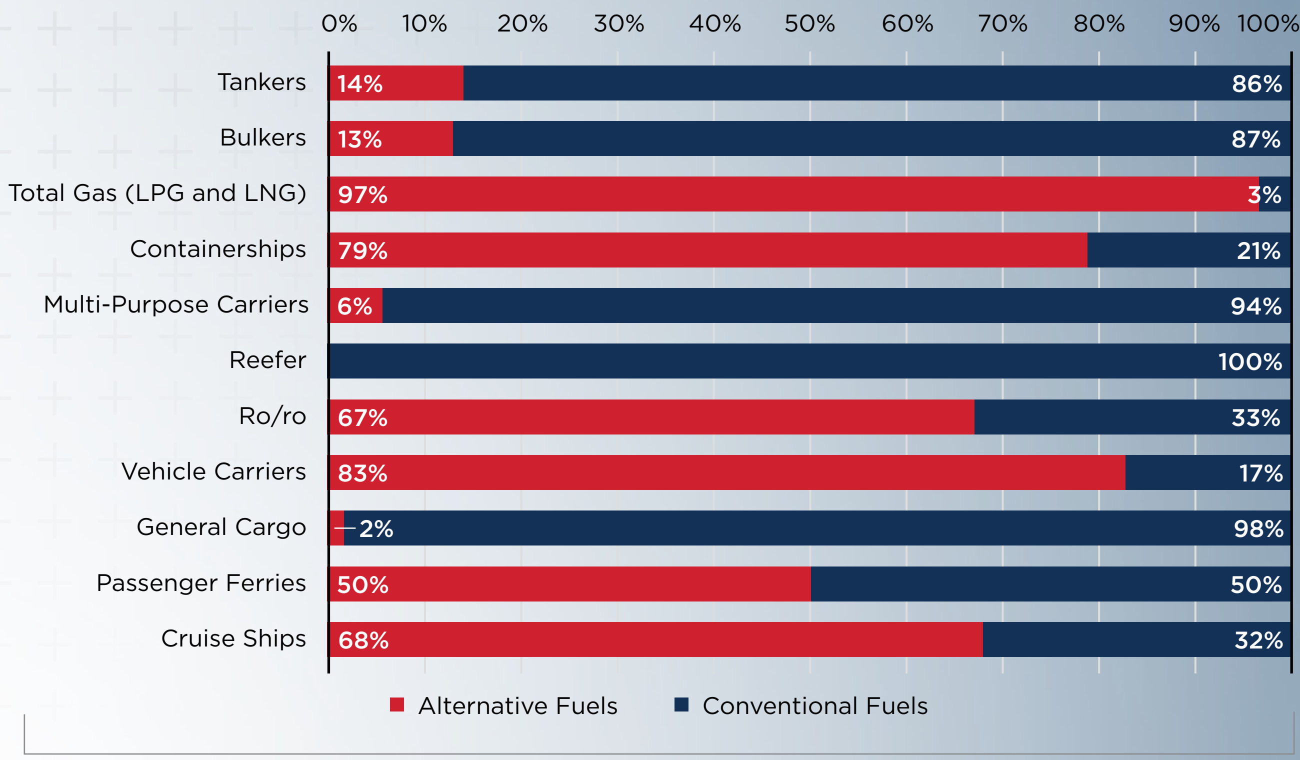
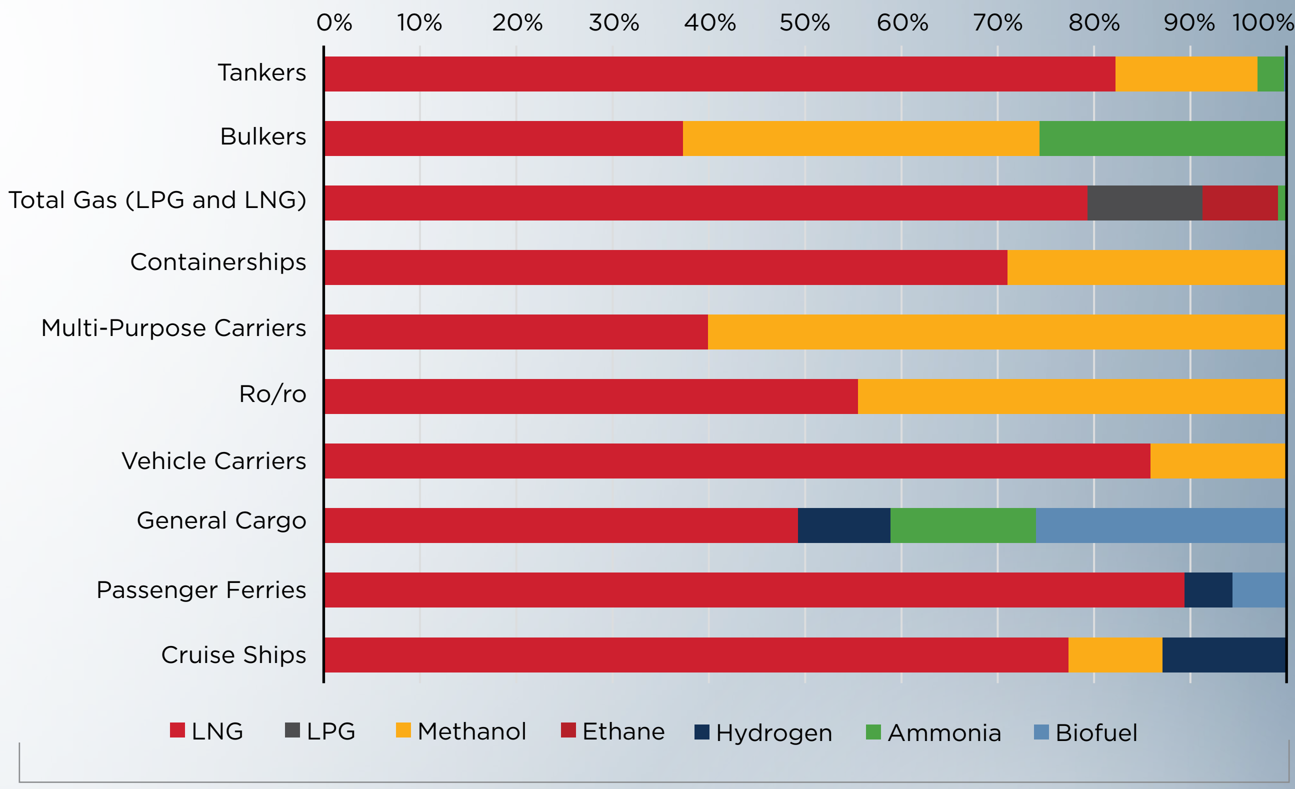


Figure 2: Total cost of ownership for different fuel options for a Panamax and IMO fuel-related costs [ABS, MSI].



Share of Alternative Fuels (per gt)



Alternative Fuel Mix (per gt)

Figure 3: Orderbook: fuel transition reality check.

Conversely, liquefied natural gas (LNG) stands out as a relatively clean alternative to conventional fossil fuels. While it may incur higher compliance costs than green fuels in the long term, LNG offers much lower base costs and a more robust global supply chain. Both base cost and future penalties for LNG can be predicted with relatively high confidence, making it a pragmatic choice for the foreseeable future. Additionally, LNG serves as a strategic enabler in the transition to blue fuels, acting as key feedstock for amine-based carbon capture, while its supply chain lays the groundwork for trading ammonia and hydrogen.

In 2024, LNG-capable vessels represented 70 percent of all alternative-fueled newbuild orders. Bunkering infrastructure is now available at more than 170 ports worldwide, supported by more than 50 dedicated LNG bunkering vessels. Shipowners are increasingly turning to LNG because it offers certainty as a proven fuel with established safety standards and expanding infrastructure. Liquefied natural gas is an affordable fuel option that enables decarbonization even in the hardest to abate ship segments.

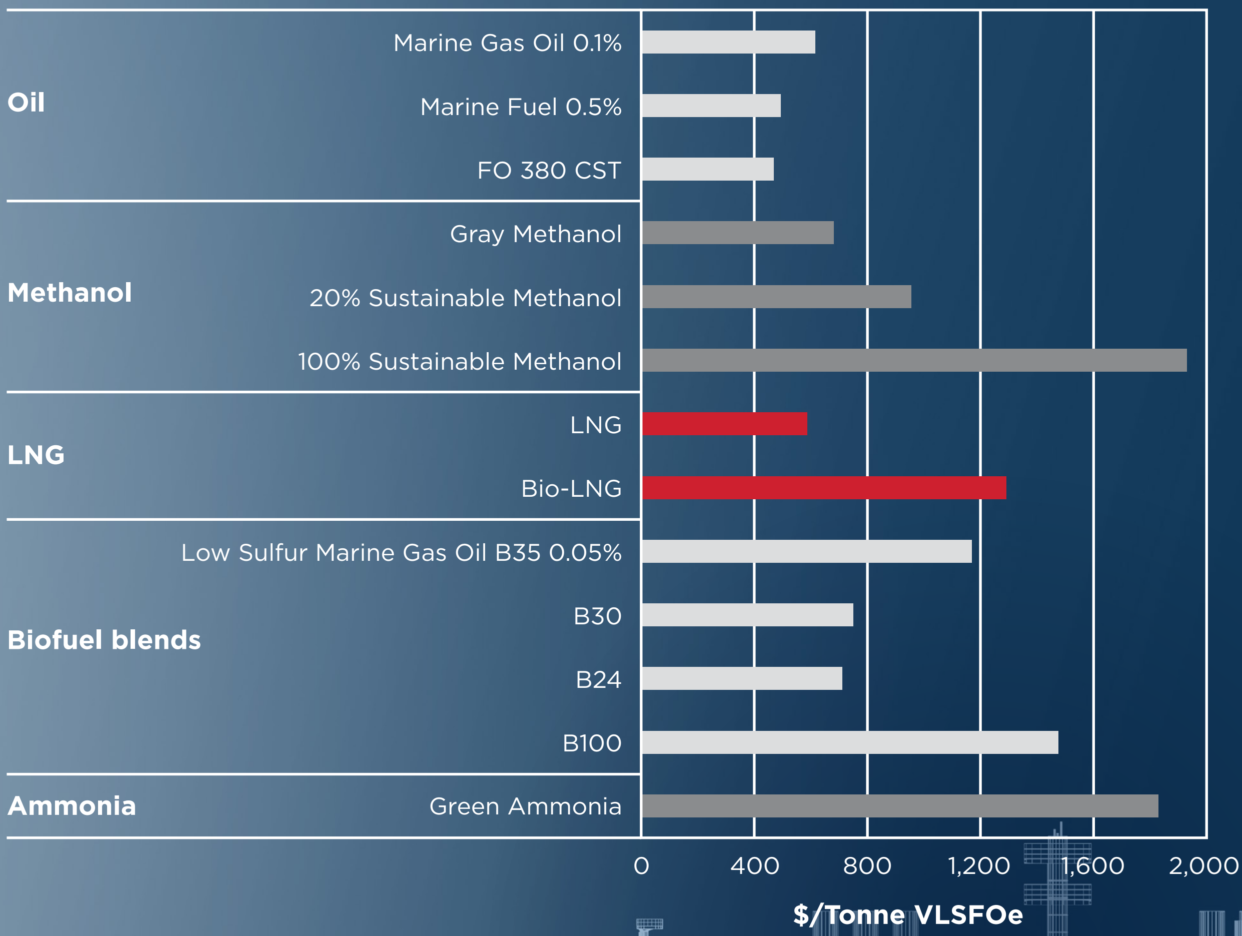
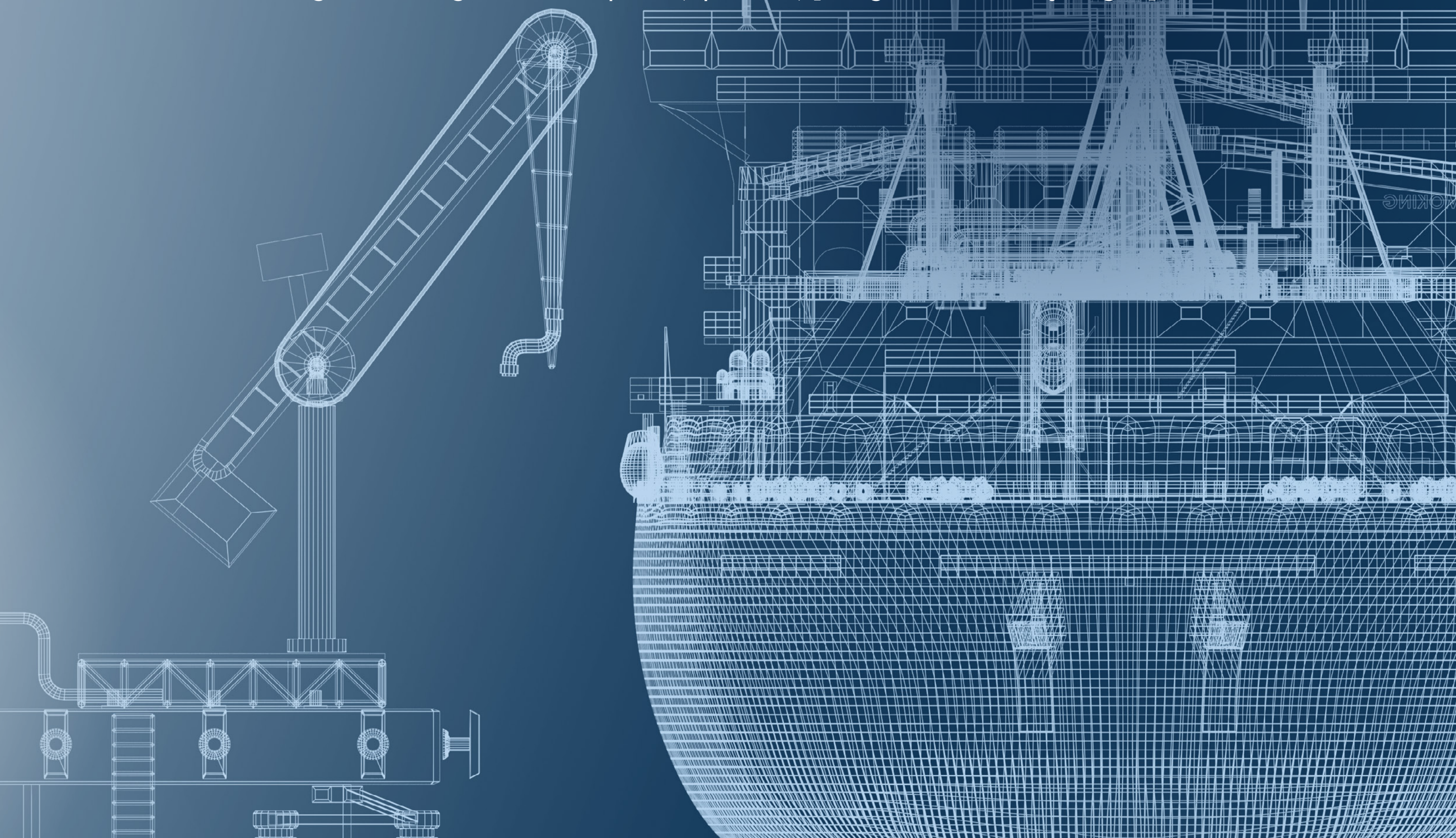


Figure 4: Average marine fuel prices (April 2025) [S&P global commodity insights].



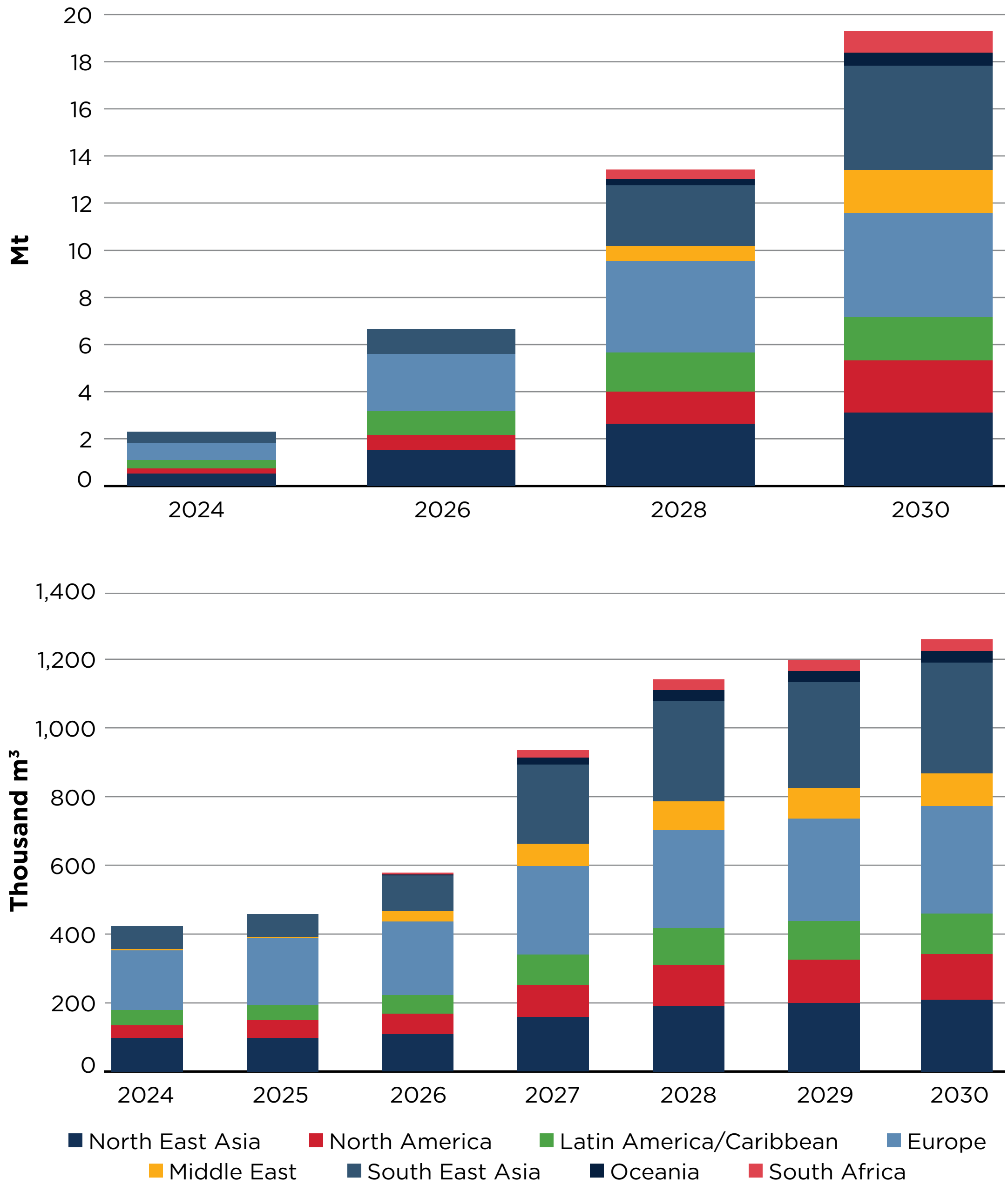


Figure 5: LNG bunker demand (top) and bunker fleet (bottom) up to 2030 [MSI, ABS].

1.3 Energy Efficiency Technologies and Carbon Capture Extend the Runaway

However, LNG's role in decarbonization has its limitations. It is not a zero-carbon fuel and must be considered within a broader, long-term strategy for emissions reduction.

Energy efficiency technologies (EETs) and carbon capture represent the industry's "runway extension." While they cannot replace the fuel transition, they can help maintain progress until scalable zero-carbon fuels and nuclear options become available.

Energy efficiency technologies such as air lubrication, wind propulsion and other energy improvement measures are rapidly scaling up, with EETs installed on nearly half of the gross tonnage currently in operation. FuelEU Maritime provides direct reward factors for wind propulsion, encouraging uptake. Although onboard carbon capture systems are not yet included in compliance measures, they are progressing toward regulatory integration. Meanwhile, liquefied carbon dioxide (LCO_2) carriers are emerging as a key transportation method in the CO_2 value chain and the production of blue fuels. However, industry readiness varies significantly by vessel type.

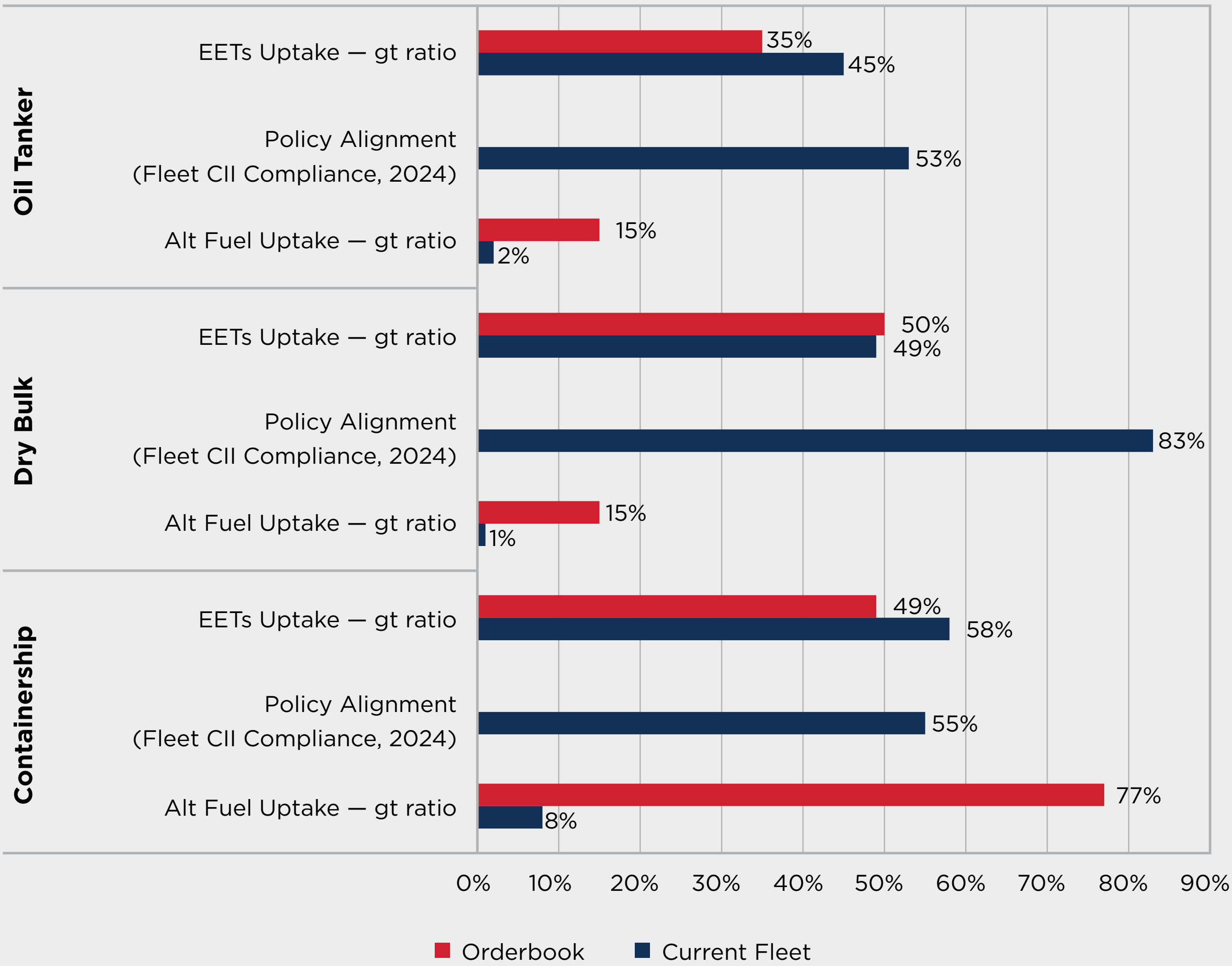


Figure 6: Industry readiness (policy alignment by vessel number).

Another constraint is shipyard capacity. Under realistic scenarios, global retrofit capacity turns negative by 2028–2030, creating a bottleneck that could leave many owners without compliance options if they delay booking slots.

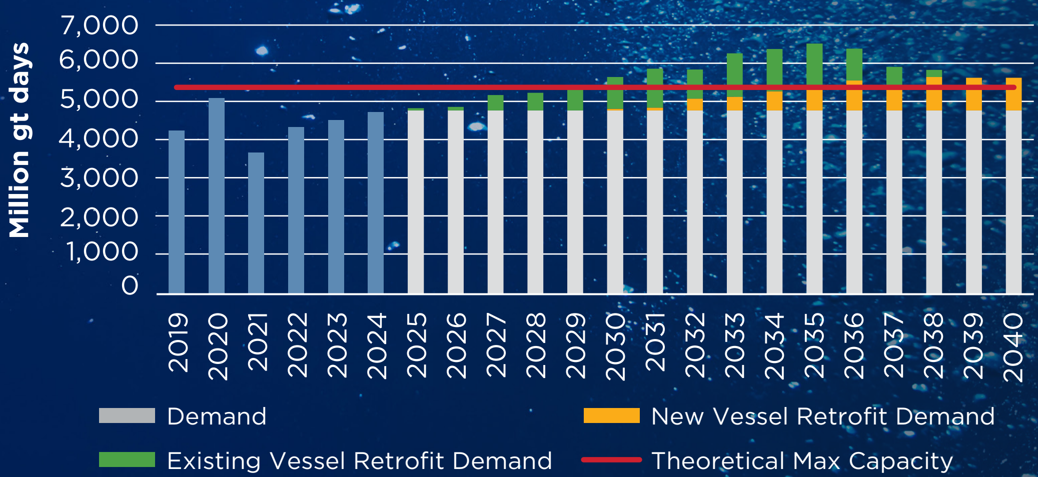


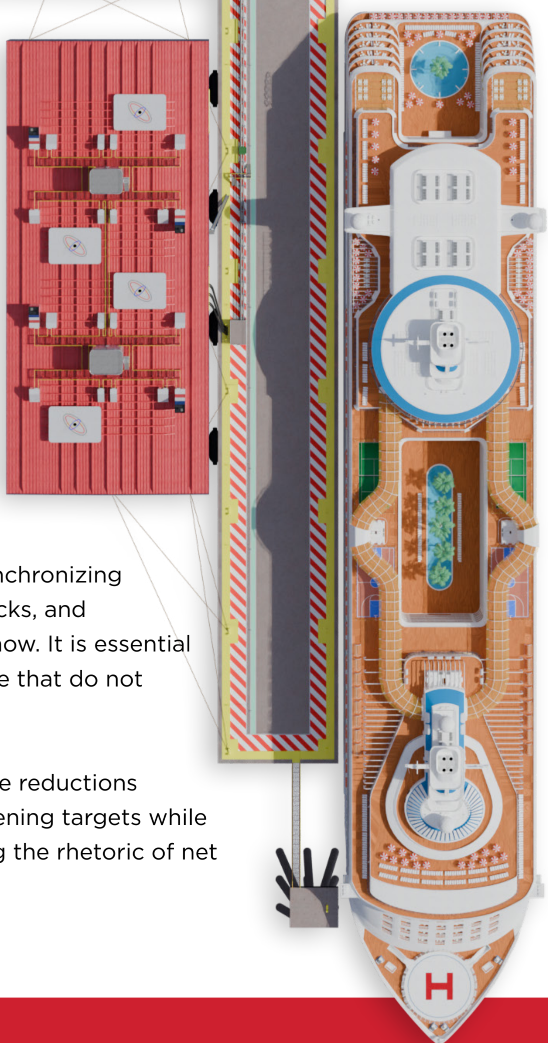
Figure 7: Shipyard capacity deficit projection.

1.4 Nuclear is the Long Game

Looking beyond 2035, nuclear propulsion — particularly using small modular reactors (SMRs) — offers a promising pathway to close the maritime decarbonization gap. Small modular reactors provide near-zero emissions and remain insulated from the volatility of green fuel markets. Early demonstrations of floating nuclear power plants are emerging, potentially paving the way for shipboard integration.

Scaling SMRs for merchant fleets depends on risk underwriting, insurance, an updated code for nuclear merchant ships and public acceptance. Floating nuclear power plants in the 2030s present a realistic entry ramp. However, widespread adoption will require robust insurance mechanisms. While technological readiness is advancing, key barriers remain, including regulatory frameworks and public perception. Notably, the International Maritime Organization (IMO) recently decided to update The Code of Safety for Nuclear Merchant Ships, which was adopted in 1981.

1.5 Conclusion



Shipping is not yet aligned with the IMO trajectory. Emissions remain above the 2008 baseline, compliance costs are compounding, and the signals shaping investment — regulation, fuel pricing, penalties, availability, scalability — are moving at different speeds. The risk is clear: the industry could end up monetizing carbon without actually delivering decarbonization.

This Outlook outlines a pragmatic course that bridges the gap between ambition and reality. As the 2030s approach, the only bankable path is to protect the bridge (LNG with methane-slip controls and credible bio- or e-LNG pathways), extend the runway (EETs and onboard carbon capture to cut WtW emissions now), and prepare the endgame (nuclear and true zero-carbon fuels when they are safe, insurable and investable at scale).

The priority is to decarbonize safely, credibly and affordably. That means synchronizing frameworks to avoid double charging, derisking retrofits amid yard bottlenecks, and focusing on lanes where vessels, fuel and infrastructure can come together now. It is essential not to over-penalize the solutions that work today, nor to over-promise those that do not yet exist at scale.

By converting monetization into mobilization, backing near-term, measurable reductions and investing with discipline in tomorrow's options, shipping can meet tightening targets while preserving safety, reliability and trade. Getting this right is not about winning the rhetoric of net zero; it is about building the system that actually delivers it.

Download the complete Outlook today at www.eagle.org/outlook2025.

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