Navigating decarbonization trajectories

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The fight against climate change is one of the most pressing challenges facing humanity. However, achieving meaningful progress for the shipping sector requires a nuanced understanding of the main drivers and opportunities that will influence future decarbonization trajectories for the industry. This extends beyond purely technical considerations: it is essential to consider key factors across the entire value chain, accounting for the broader economic context in which the transition is taking place.

To address this multifaceted challenge, Bureau Veritas Marine & Offshore (BV) has developed a bottom-up model. It is built on the premise of the micro-attributes of the global shipping fleet, accounting for the different segments and vessel types, to simulate the overall effects at a macro level. By reflecting the dynamics and inertia of the global shipping industry under different drivers, we can calculate how the fleet's greenhouse gas (GHG) emissions might fluctuate according to key influences. This enables us to understand the various potential decarbonization trajectories in the shipping industry – and, from there, outline the practical solutions and collaborative strategies that will be necessary to navigate this complex voyage.

Rather than reiterating the broad significance of decarbonization, BV's **Decarbonization Trajectories study** looks at what the journey may look like in practice. By acknowledging the intricate interplay of market dynamics, economic considerations, and technological advancements, we aim to provide actionable insights for stakeholders seeking to integrate sustainable practices into their corporate strategy.

We must start by asking which key measures can have the most impact on addressing climate change. Drawing on BV's wide-ranging expertise, our study has identified actionable levers toward decarbonization.

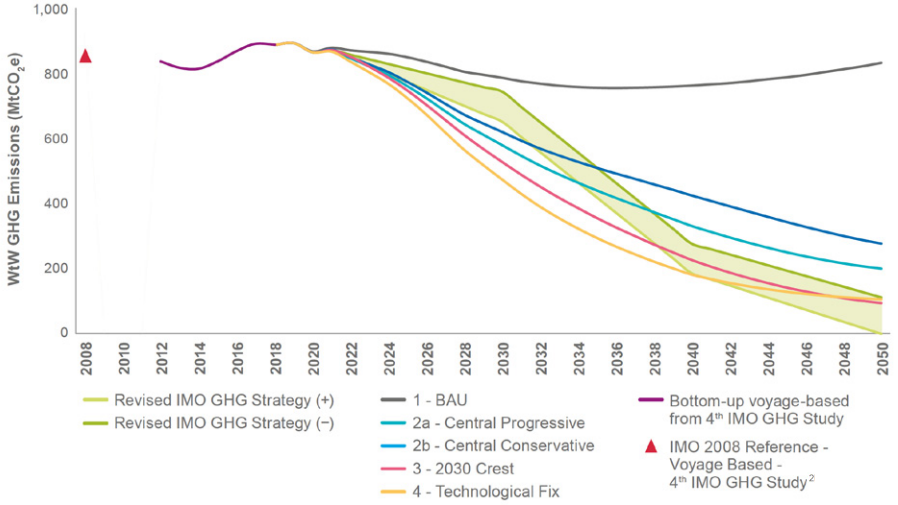
Over/under budget

A fundamental starting point for any calculation of climate impact is to consider shipping's 'GHG budget to 2050' instead of solely focusing on emission levels at the end of the journey. In short, we need to focus on the total amount of CO_2 that can be emitted up to the point of carbon neutrality. This is essential because climate change is directly linked to the total quantity of GHGes present in the atmosphere, not only those emitted annually.

Our results show that if we are to keep shipping within its 2050 GHG budget, operational measures and energy-saving technologies must be prioritized, especially early on when emissions are at their highest. The significance of reducing speed and minimizing waiting times cannot be overstated, as a ship's fuel consumption typically adheres to a cubic law in relation to its average speed during sailing time. BV's simulations show that without action to reduce speed or waiting time while ocean transportation volumes grow moderately to reach a 50% increase by mid-century, GHG emissions would be 92% higher in 2050 – with 44% more emissions over the period from a GHG budget perspective – than if these levers had been actioned. The pathway to 2050 is just as crucial as the emissions remaining by that time.

These actionable levers offer hope for substantial emission reductions globally. By exploring the various facets of this transition, we aim to provide insights into how stakeholders can navigate the complexities of decarbonization while balancing the need for sustainable practices with economic viability.

Fig. 1. International shipping well-to-wake GHG emissions[1]



[1] *IMO announced that its ambition after MEPC80 is to "reach net-zero GHG emissions by or around, i.e. close to 2050." In this graph, the most ambitious of the two IMO trajectories reaches zero emissions by 2050 while the trajectories representing the minimum ambition of IMO reaches zero emissions by 2057. Emissions are calculated for international shipping on a well-to-wake GHG emissions scope*

[2] *Tank-to-well from 4th IMO GHG Study and well-to-tank estimated based on fuel share from 3rd IMO GHG Study*

Source for figs. 1-3: BVS bottom-up model

Compounded gains

Prioritizing operational optimization and energy efficiency not only reduces emissions but also enhances cost savings and operational performance. By decreasing vessel speed, minimizing waiting time in ports, and adopting energy-saving technologies, shipping companies can lower fuel consumption per voyage, thus curbing their carbon footprint while reducing costs. The proven long-term economic viability of these measures – especially when compared with options relying on the use of alternative fuels – aligns decarbonization efforts with financial objectives and market dynamics, ultimately providing a strategic advantage.

Digitalization emerges as a central facilitator, enabling enhanced data monitoring at both a vessel and fleet level for optimization purposes and facilitating the modeling of technology impacts. Moreover, energy-saving devices and technologies, such as low-friction hull coatings and autonomous hull-cleaning robots, offer favourable avenues for efficiency gains. Wind propulsion also presents a promising option for emission reduction, with increasing interest and adoption observed in recent years.

By focusing on operational optimization, companies can lower fuel consumption and emissions per voyage. Our report underscores that even small reductions applied to a large portion of the global fleet can result in substantial fuel savings and emission reductions, having a bigger influence overall than larger overhauls that may take place gradually over a longer period. Widely adopted measures with immediate – even if smaller – impacts will likely see their effects amplified over the run-up to 2050, showcasing the effectiveness of operational measures in driving decarbonization efforts.

Failure to act swiftly risks impeding progress toward global targets and exacerbating atmospheric and oceanic GHG accumulation. While long-term decarbonization goals rely on renewable and low-carbon fuels, embracing existing technologies and efficiency measures today is essential for steering the maritime industry toward a sustainable future.

However, amidst the array of available solutions, proven results remain paramount. Shipowners seek clarity on performance, safety, crew training, and return on investment before committing to new technologies. Collaboration between classification societies and technology developers becomes even more crucial in demonstrating the technical viability and safety of innovative solutions.

Fig. 2. Importance factors of each input for Scenario 2A

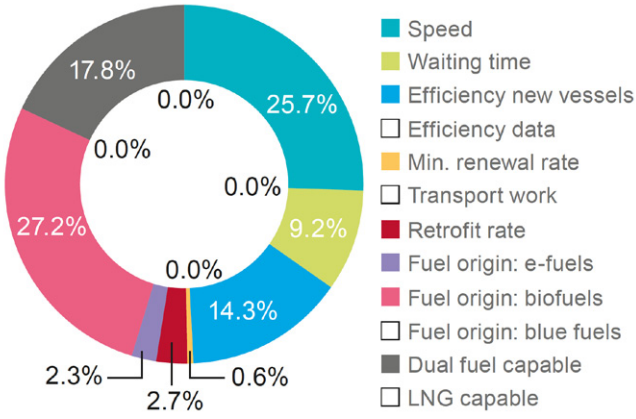
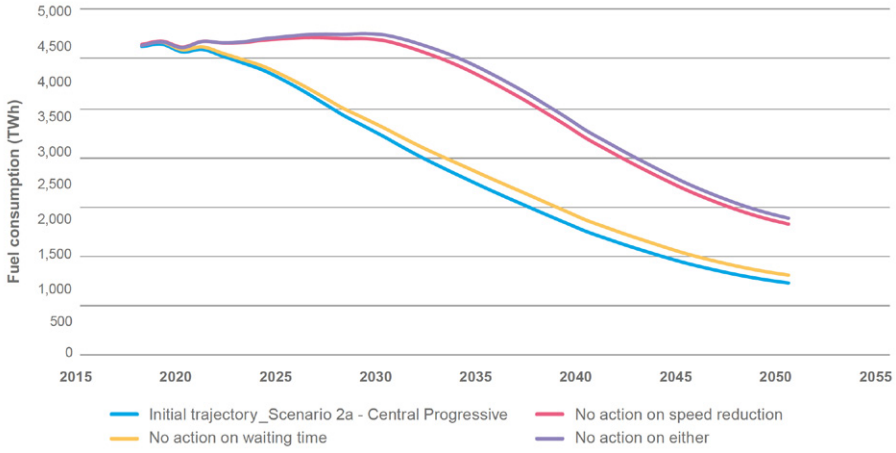


Fig. 3. Different GHG trajectories – study of the impact of speed and waiting time reductions on Scenario 2A



Energy insetting: everybody can move the needle

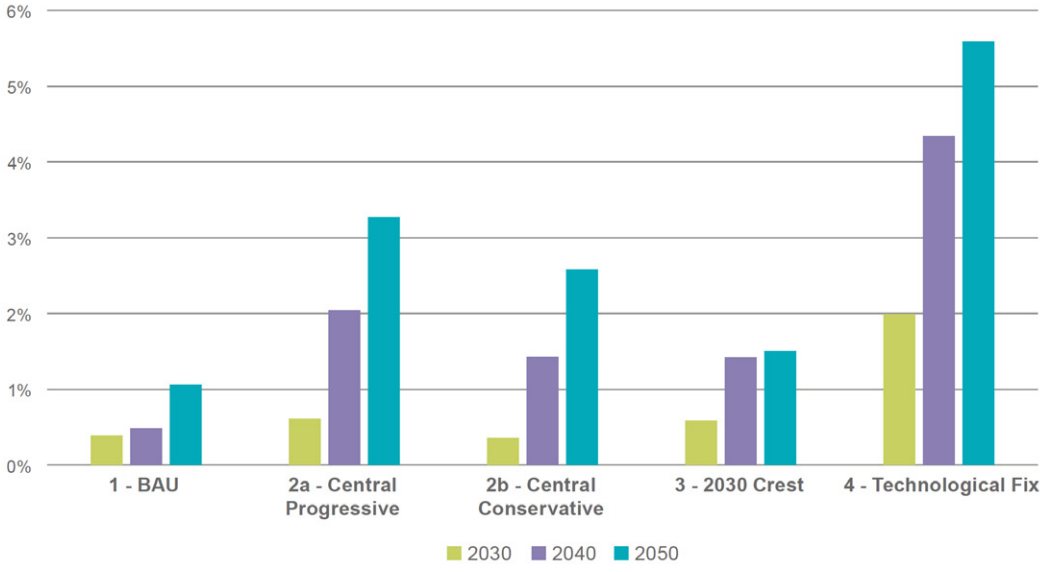
Decarbonizing the maritime industry requires more than just advancements in alternative fuels and propulsion technologies. It demands a holistic approach encompassing the entire value chain. Moving the needle on fuel production requires pragmatic solutions to unlock the necessary investment to reach the required scale. New mechanisms will have to be implemented to transmit signals from buyers to sellers to create the conditions for shipping's decarbonization to take place.

In addition to the upstream production of renewable and low-carbon fuels, we should focus our efforts on both ends of value chains. Developing shared platforms to aggregate the demands of stakeholders who wish to decarbonize their supply chains and thus form sufficiently large end-markets to sustain green shipping services will be pivotal.

This highlights the critical role of energy insetting – investing in interventions within an organization's own value chain – in bridging the price gap between conventional and renewable or low-carbon fuels in the shipping industry. All projections show that running shipping on renewable and low-carbon fuels will be significantly more costly than using fossil bunker. Unlike other market mechanisms, energy insetting directly reduces GHG emissions by implementing interventions throughout a company's value chain.

Verified by third parties, robust quality frameworks and certification schemes can enable the monetization of emission reductions achieved through renewable or low-carbon marine fuels. By utilizing blockchain technology for security, digital platforms ensure secure and traceable transactions, creating a transparent marketplace through the exchange of digital tokens representing emission savings. This approach not only addresses economic challenges but also connects stakeholders from both the supply and demand sides, stimulating the production of sustainable fuels at scale.

Fig. 4. Global share of renewable energy production used by e-fuel production for shipping, compared to IEA 2022 NZE Scenario



Source: BVS bottom-up model & IEA WEO 2022

Energy insetting made in the Baltic

One recent example from the Baltic Sea region includes the Swedish coffee maker Löfbergs, which has contracted the logistics company Scanlog (also from Sweden) to carry its shipments by vessels using bio-liquefied natural gas (bioLNG) per the mass-balanced approach. This move is said to reduce Löfbergs' sea freight carbon footprint by 100%, with the company (importing some 36 thousand tonnes of raw coffee each year) paying for bioLNG. Kajsa-Lisa Ljudén, Head of Sustainability at Löfbergs, commented, "Biogas costs more than fossil fuels, but we think we cannot afford to do otherwise. We have to reduce emissions across the entirety of our value chain. That we are financing the fuel switch 100% means that we see a functioning solution, which will hopefully contribute to others making a change, too." Matilda Jarbin, Scanlog's Chief Sustainability & Communications Officer, added, "Sea transportation has long found itself under the radar. It is, therefore, important that companies like Löfbergs dare to go further, seeing it's possible to reduce emissions here & now. We hope this will inspire other firms, speeding up the necessary transition within the transport sector."

No universal solution

The shipping industry comprises diverse segments, **each facing unique requirements and economic pressures**, resulting in differing capacities for decarbonization. Varying in vessel size, type, routes, public scrutiny, and autonomy needs, these sub-sectors experience distinct exposures to market conditions and regulatory frameworks. Moreover, companies within each segment differ in size, business model, and financial standing, influencing their ability to adopt sustainable practices.

One should also remember that the shipping industry is a deeply fragmented market. While it greatly depends on the segments under consideration, a significant portion of the global fleet is owned by a myriad of small- and medium-sized companies, many of them operating in fast-evolving markets. In addition, these companies may only keep their assets for part of their service life and have relatively modestly sized technical departments (all adapted to their needs and operating model). There are also the diverging priorities of shipowners and charterers: whereas the former might prefer to, e.g., slow steam to gain a better Carbon Intensity Indicator score, the latter might be inclined to speed up to carry out more sailings.

Decisions on emission reduction strategies must thus be tailored to each vessel, considering factors like fuel options, technological limitations, real-world market conditions, and operational requirements. There is no universal solution due to the industry's diversity and complexity. Understanding these varied challenges is crucial for progress in the shipping industry's decarbonization efforts – and this is why our research takes this diversity into account to outline realistic decarbonization scenarios.

Ambition: practical, collective, and nuanced

As the maritime industry progresses toward decarbonization, stakeholders must optimize business and operating models to align with evolving market conditions and regulatory expectations. Collaboration remains pivotal, shifting from adversarial contractual frameworks to benefit-sharing models that incentivize emissions reductions.

Moreover, gaining visibility on long-term regulatory expectations and fostering international consensus is essential for informed decision-making and effective industry-wide decarbonization efforts. Despite the challenges posed by differing national priorities and means, there is growing recognition of the need for collective action toward carbon neutrality.

While consensus may be challenging, universal goals for environmental preservation transcend individual interests and necessitate global cooperation. Ultimately, addressing the complexities of decarbonization requires a nuanced approach that balances ambition with practicality and embraces collaborative efforts across the maritime sector. □