



Practical Gaps in the International Maritime Organization's Net-Zero Framework

By **Evelyne Williams** and **Trevor Sutton**

- If adopted, the International Maritime Organization (IMO) Net-Zero Framework would become the first binding global carbon pricing mechanism under international law.
- The framework could mark a significant inflection point in trade and climate governance, but only if the IMO effectively confronts three design and implementation challenges: managing distributional impacts, enabling and responding to viable fuel pathways, and building a credible monitoring, reporting, and verification system.
- US opposition branding the framework a “global carbon tax” risks diverting attention from the more consequential operational gaps in enforcement, fuel incentives, and cost distribution that will ultimately determine the framework’s durability.

On April 11, 2025, parties to the International Maritime Organization (IMO) provisionally endorsed what could become the first binding global carbon pricing mechanism adopted under international law. Known as the “IMO Net-Zero Framework,” this mechanism targets international shipping, a sector responsible for approximately 3 percent of global greenhouse gas (GHG) emissions, or the entire emissions output of Japan, that has long been situated outside the core architecture of climate mitigation policy.¹ Barring last-minute negotiation derailment, formal adoption, which requires a two-thirds majority vote of IMO member states party to the amendment, is expected in October 2025, with implementation to begin in 2028.²

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By introducing a price on shipping emissions, the framework marks a rare innovation in trade and climate governance. Yet it has quickly become the subject of familiar disputes over ambition and cost. Criticism has concentrated less on the framework's technical design than on whether its ambition is commensurate with the scale of the climate challenge. Environmental groups and climate-vulnerable states have lamented what they see as critical omissions, such as a levy, a nonflexible emissions cap, and an explicit redistributive pricing model.³ The United States, by contrast, has condemned the framework as a costly “global carbon tax” skewed to China's advantage.⁴

Such critiques risk obscuring the underlying operational challenges that will ultimately define the framework's durability. This commentary considers three of the most persistent of these challenges:

1. Distributional and market impacts — whether the Net-Zero Fund can offset the risks of market concentration and disproportionate burdens on smaller carriers, vulnerable states, and thin trade routes.
2. Fuel transition constraints — whether the framework creates sufficient incentives and infrastructure support to scale viable low- and zero-emission fuels beyond transitional compliance strategies.
3. Verification and enforcement gaps — whether the IMO can establish a robust monitoring, reporting, and verification (MRV) system capable of ensuring compliance across highly fragmented jurisdictions.

The future of the framework will rest on whether the two-year negotiating process that follows formal adoption in October can address these challenges and sustain political consensus.

Cost Impositions

Disparate impacts across value chains

The core of the Net-Zero Framework requires ships engaged in international trade to comply with an emissions intensity limit that is set to increase annually. If a ship does not meet the GHG limit, its operator must purchase “remedial units” through direct contributions to the IMO or purchase/trade units from more efficient ships.⁵ Remedial units are priced in two tiers: Tier 1 at \$100/tons of CO₂ equivalent (tCO₂e) and Tier 2 at \$380/tCO₂e. Both are fixed until 2030 and will be reviewed thereafter. Vessels that overperform can generate “surplus units,” which are expected to be tradeable through an IMO-administered platform at market prices capped by the Tier 2 level. Projected annual revenue, financed by remedial credit purchases, is estimated to be \$11 to 13 billion,⁶ which will be allocated to the Net-Zero Fund.

As such, the framework introduces a new layer of compliance costs for ship operators. By 2035, a mid-size carrier relying exclusively on very low sulfur fuel oil (VLSFO), the prevailing “conventional” marine fuel, could face more than \$1.5 million in additional annual expenses, or 17 to 20 percent of fuel costs in this example, rising in proportion to fuel use over time.⁷

The goal of the cost imposition is to shift operators away from higher-emission fuels and toward lower-emission alternatives. Remedial unit pricing is designed to reflect the estimated future cost difference between conventional VLSFO and emerging low-carbon fuels, thereby creating a direct financial incentive for switching to low-emissions alternative fuels. In practice, however, cost differentials will likely exceed IMO projections, which assume rapid infrastructure scale-up in response to the regulation, risking added operating expenses without corresponding fuel-market development.⁸

Since penalties are based on fixed prices rather than market-based, operators can calculate with certainty the maximum compliance cost they will face within a given cycle. That predictability makes it more attractive, particularly in a capital-intensive industry with 20- to 30-year asset cycles and low historical returns, to rely on remedial credits rather than invest in retrofits or alternative fuels; for most conventional vessels, paying penalties remains the least cost-compliant strategy until at least 2031.⁹

In contrast, green ammonia, often described as the cornerstone fuel for maritime decarbonization, is projected to cost between \$885 and \$1,050 per ton, or roughly two to four times the price of VLSFO after accounting for energy density.¹⁰ Similarly, bio-methanol and e-methanol are projected to be 469 percent and 626 percent more expensive than VLSFO, respectively, with their scalability hinging on market signals shaped by IMO regulation.¹¹

Large shipping firms are considerably more likely to be able to absorb the added cost of remedial units and retrofitting their fleet, and to be able to endure the initial discomfort of an inevitable lack of supply within the low-emissions fuel market. With access to capital and larger fleets, they can retrofit vessels, secure scarce supplies of low-emission fuels, and use credit trading to offset penalties, effectively balancing the costs of older, less-efficient ships against the performance of those already prepared to run on green methanol or ammonia.

For smaller carriers, particularly those operating on thin margins, servicing irregular routes, or based in developing economies, the calculus is more constrained. Without the financial capacity to retrofit or the flexibility to optimize emissions, these carriers will experience compliance costs as either a direct hit to margins or a pass-through expense. Measures such as cutting speed in order to reduce fuel consumption (“slowsteaming”), optimizing port calls, or pooling surplus credits may provide partial relief but often at the cost of slower service, reduced reliability, and diminished competitiveness.

The 2024 extension of the EU Emissions Trading System (ETS) to maritime transport offers an instructive precedent. An analysis of more than 500 voyages by major carriers found that nearly 90 percent involved full pass-through of ETS costs to customers,¹² often with significant markups. On long-haul routes with limited competition, surcharges sometimes doubled or tripled the actual compliance cost. While cost pass-through is not inherently problematic (indeed, it is a normal feature of competitive markets), in the case of the ETS, it was largely decoupled from operational efficiency or emissions reduction. Rather than absorbing costs or driving operational efficiency, carriers largely treated the ETS as a pricing adjustment opportunity within existing market structures.

On highly competitive routes, carriers have an incentive to absorb part of the compliance costs in order to protect their market share. In contrast, on routes with limited service or monopolistic conditions, carriers that face little competitive pressure are more inclined to pass the full costs on to consumers and domestic exporters. As a result, the least competitive trade corridors, often those connecting Small Island Developing States (SIDS) and remote economies, would be disproportionately affected.

Such effects are unlikely to remain confined to carriers. Compliance costs, fuel switching expenses, and operational adjustments tend to diffuse through global supply chains, to cargo owners, port operators, freight forwarders, and ultimately consumers. Unlike explicit tariffs, such costs are absorbed at different points in the value chain depending on market structures and contractual relationships. For SIDS and lower-income markets, many of which rely heavily on maritime trade, even modest cost increases may carry disproportionate impacts.¹³

A Corrective Mechanism — But Does It Go Far Enough?

The IMO itself projected that a similar measure would impose higher burdens on long-haul, low-margin trade routes, particularly for agricultural goods, bulk materials, and manufactured inputs.¹⁴ Small and medium-sized exporters in regions such as Africa, Latin America, and the Pacific could face additional competitive pressures, potentially reinforcing structural trade imbalances.

The establishment of the Net-Zero Fund is intended to mitigate these concerns, with a directive to both reduce cost disparities between conventional and low-emission fuels and channel resources into adaptation and resilience in climate-vulnerable states, especially SIDS and Least Developed Countries (LDCs).¹⁵ In theory, such a dual mandate allows the fund to serve as both an incentive mechanism for the industry and a redistributive instrument for vulnerable economies. Yet whether it can do so remains highly uncertain.

The fund is projected to generate \$11 to 13 billion annually, which would place it among the largest dedicated climate finance vehicles globally. But such ambition faces significant institutional

challenges. The IMO, which will oversee the fund, is primarily a regulatory body with limited experience administering or managing climate finance. Establishing one of the world's largest funding mechanisms within a two-year window will require the IMO to develop governance systems, fiduciary safeguards, eligibility criteria, and disbursement protocols at an almost-unprecedented speed and scale for international climate finance.

Unlike established multilateral funds, the IMO will also have to reconcile its regulatory mandate with the political and distributive implications of managing capital flows across highly diverse economies. Much of the framework's design implicitly assumes that financial support will be available at sufficient speed and scale to offset the uneven distributional burdens created by compliance costs. But historical precedent suggests that those assumptions are optimistic. The establishment of the Green Climate Fund (GCF) took approximately five years¹⁶ and is regularly subject to criticism regarding its pace of capital allotments.¹⁷ The GCF has raised approximately \$9.3 billion since its inception and has disbursed a total of \$5.8 billion in capital over the past decade.¹⁸ By contrast, the Net-Zero Fund, annually dwarfing the GCF, must be negotiated, capitalized, and deployed within two years, while immediately delivering on promises of large-scale investment. If delays occur, the burden of compliance costs will be felt well before mitigating finance is available, disproportionately affecting the most vulnerable.

Even under ideal conditions, the mechanics of financial disbursement present structural limitations. Capital must move through national institutions, be converted into operational investments, and be paired with infrastructure development — processes that rarely align with the speed at which market shifts occur. In SIDS and developing states in particular, capacity constraints, limited port infrastructure, and logistical challenges slow the deployment of new technologies and fuel systems, meaning that even well-funded disbursements may take years to translate into practical reductions in cost burdens or emissions. The fund's effectiveness will therefore depend on both the volume of resources raised and its ability to streamline allocation, target systemic bottlenecks, and deliver relief at a pace that matches the rapid escalation of compliance costs.

A more fundamental uncertainty lies in how the fund will reward zero- and near-zero (ZNZ) fuels. The rules for ZNZ rewards, including which fuels qualify, how rewards are structured, and what portion of revenues will be dedicated, will not be finalized until 2027 at the earliest.¹⁹ That timeline collides with the long lead times fuel producers face: developing scalable e-ammonia or e-methanol requires ten- to fifteen-year offtake agreements, underpinned by predictable revenue streams. Absent clarity, the fund risks failing to derisk investment in scalable fuels at precisely the moment decisive commitments are required.

Moreover, the framework lacks earmarked provisions for adaptation projects, directing resources primarily toward fuel-cost subsidies. Should actual price differentials prove greater than

anticipated, as is likely, funding available to SIDS and developing countries for infrastructure projects will be minimal.

If the Net-Zero Fund succeeds in its mandates and timelines, it could provide a critical financial bridge, cushioning the near-term inequities of compliance and catalyzing investment in low-emission fuels and infrastructure across regions that would otherwise be left behind. If it fails, whether through delays, uneven distribution, or mismanagement, the entire legitimacy of the framework could be undermined.

Fuel Transition Constraints

Price parity is only part of the problem; realizing a transition to low- and zero-emission fuels will require far-reaching operational changes spanning ships, ports, and supporting infrastructure. The fuels expected to be “subsidized” by the Net-Zero Fund — green methanol, ammonia, and hydrogen-based fuels — are not drop-in replacements for conventional fuels. Each presents distinct barriers: lower energy density, specialized handling requirements, volatile safety profiles, and severely limited global supply. Achieving viable transition pathways demands coordinated investment in vessel retrofitting, fuel production, bunkering infrastructure, safety regulation, and workforce training, none of which can be rapidly scaled across the global fleet.

Further, the framework’s fixed prices of \$100 and \$380 per ton CO₂ equivalent risk distorting incentives across the sector, signaling to alternative fuel producers both the maximum premium they can charge over conventional fuels and the minimum price advantage needed to secure compliance demand. Such a dynamic encourages transitional fuels like LNG or early-stage biofuels to cluster just below the penalty threshold, sustaining artificially high prices while discouraging cost reductions or scaling when fuel prices sit safely below the penalty floor. Those risks are not trivial: LNG will be the cheapest compliance option until the mid-2030s, after which ammonia dual-fuel ships (first blue, then e-ammonia) emerge as the lowest-cost pathway.²⁰

Absent more frequently updated penalties and time-sensitive infrastructure co-investment, the framework risks anchoring the market in a transitional compliance equilibrium that is sufficient for regulatory thresholds but inadequate for climate goals. In a capital-intensive, risk-averse sector, added costs constrain noncompliance but also define the outer limits of innovation. Firms will pursue what is profitable within regulatory parameters, not necessarily what is transformative for decarbonization.

Verification and Enforcement Gaps

The credibility of any carbon pricing regime depends on the integrity of its MRV system. The framework's MRV design is yet to be negotiated. What is determined is that emissions data will be self-reported by operators, with enforcement delegated to national port authorities, a model prone to regulatory inconsistencies, enforcement disparities, and administrative bottlenecks across jurisdictions.

Port State Control (PSC), which is the procedure by which a country examines visiting foreign vessels at its ports to verify compliance with international rules on safety, environmental protection, and crew working conditions, is the center of enforcement. Ships will be required to carry certificates of annual compliance and proof of credit purchases covering the entirety of their international voyages, creating a clear compliance pathway: vessels calling at participating ports must be verified, even if their origin or destination lies in a nonparticipating state. Some operators may therefore seek to avoid the requirement altogether by restricting voyages within nonparticipating ports, essentially creating limited “dirty corridors” for older, higher-emission vessels within a given fleet as a means to minimize costs. Yet for stringent supply chains, avoidance is not a viable strategy. A container ship departing from London, Rotterdam, or Singapore for the United States, for example, must already be in compliance to sail, with certification covering the full route. Once the framework is anchored in the world's principal maritime hubs, compliance becomes a *de facto* prerequisite for global trade.

This dynamic has two consequences. First, it insulates the framework from outright fragmentation. While some “dirty corridors” between nonparticipating ports may persist, the scale and profitability of such markets are limited relative to the globalized trade flows that depend on major participating hubs. Second, it means that stringent supply chains linking finance, technology, pharmaceuticals, and other time-sensitive industries will remain tethered to compliant carriers. Even powerful nonparticipating economies will find it difficult to wall themselves off from the system without accepting trade frictions and competitive disadvantages.

Where fragmentation does occur, it is more likely to be concentrated in lower-value, bulk, or regionally confined trade; older, higher-emission vessels may cluster in noncompliant circuits, creating a secondary carbon-intensive market. Such a bifurcation would reduce the framework's environmental reach, but it would not free major global supply chains from its requirements, so long as major economies remain party to the regulation.

A centralized, independent verification body will be essential; without it, the system risks replicating past failures at scale, undermining both compliance integrity and the stability of the Net-Zero Fund's revenues.



Conclusion

The Net-Zero Framework offers an extraordinary precedent in a new era of trade policy and regulation, by pricing emissions embedded in the mechanism of trade itself. If the two-year guidelines process, set to follow the October vote, significantly mitigates the outlined challenges, the framework could catalyze new markets for green fuels, drive shipbuilding and retrofitting at an unprecedented scale, and channel billions of dollars toward the energy transition and resilience in vulnerable states. If, however, the framework hardens around its current design, the result may be a hollowed-out coalition of reluctant participants and strategic noncompliance. Time is critical, as it is with any international agreement, but so too is ensuring the framework's design is sufficiently robust to endure political tides.

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Notes

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2. At the April session, only sixteen states opposed the provisional text, suggesting defeat in October is possible, but unlikely. Industry, for its part, has consistently pressed the IMO for a coherent global framework, citing the administrative complexity of overlapping regional regimes. Industry advocacy also dovetails with substantial capital commitments to alternative fuels and dual-engine vessels, reinforcing technological and financial path dependencies that make the decarbonization trajectory increasingly difficult to reverse. A failed vote in October would leave the IMO free to reopen discussions, though at the cost of protracted renegotiation. Under Article 16(2) of MARPOL (the treaty for which the Net-Zero Framework is an amendment), any party may resubmit an amendment proposal for consideration by the Marine Environmental Protection Committee (MEPC) (International Convention for the Prevention of Pollution from Ships, 1973 [MARPOL], art. 16, “Amendments.”). The committee itself may also call an extraordinary session to revisit a revised draft, as it has done in past Annex VI negotiations when timing was politically or commercially pressing. A further avenue lies in Article 16(3), which obliges the organization to convene a Conference of the Parties if one-third of parties so request, allowing amendments to be reconsidered outside the MEPC format. MEPC may likewise direct subsidiary bodies to revise contentious elements for resubmission. In practice, therefore, failure in October represents a procedural setback rather than a terminal defeat: the proposal could re-emerge in modified form at a subsequent MEPC or conference, though the timing and ambition of the text would depend on the willingness of key economies to sustain pressure for an agreement.

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