MEPC Pathways Explorer — Methodology

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1. Overview

The MEPC Pathways Explorer is an analytical tool that compares six policy pathways for maritime emissions regulation currently before the IMO. It allows users to examine how each pathway performs across six dimensions of relevance to developing economies: Fund revenue and disbursement, compliance costs and trade impacts, food security, timeline to implementation, enforcement and compliance, and regulatory landscape.

The tool is the Pathways tab of the MEPC Policy Explorer at tools.fourthtack.com/nzf. It shares its computation engine, country data, and deployment infrastructure with the NZF Design tab, which models economic impacts of design choices within the Net-Zero Framework. The NZF Design module's methodology is documented separately.

This document describes the analytical framework: what the six pathways represent, how they map to quantitative and qualitative analysis, and the source material underpinning the content.

2. The Six Pathways

The pathways are derived from pre-session submissions to MEPC 84 (27 April – 1 May 2026) and represent the principal positions on the future of the IMO Net-Zero Framework. They are labelled A through F for compact reference; the ordering does not imply ranking.

Options A–C: NZF Framework

These three options preserve the IMO Net-Zero Fund and the two-tier compliance pricing mechanism established in the draft revised MARPOL Annex VI (Circular Letter No. 5005).

Option A — NZF As Is. Adopt the NZF text as circulated in CL 5005 without modification. Resume MEPC/ES.2 and complete the Article 16 adoption vote. Proponents: Fiji, Kiribati, Nauru, Palau, Solomon Islands, Tuvalu, Vanuatu (MEPC 84/7/28); Solomon Islands and Mexico (MEPC 84/7/34).

Option B — SIDS Contingency. A fallback position if the NZF text is reopened: set the direct compliance Z-factor to 100% for all years and price Tier 1 deficits at Tier 2 rates (US$380/tCO2eq). This effectively collapses the two-tier structure into a single flat price on nearly all fuel carbon content, producing dramatically higher Fund revenue (~US$50B/yr at entry into force) and correspondingly higher near-term compliance costs. Proponents: Fiji, Kiribati, Nauru, Palau, Tuvalu, Vanuatu (MEPC 84/7/36).

Option C — Brazil Package. Preserve the NZF architecture with a structured three-part package: the NZF text as approved at MEPC 83 (with date adjustments), priority implementation guidelines developed in parallel, and explanatory notes to address misunderstandings. Fold MEPC/ES.2 into MEPC 85 rather than resuming separately. Explicitly technology-neutral, including recognition of onboard carbon capture and storage (OCCS) as a compliance pathway. Proponent: Brazil (MEPC 84/7/37).

Japan's bridge proposal (MEPC 84/7/49) provides supplementary procedural context for Options A and C. It proposes a facilitated process to build consensus on implementation details without reopening the core regulatory text. Japan 7/49 is not treated as a separate pathway because it does not propose a structurally distinct policy architecture — it is a procedural mechanism to advance adoption of the existing NZF text.

Options D–F: Alternative Approaches

These three options do not preserve the IMO Net-Zero Fund. They represent fundamentally different approaches to maritime emissions regulation, or no regulation.

Option D — Market-Linked Alternative. Replace the NZF's fixed GFI trajectory with a market-responsive standard that tightens only when qualifying fuels pass a three-gate test (affordability within 15% of VLSFO, availability at ≥5% market share in 5 of 7 bunkering regions, scalability at ≥5% CAGR for 3 consecutive years). No Fund, no RU pricing, no revenue collection. Compliance incentives linked to the existing Carbon Intensity Indicator (CII) framework. Proponents: Argentina, Liberia, Panama (MEPC 84/7/38).

Option E — Oil-State Principles. Replace the NZF with an unspecified framework based on technology neutrality, food and energy security safeguards, consensus-based decision-making, and explicit (opt-in) acceptance. No fully developed alternative is proposed. Proponents: Algeria,

Bahrain, Iraq, Kuwait, Russian Federation, Saudi Arabia, Somalia, UAE (MEPC 84/7/30); UAE separately (MEPC 84/7/32).

Option F — End NZF. End all consideration of the NZF. No pricing mechanism, no Fund, no multilateral framework. Pursue emissions reductions through technology development and voluntary measures. Use explicit acceptance for any future GHG regulation. Proponent: United States (MEPC 84/7/41).

3. Analytical Framework

3.1 Quantitative Treatment (Options A, B, C)

Options A, B, and C are modelled using the same 7-step reduced-form engine described in the NZF Design methodology. The engine takes CIA Task 3 Scenario 24 as its reference point and produces country-specific estimates of GDP impact, consumer price impact, and trade cost impact.

Options A and C are economically identical — the Brazil Package preserves the NZF's pricing architecture without modification. Both are computed at the NZF Design module's default parameters:

Parameter	Value
Reward budget share (σ)	0.50
Allocation scheme	All developing states
Disbursement modality (ω)	0.33 (mixed instruments)
Reward calibration (η)	0.70
Fuel scope (φ)	1.00
SU market factor (μ)	1.00
Effective Tier 2 price (T_2)	US$380

These defaults represent the midpoint of the negotiation space for each parameter. Users who wish to explore how different NZF design choices affect outcomes can switch to the NZF Design tab, which exposes all parameters as interactive sliders.

Option B is modelled using the same engine with two modified parameters reflecting the collapsed two-tier pricing structure:

Parameter	Option A/C	Option B	Rationale
Two-tier adjustment (α at 2030)	1.29	~2.5	Collapsed pricing applies US$380/$tCO_2eq$ to nearly all fuel carbon
Base revenue (R)	~US$10	~US$50	Order-of-magnitude higher RU payments from expanded deficit band

At 2040 and 2050, $\alpha = 1.0$ for all options (fleet decarbonisation eliminates the two-tier effect), so Options A, B, and C converge. The 2030 comparison is where they differ materially.

No CIA scenario directly models Option B's collapsed-tier configuration. CIA Scenario 26 (GFS with a high levy of US$150–300/tCO2eq and revenue disbursement to developing economies) serves as a directional lower-bound proxy — Option B's effective price exceeds S26's modelled range. The "roughly 2× the 2030 cost impact of A/C" comparative framing is robust because the same model is applied to both and the relative scale is reliable even when absolute magnitudes carry uncertainty.

Option B is modelled in the Pathways Explorer only, not in the NZF Design module. The NZF Design module's credibility rests on the validated sensitivity ratio (SR) range of 0.85–1.45, within which the proportional scaling model is empirically verified against CIA cross-scenario data. Option B produces SR ≈ 2.8 at 2030, which is well outside this range. The comparative framing in the Pathways Explorer — directional comparisons with prominent uncertainty caveats — is appropriate for this extrapolation. Presenting it in the NZF Design module with the same visual precision as validated results would be misleading.

3.2 Qualitative Treatment (Options D, E, F)

Options D, E, and F cannot be modelled quantitatively because they do not specify the parameters required by the engine:

- **Option D** proposes a market-responsive GFI trajectory whose stringency depends on future fuel market developments that are inherently unpredictable. The three-gate test creates a circular dependency: the target tightens only when fuels are available, but investment in those fuels depends on regulatory certainty about future targets. The compliance cost range is bounded between near-zero (gates never triggered) and the S24 reference without fiscal offset (market eventually matches NZF trajectory but with no Fund to recycle revenue).
- **Option E** sets out principles for a future framework but does not specify GFI targets, pricing levels, or any quantifiable parameter. It cannot be modelled without assumptions that would amount to designing the framework on the proponents' behalf.
- **Option F** proposes no framework, no pricing, and no Fund. There is nothing to model. The relevant comparison is against the status quo (business-as-usual emissions trajectory and existing regional regulations).

For these options, the Explorer presents structured qualitative analysis across each dimension, grounded in the source submissions and existing regulatory facts (e.g., EU ETS costs on European routes, CII enforcement limitations). The qualitative content follows the same dimension structure as the quantitative options, enabling direct comparison.

3.3 The Structural Divide

The most consequential analytical distinction is between Options A–C (which preserve the IMO Net-Zero Fund) and Options D–F (which eliminate it). For developing economies, this determines whether there is any multilateral mechanism to offset compliance costs through revenue recycling, to fund infrastructure investment, or to address disproportionate impacts including food security.

4. The Six Analytical Dimensions

Each pathway is analysed across six dimensions. The dimensions were selected to be meaningfully different across options, answerable with sourced content, and relevant to the economic interests of developing states.

4.1 Fund Revenue and Disbursement

What revenue does each option generate, and how does it flow to developing states? This is the most quantitative dimension. For Options A/C, the engine computes country-specific fiscal offsets at the default parameters. For Option B, the engine computes at modified parameters. For Options D/E/F, revenue is zero — the analysis focuses on what the absence of Fund revenue means for just transition support.

4.2 Compliance Costs and Trade Impacts

What cost burden does each option impose, and how does it pass through to freight rates? For Options A/B/C, the engine produces maritime logistics cost (MLC) increases and sensitivity ratios (SR). For Option D, the cost range is bounded qualitatively. For Options E/F, cost analysis focuses on the regulatory patchwork — existing regional regulations (EU ETS, FuelEU Maritime) impose costs on specific routes, with revenue flowing to non-IMO jurisdictions rather than to an international fund.

4.3 Food Security

How does each option affect food prices for import-dependent economies? The NZF contains a dedicated food security regulation (Reg. 43) requiring the Committee to monitor and address disproportionate food price impacts. Options A/B/C inherit this mechanism plus Fund resources for mitigation. Options D/E/F have no equivalent provision. For Option B, the timing mismatch between the immediate cost shock and the lag before Fund disbursement becomes operational is noted as a structural feature.

4.4 Timeline to Implementation

When does each option produce a functioning framework? Analysis is grounded in IMO procedural rules: MARPOL Article 16 tacit acceptance procedure, the agreement-in-principle to adoption to entry-into-force sequence, and the specific calendar proposals before MEPC 84. Options A/C target adoption at MEPC 85 (late 2026) with entry into force in 2028–2029. Options D/E would require reopening negotiations, adding years of delay. Option F proposes no adoption timeline.

4.5 Enforcement and Compliance

What mechanisms ensure compliance? The NZF's enforcement architecture combines financial enforcement (RU pricing creates a direct cost for non-compliance), the GFI Registry (transparent recording of compliance status), and port state control. Option D relies on the existing CII framework, whose corrective action plans have well-documented enforcement limitations. Options E/F propose no enforcement mechanism.

4.6 Regulatory Landscape

What is the broader regulatory context? A global IMO framework provides governance representation for all member states, including developing countries. In the absence of an IMO framework, maritime emissions regulation defaults to regional actors — the EU ETS, FuelEU Maritime, and potentially other jurisdictions. This creates a structural asymmetry: costs are imposed on shipping serving developing-country trade routes, but revenue and governance remain with the regulating jurisdiction. The analysis treats the EU ETS as current fact, emerging initiatives (e.g., Djibouti) as publicly announced, and other jurisdictional actions as potential.

5. Content Structure

For each option within each dimension, the Explorer provides three layers of content:

- **Summary** — a concise characterisation suitable for side-by-side comparison when multiple options are selected. Typically 2–4 sentences.
- **Narrative** — a fuller explanation for single-option display, including mechanism descriptions, uncertainty notes, and cross-references to other dimensions.
- **Country personalisation** — template text populated with country-specific data from the engine (for A/B/C) or with country name and trade profile (for D/E/F) when a country is selected.

All content is sourced from MEPC 84 pre-session submissions, the CIA impact assessment, Circular Letter No. 5005, or current regulatory texts. Source citations are provided per option per dimension.

6. Relationship to the NZF Design Module

The Pathways and NZF Design modules share the same computation engine (`engine.js`), country data (`nzf_calculator_data.json`), and Cloudflare Worker for AI-powered insights. They differ in purpose:

- **Pathways** answers: "Which policy pathway produces the best outcomes for my country?" It compares six options at fixed parameters across six dimensions.
- **NZF Design** answers: "Within the NZF, which design choices matter most for my country?" It allows continuous variation of six policy parameters and displays the resulting economic impacts.

Users can navigate between the two modules via tabs in the app header. Country selection is preserved across the transition.

7. Source Documents

IMO Submissions Referenced

Documer	Title	Submitted by
CL No. 5005	Draft Revised MARPOL Annex VI	Secretariat

Documer	Title	Submitted by
MEPC 84/7/28	Adopting the Net-Zero Framework	Fiji, Kiribati, Nauru, Palau, Solomon Islands, Tuvalu, Vanuatu
MEPC 84/7/30	Main Principles for a Net-Zero Framework	Algeria, Bahrain, Iraq, Kuwait, Russia, Saudi Arabia, Somalia, UAE
MEPC 84/7/34	Resuming the Adoption of the NZF	Solomon Islands, Mexico
MEPC 84/7/36	Adopting the NZF "As Is"	Fiji, Kiribati, Nauru, Palau, Tuvalu, Vanuatu
MEPC 84/7/37	Finding Consensus on a Framework	Brazil
MEPC 84/7/38	Proposal for a Pragmatic Approach	Argentina, Liberia, Panama
MEPC 84/7/39	Comments on 7/38	Solomon Islands
MEPC 84/7/41	Comments on 7/30	United States
MEPC 84/7/44	Proposals for Fund Disbursement	DR Congo, Ghana, Togo
MEPC 84/7/49	Bridge Proposal	Japan
MEPC 84/INF.10	Comparative Analysis of Existing Fund Practices	Secretariat

Impact Assessment

Docume	Reference
CIA Task 3	MEPC 82/INF.8/Add.2 — Comprehensive Impact Assessment, Task 3 (UNCTAD). Secretariat, 2024.
CIA Task 2	MEPC 82/INF.8/Add.1 — Comprehensive Impact Assessment, Task 2 (DNV). Secretariat, 2024.

Compliance Cost Analysis

Document	Reference
UCL/UMAS (2025)	*IMO Net Zero Framework: Assessing the potential options and costs of compliance.* UCL Energy Institute.