Workshop on Protection and Indemnity Insurance

By Directorate General of Shipping

19th June 2026 |Kochi

36% Growth in Indian Tonnage from 2015

1609 Ships

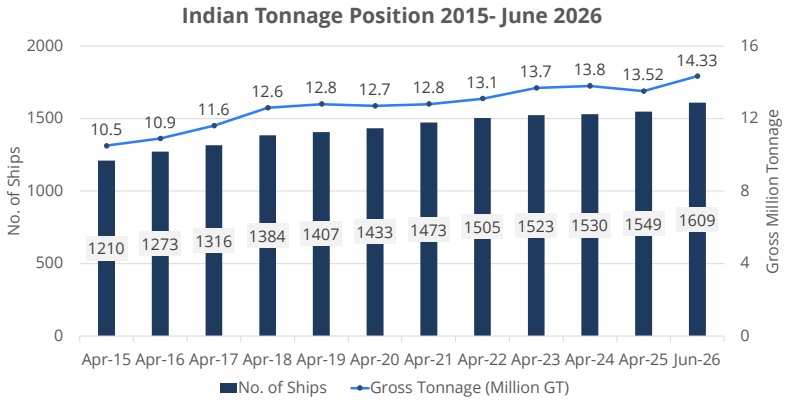
Indian-flagged vessels as of May 2026

14.33M GT

Total fleet GT- up from 10.5M GT in 2015 till June 2026

~1% Global Share

India's share of world ocean-going tonnage



As the sector expands its **role in trade and energy security**, demand for maritime insurance is rising However, a significant portion of marine insurance particularly **P&I** and **specialized risks** continues to be **serviced by international markets**, indicating a measured **opportunity for enhancing domestic capacity**.

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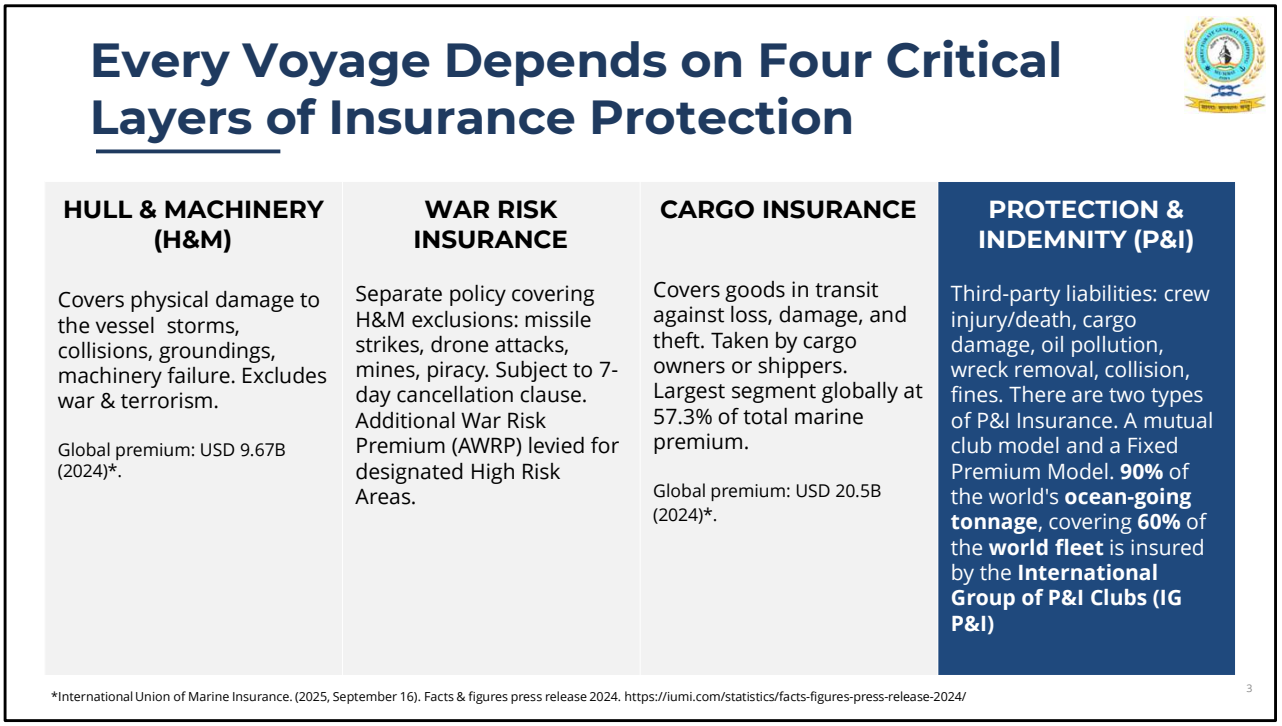
The Indian-flag fleet has grown to 1,609 ships and 14.33 million GT as of mid-2026, a roughly 36% increase in tonnage since 2015, yet India still accounts for only about 1% of world ocean-going tonnage. P&I and specialised risks remain largely serviced by international markets — the gap the Pool Tonnage has grown while the insurance value chain that supports it has not. Premium, claims handling, actuarial pricing and the issuance of port-accepted financial-security certificates all sit predominantly offshore. The full year-on-year tonnage record below

Scale matters in P&I because mutual insurance prices risk over a large, diversified pool of tonnage. Set against the major Asian maritime nations, India's position is instructive: Japan carries roughly 11% of world tonnage, China around 12%, and South Korea about 4% — and each of those three operates a national P&I capability of its own, whereas India operates none of comparable standing. The cost of that absence is measurable. Indian operators send an estimated USD 45–60 million in annual P&I premium to foreign clubs, with the wider marine-insurance outflow larger still. Every rupee of that outflow also exports the claims data, loss-prevention know-how and underwriting talent that a domestic market would otherwise accumulate. A growing fleet without a growing domestic

insurance base is, in effect, subsidising the development of foreign markets.



A voyage is protected by four distinct contracts: Hull & Machinery (global premium -USD 9.67 bn, 2024), a separate War Risk policy, Cargo insurance (-USD 20.5 bn, the largest marine segment at 57.3%), and Protection & Indemnity, where the International Group of P&I Clubs insures about 90% of ocean-going tonnage.

- **Hull & Machinery (H&M) — the ship as property**

H&M is the foundational property cover on the vessel itself — physical loss or damage from perils such as heavy weather, grounding, collision and machinery breakdown. Policies are written on standard wordings: the London-market Institute Time Clauses – Hulls (ITCH) or the Nordic Marine Insurance Plan. Premium typically runs between 0.3% and 1.5% of the agreed insured value per annum, depending on the vessel's age, type and trading area, for a modern USD 100 million tanker that is roughly USD 300,000 to USD 1.5 million a year. Crucially, the ordinary H&M policy excludes war, terrorism, piracy and malicious acts — which is precisely why a separate war-risk contract is needed. Capacity sits chiefly with Lloyd's syndicates, the International Underwriting Association company market, and the Nordic insurers (Gard, Skuld, DNK) grouped under CEFOR, GIC Re provides domestic Indian capacity.

- **War Risk — the separate, fast-cancelling cover**

Because H&M excludes war, owners buy a distinct Marine War Risks policy, usually arranged through the same broker but legally a separate contract. Two features define it. First, it carries a standard seven-day notice of cancellation, so underwriters can withdraw or reprice cover at a week's notice if a region deteriorates. Second, transits through designated high-risk areas attract an Additional War Risk Premium (AWRP), charged per voyage or per seven-day period. The areas are identified by the Lloyd's Joint War Committee's "listed areas", and under BIMCO war clauses (CONWARTIME / VOYWAR) the AWRP is commonly passed to the charterer.

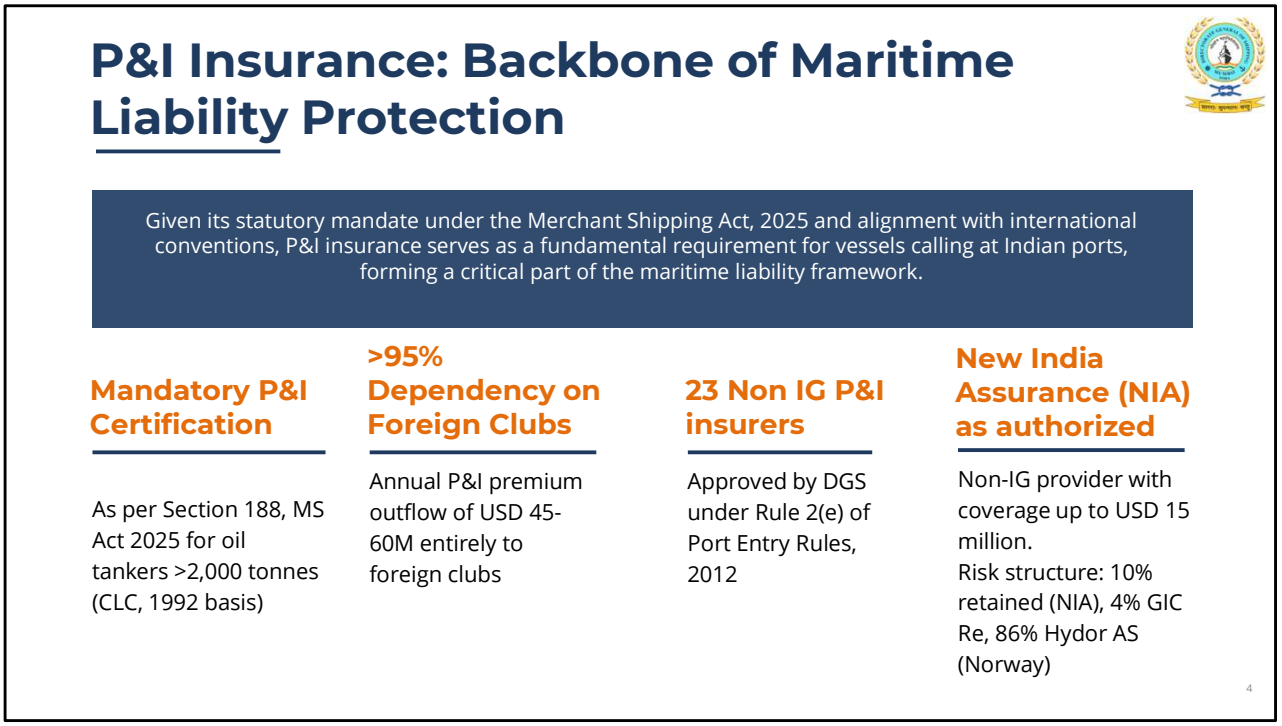
- **Cargo — the largest segment**

Cargo insurance protects goods in transit against loss, damage and theft and is taken by the cargo owner or shipper, on Institute Cargo Clauses (A) all-risks, or the narrower (B) and (C) named-perils wordings. At 57.3% of global marine premium (-USD 20.5 bn in 2024), it is the single largest marine class — a reminder that the Pool's cargo-war cover is not a marginal line but central to keeping Indian imports and exports moving.

- **Protection & Indemnity (P&I) — third-party liability**

P&I is fundamentally different from H&M: it covers the owner's liabilities to third parties rather than damage to the ship. The covered exposures include crew death, injury and illness, cargo loss or damage, oil and other pollution, wreck removal, damage to fixed and floating objects, the one-fourth collision liability not carried by H&M, fines, and crew repatriation. These can be enormous — a single pollution incident can run to hundreds of millions of dollars.

Globally, P&I is provided mutually through the International Group (IG) of P&I Clubs — 12 clubs since North and Standard merged to form NorthStandard in 2023. The IG shares risk in tiers: each club retains the first USD 10 million of a claim, claims from USD 10 million to USD 100 million are pooled across all clubs, and above that a collectively purchased Group Excess of Loss (GXL) reinsurance programme, with the Bermuda captive Hydra, extends cover into the billions. The IG insures roughly 87–90% of the world's ocean-going tonnage and collects on the order of USD 3.8 billion in annual premium.



P&I certification is mandatory under Section 188 of the Merchant Shipping Act, 2025 for oil tankers above 2,000 tonnes (on the CLC 1992 basis). India depends on foreign clubs for over 95% of P&I, with USD 45–60 million flowing abroad annually, 23 non-IG P&I insurers are approved under Rule 2(e) of the Port Entry Rules, 2012, and New India Assurance (NIA) is the authorised non-IG provider (cover to USD 15 m, 10% NIA / 4% GIC Re / 86% Hydor AS, Norway).

P&I is not optional cover — it is the legal key that lets a ship trade. A web of international conventions, now given domestic effect through the Merchant Shipping Act, 2025, requires the owner to hold evidence of insurance, issued by an acceptable P&I provider, before a vessel may enter or leave port:

- the Civil Liability Convention (CLC 1992) for oil tankers carrying persistent oil, requiring a state-issued certificate backed by P&I,
- the Bunkers Convention 2001, extending compulsory liability cover to bunker-oil pollution from non-tankers,
- the Nairobi Wreck Removal Convention 2007, requiring certificated cover for wreck-removal liability, and
- the Maritime Labour Convention (MLC 2006), requiring financial security for crew wages, repatriation and death/disability.

In each case the practical instrument is a P&I “blue card”, on the strength of

which the flag State issues the statutory certificate. This is why the IG's universal acceptance is so valuable, and why dependence on foreign clubs is a strategic vulnerability rather than a mere commercial preference: if a foreign club or its reinsurers withdraw cover — whether for sanctions, war-zone exposure or underwriting reasons — the certificate can lapse and the ship cannot lawfully trade.

Role of P&I Insurance in Salvage Operations

Role in salvage operations	Critical areas of involvement	Operational importance	
P&I insurer covers liability exposures during salvage, while Hull & Machinery insurers handle property salvage. Provides security under SCOPIC/LOU and supports Special Casualty Representative Coordinates with salvors, authorities, correspondents, lawyers and pollution experts. Manages crew, pollution and third-party claims	Pollution risk and bunker removal Port-of-refuge requirements and security demands Criminalisation/detention issues Wreck removal obligations	Ensures timely funding and security Enables informed casualty response Supports environmental protection and dispute reduction Provides access to specialised global response networks	**P&I insurer acts as the primary liability partner, particularly when cases move from salvage to regulatory and environmental implications**

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In a casualty, the P&I insurer covers liability exposures while H&M handles property salvage. The P&I club provides security under SCOPIC and letters of undertaking, supports the Special Casualty Representative, and coordinates salvors, authorities, lawyers and pollution experts — managing crew, pollution and third-party claims, and ensuring timely funding and access to global response networks.

Salvage sits at the intersection of H&M and P&I, and understanding the split is essential to the workshop. Most ocean salvage is contracted on Lloyd's Open Form (LOF) — the "no cure, no pay" agreement under which the salvor is rewarded only if property is saved, the reward being assessed against the salved value of ship and cargo (an H&M/cargo exposure). But pure "no cure, no pay" once discouraged salvors from tackling low-value but high-pollution casualties. The SCOPIC clause (Special Compensation P&I Clause, 2000) solved this: where invoked, the salvor is paid an agreed tariff for effort regardless of success, and that remuneration is a P&I cost. The club also appoints a Special Casualty Representative (SCR) to monitor the operation.

In practice the P&I club becomes the casualty's financial nerve-centre: it funds and posts security (often via letters of undertaking) to release the ship from arrest or to satisfy a port-of-refuge demand, manages pollution and bunker-

removal liabilities, handles wreck-removal obligations under the Nairobi Convention, defends against criminalisation and detention of the master and crew, and draws on a worldwide network of correspondents, lawyers and clean-up contractors. When a case migrates from salvage into regulatory and environmental territory, the P&I club is the primary liability partner throughout. This is directly relevant to the Directorate's parallel Salvage Hub initiative. The Merchant Shipping Act, 2025 ratifies the Nairobi Wreck Removal Convention 2007 and the International Salvage Convention 1989, and Section 255 empowers the empanelment of professional salvors, the Directorate is onboarding a Special Casualty Representative and building regional salvage hubs with pooled high-capacity tugs and equipment. The 2025 casualties off the Indian coast exposed how ad hoc, owner-driven response leads to delay. The lesson for BMIP is that capacity alone is insufficient — a domestic insurer must also command the claims-handling and security-issuing machinery that makes capacity usable in a live emergency.

Globally, the heavy-lift work is done by a handful of specialist salvors — SMIT Salvage (Netherlands), Resolve Marine (USA), T&T Salvage (USA) and Ardent — with whom an Indian framework will need standing arrangements.

Towards an Indian P&I Entity

Challenges faced in the Insurance Segment

01 Indian Ocean-going fleet is covered by IG P&I Clubs

02 Coastal Fleet is dependent on Fixed Premium Non-IG P&I Companies

03 **Dedicated Indian P&I Service Company does not exist**

Feasibility Study for Establishing Indian P&I Entity

- DGS had appointed M/s Ace Insurance Brokers to perform the Feasibility Study for Establishing Indian P&I Entity based on Mutual or Fixed Premium basis
- The intent is to Establish a Domestic Indian P&I Club to provide sovereign liability coverage for ocean going and coastal vessels, supported by domestic reinsurance and regulatory facilitation

- Based on the Feasibility Study the P&I Entity is Technically and Financially feasible.
- The Indian P&I Entity can be established with a **Fixed premium model** at inception and scaled to mutual model eventually.

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Three structural gaps are identified: the ocean-going fleet relies on IG clubs, the coastal fleet relies on fixed-premium non-IG insurers, and no dedicated Indian P&I service company exists. The feasibility study by M/s Ace Insurance Brokers concludes that an Indian P&I entity is technically and financially feasible, beginning on a fixed-premium model and scaling to a mutual model, supported by domestic reinsurance and regulatory facilitation.

The choice of model is the central design decision, so it is worth setting out plainly. Under a fixed-premium model, the insurer charges a set premium for the year, carries the risk on its own (shareholder) capital, and makes no further demand on the member — cover is predictable and easy to budget, and the entity can launch quickly, but capacity is limited by capital and members share no upside. Under a mutual model, the members are themselves the insurers: they pay an advance call, may be asked for supplementary calls if claims exceed expectations, and receive returns when experience is good. Mutuality delivers far greater capacity and lower long-run cost — it is the IG model — but it requires scale, member solidarity and a track record before owners will trust it with their largest liabilities.

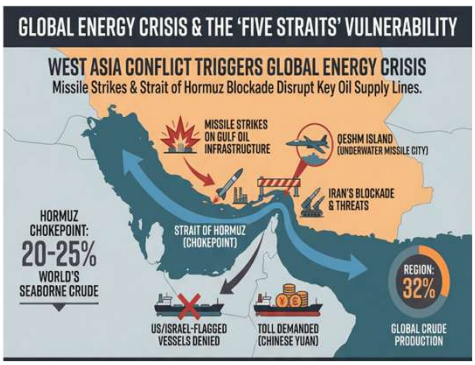
The recommended phasing — fixed-premium at inception, mutual at maturity — mirrors how every successful national club has grown. Two examples are directly

instructive for India:

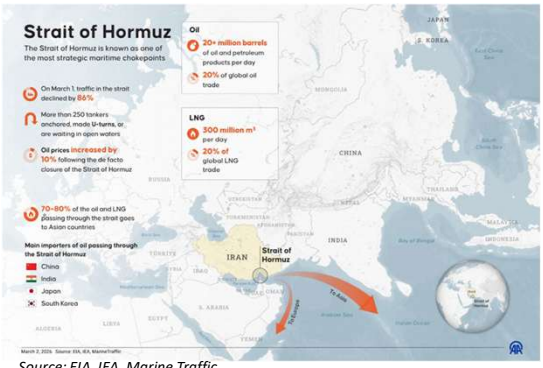
- China P&I Club (CPI) was established in Beijing on 1 January 1984 with State Council approval. Beijing recognised mutual structures in law before market scale arrived, kept capital, claims adjudication and actuarial development within Chinese jurisdiction while permitting foreign reinsurance, and grew patiently. Four decades on, CPI insures over 100 million GT, ranks among the world's larger P&I insurers, holds an A- (Excellent) rating, and runs a network of around 490 correspondents across 145 countries — even though it sits outside the International Group.
- Korea P&I Club (KP&I) was established in 2000 under a dedicated statute (the Shipowners' Mutual P&I Association Act, 1999), backed by the Ministry of Oceans and Fisheries, national lenders and shipowners — a deliberate state–industry partnership that gave the club legal standing and initial credibility.

The common thread is sequence: legal recognition and state backing first, scale and international acceptance later. India's feasibility study reaches the same conclusion. The **Viability Assessment** underpinning it examines capital requirements, premium potential from the Indian fleet, operating-cost structures, claims behaviour, reinsurance dependencies and projected break-even timelines under a fixed-premium model, it pairs these with an economic assessment of foreign-exchange savings, development of domestic maritime services, employment generation, and alignment with Maritime India Vision 2030 and Sagarmala. The recommended path is a phased build, anchored by GIC Re and global reinsurers, compliant with the DGS 16-point framework, and supported initially by experienced international service providers for claims handling and security issuance.

Middle East Conflict (Strait of Hormuz)- Impact on Maritime Trade



Source: ndtv.com



Source: EIA, IEA, Marine Traffic

- Before the conflict, Strait of Hormuz carried ~20% of global seaborne crude to Asia; during the conflict, flows were rerouted mainly via the Suez–Red Sea route, with Malacca remaining the busiest.
- As on March 1, traffic in the strait declined by 86% and Oil Prices increased 10%
- Disruptions in key chokepoints have driven volatility in war risk premiums, with repricing for high-risk zones
- 7-day cancellation clauses on standard war risk and along with additional war risk premium dependent on area or the voyage have increased uncertainty for charterers and shipowners

Source: Xinhua News Agency. (2026). How important is the Strait of Hormuz? New Vision. https://www.newvision.co.ug/category/world/how-important-is-the-strait-of-hormuz-NV_229100_042026

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Before the conflict, the Strait of Hormuz carried roughly 20% of global seaborne crude to Asia, during the conflict, flows were rerouted via the Suez–Red Sea corridor, with Malacca remaining the busiest passage. Strait traffic fell about 86% and oil prices rose about 10%. Chokepoint disruption drove war-risk premium volatility, while seven-day cancellation clauses and area-dependent AWRP increased uncertainty for charterers and owners.

India is unusually exposed to this particular chokepoint. The country imports the large majority of its crude oil, and a substantial share transits the Strait of Hormuz from Gulf producers, much of it on Indian public-sector-chartered tankers. The Strait is the world's most important oil chokepoint, when it is threatened, the consequences are felt simultaneously in freight rates, insurance premiums and the landed cost of energy.

The four great maritime chokepoints — Hormuz, Bab-el-Mandeb (the Red Sea approach), the Suez Canal and the Strait of Malacca — between them carry the bulk of seaborne energy and containerised trade. A disruption at one forces re-routing that lengthens voyages, ties up tonnage and pushes premiums up across the network, not merely at the affected point. The mechanism that transmits the shock into Indian balance sheets is the war-risk contract: the seven-day cancellation clause lets underwriters reprice or withdraw at a week's notice, and

the AWRP for listed areas, passed through charter-party war clauses, lands on the charterer — frequently an Indian importer.
This is the precise sequence that catalysed the Bharat Maritime Insurance Pool: a strategic chokepoint vital to Indian energy security became, almost overnight, a place where cover could be withdrawn or priced out of reach, and where sanctions could cause foreign reinsurers to step away entirely. The next slide quantifies what that did to premiums.

Middle East Conflict (SOH)- Impact on Maritime Insurance Market

Heightened geopolitical uncertainty in the Middle East has materially impacted maritime insurance markets, particularly for vessels transiting the Persian Gulf and adjoining strategic sea lanes.

Phase	Hull War Risk Premium	Market Response
Pre-Conflict Baseline	0.10% – 0.25%	Stable annual cover
Escalation Phase	~1.0%	Voyage-based repricing
Peak Conflict Period	3.0% – 10.0%	Severe volatility, capacity tightening
Current Position (2026)	0.4% – 0.8%	Elevated but stabilising

- Premiums remain structurally above historical norms despite moderation from peak levels.
- Insurance pricing now reflects persistent geopolitical risk in critical maritime corridors.
- Increased transit costs directly affect tanker, container and bulk shipping economics.
- Selective underwriting, rerouting decisions and schedule adjustments continue across operators.
- Energy-import dependent economies, including India, remain exposed to freight and logistics cost escalation.

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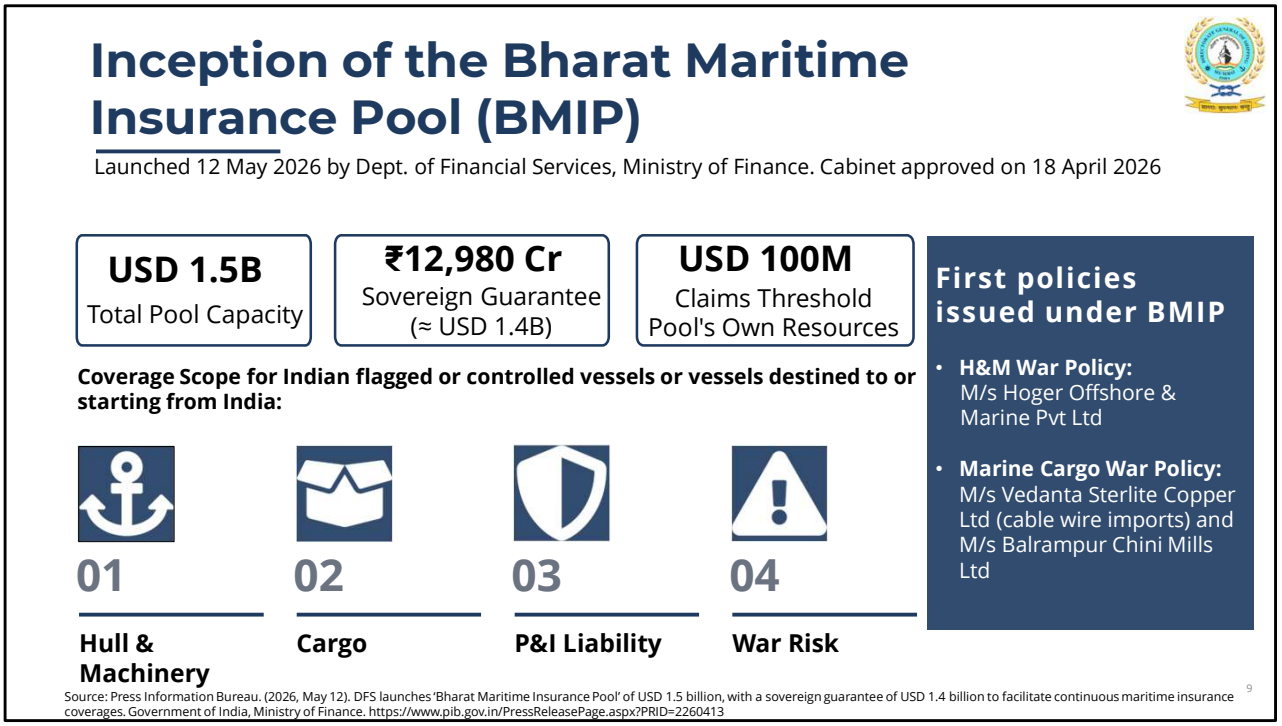
Hull war-risk premium moved through four phases: a pre-conflict baseline of 0.10–0.25% (stable annual cover), an escalation phase near 1.0% (voyage-based repricing), a peak of 3.0–10.0% (severe volatility and capacity tightening), and a current 2026 position of 0.4–0.8% (elevated but stabilising).
Premiums remain structurally above historical norms.
To see why these percentages matter, apply them to a single hull. War-risk premium is charged as a percentage of the insured value, per voyage or per seven-day period in a listed area. On a USD 100 million tanker, a pre-conflict rate of 0.1% is about USD 100,000 for the transit, at the peak rate of, say, 5% it becomes about USD 5 million — a fifty-fold increase, for the same ship making the same passage. Multiply across a fleet and the figures quickly dominate voyage economics for tankers and materially affect container and bulk operators too.
Two market dynamics sit behind the numbers. First, capacity tightening: when Lloyd's syndicates and other war underwriters cut their appetite for a region, the remaining capacity prices steeply — a classic "hard market." Second, sanctions risk: foreign reinsurers may withdraw support from any policy touching a sanctioned country, cargo or counterparty, which can collapse cover regardless of the owner's willingness to pay. This is comparable to, and in some

respects sharper than, the Red Sea repricing of 2024, when hull war rates for the southern Red Sea rose toward and beyond 1% of hull value.
For an energy-import-dependent economy, the combination is corrosive: cover that is available but unaffordable, or affordable but liable to vanish at seven days' notice. A sovereign-backed domestic pool addresses exactly this failure mode — it can keep cover in force when the commercial market reprices or retreats, preserving continuity of trade. That is the logic the next slide turns into an institution.



BMIP was launched on 12 May 2026 by the Department of Financial Services, Ministry of Finance (Cabinet approval 18 April 2026). It carries USD 1.5 billion of total pool capacity, a sovereign guarantee of ₹12,980 crore (USD 1.4 billion), and a USD 100 million claims threshold for the pool's own resources. It covers H&M, Cargo, P&I and War Risk for Indian-flagged or controlled vessels, or vessels destined to or starting from India. The first policies were an H&M War policy to M/s Hoger Offshore & Marine, and Marine Cargo War policies to M/s Vedanta Sterlite Copper (cable-wire imports) and M/s Balrampur Chini Mills.
Structurally, BMIP is a state-backed co-insurance and reinsurance pool. Domestic insurers who are pool members issue the policies, drawing on the combined underwriting capacity of the pool, and then reinsure the risks among themselves in proportion to their committed capacity, GIC Re administers the arrangement. Above the pool's own USD 100 million layer stands the sovereign guarantee — a contingent backstop of last resort, invoked only after the pool's reserves, member contributions and reinsurance are exhausted. In insurance terms it is a national catastrophe pool with a government stop-loss on top.
This is a well-established model internationally, and the comparisons are useful for the workshop:
Pool Re (United Kingdom, 1993) — an industry mutual for terrorism risk, sitting

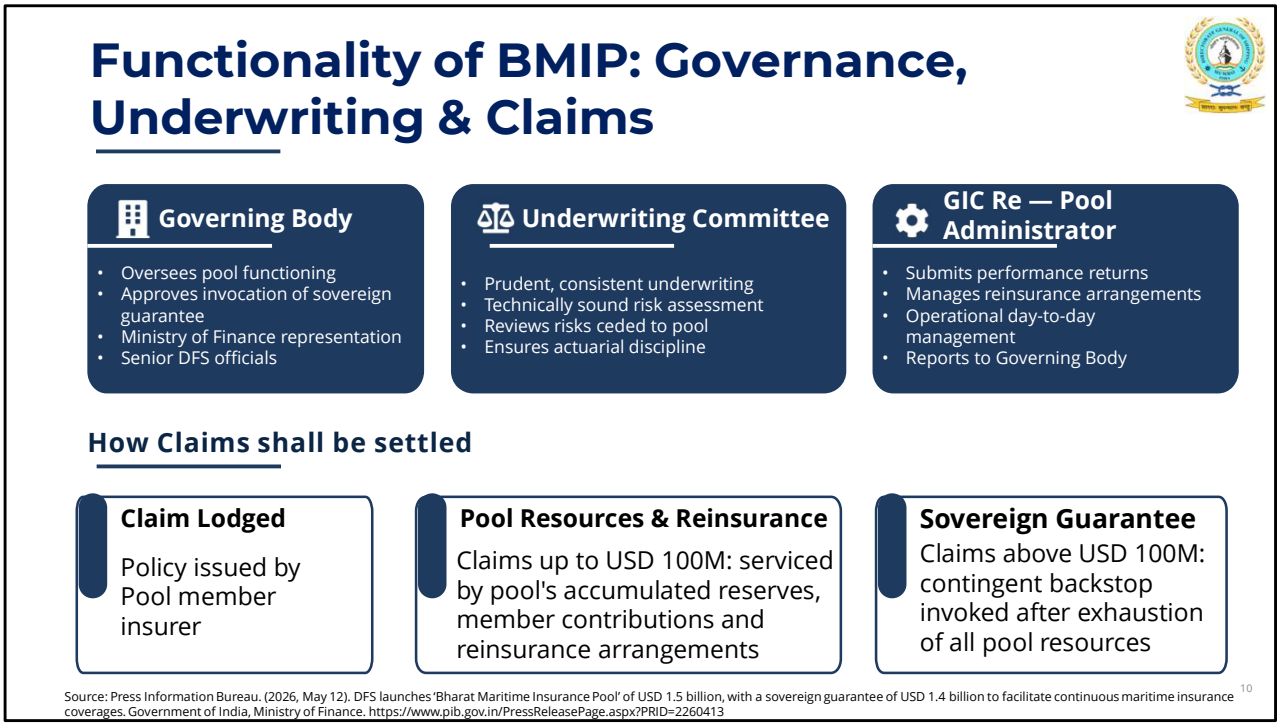
beneath an HM Treasury backstop that responds when the pool's funds are exhausted. It is the closest conceptual cousin to BMIP's "pool first, sovereign guarantee last" design.

GAREAT (France), Extremus (Germany), TRIP (United States) and ARPC (Australia) — further state-supported pools created where the private market could not, on its own, carry a politically driven catastrophe risk.

Russia's national reinsurance response — facing Western sanctions and the withdrawal of foreign reinsurance, Russia channelled marine and other risks through a state-owned national reinsurer and domestic insurers. It is the most direct precedent for BMIP's sanctions-resilience rationale: when foreign capacity leaves, sovereign capacity keeps trade moving.

Norway's DNK (the shipowners' war-risk mutual) — a long-standing, state-affiliated mutual dedicated to war risks, showing how a maritime nation can keep war cover domestic and dependable.

The first policies are deliberately illustrative rather than large: a hull-war cover for an offshore operator and cargo-war covers for an industrial importer and a sugar producer. They demonstrate that the Pool can issue across H&M-war and cargo-war lines from day one. The harder lines — full P&I and the certificate-issuing function — are where the implementation work, discussed on the closing slides, must concentrate.



Three organs run the Pool. A Governing Body oversees functioning and approves any invocation of the sovereign guarantee (with Ministry of Finance and senior DFS representation). An Underwriting Committee ensures prudent, technically sound, actuarially disciplined underwriting and reviews the risks ceded. GIC Re is the Pool Administrator, handling day-to-day management, reinsurance arrangements and performance returns to the Governing Body. Claims up to USD 100 million are met from the pool's resources and reinsurance, claims above USD 100 million invoke the sovereign guarantee after those resources are exhausted.

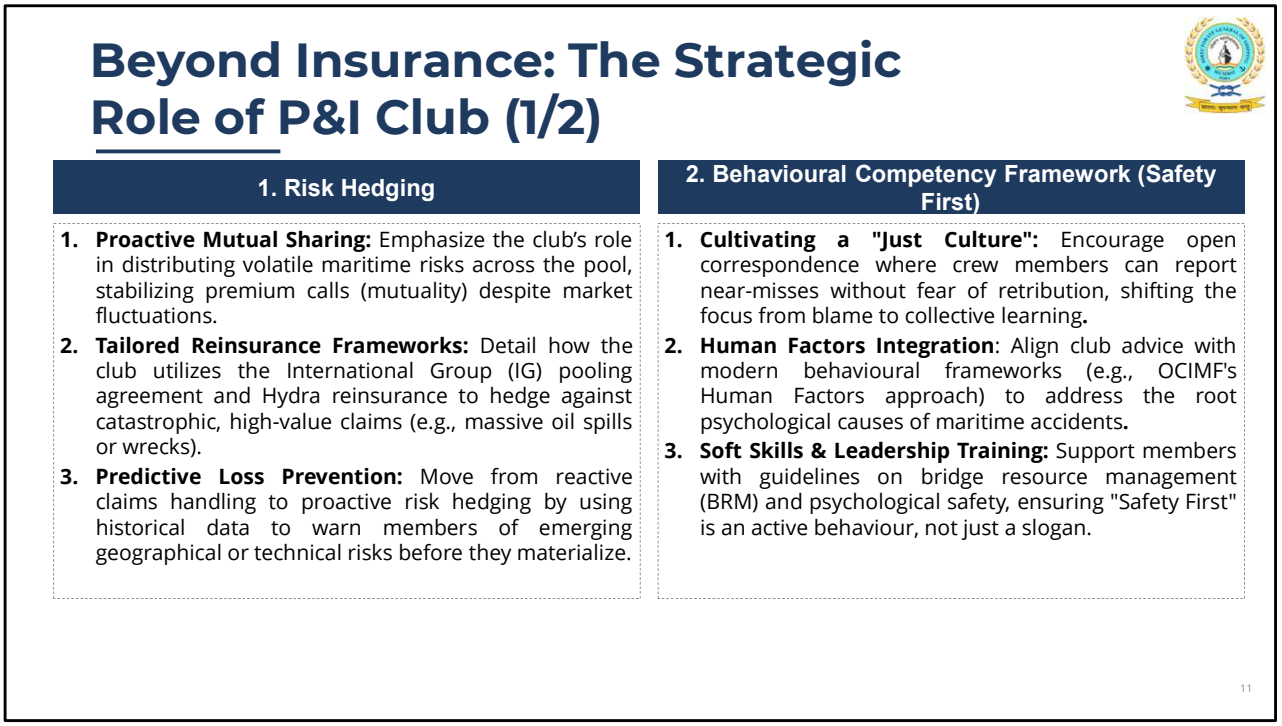
The settlement structure is a classic layered "waterfall," and it is worth lining up against the International Group's own architecture, which it consciously echoes:

- IG model: each club retains USD 10 m → USD 10–100 m pooled across the 12 clubs → above USD 100 m the collectively bought GXL reinsurance extends into the billions.
- BMIP model: member insurers issue and retain agreed shares → the pool's reserves, member contributions and reinsurance absorb claims up to USD 100 m → above USD 100 m the sovereign guarantee acts as the final backstop.

The design is sound, but three operational disciplines will determine whether it works in practice, and the workshop should treat them as priorities. First,

actuarial discipline and avoidance of adverse selection: a fixed-premium pool that prices below risk, or attracts only the worst risks others have declined, will erode its reserves and lean prematurely on the sovereign guarantee. The Underwriting Committee's independence is therefore not a formality. Second, claims-handling reach: a liability claim arises wherever the ship is, so the Pool needs a global correspondent and lawyer network to investigate, post security and settle abroad — the very capability China P&I spent decades building (around 490 correspondents in 145 countries). Third, certificate recognition: the real-world test is whether a foreign port State accepts a BMIP-backed CLC, Bunkers, Nairobi or MLC certificate. Until that acceptance is secured — through correspondent arrangements, fronting, or eventual IG engagement — ocean-going owners will hedge by retaining IG cover.

A further governance lesson from the IG is ring-fencing: the IG isolates each club's pooled exposure within its own Hydra cell, so that one club's losses do not contaminate another's capital. BMIP's pro-rata reinsurance among members achieves a similar sharing, but the Governing Body should ensure equivalent transparency on each member's exposure and contribution.



Beyond Insurance: The Strategic Role of P&I Club

Protection and Indemnity (P&I) Clubs are not merely insurance providers; they are strategic risk partners for maritime stakeholders. Their role extends beyond compensating losses to actively managing risk, improving safety culture, and enhancing operational resilience.

The note can be understood under two major dimensions:

1. Risk Hedging

Risk hedging refers to the mechanisms through which P&I Clubs reduce financial uncertainty for shipowners by distributing and managing risks effectively.

1.1 Proactive Mutual Sharing

P&I Clubs operate on a **mutuality principle**, where shipowners pool their resources to collectively bear maritime risks.

This system ensures that **volatile and high-risk exposures** (such as collisions, oil spills, or cargo damage) are distributed across a large pool of members.

By spreading risk, the club is able to:

Stabilize premium calls, even when market conditions fluctuate.

Offer consistent financial predictability to members.

This approach contrasts with traditional insurance models because it emphasizes **collaboration rather than profit-making**.

1.2 Tailored Reinsurance Frameworks

P&I Clubs further manage risk using **structured reinsurance arrangements**, particularly through:

- **International Group (IG) pooling agreement**
- **Hydra captive reinsurance structure**

These frameworks help cover **catastrophic, high-value claims**, such as:

- Massive oil spills
- Shipwrecks
- Large-scale environmental damage

Benefits include:

- **Risk diversification at a global level**
- Protection against **extreme financial losses**
- Enhanced financial security and sustainability of the clubs

1.3 Predictive Loss Prevention

P&I Clubs are shifting from reactive to **proactive risk management**.

They analyze:

- Historical claims data
- Incident trends
- Geographical and technical risk patterns

Based on this analysis, clubs:

- Issue **early warnings** to members
- Identify **high-risk routes, ports, or operational practices**
- Provide **preventive guidance** before incidents occur

This predictive capability significantly reduces:

- Accident frequency
- Financial losses
- Operational disruptions

2. Behavioural Competency Framework (Safety First)

Beyond financial coverage, P&I Clubs emphasize **human and organizational behavior** as central to maritime safety.

2.1 Cultivating a "Just Culture"

A "Just Culture" promotes:

- **Open reporting of incidents and near-misses**
- Freedom from fear of punishment or blame

Key objectives include:

- Encouraging transparency among crew members
- Transforming incidents into **learning opportunities**

This approach:

- Shifts focus from **individual blame to systemic improvement**
- Enhances **collective awareness and learning**

2.2 Human Factors Integration

P&I Clubs integrate **modern behavioural frameworks** such as:

- OCIMF (Oil Companies International Marine Forum) Human Factors approach

These frameworks address:

- **Psychological and cognitive causes** of maritime accidents
- Issues such as fatigue, miscommunication, stress, and decision-making errors

By addressing root causes, clubs:

- Improve **operational reliability**
- Reduce human error-related incidents
- Strengthen safety management systems

2.3 Soft Skills & Leadership Training

P&I Clubs promote **non-technical skill development**, especially:

- **Bridge Resource Management (BRM)**
- Communication and teamwork
- Leadership and decision-making
- Psychological safety onboard

The goal is to ensure that:

- "Safety First" becomes **a practical behavior**, not just a slogan

Training initiatives help:

- Improve coordination among crew
- Prevent misjudgments in critical situations
- Foster a more **safety-conscious organizational culture**

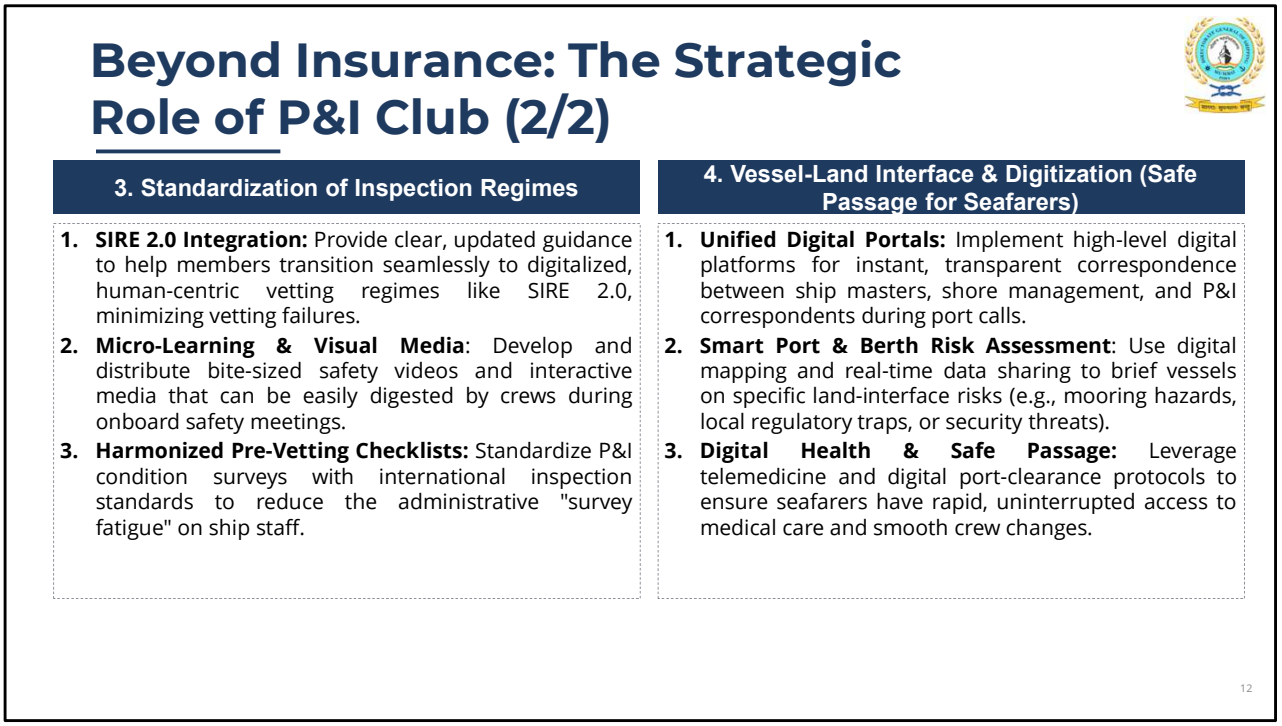
Conclusion

The strategic role of P&I Clubs extends far beyond indemnifying losses. Through **risk pooling, reinsurance frameworks, predictive analytics, and behavioral interventions**, they:

Enhance financial resilience

Improve maritime safety standards

Promote a proactive safety culture
In essence, P&I Clubs act as **partners in risk governance**, enabling safer, more efficient, and sustainable maritime operations.



This part further expands the strategic contributions of P&I Clubs, focusing on **inspection standardization** and **digital transformation at the vessel-land interface**, both of which are critical for improving operational efficiency, safety, and seafarer welfare.

3. Standardization of Inspection Regimes

P&I Clubs play a key role in streamlining and modernizing inspection processes, ensuring consistency, reducing redundancy, and improving compliance.

3.1 SIRE 2.0 Integration

SIRE (Ship Inspection Report Programme) 2.0 represents a **modern, digital, and human-centric vetting system**.

P&I Clubs assist members by:

Providing **clear and updated guidelines** for transitioning into SIRE 2.0.

Supporting adaptation to **digitized inspection methods**.

Benefits include:

Reduced inspection errors and inconsistencies

Improved transparency in vetting outcomes

Higher compliance with international safety standards

This integration helps ship operators **minimize vetting failures**, which directly impacts their commercial viability and reputation.

3.2 Micro-Learning & Visual Media

Traditional training is being replaced with **bite-sized, easily digestible content**, such as:

- Short safety videos
- Interactive modules
- Visual learning materials

These materials are:

- Delivered during onboard safety meetings
- Designed for quick understanding and retention

Advantages:

- Enhances **crew engagement and awareness**
- Improves retention compared to lengthy manuals
- Supports continuous learning in a time-constrained environment

This approach ensures that safety practices are **consistently reinforced in daily operations**.

3.3 Harmonized Pre-Vetting Checklists

P&I Clubs aim to **standardize condition surveys and pre-vetting procedures** across the industry.

This includes alignment with:

- International inspection standards
- Industry best practices

Key objective:

- Reduce **administrative burden** and "survey fatigue" experienced by ship staff due to repeated or overlapping inspections.

Outcomes:

- Increased efficiency in inspections
- Reduced duplication of efforts
- Better preparedness of vessels for external audits

4. Vessel-Land Interface & Digitization (Safe Passage for Seafarers)

P&I Clubs are increasingly involved in enhancing coordination between vessels and shore-based systems through digital transformation.

4.1 Unified Digital Portals

Development of **integrated digital platforms** to facilitate communication between:

Ship masters
Shore management teams
P&I correspondents

These platforms ensure:

Real-time information exchange
Transparent and fast decision-making during port operations

Benefits:

Reduced communication delays
Improved situational awareness
Better handling of incidents during port calls

4.2 Smart Port & Berth Risk Assessment

Use of advanced digital tools such as:

Geospatial mapping
Real-time operational data

These tools help vessels identify **specific risks at the vessel-land interface**, including:

Mooring hazards
Local regulatory requirements
Port security risks

By providing **data-driven risk briefings**, P&I Clubs enable:

Safer port entry and berthing operations
Improved planning and risk mitigation strategies

4.3 Digital Health & Safe Passage

P&I Clubs are leveraging technology to enhance **seafarer welfare and safety**, including:

Telemedicine services for onboard medical support
Digitalized port clearance and crew change processes

These innovations ensure:

- Quick access to medical care
- Reduced delays in crew changes
- Compliance with health and immigration protocols

- This contributes to:
  - Improved morale and well-being of crew
  - Continuity of operations
  - Enhanced safety standards in maritime operations

Conclusion

The second part highlights how P&I Clubs are evolving into **technology-driven and process-oriented strategic partners** by:

Standardizing inspection regimes to ensure consistency and efficiency

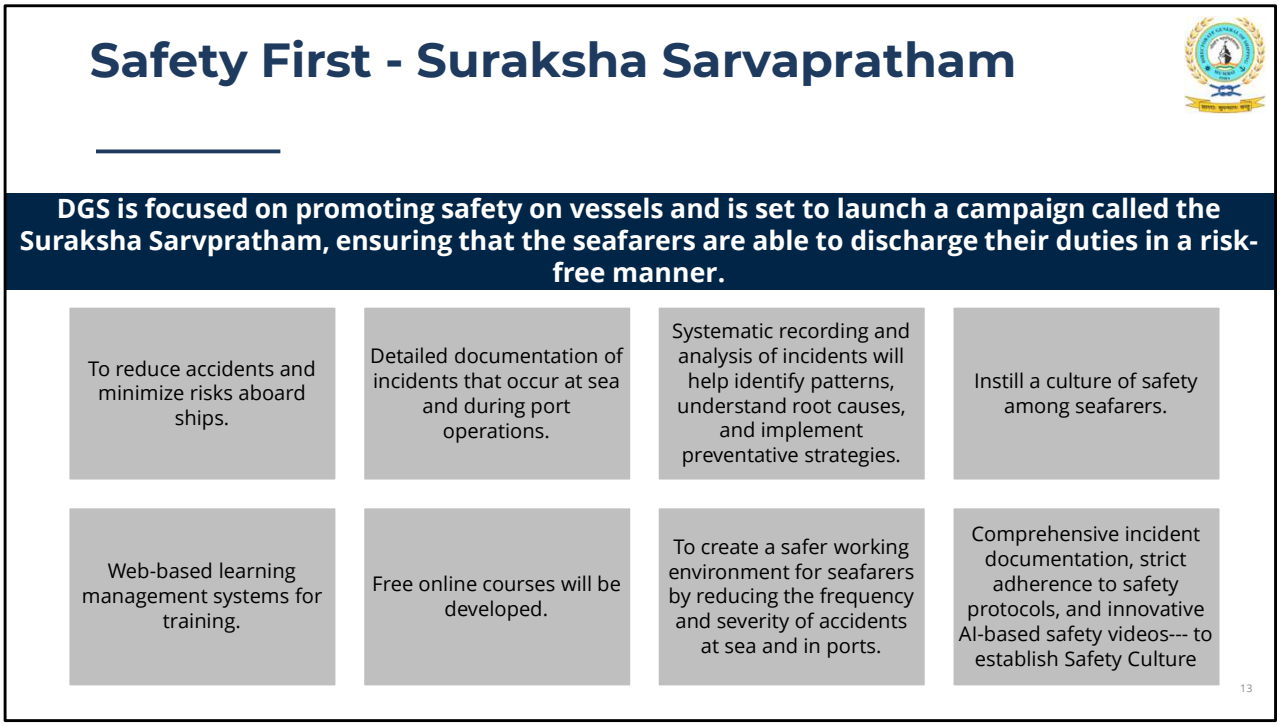
Reducing administrative burdens on ship crews

Driving digital transformation in vessel-land communication

Enhancing risk awareness at ports and berths

Improving seafarer welfare through health and safety innovations

Together with the earlier aspects (risk hedging and behavioral safety), these initiatives demonstrate that P&I Clubs are **critical enablers of safe, efficient, and future-ready maritime operations**, far beyond their traditional insurance role.

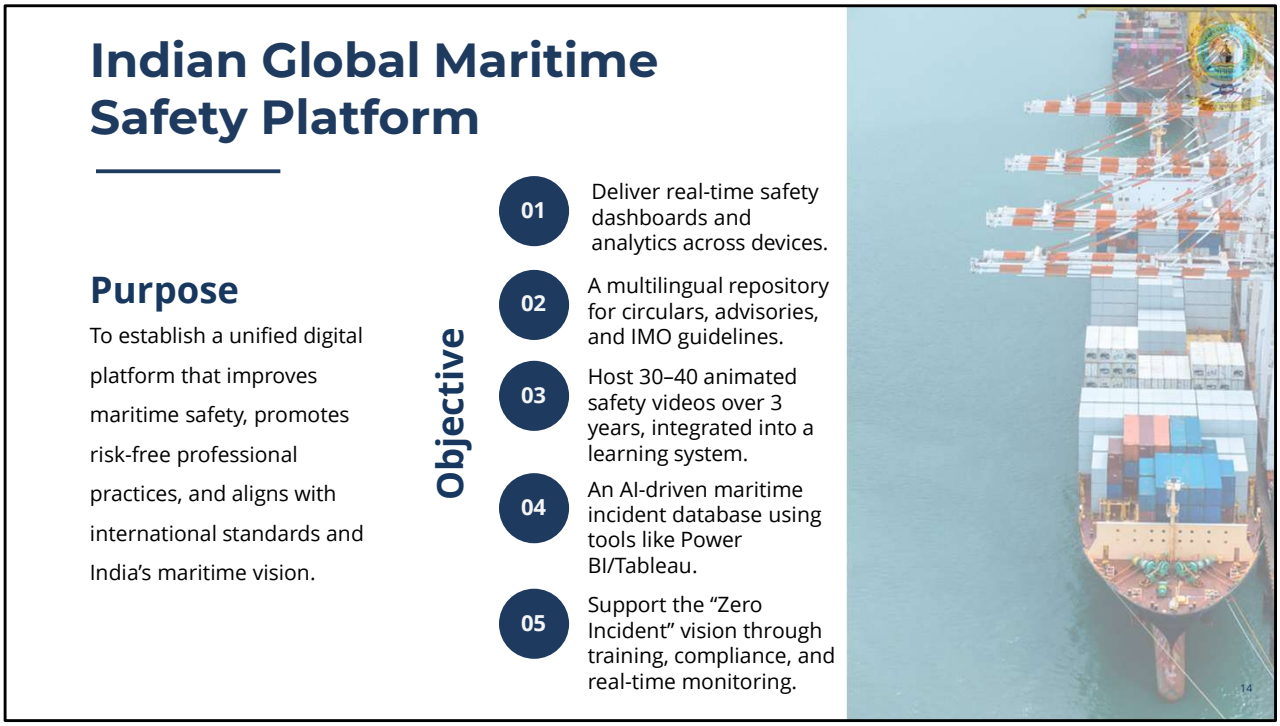


Suraksha Sarvapratham

Safety of life at sea is a fundamental priority of India's maritime administration. Recognizing the need to strengthen safety practices and reduce operational risks, the Directorate General of Shipping (DGS) is launching the "Suraksha Sarvapratham" campaign, reinforcing a Safety First culture across the maritime sector. The initiative is aimed at ensuring that seafarers are able to discharge their duties in a safe, secure, and risk-free working environment, both atsea anddduringport operations. The campaign emphasizes a structured and proactive approach to safety management through systematic incident reporting, documentation, and analysis. By identifying patterns, understanding root causes, and implementing preventive measures, the initiative seeks to reduce the frequency and severity of maritime accidents. A strong focus is placed on capacity building through web-based learning management systems, free online courses, and innovative training tools, including technology-enabled safety learning

Suraksha Sarvapratham also aims to instil a sustained culture of safety among seafarers by promoting strict adherence to safety protocols, comprehensive

incident documentation, and continuous learning. Collectively, these measures are expected to enhance operational safety, minimize risks, and contribute to safer maritime operations aligned with national and international safety objectives



Indian Global Maritime Safety Platform (IGMSP)

The Indian Global Maritime Safety Platform is a major step toward creating a unified digital ecosystem for maritime safety in India.

Its purpose is to improve safety standards, promote risk-free professional practices, and align India with global maritime requirements.

- **Vision and Key Features**

Establish a single digital platform that brings together safety data, guidelines, training content and incident information.

Provide real-time safety dashboards and analytics that can be accessed across devices for better operational awareness.

Maintain a multilingual repository of circulars, advisories and IMO guidelines to ensure updated and uniform access to safety information.

Host 30 to 40 animated safety videos over three years, integrated within a structured learning system for continuous professional development.

Create an AI-driven maritime incident database using tools such as Power BI or Tableau for trends, patterns and prevention-focused insights.

Support the Zero Incident vision by combining training, compliance and real-time monitoring to strengthen safe practices.

Build a central knowledge hub containing safety reports, infographics and

lessons learned for reference and learning.

- **Implementation Scope and Functional Modules**

Real-time dashboards with 20 to 25 safety KPIs and a device-agnostic interface for seamless access.
A central library of safety circulars with secure, multilingual access and structured training content.
Predictive insights using AI to support risk identification and data visualization for better decision-making.
Incident response modules that support real-time emergency coordination and integrate with DGCOMM and relevant crisis systems.
Knowledge and publication modules containing risk assessments, annual summaries and global collaboration inputs.
Deployment on a MeitY-approved cloud with CERT-In audits to ensure cybersecurity and system integrity.
Three years of support for data migration, testing, go-live and operations to ensure stability and continuity of the platform.

Safety Video Series

The Casualty Safety Video Series is a key safety awareness initiative of the Directorate General of Shipping aimed at reinforcing the principle that safety at sea is non-negotiable. The series is designed to sensitise seafarers to real-world operational risks through structured analysis of past marine casualties.

Scan the QR Code for

Safety Video Series- Directorate General of Shipping

Objectives

- Promote a strong safety culture onboard ships
- Highlight lessons learnt from past marine casualties
- Enhance risk awareness during shipboard operations
- Encourage strict adherence to safety procedures and best practices

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Video Series

The Directorate General of Shipping has taken an important initiative to enhance safety awareness by producing a dedicated series of animated safety videos. These videos are developed from actual maritime incidents investigated by the Casualty Investigation Branch and are designed to improve understanding, strengthen preventive measures, and support safer decision-making at sea and in ports.

Each video reconstructs the events leading to the casualty, identifies the unsafe acts and conditions involved, and most importantly explains the corrective measures that seafarers must adopt. The animations make complex events easy to understand and offer clear, practical lessons that can be incorporated into daily operations, toolbox meetings, and onboard safety trainings.

Videos currently released under the Safety Series

MV ULUSOY-11 – Enclosed Space Fatality: Focuses on the critical risks of enclosed space entry during cargo operations and highlights corrective actions such as gas monitoring, ventilation, permit-to-work compliance, and supervised entry.

DCI Dredge XVII – Hopper Tank Casualty: Explains the dangers associated with hopper tank entry and emphasises measures such as tank-entry permits,

consistent monitoring of atmosphere, lighting adequacy, and structured rescue arrangements.

Tug Alliance – Capsizing: Illustrates the operational and stability challenges faced during tug operations and underlines corrective lessons related to towline handling, communication, and understanding vessel limitations.

Key value of the Safety Video Series

These videos provide clear, actionable corrective measures and help seafarers recognise early warning signs.

They are ideal for onboard safety meetings, drills, pre-sea and post-sea training, as well as induction programs.

The objective is to support a more proactive, learning-oriented safety culture across the maritime workforce.

Call to action

All seafarers, trainers, RPSL companies, and MTIs are encouraged to view and share these videos widely.

Please scan the **QR code on the slide** to access the complete Safety Video Series on the official **DGS YouTube Channel**.

The playlist is continuously being expanded, and regular viewing is recommended for all ranks across the maritime sector.

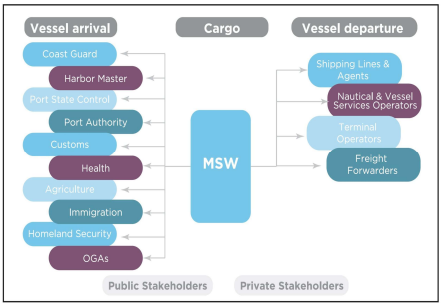
Maritime Single Window

The maritime single window (MSW) is a digital platform designed to streamline and simplify the submission of maritime-related documentation for ships arriving at or departing from ports, as per IMO's mandate.

It serves as a single-entry point where ship-owners, operators, and agents can electronically submit all the required information (FAL forms) to various authorities involved in maritime operations.

Maritime single window came into force from 01.01.2024. The implementation of the MSW aligns with the international maritime organization (IMO) and its facilitation (FAL) convention, which mandates the electronic exchange of information related to ship arrivals, departures, and cargo movements.

By digitalizing the submission and processing of regulatory documents, MSW significantly reduces manual intervention, thereby increasing the speed and accuracy of port clearances and promotes ease of doing business.
Upgradation is being pursued and has been mentioned in the upcoming slides.



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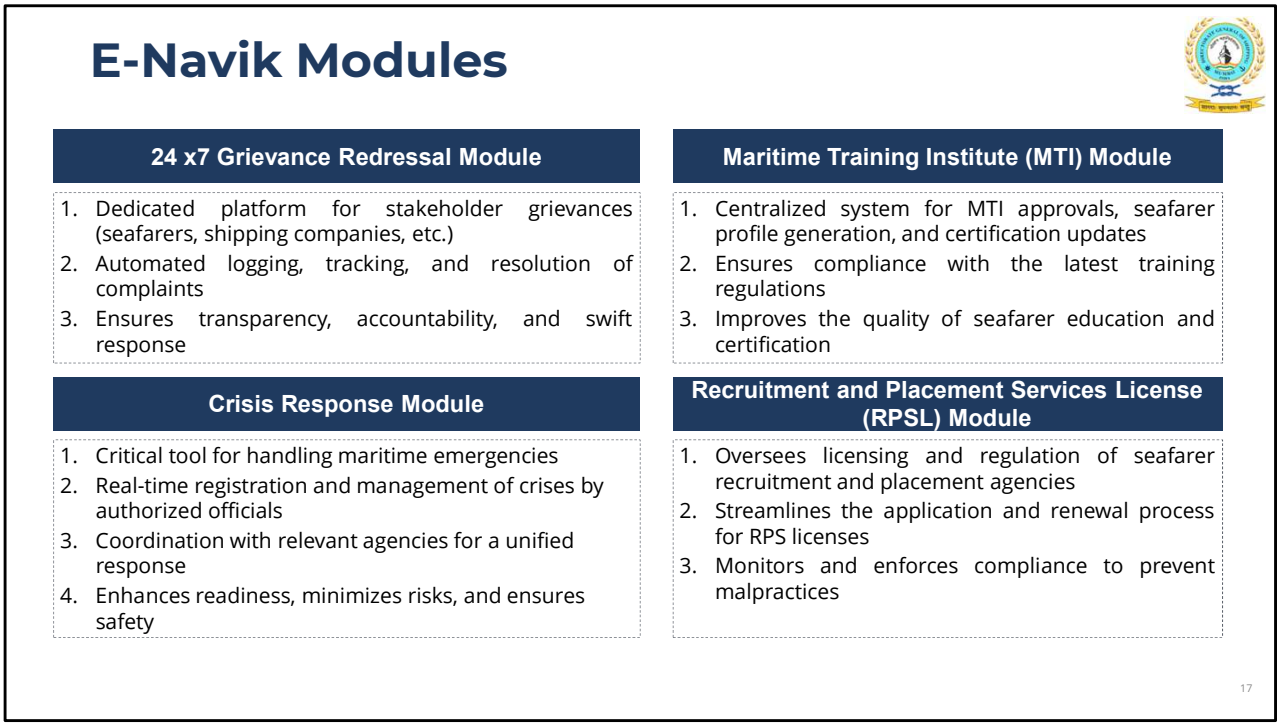
The Maritime Single Window, or MSW, is a transformative digital initiative aligned with the IMO's facilitation convention, aimed at streamlining maritime documentation. This platform, operational since 1 January 2024, acts as a single electronic entry point for ship owners, operators, and agents to submit all required information to the various authorities involved in port operations.

The MSW covers every aspect of a vessel's journey—arrival, cargo operations, and departure—integrating inputs from stakeholders such as the Coast Guard, customs, immigration, and port authorities, as well as shipping lines and terminal operators. By digitizing the submission and processing of regulatory documents, it significantly reduces manual intervention, accelerates port clearances, and promotes ease of doing business.

Most importantly, MSW marks a major leap forward for Indian maritime administration, enabling more accurate, efficient, and transparent port operations. Continuous upgradation is underway, reinforcing India's aspirations to meet international best practices and facilitate seamless global maritime trade.



At its core, E-Navik is designed as a comprehensive platform comprising four strategically important modules: **Grievance Redressal Management, Crisis Management, Recruitment and Placement Services License (RPSL), and Maritime Training Institutes (MTI)**. Together, these modules form an integrated framework that strengthens maritime governance while ensuring efficiency, accountability, transparency, and service excellence across the maritime ecosystem.

One of the most impactful components of E-Navik is the **24x7 Grievance Redressal Module**. Seafarers often operate in challenging environments across international waters and may encounter issues relating to employment, welfare, certification, contractual obligations, or workplace conditions.
The 24x7 Grievance Redressal Module provides a dedicated digital platform through which complaints can be registered, tracked, monitored, and resolved in a transparent and time-bound manner. By automating grievance workflows and maintaining complete visibility throughout the resolution process, DG Shipping aims to enhance accountability while reinforcing trust among seafarers and maritime stakeholders. The platform ensures that every grievance receives appropriate attention, thereby strengthening the confidence of seafarers in

India's maritime regulatory framework.

The second pillar of E-Navik is the **Crisis Management Module**, which has been designed to support rapid and coordinated responses to maritime emergencies. In a sector where accidents, natural disasters, medical emergencies, piracy incidents, and geopolitical disturbances can impact seafarers and vessels, timely intervention is critical. The Crisis Management Module enables authorized officials to register, monitor, coordinate, and manage emergency situations in real time. By facilitating communication and collaboration among various agencies and stakeholders, the platform supports informed decision-making and rapid response mechanisms during critical situations. This capability significantly enhances India's preparedness to address maritime crises while ensuring the safety and welfare of Indian seafarers worldwide.

A key strength of any maritime nation lies in the quality of its maritime education and training framework. Recognizing this, E-Navik incorporates a dedicated **Maritime Training Institutes (MTI) Module**. Maritime Training Institutes play a fundamental role in developing competent and internationally recognized maritime professionals. The MTI Module streamlines processes related to approval, monitoring, compliance management, and seafarer training records. It enables centralized management of institute profiles, training courses, certifications, and seafarer competency records. By digitizing these functions, DG Shipping can ensure standardization, regulatory compliance, transparency, and quality assurance across India's maritime training ecosystem. The result is a more efficient system that contributes directly to the development of highly skilled maritime professionals capable of meeting global industry standards.

The fourth component of E-Navik is the **Recruitment and Placement Services License (RPSL) Module**, which addresses one of the most critical aspects of seafarer welfare and protection—ethical recruitment. Recruitment and placement agencies serve as vital intermediaries between shipping companies and seafarers. However, ensuring that these agencies operate in compliance with regulatory requirements is essential to preventing exploitation, malpractice, and unfair employment practices. The RPSL Module digitizes the licensing, approval, renewal, monitoring, and compliance processes associated with recruitment and placement agencies. Through a transparent digital workflow, only qualified and compliant agencies are permitted to operate, thereby protecting seafarers and promoting ethical employment practices throughout the maritime industry.

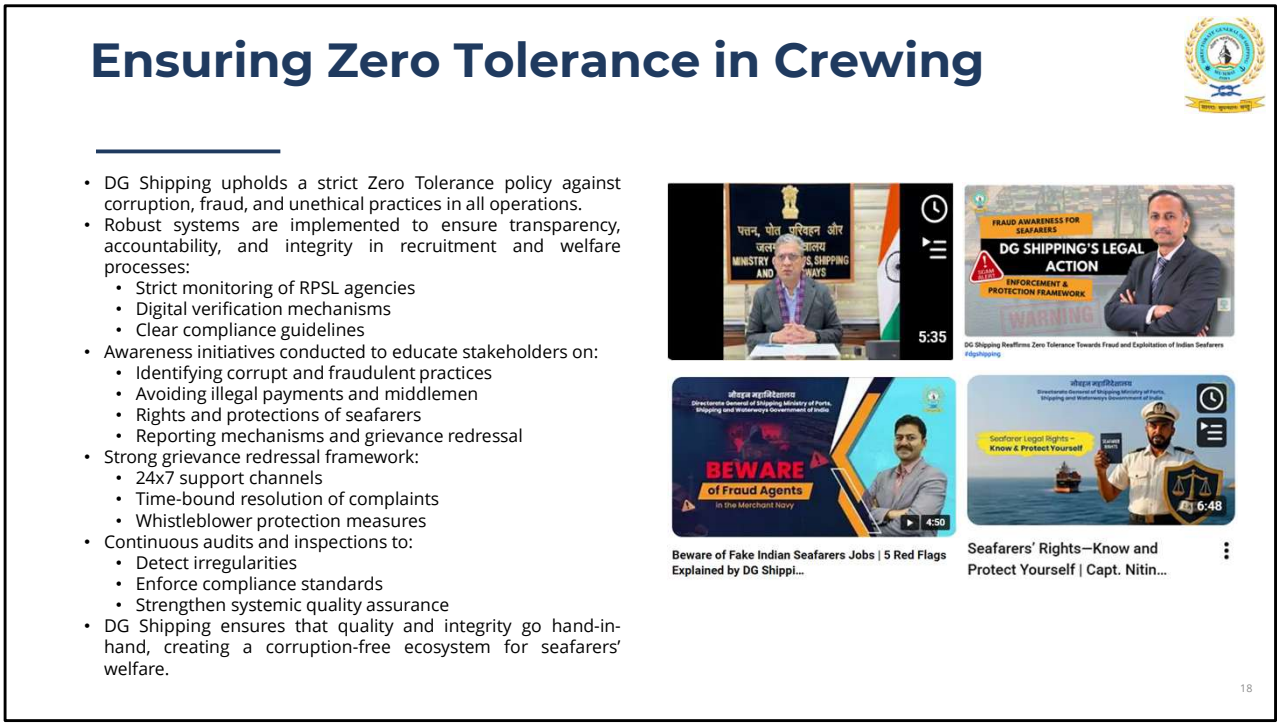
What makes E-Navik particularly significant is its holistic approach to maritime governance. Rather than functioning as individual applications, the four modules are designed as interconnected components of a larger digital ecosystem. This integration enables seamless data flow, improved decision-making, enhanced monitoring capabilities, and comprehensive stakeholder engagement. It creates a unified platform where seafarers, training institutions, recruitment agencies,

and regulatory authorities can interact efficiently within a secure digital environment.

The strategic importance of E-Navik extends beyond process automation. The platform embodies DG Shipping's commitment to recognizing seafarers as **global key workers** whose welfare, safety, training, and professional development are central to the success of India's maritime sector. Through digital transformation, E-Navik seeks to reduce administrative burdens, improve service delivery, strengthen regulatory oversight, and create a more responsive governance framework. By replacing fragmented processes with integrated digital services, the platform enhances both operational efficiency and stakeholder satisfaction.

As India advances toward the objectives of Maritime India Vision 2030 and its long-term ambition of becoming a leading maritime nation, E-Navik represents a critical enabler of that journey. It demonstrates how digital technology can be leveraged to improve governance, strengthen human capital, promote transparency, and protect the interests of seafarers. More importantly, it reflects a forward-looking vision in which maritime administration evolves from a traditional regulatory framework into a dynamic, technology-driven service ecosystem.

In many ways, E-Navik is more than a digital platform is a strategic investment in the future of India's maritime community. By integrating grievance redressal, crisis management, maritime training, and recruitment governance into a single technological framework, DG Shipping is building a resilient, efficient, and stakeholder-centric maritime ecosystem that will serve as a benchmark for maritime administrations across the world. The initiative marks a significant milestone in India's maritime digital transformation and reaffirms the nation's commitment to supporting its seafarers through innovation, responsiveness, and good governance.

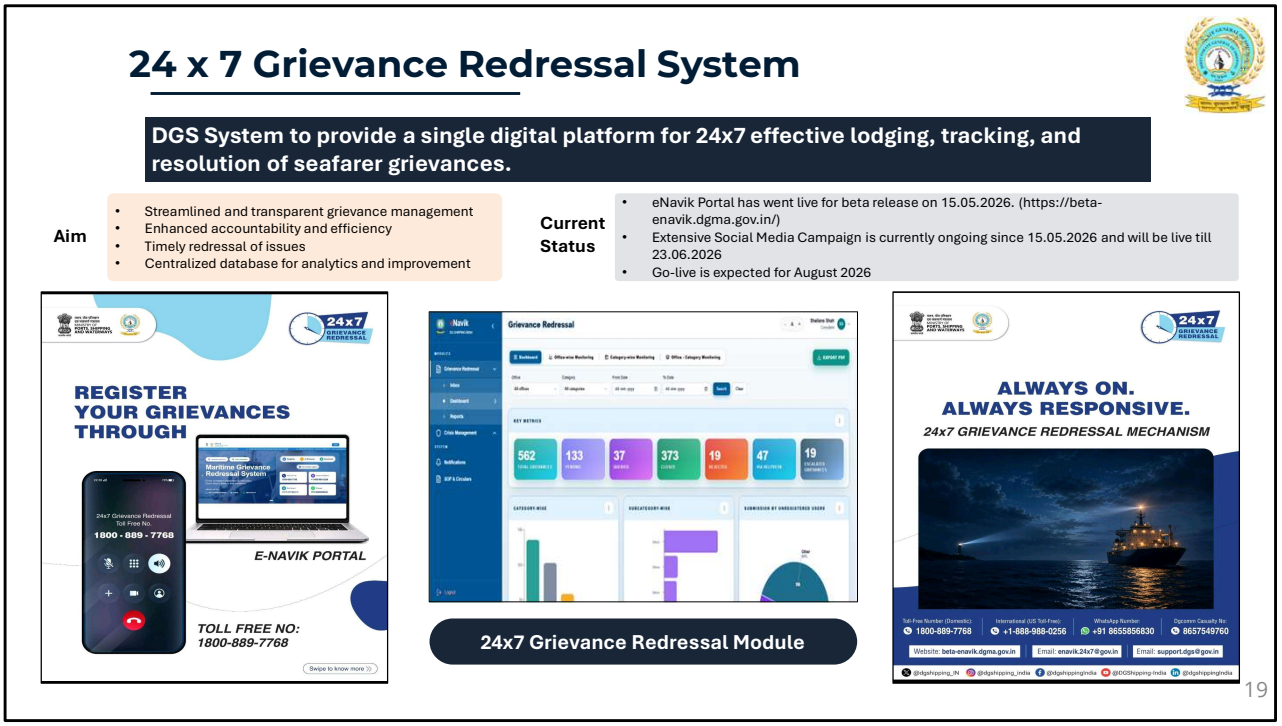


Ensuring Zero Tolerance In Crewing

Ensuring fairness, transparency, and ethical conduct in seafarer recruitment and crewing is a core priority of India's maritime administration. The Directorate General of Shipping (DG Shipping) follows a strict zero-tolerance policy against fraud, cheating, and illegal recruitment practices to safeguard the rights, welfare, and professional interests of seafarers. To strengthen awareness and preventive action, a nationwide digital outreach campaign has been launched through DG Shipping's official communication channels. The campaign focuses on educating seafarers about fraudulent agents and job offers, unauthorized payments to recruitment and placement service providers, statutory rights and entitlements, and the availability of 24×7 grievance redressal mechanisms. These initiatives are designed to empower seafarers with accurate information and enable informed decision-making. In addition to digital engagement, DG Shipping has complemented the campaign with on-ground symposia and stakeholder interactions focused on seafarer recruitment and welfare.

By combining policy enforcement, awareness generation, and structured grievance redressal, the initiative aims to prevent exploitation, promote ethical

crewing practices, and reinforce confidence in India’s maritime regulatory framework



24×7 Grievance Redressal System

The 24×7 Grievance Redressal System is designed as a centralized digital platform developed by the Directorate General of Shipping to enable continuous, end-to-end handling of seafarer grievances. The system supports round-the-clock lodging, tracking, and resolution of complaints through a unified interface, ensuring uninterrupted accessibility and operational continuity.

The primary objective of the system is to streamline grievance management by introducing a transparent and structured mechanism. It enables improved accountability by recording each stage of complaint handling within a centralized database. The system enhances efficiency by minimizing manual processes and allows timely redressal through defined workflows and monitoring features. In addition, the centralized repository of grievance data supports analytics, enabling identification of recurring issues and facilitating policy-level improvements.

The platform operates through the eNavik portal, which serves as the digital interface for users to register and monitor grievances. The portal has been launched in a beta version on 15 May 2026, with a dedicated online access link for users. A social media outreach campaign commenced on the same date and is scheduled to continue until 23 June 2026 to promote awareness and adoption of the system. Full-scale operational deployment is expected in August 2026, marking the transition from beta testing to complete implementation.

The grievance redressal process is supported by multiple access channels. Users can register complaints digitally through the portal interface, while additional support is provided via a 24×7 toll-free helpline number, 1800-889-7768. The interface allows for real-time tracking of complaint status and progress, ensuring visibility at each stage of resolution. The system also integrates backend dashboards that display key operational metrics, including the number of grievances received, pending cases, resolved cases, rejected cases, and escalations, enabling performance monitoring and administrative oversight.

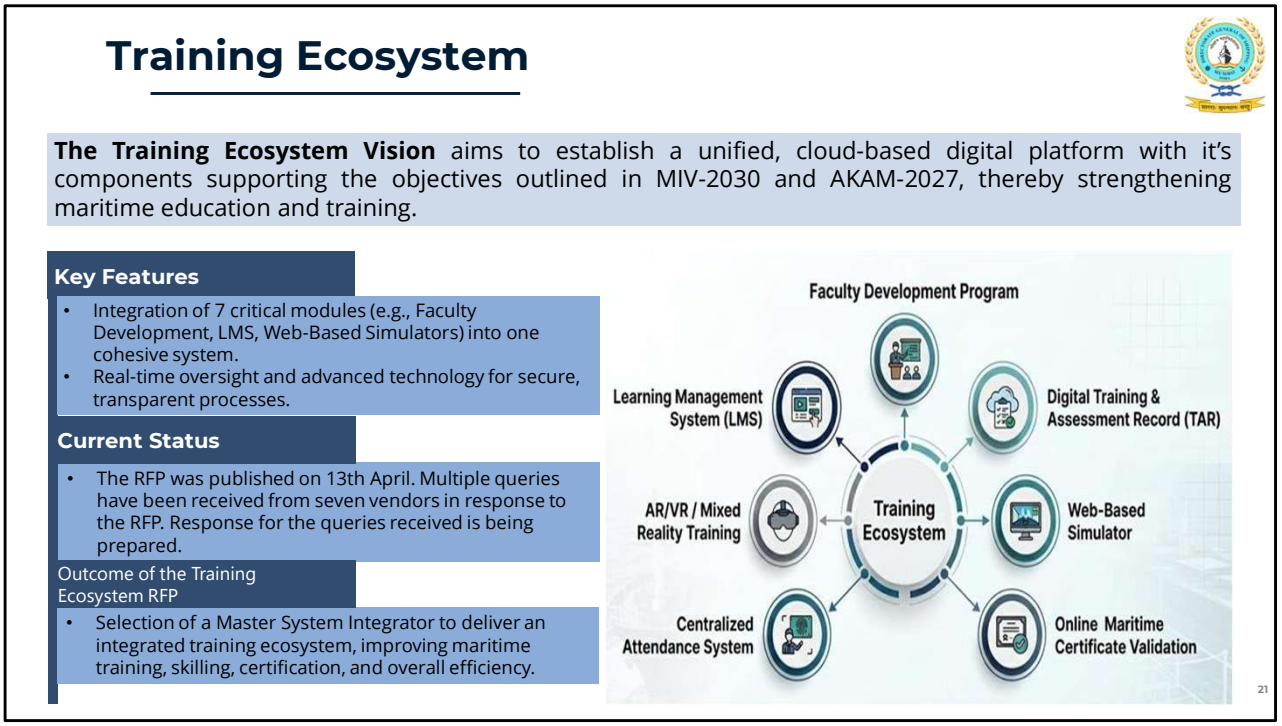
The system emphasizes continuous availability and responsiveness, highlighted by the operational model of “always on” and “always responsive.” It ensures that grievances can be submitted and processed at any time without dependency on manual office hours. The integration of digital tools enables automated routing, categorization, and escalation of complaints, ensuring structured handling and timely intervention where required.

Overall, the 24×7 Grievance Redressal System establishes a comprehensive framework for grievance management within the maritime sector. By integrating digital access, centralized monitoring, real-time tracking, and structured workflows, the system strengthens transparency, accountability, and efficiency in addressing seafarer concerns while supporting data-driven improvements in governance and service delivery.

Zero Tolerance in Training

The Directorate's Zero Tolerance initiative aims to strengthen integrity, accountability, and grievance-resolution mechanisms across the maritime training ecosystem. A structured reporting framework enables candidates and stakeholders to raise issues through calls, SMS, or WhatsApp, supported by a dedicated helpline available during defined working hours. Reported concerns follow an escalation pathway that ensures timely resolution, followed by guidance and support to prevent recurrence. Each case undergoes systematic analysis to identify corrective actions and strengthen processes.

To reinforce awareness and transparency, the Directorate actively disseminates information through social media platforms, highlighting regulatory updates, training guidelines, industry initiatives, and best practices. This sustained outreach helps create an informed training environment and encourages candidates to report concerns responsibly, thereby reinforcing a culture of compliance and zero tolerance toward misconduct in maritime training.



Training Ecosystem

1. Training Ecosystem Vision

The Training Ecosystem envisions the creation of a unified, cloud-based digital platform to regulate, monitor, and modernize maritime training, certification, and skill development. The objective is to bring all stakeholders—training institutes, faculty, trainees, regulators, and certifying authorities—onto a single integrated system, ensuring consistency, compliance, transparency, and quality enhancement across the maritime training landscape.

2. Key Features

The proposed ecosystem integrates seven critical modules, including Learning Management Systems (LMS), Faculty Development, Web-Based Simulators, AR/VR-based training, centralized attendance, certificate validation, and digital training & assessment records, into one cohesive

digital framework. The platform enables real-time oversight, data-driven decision-making, and secure, transparent operational processes through advanced technology and centralized governance.

LMS-The LMS is a secure, DGS-compliant e-learning platform for standardized maritime training which ensures training integrity through real-time tracking, anti-cheating controls, and assessment access only after full course completion.

Web Based Simulation-A web-based simulator provides an immersive, interactive platform that replicates real-world maritime scenarios for effective learning and assessment.

Digital Tar-The Training and Assessment Record (TAR) Book is a mandatory document that records and verifies a seafarer's structured onboard training and practical competencies.

CAS 2.0-The Centralized Attendance System (CAS) uses facial biometrics to securely verify the presence of candidates, faculty, and administrators across Maritime Training Institutes.

OMCV-Online Marine Certificates Verification (OMCV) is a digital platform that enables secure upload, verification, and digital stamping of maritime certificates to ensure authenticity.

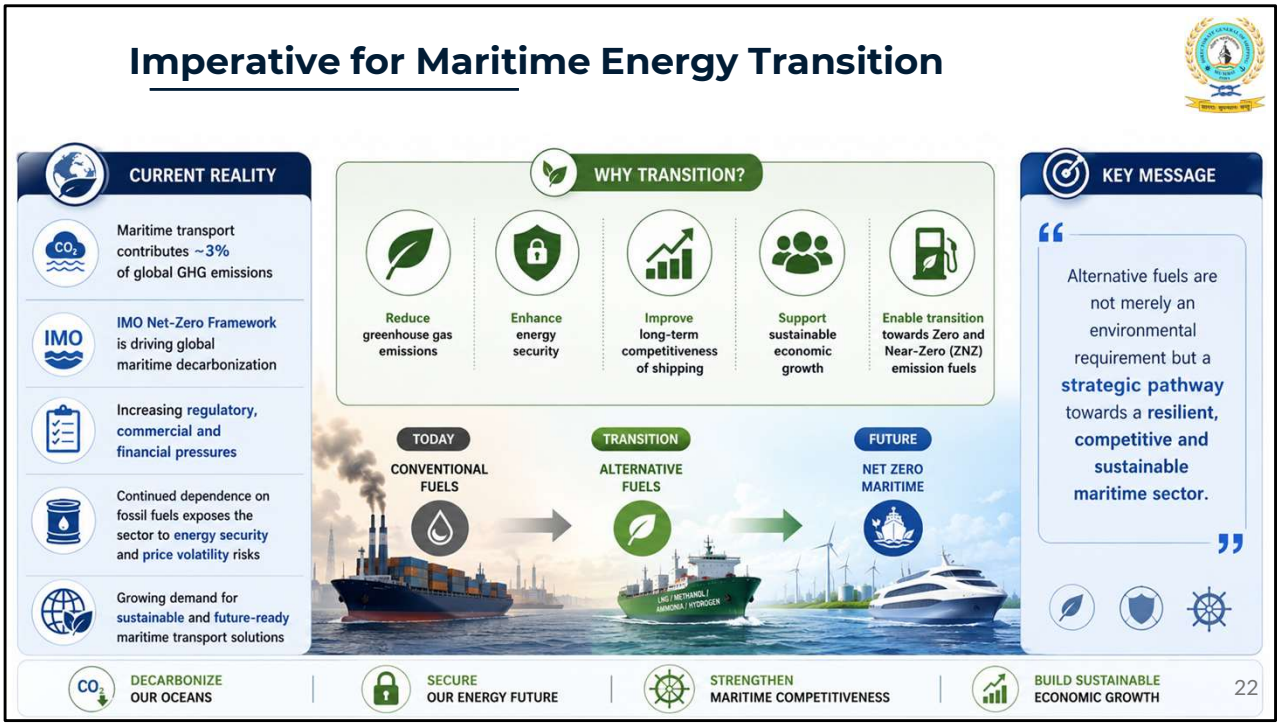
FDP-A Faculty Development Program (FDP) is a structured initiative designed to upgrade teaching skills, subject expertise, and professional competencies of faculty members through continuous learning and assessment.

AR/VR-Augmented Reality (AR) and Virtual Reality (VR) are immersive digital technologies designed to deliver realistic, interactive experiences for training, learning, and operational simulation. These technologies enhance engagement, situational awareness, and skill development.

Outcome of the Training Ecosystem RFP

The RFP aims to facilitate the selection of a **Master System Integrator** responsible for designing, developing, and implementing the integrated

Training Ecosystem. The successful implementation is expected to enhance maritime training quality, enable standardized skilling and certification, improve regulatory oversight, and significantly increase overall system efficiency.



The global maritime sector is undergoing a fundamental transformation driven by climate commitments, evolving regulatory frameworks, energy security concerns and changing market expectations. As international shipping accounts for approximately 3% of global greenhouse gas (GHG) emissions, the sector is increasingly expected to contribute towards global decarbonization efforts while continuing to facilitate international trade and economic growth.

Current Reality

The maritime sector today operates predominantly on conventional fossil fuels such as Heavy Fuel Oil (HFO), Marine Gas Oil (MGO) and Marine Diesel Oil (MDO). While these fuels have historically enabled reliable and cost-effective maritime transport, their continued use presents several challenges.

First, maritime transport contributes significantly to global greenhouse gas emissions and therefore remains a key focus area in international climate negotiations. Recognizing this, the International Maritime Organization (IMO) has adopted the IMO Net-Zero Framework, establishing a long-term pathway for reducing emissions from international shipping and accelerating the adoption of low-carbon and zero-emission technologies.

Second, shipowners and maritime stakeholders are facing increasing regulatory, commercial and financial pressures. Environmental regulations are becoming

progressively stringent, cargo owners are demanding greener logistics solutions, investors are integrating ESG considerations into financing decisions and global supply chains are increasingly prioritizing sustainability. Consequently, environmental performance is emerging as an important determinant of competitiveness.

Third, continued dependence on fossil fuels exposes the maritime sector to energy insecurity and fuel price volatility. Geopolitical tensions, supply chain disruptions and fluctuations in global energy markets can significantly impact fuel availability and operating costs. Such dependence creates vulnerabilities that can affect both shipping operations and national energy security.

Finally, there is growing demand for sustainable and future-ready maritime transport solutions. Customers, investors, governments and international institutions increasingly expect the shipping sector to align with broader sustainability objectives while maintaining operational efficiency and economic viability.

Why Transition?

The transition towards alternative fuels is driven by multiple strategic objectives extending well beyond environmental compliance.

A primary objective is the reduction of greenhouse gas emissions. Alternative fuels such as biofuels, methanol, ammonia and hydrogen offer pathways for substantially lowering lifecycle emissions from shipping operations and supporting the sector's long-term decarbonization goals.

The transition also enhances energy security by reducing dependence on imported fossil fuels and encouraging diversification of fuel sources. Greater utilization of domestically produced renewable fuels and green energy derivatives can strengthen resilience against external supply shocks and geopolitical uncertainties.

From a commercial perspective, the transition improves the long-term competitiveness of shipping. As global markets increasingly favour low-carbon transport solutions, early adoption of alternative fuels can help shipping companies maintain market access, attract green finance and remain competitive in a rapidly evolving regulatory environment.

The transition further supports sustainable economic growth by stimulating investment in renewable energy, fuel production, shipbuilding, port infrastructure and associated industries. The development of new fuel value chains can generate employment, encourage technological innovation and strengthen industrial capabilities.

Most importantly, the transition enables the gradual movement towards Zero and Near-Zero (ZNZ) emission fuels, which are expected to form the foundation of future maritime energy systems. Establishing the necessary production, storage, distribution and bunkering infrastructure today is essential for achieving long-term decarbonization objectives.

Maritime Energy Transition Pathway

The slide depicts a three-stage transition pathway representing the evolution of maritime fuels and technologies.

Today – Conventional Fuels

The current maritime ecosystem is dominated by conventional fossil fuels. While these fuels benefit from established global supply chains, mature technologies and extensive bunkering infrastructure, they are associated with significant greenhouse gas emissions and increasing exposure to regulatory and market risks.

Transition – Alternative Fuels

The intermediate phase involves the adoption of alternative fuels such as LNG, methanol, ammonia, hydrogen and sustainable biofuels. This stage represents a period of technological development, infrastructure creation, operational learning and progressive emissions reduction. During this phase, shipping companies, ports, fuel suppliers and regulators must work collaboratively to develop the ecosystems required for large-scale deployment of cleaner fuels.

Future – Net Zero Maritime

The ultimate objective is the establishment of a Net Zero Maritime ecosystem powered by Zero and Near-Zero emission fuels. In this future state, shipping operations are expected to be supported by clean energy supply chains, green bunkering infrastructure, advanced vessel technologies and integrated renewable energy systems. Such a system would significantly reduce environmental impacts while enhancing resilience and long-term competitiveness.

Strategic Message

The central message emerging from the transition pathway is that alternative fuels should not be viewed solely as an environmental obligation. Rather, they represent a strategic enabler of the future maritime economy.

The maritime energy transition simultaneously addresses four critical objectives:

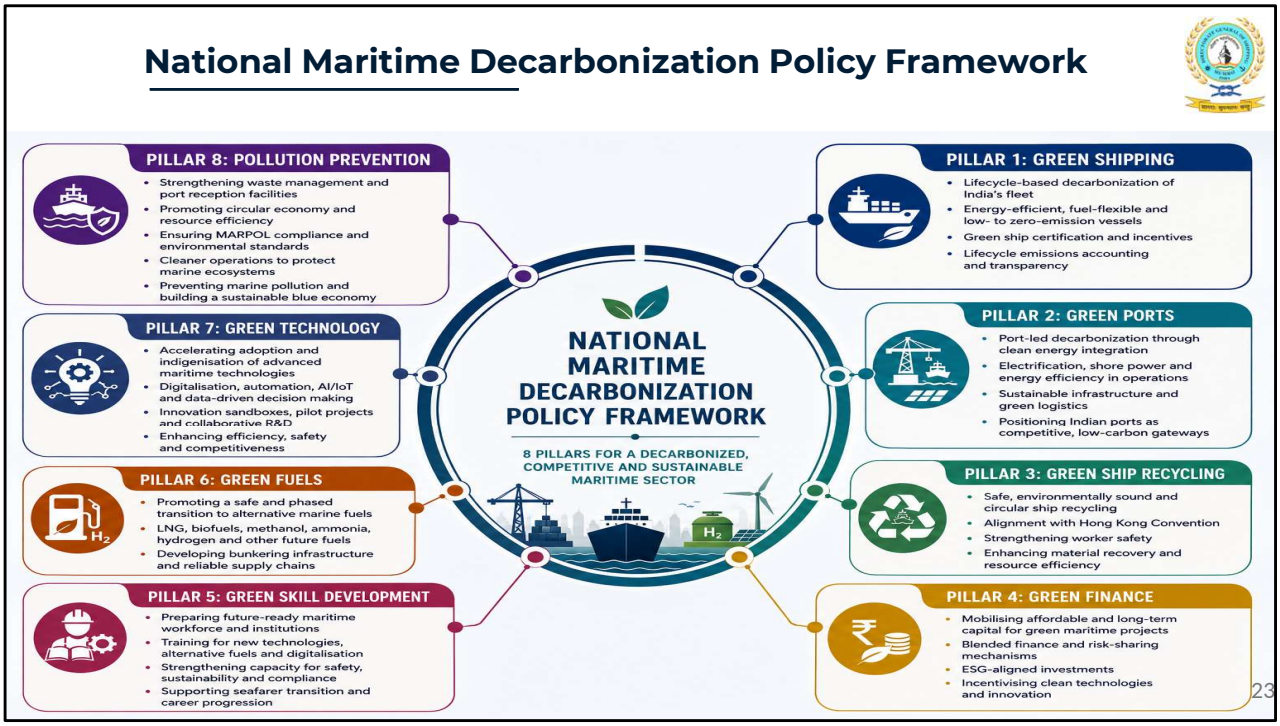
Decarbonizing oceans through substantial reductions in shipping emissions.

Securing the energy future by diversifying fuel sources and reducing dependence on fossil fuels.

Strengthening maritime competitiveness through innovation, regulatory preparedness and access to emerging green markets.

Supporting sustainable economic growth through investment, industrial development, job creation and new maritime value chains.

Accordingly, the transition to alternative fuels represents a strategic pathway towards a resilient, competitive and sustainable maritime sector capable of supporting future trade, economic development and climate objectives. For India, this transition also presents a significant opportunity to emerge as a major producer, supplier and bunkering hub for future maritime fuels while strengthening its position as a leading global maritime nation.



The National Maritime Decarbonization Policy Framework (NMDP) is envisaged as India's umbrella transition framework to systematically decarbonise and green the entire maritime ecosystem. It provides a unified national approach covering ships, ports, marine fuels, shipbuilding and ship repair, ship recycling, green finance, human capital development and digital governance systems, across both coastal and inland waterways.

The NGSP is designed not merely as an environmental policy, but as a strategic transformation instrument that aligns India's maritime growth ambitions with national climate commitments, international regulatory developments and long-term economic competitiveness. It seeks to embed sustainability as a core operational and investment principle across maritime planning, regulation and implementation, rather than treating decarbonisation as a parallel or incremental activity.

Policy Evolution and Development Process

The formulation of the NMDP has followed a phased, consultative and evidence-led approach.

An initial Consultative Document on the National Green Shipping Policy was developed by Lloyd's Register. This consultative document laid out the preliminary policy landscape, identified gaps in India's green maritime

ecosystem and proposed a broad set of policy actions across technology, fuels, ports, finance and regulation. The document was formally released during the Green Shipping Conclave, marking the commencement of structured stakeholder engagement on the proposed policy.

Building upon this consultative foundation, the draft National Green Shipping Policy was subsequently prepared by TERI – National Centre of Excellence for Green Ports and Shipping (NCoEGPS). This stage involved extensive stakeholder consultations and focused sectoral discussions, covering key maritime verticals including shipping, ports, shipbuilding, ship recycling, green fuels, finance and skill development. Inputs from central ministries, regulators, port authorities, shipowners, shipyards, technology providers, financial institutions, academia and international partners were systematically incorporated to strengthen policy coherence, practicality and implementability.

This two-stage process ensured that the NMDP evolved from a conceptual and gap-identification exercise into a robust, nationally owned draft policy, grounded in stakeholder consensus and aligned with India's developmental and institutional realities.

Role of NMDP as a Convergence Policy

Importantly, the NMDP is not a standalone scheme or isolated programme. It functions as a convergence and integration policy, bringing together multiple existing national visions, guidelines and sectoral initiatives under a single, coherent framework. These include Maritime India Vision 2030, Maritime Amrit Kaal Vision 2047, the Harit Sagar Guidelines and the Green Tug Transition Programme.

By consolidating these initiatives, the NMDP addresses the current fragmentation in India's green maritime landscape, where policies, schemes and pilot projects exist but lack a common definitional basis, emissions baseline, monitoring architecture and implementation sequencing. The policy therefore serves as the principal national reference framework for defining what constitutes "green" in the maritime context, establishing measurable targets, standardised monitoring and reporting mechanisms and enabling coordinated action across ministries, regulators, ports, shipping companies, shipyards and financial institutions.

At a strategic level, the NMDP positions India to pursue a phased, realistic and nationally aligned maritime decarbonisation pathway, balancing developmental priorities with environmental responsibility, while providing a credible basis for engagement with evolving global maritime decarbonisation frameworks.

Why NMDP Is Imperative Now

The need for a National Maritime Decarbonization Policy Framework (NMDP) has become immediate and unavoidable due to the convergence of global regulatory pressures, domestic policy gaps and India's rapidly expanding maritime

footprint. While India has launched several forward-looking green maritime initiatives over the past decade, these efforts remain fragmented, scheme-driven and unevenly implemented, limiting their cumulative impact.

Escalating Global Regulatory and Market Pressures

International shipping is entering a decisive phase of decarbonisation. The International Maritime Organization (IMO), through its Revised GHG Strategy (2023), has committed to achieving net-zero greenhouse gas emissions from international shipping by or around 2050, with interim targets for 2030 and 2040. These developments are being reinforced by emerging market-based measures, fuel standards and emissions reporting requirements across major trading blocs. In the absence of a comprehensive national framework, Indian shipping, ports and maritime service providers risk:

Regulatory misalignment with global standards

Higher compliance costs and trade frictions

Reduced competitiveness of Indian-flag vessels and ports

The NGSP is therefore required to provide policy certainty, regulatory preparedness and strategic alignment, enabling Indian maritime stakeholders to anticipate and adapt to evolving international obligations in a coordinated manner.

Fragmentation of Domestic Green Maritime Initiatives

India has already initiated several important green maritime measures, including the Harit Sagar Guidelines, the Green Tug Transition Programme, ship recycling reforms and pilot green fuel projects at select ports. However, these initiatives currently operate as standalone interventions, without a common framework for:

Defining what constitutes a “green ship”, “green port” or “green fuel”

Establishing national emissions baselines across ships, ports and inland waterways

Standardising Monitoring, Reporting and Verification (MRV) systems

Sequencing short-term, medium-term and long-term decarbonisation actions

This fragmentation constrains scale-up and dilutes accountability. The policy is imperative to unify these disparate efforts into a single national transition architecture, ensuring coherence across policies, programmes and investments.

Scale and Growth of India’s Maritime Sector

India’s maritime sector underpins nearly 95% of the country’s trade by volume and continues to expand rapidly, supported by major investments in ports, inland waterways, coastal shipping and shipbuilding. With new mega ports, industrial clusters and logistics corridors under development, the carbon footprint of maritime activities is set to increase sharply if sustainability is not embedded at the planning stage.

Without a guiding national policy:

Infrastructure investments risk locking in carbon-intensive pathways

Retrofitting costs will rise over time
Opportunities for early adoption of clean technologies may be missed
The policy is therefore critical to mainstream decarbonisation at the design, procurement and investment stages, rather than treating it as a post-facto corrective measure.

Alignment with India's National Climate Commitments

India's climate commitments under the Panchamrit framework and the Long-Term Low Emission Development Strategy (LT-LEDS) set a national net-zero target for 2070. However, the maritime sector requires a sector-specific transition pathway to translate these economy-wide goals into actionable measures for ships, ports and fuels.
The policy bridges this gap by:
Translating national climate commitments into maritime-specific targets
Aligning domestic timelines with global maritime decarbonisation trajectories
Providing a calibrated and development-sensitive transition pathway
In doing so, it ensures that India's maritime decarbonisation efforts are credible, measurable and nationally appropriate.

Enabling Green Finance and Investment Readiness

The transition to green shipping will require significant capital mobilisation for new vessels, retrofits, alternative fuel infrastructure, renewable energy integration and digital systems. Global climate finance, sustainability-linked lending and green bonds are increasingly tied to clear policy signals, measurable outcomes and robust governance frameworks.
In the absence of a national policy:
Investors face uncertainty and higher perceived risks
Access to international green finance remains constrained
Domestic financial institutions lack clear guidance on eligibility and metrics
The NMDP is imperative to establish the policy and institutional foundations for green maritime finance, de-risking investments and enabling access to domestic and international capital.

Strategic Opportunity for Global Leadership

Finally, the timing of the NMDP presents a strategic opportunity. India is simultaneously:
Expanding its maritime and port infrastructure
Scaling renewable energy capacity
Emerging as a leader in ship recycling and green fuel potential
By acting now, India can move from being a policy follower to a rule-shaper in global green shipping, positioning itself as a credible hub for green vessels, green fuels and sustainable maritime services.
In essence, the NMDP is imperative now because delay would increase transition

costs, fragment action and weaken India's strategic positioning, whereas timely adoption enables a coordinated, cost-effective and globally aligned green maritime transition.

NMDP Objectives and Pillar Architecture

Core Objectives of the National Maritime Decarbonization Policy Framework

The National Maritime Decarbonization Policy Framework (NMDP) articulates a set of clear, interlinked objectives aimed at guiding India's maritime sector through a phased, measurable and inclusive green transition. These objectives serve as the operational foundation for all actions undertaken under the policy. The key objectives of the NMDP are to:

Decarbonise India's maritime sector in a structured and time-bound manner

The NMDP seeks to progressively reduce greenhouse gas emissions across ships, ports, fuels and associated maritime activities, while aligning domestic action with India's national climate commitments and evolving international maritime decarbonisation frameworks.

Establish a common national definition and standards for "green" maritime activities

A core objective of the policy is to define, standardise and operationalise what constitutes a *green ship*, *green port* and *green fuel*, using measurable, auditable and lifecycle-based criteria. This is intended to remove ambiguity and enable consistency across regulation, procurement, certification and financing.

Create a robust governance, monitoring and reporting framework

The NMDP aims to institutionalise national emissions baselines, Monitoring Reporting and Verification (MRV) systems and performance assessment mechanisms, ensuring transparency, accountability and data-driven decision-making across the maritime ecosystem.

Enable investment and de-risk the green maritime transition

Recognising the scale of capital required, the policy seeks to unlock domestic and international green finance by providing policy certainty, standardised metrics and institutional mechanisms that reduce risk for investors, shipowners, ports and technology providers.

Promote technology adoption, innovation and indigenisation

The NMDP encourages the adoption of clean and energy-efficient maritime technologies while supporting domestic manufacturing, research and innovation in areas such as alternative fuels, propulsion systems, digital solutions and emissions reduction technologies.

Ensure a just, inclusive and capacity-driven transition

The policy explicitly integrates human capital development, green skilling and inclusion of MSMEs, informal operators and coastal communities, ensuring that the benefits of the green transition are equitably distributed.

Pillar Architecture of the NMDP

To operationalise these objectives, the NMDP is structured around a multi-pillar architecture, with each pillar addressing a critical dimension of the maritime ecosystem. The pillars are designed to function interdependently, enabling coordinated implementation rather than isolated interventions.

The NMDP pillar framework comprises:

1. Green Shipping

This pillar focuses on decarbonisation of vessels across coastal, inland and international shipping segments, including shipbuilding and ship repair. It addresses green ship standards, retrofitting, new builds, emissions monitoring, certification and financial incentives for cleaner vessels.

2. Green Ports

The Green Ports pillar targets reduction of emissions and environmental impacts at ports and terminals through renewable energy integration, energy efficiency, electrification, shore-to-ship power, waste management, digital monitoring and green port certification mechanisms.

3. Green Ship Recycling

The Green Ship Recycling pillar aims to strengthen environmentally sound and safe ship recycling practices, aligned with international conventions and domestic regulations, while promoting circularity, transparency and occupational safety.

4. Green Finance

This pillar focuses on mobilising and de-risking capital for green maritime investments through dedicated funds, sustainability-linked finance instruments, incentives, subsidies and blended finance mechanisms aligned with measurable performance outcomes.

5. Green Skill Development

This pillar addresses the workforce dimension of the transition by strengthening green skilling, certification, training and institutional capacity across seafarers, port workers, shipyard personnel, regulators and allied maritime professionals.

6. Green Fuels

This pillar supports the transition from conventional marine fuels to low- and zero-carbon alternatives such as biofuels, LNG, green hydrogen, ammonia and methanol. It covers fuel standards, lifecycle emissions assessment, bunkering infrastructure, green corridors and fuel transition pathways.

7. Green Technology

The Green Technology pillar promotes adoption and indigenisation of clean maritime technologies, including propulsion systems, energy storage, emissions reduction solutions and digital tools. It also emphasises research, development and international technology collaboration.

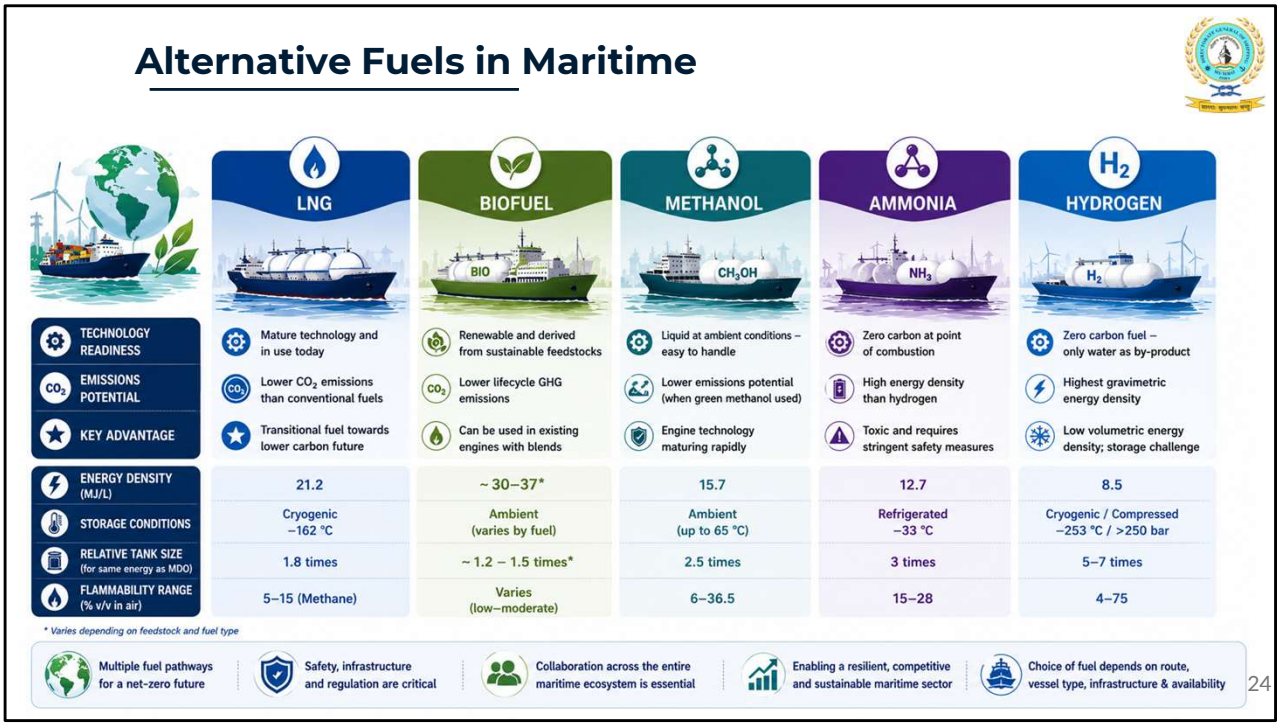
8. Pollution Prevention

Preventing Marine Pollution and building sustainable blue economy.

Strengthening waste management and port reception facilities, Ensuring MARPOL Compliance and environmental standards. Cleaner operations to protect marine ecosystem.

Relevance of the Pillar Architecture for Implementation

The pillar-based structure allows the NMDP to be **translated into actionable programmes, timelines and responsibilities**, while enabling coordination across ministries, regulators, ports, shipping companies, shipyards, financial institutions and technology providers. It also facilitates **tracking, monitoring and course correction** by clearly mapping actions, stakeholders and outcomes to specific thematic pillars.



The global maritime sector is undergoing a structural and irreversible transition driven by the convergence of tightening international climate regulations, rapid technological evolution and shifting fuel economics. Shipping, which has traditionally relied on energy-dense fossil fuels, is now subject to explicit decarbonisation pathways that fundamentally alter how vessels are designed, operated and fuelled.

A critical inflection point in this transition is the adoption of the IMO Net-Zero Framework by the International Maritime Organization, which operationalises global decarbonisation objectives through binding regulatory instruments. Central to this framework is the introduction of mandatory Greenhouse Gas Fuel Intensity (GFI) requirements, assessed on a well-to-wake lifecycle basis, covering emissions from fuel production, transport and onboard use. This marks a decisive shift away from earlier, predominantly efficiency-based measures toward a fuel-centric regulatory regime.

Under this emerging framework, fuel choice becomes the primary determinant of regulatory compliance. Unlike earlier phases of maritime environmental regulation, where incremental efficiency improvements could offset emissions growth, the new regime directly links compliance status, financial exposure and operational flexibility to the carbon intensity of the fuel used. As a result, vessels

relying on conventional fossil marine fuels are increasingly exposed to:
escalating compliance costs
reduced commercial attractiveness
long-term asset obsolescence
Consequently, conventional marine fuels such as heavy fuel oil and marine diesel oil are expected to be progressively displaced over the coming decades by low-carbon and zero-carbon alternatives, including biofuels and hydrogen-derived fuels. In this context, fuel transition has emerged as the single most critical decarbonisation lever for shipping, outweighing incremental gains from hull design, operational optimisation or energy efficiency measures alone.
This global transition imperative establishes the foundational context for national and sectoral strategies on alternate fuels for maritime applications, requiring countries to align domestic fuel pathways with evolving international regulatory trajectories while managing economic, safety and technological constraints.

Indian Maritime Context and Rationale for a Multi-Fuel Pathway
India's maritime ecosystem is characterised by significant heterogeneity across vessel types, operational profiles, trade routes and fleet age. The national fleet spans inland waterway vessels, coastal and short-sea shipping, offshore support vessels and deep-sea ocean-going vessels (OGVs), each operating under distinct technical, economic and regulatory constraints. This diversity inherently limits the feasibility of a uniform fuel transition pathway.
The Future Fuel Strategy prepared by the Indian Register of Shipping (IRS) and the Advanced Green Fuels Road Map for Maritime Applications led by Dr Piyali Das under TERI–NCoEGPS both converge on the assessment that a single-fuel transition pathway is neither technically viable nor economically optimal for India. Instead, fuel choices must be tailored to vessel size, engine configuration, operating range, voyage duration and refuelling frequency.
The analyses highlight that short-sea, coastal and inland vessels operate under markedly different conditions compared to deep-sea OGVs. These segments typically involve shorter voyage lengths, frequent port calls and smaller engine capacities, which allow for earlier adoption of certain alternate fuels and technologies. In contrast, OGVs face stringent energy density requirements, long endurance needs and limited refuelling opportunities, constraining near-term fuel choices and pushing zero-carbon fuel adoption further into the medium and long term.
Further, the existing fleet composition presents a critical constraint. A substantial proportion of India's operational fleet comprises vessels that were not designed for zero-carbon fuels, making immediate large-scale conversion economically prohibitive. Both IRS and TERI assessments therefore emphasise the necessity of transitional fuel solutions—such as blend fuels and drop-in alternatives—to enable near-term regulatory compliance while avoiding

premature asset stranding.
In this context, India's maritime fuel transition is framed as a phased, portfolio-based approach, rather than a linear or single-fuel shift. This approach balances:
near-term compliance requirements under evolving international regulations
medium-term technology maturation and infrastructure development and
long-term decarbonisation objectives aligned with zero-carbon fuels
Such a pathway allows India to manage regulatory risk, control transition costs and progressively align its maritime sector with global decarbonisation trajectories, while remaining responsive to domestic operational realities.

Transitional Fuels and Near-Term Compliance Options

Fossil-Liquefied Natural Gas (LNG)
Fossil-based LNG is recognised in the NMDP and associated consultative material as a **transitional marine fuel,** offering limited greenhouse gas intensity benefits relative to conventional marine fuels but not constituting a net-zero solution in the long term.
The policy framing reflects international regulatory developments under the IMO, particularly the shift toward well-to-wake greenhouse gas accounting, under which the climate benefits of fossil LNG are constrained by **upstream methane emissions and lifecycle impacts**. As a result, LNG is positioned within NMDP as an **intermediate compliance pathway**, whose long-term acceptability depends on a transition toward bio-LNG or synthetic LNG rather than continued reliance on fossil LNG.
From a lifecycle perspective, fossil LNG can exhibit lower greenhouse gas fuel intensity than heavy fuel oil under specific conditions, particularly when used in high-pressure dual-fuel engines with minimal methane slip and low upstream leakage. Well-to-wake assessments typically place fossil LNG between approximately **65 and 100 gCO_2eq/MJ, compared to 90–94 gCO_2eq/MJ for HFO**, with outcomes highly sensitive to engine technology and methane slip rates.
Fuel
Approx. GFI (gCO_2eq/MJ)
HFO
~90-94
LNG
~65-100
Bio-methanol
~9–17
Green ammonia
~3–12

While this differential enables near-term compliance gains, it remains

insufficient to meet post-2040 and net-zero trajectories without carbon-neutral sourcing or offset mechanisms. This technical limitation underpins NMDP's **explicit avoidance of LNG as an end-state fuel**.

National future fuel assessments referenced in the NMDP documentation further reinforce LNG's transitional status. For Indian shipping, LNG demand is projected to decline over time, reflecting tightening international regulations and the increasing role of hydrogen-derived fuels. While LNG retains relevance in the near term due to existing engine technology, operational familiarity and partial infrastructure availability, the policy framework anticipates that continued use of LNG beyond the medium term will require a shift toward bio-LNG or synthetic LNG to remain compliant with international decarbonisation pathways.

Key Policy Signals on LNG:

Fossil-LNG is acknowledged as a **lower-carbon alternative to conventional marine fuels**, but not a zero- carbon fuel.

Its role is explicitly framed as **transitional, supporting early emissions reduction** while alternative fuels mature.

LNG's long-term compatibility with IMO net-zero targets is conditional on **green or bio-based sourcing.**

Methane slip and **upstream emissions** limit LNG's effectiveness under well-to-wake GHG accounting.

Policy emphasis **shifts progressively away from fossil LNG** toward methanol, hydrogen and ammonia pathways.

Ports and shipowners are cautioned against **long-term lock-in risks** associated with LNG-specific infrastructure and assets.

Biofuels

Biofuels are recognised in the NDMP as **critical near-term and transitional solutions** for reducing greenhouse gas emissions from shipping, particularly during the early phases of fuel transition. Their policy relevance stems from their **compatibility with existing vessel engines** and fuel handling systems, enabling emissions reduction **without requiring immediate fleet replacement** or large-scale retrofitting. Within the NDMP framework, biofuels are positioned as an enabling pathway that supports early compliance with evolving IMO greenhouse gas fuel intensity requirements while longer-term zero-carbon fuels mature.

From a lifecycle emissions perspective, biofuels demonstrate **substantially lower well-to-wake greenhouse gas intensity** compared to conventional marine fuels. Assessments referenced in the consultative process indicate that **biodiesel and bio-methanol achieve GFI values in the range of approximately 10-30 gCO_2eq/MJ**, depending on feedstock and production pathway, compared to **~90-95 gCO_2eq/MJ for heavy fuel oil**. This differential allows biofuels to

deliver meaningful emissions reductions within existing technical constraints, reinforcing their role as an early-stage compliance option under GFI-based regulatory regimes.
For India, biofuels are particularly relevant in the near to medium term due to **domestic feedstock availability, alignment with waste-to-energy and circular economy objectives and comparatively lower infrastructure complexity**.
While biofuels alone are not sufficient to achieve net-zero emissions by mid-century, the policy framework recognises their role in **reducing cumulative emissions, building operational experience and mitigating transition risks** during the early phases of decarbonisation.
Below table summarises the compatibility and infrastructure requirements for biofuels:

Parameter
Biofuels
Engine compatibility
Compatible with existing ICEs (subject to OEM limits)
Vessel modification
Not required for low-percentage blends
Fuel storage
Existing liquid fuel tanks usable
Bunkering systems
Existing liquid bunkering infrastructure
Safety classification
Comparable to conventional liquid fuels
Port readiness requirement
Low incremental change

Key Policy Signals on Bio-fuels:

Biofuels such as biodiesel and renewable diesel as well as e-FT diesel are treated as **transition fuels** and are not considered long-term zero-carbon fuels.
Reported well-to-wake greenhouse gas fuel intensity values for biofuels range from **approximately 9 to 17 gCO_2/MJ**, depending on the feedstock and production method.
Biofuels are mainly considered for **blended or drop-in use**, rather than as sole propulsion fuels.
Long-term decarbonisation will require a move to e-hydrogen, with biofuels playing a supporting role during the transition period.
The use of biofuels requires **clear sustainability criteria and lifecycle emissions accounting** to ensure that greenhouse gas reductions are credible.

Green Ammonia
Ammonia is identified as a long-term zero-carbon fuel option for maritime

transport, particularly in the context of achieving deep decarbonisation consistent with international net-zero trajectories. The policy framework treats ammonia as a fuel that will require **significant lead time for technology maturation, safety standardisation and infrastructure development** and therefore positions it primarily in the medium to long term. Only ammonia produced using **renewable electricity and green hydrogen pathways** is considered compatible with long-term decarbonisation objectives. Fossil-derived ammonia does not provide meaningful lifecycle greenhouse gas reductions and is therefore not aligned with net-zero pathways.

From an energy and fuel characteristics perspective, ammonia exhibits a substantially lower energy density than conventional marine fuels. On a mass basis, the lower calorific value of ammonia is approximately **18.6–18.9 MJ/kg**, compared to **~41–44 MJ/kg for HFO and MGO**, implying a requirement of roughly **2.2–2.3 times more fuel by mass** to deliver equivalent energy. More critically for ship design, liquid ammonia has a volumetric energy density of only **~12–13 MJ/L**, versus **~35–40 MJ/L for HFO/MGO**, resulting in a need for approximately **three times the onboard fuel storage volume**. This significant volumetric penalty has direct implications for vessel layout, tank integration and cargo capacity, reinforcing ammonia's positioning as a medium- to long-term fuel option requiring purpose-built vessels and dedicated infrastructure.

This has direct implications for ship design, cargo capacity and retrofitting feasibility, making ammonia more suitable for **newbuild vessels** rather than retrofits in most cases. The document also notes that ammonia combustion presents challenges related to **ignition, flame speed and NOx formation**, which are currently being addressed through engine development, dual-fuel concepts and after-treatment systems.

Currently, ammonia is considered at a **lower technology readiness level compared to LNG and methanol**, with commercial-scale marine engines still under development and early demonstration. As a result, ammonia is treated as a **medium- to long-term fuel option**, with near-term activity expected to focus on **pilots, test vessels and controlled deployment** rather than widespread adoption. The document emphasises that regulatory frameworks, classification rules and international safety standards for ammonia as a marine fuel are still evolving.

Combustion of ammonia can result in **nitrous oxide (N_2O)** emissions, a potent greenhouse gas with a high **global warming potential**, which may materially affect lifecycle greenhouse gas intensity. This risk applies irrespective of whether ammonia is fossil-derived or produced via renewable hydrogen pathways. **Effective mitigation** of N_2O emissions through engine design, combustion control and exhaust after-treatment remains unproven at commercial marine scale, reinforcing the need for **extensive testing and validation** before ammonia can be considered fully aligned with net-zero objectives.

Key Policy Signals on Ammonia:

The **energy density of ammonia is significantly lower than conventional marine fuels**, resulting in substantially higher onboard fuel storage volume requirements to achieve equivalent range, with direct implications for ship layout and payload capacity.

Marine engine technology capable of operating on ammonia is **still under development**, with current designs addressing challenges related to **high ignition temperature, low flame speed and combustion stability**.

Combustion of ammonia leads to **elevated nitrogen oxide (NOx) emissions**, necessitating the use of advanced combustion control strategies and exhaust after-treatment systems to comply with emission limits.

Retrofitting existing vessels for ammonia use is assessed as **technically complex and economically challenging**, due to fuel storage requirements, material compatibility and safety system integration, making ammonia more suitable for **newbuild vessels**.

Ammonia is **toxic and corrosive**, requiring dedicated containment systems, continuous leak detection, ventilation, emergency shutdown mechanisms and enhanced crew training to manage operational and safety risks.

While ammonia is widely handled in industrial applications, **marine fuel use introduces additional risks** related to confined spaces, vessel motion and port interface operations, requiring marine-specific safety standards and procedures.

Bunkering and port infrastructure for ammonia as a marine fuel are currently limited, with requirements for specialised storage tanks, transfer systems, safety exclusion zones and emergency response arrangements.

Regulatory frameworks, classification rules and international standards for ammonia as a marine fuel are **still evolving**, indicating the need for pilot projects and phased deployment prior to large-scale adoption.

Green Methanol

Methanol is considered under the NGSP as a **transition fuel that can be deployed at scale earlier than hydrogen and ammonia**, while still contributing to greenhouse gas reduction when sourced from e-pathways. Its relevance lies in the availability of commercial marine engine technology, simpler storage and handling requirements and compatibility with existing liquid fuel logistics. The policy does not treat methanol as a final zero-carbon fuel, but as an intermediate option that supports phased decarbonisation and reduces transition risk.

The GHG performance of methanol is **directly determined by its production pathway**. Fossil-based methanol does not provide material well-to-wake greenhouse gas reductions and is therefore not aligned with long-term decarbonisation objectives under the NGSP. In contrast, **bio-methanol and green methanol** demonstrate substantially lower lifecycle emissions, with reported greenhouse gas fuel intensity values in the range of **approximately 5-25**

gCO_2eq/MJ, depending on feedstock and production route, compared to **91-95 gCO_2eq/MJ for heavy fuel oil**. Accordingly, only bio-based and renewable methanol pathways are considered relevant for emissions reduction under GFI-based regulatory frameworks.

From an operational and infrastructure perspective, methanol is handled as a liquid fuel at ambient temperature and pressure, eliminating the need for cryogenic storage or high-pressure systems. This enables the use of storage tanks and bunkering arrangements broadly similar to those employed for conventional liquid marine fuels, subject to additional safety provisions related to toxicity and flammability. From an energy standpoint, the lower calorific value of methanol is approximately **19.9–20 MJ/kg**, compared to **~41–44 MJ/kg for HFO and MGO**, meaning methanol contains **around 50–55% less energy per unit mass**. This lower mass-based energy content, combined with methanol's lower density, results in a volumetric energy density of only **~15–16 MJ/L**, versus **~35–40 MJ/L for HFO/MGO**. Consequently, vessels operating on methanol require substantially higher onboard fuel volumes to achieve equivalent range, leading to increased tank space requirements and potential impacts on vessel layout, payload capacity and retrofit feasibility.

Green Hydrogen as a Marine Fuel

Hydrogen is considered in alternative fuels studies as a **zero-carbon fuel option**, either for direct use onboard vessels or as a **primary energy carrier for hydrogen-derived fuels**. It produces no carbon dioxide at the point of use. Its relevance to maritime decarbonisation is therefore linked to its ability to achieve **very low well-to-wake greenhouse gas emissions**, provided that hydrogen is produced from electrolysis of water using renewable electricity (or nuclear based electricity). Renewable hydrogen and RFNBO (Renewable Fuels of Non-Biological Origin) compliant e-methanol and e-ammonia represent the long-term net-zero pathway. Bio-based methanol and ammonia may play a limited transitional role where sustainable biomass is available, but face scalability constraints.

Hydrogen can be stored onboard vessels either as **compressed gas** or as **liquid hydrogen**. Compressed hydrogen is typically stored at pressures of **350–700 bar**, while liquid hydrogen requires storage at **−253°C**. Both storage options impose significant design and operational constraints compared to conventional marine fuels. Hydrogen has a **high gravimetric energy density (approximately 120–142 MJ/kg)**, but a **very low volumetric energy density**, resulting in large fuel storage volumes and reduced vessel range for a given tank size.To deliver the same energy as conventional fuel oil, **compressed hydrogen at 700 bar requires approximately five to six times the storage volume**, while **liquid hydrogen requires approximately four to five times the storage volume**. These volume penalties directly affect vessel layout, cargo capacity and retrofit feasibility, making hydrogen more suitable for **newbuild vessels or short-range**

applications.
Hydrogen propulsion can be achieved using **internal combustion engines adapted for hydrogen** or **fuel cell systems**. Marine hydrogen internal combustion engines remain under development, while fuel cell systems have reached early commercial deployment for **inland waterways and short-sea vessels**. The studies note that hydrogen combustion and handling introduce additional safety considerations due to its **wide flammability range** (approximately 4–75 %by volume in air) and **low ignition energy**, requiring stringent containment, ventilation and detection systems.
Port and bunkering infrastructure for hydrogen is assessed as **limited at present**. Dedicated storage, transfer systems, safety exclusion zones and emergency response arrangements are required. As a result, hydrogen deployment is expected to follow a **pilot-led and phased approach**, aligned with the development of standards, crew training and port readiness.
Additionally, India is stepping up its green energy transition with the development of a Hydrogen Hub under the National Green Hydrogen Mission, which aims to produce and export around 5 million tonnes of green hydrogen over the next five to six years. The initiative is a key part of India's long-term strategy to achieve net-zero carbon emissions by 2070. On January 28th, 2026 Deendayal Port Authority, Kandla, has signed an agreement with energies company, for the design, supply, installation, testing and commissioning of 5 MW Green Hydrogen Plant at Deendayal Port, Kandla.

Key Signals on Hydrogen

Hydrogen is recognised as a **clean fuel aligned with long-term decarbonisation goals**
The policy treats hydrogen as part of a **phased transition**, with early focus on pilots, demonstrations and standards development.
Hydrogen deployment is explicitly linked to **national green hydrogen production and renewable energy availability**.
Port and bunkering infrastructure for hydrogen are to be developed **progressively**, alongside safety and regulatory frameworks.

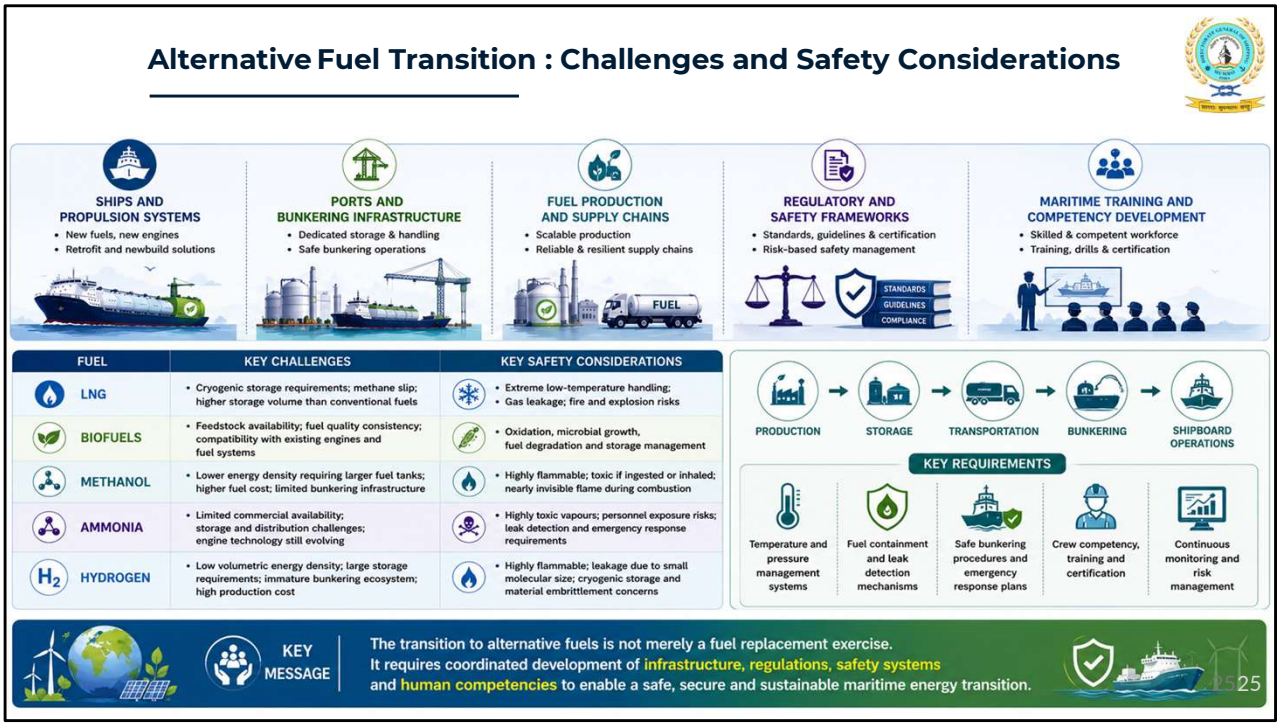
Battery Electric Energy

Battery electric propulsion is considered P as a **near-term decarbonisation solution for specific vessel segments**, particularly those operating on **short, fixed routes with predictable duty cycles**. The policy recognises that battery electric systems eliminate direct fuel combustion onboard and therefore produce **zero emissions at the point of use**, while overall emissions performance depends on the carbon intensity of grid electricity used for charging.
The NGSP positions battery electric energy as **segment-specific rather than fleet-wide**, due to limitations related to energy density, vessel range, charging

time and grid interface requirements. As a result, battery electric propulsion is primarily associated with **inland waterways vessels, ferries, harbour craft, tugs and short-sea coastal operations**, where daily return-to-base operations enable controlled charging.
Battery systems are addressed within the broader framework of **electrification of maritime operations**, alongside shore power and port-side electrification. The policy links battery adoption to port readiness, grid capacity and renewable electricity integration, rather than treating it as a standalone fuel pathway.

National Green Hydrogen Mission – Enabling Ecosystem
India's long-term maritime fuel transition is underpinned by the National Green Hydrogen Mission, launched in 2023.
India targets 5 MMT of green hydrogen production annually by 2030
Green hydrogen is defined using a lifecycle emissions threshold of ≤2 kg CO_2e per kg H_2
Deendayal Port Authority, V.O. Chidambaranar Port Authority and Paradip Port Authority have been designated as Green Hydrogen Hubs
Port-based pilot projects have been commissioned to support early adoption
These initiatives establish the upstream production, certification and infrastructure base required for hydrogen-derived maritime fuels.

Alignment with the National Maritime Decarbonization Policy Framework
The National Maritime Decarbonization Policy Framework integrates the above technical assessments into a national policy framework by:
Recognising blend fuels as near-term compliance solutions
Positioning methanol and ammonia as long-term decarbonisation fuels
Linking fuel transition with port infrastructure, safety regulation, finance and skill development
NMDP thus functions as the policy convergence layer, translating evidence-based fuel roadmaps into coordinated national action.



The maritime sector's transition towards alternative fuels is a complex and multi-dimensional undertaking that extends far beyond the replacement of conventional marine fuels. Achieving maritime decarbonization requires transformation across the entire maritime value chain, including ships and propulsion systems, ports and bunkering infrastructure, fuel production and supply chains, regulatory frameworks and human competencies. Each component must evolve in a coordinated manner to ensure that the transition remains safe, reliable and economically sustainable.

Unlike conventional marine fuels, alternative fuels possess distinct physical and chemical characteristics that introduce new operational requirements and risk profiles. Consequently, infrastructure development, technology deployment, regulatory oversight and workforce preparedness must advance simultaneously to support their safe and effective adoption.

System-Wide Transition Requirements

Ships and Propulsion Systems

The adoption of alternative fuels requires significant changes in vessel design, onboard fuel storage arrangements and propulsion technologies. Newbuild vessels increasingly incorporate dual-fuel or alternative-fuel-ready designs,

while existing vessels may require extensive retrofitting to accommodate new fuel systems. These modifications often involve specialized fuel tanks, enhanced safety systems, dedicated fuel supply arrangements and revised operational procedures.

Ports and Bunkering Infrastructure
Ports play a critical role in enabling fuel transition. Dedicated storage facilities, handling systems and bunkering infrastructure must be established to safely receive, store and supply alternative fuels. Given the varying characteristics of different fuels, bunkering operations require specialized procedures, equipment and emergency response arrangements.

Fuel Production and Supply Chains
Large-scale adoption of alternative fuels depends upon the availability of reliable and resilient supply chains. Fuel production capacity, storage terminals, transportation networks and distribution infrastructure must be developed to ensure consistent fuel availability across major shipping routes and ports. Without adequate supply chain readiness, fuel adoption may be constrained despite technological advancements onboard vessels.

Regulatory and Safety Frameworks
The introduction of new fuels requires comprehensive regulatory frameworks covering design standards, fuel handling procedures, bunkering operations, inspections, emergency preparedness and certification requirements. Risk-based safety management approaches are essential to ensure that emerging fuel technologies are deployed without compromising operational safety.

Maritime Training and Competency Development
Human competence remains central to maritime safety. Seafarers, port personnel, surveyors, emergency responders and regulators must acquire new skills and knowledge relating to alternative fuel technologies. Training programmes, drills, simulations and certification systems are therefore critical components of a successful energy transition.

Fuel-Specific Challenges
Each alternative fuel presents distinct technological, operational and commercial challenges that influence its adoption pathway.
LNG
Cryogenic storage requirements due to extremely low storage temperatures.
Methane slip concerns impacting overall emissions performance.
Larger storage volume requirements compared to conventional marine fuels.
Additional onboard systems required for fuel handling and management.

Biofuels
Dependence on sustainable feedstock availability.
Variability in fuel quality and consistency across suppliers.
Potential compatibility issues with existing engines and fuel systems.
Long-term scalability challenges linked to feedstock supply.
Methanol
Lower energy density requiring larger onboard fuel tanks.
Higher fuel consumption compared to conventional fuels.
Limited bunkering infrastructure in many regions.
Need for dedicated storage and handling arrangements.
Ammonia
Limited commercial availability at present.
Underdeveloped storage, transportation and distribution infrastructure.
Ongoing development of marine engine technologies.
Significant investment requirements across the fuel supply chain.
Hydrogen
Very low volumetric energy density requiring substantial storage space.
High production costs compared to conventional fuels.
Limited bunkering infrastructure and supply ecosystem.
Technology maturity challenges for large-scale maritime deployment.

Fuel-Specific Safety Considerations
The unique properties of each alternative fuel introduce specific safety risks that must be effectively managed throughout production, storage, transportation, bunkering and shipboard operations.
LNG
Risks associated with handling cryogenic liquids at extremely low temperatures.
Potential gas leakage during storage and transfer operations.
Fire and explosion hazards arising from vaporized gas accumulation.
Requirement for robust containment and ventilation systems.
Biofuels
Oxidation and fuel degradation during storage.
Microbial contamination risks affecting fuel quality.
Storage stability concerns over extended periods.
Need for effective fuel quality monitoring and management.
Methanol
Highly flammable fuel requiring stringent fire protection measures.
Toxic if ingested, inhaled or absorbed through the skin.
Methanol flames can be nearly invisible during combustion, complicating firefighting efforts.
Requirement for enhanced leak detection and personnel protection measures.
Ammonia

Highly toxic vapours posing significant health hazards.
Personnel exposure risks during storage, transfer and bunkering operations.
Requirement for advanced leak detection systems.
Comprehensive emergency response and evacuation procedures necessary.

Hydrogen

Extremely flammable across a wide range of concentrations.
High leakage potential due to small molecular size.
Cryogenic storage challenges for liquid hydrogen applications.
Material embrittlement concerns affecting storage and fuel system components.

End-to-End Safety Management

Safe deployment of alternative fuels requires management across the entire fuel value chain:

Production → Storage → Transportation → Bunkering → Shipboard Operations

Safety considerations cannot be confined to vessel operations alone. Risks must be assessed and controlled throughout the entire lifecycle of the fuel, from production facilities to onboard consumption.

Key Enablers for Safe Fuel Adoption

The successful adoption of alternative fuels requires several enabling measures:
Temperature and pressure management systems.
Fuel containment and leak detection mechanisms.
Standardized bunkering procedures and emergency response plans.
Crew competency, training and certification frameworks.
Continuous monitoring, auditing and risk management systems.

Key Message

The transition to alternative fuels is not merely a fuel replacement exercise. It requires coordinated development of ships, ports, fuel supply chains, regulatory frameworks, safety systems and human competencies. A successful maritime energy transition will depend upon simultaneously addressing technological, infrastructure, safety and workforce challenges while ensuring that decarbonization objectives are achieved without compromising operational safety or reliability.

Just Transition in Maritime
Putting People at the Core of Decarbonisation

The global maritime sector is undergoing a structural transformation driven by decarbonisation commitments, alternative fuel adoption and digitalisation. However, decarbonisation is not merely a technological or fuel transition — it represents a workforce transition.
For maritime economies such as India, this dimension assumes critical importance. With approximately 3.23 lakh Indian seafarers as of 2025 — accounting for nearly 12% of the global maritime workforce — India plays a pivotal role in shaping the human dimension of maritime transition.
A green transition that does not account for employment continuity, skills upgrading and safety risks would create structural imbalances. Therefore, the principle of a Just Transition seeks to ensure that environmental progress does not come at the cost of workforce vulnerability.

Workforce Implications of Fuel Transition

The shift toward alternative marine fuels such as green ammonia, hydrogen, methanol and other low-flashpoint fuels introduces new technical and operational complexities.
These fuels:
Present distinct toxicity and flammability risks
Require modified onboard storage and handling systems
Demand new emergency response protocols
Necessitate revised competency standards
This implies that decarbonisation will require new competencies across engineering, deck operations, safety management and port handling systems.
A structured upskilling strategy is therefore essential to ensure that the maritime workforce transitions alongside technological change.

Skills and Training Ecosystem
A Just Transition framework must prioritize large-scale capacity building.
Key areas include:
Structured upskilling for handling green fuels
Modernization of STCW-aligned training modules
Investment in simulator-based training for ammonia, hydrogen and hybrid propulsion systems
Upgradation of maritime training infrastructure
India's maritime training institutions must progressively integrate green fuel modules into curricula. This is not a short-term training exercise but a phased institutional transformation.
The emphasis must be on competency-based certification aligned with emerging IMO standards and future regulatory frameworks.

Safety and Standards
Alternative fuels introduce unfamiliar safety risks. For example:
Ammonia exposure risks
Hydrogen storage complexities
Low flashpoint fuel handling hazards
A Just Transition requires a safety-first approach.
This includes:
Strengthening onboard safety protocols
Revising emergency preparedness standards
Aligning operational practices with evolving IMO IGF Code provisions
Ensuring compliance with the Maritime Labour Convention (MLC 2006) and international labour norms
Safety cannot be compromised in pursuit of decarbonisation targets.
Technological adoption must be matched by risk mitigation frameworks.

Equity and Inclusion

The maritime workforce is globally distributed, with developing nations supplying a significant share of seafarers. Without coordinated support, the transition to green fuels risks widening global skills gaps.

A Just Transition approach must therefore:

Avoid marginalization of seafarers from developing maritime nations

Promote equal access to new training pathways

Encourage gender inclusion and diversity within maritime professions

Support global knowledge-sharing mechanisms

India, as a leading supplier of maritime manpower, has both an opportunity and responsibility to advocate for inclusive transition pathways.

Policy Direction for India

India's maritime decarbonisation roadmap must embed workforce considerations within broader sustainability initiatives.

Key policy directions may include:

Integration of green fuel competencies within national maritime training frameworks.

Structured collaboration between DGS, training institutes and industry stakeholders.

Development of standardized certification pathways for alternative fuel operations.

Incorporation of Just Transition principles within National Maritime Decarbonization Policy Framework frameworks.

The objective should be to ensure that environmental ambition is matched with human resilience.

India as a Net Green Energy Exporter & Bunkering Destination

India's positioning as a net green energy exporter and global bunkering destination should be viewed as a long-term strategic vision, rather than a reflection of current energy balances. Historically, India has been a net energy-importing and energy-deficit nation, with high dependence on imported fossil fuels to meet domestic and industrial demand, including for the maritime sector. The emerging global transition towards low-carbon and zero-carbon fuels presents India with a structural opportunity to reverse this trajectory over the coming decades. By leveraging its renewable energy potential, coastline advantages and expanding port infrastructure, India aims to progressively transition from an energy-deficit economy to a net energy-surplus nation, capable of supplying green energy and green fuels not only for domestic consumption but also for international markets.

In the maritime context, this vision translates into India evolving from a fuel-import dependent shipping ecosystem to a producer, exporter and bunkering hub for green maritime fuels, including hydrogen-derived fuels such as green ammonia and green methanol. This shift is envisioned to occur in a phased manner, aligned with the maturation of fuel technologies, scaling of renewable

energy capacity and development of safe port-based bunkering infrastructure. Achieving net energy surplus status is therefore not an immediate outcome but a strategic end-state, underpinned by long-term national initiatives on renewable energy expansion, green hydrogen production, port modernisation and maritime decarbonisation. As these elements converge, India's maritime sector is expected to move from being a passive energy consumer to an active contributor to global green energy supply chains.

This future-oriented vision underpins India's policy approach to green shipping and bunkering and frames the country's ambition to play a system-level role in the global maritime energy transition, while strengthening long-term energy security and economic resilience.

Thank You