IMO GloNoise URN Toolkit Workshop

Presentation Note by

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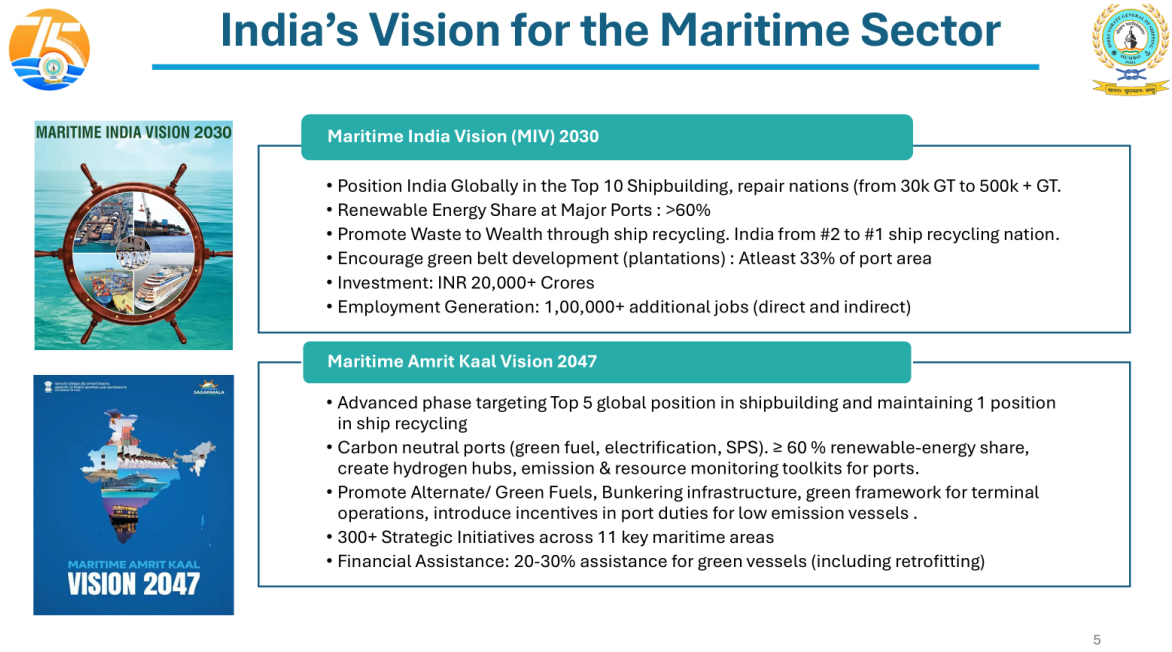
India’s Maritime Vision



Maritime India Vision 2030

Maritime India Vision 2030 is the Government of India’s long-term strategic blueprint for the maritime sector for the decade up to 2030. It has been prepared by the Ministry of Ports, Shipping and Waterways as a coordinated roadmap to accelerate growth across ports, shipping and inland waterways. The document positions the maritime sector as a critical enabler of India’s economic growth, trade competitiveness, logistics efficiency and employment generation.

The report makes it clear that India’s maritime sector is not being treated merely as a transport function, but as a strategic economic multiplier. With a coastline of about 7,500 km, 12 Major Ports, 200+ Non-Major Ports and a large inland waterway network, the sector is central to trade and industrial development. The report notes that about 95% of India’s trade by volume and 65% by value moves through maritime transport. This gives the maritime domain a foundational role in India’s development trajectory.

MIV 2030 is therefore not just a sectoral plan. It is a national competitiveness document aimed at making India a stronger maritime nation by improving infrastructure, reducing logistics costs, raising productivity, modernising governance and building future-ready maritime capacity.

Nature and Approach of the Report

The document has been developed through a large consultative exercise involving 350+ stakeholders, 250+ brainstorming sessions, study of 100+ global benchmarks and best-in-class examples and analysis of 50+ laws and Acts, including State and environmental frameworks. This gives the report a strong institutional and policy basis.

The report is framed as a time-bound, implementation-oriented vision document rather than a purely conceptual one. It identifies 150+ initiatives across the maritime ecosystem and links them to policy reforms, infrastructure development, institutional strengthening and measurable performance outcomes.

The report adopts six guiding principles:

- Analyse present and future challenges before defining initiatives
- Use innovation and latest technology as core enablers
- Create time-bound action plans
- Benchmark against best-in-class international practices
- Focus on capability building and human resources
- Promote “waste to wealth” approaches

These principles are important because they show that the report is not confined to physical infrastructure. It also covers governance, innovation, sustainability and human capital.

Strategic Intent of MIV 2030

At its core, MIV 2030 seeks to move India from being a large maritime economy with untapped potential to becoming a globally competitive maritime power. The report tries to address multiple structural issues at once:

- inadequate world-scale port infrastructure in some locations
- high logistics costs relative to global benchmarks
- dependence on foreign transshipment hubs
- limited share in global shipbuilding and ship repair
- insufficient technological integration across the maritime value chain
- need for safer, greener and more efficient port operations
- need to expand India’s role as a seafaring nation

The report therefore combines hard infrastructure, soft infrastructure, policy reform, technology adoption, institutional change and skill development.

Structure of the Vision

The report is organised around 10 key themes, which together define the architecture of MIV 2030.

Theme 1: Develop Best-in-Class Port Infrastructure

This theme focuses on strengthening port capacity, expanding draft, modernising infrastructure and creating globally competitive port systems. The report recognises that India's cargo volumes are growing, vessel sizes are increasing and India needs deeper and more efficient ports to handle future trade demand. It highlights that only a limited share of Indian cargo transshipment is currently handled in Indian ports and that strengthening domestic transshipment capability is strategically necessary.

Theme 2: Drive End-to-End Logistics Efficiency and Cost Competitiveness

The report identifies India's logistics cost as higher than best-in-class benchmarks and links this to hinterland connectivity issues, evacuation delays and high unit costs. This theme therefore focuses on mechanisation, port connectivity, evacuation systems, port-led industrialisation and cost-effective logistics.

Theme 3: Enhance Logistics Efficiency through Technology and Innovation

MIV 2030 places strong emphasis on digital transformation. It mentions digitalisation of maritime stakeholder processes, National Logistics Portal (Marine), smart ports and system-driven performance monitoring. The objective is to improve ease of doing business and operational efficiency through technology.

Theme 4: Strengthen Policy and Institutional Framework

This theme addresses governance, legislation, institutional arrangements and financial resilience. The report recognises that infrastructure alone is insufficient unless backed by supportive legal, regulatory and policy systems.

Theme 5: Enhance Global Share in Shipbuilding, Repair and Recycling

This is highly relevant from the engineering and industrial standpoint. The report notes that India's share in global shipbuilding is still low, while ship repair is nascent. At the same time, India already has a strong position in ship recycling. MIV 2030 seeks to leverage domestic demand, create industrial ecosystems and promote "waste to wealth," especially through recycling and use of scrap in the steel sector.

Theme 6: Enhance Cargo and Passenger Movement through Inland Waterways

The report sees inland waterways as both economical and environmentally friendly. It proposes interventions for fairway development, terminal infrastructure, supportive regulatory policies and promotion of Ro-Ro and ferry movement.

Theme 7: Promote Ocean, Coastal and River Cruise Sector

MIV 2030 identifies cruise as a high-growth but underdeveloped segment in India. It proposes cruise terminals, themed circuits, island ecosystem development and cruise training infrastructure.

Theme 8: Enhance India's Global Stature and Maritime Cooperation

This theme expands the vision beyond domestic infrastructure to geopolitical and international maritime positioning. It aims to strengthen maritime cooperation, representation and connectivity with neighbouring and advanced maritime nations.

Theme 9: Lead the World in Safe, Sustainable and Green Maritime Sector

This is one of the most important themes from the current perspective. The report explicitly addresses renewable energy, emission reduction, water use efficiency, solid waste management and safety systems. It links Indian ports to sustainability obligations and global environmental expectations.

Theme 10: Become a Top Seafaring Nation with World-Class Education, Research and Training

The report recognises that India already contributes significantly to the global seafarer pool, but faces competition from other countries. It therefore stresses education, research, training, innovation and development of a stronger ecosystem for seafarers.

Key Targets and Performance Indicators

The report sets out measurable Key Performance Indicators (KPIs) to be achieved by 2030. These are important because they show that the document is meant to be implementation-focused.

Some of the major targets include:

- 3 Major Ports with more than 300 MTPA cargo handling capacity
- Increase the share of Indian cargo transshipment handled by Indian ports from 25% to more than 75%
- Increase the share of cargo handled at Major Ports by PPP/other operators from 51% to more than 85%
- Reduce average vessel turnaround time from 25 hours to under 20 hours
- Reduce average container dwell time from 55 hours to under 40 hours
- Increase average ship daily output from 16,500 gross tonnage to above 30,000
- Improve global ranking in shipbuilding and ship repair from 20+ to Top 10
- Raise India from 2nd to 1st position in ship recycling
- Increase annual cruise passengers from 4.68 lakh to over 15 lakh
- Raise India's share of global seafarers from 12% to above 20%
- Increase renewable energy share at Major Ports from less than 10% to more than 60%

These targets show that MIV 2030 is not limited to trade growth alone. It includes sustainability, seafaring, cruise, industrial capability and energy transition.

Investment and Economic Impact

The report envisions an overall investment of around ₹3,00,000–3,50,000 crore across ports, shipping and inland waterways. It estimates that this vision could unlock:

- ₹20,000+ crore of potential annual revenue for Indian ports
- 20,00,000+ additional jobs direct and indirect across the maritime sector

This is significant because it positions the maritime sector not just as a logistics enabler but as a major employment and investment platform.

Port Infrastructure and Traffic Planning Logic

The opening chapter on port infrastructure shows the level of analytical depth used in the report. It undertakes commodity-wise traffic forecasting using bottom-up origin-destination analysis, ministry policy inputs, industrial mapping and scenario planning. The report maps major producing and consuming sectors such as coal, steel, cement, fertilisers and refineries, and uses this to project future port demand.

For example, for commodities such as POL, coal, iron ore, containers, cement, steel and fertilisers, the report develops high, base and low scenarios depending on demand trends, domestic production, policy changes and industrial expansion.

This analytical method is important because it means the infrastructure proposals are tied to demand forecasts, not generic expansion.

Green and Sustainable Maritime Dimension

One of the strongest aspects of the report is that it integrates sustainability and safety into the mainstream maritime development agenda rather than treating them as separate issues.

Under Theme 9, the report highlights the need to:

- increase use of renewable energy
- reduce air emissions
- optimise water use
- improve solid waste management
- implement zero-accident safety programmes
- create centralised monitoring systems
- align with international sustainability and safety practices

This makes MIV 2030 the early foundation for later developments in India's green maritime agenda, including green ports, renewable energy adoption in ports and broader decarbonisation strategies.

Seafaring, Education and Human Capital

Theme 10 is especially relevant for your FSM work. The report clearly identifies human capital as a strategic pillar. It notes that India contributes around 10–12% of world seafarers and aims to raise this to more than 20% by 2030.

The report's emphasis is not only on increasing numbers, but also on:

- world-class maritime education
- research and innovation
- stronger training ecosystems
- capability building
- support for seafarers as a professional class

This theme strongly supports the broader argument that maritime competitiveness will increasingly depend on quality of human capital, not only on port capacity or fleet size.

Strategic Significance of MIV 2030

From a strategic standpoint, MIV 2030 is important for five reasons.

First, it shifts maritime policy from fragmented development to integrated planning.

Instead of addressing ports, shipbuilding, logistics, waterways and seafarers separately, it presents a unified national maritime roadmap.

Second, it links maritime development to national economic competitiveness.

By focusing on logistics cost, turnaround time, transshipment, capacity and connectivity, it directly supports India's manufacturing, trade and export ambitions.

Third, it expands the maritime agenda beyond infrastructure.

The report includes sustainability, training, institutional reform, digitalisation and innovation.

Fourth, it lays the foundation for India's maritime leadership ambitions.

The report is not defensive. It aims for global positioning in shipbuilding, recycling, seafaring and port performance.

Fifth, it provides a policy bridge between growth and future readiness.

Themes such as green ports, digital systems, training and research show that the report was already anticipating the future transition of the sector.

Maritime AmritKal Vision 2047

The **Maritime Amrit Kaal Vision 2047 (MAKV 2047)** is the Government of India's long-term strategic roadmap aimed at transforming India into a **leading global maritime power by the centenary year of independence in 2047**. The vision has been developed by the **Ministry of Ports, Shipping and Waterways (MoPSW)** through extensive stakeholder consultations involving government agencies, industry stakeholders, financial institutions and academic institutions.

India possesses a vast maritime geography, with **over 7,500 km of coastline**, **12 major ports** and **more than 200 non-major ports**, making maritime infrastructure critical to the country's trade and economic growth. The maritime sector facilitates a major share of India's external trade and plays a crucial role in logistics, industrial development and global connectivity.

The MAKV 2047 builds upon earlier initiatives such as **Maritime India Vision 2030**, the **National Logistics Policy** and the **PM Gati Shakti National Master Plan**, and aims to create a holistic maritime ecosystem encompassing ports, shipping, shipbuilding, coastal infrastructure, maritime services and human capital.

The vision document has been prepared through **more than 150 stakeholder consultations** and benchmarking of **over 50 international policies and best practices**, resulting in the identification of **more than 300 actionable initiatives** across the maritime sector.

Strategic Objective of MAKV 2047

The central objective of MAKV 2047 is to enable India to achieve **global maritime leadership** by strengthening infrastructure, improving logistics efficiency, promoting sustainable maritime operations and expanding India's global maritime presence.

The vision is aligned with the broader national development agenda and supports India's ambition of becoming a **$30 trillion economy by 2047**. It also integrates the concept of the **Blue Economy**, which recognizes the oceans as a major driver of economic growth, employment generation and environmental sustainability.

The MAKV framework seeks to achieve this transformation through:

- expansion of port infrastructure
- development of shipping capacity
- promotion of coastal shipping and inland waterways
- development of shipbuilding and ship repair industries
- strengthening maritime education and research

- technological modernization and digitalisation
- environmental sustainability and decarbonisation

Guiding Principles of the Vision

The development of MAKV 2047 follows several guiding principles aimed at ensuring a practical and implementable roadmap.

First, the vision emphasizes **gap analysis of the current maritime ecosystem**, identifying areas requiring policy reforms, infrastructure upgrades and institutional strengthening.

Second, the framework draws extensively on **international best practices**, ensuring that India's maritime policies remain aligned with global standards in infrastructure, regulation and sustainability.

Third, the vision promotes **innovation and financing frameworks** to support the development of maritime infrastructure and industry.

Fourth, the document emphasizes **Atmanirbhar Bharat**, encouraging domestic manufacturing, shipbuilding capabilities and indigenous maritime technology development.

Finally, the roadmap includes **clearly defined timelines for the implementation of action points**, ensuring that the vision translates into measurable outcomes.

Major Strategic Themes

MAKV 2047 identifies **11 key themes** that collectively define India's maritime transformation roadmap.

Lead the World in Safe, Sustainable and Green Maritime Sector

One of the most important pillars of MAKV 2047 is the transition toward a **green and sustainable maritime ecosystem**.

The vision aligns India's maritime sector with global climate commitments and the **IMO greenhouse gas reduction strategy**. The government intends to reduce emissions from maritime operations through the adoption of cleaner fuels, renewable energy and energy-efficient technologies.

Several initiatives have been proposed to achieve this goal, including:

- development of **carbon-neutral ports**
- adoption of **alternative fuels such as LNG, hydrogen, ammonia and biofuels**
- introduction of **shore-to-ship power systems**

- expansion of **renewable energy use in ports**
- development of **green maritime shipping programs**

The vision proposes the establishment of a **Decarbonization Cell at the Directorate General of Shipping (DG Shipping)** to coordinate the implementation of maritime decarbonisation initiatives.

Promote Ocean, Coastal and River Cruise Sector

MAKV 2047 identifies maritime tourism as an important growth area for the Indian maritime economy.

Although the global cruise industry has been expanding rapidly, India's share in cruise tourism remains limited. The vision therefore proposes the development of:

- cruise terminals and marinas along the eastern and western coasts
- river cruise infrastructure along inland waterways
- improved regulatory frameworks for cruise operations
- simplified visa processes and fiscal incentives

These initiatives aim to significantly increase cruise passenger volumes and position India as a major cruise tourism destination.

Enhance Modal Share of Coastal Shipping and Inland Waterways

The vision recognizes that India has not fully utilized its **coastal shipping and inland waterway potential**, despite having extensive navigable waterways and a long coastline.

Compared to road and rail transport, water-based transportation offers several advantages:

- lower cost of cargo movement
- reduced emissions
- higher energy efficiency
- reduced congestion in land transport networks

To address this gap, MAKV 2047 proposes initiatives such as:

- development of coastal shipping corridors
- expansion of inland waterway infrastructure
- introduction of low-draft vessels
- improved multimodal connectivity

- reduction in port charges and logistics costs

The vision targets a significant increase in cargo movement through inland waterways, from **109 MMTPA currently to over 500 MMTPA by 2047**.

Promote Maritime Clusters

The development of **maritime industrial clusters** is another key theme of MAKV 2047.

These clusters aim to integrate port infrastructure with manufacturing, logistics, shipbuilding and maritime services, thereby creating regional maritime economic hubs.

The vision proposes maritime cluster development in locations such as:

- Deendayal Port Authority
- Visakhapatnam Port
- Syama Prasad Mookerjee Port (Haldia)
- Andaman and Nicobar Islands

Island development projects also include plans to develop specific islands for specialized maritime functions such as:

- ship repair hubs
- bunkering facilities
- maritime logistics services.

Promote Maritime Professional Services

A modern maritime economy requires a strong ecosystem of **professional services**, including finance, insurance, arbitration and maritime law.

MAKV 2047 proposes the creation of institutional frameworks that can support maritime investments and dispute resolution mechanisms.

Key initiatives include:

- establishment of a **Maritime Development Fund** for long-term financing
- development of **international maritime arbitration centres**
- strengthening maritime insurance services
- providing fiscal incentives for maritime investments

These initiatives aim to position India as a regional hub for maritime financial and professional services.

Become a Global Player in Shipbuilding, Repair and Recycling

India already holds a strong position in **ship recycling**, particularly through the Alang ship recycling cluster. However, the country's global share in **shipbuilding and ship repair remains relatively small**.

MAKV 2047 therefore proposes measures to strengthen the shipbuilding ecosystem through:

- extension of shipbuilding financial assistance schemes
- development of new shipyard infrastructure
- simplified customs procedures for vessel spares
- promotion of domestic shipbuilding under Atmanirbhar Bharat

The vision also proposes expanding ship recycling capacity and developing new recycling locations along the eastern coast of India.

Develop World-Class Maritime Education, Research and Training

Human capital development is recognized as a crucial element of maritime growth.

The vision highlights the need to create a **strong maritime knowledge ecosystem**, including:

- maritime research centres
- innovation incubators and accelerators
- international partnerships with leading maritime institutes
- maritime knowledge clusters
- centres of excellence in maritime logistics and technology

These initiatives aim to promote innovation, skill development and research capabilities in the maritime sector.

Strengthen India's Global Maritime Presence

MAKV 2047 emphasises the importance of international cooperation and global engagement in maritime governance.

Key initiatives include:

- establishment of a dedicated **IMO coordination cell**
- strengthening India's representation in international maritime institutions

- development of maritime partnerships with regional organizations such as **BIMSTEC and IORA**
- promotion of international maritime diplomacy

These initiatives aim to enhance India's influence in global maritime policy-making.

Develop World-Class Next Generation Ports

The vision proposes a major expansion of port capacity and efficiency.

India’s current port capacity is estimated at **around 2,500 million tonnes**, while the MAKV 2047 roadmap targets an increase to **over 10,000 million tonnes by 2047**.

Key initiatives include:

- development of deep-draft ports (18–23 meters)
- creation of port clusters with capacities exceeding **300 MTPA**
- development of transshipment hubs
- construction of new major ports
- increased private sector participation in port development

Enhance Efficiency Through Technology and Innovation

Digital transformation is a major focus area in MAKV 2047.

Technological initiatives proposed include:

- implementation of **Just-in-Time arrival systems**
- development of **digital twins for ports**
- adoption of **AI-based berth allocation systems**
- drone-based inventory management
- automated cargo handling equipment
- establishment of digital innovation centres for maritime technology

These measures aim to improve operational efficiency and reduce logistics costs.

Enhance India’s Shipping Tonnage

India’s share in global shipping tonnage remains relatively small compared to other major maritime nations.

To strengthen India’s merchant fleet, MAKV 2047 proposes policy reforms such as:

- fiscal incentives for Indian shipping companies
- infrastructure status for the shipping industry
- financing support through alternative investment mechanisms
- regulatory simplification for ship registration and operations

These reforms aim to increase India's share in the global shipping fleet and strengthen domestic shipping capacity.

Strategic Aspirations for 2047

The vision outlines several ambitious targets to be achieved by 2047, including:

- development of **14 carbon-neutral major ports**
- establishment of **hydrogen and ammonia bunkering hubs**
- development of **three transshipment hubs**
- increase in inland waterway cargo movement to **more than 500 MMTPA**
- development of **13 deep-draft ports**
- establishment of **smart ports with Just-in-Time operations**
- expansion of India's global ranking in shipbuilding to the **Top 5**.

Mercantile Marine Legislation

Mercantile Marine Legislation

5 New Acts 2025

Progressive policies and modernized regulations create an enabling environment for investment, ease of doing business, and global competitiveness.

Merchant Shipping Act, 2025 – Modernizes maritime regulations by broadening the definition of vessels, easing ownership norms, and aligning India's shipping framework with global standards, thereby strengthening maritime capabilities.

Indian Ports Act, 2025 – Replaces the century-old 1908 Act, introducing a modern regulatory framework for port operations, management, and environmental safeguards. It ensures tariff transparency and mandates pollution control and disaster management plans at ports.

Coastal Shipping Act, 2025 – Enhances the role of coastal and inland shipping, promoting efficient use of waterways as a sustainable, cost-effective transport mode that reduces logistics costs and congestion.

Bill of Ladings Act, 2025 – Establishes a modern legal framework for electronic and physical bills of lading, enhancing transparency, traceability, and security in maritime trade documentation.

Carriage of Goods by Sea Act, 2025 – Updates liability and carriage rules to align with international conventions, ensuring fair, efficient, and standardized practices for transporting goods by sea.

The Merchant Shipping Act 2025 & Coastal Shipping Act into force wef. March 15, 2026

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India's maritime sector is supported by a **comprehensive and evolving legislative framework**, which forms the backbone of:

- Safe and efficient shipping operations
- Regulatory oversight and compliance
- Trade facilitation and logistics efficiency
- Environmental protection and sustainability

A strong legal ecosystem is critical for:

- **Ease of doing business in maritime sector**
- **Alignment with international conventions (IMO, ILO, UNCLOS etc.)**
- **Enhancing global competitiveness of Indian shipping**

Evolution of India's Maritime Legislative Framework

India’s maritime laws have evolved in response to:

- Technological advancements in shipping and port operations
- Growing complexity of global supply chains
- Environmental and sustainability obligations
- Need for digitisation and modern trade practices

The transition from legacy laws to **modern, forward-looking legislations (2025 reforms)** reflects:

- Regulatory modernization
- Institutional strengthening
- Integration with global maritime ecosystem

Key Legislative Instruments – 2025 Reforms

The **five new Acts (2025)** represent a major overhaul of India’s maritime legal framework:

Merchant Shipping Act, 2025

- Principal legislation governing Indian shipping
- Expands definition of vessels and ownership norms
- Aligns with international safety and operational standards
- Strengthens regulatory oversight of vessels

Indian Ports Act, 2025

- Replaces the Indian Ports Act, 1908
- Introduces modern governance framework for ports
- Mandates:
    - Environmental safeguards
    - Tariff transparency
    - Disaster preparedness

Coastal Shipping Act, 2025

- Promotes coastal and inland water transport
- Enhances modal shift from road/rail to waterways

- Supports cost-effective and sustainable logistics

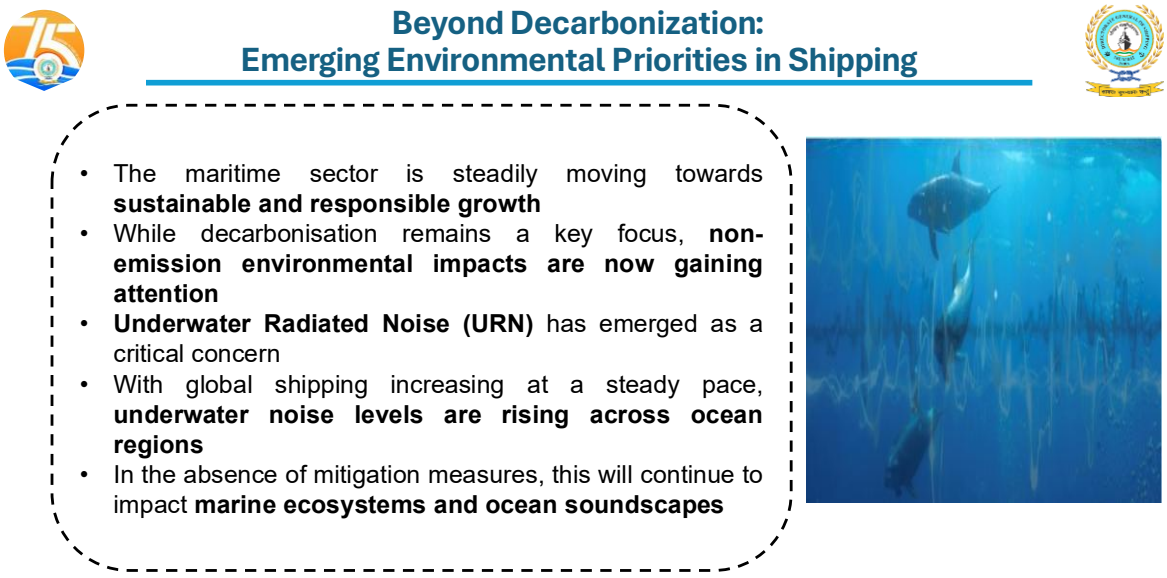
Bills of Lading Act, 2025

- Modernises trade documentation framework
- Enables electronic bills of lading
- Improves:
    - Transparency
    - Traceability
    - Trade security

Carriage of Goods by Sea Act, 2025

- Updates liability and carriage provisions
- Aligns with international conventions
- Ensures uniform and predictable trade practices

Beyond Decarbonization : Emerging Environmental Priorities in Shipping



The maritime sector is steadily transitioning towards a model of sustainable and responsible growth, driven by global environmental commitments, regulatory frameworks and the increasing need to balance economic development with ecological preservation.

Traditionally, the focus of maritime sustainability has been centred around **decarbonisation**, with significant emphasis on reducing greenhouse gas emissions through cleaner fuels, improved energy efficiency and adoption of green technologies. These efforts continue to remain a key priority at both international and national levels.

However, in recent years, there has been a growing recognition that environmental impacts of shipping are not limited to emissions alone. **Non-emission environmental externalities** are now gaining increasing attention within global maritime discourse.

One such emerging and critical concern is **Underwater Radiated Noise (URN)**.

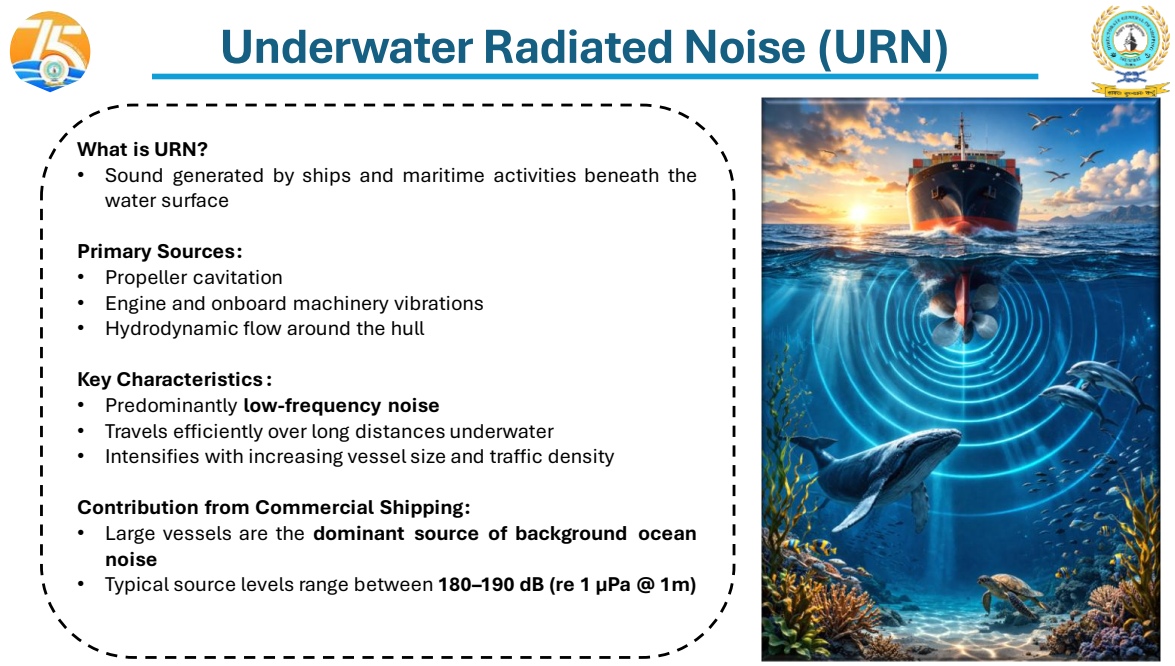
URN refers to the sound generated by ships during their operation, which propagates through the marine environment. With global shipping activity expanding steadily, driven by increasing trade volumes, underwater noise levels are also rising across major ocean regions, particularly in busy shipping lanes and coastal areas.

This increase in underwater noise is not merely a technical issue, but an ecological one. Marine species rely heavily on sound for essential life functions such as communication, navigation, foraging and reproduction. The introduction of persistent anthropogenic noise disrupts these natural processes, thereby affecting marine ecosystems.

In the absence of effective mitigation measures, the continued growth of the shipping sector is expected to further intensify underwater noise levels, leading to long-term alterations in ocean soundscapes and increased stress on marine biodiversity.

Therefore, it is imperative that maritime sustainability efforts evolve beyond a singular focus on emissions and adopt a more comprehensive approach that also addresses emerging environmental challenges such as underwater radiated noise.

Underwater Radiated Noise (URN)



Underwater Radiated Noise (URN) refers to the sound generated by ships and maritime activities that propagates through the underwater environment. Unlike airborne noise, sound travels significantly faster and over much longer distances underwater, making its impact more widespread and persistent.

URN is primarily generated as a by-product of normal ship operations and is not typically visible or immediately perceptible, yet it constitutes a major component of anthropogenic noise in the marine environment.

The **primary sources of URN** from ships include:

- **Propeller cavitation**, which is the formation and collapse of air bubbles around the propeller blades, and is widely recognised as the dominant contributor to underwater noise
- **Engine and onboard machinery vibrations**, which are transmitted through the ship's structure into the water
- **Hydrodynamic flow around the hull**, especially at higher speeds, contributing to additional noise generation

These sources collectively contribute to a continuous acoustic footprint generated by vessels during operation.

In terms of **acoustic characteristics**, URN is predominantly **low-frequency in nature**, typically ranging from approximately 10 Hz to several hundred Hz. This low-frequency sound has the ability to travel efficiently over long distances underwater with relatively low attenuation.

A key concern is that these frequencies significantly overlap with the hearing and communication ranges of many marine species, particularly large marine mammals such as whales and certain fish species.

Furthermore, URN intensity is closely linked to **vessel size, speed and traffic density**. Larger commercial vessels, including container ships, tankers and bulk carriers, generate stronger and lower-frequency noise compared to smaller vessels.

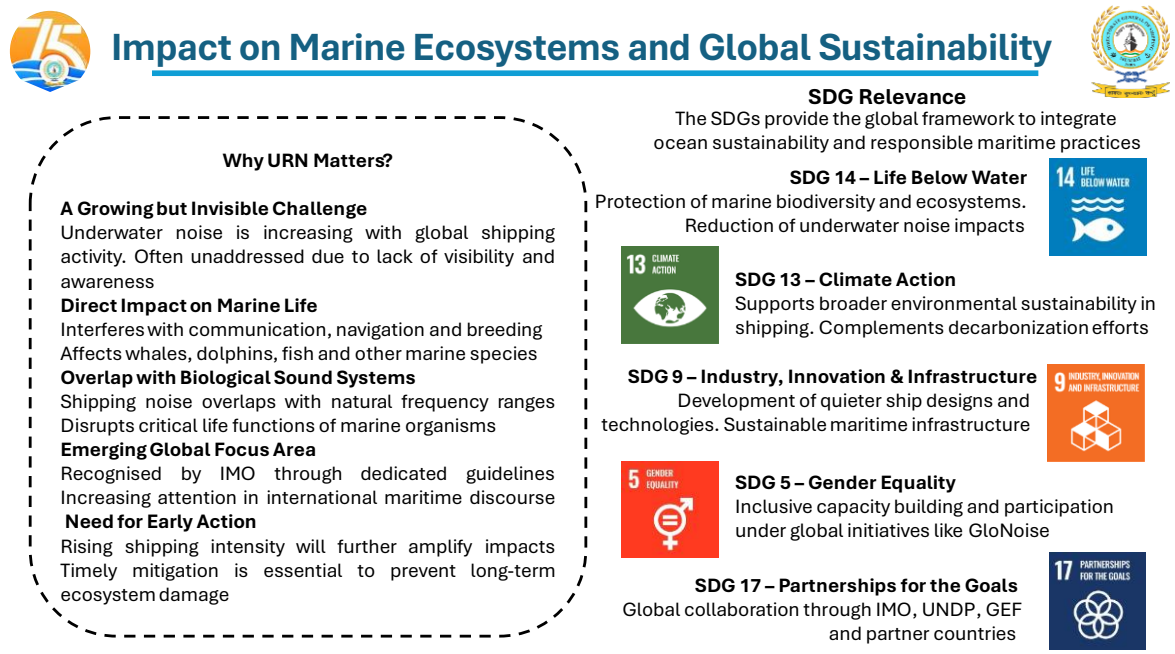
As a result, **large commercial shipping fleets are the dominant contributors to background ocean noise**, especially in major shipping routes and coastal regions.

Typical sound source levels from large commercial vessels are in the range of **180–190 dB re 1 µPa at 1 metre**, with some variations depending on vessel design, operational conditions and propulsion systems .

Over the past few decades, global shipping activity has increased at an estimated rate of approximately **4% annually**, leading to a corresponding rise in underwater noise levels across ocean basins. This trend highlights the growing scale of the issue and reinforces the need for systematic monitoring and mitigation.

In essence, URN represents an **invisible yet significant environmental footprint** of global shipping, with implications that extend across marine ecosystems and ocean health.

Impact on Marine Ecosystem and Global Sustainability



Underwater Radiated Noise (URN) represents a **growing yet largely invisible environmental challenge** within the maritime sector. Unlike conventional forms of pollution, underwater noise is not immediately perceptible, which often results in limited awareness and delayed policy attention. However, its ecological consequences are both significant and far-reaching.

With the steady increase in global shipping activity, anthropogenic noise levels in the oceans are rising, particularly in high-traffic shipping routes and coastal zones. This has led to increasing concern within the scientific and policy communities regarding its impact on marine ecosystems.

Marine species rely heavily on sound as a primary sensory mechanism. In the underwater environment, where visibility is limited, sound plays a critical role in **communication, navigation, foraging, reproduction and predator avoidance**.

The introduction of persistent underwater noise from shipping interferes with these natural acoustic processes. This results in a range of impacts on marine life, including:

- **Behavioural changes**, such as altered migration routes and avoidance patterns
- **Stress responses**, affecting feeding and reproductive efficiency

- **Masking of communication signals**, making it difficult for species to interact
- **Habitat displacement**, particularly in noise-intensive regions
- In extreme cases, **physical harm or long-term physiological effects**, depending on exposure levels

A key concern is the **overlap between shipping noise frequencies and biological sound ranges**. Large commercial vessels predominantly emit low-frequency noise, which coincides with the communication frequencies of several marine species, particularly large whales, certain fish species and marine mammals. This overlap significantly amplifies the ecological impact.

Recognising these concerns, underwater noise has emerged as an **important focus area within international maritime and environmental governance**, particularly under the International Maritime Organization (IMO), which has issued guidelines for its mitigation.

Importantly, the issue of URN is closely aligned with multiple **United Nations Sustainable Development Goals (SDGs)**, highlighting its broader relevance beyond the maritime sector.

- **SDG 14 – Life Below Water**:
  Directly linked to the protection of marine biodiversity and ecosystems. Reducing underwater noise contributes to preserving ocean health and ecological balance.
- **SDG 13 – Climate Action**:
  While URN is not a climate pollutant, its mitigation complements broader environmental sustainability efforts in shipping, reinforcing integrated approaches to environmental management.
- **SDG 9 – Industry, Innovation and Infrastructure**:
  Drives the development of quieter ship designs, advanced propulsion systems and sustainable maritime infrastructure.
- **SDG 5 – Gender Equality**:
  Reflected through inclusive capacity building, training and participation in global initiatives such as GloNoise, ensuring diverse stakeholder engagement.
- **SDG 17 – Partnerships for the Goals**:
  Highlights the importance of international collaboration among organizations such as IMO, UNDP, GEF and participating countries to address transboundary environmental challenges.

Given the increasing scale of shipping activity, the impacts of underwater noise are expected to intensify unless addressed proactively. Therefore, **early and targeted intervention is critical** to prevent long-term degradation of marine ecosystems and ensure sustainable use of ocean resources.

IMO Led Projects

GloLitter :
Tackling Plastics and Marine Litter

Green Voyage 2050 :
Advancing IMO GHG Reduction Strategies

GloNoise :
Reducing Underwater Radiated Noise Pollution

11

The International Maritime Organization (IMO), in collaboration with global partners, is leading several flagship initiatives aimed at addressing key environmental challenges in the maritime sector. These initiatives are designed to support developing countries through **capacity building, policy support, technology adoption and implementation frameworks**, ensuring a coordinated global response to sustainability challenges.

Among these, **GloLitter Partnerships, GreenVoyage2050 and GloNoise Partnership** represent critical interventions addressing marine pollution, greenhouse gas emissions and underwater noise respectively.

GloLitter Partnerships - Tackling Marine Plastic Litter

The **GloLitter Partnerships Project** is a global initiative focused on the prevention and reduction of marine plastic litter originating from sea-based sources, particularly from shipping and fisheries sectors.

The project is jointly implemented by the **International Maritime Organization (IMO)** and the **Food and Agriculture Organization (FAO)**, and primarily supports developing countries, including Small Island Developing States (SIDS) and Least Developed Countries (LDCs), in strengthening their regulatory and institutional frameworks.

The initiative operates under the broader **OceanLitter Programme**, which serves as a platform for coordinated action against marine litter.

The GloLitter project has a wide global footprint, with **30 participating countries across five regions**, including both Lead Partner Countries and Partner Countries, enabling cross-regional knowledge exchange and implementation of best practices.

Key areas of intervention include:

- Development of National Action Plans (NAPs) for marine litter management
- Strengthening legal, policy and institutional frameworks
- Enhancing Port State Control (PSC) capacity for enforcement of MARPOL Annex V
- Promoting public-private partnerships for waste management solutions
- Supporting capacity building and training programmes

The project has achieved significant progress, with multiple countries, including India, developing **National Action Plans (NAPs)** and strengthening enforcement and compliance mechanisms.

Building on the GloLitter framework, the **RegLitter Project** has been launched as a regional initiative focused on Asia, aimed at advancing implementation at both national and regional levels.

RegLitter includes **seven participating countries** — India, Indonesia, Philippines, Sri Lanka, Thailand, Timor-Leste and Viet Nam — and focuses on strengthening regional cooperation, policy alignment and institutional capacity for tackling marine plastic litter.

A key milestone under RegLitter was the **Regional Task Force (RTF) Workshop held in Kochi, India, from 8–12 December 2025**, where participating countries collaborated to:

- Review progress on national and regional actions
- Share best practices and national experiences
- Strengthen cooperation on research and policy frameworks
- Build capacity for implementation of MARPOL Annex V and related instruments

The workshop also included targeted training programmes, including **Port State Control (PSC) training on ship-generated waste management**, enhancing enforcement capabilities at the operational level.

Overall, GloLitter, along with RegLitter, plays a crucial role in addressing plastic pollution at source, promoting regional cooperation and contributing to cleaner oceans and sustainable maritime operations.

GreenVoyage2050 - Advancing Maritime Decarbonisation

GreenVoyage2050 is IMO's flagship programme supporting developing countries in reducing **greenhouse gas (GHG) emissions from shipping**, aligned with the **IMO 2023 GHG Strategy**.

The programme is being implemented in two phases:

- **Phase 1 (2019–2023):** Focused on developing **policy frameworks, regulatory readiness and pilot project identification**
- **Phase 2 (2024–2030):** Focused on **scaling implementation**, including pilot projects, technology demonstrations and financing mechanisms

The initiative provides comprehensive support to partner countries across multiple areas:

- Development of **national policies and regulatory frameworks**
- Identification and execution of **pilot projects and green corridor initiatives**
- Promotion of **energy efficiency technologies and alternative fuels**
- Facilitation of **access to finance for green maritime technologies**

GreenVoyage2050 acts as a central pillar in IMO's broader GHG reduction efforts, ensuring that developing countries are able to actively participate in the transition towards **low and zero carbon shipping**.

The programme is supported by multiple donor countries including Norway, Denmark, Finland, France, Germany and the Netherlands, highlighting strong international commitment towards maritime decarbonisation.

GloNoise Partnership - Addressing Underwater Radiated Noise

The **GloNoise Partnership** focuses on mitigating the impacts of **underwater radiated noise (URN)** from shipping on marine ecosystems.

Led by IMO in collaboration with **UNDP and GEF**, the project supports the implementation of the **IMO Revised Guidelines for the Reduction of Underwater Noise (MEPC.1/Circ.906/Rev.1)**.

The initiative includes:

- **Nine beneficiary countries**, comprising:
    - **Six Lead Pilot Countries:** Argentina, Chile, Costa Rica, India, South Africa and Trinidad and Tobago

- **Three Twinning Partner Countries:** Georgia, Madagascar and Malaysia

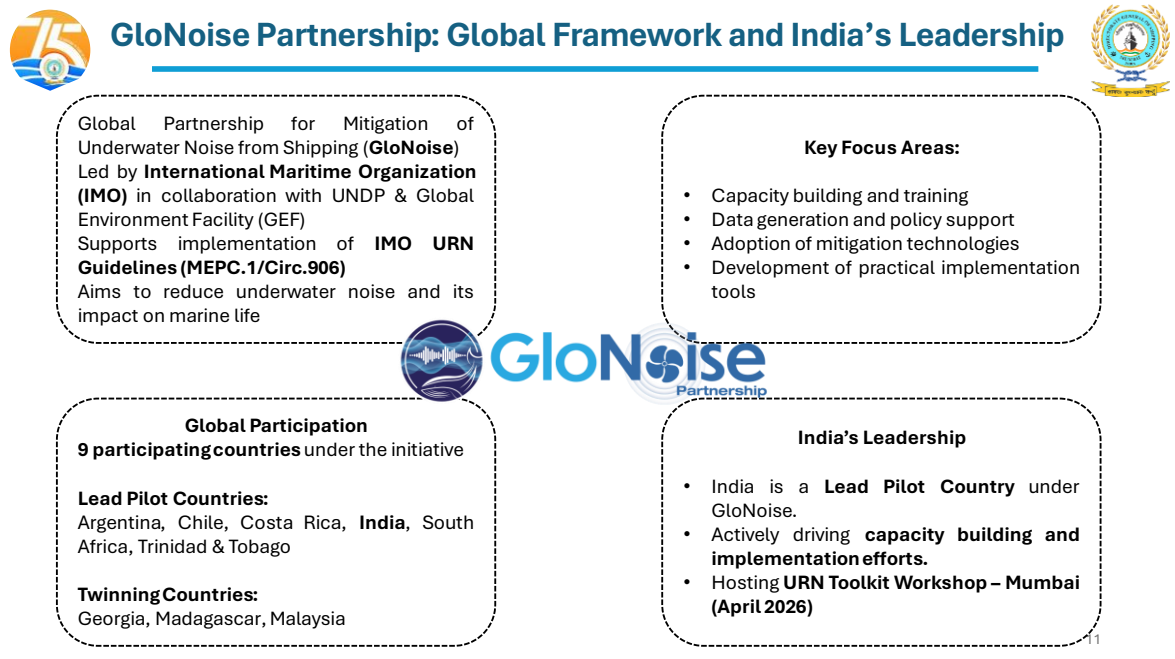
Key focus areas include:

- **Capacity building and technical training**
- Development of **data and evidence for policy formulation**
- Creation of tools such as the **URN Toolkit (RAINDROP)**
- Support for **national-level implementation of IMO guidelines**

The project aims to reduce underwater noise and its ecological impacts, particularly on marine species that rely on sound for communication, navigation and survival.

India, as a **Lead Pilot Country**, is actively contributing to global efforts through workshops, stakeholder engagement and capacity building initiatives, reinforcing its role in sustainable maritime governance.

GloNoise Partnerships : Global Framework and India's Leadership



The **GloNoise Partnership**, formally known as the *Global Partnership for Mitigation of Underwater Noise from Shipping*, represents a structured global initiative aimed at addressing the growing challenge of underwater radiated noise (URN) from maritime activities.

The initiative is led by the **International Maritime Organization (IMO)**, in collaboration with the **United Nations Development Programme (UNDP)** and the **Global Environment Facility (GEF)**. It forms part of the broader international effort to integrate environmental considerations into maritime operations and governance.

The primary objective of the GloNoise Partnership is to **support the implementation of the IMO Revised Guidelines for the Reduction of Underwater Noise from Commercial Shipping** *(MEPC.1/Circ.906/Rev.1)*. These guidelines provide a framework for member states and industry stakeholders to assess, manage and mitigate underwater noise impacts on marine life.

The initiative adopts a **multi-dimensional approach**, focusing not only on technical solutions but also on capacity development and policy support. Its key focus areas include:

- **Capacity building and training** for maritime administrations and stakeholders
- **Data generation and scientific assessment**, enabling evidence-based policymaking
- **Adoption of mitigation technologies**, including quieter ship design and operational measures
- **Development of practical implementation tools**, to support national-level action

In terms of participation, the GloNoise Partnership currently involves **nine countries**, structured into **Lead Pilot Countries and Twinning Countries**.

The **Lead Pilot Countries** : Argentina, Chile, Costa Rica, India, South Africa and Trinidad & Tobago, are responsible for driving implementation, testing methodologies and demonstrating best practices.

The **Twinning Countries** : Georgia, Madagascar and Malaysia, are engaged in knowledge sharing, capacity enhancement and collaborative learning under the framework.

India's Role and Leadership

India plays a significant role in this initiative as a **Lead Pilot Country**, reflecting its growing commitment to sustainable and environmentally responsible maritime development.

Under the GloNoise framework, India is actively contributing towards:

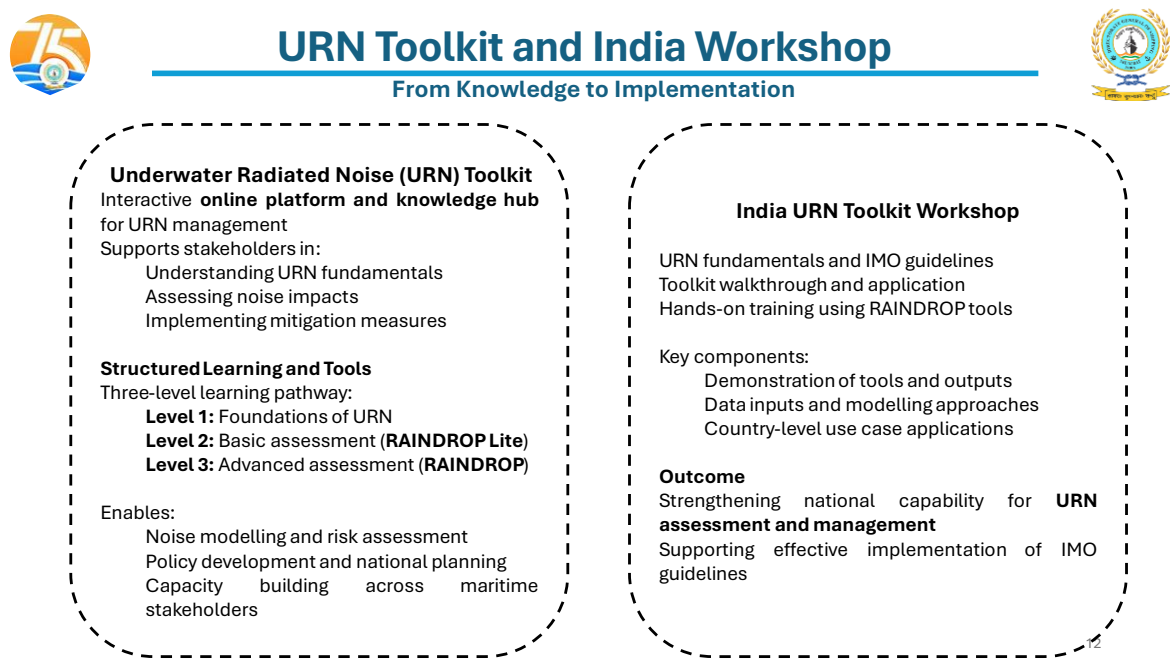
- **Driving capacity building initiatives**, including training and stakeholder engagement
- **Supporting implementation of IMO guidelines** at the national level
- **Facilitating knowledge exchange and regional collaboration**

A key milestone in this regard is the **hosting of the Underwater Radiated Noise (URN) Toolkit Workshop in Mumbai (April 2026)**, which represents an important step towards operationalising URN assessment and management capabilities in India.

This leadership role aligns with India's broader maritime vision, including its commitments under green shipping initiatives and sustainable ocean governance.

The GloNoise Partnership provides a **structured global platform**, while India's active participation positions it at the **forefront of efforts to address underwater noise in shipping**.

URN Toolkit and India Workshop



To effectively address the challenge of underwater radiated noise, there is a need to move beyond awareness and policy frameworks towards **practical implementation and capacity building**. In this context, the **Underwater Radiated Noise (URN) Toolkit** has been developed as a key enabling platform under the GloNoise Partnership.

The URN Toolkit is designed as an **interactive online platform and knowledge hub**, aimed at supporting maritime stakeholders in understanding, assessing and managing underwater noise.

It serves as a comprehensive resource that enables stakeholders, including maritime administrations, port authorities, ship operators and technical experts, to:

- Develop a clear understanding of **URN fundamentals and sources**
- Assess the **extent and impact of underwater noise** in different operational contexts
- Identify and implement **appropriate mitigation measures**

A key strength of the toolkit lies in its **structured learning framework**, which is organised into three progressive levels:

- **Level 1 : Foundations of URN**:
  Provides fundamental knowledge on underwater noise, its sources, characteristics and environmental implications
- **Level 2 : Basic Assessment (RAINDROP Lite)**:
  Introduces simplified tools for preliminary noise assessment, enabling users to understand baseline noise conditions
- **Level 3 : Advanced Assessment (RAINDROP)**:
  Offers detailed modelling and analytical capabilities for comprehensive noise assessment and scenario analysis

Through this structured approach, the toolkit enables **scientific assessment, decision-making and policy formulation**.

In addition, the toolkit supports:

- **Noise modelling and risk assessment**, helping quantify impacts
- **Policy development and national planning**, aligned with IMO guidelines
- **Capacity building across maritime stakeholders**, ensuring effective implementation

India URN Toolkit Workshop

Building on this platform, the **India URN Toolkit Workshop** serves as a critical step towards translating knowledge into practical application.

The workshop focuses on:

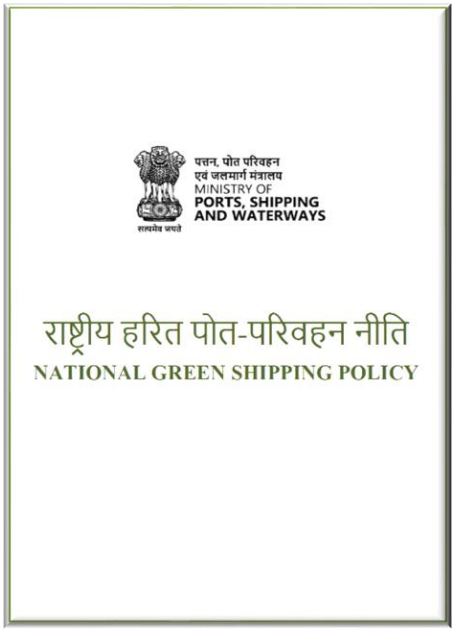
- Providing an understanding of **URN fundamentals and IMO guidelines**
- Demonstrating the **toolkit functionalities and applications**
- Delivering **hands-on training using RAINDROP Lite and RAINDROP tools**

A key aspect of the workshop is its practical orientation, which includes:

- **Demonstration of tools and outputs**, enabling participants to interpret results
- **Data inputs and modelling approaches**, ensuring scientific robustness
- **Country-level use case applications**, contextualising the tools for national scenarios

The workshop is expected to significantly **strengthen national capability** in the area of underwater noise assessment and management.

National Green Shipping Policy (NGSP)



The National Green Shipping Policy (NGSP) 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 NGSP 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 NGSP 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 NGSP as a Convergence Policy

Importantly, the NGSP 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 NGSP 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 NGSP 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 NGSP Is Imperative Now

The need for a National Green Shipping Policy (NGSP) 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 NGSP 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 NGSP 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 NGSP 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 NGSP 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 NGSP 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 NGSP 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.

NGSP Objectives and Pillar Architecture

Core Objectives of the National Green Shipping Policy

The National Green Shipping Policy (NGSP) 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 NGSP are to:

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

To operationalise these objectives, the NGSP 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 NGSP 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 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.

4. 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.

5. 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.

6. Green Skill Development and Human Resources

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.

7. Green Ship Recycling

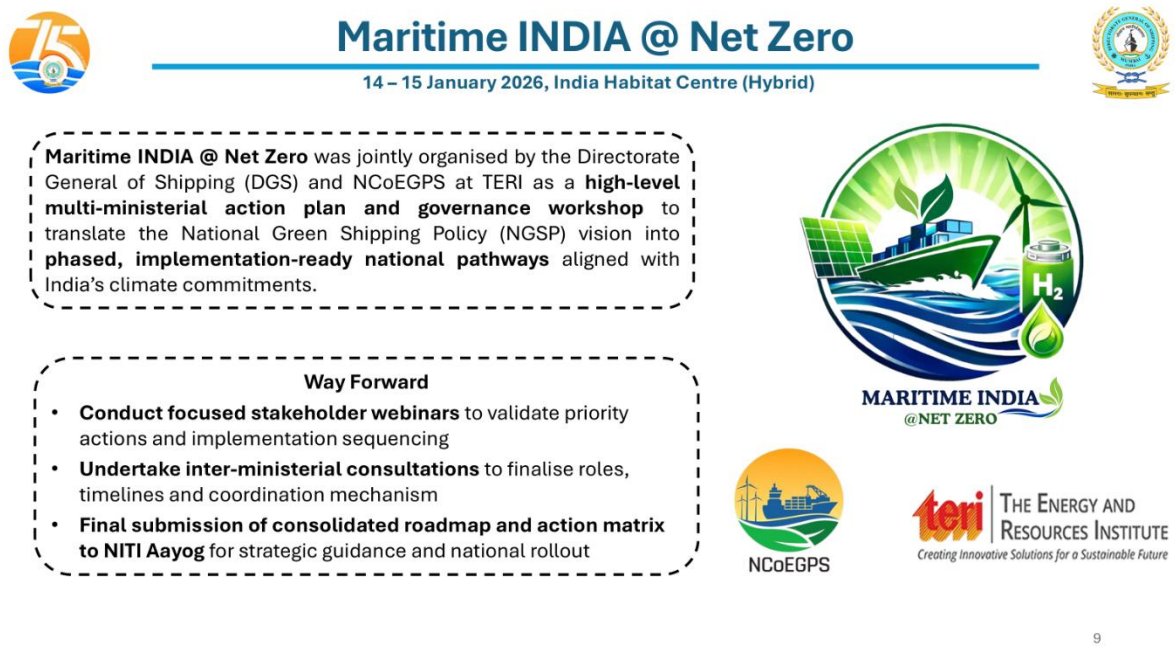
The Green Ship Recycling pillar aims to strengthen environmentally sound and safe ship recycling practices, aligned with international conventions and domestic regulations, while promoting circularity, transparency and occupational safety.

Relevance of the Pillar Architecture for Implementation

The pillar-based structure allows the NGSP 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.

Maritime INDIA @ Net Zero

NGSP Multi-Ministerial Action Planning and Governance Workshop



India's maritime sector underpins national economic growth, with nearly 95% of India's trade by volume carried through maritime transport. At the same time, international shipping is entering a decisive transition phase driven by the International Maritime Organization's (IMO) revised 2023 GHG Strategy, which commits global shipping to net-zero greenhouse gas emissions by or around 2050, supported by enforceable interim measures based on lifecycle (well-to-wake) emissions.

In parallel, India has articulated its own long-term climate pathway, including a net-zero target by 2070, requiring calibrated alignment between domestic development priorities and evolving international regulatory regimes such as EEXI, CII and forthcoming GHG Fuel Intensity (GFI) standards.

Against this backdrop, the National Green Shipping Policy (NGSP) has been developed as India's unifying national framework for maritime decarbonisation, integrating ships, ports, fuels, shipbuilding, ship recycling, finance, skilling and governance into a single transition architecture.

To move NGSP from policy articulation to implementation readiness, the Maritime INDIA @ Net Zero Workshop was convened as a high-level, multi-ministerial and multi-stakeholder platform focused on execution planning, coordination and governance alignment.

Workshop Overview

The Maritime INDIA @ Net Zero – NGSP Multi-Ministerial Action Plan and Governance Workshop was held on 14–15 January 2026 at India Habitat Centre, New Delhi, in hybrid mode. The workshop was organised by the Directorate General of Shipping (DGS), Ministry of Ports, Shipping and Waterways (MoPSW), in collaboration with the National Centre of Excellence for Green Ports and Shipping (NCoEGPS), TERI, which has been designated by MoPSW as the national technical and knowledge partner for India's green maritime transition.

The workshop brought together senior officials from central ministries, maritime administrations, ports, industry, financial institutions, international organisations and knowledge partners.

A key milestone during the workshop was the release of the knowledge document "Advanced Green Fuels for Maritime Applications – Roadmap for India", prepared by Dr Piyali Das (NCoEGPS–TERI), providing a structured, lifecycle-based foundation for alternative fuel transition planning in India's maritime sector .

Objectives

The workshop was explicitly designed to go beyond awareness-building and instead focus on implementation-oriented action planning. The core objectives were to:

- Translate NGSP into phased national action plans with short-, medium- and long-term priorities
- Deliberate transition pathways across green ships, green ports, green fuels, ship recycling and enabling pillars
- Assess regulatory, safety and institutional readiness for emerging technologies and alternate fuels
- Examine finance, market instruments and de-risking mechanisms for maritime sustainability investments
- Strengthen governance, coordination, monitoring and review mechanisms for NGSP implementation
- Position India within global maritime decarbonisation initiatives and international cooperation frameworks

Strategic Significance

The Maritime INDIA @ Net Zero Workshop marked a clear turning point in India's approach to green shipping. It moved the conversation away from isolated and fragmented green initiatives towards a shared, nationally coordinated pathway for maritime decarbonisation. By bringing all key stakeholders to the same table, the workshop helped create a common understanding of priorities, sequencing and responsibilities.

Importantly, the workshop reinforced the National Green Shipping Policy (NGSP) as the central reference framework for both domestic action and international engagement. It positioned the maritime sector not just as a compliance-driven industry, but as an active contributor to India's long-term climate goals, energy security and economic growth.

In doing so, Maritime INDIA @ Net Zero laid the groundwork for a more structured, collaborative and implementation-focused green transition—one that aligns India's maritime ambitions with global developments while remaining grounded in national realities.

Inaugural Session

The inaugural session set the strategic tone for the two-day deliberations.

- Shri R. R. Rashmi, Distinguished Fellow, TERI, situated NGSP within the global climate and energy transition, emphasising the importance of realistic timelines, lifecycle-based decision-making and system-level thinking.
- Shri Shyam Jagannathan, IAS, Director General of Shipping, outlined NGSP's alignment with emerging IMO regulations on emissions, fuel intensity and safety and highlighted the need for credible national governance and MRV systems.
- Shri Rajesh Kumar Sinha, IAS, Special Secretary, MoPSW, underscored the necessity of clear institutional ownership, inter-ministerial coordination and phased execution mechanisms to translate policy intent into measurable outcomes.

Session-Wise Key Themes

Session 1: National Green Shipping Policy – Framework and Governance

This session presented NGSP as a comprehensive national transition framework, not a standalone scheme. Discussions focused on:

- NGSP's pillar architecture and lifecycle-based approach
- Establishment of a national maritime emissions baseline (2021)
- Development of an integrated Monitoring, Reporting and Verification (MRV) framework
- Proposal of the National Green Shipping Coordination Cell (NGSCC) as the nodal governance mechanism
- Introduction of a Rolling National Green Maritime Implementation Plan (NGMIP) to convert policy into time-bound action

Stakeholders emphasised the need for statutory strength, escalation powers and decision-linked MRV systems.

Session 2: Green Ship Recycling and Circular Economy

This session focused on strengthening India's ship recycling ecosystem under NGSP, particularly in light of the Hong Kong International Convention entering into force.

Key themes included:

- Safe and environmentally sound recycling practices
- Circular economy linkages and green steel value chains
- Worker safety, skilling and welfare
- Digitalisation, compliance monitoring and transparency systems

Ship recycling was positioned as a strategic decarbonisation and resource-efficiency lever, not merely an end-of-life activity.

Session 3: Green Fuels and Alternate Energy Pathways

This session examined India's fuel transition through a technology-neutral, lifecycle-based portfolio approach.

Deliberations covered:

- Definition of green fuels under NGSP (biofuels, green hydrogen, green ammonia, green methanol, renewable LNG etc.)
- Phase-wise transition targets (short, medium and long term)
- Safety standards, fuel handling and infrastructure readiness
- Integration with port bunkering systems and MRV frameworks

The session reinforced that fuel transition must be safe, phased and system-integrated, avoiding premature fuel lock-in.

Session 4: Green Ports and Port-Led Decarbonisation

Ports were identified as critical system anchors for maritime decarbonisation.

Discussions focused on:

- Renewable energy integration and energy efficiency
- Shore-to-Ship Power (OPS) and port electrification
- Port-level emissions accounting and benchmarking
- Integration of ports with green fuel hubs and logistics clusters

The session highlighted that port readiness will directly determine the pace and credibility of shipping decarbonisation.

Session 5: Green Ships and Green Technology Transition

This session addressed vessel-side decarbonisation across coastal, inland and ocean-going fleets.

Key focus areas included:

- Technology transition pathways for newbuilds and retrofits
- Fuel-flexible and hybrid vessel configurations
- Readiness of Indian shipyards and technology ecosystems
- Alignment of standards, certification and safety regimes

Green shipping was positioned as a technology-enabled and finance-dependent transition, requiring coordinated policy signals.

Session 6: Green Finance and Market Instruments

This session examined finance as a core enabler of NGSP implementation.

Discussions covered:

- Limitations of conventional maritime finance
- Need for de-risking instruments for first-of-a-kind projects
- Role of blended finance, guarantees, green bonds and incentives
- Alignment with global ESG and climate finance frameworks

Participants emphasised that without credible finance mechanisms, green maritime investments will not scale.

Session 7: Training and Capacity Building

The workshop deliberately reframed the originally envisaged pollution-prevention focus into a dedicated session on training and capacity building, recognising that environmental outcomes depend fundamentally on human and institutional capability.

The session addressed:

- Skill gaps arising from new fuels, technologies and safety regimes
- Capacity requirements for regulators, surveyors, ports and crews
- Alignment of maritime education and training with NGSP needs
- Long-term development of India as a green maritime skills hub

Session 8: International Collaboration and Global Best Practices

This session situated NGSP within global maritime decarbonisation initiatives, including:

- IMO GreenVoyage2050
- Green shipping corridors
- Bilateral and multilateral cooperation frameworks

India's potential leadership role in the Indian Ocean region was highlighted, alongside the importance of coordination, capacity building and technology transfer.

Key Outcomes of Maritime INDIA @ Net Zero Workshop

The Maritime INDIA @ Net Zero Workshop resulted in a shared, cross-stakeholder understanding that India's maritime decarbonisation journey must be coordinated, phased and institutionally anchored, rather than driven through isolated initiatives.

A key outcome was the collective endorsement of the National Green Shipping Policy (NGSP) as the single, unifying framework for India's green maritime transition, cutting across ships, ports, fuels, ship recycling, finance, skilling and governance. Stakeholders broadly converged on the need to avoid fragmented pilots and instead pursue system-level implementation aligned to NGSP pillars.

The workshop generated session-wise technical and policy inputs across all NGSP domains, highlighting:

- the critical role of fuel transition and bunkering readiness as long-term decarbonisation levers
- the centrality of ports as system enablers for energy transition, electrification and fuel deployment
- the importance of ship recycling and circular economy linkages as a comparative strength for India
- the recognition that green finance and de-risking mechanisms are prerequisites for scaling investments
- the acknowledgement that capacity building and institutional readiness are foundational to safe and effective implementation

Stakeholders also identified common cross-cutting challenges, including:

- absence of harmonised emissions baselines and MRV systems
- safety and regulatory preparedness for alternate fuels
- high upfront capital costs and limited access to concessional finance
- skills gaps across ships, ports and regulatory institutions

Overall, the workshop marked a shift from policy intent to execution thinking, with emphasis on sequencing, prioritisation and accountability.

Way Forward

Building on the deliberations and stakeholder inputs, the following next steps have been identified to operationalise outcomes from the workshop:

1. **Consolidation of Workshop Outputs**
   Session-wise recommendations and inputs will be distilled into a structured NGSP Action-Point Matrix, aligned to policy pillars and categorised into short-term, medium-term and long-term actions, with indicative ownership and dependencies.

2. **Stakeholder Validation and Refinement**
   Following consolidation, focused thematic webinars and consultations will be conducted to validate proposed actions, refine sequencing and strengthen alignment among concerned ministries, regulators, ports and industry stakeholders.

3. **Inter-Ministerial Convergence**
   The consolidated action matrix will be taken up for inter-ministerial consultation, to clarify roles, responsibilities and coordination mechanisms across shipping, ports, energy, environment, finance and skilling domains.

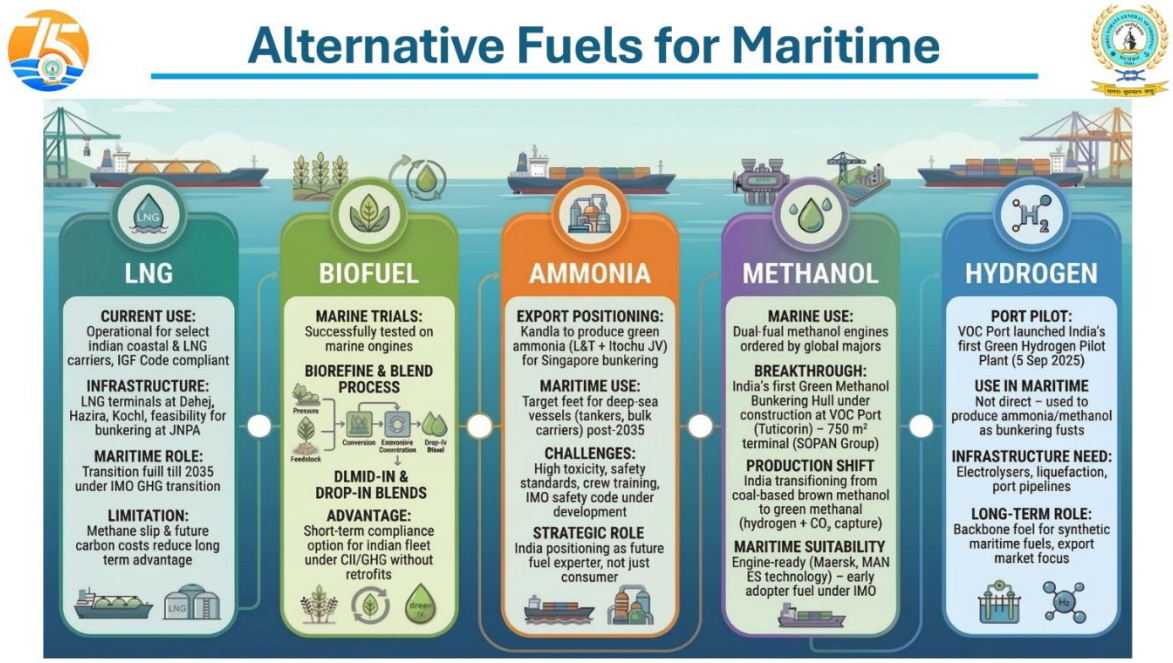
4. **Policy-Level Review and Strategic Alignment**
   The refined and implementation-ready NGSP action framework will be presented to NITI Aayog for policy-level review, strategic alignment with national climate and energy pathways and guidance on national rollout.

5. **Governance and Execution Mechanism**
   Parallel to the above, governance and execution arrangements under NGSP will be strengthened, including mechanisms for coordination, monitoring and periodic review. TERI–NCoEGPS, as the designated National Centre of Excellence for Green Ports and Shipping, will support technical facilitation, knowledge development and stakeholder coordination as required.

6. **Initiation of Priority Pilot Actions**
   Based on readiness and impact potential, priority pilot actions across fuels, ports, ships, finance and capacity building will be identified for early implementation, to generate learning, build confidence and inform scale-up.

Alternative Fuels for Maritime

Global Transition Imperative in Maritime Fuels



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 NGSP 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 NGSP 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.

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 NGSP's **explicit avoidance of LNG as an end-state fuel**.

Fuel	Approx. GFI (gCO_2eq/MJ)
HFO	~90-94
LNG	~65-100
Bio-methanol	~9–17
Green ammonia	~3–12

National future fuel assessments referenced in the NGSP 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 from NGSP:

- 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 NGSP 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 NGSP 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 from NGSP:

Biofuels such as biodiesel and renewable diesel as well as e-FT dieselare treated under the NGSP 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.

In the NGSP assessments, biofuels are mainly considered for **blended or drop-in use**, rather than as sole propulsion fuels.

The NGSP recognises that **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 in the NGSP 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 in the NGSP 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 from NGSP:

- 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 the NGSP and the associated 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.[1]

Key NGSP 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**.
- The NGSP avoids prescribing **direct hydrogen propulsion** for ships in the short term.
- Port and bunkering infrastructure for hydrogen are to be developed **progressively**, alongside safety and regulatory frameworks.

Battery Electric Energy

Battery electric propulsion is considered under the NGSP 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 Green Shipping Policy (NGSP)

The National Green Shipping Policy (NGSP) 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

NGSP thus functions as the policy convergence layer, translating evidence-based fuel roadmaps into coordinated national action.

Alternative Fuels Properties Comparison

Parameter	E-LNG	Methanol	Ammonia	Hydrogen
Physical properties for storage	Liquid at −162 °C	Liquid (up to 65 °C)	Liquid at −33 °C	Compressed gas at > 250 bar or liquid at −253 °C
Fuel tank size for same energy content as MDO	1.8 times	2.5 times	3 times	5–7 times
Flammability limits in air (%V/V)	5%–15% (Methane)	6%–36.5%	15%–28%	4%–75%
Ignition temperature (°C)	595	464	630	560
Flashpoint (°C)	−188	12	132	—
Density of liquid phase (kg/m³)	450	790	696	71
LCV (MJ/kg)	50	19.9	18.6	120
Energy density (MJ/L)	21.2	15.7	12.7	8.5

Alternative Fuels Comparison

Hydrogen

Pros
- High gravimetric energy density
- Very pure hydrogen
- Only emits water

Cons
- Highly flammable
- Cryogenic temperature
- Complex storage necessary
- Difficult to handle
- No IMO rules available

E-Ammonia

Pros
- Carbon free
- Experience as cargo or refrigerant
- Higher energy density than hydrogen
- Since Dec 2024 IMO guidelines

Cons
- Toxic
- Not commercially available yet
- Highly trained personal needed
- High cost

E-Methanol

Pros
- Liquid at room temperature
- Easy to handle
- Mature technology
- Rules exist
- Higher energy density than hydrogen

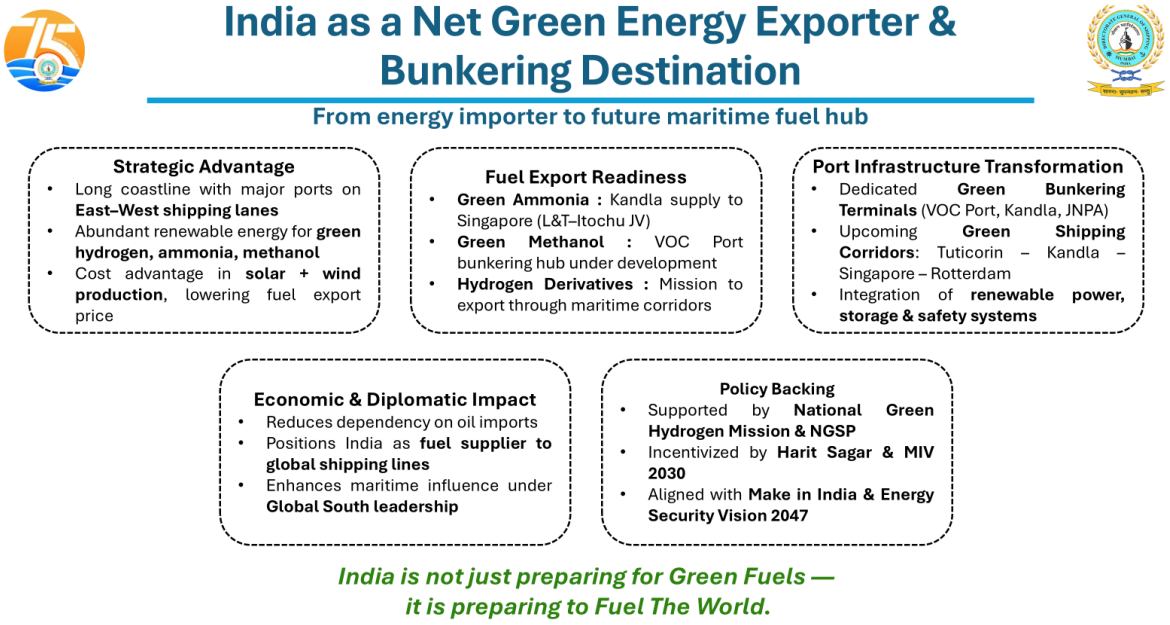
Cons
- Toxic
- Highly flammable
- Still contains carbon
- High cost

E-LNG

Pros
- Mature technology
- Rules exist
- Higher energy density than hydrogen

Cons
- Not commercially available yet (fuel production)
- Cryogenic temperature
- Complex storage necessary
- High cost
- Risk of methane leakage / slip

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.

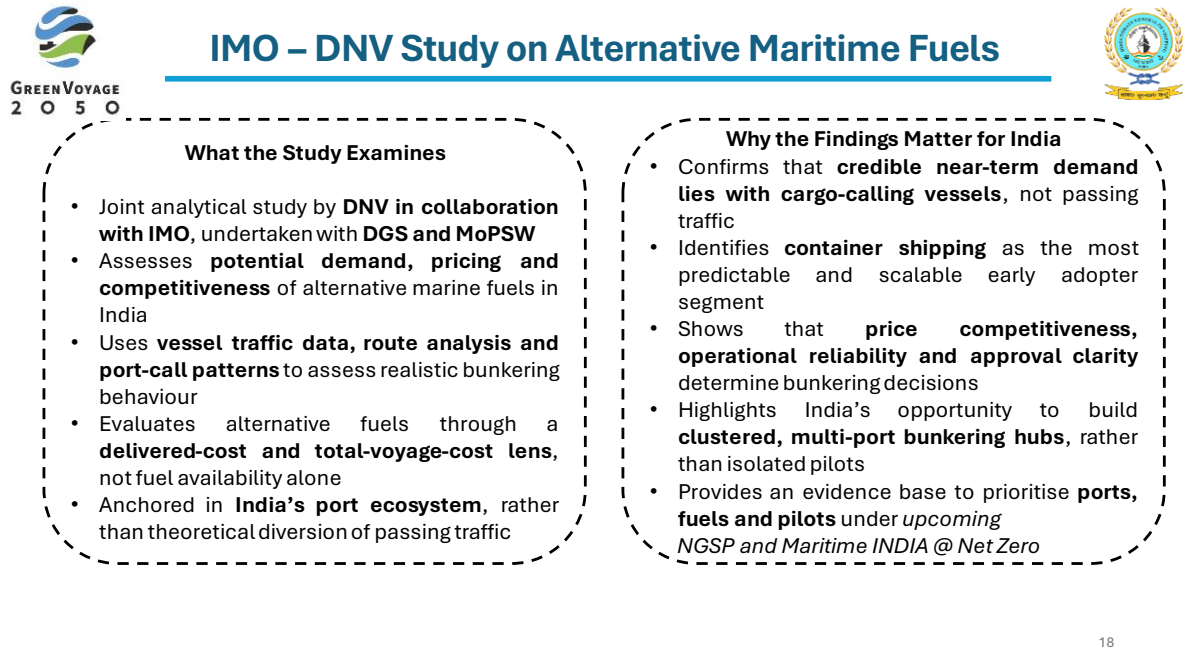
Green Maritime Corridors

Green Maritime Corridors have emerged internationally as a pragmatic and implementation-oriented mechanism to advance maritime decarbonisation in a structured manner. Rather than attempting immediate sector-wide transformation, green corridors focus on specific routes, vessel segments and port pairs where coordinated action across the value chain can be demonstrated under real operating conditions.

The corridor approach enables regulators, ports, shipowners, fuel producers and technology providers to collectively address the key barriers to adoption of alternative marine fuels, including fuel availability, pricing, safety, operational reliability and regulatory readiness. By concentrating effort on defined corridors, early investments can be de-risked and lessons generated for wider replication.

In the Indian context, green maritime corridors form the core implementation pillar of the Green Voyage approach, translating long-term policy ambition on green shipping into route-based, evidence-driven and commercially grounded interventions.

Study on Potential Demand and Pricing of Alternative Marine Fuels in India



One of the foundational analytical inputs supporting India's Green Voyage strategy is the Study on Potential Demand and Pricing of Alternative Marine Fuels in India, undertaken under the aegis of the International Maritime Organization, in partnership with the Directorate General of Shipping and the Ministry of Ports Shipping and Waterways, with technical support from DNV.

The study evaluates India's prospects of developing into a regional bunkering hub for alternative marine fuels, examining demand drivers, pricing dynamics, operational constraints and competitive positioning. A central and policy-critical conclusion of the study is that:

India's strongest and most realistic bunkering opportunity lies with container vessels already calling at Indian ports for cargo operations or transshipment, rather than with vessels merely passing by along international shipping lanes.

This finding has important strategic implications. The study demonstrates that proximity to shipping lanes alone does not generate bunkering demand. Global shipping lines rarely deviate from established routes unless the bunkering proposition offers clear advantages in delivered fuel cost, operational reliability and turnaround efficiency. As a result, bunkering strategies premised on deviation-based demand are inherently weak.

Instead, the study underscores that cargo-linked demand, particularly from containerised liner services with regular port calls, provides a stable and predictable foundation for early

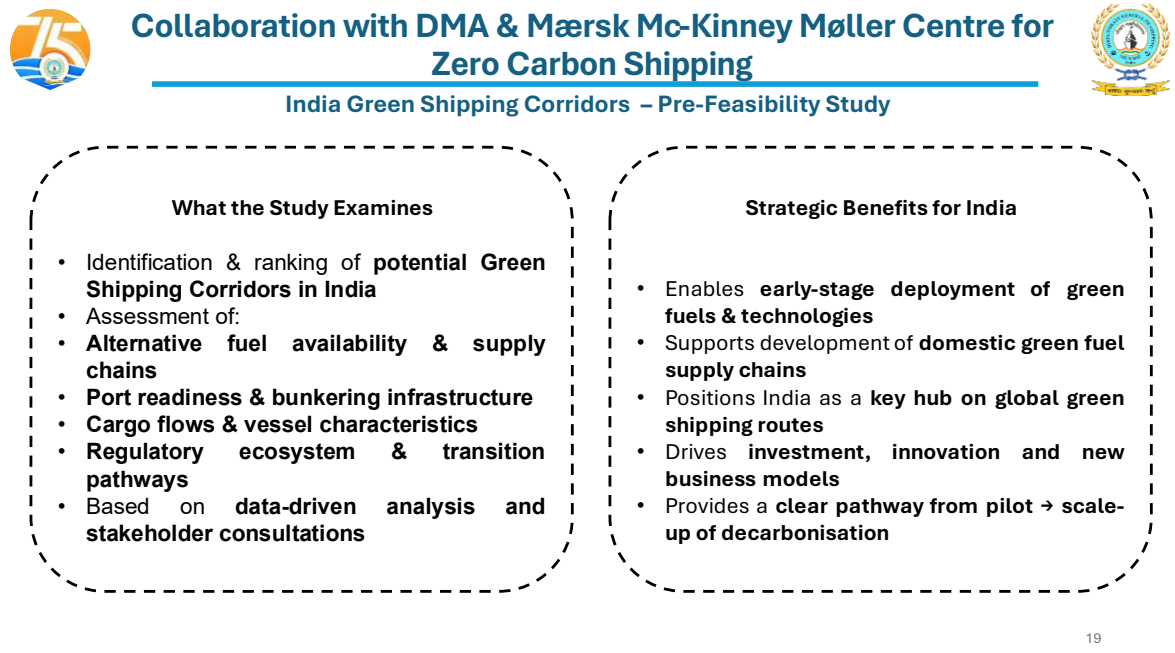
alternative fuel uptake. Transshipment hubs, where vessels already berth for cargo consolidation, offer especially strong potential, as bunkering can be integrated without additional operational disruption.

Key insights from the study include:

- Container vessels represent the most viable early adopters due to frequency of port calls and fleet standardisation
- Early demand for alternative fuels is likely to be led by biofuels, given cost and compatibility, with e-methanol and e-ammonia scaling over time
- Bunkering hub development should be selective and concentrated, rather than dispersed across multiple ports
- Policy certainty, targeted incentives and infrastructure readiness are decisive factors for market uptake

The study thus provides a market-grounded demand lens for India's green corridor planning.

Green Corridor Pre-Feasibility Study under the Indo-Danish Centre of Excellence



Complementing the demand and pricing analysis, a Green Corridor Pre-Feasibility Study is proposed as one of the first substantive deliverables of the Indo-Danish Centre of Excellence (CoE). This activity follows directly from the Joint Statement issued by the Hon'ble Ministers of India and Denmark during their meeting in Copenhagen in June 2025, as communicated through the Press Information Bureau.

The study is being undertaken in collaboration with the Danish Maritime Authority and the Mærsk Mc-Kinney Møller Centre for Zero Carbon Shipping, which will be responsible for executing the technical analysis.

The objective of the pre-feasibility study is to identify and assess specific green corridor candidates, moving beyond high-level intent to a structured evaluation of:

- suitable trade routes and port pairs
- vessel segments most amenable to early fuel transition
- availability and scalability of alternative fuel supply
- bunkering infrastructure and safety requirements
- regulatory, commercial and operational gaps

A key institutional element of this exercise is the designation of workstream leads by MoPSW. These workstream leads are envisaged to act as coordinators, ensuring that relevant data, port inputs, regulatory perspectives and stakeholder feedback are consolidated and made available to the study team. The actual analytical and modelling work will be undertaken by the Mærsk Mc-Kinney Møller Centre, while the Indian side facilitates structured engagement and ownership.

Role of Green Corridors in Advancing the Green Voyage

Taken together, the two studies address distinct but complementary dimensions of India's Green Voyage strategy:

- The IMO-supported demand and pricing study anchors green bunkering decisions in commercial reality, identifying where demand is likely to materialise and under what conditions.
- The Indo-Danish green corridor study translates this understanding into route-specific implementation pathways, focusing on feasibility, sequencing and coordination.

Once operational, green maritime corridors are expected to:

- contribute to the establishment of alternative fuel supply chains and offtake arrangements
- accelerate the scaling of new fuels and technologies through real-world demonstration
- align first-mover actions across ports, shipping lines, fuel suppliers and regulators
- enable experimentation with new commercial and contractual models

In effect, green corridors function as controlled transition laboratories, allowing India to build institutional capacity, regulatory confidence and market credibility in green shipping.

Green Ports

India's ports form an essential backbone of the national economy and the maritime transport system, underpinning about 95 per cent of the country's trade by volume and almost 68 per cent by value. Backed by a coastline covering more than 7,500 kilometres, the country's port system includes **12 major ports in addition to over 200 non-major ports**, enabling international trade and coastal shipping while supporting inland waterways transport and port-based industrialisation.

Ports are not only gateways for freights, but they are also important logistics and industry hubs that integrate sea transport with rail, road, and inland waterways, and therefore are at the core of supply chain efficiency and competitive advantage. Port operations are becoming increasingly energy-intensive as India's trade volumes increase and the port infrastructure increases its capability while it makes room for large ships and throughput. Cargo handling, vessel berthing, port craft operations, building services, and auxiliary infrastructure all contribute to greenhouse gas emissions, local air pollution, noise and pressure on coastal and marine ecosystems. The impacts are mostly concentrated in and around port regions, which are typically situated neighbouring major urban centres and ecologically sensitive coastal areas

In consequence, **improving the environmental performance of ports** has risen from being a peripheral concern into central necessity for sustainable maritime growth and social acceptance and long-term operational resilience. National climate commitments set out in India, including its goal of becoming **net zero emissions by 2070** and its interim goals based on the Paris Agreement provide an opportunity to implement sector-level strategies that link macro-level targets with real-world action by the sector. With their long use lifetimes of assets, high energy consumption and prominent position in maritime logistics, ports constitute one of the most viable interfaces for promoting sustainable environmental reductions within the maritime industry.

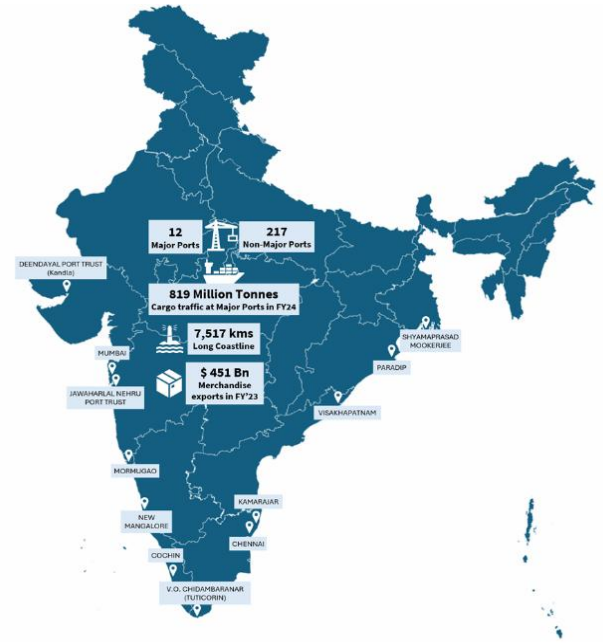


Figure 1 Ports of India

Therefore, responding to emissions and environmental impacts at ports not only **helps national targets for climate** but also contributes to **improved air quality, resource management efficiency and the resilience of the local coastline's infrastructure**.

GREEN PORTS IN INDIA

Green ports occupy a crucial facilitating position in India's green shipping and maritime decarbonisation trajectory. Ports therefore can impact emissions outcomes along multiple pathways across maritime value chains, as a set of fixed infrastructure nodes that interact face to face with vessels, fuels, energy systems and logistics infrastructure, directly from the port to ships, fuel sector with the fuel system to logistics network. Because of this, green ports are not just concerned with their own operational footprint, but they also provide the conditions for **cleaner shipping and sustainable maritime operations**.

By Indian policy framework green ports would aim to make the practice of environmentally sustainable operations systematic, infrastructural and governing. Common key areas include emissions reduction of port-controlled assets through electrification and energy optimisation, renewable generation of energy as part of port power solutions, shore-to-ship power systems to minimise ship emissions on board ships, and environmental monitoring and management systems.

Simultaneously, ports are also believed to play a pivotal role in facilitating the switch to **alternative and low carbon fuels**, *providing storage, handling and bunkering infrastructure* and holding all these facilities to a high standard of safety and environmental sustainability.

Ports also grow to be even more critical determinants of shipping emissions performance. Port infrastructure and services including effective berth allocation, reduced hold-up times, arrival through ports just-in-time system and shore power directly impact vessel fuel consumption and adherence to global indicators like the Carbon Intensity Indicator (CII). Green ports in this space serve as **systemic enablers** that help ship operators fulfil regulatory requirements and operating efficiency requirements while also helping with broader decarbonisation results.

The National Green Shipping Policy recognises green ports as an essential component of India's maritime transition, supported by complementary instruments such as the **Harit Sagar Green Port Guidelines** (which gives guidance on implementation) and the **Green Port Performance Index (GPPI),** which provides a systematic framework for measurement and benchmarking of environmental performance.

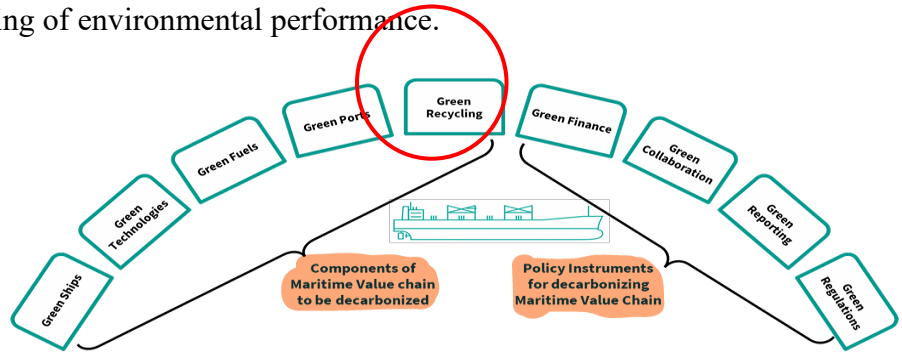


Figure 2 Core areas of NGSP

Together, these instruments create a coherent architecture that connects policy objectives to the **phased implementation and performance-based governance**. By implementing green port practice on an incremental basis with an emphasis on readiness to go green and pilot schemes to widespread and institutionalised application of this approach, Indian ports may become the anchors of port-led decarbonisation.

While the green ports have the capacity to act as systemic enablers of cleaner shipping and maritime decarbonization, translating this role into practice is constrained by a set of regulatory, infrastructure, technological, financial and coordination challenges. Understanding these constraints is essential for designing phased, targeted interventions that unlock effective and scalable implementation.

The following highlights they key barriers that must be addressed to enable green ports to deliver sustained environmental and operational outcomes

KEY PILLARS OF GREEN PORT

Energy and Emissions

Energy consumption and reduction of emissions is the foundation of Green Port building because ports, located in dense hotspots for electricity, fuel use and GHG, the main sources of power/fuel usage along with GHG emission are highly concentrated ports. Emissions are generated by ships at berth, cargo handling apparatus, vehicles and auxiliary power facilities, and ports are important places for intervention to promote decarbonisation.

Green Ports focus on renewable energy uptake and electrification of port equipment, shore power installation and energy-saving measures to mitigate both direct and indirect CO2 emissions. These interventions are consistent with national climate targets and are also associated with enduring cost efficiencies and operational sustainability

Water and Waste Management

Successful water and waste management is a basic component of Green Ports, addressing effluents, ballast water, stormwater runoff and solid and hazardous waste left after port and shipping operations. Dysregulation of these streams may have the potential to damage marine ecosystems and erode the confidence of port communities, in the ports and marine pollution and pollution remediation by the port community.

Waste in Green Ports is governed along integrated water stewardship principles and circular waste management mechanisms promoting the reduction, reuse, recycling, and safe disposal. Such practices promote environmental protection and enhance regulatory compliance and operational efficiency.

Biodiversity and Ecosystem Protection

Ports are frequently situated in natural coastal zones, where human activities and construction can disrupt habitats, fisheries, and natural coastal systems. Loss and degradation of

biodiversity, which is not only environmentally vulnerable but also leads to potential future operational and regulatory risk for ports

Green Ports includes biodiversity into planning and management and habitat restoration-oriented nature-based environmental solutions-based environment monitoring. This framework integrates port development with long-term challenges for environmental resilience and climate adaptation.

Digitalisation and Operational Efficiency

Digitalisation is a major enabler of Green Ports which helps them to monitor port operations in real time with performance optimization supported by data-driven decision making. Digital tools help ports monitor energy consumption, emissions, shipments flow, environmental impact more efficiently. It increases transparency and the efficiency of production thereby fulfilling the environmental sustainability and competitive goals, strengthening the connection of the two.

Stakeholder Engagement and Governance

Development of Green Port is supported by robust governance mechanisms and the proactive participation of stakeholders, port authorities, terminal operators, shipping lines, regulators, communities, and financiers. Good stakeholder participation will facilitate objectives alignment, transparency and shared ownership over sustainability results. Strong governance also enables ports to align sustainability with strategic planning, investment decision-making, and performance management thereby enhancing the likelihood of sustainability beyond projects or leadership cycles

KEY FOCUS AREA FOR IMPLEMENTATION

The Green Port Guidelines of the **Harit Sagar** target the sustainable development of the port ecosystem where national Green Port performance standards have been defined. These priorities center around **minimising the emissions** associated with port activity by electrifying plant equipment and vehicles, increasing the use of renewable energy, shore-to-ship power supply to reduce vessel emissions at berth, and transitioning port crafts to cleaner propulsion systems aligned with national energy targets. Collectively, these interventions aim to reduce the carbon intensity of port activities, while promoting energy efficiency, operational reliability, and environmental performance.

Aside from driving emissions reduction, the Guidelines focus very much on **resource and environmental efficiency** improving water and wastewater management, waste handling and recycling, protection of marine and coastal ecosystems, and green cover among port areas to create biodiversity and to operate as natural carbon sink mechanisms. The main focus areas include an emphasis on energy-efficient buildings, digital optimisation of port operations, promotion of coastal shipping as a low carbon transport mode, and good management of the environment with clear performance indicators, audits, and incentive structures

Collectively, these focus areas provide a comprehensive and flexible framework for ports to adopt best practices, resilient designs, and continuous performance improvement in line with national and global sustainability objectives.

The solutions and opportunity areas contained in this table are drawn upon and aligned with the possible solutions and Key opportunities outlined in the NGSP consultative framework

Solutions	Key Opportunities
Green Corridors	• Requires coordinated efforts among governments, industry bodies, and international partners. • India can leverage its bilateral and multilateral relationships to formalize Green Corridors
Just-In-Time Arrival and Port Efficiency	• Standardization of digital solutions and harmonization of port systems will enable seamless operations • Optimizing port design and berthing schedules can reduce congestion and emissions • Digitalization of port operations and intelligent scheduling can improve turnaround times • Linking port efficiency with CII compliance can drive sustainable practices. • National strategy for JIT implementation can ensure uniformity across ports
Shore Power (Cold Ironing)	• Variations in power tariffs and tax structures across states pose challenges • India's lower shore power costs compared to Western markets offer an opportunity • A centralized policy, similar to the EV Charging Policy, can standardize shore power infrastructure • PPPs can support the integration of solar energy and carbon sinks into port infrastructure.
Greener Dredgers & Harbour Crafts	• Current efficiency regulations (e.g., EEXI) do not apply to dredgers and harbour crafts • Gaps in maintenance and energy efficiency training need to be addressed. • Hybrid diesel-electric dredgers can serve as a transitional solution. • Phasing out inefficient harbour crafts through regulatory mandates can support energy transition.
Bunkering Hubs for Alternative Fuels	• India can emerge as a major bunkering hub for alternative fuels like hydrogen and ammonia • Demand-supply assessment and regional baseline planning are required. • Financial mechanisms such as concessional finance and partial credit guarantees can de-risk investments. • Collaboration across the fuel value chain is crucial for infrastructure development

Table Solution and Key opportunities in green ports

INTERNATIONAL GREEN PORT BENCHMARKS

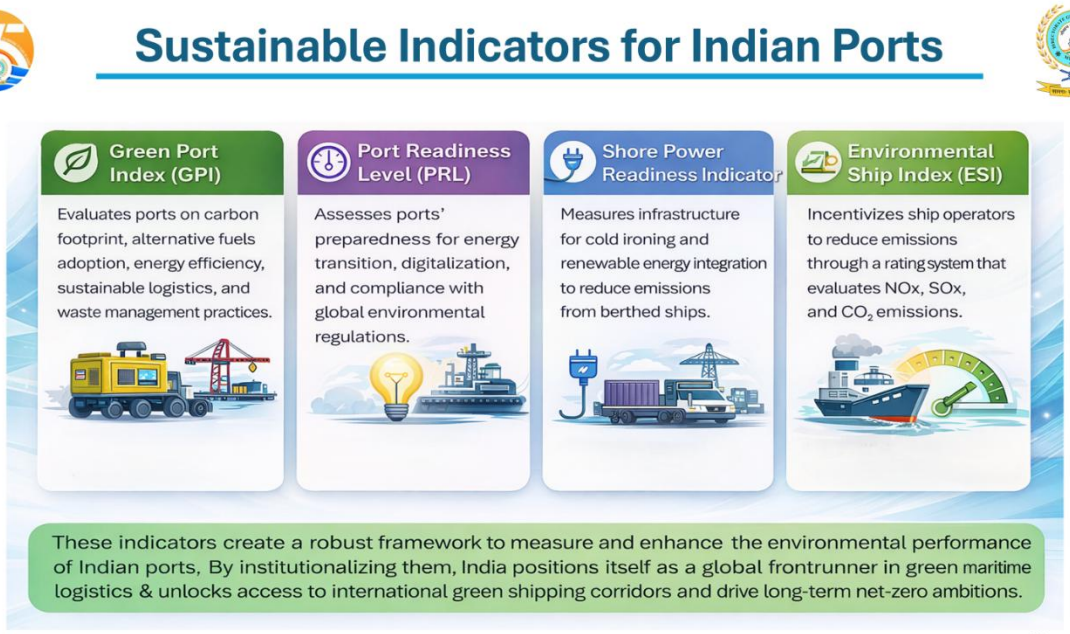
International experience shows that early-stage green port programmes succeed when they combine (i) phased delivery, (ii) credible benchmarking, and (iii) targeted incentives that reduce first-mover risk. LR's NGSP consultative work already points to the value of aligning national approaches with recognised green port benchmarking schemes (e.g., Eco Ports in Europe and Green Marine in North America), using tiered criteria, periodic verification, and public reporting to create transparency and a "race to the top".

A consistent lesson is that incentives and tariff design matter as much as technology. Early OPS/electrification roll-out is often constrained by power pricing, taxes, and grid readiness; therefore, national-level measures that harmonise the OPS policy approach and enable PPP delivery models can accelerate adoption and standardisation, while avoiding fragmented port-by-port approaches.

Green corridors are another proven accelerator because they concentrate demand, investment and collaboration across the value chain. Recent regional studies (e.g., UN ESCAP) highlight that corridors face barriers such as limited awareness and infrastructure, and stress that digitalisation enables decarbonisation through data-sharing, optimisation and port call synchronisation. In practical terms, tools that support Just-in-Time arrival and port call optimisation, together with IoT/AI-enabled monitoring and "digital twin" approaches, can unlock material efficiency gains and support scalable MRV.

Implication for India: adopt a staged "pilot → scale" pathway anchored in national enablers (standards, tariffs, finance, MRV) while using GPPI/certification to verify progress; the NGSP consultative milestones already envisage early designation of initial green ports with OPS and subsequent corridor scale-up."

Sustainable Indicators Framework for Indian Ports



As part of India's broader transition towards sustainable maritime development, a structured framework of measurable sustainability indicators is being institutionalized for Indian ports. The objective is not merely to adopt isolated environmental measures, but to establish a coherent system through which port performance can be evaluated, benchmarked and progressively improved.

The proposed framework rests on four interlinked indicators:

1. Green Port Index (GPI)

The Green Port Index serves as a comprehensive evaluation tool to assess the overall environmental performance of ports. It measures parameters such as:

- Carbon footprint and greenhouse gas emissions
- Adoption of alternative fuels
- Energy efficiency measures
- Sustainable logistics practices
- Waste management systems

The intent of GPI is to move beyond project-based interventions and bring sustainability into routine port operations. By quantifying environmental performance across multiple dimensions, ports can identify specific gaps and prioritize targeted improvements. Over time, the index will enable benchmarking across ports and support evidence-based decision-making.

2. Port Readiness Level (PRL)

The Port Readiness Level indicator evaluates the preparedness of ports for the ongoing energy transition and digital transformation.

PRL examines:

- Infrastructure readiness for alternative fuels
- Compliance alignment with evolving international environmental regulations
- Digital systems supporting operational efficiency
- Integration of sustainability into planning and governance

As global shipping moves toward low-carbon fuels and stricter environmental standards, ports must adapt accordingly. PRL provides a structured method to assess whether ports are capable of supporting next-generation vessels and future regulatory requirements. This indicator ensures that ports are not reactive, but forward-prepared.

3. Shore Power Readiness Indicator

Shore power, or cold ironing, is increasingly recognized as a critical intervention to reduce emissions from ships at berth. The Shore Power Readiness Indicator evaluates:

- Availability of onshore power supply infrastructure
- Capacity to integrate renewable energy sources
- Grid stability and connection systems
- Operational protocols for ship–shore interface

Emissions from berthed vessels contribute significantly to local air pollution. By measuring infrastructure readiness and operational capability, this indicator supports phased implementation of shore-to-ship power systems across Indian ports. It also aligns with international decarbonization pathways and improves air quality in port cities.

4. **Environmental Ship Index (ESI)**

The Environmental Ship Index focuses on incentivizing ship operators to reduce emissions. It evaluates vessels based on emissions performance, including:

- Nitrogen oxides (NOx)
- Sulphur oxides (SOx)
- Carbon dioxide (CO_2)

Ports may integrate ESI-based incentives such as differential port dues or priority berthing for higher-rated vessels. This creates a market-based mechanism encouraging cleaner ship operations and aligns port policy with vessel-level environmental performance.

Integrated Impact of the Framework

Individually, each indicator addresses a specific dimension of port sustainability. Collectively, they create a robust governance framework that integrates infrastructure, operations, compliance and incentives.

Institutionalizing these indicators will:

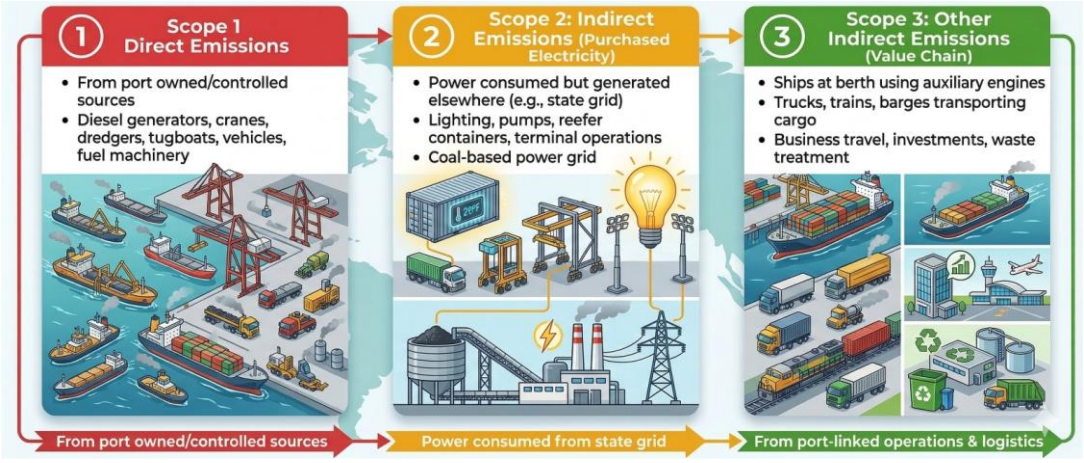
- Enable measurable tracking of environmental performance across Indian ports
- Support structured transition toward low-carbon port operations
- Strengthen India's credibility in global green maritime logistics
- Facilitate participation in international green shipping corridors
- Contribute to long-term net-zero objectives

Rather than relying solely on regulatory mandates, this framework introduces performance measurement and benchmarking into port governance. Over time, it will support standardization of sustainability practices across both major and non-major ports.

By embedding these indicators within policy and operational systems, India positions its ports not only as trade gateways, but as active enablers of the global maritime energy transition.

GHG Emission Scopes

GHG Emission Scope at Ports



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Effective decarbonisation of the port sector requires a **clear understanding of emission sources across the port ecosystem**. Ports are complex, multi-actor environments where emissions arise not only from port-owned assets but also from energy consumption and broader logistics activities.

To enable **standardised measurement, reporting and mitigation**, port emissions are classified into **three internationally recognised scopes - Scope 1, Scope 2 and Scope 3**, aligned with global frameworks such as the GHG Protocol.

This classification allows ports to transition from **fragmented emission management to a holistic, system-wide decarbonisation approach**.

Scope 1 – Direct Emissions

Scope 1 emissions refer to **direct greenhouse gas emissions from sources owned or controlled by the port authority or terminal operators**.

Key Sources

- Diesel generators
- Cargo handling equipment (cranes, RTGs, forklifts)
- Dredgers and tugboats
- Port-owned vehicles
- Fuel-based machinery within port premises

Characteristics

- Fully under **operational control of port authorities**
- Most straightforward to **measure, monitor and regulate**
- Typically dependent on fossil fuel consumption

Strategic Importance

- Represents the **starting point for decarbonisation interventions**
- Offers **immediate emission reduction opportunities**

Scope 2 – Indirect Emissions (Electricity Consumption)

Scope 2 emissions arise from **electricity purchased and consumed by port operations but generated externally**, typically from the grid.

Key Sources

- Terminal lighting systems
- Pumping operations
- Reefer container power supply
- Administrative and operational buildings
- Electrified equipment and terminal infrastructure

Characteristics

- Emissions are **indirect but energy-linked**
- Strongly influenced by **grid emission intensity**
- High contribution in regions with **coal-dominated power generation**

Strategic Importance

- Increasing relevance due to **electrification of port operations**
- Critical lever for decarbonisation through **clean energy transition**

Scope 3 – Other Indirect Emissions (Value Chain Emissions)

Scope 3 emissions encompass **all other indirect emissions occurring across the port value chain**, outside direct ownership or control of the port.

Key Sources

- Ships at berth using auxiliary engines

- Cargo transport via trucks, rail and barges
- Hinterland logistics operations
- Waste treatment and disposal
- Business travel and associated activities
- Upstream and downstream supply chain emissions

Characteristics

- **Largest and most complex emission category**
- Occurs beyond the physical boundary of the port
- Requires **multi-stakeholder coordination**

Strategic Importance

- Represents the **dominant share of total port-related emissions**
- Central to achieving **deep decarbonisation outcomes**

Integrated Understanding of Port Emissions

The three scopes together provide a **comprehensive view of emissions across the port ecosystem**:

- Scope 1 → Operational emissions within direct control
- Scope 2 → Energy-linked emissions influenced by power systems
- Scope 3 → Value chain emissions requiring collaborative action

This integrated classification enables:

- End-to-end emissions mapping
- Prioritisation of mitigation strategies
- Alignment with international reporting standards

National Port Sustainability Council (NPSC) – Proposed

India's port sector is entering a phase where sustainability can no longer be treated as a peripheral issue. With more than 200 ports, including 12 major ports, and with increasing pressure from global decarbonisation rules, ESG-linked trade expectations and the need for climate-resilient infrastructure, Indian ports require a more structured and measurable approach to sustainability. The concept note therefore proposes the creation of a **National Port Sustainability Council (NPSC)** as a central institutional mechanism to guide, monitor and standardise sustainability efforts across both major and non-major ports.

The note is built around the idea that sustainability at ports must be assessed through a defined set of indicators rather than through isolated projects. For this reason, it brings together frameworks such as **Green Port Indexing (GPI)**, **Green Port Readiness Level / Port Readiness Level (GPRL/PRL)**, **Smart Port Shore Power Index (SPSPI)**, **Environmental Ship Indexing (ESI)** and an institutionalised **GHG emissions inventory**.

Need for a National Institutional Mechanism

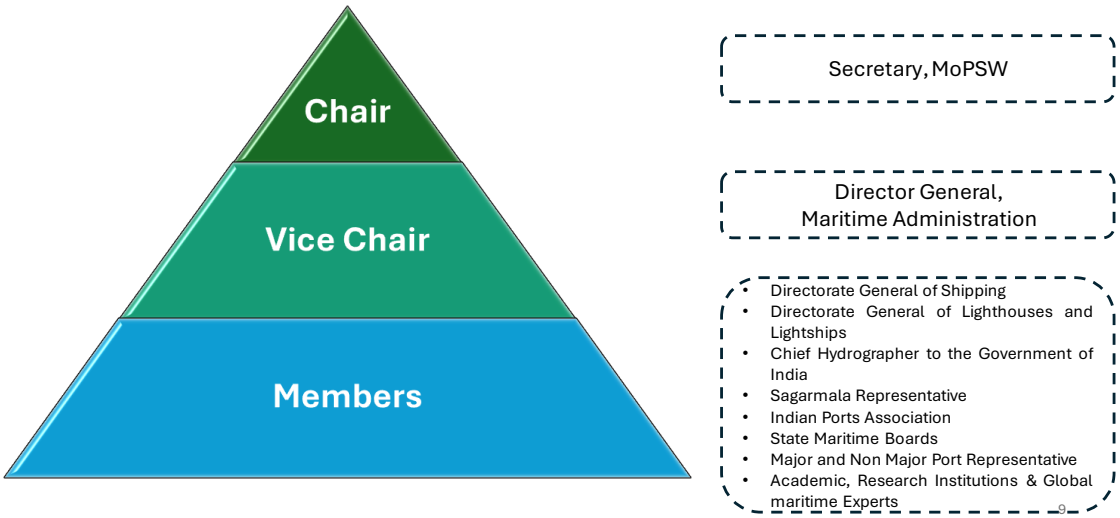
The central argument of the concept note is that India presently has policy intent, individual initiatives and broad sustainability ambitions, but does not yet have a unified national framework that can consistently assess readiness, compare port performance and link sustainability with compliance, investment and global competitiveness. The proposed NPSC is therefore conceived as an apex regulatory and advisory body under the Ministry of Ports, Shipping and Waterways to bring coherence to these efforts.

The note also places this proposal in the context of the expected transition from DG Shipping to the **Directorate General of Maritime Administration (DGMA)** under the forthcoming Merchant Shipping Bill / Maritime Services Bill framework. In the concept note, DGMA is visualised as a broader authority with responsibilities extending beyond vessel and seafarer regulation into port sustainability, alternative fuel readiness, digital governance and environmental compliance.

In practical terms, the NPSC is meant to provide national direction on issues such as emissions monitoring, electrification, alternative fuel readiness, digital port systems, green financing signals and harmonisation with global standards such as the IMO Revised GHG Strategy, EU Fit-for-55 and Maritime Vision 2030.

National Port Sustainability Council – Proposed Role

The NPSC is presented not as a symbolic committee but as a working governance structure that would monitor, evaluate and facilitate the implementation of sustainability and readiness frameworks across Indian ports. Its proposed role includes standard setting, benchmarking, compliance oversight, coordination with central and state-level bodies and support for digital platforms needed for real-time monitoring.



The proposed governing structure is chaired by the Secretary, MoPSW, with the DGMA as Vice-Chairperson. The membership is broad-based and includes the Chief Hydrographer, DGLL, DG Shipping representative, Sagarmala representative, Indian Ports Association, State Maritime Boards, port authorities, private port operators, academic institutions and global maritime experts. This reflects the note's view that port sustainability cannot be managed only through a single regulator and requires operational, technical and policy coordination.

The concept note further proposes specialised technical committees within the NPSC dealing with port safety and navigation, GHG emissions and energy transition, digitalisation and smart ports, sustainable infrastructure and policy and compliance. This is useful because it breaks down sustainability from a broad concept into operational workstreams.

Integration of Navigational Safety and Sustainability

A major point in the note is that sustainability and safety should not be treated as separate verticals. The document therefore links the modernization of the **Navigational Safety at Ports Committee (NSPC)** with the creation of the NPSC. The NSPC, constituted in 1997, has traditionally focused on navigational safety, emergency preparedness, environmental protection and compliance with conventions such as SOLAS, MARPOL and the ISPS Code.

The note argues that port safety today must evolve to include digital systems, emissions considerations, shore power, alternative fuels and climate-related resilience. For that reason, it recommends strategic integration of the NSPC within the broader NPSC framework so that safety, readiness and sustainability are assessed together. The reasons given include holistic port governance, regulatory synergy, better use of resources, stronger crisis preparedness and improvement in India's global competitiveness.

This is one of the stronger ideas in the note because it avoids creating parallel structures for safety on one side and green transition on the other. Instead, it suggests a single institutional architecture where navigation, environment, infrastructure and digital systems are viewed together.

Sustainable Indicators for Indian Ports

The note makes it clear that sustainability must be measurable. It therefore proposes a set of indicators that can be used to assess ports on environmental performance, infrastructure preparedness and operational transition. It specifically highlights GPI, PRL, SPSPI and ESI as the core tools through which Indian ports can be benchmarked and guided.

The need for such indicators is linked to several factors. First, international regulations such as IMO's carbon-related measures and the EU's Fit-for-55 package are creating real commercial pressure on ports and supply chains. Second, India's own port modernisation ambitions under Maritime Vision 2030 require ports to become low-emission and digitally integrated hubs. Third, participation in future green shipping corridors will require ports to demonstrate readiness in a structured and internationally understandable form.

The note also refers to the need for an institutionalised mechanism for port emissions assessment so that green initiatives can actually be tracked and verified rather than only announced. This includes the use of real-time digital emissions monitoring systems and formal carbon accounting tools.

Green Port Indexing (GPI)

The Green Port Index is described as a framework to evaluate the environmental performance of ports in a structured way. The document identifies the main objectives of GPI as benchmarking sustainability performance, encouraging best practices, informing policy, supporting stakeholder engagement and attracting investment into eco-friendly infrastructure.

For India, the GPI framework is linked with national environmental regulation as well as Harit Sagar-type environmental indicators. The note groups assessment into management indices, operational indices and condition indices. It also lists pollution-related parameters covering air, water, noise, effluent and waste-related metrics.

The note proposes a multi-tier institutional structure for GPI implementation. At the national level, MoPSW would provide the policy framework. The NPSC would standardise criteria and ensure regulatory alignment. The Indian Ports Association would act as an executing authority, including through annual reporting, digital emissions platforms and pilot implementation at selected ports such as JNPT, Chennai and Visakhapatnam.

The key assessment parameters proposed for Indian ports under GPI include carbon footprint and GHG emissions, renewable energy and electrification, sustainable cargo handling and logistics, waste management and marine pollution control, and digitalisation / smart port initiatives.

Green Port Readiness Level (GPRL / PRL)

The note draws on the IAPH's Port Readiness Level approach to assess how prepared ports are for the energy transition, digitalisation and future regulatory requirements. The readiness assessment is built across dimensions such as alternative fuel readiness, shore power integration, digital and smart port systems, regulatory compliance and net-zero infrastructure transition.

The readiness levels range from basic recognition of sustainability needs at lower levels to global sustainability leadership at the highest level, where ports are fully digitalised and effectively carbon-neutral. The note also mentions global examples such as Rotterdam, Singapore, Los Angeles and Hamburg as leading references.

For Indian application, the note proposes a National Port Readiness Framework supported by MoPSW, with the NPSC acting as the regulatory body and IPA as the executing authority. It recommends annual readiness reports, digital dashboards and pilot implementation at ports such as JNPT, Chennai and Deendayal. Assessment dimensions for India include decarbonisation and alternative fuels, digitalisation and smart readiness, regulatory compliance, net-zero infrastructure readiness and sustainable cargo and logistics efficiency.

Smart Port Shore Power Index (SPSPI)

The concept note gives separate importance to shore power through the proposed Smart Port Shore Power Index. This is significant because emissions from berthed ships are increasingly becoming a major focus in global port decarbonisation. The SPSPI is intended to assess port readiness for shore-to-ship power, renewable energy integration, smart grid preparedness, regulatory compliance and economic viability.

The note goes a step further by proposing a certification framework for ships that use shore power at Indian ports. Under this proposal, calibrated metering, auditable data systems, grid-based emission factor calculations and digital access to certificates would allow vessels to demonstrate verified emission reductions. The note also suggests that such certification could support reduced port charges and potential carbon credit eligibility.

Institutionally, the SPSPI framework again follows a multi-tier model: MoPSW for national policy, NPSC for regulatory standards and IPA for dashboards, rankings and capacity building. Pilot ports suggested include JNPT, Chennai and Deendayal.

Environmental Ship Indexing (ESI)

The note includes the Environmental Ship Index as a way to align ship-side environmental performance with port-side incentives. It describes ESI as a voluntary global system developed by IAPH that scores ships on emissions performance, fuel efficiency, shore power compatibility and alternative fuel adoption.

The relevance for India lies in using ESI to support greener shipping practices at Indian ports by linking incentives such as reduced port dues or priority treatment to better-performing vessels. The note also sees ESI as complementary to mandatory IMO measures such as CII, EEXI and SEEMP, thereby allowing ports to use one framework for incentive design while remaining aligned with international regulatory systems.

This is an important idea because it shifts the role of ports from passive infrastructure providers to active participants in shaping cleaner fleet behaviour.

GHG Emissions Inventory

One of the strongest and most practical portions of the note is its emphasis on creating a formal GHG emissions inventory for Indian ports. The document argues that without a structured inventory of energy users and emission sources, it is not possible to understand the baseline, identify hotspots or build cost-effective reduction strategies.

The note recommends a centralised institutional mechanism for emissions monitoring, reporting and mitigation. Suggested elements include emission inventories, air quality monitoring systems, use of emission factors, carbon accounting software, eco-efficiency indicators, ISO 14001-based environmental management systems and third-party audits. It also refers to international best practices such as AI-based monitoring and real-time reporting using IoT and blockchain.

The value of this part of the note is that it moves from a broad sustainability narrative to the actual systems needed for measurement, reporting and verification.

Harit Sagar – Green Port Guidelines

The **"Harit Sagar" Green Port Guidelines**, issued by the Ministry of Ports, Shipping and Waterways in May 2023, provide the broad framework for Major Ports in India to reduce carbon intensity and move towards environmentally sustainable port development and operations. The guidelines were circulated through an Office Memorandum dated 11 May 2023 for further action by all Major Ports.

The document has been positioned as a practical guidance framework for ports to prepare action plans, adopt green technologies, reduce wastage and monitor measurable outcomes over defined timelines. It is also linked to the broader national context of **COP-26 commitments**, **Panchamrit targets**, **Maritime India Vision 2030**, and India's long-term objective of reaching **net zero by 2070**. The introductory section of the guidelines clearly states that ports are expected to contribute to de-carbonisation by reducing carbon emissions per ton of cargo handled and by promoting a sustainable ecosystem around port operations.

Vision of the Guidelines

The central vision of the document is to reduce carbon intensity and develop an environment-friendly ecosystem at Major Ports through participation of all stakeholders, including terminal operators, logistics service providers, partner government agencies and shipping lines. The broader intent is to position Major Ports not just as cargo gateways, but as sustainable hubs of economic growth and development. This is to be achieved through optimization of procedures, adoption of green technologies, reduction of wastages and measurable decarbonisation benchmarks. The vision statement is set out explicitly in the guideline document and is also highlighted visually on the vision page.

Policy Context and Importance

The guidelines derive importance from three connected policy drivers.

First, the maritime sector has a major role in national trade. The guidelines note that the sector accounts for **95 percent of trade by volume and 65 percent by value**, which means that any sustainability transition in ports has a large impact on the economy as a whole. Second, India's climate commitments require a reduction in emission intensity and increased use of non-fossil energy sources by 2030. Third, ports are recognized as critical points where energy use, vessel interface, cargo handling, water use, waste generation and local environmental impacts converge.

The document therefore treats ports as a major lever for achieving environmental goals, rather than only as operational infrastructure. It also makes it clear that the purpose is not limited to carbon accounting alone; the framework covers air, water, waste, noise, ecology, resource efficiency and reporting.

Principles Underlying Harit Sagar

The guidelines are based on a set of broad principles that shape the rest of the document. These include ensuring environmental, economic and social sustainability in port development, adopting environmentally compatible designs, promoting clean and green energy, minimizing carbon and other harmful emissions through the **Eliminate, Reduce and Control (ERC)** approach, minimizing waste through the **5R concept**, conducting appropriate environmental impact assessments and strengthening continuous monitoring and reporting. The document also emphasizes the concept of **"Working with Nature"**, linking port development with ecosystem sensitivity rather than only engineering expansion.

This is important because the guidelines are not drafted as a narrow engineering manual. They are framed as a management and governance instrument that asks ports to integrate sustainability into planning, operation, maintenance and reporting.

Applicability

The guidelines are explicitly applicable to **all Major Ports of India**. At the same time, the message from the Secretary in the front portion of the document indicates that the framework could also be recommended to State Governments and State Maritime Boards for adoption in ports other than Major Ports. This shows that while the legal applicability is limited to Major Ports at present, the document is intended to serve as a broader model for the wider port sector.

Focus Areas for Implementation

The main strength of the Harit Sagar document is that it converts the sustainability agenda into concrete implementation areas.

Green Cover

Ports are required to increase green area cover in order to capture fugitive emissions, attenuate noise and support biodiversity. The target is to increase green belt area to **more than 20 percent by 2030** and **33 percent by 2047** of port area. The document links this not only to visual

greening but also to soil moisture retention, erosion control, groundwater recharge and carbon sink creation.

Electrification of Port Equipment and Vehicles

Ports are asked to move progressively towards electrification of vehicles and equipment, targeting **more than 50 percent electrification by 2030** and **more than 90 percent by 2047**. Existing diesel-powered equipment is to be retrofitted or converted in a phased manner and future procurement is expected to favour electric systems or compatibility with greener fuels such as methanol, ethanol, ammonia, hydrogen fuel cell and CNG.

Port Crafts

The guidelines extend beyond landside equipment and also cover port crafts such as tugs, pilot boats, mooring boats and survey boats. Ports are expected to prepare action plans for retrofitting these with cleaner propulsion technologies and for creating infrastructure under the National Green Hydrogen Mission. The document specifically states that **green ammonia bunkers and refuelling facilities are to be established at all Major Ports by 2035**.

Renewable Energy

Renewable energy is one of the most explicit targets in the guidelines. Ports are expected to ensure that the share of renewable energy exceeds **60 percent by 2030** and **90 percent by 2047**. The guidelines also provide for **at least one LNG bunkering station by 2030** and adequate EV charging stations in port campuses or nearby areas by 2025. In addition, select ports are expected to support offshore wind energy development. The document specifically mentions V.O. Chidambaranar Port as a pilot port for offshore wind-linked activity.

Shore to Ship Power Supply

All ports are required to develop infrastructure for shore power in a phased manner, beginning with port crafts, then extending to Coast Guard / Navy / small coastal vessels and finally to EXIM vessels. The phased timelines given are **2023, 2024 and 2025** respectively. This is significant because it shows that the guidelines were not only aspirational but provided a sequence for implementation.

Resource Utilisation

The guidelines address water efficiency in a fairly detailed way. Ports are required to increase treatment capacity, use treated water, reduce fresh water consumption per ton of cargo by **more than 20 percent by 2030**, and achieve **100 percent recycle and reuse of consumed water**. The document also encourages installation of STPs, rainwater harvesting, desalination plants and even utilisation of condensed water from LNG terminal chilling plants.

Energy-Efficient Equipment and Green Buildings

Ports are directed to use energy-efficient equipment and materials such as LED smart lighting and highly rated appliances, reduce energy consumption per ton of cargo by **more than 20 percent by 2030**, and adopt green building concepts for all new buildings. The document also

encourages use of digital systems such as Sagar Setu, NLP-Marine, EBS and RFID to improve efficiency and thereby reduce carbon footprint.

Promotion of Coastal Shipping

The guidelines recognise coastal shipping as a cost-effective and energy-efficient alternative mode of transport and ask ports to facilitate it through infrastructure and viable mechanisms. This reflects an important systems-level view: decarbonisation is not only about what happens inside the port boundary, but also about improving cargo movement choices.

Effluent, Marine Ecosystem and Waste Management

The document includes explicit directions regarding effluent discharge, monitoring of waste from ships under MARPOL, prohibition of wastewater and bilge discharge into port waters, declaration of waste by ships, protection of mangroves and shore ecosystems, oil spill preparedness under NOS-DCP, ballast water management and shore reception facilities. These provisions show that the guidelines treat sustainability as wider than only carbon reduction.

Environmental Management and Incentives

Each port is expected to have approved Environment Management Guidelines, an Environment Management Plan and a dedicated Environment Cell. Independent annual environmental audits are required and the audit reports are to be uploaded on the port website before **30 April every year**. The guidelines also encourage ports to earn carbon credits and introduce green incentives for ships, private craft operators, concessionaires, truck operators and other port users adopting cleaner fuels or shore power-compatible systems. They further direct ports to incorporate green and sustainability aspects into DPRs and PPP projects.

Methodology for Implementation and Compliance

The Harit Sagar document is notable because it does not stop at listing areas of intervention. It also prescribes a method for implementation.

All ports are required to prepare an action plan within **two months** of launch of the guidelines, in reference to the listed Environment Performance Indicators. Ports are expected to establish real-time **Continuous Ambient Air Quality Monitoring Stations (CAAQMS)**, **Continuous Marine Water Quality Monitoring Stations (CMWQMS)** and **Online Continuous Effluent Monitoring Systems (OCEMS)**, all linked to digital dashboards and to the MoPSW server / portal / Sagarmanthan dashboard for real-time monitoring and feedback. Different timelines are prescribed depending on the type of port operations.

The guidelines further provide that until these real-time systems are installed, regular reports should be prepared by independent environment auditors and uploaded annually on port websites. In addition, all ports are required to undertake a **baseline study using FY 2022–23 as the base year** within three months, including GHG emissions, carbon footprint and annual emissions of pollutants from all relevant port-related sources such as vessels, harbour crafts, cargo handling equipment and trucks.

This makes the document more implementation-oriented than many broad policy guidelines, because it links targets with baseline data and monitoring architecture.

Environmental Performance Indicators and Targets

The annexures are one of the most useful parts of the document because they convert broad sustainability language into measurable parameters.

Legal Compliance Framework

Annexure-A lists applicable laws relating to air, noise, DG set noise, water, hazardous waste, e-waste, solid waste, biomedical waste, plastic waste, battery waste, construction and demolition waste, and environmental clearance. This makes clear that Harit Sagar is not a standalone framework outside the legal system, but is intended to operate in conjunction with existing environmental law and regulatory rules.

Environmental Performance Indicators

Annexure-B lists indicators for air, water, noise and effluent. These include parameters such as SO_2, NO_2, PM10, PM2.5, ozone, lead, ammonia, benzene, arsenic, mercury, dissolved oxygen, BOD, COD, turbidity, salinity, noise levels and effluent discharge parameters. Annexure-C provides a reporting format for waste management across hazardous waste, e-waste, solid waste, plastic waste, battery waste, construction and demolition waste and biomedical waste.

Sustainability Targets

Annexure-D sets out specific sustainability targets. These include:

- Renewable energy share at ports: **more than 60 percent by 2030** and **more than 90 percent by 2047**
- Electrified port equipment / vehicles: **more than 50 percent by 2030** and **more than 90 percent by 2047**
- Area under green belt: **more than 20 percent by 2030** and **more than 33 percent by 2047**
- Reduction in CO_2 emission per ton of cargo: **more than 30 percent by 2030** and **more than 70 percent by 2047**
- Reduction in GHG emissions in coastal / EXIM vessels: **more than 10 percent by 2030** and **more than 50 percent by 2047**
- Reduction in fresh water consumption per ton of cargo: **more than 20 percent by 2030**
- Recycle and reuse of consumed water: **more than 100 percent by 2030**
- Reduction in energy consumption per ton of cargo: **more than 20 percent by 2030**
- One LNG bunkering station: **by 2030**
- Green hydrogen / ammonia bunkering and refuelling facilities: **by 2035**

- Adequate number of EV charging stations: **by 2025**.

These annexed targets are perhaps the most important operational takeaway from the document because they provide benchmarks that ports can actually monitor and report.

Reporting, Review and Recognition

The guidelines also stress reporting and communication. Ports are encouraged to adopt the **Green Reporting Initiative (GRI)** as a global standard for communicating accountability with regard to impacts on environment, economy and people. The Ministry also reserves the power to interpret, clarify and relax provisions in public interest and may amend the guidelines from time to time.

An important provision is that the Ministry will recognize and award the **best three green performing ports of the year** based on evaluation criteria. This gives the guidelines a performance-based character rather than merely a compliance-based one.

Green Tug Transition Program (GTTP)

Harbour tugs play a critical role in port operations, particularly in berthing, unberthing and ship-assist functions. However, these vessels are typically powered by diesel engines and operate continuously within port limits, making them a concentrated source of greenhouse gas (GHG) emissions as well as local air pollutants such as NOx, SOx and particulate matter.

With increasing emphasis on maritime decarbonisation under national and global commitments, port-based emissions have emerged as a priority area for intervention. In this context, the Government of India has introduced the **Green Tug Transition Program (GTTP)** as a focused initiative to transition harbour tug fleets towards cleaner and low-emission alternatives.

The program forms part of the broader sustainability agenda under maritime sector reforms and aligns with national frameworks such as Maritime India Vision 2030 and Maritime Amrit Kaal Vision 2047.

The GTTP is designed to facilitate the phased replacement of conventional diesel-powered harbour tugs with environmentally sustainable alternatives using zero-emission or low-emission technologies.

The program envisages a structured transition pathway, supported by standardized design specifications, phased implementation and institutional oversight.

As per the official launch, Phase 1 of the program will be implemented from **October 2024 to December 2027**, with an estimated investment of approximately **INR 1000 crore** for development and deployment of green tugs .

Implementation Framework

Phase 1 (2024–2027)

The initial phase focuses on early adoption and demonstration across select major ports. The following four ports have been identified:

- Jawaharlal Nehru Port Authority (JNPA)
- Deendayal Port Authority (DPA)
- Paradip Port Authority
- V.O. Chidambaranar Port Authority

Each port is expected to procure or charter a minimum of two green tugs, based on standardized designs developed by the **Standing Specification Committee (SSC)** .

The first set of tugs will primarily be **battery-electric**, with provision for adoption of other emerging propulsion technologies such as hybrid systems, methanol and green hydrogen as technology maturity improves.

Technology Approach

The GTTP adopts a **technology-neutral but future-ready approach**, enabling ports to adopt suitable propulsion systems based on operational requirements and infrastructure readiness.

Key technology pathways include:

- Battery-electric propulsion for short-duration harbour operations
- Hybrid propulsion combining battery and fuel-based systems
- Alternative fuels such as methanol and green hydrogen
- Provision for retrofitting and modular upgrades as technologies evolve

This approach ensures flexibility while maintaining alignment with long-term decarbonisation objectives.

Standardization and Compliance

A key feature of the GTTP is the development of **Approved Standard Tug Designs and Specifications (ASTDS)** to ensure:

- Uniformity in design and performance benchmarks
- Safety and operational reliability
- Ease of procurement and scalability
- Alignment with environmental performance standards

Further, it has been envisaged that:

- By **2033**, all new tugs built for Indian ports will be required to comply with GTTP standards
- By **2040**, all tugs operating in major ports are targeted to transition to green alternatives

Strategic Alignment

The GTTP is closely aligned with national maritime and climate objectives:

Maritime India Vision 2030 (MIV 2030)

- Target of **30% reduction in carbon emissions per ton of cargo**
- Increased adoption of renewable energy across ports

Maritime Amrit Kaal Vision 2047

- Long-term decarbonisation of port operations
- Reduction in emissions from port-owned vessels

The transition of harbour tugs represents a **high-impact, low-complexity intervention**, as these vessels operate within controlled port environments and are well-suited for electrification and alternative fuels.

Industrial and Economic Impact

The GTTP is also positioned as an industrial development initiative:

- All tugs under the program are to be constructed in Indian shipyards under the **Make in India** initiative
- Expected to generate demand in shipbuilding, design and marine engineering sectors
- Creation of employment across manufacturing and ancillary industries
- Development of domestic capabilities in green vessel technologies

Environmental Significance

The transition to green tugs is expected to deliver measurable environmental benefits:

- Reduction in direct (Scope 1) emissions from port-owned vessels
- Improvement in air quality in port cities
- Contribution towards national GHG reduction commitments

- Demonstration effect for wider adoption of green technologies in maritime sector

Given the high utilisation rates of harbour tugs, even limited fleet replacement can result in **disproportionately high emission reductions**.

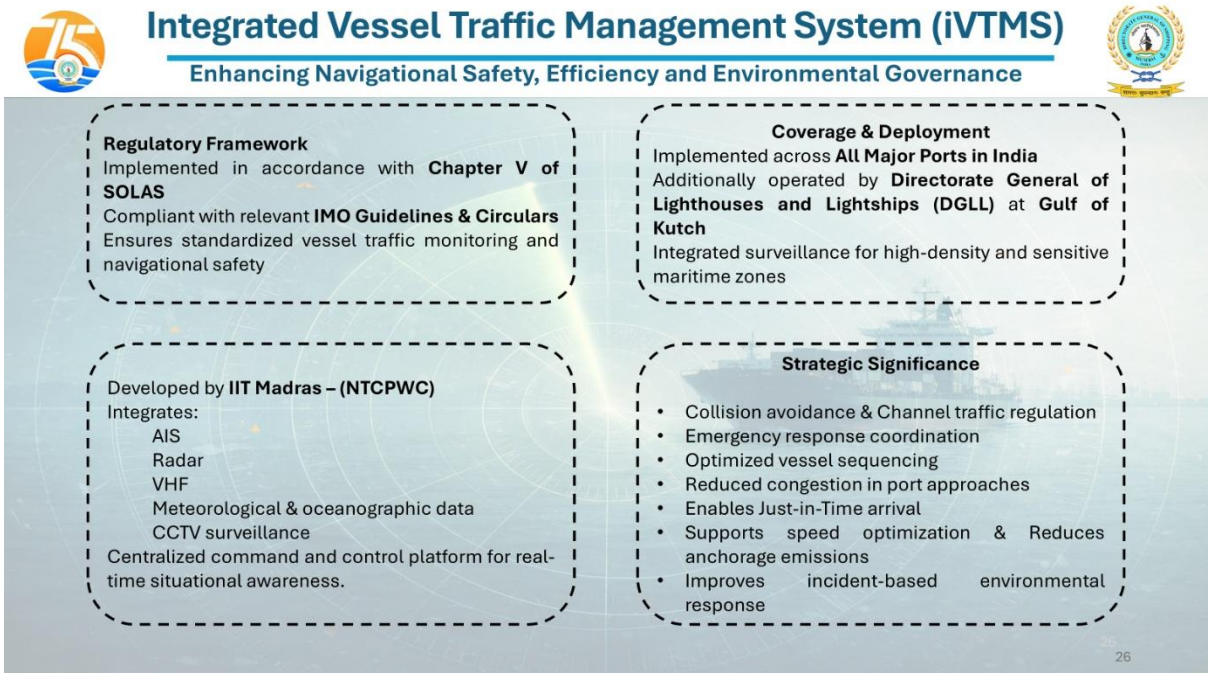
Key Challenges and Considerations

While the program is well structured, certain implementation challenges need to be addressed:

- High upfront capital cost of green technologies
- Charging or fuel infrastructure readiness at ports
- Technology maturity, particularly for hydrogen-based systems
- Operational reliability and lifecycle performance
- Need for capacity building among port operators and crew

Addressing these will be critical for scaling beyond the initial phase.

Integrated Vessel Traffic Management System (iVTMS)



The Integrated Vessel Traffic Management System (iVTMS) has been implemented in accordance with Chapter V of the International Convention for the Safety of Life at Sea (SOLAS), which deals with safety of navigation. The system aligns with relevant IMO guidelines and circulars governing vessel traffic services and navigational safety standards.

The primary objective of iVTMS is to ensure standardized vessel traffic monitoring in high-density maritime areas, port approaches and sensitive coastal zones. By institutionalising real-time surveillance and control mechanisms, the system strengthens India's compliance posture under international maritime safety obligations.

The regulatory basis of iVTMS ensures that its deployment is not discretionary or project-based, but anchored within an established global maritime safety framework.

Coverage and Deployment

iVTMS has been implemented across all Major Ports in India, creating a uniform navigational safety architecture across the country's principal maritime gateways.

In addition, the Directorate General of Lighthouses and Lightships (DGLL) operates iVTMS in the Gulf of Kutch region, one of India's most sensitive and high-density maritime corridors. This region handles significant volumes of crude oil traffic and large tankers, requiring enhanced surveillance and traffic coordination.

The system therefore provides integrated monitoring in both port-specific and broader coastal maritime zones. This layered deployment enhances oversight in congested approaches, narrow channels and environmentally sensitive areas.

System Architecture and Technical Integration

iVTMS is a centrally integrated command-and-control platform developed by IIT Madras through the National Technology Centre for Ports, Waterways and Coasts (NTCPWC).

The system integrates multiple real-time data sources, including:

- Automatic Identification System (AIS)
- Radar surveillance
- VHF communication channels
- Meteorological and oceanographic inputs
- CCTV-based visual monitoring

These inputs are consolidated into a unified operational dashboard, enabling maritime authorities to maintain real-time situational awareness.

The integration of navigational, meteorological and communication systems into a single interface significantly reduces response time during abnormal situations and improves traffic sequencing efficiency.

Operational Significance

The operational value of iVTMS extends beyond passive vessel tracking.

It enables:

- Collision avoidance through proactive traffic regulation
- Structured channel traffic management in constrained waterways
- Coordinated emergency response in case of mechanical failure, grounding or collision
- Optimised vessel sequencing to reduce waiting time
- Congestion management in port approaches

By providing predictive and real-time visibility of vessel movements, iVTMS reduces uncertainty in navigation and enhances overall maritime safety.

Environmental Governance Dimension

While iVTMS is primarily a navigational safety system, its environmental implications are equally significant.

First, optimized vessel sequencing reduces unnecessary anchorage time. Prolonged anchorage leads to continuous operation of auxiliary engines, resulting in avoidable emissions. By enabling Just-in-Time (JIT) arrival practices, iVTMS contributes indirectly to emission reduction.

Second, traffic regulation supports speed optimization. Controlled speed adjustments during approach reduce fuel consumption and associated GHG emissions.

Third, in the event of maritime incidents such as oil spills or collisions, real-time surveillance supports rapid response coordination, thereby limiting environmental damage.

In this manner, iVTMS serves as both a safety and environmental governance tool.

Strategic Importance for India

India's maritime traffic density is increasing, with rising cargo volumes, crude imports and containerized trade. As port capacity expands, navigational complexity correspondingly increases.

iVTMS provides the digital backbone required to manage this complexity. It enhances India's credibility as a safe maritime destination and aligns with global best practices in vessel traffic services.

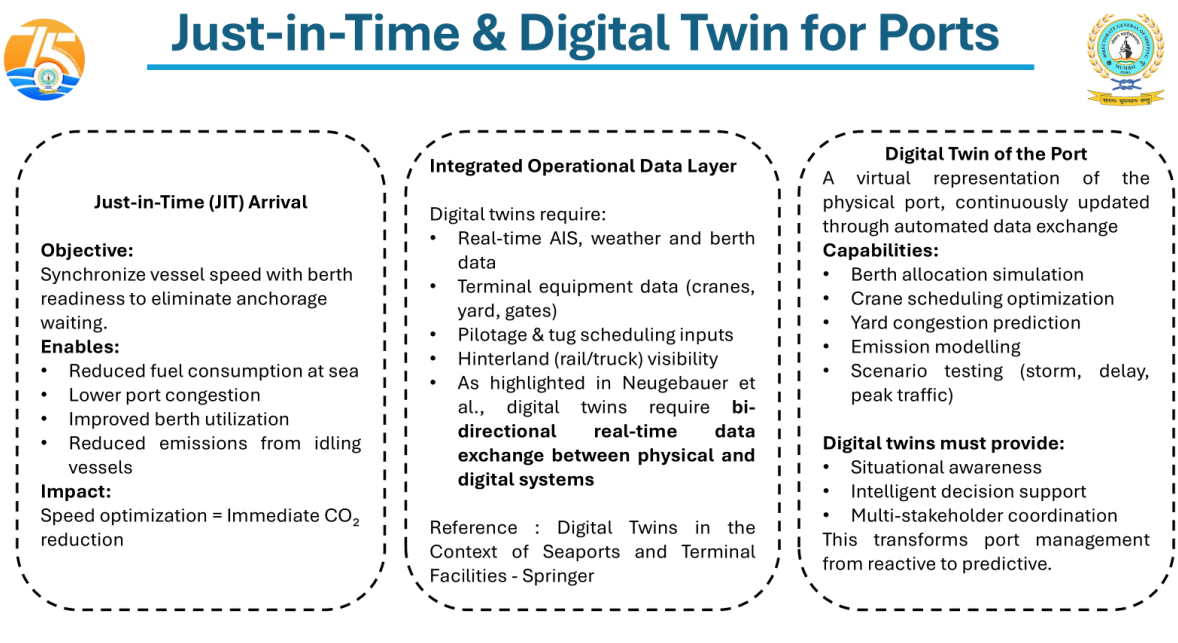
Furthermore, integration of iVTMS with future digital initiatives such as digital twins, Just-in-Time arrival systems and port community platforms can create a seamless operational ecosystem.

In the long term, iVTMS strengthens three core pillars:

- Navigational Safety
- Operational Efficiency
- Environmental Responsiveness

It therefore represents a foundational infrastructure element in India's broader maritime modernization strategy.

Just-in-Time Arrival and Digital Twin for Ports



Just-in-Time (JIT) Vessel Arrival – Eliminating Anchorage Inefficiencies

One of the persistent inefficiencies in port operations globally is excessive anchorage waiting. Vessels often arrive at port approaches ahead of berth availability and remain at anchor with auxiliary engines running, leading to avoidable fuel consumption, congestion and emissions.

The Just-in-Time (JIT) arrival framework seeks to address this structural inefficiency by synchronizing vessel speed with real-time berth readiness.

Objective

The core objective of JIT is to align vessel arrival with confirmed berth availability so that ships can reduce speed during voyage and avoid idle waiting at anchorage.

Operational Principle

Instead of vessels rushing to port and waiting, dynamic scheduling information is shared in advance. Based on real-time berth status, crane availability, pilotage inputs and channel conditions, vessels adjust speed to arrive precisely when required.

Benefits

- Reduced fuel consumption at sea through speed optimization
- Lower congestion in port approaches
- Improved berth utilization
- Elimination or reduction of emissions from idling vessels at anchorage

Speed optimization has an immediate impact on carbon dioxide emissions. Even modest reductions in sailing speed can produce measurable emission savings due to the non-linear relationship between speed and fuel consumption.

JIT is therefore not merely an operational improvement — it is a decarbonization intervention embedded in voyage planning.

Digital Twin Architecture for Ports

JIT cannot function effectively without an integrated digital data environment. This is where the Digital Twin concept becomes foundational.

A Digital Twin of a port is a dynamic virtual representation of the physical port ecosystem, continuously updated through automated real-time data exchange.

Integrated Operational Data Layer

For a Digital Twin to function effectively, it must integrate multiple real-time inputs:

- AIS vessel tracking data
- Weather and oceanographic conditions
- Berth occupancy status
- Terminal equipment data including cranes and yard operations
- Pilotage and tug scheduling inputs
- Hinterland connectivity visibility (rail and truck flows)

The system must enable bi-directional real-time data exchange between physical infrastructure and digital platforms. It is not merely a visualization tool but a decision-support architecture.

Capabilities of a Port Digital Twin

When fully functional, a Digital Twin can enable:

- Simulation of berth allocation scenarios
- Crane and yard scheduling optimization
- Congestion prediction in yard and gate operations
- Emission modelling under different traffic scenarios
- Scenario testing for weather disruptions, peak traffic or operational delays

This shifts port management from reactive intervention to predictive planning.

Governance Implication

A well-designed Digital Twin supports:

- Situational awareness
- Intelligent decision support
- Multi-stakeholder coordination across port authority, terminal operators, pilots and shipping lines

It creates a unified operational picture, reducing information asymmetry between stakeholders.

Digital Twin Pilot – VOCPA Tuticorin

Digital Twin at VOCPA Tuticorin

Prestigious Digital Twin System commissioned in record 6 months

Cost: ₹24.62 Crore

Executed by: IPRCL

Inaugurated by Hon'ble Minister of MoPSW Shri Sarbananda Sonowal (23 Feb 2026)

Salient Features

Complete 3D Port Visualization

The entire port ecosystem is displayed in real-time 3D on a holographic table, enabling intuitive and immersive operational oversight.

Integrated CCTV Surveillance (~400 Cameras)

Nearly 400 CCTV cameras are mapped to their exact physical locations, allowing centralized and location-specific monitoring of port activities.

VTMS Integration – Real-Time Vessel Intelligence

The Vessel Traffic Management System is fully integrated. With a single click on a vessel image, movement details and cargo information are instantly accessible.

Integrated Weather Monitoring

Live weather systems are embedded into the platform, enabling proactive monitoring of rainfall, cyclones and other atmospheric disturbances.

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The Digital Twin initiative at VO Chidambaranar Port Authority (VOCPA), Tuticorin represents India's first structured implementation of this next-generation port management architecture.

The project was executed in record time and commissioned within six months at an approximate cost of ₹24.62 crore. It was executed by IPRCL and inaugurated by the Hon'ble Minister of Ports, Shipping and Waterways on 23 February 2026.

Key Features of the VOCPA Digital Twin

1. Complete 3D Port Visualization

The entire port ecosystem is rendered in real-time 3D format through an interactive visualization platform. This enables immersive and intuitive operational monitoring across berths, yards and channel approaches.

This visualization capability is not cosmetic; it enhances comprehension of spatial relationships between vessel movements, equipment positions and yard occupancy.

2. Integrated CCTV Surveillance (~400 Cameras)

Nearly 400 CCTV cameras across the port are mapped to their exact physical coordinates within the digital environment. This allows location-specific monitoring and centralised oversight of activities.

Operators can transition from a macro port view to micro-level surveillance instantly.

3. VTMS Integration – Real-Time Vessel Intelligence

The Vessel Traffic Management System is fully integrated with the digital twin. Vessel movement details, cargo status and navigational information are accessible through a single operational interface.

This integration strengthens navigational oversight and supports synchronized berth planning.

4. Integrated Weather Monitoring

Live weather systems are embedded within the platform, enabling proactive monitoring of rainfall, cyclonic activity and atmospheric disturbances.

This capability supports early-warning based decision-making and improves resilience against extreme weather events.

Strategic Significance of the VOCPA Pilot

The VOCPA Digital Twin is not an isolated technology demonstration. It establishes a proof-of-concept for:

- JIT-enabled berth synchronization
- Data-driven emission reduction
- Predictive congestion management
- Integrated maritime safety and environmental governance

By linking vessel traffic intelligence, equipment data and weather inputs into a unified platform, the pilot demonstrates how digital infrastructure can directly support operational efficiency and decarbonisation objectives.

The next logical step would involve scaling such platforms across major ports, integrating them with JIT frameworks and aligning them with Green Port Index parameters.

Shore-to-Ship Power (SPS) – Decarbonising Emissions at Berth

Shore-to-Ship Power (SPS), also referred to as cold ironing or Onshore Power Supply (OPS), involves supplying electricity from the shore grid to a vessel while it is berthed at port. During this period, the ship's auxiliary engines and diesel generators are switched off, thereby eliminating onboard fuel combustion for hoteling loads.

Under conventional operations, even when ships are stationary at berth, auxiliary engines continue to run to support lighting, ventilation, refrigeration, cargo operations and other onboard systems. These engines consume marine fuel and emit carbon dioxide (CO_2), nitrogen oxides (NOx), sulphur oxides (SOx) and particulate matter (PM), contributing to localized air pollution within port areas.

SPS replaces this combustion-based generation with shore-based electricity, significantly reducing emissions at berth.

Environmental and Regulatory Significance

The introduction of SPS directly addresses one of the most visible sources of port-area emissions — emissions from berthed vessels.

Its environmental impact includes:

- Reduction in CO_2 emissions during hoteling period
- Elimination of NOx and SOx emissions at berth
- Significant reduction in particulate matter in port zones

- Improvement in ambient air quality in port-adjacent urban areas

From a regulatory standpoint, SPS contributes to:

- Compliance alignment with IMO's Carbon Intensity Indicator (CII) framework
- Support to GHG reduction commitments
- Strengthening of Green Port Index parameters
- Enhancement of ESG metrics for Indian ports

As global shipping transitions toward decarbonisation, ports that provide SPS infrastructure become more attractive to environmentally compliant ship operators.

Strategic Importance for Indian Ports

For India, SPS has three distinct strategic implications:

First, it improves local air quality. Many Indian ports are located near dense urban populations. Reduction of emissions at berth has direct public health benefits.

Second, it strengthens India's positioning in green shipping corridors. Several international green corridor initiatives now incorporate shore power as a baseline infrastructure requirement.

Third, it enhances competitiveness. As shipping lines increasingly report Scope 1 and Scope 3 emissions, availability of SPS allows vessel operators to reduce emissions during port calls, improving their sustainability performance.

SPS therefore shifts ports from being passive infrastructure providers to active contributors in maritime decarbonisation.

Implementation Status in Indian Ports

- **Kamarajar Port** has implemented 500 kW, 400V, 50–60 Hz SPS systems at Coal Berths 1 and 2.
- **VO Chidambaranar Port** has installed 305 kW, 400V, 60 Hz systems at VOC Berths 2 and 3.
- **Jawaharlal Nehru Port Authority (JNPA)** has deployed SPS for tug operations and has planned full-scale deployment across all terminals with an estimated 45 MVA capacity and projected investment of approximately INR 600 crore.
- **Paradip Port** has recently commissioned SPS facilities and delivered full load power to vessels at CB1 berth.

These early deployments indicate proof-of-concept and operational viability. However, large-scale adoption across cargo terminals will require capacity augmentation, grid integration and financial structuring.

Technical and Infrastructure Considerations

Implementation of SPS requires careful technical planning:

- Grid capacity and substation upgrades
- Frequency compatibility (50/60 Hz considerations)
- High-voltage connection systems for large container and cruise vessels
- Cable management systems and automated connection interfaces
- Safety interlocks and harmonised standards for ship–shore interface

Vessels must also be SPS-ready, meaning onboard electrical systems must be configured for shore connection. Therefore, adoption requires coordination between ports, ship operators and classification societies.

Financial Structuring and Investment Models

SPS infrastructure involves significant capital expenditure, especially for high-capacity berths. To scale deployment, diversified financing models may be required.

Possible approaches include:

- **Blended finance models**, combining government support, multilateral development banks and private investment.
- **Green or blue bonds**, specifically earmarked for shore power and decarbonisation infrastructure.
- **Public–Private Partnership (PPP) models**, where terminal operators co-invest in SPS infrastructure.

Given the long asset life and public-good environmental benefits, concessional finance mechanisms may improve viability.

Challenges and Way Forward

While SPS offers clear environmental benefits, certain practical challenges remain:

- High upfront capital costs
- Tariff competitiveness versus onboard fuel generation
- Standardisation across vessel categories
- Grid stability and renewable energy integration

To address these challenges, a phased expansion approach may be adopted:

1. Prioritisation of high-traffic container and cruise terminals.
2. Integration with renewable energy sources to maximize decarbonisation benefit.

3. Development of uniform national technical standards.
4. Incentivization mechanisms for vessels that utilise SPS.

Long-term viability will depend on coordinated policy support, tariff rationalisation and integration within broader port decarbonisation strategies.

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:

1. Integration of green fuel competencies within national maritime training frameworks.
2. Structured collaboration between DGS, training institutes and industry stakeholders.
3. Development of standardized certification pathways for alternative fuel operations.
4. Incorporation of Just Transition principles within national green shipping policy frameworks.

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

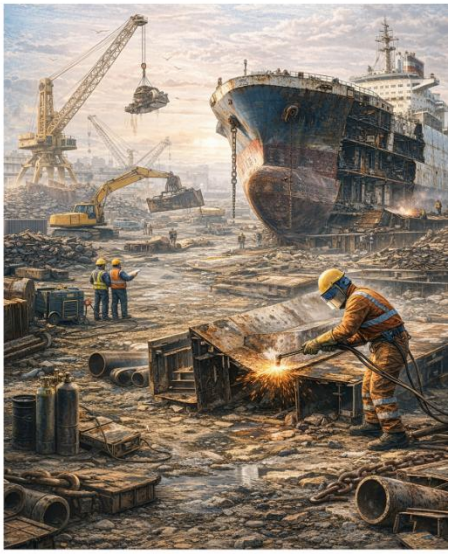
Ship Recycling

Ship Recycling

- Process of dismantling end-of-life ships to recover **steel and other valuable materials**.
- India is a **global leader**, with Alang–Sosiya in Gujarat being the **world's largest ship recycling cluster**.
- Governed internationally by the **Hong Kong Convention (HKC)**, which came into force on **26 June 2025**.
- Integral to the **circular economy**, reducing the demand for virgin raw materials.

India's Role & Importance

- Handles **30% - 35% of global ship recycling tonnage** annually.
- Provides **20 - 25% of India's ferrous scrap requirement**, reducing dependence on imports.
- India is the **only country with 100+ HKC Compliant Recycling Yards. [115 HKC Compliant Yards at Alang]**
- Supplies input material for the **Green Steel ecosystem**, boosting India's low-carbon transition.
- Generates **direct employment for 15000+ workers** and **indirect livelihood opportunities** for thousands more in logistics, scrap processing, and allied services.
- Strengthens India's position in **global maritime sustainability.**



Ship recycling forms the terminal stage of a vessel's operational life and has historically been treated as a downstream industrial activity. However, in the present regulatory and sustainability environment, it has evolved into a strategically important maritime segment with implications for industrial policy, environmental governance and international compliance.

Ships typically operate for 25 to 30 years. At the end of this lifecycle, dismantling must be carried out in a manner that ensures safe handling of hazardous materials, recovery of recyclable components and minimal environmental impact. A modern ocean-going vessel contains large quantities of high-grade steel along with non-ferrous metals, machinery, electrical systems and reusable equipment. When dismantled under controlled conditions, a significant proportion of this material re-enters the industrial supply chain.

The global regulatory framework governing this activity changed materially with the entry into force of the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships on 26 June 2025 .

Post-HKC, ship recycling is no longer a loosely regulated industrial activity; it is now a structured compliance-based system requiring lifecycle documentation, certification and facility authorisation.

India has aligned its domestic legal framework accordingly through the Recycling of Ships Act, 2019 and related Rules, positioning itself as an early mover in the post-HKC regime.

India's Leadership

India today occupies a central position in global ship recycling. The Alang–Sosiya ship recycling cluster in Bhavnagar, Gujarat is the largest such cluster in the world .

Current status of the Alang cluster:

- 150 total plots
- 128 operational plots
- 115 HKC compliant yards

The fact that 115 yards are HKC compliant is significant. It reflects not only infrastructure upgradation but a conscious regulatory transition over the past decade. No other recycling nation currently has over 100 HKC compliant facilities concentrated in a single cluster .

In volume terms, India handles approximately 30–35% of global ship recycling tonnage annually

At the national level, the sector supplies around 20–25% of India's ferrous scrap requirement Given India's steel production expansion targets, this contribution is strategically relevant.

The sector provides direct employment to more than 15,000 workers and sustains a broader ecosystem involving logistics operators, re-rolling mills, scrap traders and ancillary service providers .

India's leadership is therefore based on scale, regulatory alignment and economic integration.

Strategic Importance

Ship recycling intersects with India's priorities in steel production, maritime manufacturing and sustainability commitments.

First, it strengthens domestic scrap availability. Scrap-based steel production is less energy intensive compared to primary steelmaking and reduces dependence on iron ore extraction and coal usage. In the context of decarbonisation and resource efficiency, this is important.

Second, it supports maritime industrial integration. The introduction of the Ship Recycling Credit Note under SBFA 2.0 has created a policy linkage between dismantling and new shipbuilding . This ensures that economic value generated from recycling remains within the domestic maritime ecosystem.

Third, post-HKC, shipowners assess recycling destinations on compliance credentials. India's compliance depth strengthens its credibility and reduces the risk of business diversion to alternative jurisdictions.

Hong Kong Convention (HKC)

The Hong Kong Convention establishes binding obligations for both ships and recycling facilities.

For ships:

- New ships are required to comply from 26 June 2025.
- Existing ships must comply by 26 June 2030 .

Ships proceeding for recycling after 26 June 2025 must carry:

- A valid Inventory of Hazardous Materials (IHM).
- Updated IHM Parts II and III.
- A ship-specific Recycling Plan.
- An International Ready for Recycling Certificate (valid for three months) .

For recycling facilities:

- An approved Ship Recycling Facility Plan is mandatory.
- Authorisation by the competent authority is required.
- A valid Document of Authorisation for Ship Recycling (DASR) must be held .

India's Recycling of Ships Act, 2019 operationalises these requirements domestically, ensuring harmonisation between international obligations and national enforcement.

Compliance and Risk

In the current regime, compliance gaps carry both regulatory and commercial consequences.

Improper handling of hazardous materials such as asbestos, PCBs, oils or sludge can result in environmental contamination and worker safety incidents. Documentation deficiencies in IHM or recycling plans can undermine international confidence.

Reputational risk is particularly relevant in the post-HKC environment, where shipowners and flag administrations are expected to exercise due diligence in selecting recycling destinations.

India's approach has therefore emphasised:

- Yard infrastructure upgradation.
- Adoption of internationally recognised management systems.
- Structured inspection and oversight.
- Progressive digitalisation of compliance processes.

The objective is to institutionalise compliance rather than rely solely on periodic enforcement.

Inventory of Hazardous Materials (IHM)

The IHM framework is central to safe and environmentally sound recycling.

The IHM consists of three parts:

- Part I – Hazardous materials present in ship structure and equipment.

- Part II – Operational wastes.
- Part III – Stores.

Ships must maintain a valid IHM certificate, generally with a five-year validity . Prior to recycling, Parts II and III must be completed and verified.

The IHM enables:

- Identification of hazardous substances.
- Planning of removal and segregation.
- Safe disposal pathways.
- Worker safety during dismantling.

In practical terms, effective IHM governance reduces uncertainty at the yard stage and supports structured dismantling.

ISO Standards

A significant number of Indian recycling facilities operate under ISO-based management systems , including:

- ISO 9001 – Quality Management.
- ISO 14001 – Environmental Management.
- ISO 30000 – Ship Recycling Management.
- ISO 45001 – Occupational Health and Safety.

These systems formalise documentation control, environmental monitoring, safety audits and corrective action mechanisms. ISO certification strengthens process discipline and enhances international credibility.

Ferrous Scrap Development Fund (FSDF)

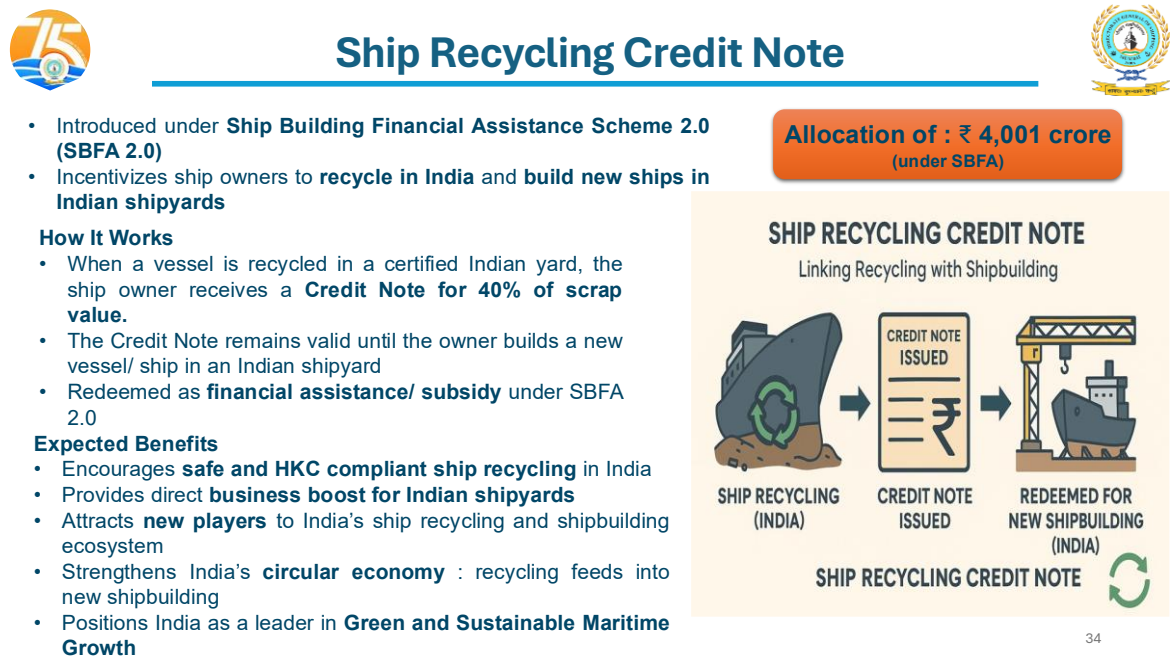
The Ferrous Scrap Development Fund supports systemic improvements in the recycling ecosystem

The Fund is utilised for:

- Yard infrastructure improvements.
- Effluent treatment and hazardous waste management systems.
- Worker housing and welfare facilities.
- Skill development and training initiatives.
- Research and consultancy inputs.

The objective is to ensure that compliance and safety improvements are capital-backed and sustainable.

Ship Recycling Credit Note



The **Ship Recycling Credit Note (SRCN)** is a strategic financial incentive mechanism introduced under the **Shipbuilding Financial Assistance Scheme (SBFAS) 2.0** to promote a **circular maritime economy in India**.

It aims to **link ship recycling with shipbuilding**, incentivising ship owners to:

- Recycle vessels in India (HKC-compliant yards)
- Reinvest in new shipbuilding within Indian shipyards

This initiative strengthens India's position as a **global hub for sustainable ship recycling and domestic shipbuilding**.

Policy Objective

The SRCN mechanism is designed to:

- Promote **safe and environmentally sound ship recycling** in India
- Encourage **domestic shipbuilding demand**
- Create a **closed-loop maritime ecosystem (Recycle → Build → Operate)**
- Support India's commitments under the **Hong Kong Convention (HKC)**
- Enhance **circular economy linkages (steel reuse and resource efficiency)**

Key Features of the Scheme

Credit Value

- Ship owner receives a **Credit Note equivalent to 40% of Fair Scrap Value (FSV)**
- FSV determined based on notified **price per LDT (quarterly basis)**

Validity

- Credit Note valid for **3 years from date of scrapping completion**

Redemption Limit

- Redeemable amount is the **lower of**:
    - Credit Note value
    - **5% of Fair Price of new vessel**

Mode of Benefit

- Redeemed as **financial assistance/subsidy**
- Paid directly to **Indian shipyard constructing the vessel**

Eligibility Criteria

Vessel Eligibility

- Indian or foreign-flagged vessels
- Must be scrapped in **India**
- Recycling yard must be:
    - **HKC-compliant**
    - Certified by recognised organisations / State Maritime Boards

Regulatory Conditions

- Permission for recycling issued **on or after 24 September 2025**
- Mandatory:
    - Certificate of Recycling / Demolition Completion
    - Approval from State Maritime Board / State Government

Operational Mechanism

Step 1: Recycling

- Vessel scrapped in certified Indian recycling yard

Step 2: Application

- Ship owner applies via **designated online portal**
- Submission within **3 months of scrapping completion**

Step 3: Verification

- Competent Authority verifies:
    - Vessel details
    - Scrapping proof
    - Compliance documentation

Step 4: Credit Note Issuance

- Digital SRCN issued with:
    - Unique serial number
    - Credit value
    - Validity period
    - Vessel details

Step 5: Redemption

- Used for:
    - New vessel construction in Indian shipyard
- Redemption allowed:
    - After vessel launch
    - Before final subsidy tranche is released

Flexibility & Market Features

Transferability

- SRCN can be:
    - **Sold or transferred** to another entity
- Executed through:
    - Online portal
    - Legally documented transfer agreement
- Pricing:
    - **Market-driven**

Stacking Mechanism

- Multiple SRCNs can be combined
- Applicable to:
    - Single vessel
    - Series shipbuilding orders
- Subject to:
    - **5% cap on vessel value**

Partial Utilisation

- Unused balance remains valid within original timeline

Risk & Compliance Safeguards

- Mandatory:
    - Digital tracking via portal
    - Documentation verification
- Security:
    - Redemption backed by **security instruments**
- In case of:
    - Cancellation → refund with **9% interest**
    - Non-utilisation → expiry after 3 years
- Ensures:
    - Transparency
    - Accountability
    - Financial discipline

Financial Outlay

- Allocated under SBFAS: **₹ 4,001 crore**

This allocation supports both:

- Shipbuilding incentives
- Ship recycling-linked credit mechanism

Strategic Impact

For Ship Recycling Sector

- Boosts demand for **HKC-compliant recycling yards (Alang ecosystem)**
- Encourages **formalisation and compliance**

For Shipbuilding Sector

- Generates **direct order pipeline**
- Improves utilisation of Indian shipyards

For Maritime Economy

- Strengthens **circular economy (steel reuse → shipbuilding)**
- Reduces dependency on imports
- Enhances domestic value creation

For Global Positioning

- Positions India as:
    - **Leader in sustainable ship recycling**
    - Emerging hub for **green shipbuilding ecosystem**

Key Challenges

- Awareness among global ship owners
- Price competitiveness vs international yards
- Efficient digital implementation and tracking
- Alignment with financing and leasing ecosystem

Green Steel

Green Steel is defined as steel with emission intensity below 2.2 tonnes of CO_2 per tonne of finished steel

Scrap-based steel production significantly reduces resource consumption. For every tonne of scrap steel used:

- 1,370 kg of iron ore is conserved.
- 780 kg of coal is saved.
- 270 kg of limestone is saved

Ship recycling therefore directly contributes to resource conservation and emissions reduction objectives.

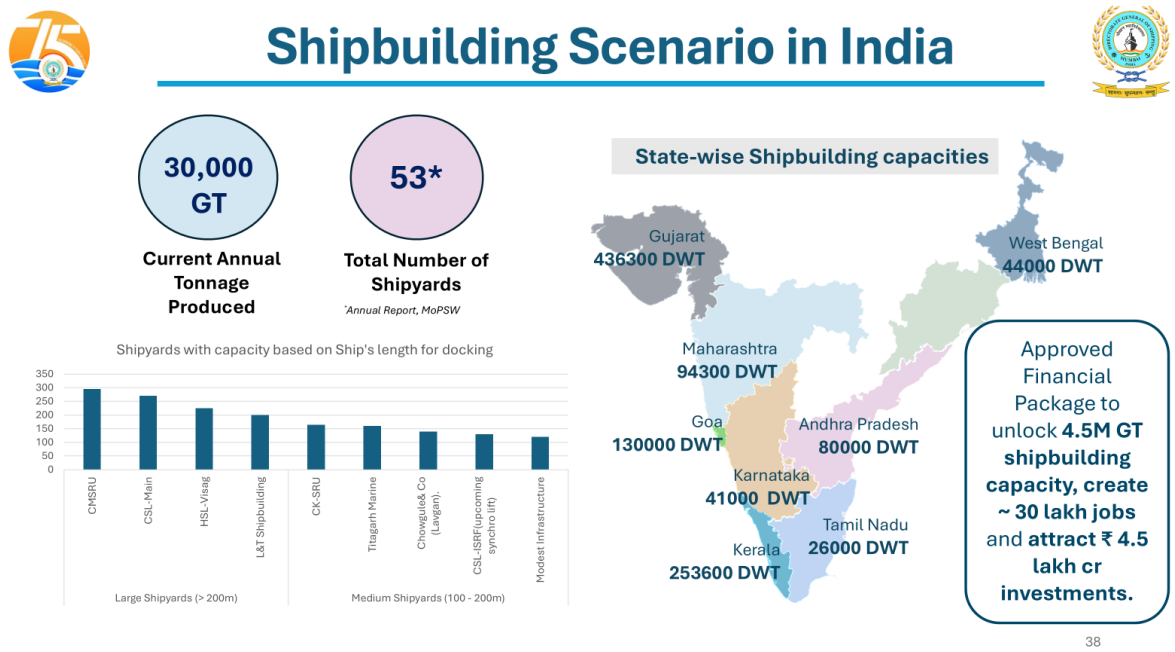
Circular Economy Linkage

India's ship recycling model now reflects a structured circular framework:

- Ships are dismantled in HKC-compliant yards.
- Scrap is channelled into domestic steel production.
- The Credit Note incentivises new vessel construction in India.
- Fleet renewal supports technological modernisation.
- FSDF reinvests in safety and infrastructure.
- Digital governance improves transparency and oversight.

The emphasis going forward will be on maintaining documentation integrity, strengthening digital systems and ensuring that worker safety and environmental safeguards remain embedded in operations.

Ship Building Sector

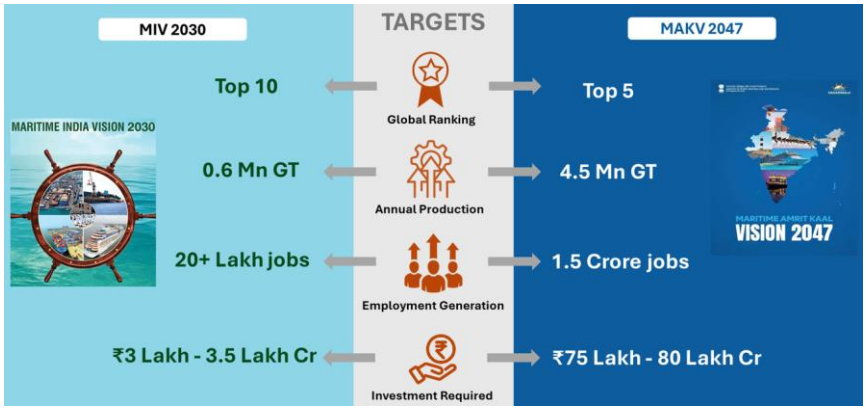


Shipbuilding is a strategic pillar of India's maritime and industrial ecosystem, with far-reaching implications for economic growth, national security, and self-reliance. As a mother industry for heavy engineering, shipbuilding drives demand across steel, machinery, electricals, design, and advanced manufacturing, creating strong industrial linkages. It is a major generator of direct and indirect employment, supporting a wide spectrum of skilled and semi-skilled jobs.

From a strategic perspective, shipbuilding enables the creation of critical maritime assets required for trade, energy security, defence, and coastal connectivity. With India's growing dependence on energy imports and rising seaborne trade, strengthening domestic shipbuilding capacity is essential to reduce reliance on foreign-built vessels, curb foreign exchange outflow, and enhance control over national tonnage. Recognising these imperatives, shipbuilding forms a core focus area under the Shipbuilding Pillar, aimed at building resilient, competitive, and globally integrated shipbuilding capabilities in India.

National Vision for Shipbuilding: From MIV 2030 to MAKV 2047

India's national vision for shipbuilding is anchored in a long-term, phased transformation of the sector, aligned with the objectives of **Maritime India Vision (MIV) 2030** and **Maritime Amrit Kaal Vision (MAKV) 2047**. This vision recognises shipbuilding as a strategic industry critical to economic growth, industrial deepening, employment generation, and maritime self-reliance. The approach envisages a calibrated scale-up of capacity, capability, and global competitiveness over the next two decades.



Under **MIV 2030**, India aims to emerge among the **top 10 shipbuilding nations globally**, with an annual shipbuilding production capacity of approximately **0.6 million gross tonnage (GT)**. This phase focuses on laying strong foundations through targeted policy support, development of shipbuilding and ship repair clusters, modernisation of existing shipyards, and creation of a robust domestic supply chain for key inputs such as steel, marine equipment, and design services. A significant emphasis is placed on skill development, technology adoption, and improving ease of doing business to attract both domestic and global players. By 2030, the sector is expected to generate **over 20 lakh direct and indirect jobs**, reflecting its high employment multiplier across manufacturing, logistics, and ancillary industries. The estimated investment requirement during this phase is in the range of **₹3 lakh to ₹3.5 lakh crore**, largely driven by infrastructure creation, technology upgradation, and capacity expansion.

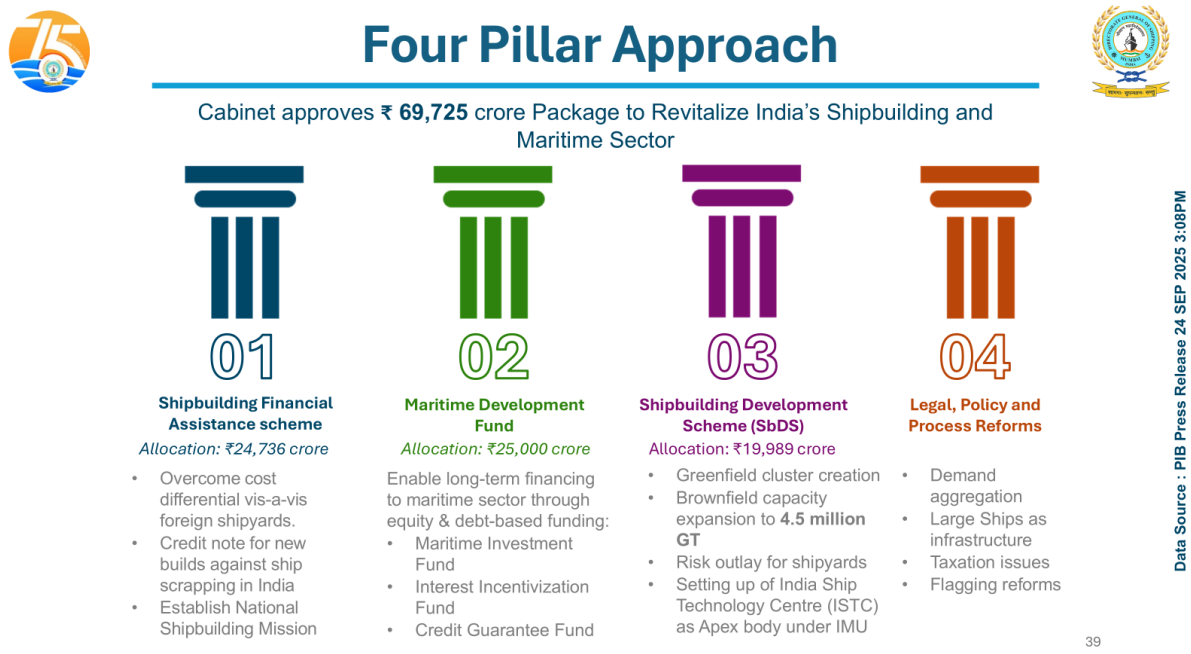
Building on these foundations, **MAKV 2047** presents a bold and aspirational roadmap aligned with India's centenary of independence. The vision targets positioning India among the **top 5 global shipbuilding nations**, with a quantum leap in annual production capacity to about **4.5 million GT**. This phase envisages India becoming a global hub for construction of large, technologically advanced vessels, including container ships, tankers, gas carriers, cruise vessels, and specialised ships. The sector is expected to support employment generation of nearly **1.5 crore jobs**, reflecting the maturation of domestic manufacturing ecosystems, advanced engineering capabilities, and export-oriented growth. Achieving this scale will require substantial investments estimated at **₹75 lakh to ₹80 lakh crore**, driven by mega shipbuilding clusters, advanced dry docks, automation, green ship technologies, and integrated industrial townships around shipbuilding hubs.

Together, MIV 2030 and MAKV 2047 articulate a clear, outcome-oriented national vision that transitions India from a modest shipbuilding presence to a globally competitive maritime manufacturing powerhouse. This vision underscores the strategic importance of coordinated policy action, Centre–State collaboration, private sector participation, and sustained investment to unlock India's full shipbuilding potential.

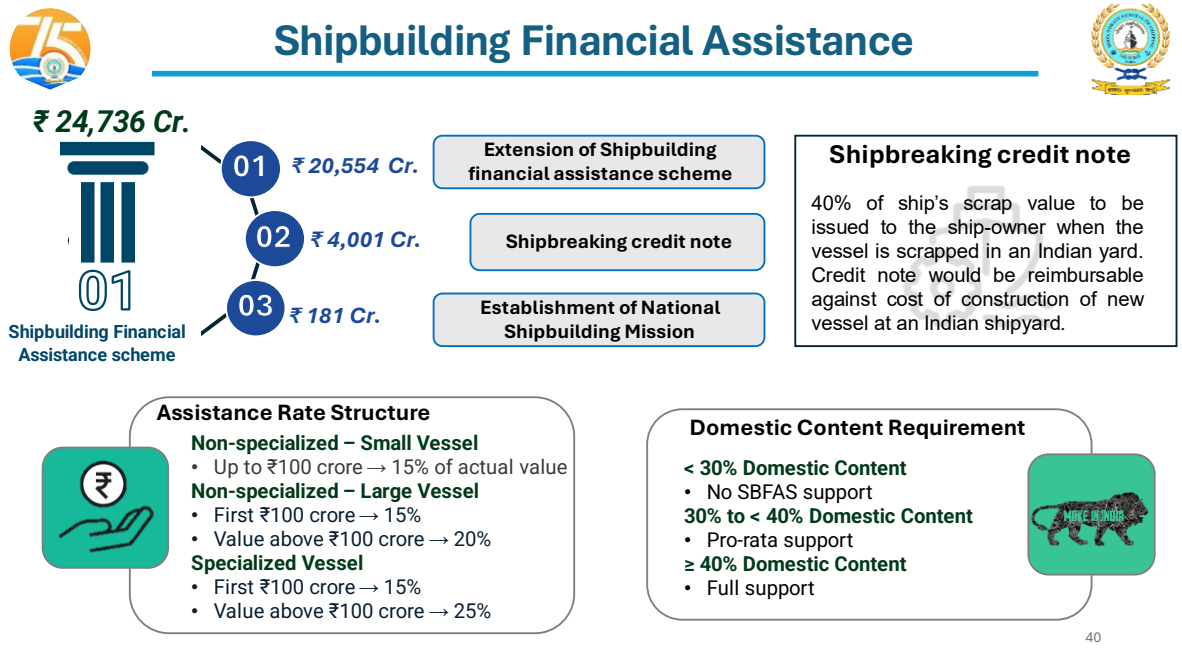
Four Pillar Approach for Strengthening India's Shipbuilding Ecosystem

To achieve the ambitious national targets set out under Maritime India Vision 2030 and Maritime Amrit Kaal Vision 2047, the Government of India has adopted a **Four Pillar**

Approach for holistic development of the shipbuilding and ship repair sector. This approach recognises that shipbuilding is a capital-intensive, long-gestation industry requiring coordinated financial support, institutional mechanisms, capacity augmentation, and regulatory reforms. Accordingly, a total allocation of **₹69,725 crore** has been earmarked to support the sector through four mutually reinforcing pillars.



Pillar I: Shipbuilding Financial Assistance Scheme (Allocation: ₹24,736 crore)

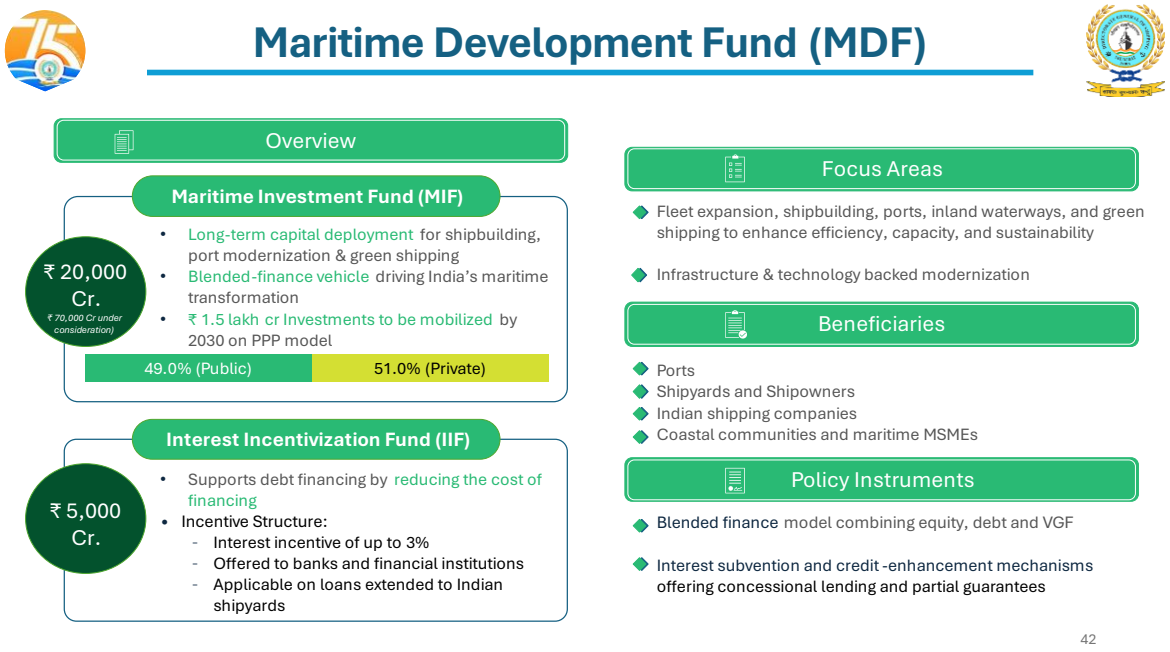


The Shipbuilding Financial Assistance (SFA) Scheme is designed to enhance the global competitiveness of Indian shipyards by addressing cost disadvantages vis-à-vis leading international shipbuilding nations. The scheme provides direct financial support to shipyards

for the construction of vessels, thereby reducing the effective cost of production and encouraging domestic as well as export-oriented shipbuilding.

A key component under this pillar is the **Shipbreaking Credit Note** mechanism, with an allocation of **₹4,001 crore**, which incentivises environmentally compliant ship recycling and links shipbreaking activity with new ship construction. This creates a circular economy within the maritime sector, promotes sustainable practices, and supports domestic yards through credit offsets. Overall, Pillar I plays a critical role in stimulating demand, improving order books of Indian shipyards, and attracting private investment into the sector.

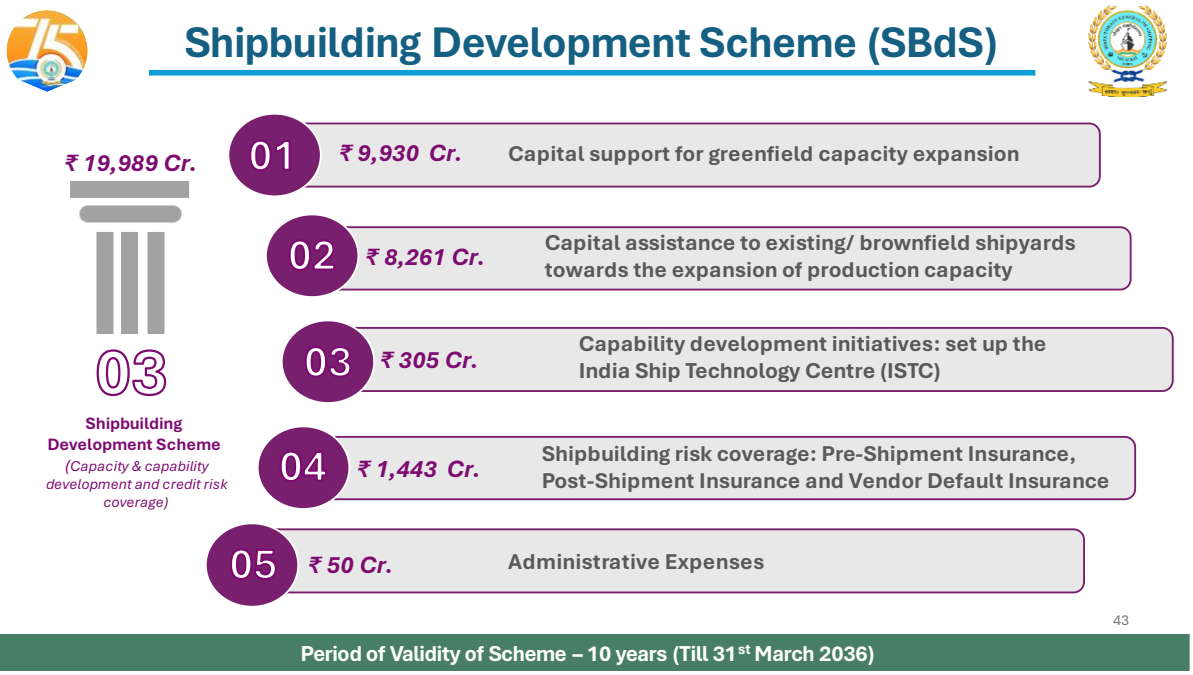
Pillar II: Maritime Development Fund (Allocation: ₹25,000 crore)



The Maritime Development Fund (MDF) addresses one of the most persistent challenges faced by the shipbuilding industry—**access to affordable and long-term finance**. Under this pillar, a dedicated **Maritime Investment Fund of ₹20,000 crore** has been envisaged to catalyse investments in shipbuilding, ship repair, ports, and allied maritime infrastructure.

In addition, an **Interest Incentivisation Fund of ₹5,000 crore** has been provided to reduce borrowing costs for shipyards and maritime enterprises. By lowering financial risk and improving credit availability, this pillar aims to crowd in private capital, encourage large-scale infrastructure creation, and support technology-intensive investments such as automation, advanced dry docks, and green ship technologies. Pillar II thus strengthens the financial backbone of the maritime sector and ensures sustained investment momentum.

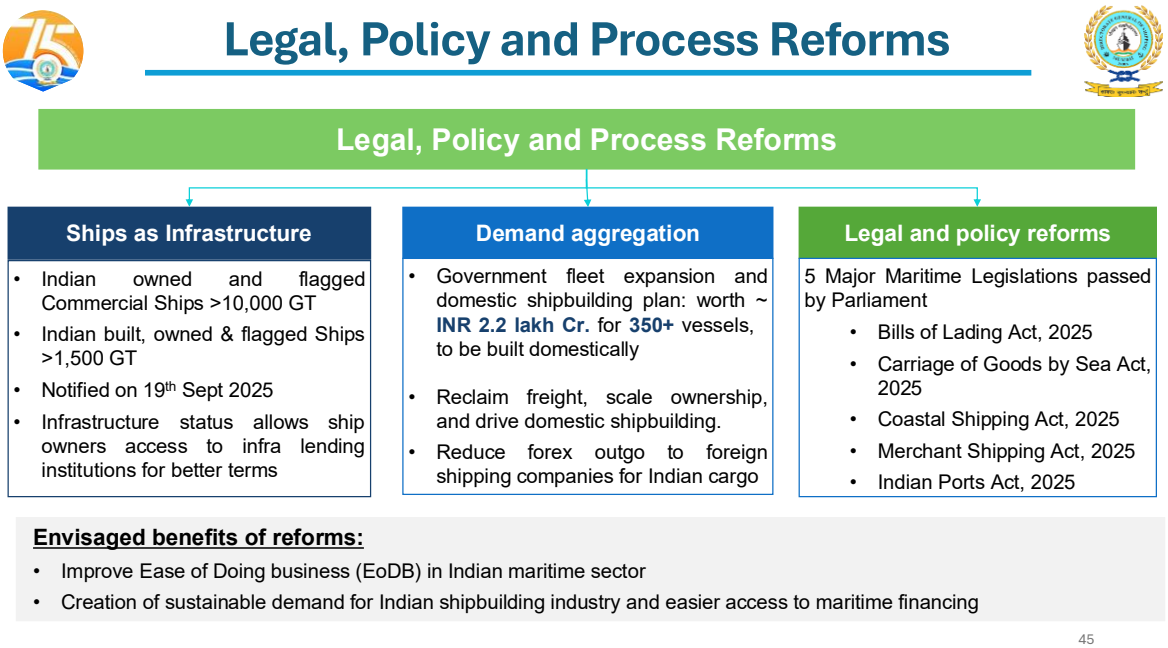
Pillar III: Shipbuilding Development Scheme (Allocation: ₹19,989 crore)



Pillar III focuses on **capacity and capability development** across the shipbuilding value chain. This includes support for the creation of **mega shipbuilding clusters**, modernisation and expansion of existing shipyards, development of common infrastructure, and enhancement of ancillary and supplier ecosystems.

A significant emphasis is placed on **credit risk coverage mechanisms**, which reduce lender exposure and enable shipyards to undertake large and complex vessel construction projects. This pillar also supports technology upgradation, skill development, and adoption of global best practices in design, production, and quality assurance. By addressing structural and operational gaps, Pillar III aims to transform Indian shipyards into globally competitive facilities capable of building large, sophisticated vessels.

Pillar IV: Legal, Policy and Process Reforms



The fourth pillar underpins the entire framework by focusing on **systemic reforms** required to improve ease of doing business and long-term sectoral sustainability. This includes streamlining approval processes, simplifying contracting and procurement norms, harmonising regulatory frameworks, and aligning policies across central and state governments.

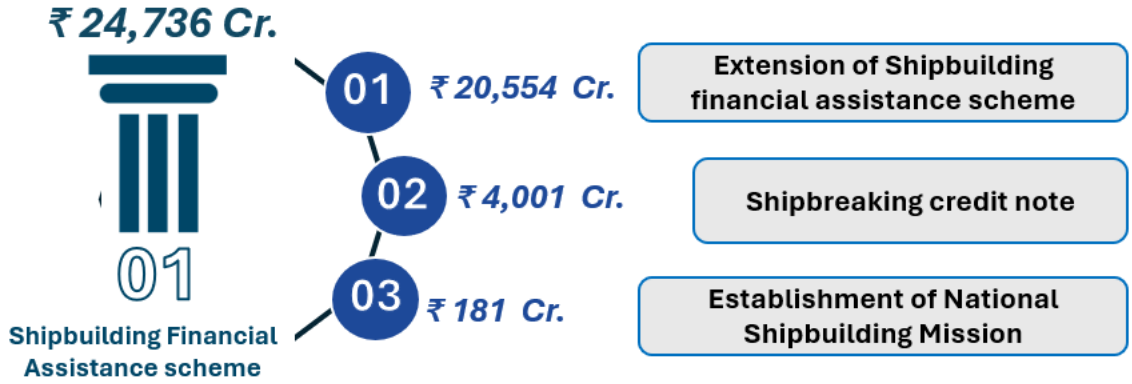
Pillar IV also emphasises rationalisation of taxation, standardisation of contracts, dispute resolution mechanisms, and greater clarity in land acquisition and environmental clearances. These reforms are essential to reduce project delays, improve investor confidence, and ensure efficient implementation of shipbuilding projects. By creating a predictable and transparent policy environment, this pillar enables the effective functioning of the financial and developmental instruments introduced under the other pillars.

Integrated Impact of the Four Pillars

Together, the Four Pillar Approach provides a comprehensive and balanced framework that addresses financial viability, institutional support, physical capacity creation, and regulatory efficiency. The integrated design ensures that short-term demand stimulation is complemented by long-term structural reforms, positioning India to emerge as a globally competitive shipbuilding hub while advancing the national objectives of *Atmanirbhar Bharat*, employment generation, and maritime self-reliance.

Shipbuilding Financial Assistance Scheme (SFAS): Structure, Incentives and State-Level Relevance

The **Shipbuilding Financial Assistance Scheme (SFAS)** constitutes a critical component of the Four-Pillar Approach under Pillar 2 – Shipbuilding, with a total allocation of **₹24,736 crore**. The scheme is designed to enhance the cost competitiveness of Indian shipyards, stimulate domestic shipbuilding demand, promote circular economy practices through ship recycling, and establish robust institutional mechanisms for sectoral coordination. For coastal States, SFAS provides a direct lever to attract shipbuilding investments and accelerate the development of shipbuilding clusters.

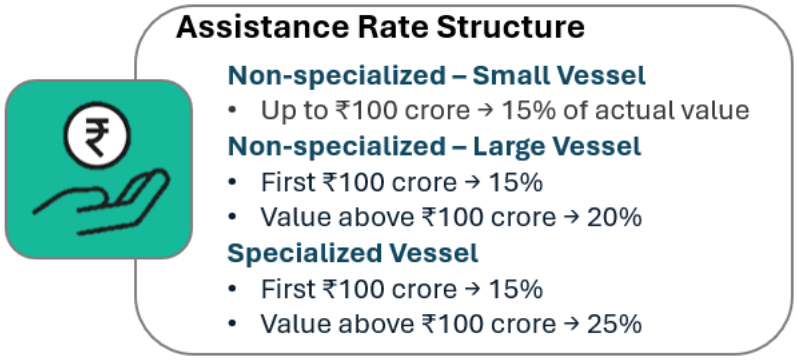


Key Components of the Scheme

The total allocation under SFAS is distributed across three major components:

1. **Extension of Shipbuilding Financial Assistance Scheme – ₹20,554 crore:** This component extends the existing financial assistance framework to new shipbuilding contracts. Assistance is linked to the actual contract value of vessels constructed in Indian shipyards and is aimed at offsetting cost disadvantages arising from higher capital costs, taxation, and input prices compared to global competitors.
2. **Shipbreaking Credit Note – ₹4,001 crore:** To promote integration between shipbreaking and shipbuilding, a credit note equivalent to **40% of the scrap value** of a vessel is issued to the ship-owner when the ship is scrapped at an Indian yard. This credit note can be reimbursed against the cost of constructing a new vessel at an Indian shipyard. This mechanism encourages recycling of end-of-life vessels within India while creating a direct pipeline for new ship orders.
3. **Establishment of National Shipbuilding Mission – ₹181 crore:** This component supports the creation of a dedicated institutional framework to coordinate policy implementation, monitor outcomes, and align central and State-level initiatives related to shipbuilding.

Assistance Rate Structure



The scheme provides differentiated assistance based on vessel type and contract value:

- **Non-specialised Small Vessels (up to ₹100 crore)**
  - Assistance of **15% of actual contract value**
- **Non-specialised Large Vessels**
  - First ₹100 crore: **15% assistance**
  - Value above ₹100 crore: **20% assistance**
- **Specialised Vessels** (such as LNG carriers, dredgers, offshore vessels)
  - First ₹100 crore: **15% assistance**
  - Value above ₹100 crore: **25% assistance**

This graded structure incentivises construction of larger and more technologically complex vessels in Indian yards.

Domestic Content Requirement (DCR)

SFAS strongly promotes localisation and domestic manufacturing through a defined Domestic Content Requirement:

- **Less than 30% domestic content**: No SFAS support
- **30% to less than 40% domestic content**: Pro-rata assistance
- **40% or more domestic content**: Full assistance

This provision encourages the development of indigenous component manufacturing, vendor ecosystems, and MSME participation around shipyards.

Implications for Coastal States

For coastal States, SFAS presents an opportunity to position their shipyards as preferred destinations for new vessel orders. States can play a facilitative role by ensuring timely approvals, supporting vendor park development, enabling ship recycling facilities, and aligning skilling initiatives with specialised vessel requirements. Effective State-level implementation will be essential to fully leverage the financial incentives under SFAS and translate them into sustained industrial and employment growth.

Shipbuilding Development Scheme (SBDS): Relevance and Opportunities for Coastal States

The Shipbuilding Development Scheme (SBDS) is a critical pillar of India's shipbuilding strategy, designed to address structural gaps in capacity, capability, technology, and risk mitigation within the domestic shipbuilding ecosystem. With a total outlay of **₹19,989 crore**, SBDS directly supports the creation and expansion of shipbuilding infrastructure while reducing financial and operational risks for investors. For coastal states, the scheme presents a strategic opportunity to anchor maritime-led industrial growth, employment generation, and regional economic diversification.

Capital support for greenfield shipbuilding capacity (₹9,930 crore) is a core component of SBDS and is particularly relevant for coastal states with available waterfront land, deep-draft access, and proximity to ports. This support enables states to attract private investment for establishing new shipyards, including facilities capable of building large commercial vessels, specialised ships, and future-ready green vessels. Coastal states can leverage this component to develop maritime industrial clusters aligned with port-led development and Sagarmala objectives.

Capital assistance for existing and brownfield shipyards (₹8,261 crore) allows coastal states with legacy shipbuilding facilities to modernise and expand production capacity. This includes investments in advanced fabrication infrastructure, dry docks, automation, and digital shipbuilding technologies. By supporting upgradation, SBDS helps coastal states revive underutilised assets, enhance productivity, and improve the global competitiveness of existing yards, while retaining skilled local workforces.

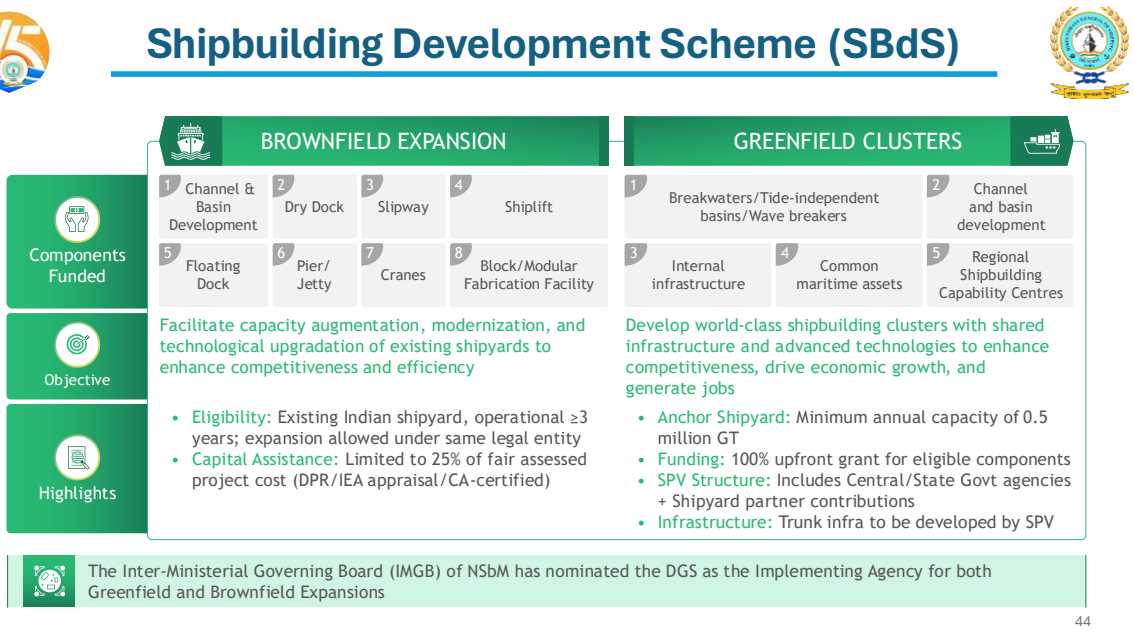
A forward-looking element of the scheme is the **capability development initiative through the India Ship Technology Centre (ISTC) (₹305 crore)**. ISTC is envisioned as a national hub for ship design, engineering, technology standardisation, and R&D. Coastal states stand to benefit from access to advanced design capabilities, technology transfer, and skilling support, enabling local shipyards and MSMEs to move up the value chain and participate in complex vessel construction.

To address risk perceptions in shipbuilding, SBDS provides **shipbuilding risk coverage (₹1,443 crore)** through pre-shipment insurance, post-shipment insurance, and vendor default insurance. This component is especially significant for coastal states seeking to attract first-time investors or expand MSME participation, as it lowers financial risks across the supply chain and improves access to institutional finance.

Finally, **administrative support (₹50 crore)** ensures effective scheme implementation, monitoring, and coordination between the Centre, states, and industry stakeholders.

Overall, SBDS empowers coastal states to play a proactive role in India's shipbuilding resurgence by providing targeted financial support, technology access, and risk mitigation—enabling them to position shipbuilding as a cornerstone of coastal economic development.

Brownfield and Greenfield Expansion under the Shipbuilding Development Scheme



The Shipbuilding Development Scheme (SBDS) adopts a dual-track approach to capacity creation by supporting both **brownfield expansion of existing shipyards** and **greenfield development of new shipbuilding clusters**. This balanced framework ensures rapid scale-up of India's shipbuilding capacity while simultaneously building long-term, world-class infrastructure aligned with global standards.

Brownfield Expansion: Modernising Existing Shipyards

Brownfield expansion focuses on strengthening and upgrading **existing Indian shipyards** to enhance efficiency, productivity, and competitiveness. The objective is to enable operational shipyards to scale up capacity, adopt modern technologies, and handle more complex and higher-value vessel construction.

Eligibility under the brownfield component is limited to Indian shipyards that have been **operational for a minimum of three years**, with expansion undertaken under the same legal entity. Capital assistance is provided up to **25% of the fair assessed project cost**, based on duly appraised DPRs, IEAs, or CA-certified estimates. This ensures fiscal discipline while supporting genuine capacity augmentation.

The scheme supports a wide range of critical infrastructure components, including:

- Channel and basin development to improve navigability and vessel access

- Construction and upgradation of dry docks and slipways
- Installation of ship lifts and floating docks
- Development of piers, jetties, and material handling systems
- Procurement of heavy cranes and yard equipment
- Creation of block and modular fabrication facilities

For coastal states with legacy shipyards, this component provides a pathway to **revitalise underperforming assets**, attract new orders, retain skilled manpower, and integrate local MSMEs into the shipbuilding value chain.

Greenfield Expansion: Creating World-Class Shipbuilding Clusters

The greenfield component of SBDS is aimed at developing **integrated shipbuilding clusters** with shared infrastructure and advanced technologies. These clusters are envisioned as large-scale, globally competitive ecosystems capable of constructing large commercial vessels, specialised ships, and next-generation green vessels.

A key feature of greenfield development is the presence of an **Anchor Shipyard** with a **minimum annual capacity of 0.5 million GT**, ensuring scale, credibility, and long-term viability. The scheme provides **100% upfront grant support for eligible common infrastructure components**, significantly reducing entry barriers for large investments.

Supported components include:

- Breakwaters, wave breakers, and tide-independent basins
- Channel and basin development
- Internal road, power, water, and utility infrastructure
- Common maritime assets and shared facilities
- Regional Shipbuilding Capability Centres for design, skilling, and technology support

Greenfield clusters are implemented through an **SPV structure**, involving Central and State Government agencies along with shipyard and private partners. While the SPV develops trunk infrastructure, individual shipyards focus on core production facilities, ensuring efficient risk sharing and governance.

For coastal states, greenfield shipbuilding clusters offer a transformational opportunity to anchor **port-led industrialisation**, generate large-scale employment, and position themselves as global shipbuilding hubs.

Together, brownfield and greenfield expansion under SBDS provide a comprehensive framework for accelerating India's shipbuilding growth while enabling coastal states to align infrastructure development with national maritime priorities.

Cluster-Based Approach: Concept, Relevance and Governance Imperatives

Concept and Rationale of a Maritime Industrial Cluster

A maritime industrial cluster is a geographically co-located ecosystem comprising **anchor shipyards**, **ancillary and supplier units**, **shared infrastructure**, and **supporting social and urban facilities**, planned and operated as an integrated whole.
The core idea of the cluster approach is to move away from fragmented, stand-alone facilities towards a **shared-capacity, network-driven model** that enhances productivity, reduces costs, and accelerates capability development.

In the context of greenfield capacity creation, clustering allows multiple shipyards and ancillary units to leverage **common maritime frontage, breakwaters, dredging, utilities, testing facilities, and logistics infrastructure**, thereby improving capital efficiency and operational viability.

Relevance of Clusters in Achieving Capacity and Capability Targets

The cluster-based approach is critical for achieving national targets related to **shipbuilding, ship repair, and maritime industrial expansion** due to the following reasons:

- **Optimised Asset Utilisation:** High-cost marine infrastructure such as dry docks, heavy-lift cranes, waterfront access, and testing facilities can be shared across multiple players, improving utilisation and reducing duplication.
- **Scalable Capacity Creation:** Clusters allow phased expansion of yards and ancillaries, enabling rapid scaling of capacity in response to market demand.
- **Strengthening Domestic Value Chains:** Proximity of Tier 1, Tier 2, and Tier 3 suppliers supports localisation of components, reduces lead times, and enhances self-reliance.
- **Technology and Skill Upgradation:** Shared R&D centres, training institutes, and testing facilities accelerate technology absorption and workforce skilling.
- **Improved Global Competitiveness:** Integrated clusters reduce production costs, improve delivery timelines, and enhance quality standards, positioning Indian yards competitively in global markets.

By aggregating demand, skills, and infrastructure, clusters serve as **multipliers**, enabling faster and more sustainable achievement of sectoral growth targets.

Idea and Key Components of a Maritime Cluster

A well-functioning maritime cluster typically comprises the following components:

1. **Anchor Shipyard(s)**
   Large shipbuilding and/or ship repair yards that act as demand generators and technology anchors for the cluster.

2. **Ancillary and Supplier Ecosystem**
   Tier 1, Tier 2, and Tier 3 suppliers providing hull fabrication, machinery, electrical systems, coatings, outfitting, logistics, and specialised services.
3. **Common Cluster Facilities**
    - Shared dry docks and wet berths
    - Testing and certification facilities
    - R&D and design centres
    - Skill development and training institutes
    - Warehousing and logistics hubs
4. **Maritime and Connectivity Infrastructure**
    - Breakwaters, dredging, and navigational channels
    - Road, rail, and utility connectivity
    - Digital and communication infrastructure
5. **Trunk and Social Infrastructure**
    - Housing, healthcare, education, and urban amenities
    - Worker accommodation and transport systems

The integration of these elements ensures **operational efficiency, workforce stability, and long-term sustainability** of the cluster.

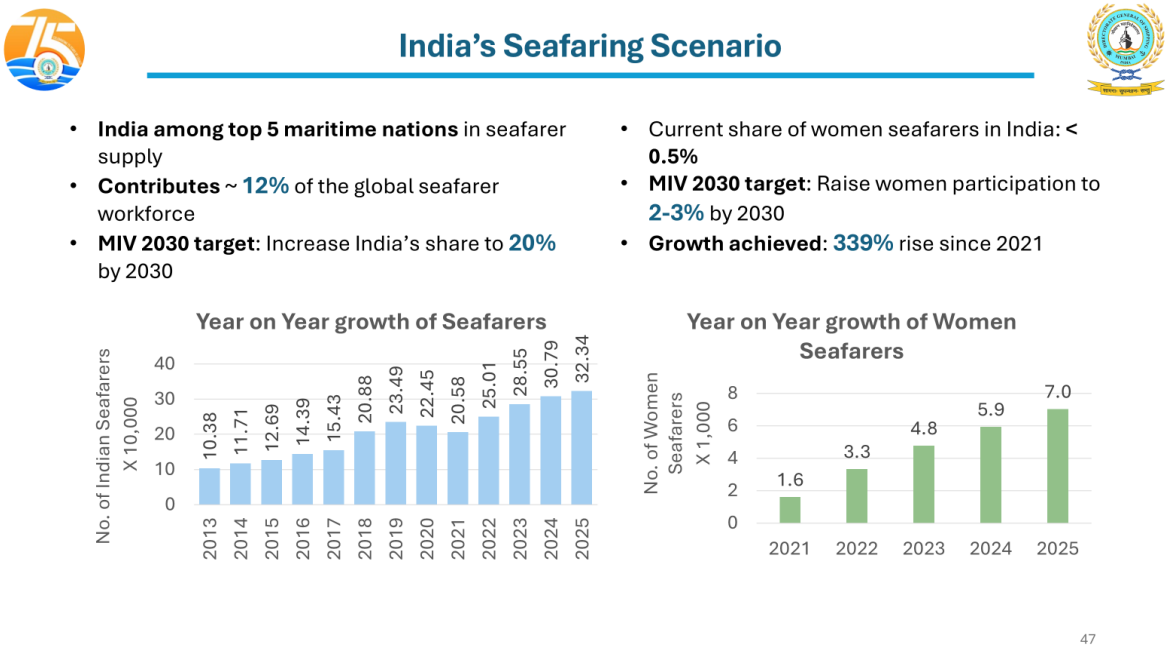
Importance of State Collaboration and Institutional Coordination

State collaboration is a **foundational requirement** for the success of maritime clusters, given the scale, complexity, and cross-sectoral nature of interventions involved. Effective cluster development requires:

- **Land Assembly and Zoning Support:** States play a key role in providing contiguous land parcels, coastal zoning approvals, and environmental clearances.
- **Infrastructure Provisioning:** Development of external connectivity, utilities, and social infrastructure largely falls within the State's mandate.
- **Policy Alignment and Incentives:** Harmonisation of central and state policies, fiscal incentives, and regulatory frameworks to improve investor confidence.
- **Single-Window Governance Mechanisms:** Coordinated approvals across departments to reduce timelines and transaction costs.
- **Public–Private Collaboration:** States act as facilitators, enabling private investment while ensuring long-term regional development objectives are met.

Strong Centre–State coordination ensures that clusters evolve not merely as industrial enclaves, but as **integrated maritime growth hubs** aligned with national strategic and economic priorities.

India's Seafaring Workforce: Expanding Global Leadership



India is currently positioned among the **top five maritime nations** in terms of supplying seafarers to the global shipping workforce. The country contributes nearly **12%** of the world's seafarers, and under the **Maritime India Vision (MIV) 2030**, the target is to further increase this share to **20%** by 2030.

Four key pillars to enhance India's share is outlined in Exhibit 10.5 of MIV 2030. It acts as a comprehensive national approach to increasing India's global share of seafarers through **four strategic pillars**. Each pillar targets a critical component of seafarer development ranging from improving training quality to expanding career opportunities and strengthening welfare frameworks.

1. Enhancement of Quality of Maritime Training

This pillar aims to ensure that India produces high-calibre seafarers by introducing standardized entrance tests, redesigning maritime curricula with digital and e-learning components, upgrading faculty development systems, and providing specialized training (including cruise hospitality).

2. Improved On-Board Training Opportunities and Placements

India seeks to expand shipboard experience opportunities by increasing Indian tonnage and mainline calls, mandating training berths on foreign vessels, forming bilateral agreements with major ship-owning nations, and boosting overall training capacity for cadets and ratings.

3. Promotion of Careers at Sea

Focused on attracting and retaining talent, this pillar reinvigorates the image of seafaring through marketing campaigns, success stories, and digital media. It also emphasizes expanding training academies in key seafarer-producing regions and providing scholarships and benefits especially for women thereby encouraging wider participation.

4. Seafarer Welfare and Attractive Alternative Career Opportunities

To enhance retention and post-sea career mobility, this pillar prioritizes professional development courses, seafarer welfare facilities, mental health support, and defined alternative career pathways. It promotes flexible learning options, counselling, and upskilling to support seafarers both during and after their time at sea.

Initiative 10.15 from MIV 2030 focuses on increasing women's participation in India's seafaring workforce, where women currently represent only **0.5%**of active on-board seafarers. The low representation is attributed to limited awareness of career opportunities, lack of incentives from shipping companies, and prevailing cultural barriers. To address these challenges, the initiative proposes an **awareness campaign**to highlight success stories of women seafarers and promote available opportunities. Additionally, it recommends strengthened **onboard gender sensitization** and launching an **onboarding buddy programme** to support women entering the profession.

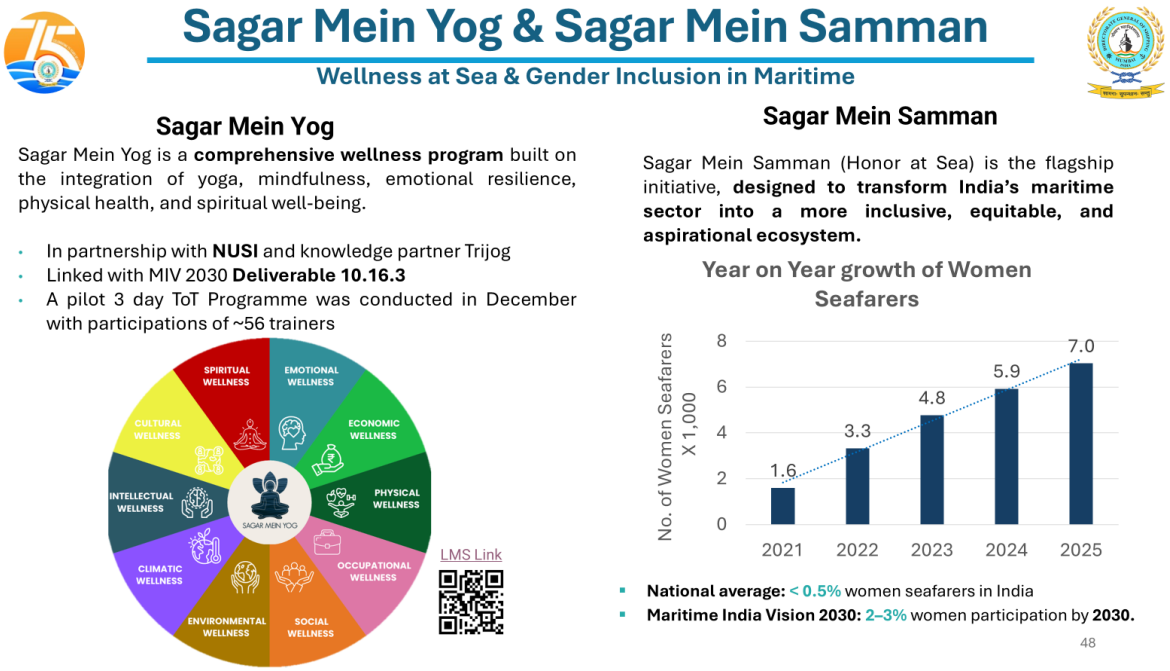
Further, the initiative underscores the importance of ensuring seafarers' **mental well-being**, noting the current lack of awareness and support structures in this area. To address this gap, it advocates for establishing **port welfare committees** to build a holistic ecosystem of care, support, and well-being for all seafarers.

Over the past decade, India has witnessed **steady year-on-year growth** in the number of seafarers, as reflected in the bar chart. The seafarer pool has expanded significantly, showcasing India's increasing relevance in global maritime operations.

In terms of gender participation, the current share of women seafarers stands at **less than 0.5%**, but the growth trajectory is highly encouraging. MIV 2030 aims to raise this participation to **2–3%**. Notably, India has already achieved a **339% increase** in women seafarers over the last 5 years, as shown by the green chart.

Overall, the data highlights India's expanding maritime talent pool, strong global positioning, and focused efforts toward enhancing both workforce size and gender inclusivity in the sector.

Sagar Mein Samman & Sagar Mein Yog



One of the most significant shifts taking place in India's maritime landscape today is the growing focus on empowering women across a field long viewed as male dominated. For many years, women have represented less than half a percent of the seafaring workforce, and this imbalance has held back both individual potential and the overall strength of the maritime ecosystem. Recognizing this gap, India introduced **Sagar Mein Samman** as a landmark initiative designed to transform the maritime environment into one where every woman is treated with dignity, respect, and equal opportunity. It was created to ensure that women can enter the sector, progress through it, and contribute meaningfully without encountering the systemic obstacles that have limited their representation in the past.

Sagar Mein Samman is built on the understanding that gender inclusion is not only a matter of fairness but also a pathway to a stronger and more resilient workforce. It draws inspiration from the Maritime India Vision 2030, which aims to increase women's participation to two to three percent by 2030. This initiative recognizes that real change requires more than policy statements, so it brings together training institutions, industry partners, maritime unions, academic bodies, and administrators to create a unified environment where women can thrive. A key step in this journey was the introduction of the draft policy framework on the International Day for Women in Maritime, signaling India's commitment to move from intent to structured action.

Women in maritime today face challenges that go far beyond numbers. Many of them encounter discrimination in pay and promotions, restricted access to leadership roles, and cultural biases that remain deep rooted across the global maritime community. Safety concerns, harassment, limited mentorship, and a lack of role models create additional barriers. For those balancing family responsibilities or dealing with inadequate onboard facilities, the path becomes even more difficult. These challenges are well known, and Sagar Mein Samman addresses them by building a comprehensive ecosystem of support that focuses on empowerment, inclusivity, safety, and continuous skill development.

The programme promotes awareness campaigns that reach young women who may not previously have considered maritime careers. It creates scholarship pathways that help them overcome financial constraints. It encourages companies to adopt recruitment practices that are inclusive and transparent. It expands gender sensitization efforts across ships and training institutes to reshape workplace culture. And it introduces buddy programmes, counselling access, and stronger welfare support at ports to ensure that women feel protected both during their time at sea and when they return home. Through these measures, the initiative creates a complete safety and support framework around women, giving them the confidence to remain in the profession and grow as leaders.

At the same time, the initiative has a strong focus on skill building. Women receive training that prepares them for the technical and leadership demands of the maritime world, and mentorship channels help them navigate the challenges of early career progression. These elements do more than support individual growth. They help create role models whose success will inspire more young women to envision themselves in this industry. The story of India's maritime workforce over the past decade already includes remarkable progress, with the number of women seafarers growing many times over, and this upward trend is exactly what Sagar Mein Samman is designed to accelerate.

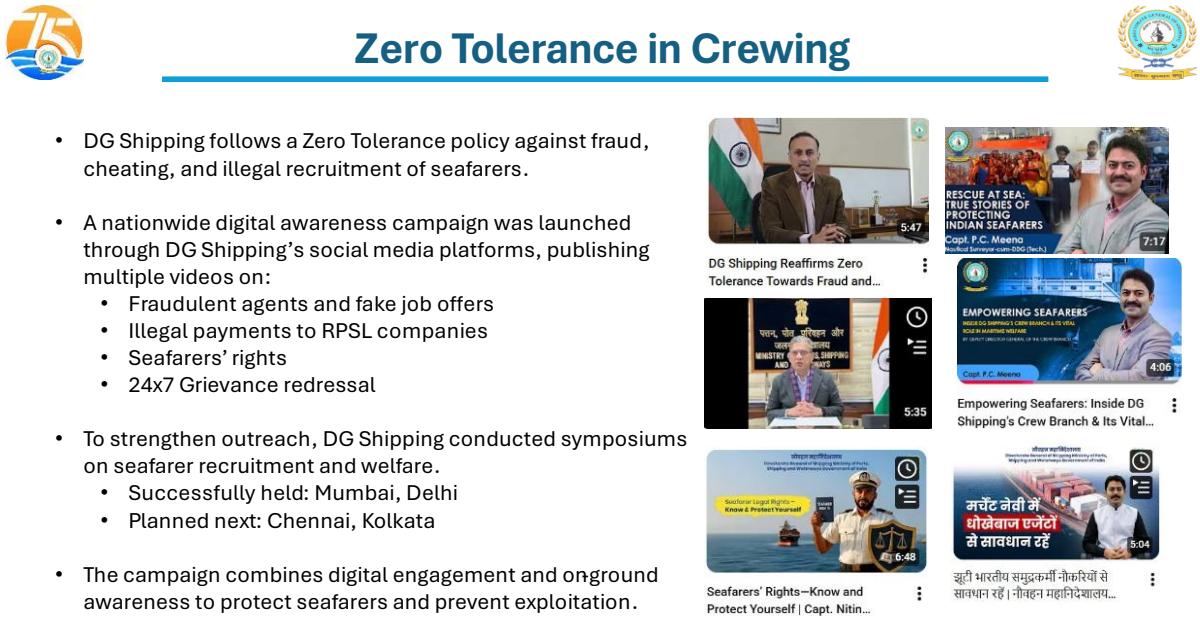
Sagar Mein Yog is a structured wellness programme introduced under DGS Order 19 of 2024 to address the mental, physical and emotional challenges that seafarers routinely encounter due to prolonged isolation, irregular work schedules and high pressure working conditions. The initiative provides a comprehensive framework of wellness practices that are meant to be an integral part of both maritime training and daily life at sea, reflecting the Directorate General of Shipping's focus on developing a healthier and more resilient workforce. The programme is designed in partnership with the National Union of Seafarers of India and is supported by Trijog Know Your Mind, a collaboration that ensures the content is guided by professional psychological and behavioural expertise. Its foundation is built on ten core wellness pillars that cover emotional, economic, physical, occupational, social, environmental, climatic, intellectual, cultural and spiritual wellness, creating a holistic system that nurtures the mind, body and inner stability of seafarers throughout their maritime journey.

These wellness pillars are supported through practical tools, reflective practices, guided learning and experiential content that respond directly to the unique lifestyle and demands of seafaring. The initiative integrates its modules across Pre Sea, At Sea and Post Sea stages so that wellness becomes a continuous, structured support system rather than a limited training intervention. To operationalise this framework, a pilot Training of Trainers programme was conducted with participation from approximately fifty trainers, ensuring that implementation capacity is already in place for wider rollout. The approach emphasises stress management, physical fitness, emotional stability and mindful awareness, which together contribute to improved safety and wellbeing on board. The Directorate General of Shipping notes that yoga, mindfulness and wellness routines incorporated into daily schedules can significantly improve mental resilience and reduce fatigue, which makes these practices essential components of the programme's design.

Sagar Mein Yog further strengthens its reach through a dedicated digital learning management system that offers easy access to structured wellness modules, guided audiovisual practices and reflective material for seafarers whether they are onboard or ashore. This learning ecosystem allows seafarers to study at their own pace and maintain consistent engagement with the wellness curriculum. The LMS provides a comprehensive curriculum booklet that outlines learning outcomes, practical routines and suggested practices for all ten wellness pillars, ensuring standardisation across maritime training institutes and shipboard environments. The digital platform reflects the Ministry of Ports, Shipping and Waterways commitment to delivering accessible wellness education for the entire maritime community and supports the broader vision of modern, inclusive and welfare driven maritime governance.

In essence, the Sagar Mein Yog initiative institutionalises wellness by embedding holistic health practices into maritime training systems and shipboard operations. It is designed to cultivate resilience, emotional balance, physical readiness and sustained well being among Indian seafarers, creating a healthier workforce that is better equipped to manage the demands of life at sea. The programme combines structured educational content, digital accessibility and a multi dimensional wellness philosophy to align seafarer welfare with modern global expectations and national maritime objectives.

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)** has adopted a **strict Zero Tolerance policy** against:

- Fraudulent recruitment practices
- Cheating and misrepresentation
- Illegal placement and unauthorized intermediaries

This approach is aimed at safeguarding the **rights, welfare and professional integrity of Indian seafarers**, while strengthening trust in the regulatory framework governing maritime employment.

Core Objective

To establish a **transparent, accountable and exploitation-free crewing ecosystem** in India.

Key Policy Pillars

- Prevention of fraud and illegal recruitment
- Protection of seafarer rights and welfare
- Promotion of ethical and compliant crewing practices

- Strengthening regulatory oversight and enforcement

Key Challenges Addressed

The initiative directly targets persistent issues in the crewing ecosystem:

- Fraudulent agents and fake job offers
- Unauthorized payments to RPSL (Recruitment and Placement of Seafarers License) companies
- Lack of awareness among seafarers regarding rights and entitlements
- Limited access to grievance redressal mechanisms
- Risk of exploitation, especially among new entrants

Digital Awareness Campaign

Nationwide Outreach

DG Shipping has launched a **comprehensive digital awareness campaign** through its official platforms, including social media channels.

Key Focus Areas

The campaign disseminates targeted information on:

- Identification of **fraudulent agents and fake job offers**
- Risks associated with **illegal payments to RPSL companies**
- Awareness of **seafarers' statutory rights and entitlements**
- Availability of **24×7 grievance redressal mechanisms**

Content Strategy

- Use of **short informational videos and advisories**
- Simplified messaging for wider reach
- Multilingual communication for inclusivity

Outcome

- Enhances **awareness and vigilance among seafarers**
- Enables **informed decision-making**
- Reduces vulnerability to exploitation

On-Ground Outreach & Stakeholder Engagement

Symposia & Workshops

DG Shipping has complemented digital outreach with **physical engagement initiatives**, including:

- National-level symposia on **seafarer recruitment and welfare**
- Stakeholder consultations involving:
    - RPSL companies
    - Training institutes
    - Maritime professionals

Implementation Status

- Successfully conducted in: **Mumbai, Delhi, Kolkata**
- Planned expansion to: **Chennai**

Impact

- Strengthens **industry alignment with regulatory expectations**
- Facilitates **direct engagement with seafarer community**
- Promotes **compliance culture across stakeholders**

Grievance Redressal Mechanism

24×7 Support System

- Dedicated grievance channels available round-the-clock
- Accessible to all seafarers across India

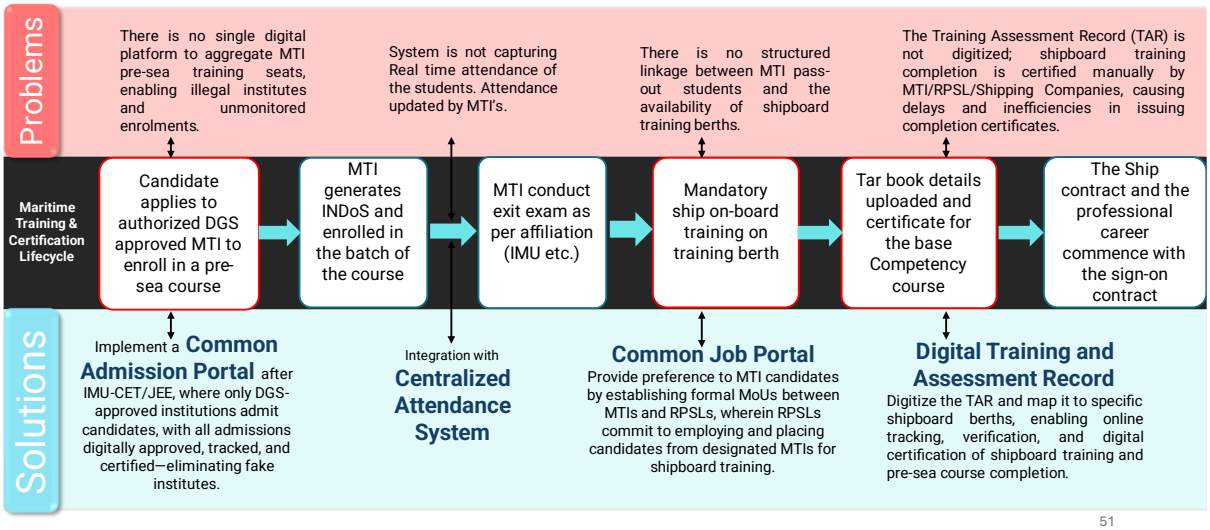
Key Features

- Complaint registration and tracking
- Timely response and resolution
- Escalation mechanisms for serious violations

Strategic Role

- Acts as a **deterrent against malpractice**
- Builds **confidence among seafarers**
- Strengthens regulatory enforcement

Maritime Training and Certification Lifecycle



The maritime training and certification ecosystem in India plays a critical role in sustaining the country's position as a leading supplier of global seafarers. However, the current system has evolved in a **fragmented and largely non-integrated manner**, with multiple stakeholders operating in silos — MTIs, RPSLs, shipping companies and regulatory bodies.

This has resulted in **limited visibility across the lifecycle of a candidate**, from admission to certification, and has created operational gaps that impact both efficiency and regulatory oversight.

Key Systemic Issues

Admission-Level Gaps

At present, there is no unified mechanism to track or regulate **pre-sea training seat allocation across MTIs**. Admissions are handled independently by institutes, which creates scope for:

- Entry of non-compliant or unauthorized entities
- Lack of transparency in seat utilization
- Difficulty in monitoring intake capacity at a national level

This weakens the credibility of the training pipeline at the entry stage itself.

Absence of Real-Time Monitoring

Student attendance, which is a fundamental compliance requirement, is currently:

- Recorded manually
- Updated periodically by MTIs

There is no provision for **real-time validation or central visibility**, making it difficult for the regulator to ensure adherence to training norms.

Disconnect Between Training and Employment

One of the most critical gaps lies in the transition from **classroom training to shipboard training**.

Currently:

- There is no structured mechanism linking MTI graduates with **availability of training berths onboard vessels**
- Candidates are often left to navigate placement independently

This results in:

- Delays in securing onboard training
- Underutilization of trained manpower
- Increased dependence on informal channels

Manual and Fragmented TAR System

The Training Assessment Record (TAR), which is central to competency certification, continues to be:

- Maintained in physical/manual format
- Verified through multiple entities without a unified system

This leads to:

- Delays in certification issuance
- Lack of audit trail
- Inefficiencies in verification and validation

Need for Lifecycle-Based Reform

The above challenges are not isolated — they stem from the absence of a **connected lifecycle approach**.

What is required is a system where:

- Each stage of a candidate's journey is digitally linked
- Data flows seamlessly across stakeholders
- The regulator has end-to-end visibility

Proposed Digital Lifecycle Framework

A structured, technology-enabled lifecycle has been conceptualised to address these gaps.

Entry-Level Standardisation – Common Admission Portal

The introduction of a **Common Admission Portal** will act as the first control point in the system.

Key features:

- Admission restricted strictly to **DGS-approved MTIs**
- Centralised seat allocation and tracking
- Integration with entrance mechanisms (IMU-CET/JEE)

Impact:
Brings discipline at the entry stage and eliminates scope for unauthorized admissions.

Unified Candidate Identity – Digital INDoS Integration

Post admission, candidate data is captured through:

- Digital generation of **INDoS number**
- Batch-level enrollment managed centrally

Impact:
Creates a **single verified identity** for each candidate, enabling tracking across the lifecycle.

Compliance Monitoring – Centralized Attendance System

A real-time attendance system is proposed to:

- Capture attendance digitally at source
- Provide central visibility to regulators

Impact:
Shifts attendance from a declaratory system to a **verifiable compliance mechanism**.

Academic Integration – Exit Examination Layer

Exit examinations will continue under affiliating bodies such as IMU, but:

- Results and certification data will be digitally integrated

Impact:
Ensures continuity of data without disrupting existing academic structures.

Industry Linkage – Common Job Portal

To address the current disconnect, a **Common Job Portal** is proposed.

Key design principle:

- Formal linkage between **MTIs and RPSLs**

Through this:

- RPSLs can access verified candidate pools
- MTIs can align output with industry demand
- Candidates can access structured onboarding opportunities

Impact:
Transforms placement from an informal process to a **system-driven pipeline**.

Digitisation of TAR – Closing the Loop

The digitisation of the **Training Assessment Record (TAR)** is a critical reform element.

Proposed features:

- Digital TAR linked to candidate profile
- Mapping with specific shipboard training berths
- Online validation by shipping companies

Impact:

- Eliminates delays in certification
- Creates a complete audit trail
- Enables faster issuance of Certificates of Competency

End-to-End Lifecycle Integration

The proposed system ensures that the candidate journey is **fully traceable and connected**:

Admission → Enrollment → Attendance → Examination → Placement → Onboard Training → Certification

Each stage feeds into the next, removing discontinuities that currently exist.

Expected System-Level Improvements

Regulatory Control

- Real-time visibility for DGS
- Stronger compliance enforcement

Process Efficiency

- Reduced delays across stages
- Faster certification timelines

Transparency

- Elimination of informal and unverified channels
- Improved trust among stakeholders

Workforce Alignment

- Better matching of trained candidates with industry requirements

Strategic Relevance

The proposed lifecycle reform is aligned with:

- India's push towards **digital governance in maritime administration**
- Global expectations on **quality and traceability of seafarer certification**
- Long-term objective of maintaining India's position as a **trusted seafarer supply nation**

Way Forward

- Development of integrated digital platforms under a unified architecture
- Stakeholder onboarding (MTIs, RPSLs, shipping companies)
- Phased rollout with pilot implementation
- Continuous monitoring and system refinement

Training Ecosystem

Maritime training in India is currently managed through a combination of institutional processes and regulatory oversight mechanisms, many of which operate independently. While the existing framework has supported scale, it has also led to **fragmentation across key stages such as training delivery, attendance monitoring, onboard training records and certification**.

As a result, there is **limited end-to-end visibility of a candidate's progression**, and certain processes continue to rely on manual intervention and physical documentation. This creates challenges in ensuring consistency, transparency and timely decision-making.

With increasing emphasis on **digital traceability, quality assurance and alignment with international standards**, there is a clear need to move towards a more integrated and system-driven approach.

Concept of the Training Eco-System

The Training Eco-System has been conceptualized as a **unified, cloud-based digital platform** to bring together the key elements of maritime training, certification and professional development within a single framework.

The objective is not to replace individual components, but to **connect them through a common digital backbone**, enabling seamless flow of information across the entire training lifecycle — from admission to certification and employment linkage.

This approach shifts the focus from managing individual processes to **managing the ecosystem as a whole**.

Key Features of the Proposed System

Integrated Platform

The system integrates multiple functional areas including learning management, attendance tracking, training records, certification validation and industry engagement. This ensures that data is not isolated within individual modules but is available across the system.

Real-Time Monitoring and Oversight

Digital capture of attendance, training progress and assessment records enables **real-time visibility for the regulator**, reducing dependence on periodic reporting and improving overall oversight.

Digital Records and Traceability

The transition from paper-based documentation to digital records — particularly for Training Assessment Records (TAR) — ensures:

- Consistency of data
- Reduced processing time
- Availability of audit trails

Strengthened Industry Linkages

The inclusion of structured mechanisms such as a common job portal and engagement platforms helps bridge the gap between training institutions and industry requirements, ensuring better alignment of skills with onboard opportunities.

Functional Components

The Training Eco-System brings together the following key components within a single platform:

- **Learning Management System (LMS)** for course delivery and progress tracking
- **Centralized Attendance System** for real-time monitoring and compliance
- **Digital TAR Book** for onboard training documentation
- **Online Certificate Validation System** to enhance credibility and reduce fraud
- **Faculty Development Programme** to strengthen instructional quality
- **Web-Based Simulation Modules** aligned with modern shipboard technologies
- **Senior Seafarer Engagement Mechanism** to incorporate industry experience into training

Expected Outcomes

The implementation of the Training Eco-System is expected to result in:

- Improved **consistency and quality in training delivery**
- Enhanced **transparency in certification processes**
- Reduction in **manual intervention and associated delays**
- Availability of **reliable, real-time data for decision-making**
- Better **alignment between training output and industry requirements**

In addition, the system will help address long-standing issues related to **data gaps, duplication and lack of traceability**.

Strategic Importance

The Training Eco-System represents a broader shift towards **digitally enabled governance in maritime education and certification**.

It supports:

- Compliance with evolving international expectations
- Strengthening of regulatory confidence
- Improved global acceptance of Indian certification standards

More importantly, it enables a move from **process-based oversight to system-based governance**, which is critical for a sector of this scale.

Implementation Approach

Given the scope of the system, a **phased implementation approach** is considered appropriate:

- Initial rollout of core modules such as attendance, LMS and TAR
- Pilot implementation with selected institutions
- Gradual integration of certification and industry linkage components
- Scale-up based on operational feedback and system stability

New MTI Module

The Directorate General of Shipping (DGS) has, over the years, established a regulatory framework for Maritime Training Institutes (MTIs) covering approvals, inspections, faculty requirements and compliance monitoring. The existing MTI Module has been central to this framework and has supported the growth of maritime training capacity in the country.

However, with the increase in the number of institutes and the growing complexity of regulatory requirements, certain limitations have become evident. Key processes such as inspections, compliance tracking and record verification continue to depend on **periodic reporting and manual intervention**, resulting in gaps in real-time visibility.

There have also been instances of **non-compliance and inconsistencies in training delivery**, indicating the need for stronger monitoring mechanisms and a more integrated regulatory approach.

Need for a Revamped MTI Module

The existing system, while functional, is not fully equipped to support **real-time oversight and data-driven governance**. The absence of seamless integration between related systems — such as certification modules, TAR records and inspection frameworks — limits the ability to monitor the full lifecycle of training and certification.

In addition, increasing expectations from international stakeholders, particularly in relation to **STCW compliance and quality assurance**, require a system that can provide reliable, verifiable and readily accessible data.

A modernized MTI Module is therefore required to:

- Strengthen regulatory oversight
- Improve transparency in institutional functioning
- Ensure consistency in training standards across institutes

Concept of the New MTI Module

The New MTI Module is envisaged as a **central digital regulatory platform** that will serve as the backbone for overseeing Maritime Training Institutes in India.

The focus is on building a system that not only records information, but also **enables continuous monitoring, validation and decision-making**.

The module will bring together key regulatory functions — including approvals, inspections, faculty records and compliance tracking — within a **single, integrated digital environment**.

Key Features

Centralized Regulatory Control

All MTI-related activities, including approvals, renewals and inspections, will be managed through a unified platform, ensuring consistency and reducing dependency on fragmented processes.

Real-Time Monitoring and Compliance Tracking

The system will enable **real-time visibility of MTI operations**, including:

- Inspection status
- Compliance reports
- Faculty and infrastructure records

This reduces reliance on delayed submissions and enhances proactive oversight.

Integration with Related Modules

A key improvement in the new module is its integration with:

- **CIP (Continuous Improvement Programme)**
- **STCW Module**
- **Digital TAR Book**
- **Master Checklist Framework**

This ensures that regulatory oversight is not limited to isolated functions but extends across the entire training and certification ecosystem.

Strengthened Data Integrity

By digitizing records and standardizing data capture, the system will:

- Minimize discrepancies
- Enable easier verification
- Maintain a clear audit trail

Expected Outcomes

The implementation of the New MTI Module is expected to result in:

- **Improved compliance and regulatory control** through continuous monitoring
- **Enhanced transparency** in approvals, inspections and certification processes
- **Better training quality** through closer alignment with updated standards
- **Reduced scope for non-compliance and procedural gaps**
- **Improved global credibility** of Indian maritime training institutions

Strategic Significance

The New MTI Module is not merely a system upgrade, but a **structural improvement in the way maritime training is regulated**.

It enables a shift from:

periodic, document-based oversight to continuous, system-driven monitoring

This transition is essential to maintain alignment with global standards and to ensure that India continues to be a **reliable and high-quality source of trained seafarers**.

Examination Reforms by C-DAC & NTA

The examination reforms introduced by C-DAC and the National Testing Agency (NTA) mark a significant shift toward a fully digitized, transparent, and secure assessment system for seafarers. These reforms cover the entire examination lifecycle—from user registration and eligibility verification to seat booking, conduct of examinations, evaluation, data storage, and the management of question banks. By digitizing each stage, the system aims to eliminate procedural inconsistencies and enhance uniformity across all Mercantile Marine Departments (MMDs).

The revamped framework is designed to create a secure and reliable examination environment through biometric authentication, CCTV-based surveillance, online proctoring, encrypted question papers, and digital scanning of answer scripts. This is supported by structured grievance-redressal and feedback mechanisms, ensuring accountability and responsiveness. The system applies to both written and oral examinations conducted in hybrid or computer-based modes, thereby increasing flexibility while maintaining high integrity standards.

Collectively, these reforms have strengthened examination quality, improved operational efficiency, and ensured a consistent candidate experience nationwide. By embedding digital safeguards and streamlining workflows, the new examination system significantly enhances transparency, reduces the scope for misconduct, and supports the competency-based certification of Indian seafarers.

Common Admission Portal

Admissions to Maritime Training Institutes (MTIs) in India are currently carried out by individual institutes, each following its own process within the broader regulatory framework of DG Shipping. While guidelines exist, the absence of a **single unified system** has resulted in variations in admission practices across institutes.

This has led to concerns such as:

- Lack of uniformity in eligibility verification
- Limited transparency in seat allocation
- Inconsistent documentation and record-keeping
- Difficulty in monitoring adherence to approved intake capacities

In addition, there is currently **no centralized visibility for the regulator** on real-time admission status across institutes.

Need for a Common Admission Portal

Given the scale of maritime training in India and the importance of maintaining credibility in pre-sea education, there is a need to bring admissions under a **standardized and transparent framework**.

A centralized system would:

- Ensure that admissions are conducted strictly as per approved norms
- Reduce inconsistencies across institutes
- Provide visibility to DG Shipping for effective oversight
- Simplify the process for students

Concept of the Common Admission Portal

The Common Admission Portal is proposed as a **single, centralized digital platform** for all students seeking admission to DG Shipping-approved Maritime Training Institutes.

The portal is designed to handle the complete admission process in a structured manner, covering:

- Eligibility verification
- Application submission
- Document validation
- Merit-based ranking
- Seat allocation

The intent is to ensure that admissions are carried out in a **uniform, transparent and merit-driven manner across the country**.

Key Features of the Portal

Centralized Application System

Students will apply through a single platform instead of multiple institute-level applications, reducing duplication and improving accessibility.

Standardized Eligibility Checks

Eligibility criteria will be embedded within the system, ensuring that only candidates meeting prescribed requirements are allowed to proceed.

Online Document Verification

Digital submission and verification of documents will:

- Reduce manual errors
- Speed up the admission process
- Improve reliability of records

Merit-Based Ranking and Seat Allocation

Admissions will be based on clearly defined merit criteria, with automated seat allocation aligned to:

- Approved MTIs
- Recognized courses
- Sanctioned intake capacities

Real-Time Monitoring

The system will provide DG Shipping with **real-time visibility** on:

- Number of applicants
- Seat allocation status
- Institute-wise admissions

This enables better control and timely intervention where required.

Stakeholder Roles

The portal clearly defines responsibilities across stakeholders:

- **Students**

  Apply for courses, upload documents, track admission status

- **Maritime Training Institutes (MTIs)**

  Verify applications, manage course intake, approve admissions

- **DG Shipping**

  Monitor admissions across institutes, ensure compliance with approved capacities

- **Portal Administrators**

  Manage system operations, user access and platform integrity

Expected Outcomes

The Common Admission Portal is expected to bring the following improvements:

- **Uniformity in admission processes** across all MTIs
- **Enhanced transparency and fairness** in seat allocation
- **Reduction in discrepancies and manual errors**
- **Improved compliance with approved intake capacities**
- **Better data availability for regulatory oversight**

It will also make the process more streamlined for students by providing a **single point of access**.

Importance

The introduction of a Common Admission Portal is a key step towards **standardizing entry into the maritime training ecosystem**.

It supports:

- Strengthening of regulatory control
- Improved credibility of training institutions
- Alignment with digital governance initiatives

Most importantly, it ensures that the **quality of intake into maritime training remains consistent**, which directly impacts the overall standard of seafarers entering the system.

Transparency and Zero Tolerance for Fraud

1. Reporting Issue

Concerns or irregularities can be reported through established communication channels, including telephone, SMS, and WhatsApp. This ensures accessibility and timely submission of complaints or queries.

2. Dedicated Helpline Support

A helpline operates during defined working hours (09:00 AM to 06:00 PM) to address inquiries, provide initial assistance, and record details for further action.

3. Structured Escalation Mechanism

Unresolved issues follow a formal escalation path, ensuring that complex or critical matters are reviewed by the appropriate authority level for effective resolution.

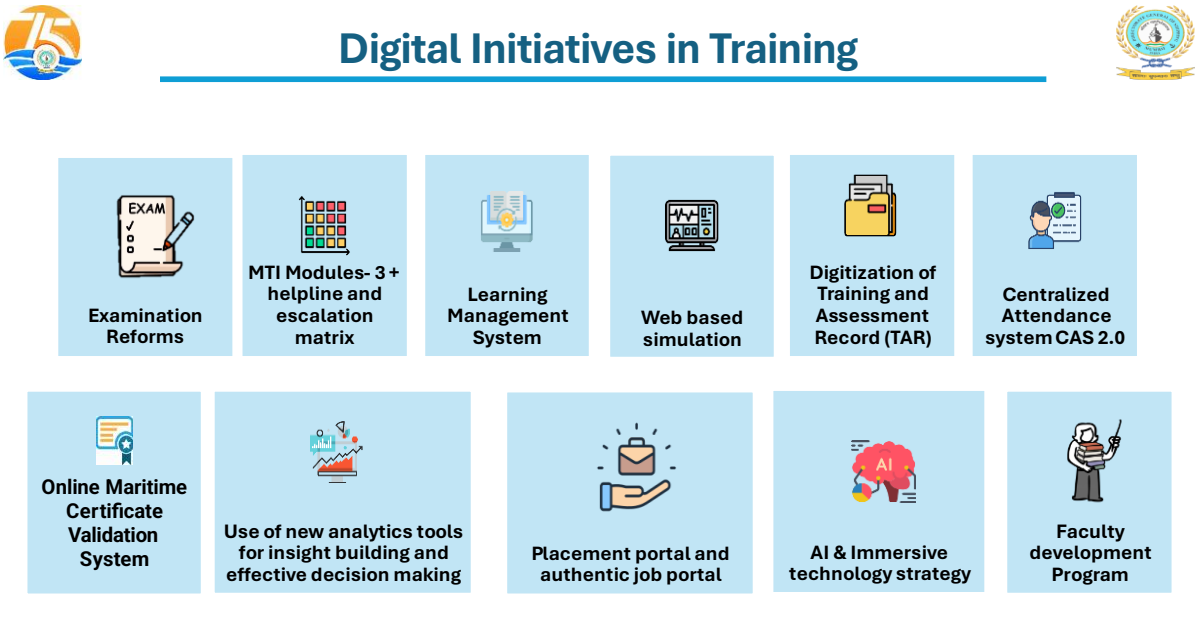
4. Follow-Up and Guidance

Each case receives systematic follow-up to verify progress, offer necessary guidance, and ensure that the individual receives accurate and timely support throughout the process.

5. Analysis and Corrective Action

Reported issues undergo detailed analysis to identify root causes. Corrective and preventive measures are then implemented to avoid recurrence and strengthen overall operational integrity.

Digital Initiatives in Training



MTI Modules - The MTI Module serves as DG Shipping's central digital system for regulating Maritime Training Institutes, overseeing approvals, inspections, faculty records, INDoS generation, and compliance activities, but rising non-compliance and limited monitoring capacity have exposed the need for a modernized platform with stronger oversight and improved data integrity. A redesigned module would support STCW Board workflows, enhance inspection management across all inspection types, and integrate seamlessly with systems such as the LMS, faculty development programs, examination reforms, INDoS, RPSLs, grievance redressal mechanisms, and CAS. It would also provide better tools for updating faculty information, uploading batch data, enabling dynamic batch sizing, and capturing key institutional details such as approvals, MOUs, certifications, and course structures, ultimately improving transparency, accountability, and overall training quality across the maritime education ecosystem.

Dynamic Batch Sizing - Dynamic Batch Sizing is a data-driven method used to calculate the intake capacity for new pre-sea courses. It evaluates how many trainees joined shipboard training within the last 12 months and how quickly they transitioned after course completion. The method adds a 25% buffer to this verified placement-linked number to determine realistic intake capacity. If the number of students in an MTI who are getting shipboard training within 12 months decreases it negatively affects the intake capacity of the MTI for the next batch.

This ensures batch sizes are aligned with actual industry absorption, preventing oversupply and maintaining training quality.

Learning Management System -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 Simulator - A web-based simulator provides an immersive, interactive platform that replicates real-world maritime scenarios for effective learning and assessment.

Faculty Development Program (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.

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

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

Placement portal and authentic job portal - A placement portal is a structured platform used by institutes or organizations to connect trainees with verified employment opportunities, an authentic job portal ensures legitimacy by listing only genuine, vetted job openings, protecting candidates from misleading or fraudulent postings.

Indian Global Maritime Safety Platform

Maritime safety management today is increasingly dependent on **timely access to information, data-driven decision-making and continuous learning**. While India has established regulatory frameworks and issued multiple circulars, advisories and guidelines over time, these are often **dispersed across different platforms and formats**.

As a result:

- Access to critical safety information is not always immediate
- Learning from past incidents is not systematically institutionalized
- There is limited integration between safety data, training and operational practices

With the growing complexity of maritime operations and increasing emphasis on **risk prevention rather than incident response**, there is a need to move towards a more structured and technology-enabled safety ecosystem.

Concept of Indian Global Maritime Safety Platforms

The proposed initiative aims to develop a **unified digital platform for maritime safety**, bringing together safety-related data, regulatory guidance, training content and analytics within a single framework.

The platform is intended to serve as:

- A **central repository of safety knowledge**
- A **decision-support system based on real-time data and analytics**
- A **learning and awareness tool for maritime stakeholders**

The broader objective is to shift from a fragmented approach to a **continuous, system-driven safety management model**.

Purpose

The platform is designed to:

- Improve maritime safety across operations
- Promote a culture of **risk awareness and prevention**
- Align domestic practices with **international safety standards and best practices**

It also supports India's broader maritime vision by strengthening safety governance and operational reliability.

Key Features

Real-Time Safety Dashboards and Analytics

The platform will provide dynamic dashboards accessible across devices, enabling:

- Monitoring of safety indicators
- Identification of risk patterns
- Data-driven decision-making

Centralized Repository of Safety Information

A structured and multilingual repository will be developed, covering:

- Circulars and advisories
- IMO guidelines and international references
- Best practices and safety protocols

This ensures that all stakeholders have **easy and consistent access to verified information**.

Integration of Safety Training Content

The platform will host a series of **animated and module-based safety videos**, which can be integrated into training programmes.

These will:

- Simplify complex safety concepts
- Improve retention and awareness
- Support continuous learning

Maritime Incident Database and Analytics

An integrated database of maritime incidents will be developed, supported by analytical tools such as Power BI or Tableau.

This will enable:

- Identification of recurring causes
- Trend analysis
- Preventive action planning

Support for "Zero Incident" Approach

By combining data, training and monitoring, the platform will support a shift towards a **preventive safety culture**, rather than reactive compliance.

Expected Outcomes

The implementation of the platform is expected to:

- Improve **access to safety information** across stakeholders
- Enable **data-backed decision-making**
- Strengthen **learning from past incidents**
- Enhance **awareness and training effectiveness**
- Support better **compliance with safety standards**

Over time, this will contribute to a measurable improvement in **overall safety performance in the maritime sector**.

Strategic Importance

The Indian Global Maritime Safety Platforms initiative represents a step towards **digitally enabled safety governance**.

It aligns with:

- International expectations on safety management systems
- Increasing use of analytics and digital tools in maritime operations
- India's focus on strengthening its maritime ecosystem

Importantly, it enables a move from static documentation to dynamic, data-driven safety systems

Implementation Approach

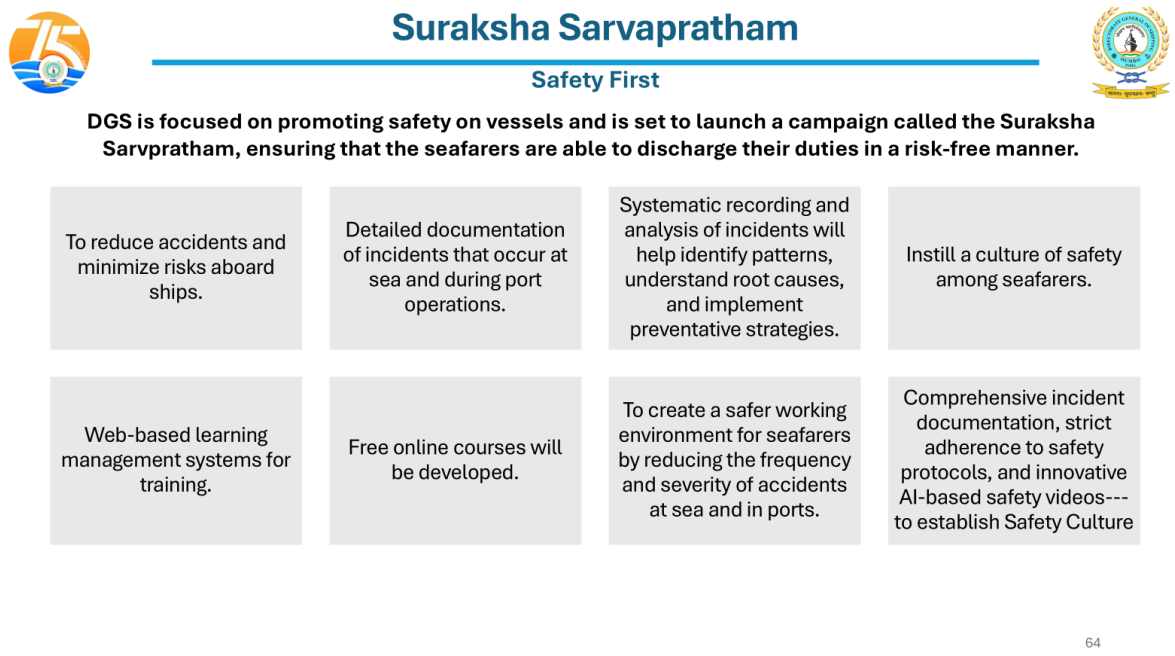
The platform may be developed and rolled out in phases:

- Creation of core repository and dashboard framework
- Integration of incident data and analytics tools
- Development of training content and learning modules
- Expansion to include advanced analytics and predictive insights

Stakeholder engagement will be critical to ensure usability and adoption.

Suraksha Sarvapratham

Safety First – Institutionalising a Culture of Maritime Safety



Maritime operations inherently involve exposure to risk — whether during navigation at sea, cargo operations at port, machinery handling, confined space entry or interaction with heavy equipment. While regulatory frameworks and international conventions provide the structural backbone for safety compliance, incidents continue to occur due to operational lapses, human error, inadequate documentation or insufficient training reinforcement.

Recognising this, the Directorate General of Shipping (DGS) proposes to launch a focused safety campaign titled **"Suraksha Sarvapratham" (Safety First)**. The initiative aims to institutionalise a preventive safety culture across Indian-flag vessels and among Indian seafarers serving globally.

The campaign seeks to ensure that seafarers are able to discharge their duties in a structured, risk-aware and safety-compliant environment, both at sea and during port operations.

Core Objectives of the Campaign

The Suraksha Sarvapratham initiative is guided by four primary objectives:

1. **Reduction in Accidents and Near Misses**
   To systematically reduce the frequency and severity of onboard accidents through structured preventive interventions.
2. **Strengthening Incident Documentation and Analysis**
   To ensure detailed recording of all safety incidents, near misses and hazardous occurrences at sea and in port.

3. **Root Cause Identification and Preventive Strategy Development**
   To analyse incident data in order to identify recurring patterns, systemic gaps and operational vulnerabilities.
4. **Institutionalisation of Safety Culture**
   To embed safety awareness as a behavioural norm rather than a compliance obligation.

The initiative moves beyond reactive investigation toward structured risk anticipation and mitigation.

Structured Incident Recording and Data Analytics

A central component of the campaign will be the systematic recording of:

- Personal injury incidents
- Machinery failures
- Cargo handling accidents
- Navigational near misses
- Port operation hazards

By building a centralized database of reported events, DGS will be able to:

- Identify trends across vessel types
- Map risk-prone operational areas
- Recognize training deficiencies
- Recommend targeted corrective measures

The emphasis will be on converting isolated incident reports into actionable safety intelligence.

Web-Based Learning and Digital Training Support

To reinforce safety practices, the campaign will leverage digital platforms for structured learning.

Key elements include:

- Web-based learning management systems for safety training
- Development of free online safety modules
- Refresher courses on critical operational procedures
- Scenario-based learning tools

These digital modules will support continuous professional development and ensure accessibility across geographic locations.

The objective is to make safety training dynamic, easily accessible and regularly updated.

Promotion of Proactive Safety Culture

Safety culture cannot be achieved solely through regulation; it requires behavioural reinforcement.

The campaign will promote:

- Strict adherence to established safety protocols
- Transparent reporting of near misses without fear of reprisal
- Leadership accountability onboard vessels
- Periodic safety audits and awareness drives

In addition, innovative tools such as AI-based safety awareness videos and interactive learning formats may be deployed to enhance engagement and comprehension.

The long-term goal is to ensure that safety is perceived not as a compliance requirement but as a professional obligation.

Safer Working Environment and Human-Centric Focus

The campaign recognises that seafarer well-being is central to safe operations. By reducing accident frequency and operational risk exposure, the initiative contributes to:

- Improved physical safety onboard
- Reduced psychological stress associated with hazardous conditions
- Enhanced operational confidence
- Stronger trust in regulatory oversight

Creating a safer working environment also improves morale and supports retention within the maritime workforce.

Expected Outcomes

If implemented effectively, Suraksha Sarvapratham is expected to:

- Reduce accident frequency and severity over time
- Improve quality and consistency of incident reporting
- Enhance compliance with international safety standards
- Strengthen India’s reputation as a responsible maritime administration
- Foster a sustained culture of safety across Indian seafarers globally

The initiative aligns with broader objectives of maritime governance reform and workforce protection.

Coastal Shipping

Coastal shipping refers to the movement of goods and passengers along a country's coastline using sea routes. In the Indian context, it offers a **cost-effective and energy-efficient alternative** to traditional modes such as road and rail.

Despite having a long coastline and significant inland water potential, coastal shipping in India has historically remained **underutilised**, with a larger share of cargo continuing to move through land-based transport. This has implications for logistics cost, congestion and environmental impact.

With increasing focus on **multi-modal logistics and decarbonisation**, coastal shipping is being revisited as a key component of the national transport strategy.

India's Potential

India is well-positioned to expand coastal shipping, given its natural and infrastructural advantages:

- A coastline of over **11,000 km**
- Around **14,000 km of navigable waterways**
- Presence of major and non-major ports along key trade routes

However, this potential is yet to be fully realised, particularly when compared to the share of cargo carried by road and rail. Unlocking this capacity can significantly improve logistics efficiency.

Current Trends and Growth

Coastal shipping has shown steady growth in recent years. Coastal cargo movement reached approximately **187 million tonnes in 2023–24**, reflecting gradual improvement.

The cargo mix primarily includes:

- Petroleum, oil and lubricants (POL)
- Crude oil
- Containers

- Bulk commodities such as iron ore

Ports such as **Paradip and Deendayal** have emerged as key hubs for coastal cargo movement.

While the growth trend is positive, the overall share of coastal shipping in total cargo movement remains relatively modest, indicating scope for further expansion.

Policy and Reform Measures

Recognising its importance, several policy initiatives have been undertaken to strengthen the sector:

- The proposed **Coastal Shipping Bill, 2025** aims to provide a modern legal framework aligned with international cabotage practices
- A target of **230 million tonnes of coastal cargo by 2030** has been set
- Development of a **National Coastal and Inland Shipping Strategic Plan**
- Creation of a **National Database for Coastal Shipping** to improve data availability and planning

These measures are intended to create a more enabling environment for operators and encourage modal shift towards sea transport.

Benefits of Coastal Shipping

Cost and Carbon Efficiency

Shipping is widely recognised as the **most energy-efficient mode of transport per tonne-kilometre**, resulting in lower fuel consumption and emissions compared to road and rail.

Reduction in Congestion and Pollution

Shifting cargo movement to coastal routes helps:

- Reduce pressure on highways and rail networks
- Lower urban congestion
- Improve air quality in logistics corridors

Support to Green Logistics

Coastal shipping aligns with India's broader push towards **low-carbon logistics systems** and supports commitments related to climate targets and sustainability.

Contribution to Large-Scale Logistics Efficiency

Movement of bulk cargo through coastal routes reduces dependency on fossil fuel-intensive transport modes and improves overall system efficiency.

It also acts as a key enabler for the **Blue Economy and Green Economy transition**, linking ports, industries and hinterland regions.

Strategic Importance

Coastal shipping plays an important role in:

- Diversifying India's logistics network
- Reducing overall logistics cost
- Supporting industrial and port-led development

It is also aligned with national priorities such as:

- **Atmanirbhar Bharat**
- **Viksit Bharat 2047**
- Maritime India Vision and related sectoral strategies

Coastal State Workshops

India's maritime ecosystem operates across a federal structure, where coastal states play a significant role in areas such as port operations, coastal shipping, shipbuilding, ship recycling, fisheries interface, environmental protection and maritime manpower development.

While national policies provide overarching direction, effective implementation requires structured coordination with State Maritime Boards, port authorities and local maritime stakeholders.

In this context, the Directorate General of Shipping proposes to institutionalize a series of **Coastal State Workshops** aimed at strengthening maritime governance, advancing capacity building and fostering collaborative implementation of national maritime priorities at the state level.

These workshops are intended not merely as consultative events, but as structured engagement platforms to align state-level initiatives with national maritime vision frameworks including Maritime India Vision 2030 and long-term sustainability objectives.

Strategic Objectives

The Coastal State Workshops are designed with the following core objectives:

- Strengthen coordination between DGS and State Maritime Boards
- Identify state-specific maritime opportunities and challenges
- Facilitate structured dialogue on shipbuilding, ship recycling and coastal shipping
- Promote safety, skilling and compliance frameworks
- Support sustainability and decarbonisation initiatives at regional level

The workshops aim to translate national maritime policy into actionable state-level engagement.

Six-Pillar Framework

The workshops will be structured around six thematic pillars, ensuring comprehensive coverage of key maritime domains.

Pillar 1: Maritime Safety and Casualty Response

This pillar will focus on:

- Strengthening casualty reporting mechanisms
- Enhancing coordination between port authorities, coastal states and DGS during incidents
- Promoting compliance with safety standards
- Building capacity for emergency preparedness and response

The objective is to reduce maritime accidents and improve coordinated response capabilities.

Pillar 2: Shipbuilding and Ship Recycling Opportunities

This pillar will explore:

- State-level shipbuilding capacity
- Ship repair clusters
- Ship recycling potential in coastal regions
- Policy incentives and infrastructure gaps

The aim is to identify industrial growth opportunities while ensuring regulatory compliance and environmental safeguards.

Pillar 3: Maritime Training, Skilling and Zero Corruption in Maritime

This pillar addresses:

- Expansion of maritime training infrastructure
- Skill development aligned with emerging technologies and green fuels
- Strengthening transparency in maritime certification and training processes
- Promoting integrity and zero tolerance toward corruption

The focus is to enhance human capital development and governance standards.

Pillar 4: Maritime Crewing and Employment Opportunities

This pillar will discuss:

- Increasing employment opportunities for seafarers
- Strengthening state-level engagement with crewing agencies
- Promoting zero tolerance in crewing and manning irregularities
- Addressing welfare concerns of seafarers

This directly supports India's ambition to increase its share in the global maritime workforce.

Pillar 5: Decarbonization, Sustainability and Sea & Environment Protection

This pillar integrates environmental governance at the state level, covering:

- Port sustainability initiatives
- Alternative fuel readiness
- Shore-to-ship power systems
- Waste management and marine pollution control
- Alignment with Green Port Index parameters

The objective is to mainstream environmental compliance and decarbonisation across coastal states.

Pillar 6: Coastal Shipping and Multimodal Shift

This pillar focuses on:

- Promoting coastal shipping as a cost-efficient and lower-emission transport mode
- Strengthening inland navigation integration
- Enhancing multimodal logistics connectivity

- Identifying infrastructure and policy bottlenecks

The emphasis is on shifting cargo movement toward more sustainable transport modes.

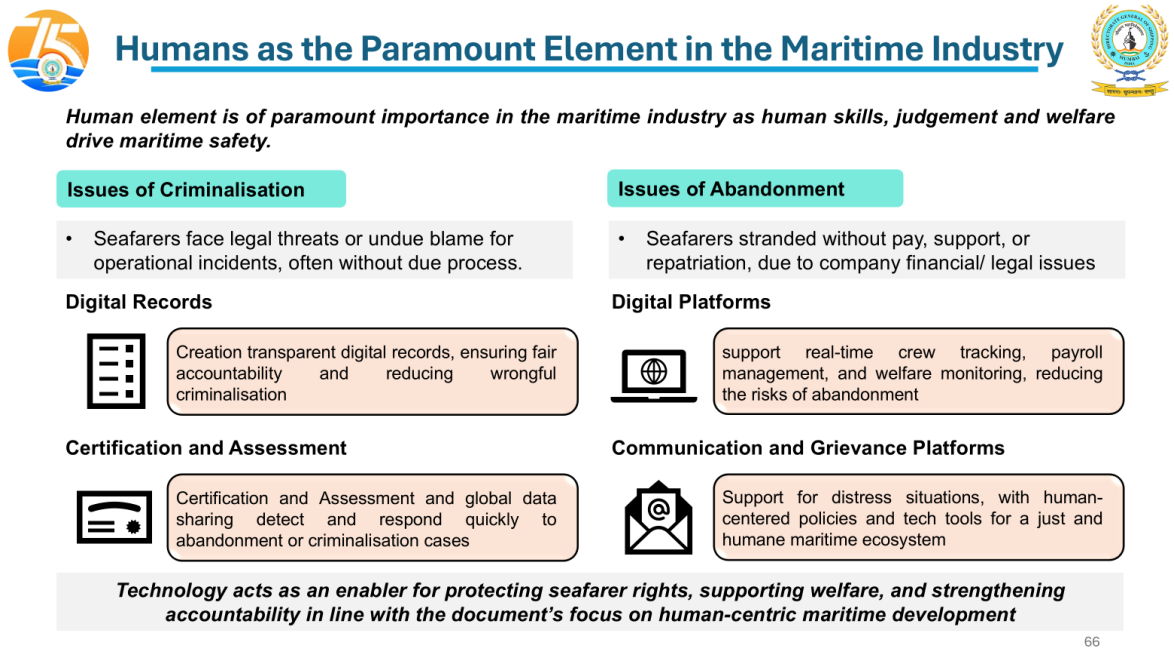
Expected Outcomes

The Coastal State Workshops are expected to deliver:

- Improved alignment between central and state maritime priorities
- Identification of state-specific development roadmaps
- Enhanced safety and compliance awareness
- Acceleration of shipbuilding and recycling clusters
- Strengthened decarbonisation and sustainability implementation
- Increased employment and skill development pathways

Over time, these workshops can evolve into a regular consultative mechanism bridging policy formulation and ground-level execution.

Humans as the paramount element in Maritime Industry



The maritime sector is undergoing an unprecedented transformation driven by decarbonisation, digitalisation, automation and evolving regulatory expectations. Despite these technological advancements, the **human element remains the most critical factor in ensuring safe, efficient and sustainable maritime operations**.

Ships may increasingly incorporate advanced digital systems, autonomous technologies and data-driven decision tools, but the **judgement, experience, professionalism and wellbeing of seafarers continue to form the foundation of maritime safety and operational reliability**. International maritime safety frameworks, including those under the International Maritime Organization (IMO), consistently recognise that **a large proportion of maritime incidents are influenced by human factors**, such as decision-making processes, operational fatigue, communication gaps or organisational pressures.

Therefore, strengthening the human dimension of maritime operations is not only a welfare issue but also a **core safety and governance priority for the global maritime industry**.

The slide highlights two major concerns that are increasingly being discussed in global maritime governance: **criminalisation of seafarers and abandonment of seafarers**.

Issues of Criminalisation of Seafarers

One of the most concerning developments in the maritime sector is the **increasing criminalisation of seafarers following maritime incidents**.

In certain cases involving accidents, pollution events or operational failures, seafarers have been subjected to **legal prosecution, detention or undue blame even before full investigation of the incident is completed**. This situation may arise when local legal frameworks hold ship personnel directly responsible for incidents that may actually result from systemic failures such as technical malfunction, inadequate safety management systems, regulatory ambiguity or operational pressures imposed by shipping companies.

Such circumstances can undermine the principles of **fair investigation and due process**, which are essential for maintaining confidence among maritime professionals. The fear of criminalisation may discourage open reporting of operational issues and could negatively impact the safety culture within the maritime industry.

To address this concern, there is increasing emphasis on the creation of **transparent digital documentation systems** that record operational activities, safety compliance and decision-making processes onboard ships. These digital records help ensure accountability while protecting seafarers from wrongful accusations by providing verifiable evidence of operational conduct.

The integration of **digital logs, automated monitoring systems and tamper-proof operational records** can help improve transparency and fairness in post-incident investigations. By establishing reliable data trails, such systems help regulators and investigators determine the actual causes of incidents and prevent unjust criminalisation of maritime personnel.

Issues of Abandonment of Seafarers

Another major human welfare issue in the maritime sector is the **abandonment of seafarers by shipowners or operators**.

Abandonment typically occurs when shipowners face financial distress, legal disputes or bankruptcy, leaving crew members stranded onboard vessels or in foreign ports without wages, repatriation arrangements or basic support. Such situations can place seafarers in extremely vulnerable circumstances, often without access to adequate food, medical care or legal assistance.

The issue of abandonment has received increasing international attention in recent years, with several global institutions highlighting the need for stronger monitoring and accountability mechanisms.

To address this challenge, digital solutions are emerging as important tools for **crew welfare monitoring and transparency in employment practices**. Digital platforms can support real-time crew tracking, contract monitoring, wage payment verification and welfare status updates.

Through integrated maritime digital platforms, authorities and shipping companies can monitor the **status of crew contracts, payroll compliance and repatriation arrangements**, thereby

reducing the risk of abandonment and enabling early intervention in cases where crew welfare may be compromised.

Role of Certification, Data Sharing and Regulatory Oversight

Effective protection of seafarer rights requires **robust certification and global information-sharing mechanisms** among maritime authorities, training institutions and international organisations.

Certification and assessment systems play a vital role in ensuring that seafarers possess the necessary competencies to operate safely in increasingly complex maritime environments. At the same time, global databases and regulatory networks allow authorities to **identify emerging issues such as abandonment cases or wrongful criminalisation** and coordinate responses across jurisdictions.

Data-sharing frameworks also allow faster identification of non-compliant operators, enabling regulators to intervene before situations escalate into serious human welfare concerns.

Importance of Communication and Grievance Mechanisms

An effective maritime ecosystem must also provide **accessible communication channels through which seafarers can raise concerns, report grievances and seek assistance in distress situations**.

Grievance redressal systems, helplines and digital communication platforms allow seafarers to report issues related to contractual disputes, safety concerns, harassment or welfare challenges. These platforms ensure that seafarers remain connected with regulatory authorities and welfare organisations even while operating in remote maritime environments.

By combining human-centred policies with technology-enabled communication tools, the maritime sector can create a more **transparent, accountable and supportive environment for maritime professionals**.

Technology as an Enabler of Human-Centric Maritime Governance

While technological transformation is rapidly reshaping maritime operations, technology should not be viewed as a replacement for human capabilities but rather as a **support system that strengthens human performance and welfare**.

Digital technologies such as automated recordkeeping systems, crew management platforms and integrated maritime databases can enhance accountability while protecting seafarer rights. When designed properly, these tools enable better monitoring of working conditions, fair treatment of personnel and improved operational transparency.

The adoption of such technologies reflects the growing global consensus that **future maritime development must remain human-centric**, ensuring that innovation in shipping and port operations is accompanied by stronger safeguards for seafarer wellbeing.

Human-Centric Maritime Development

Ultimately, the long-term sustainability of the maritime industry depends on maintaining a strong focus on the **human element**.

Seafarers remain the backbone of global maritime trade, responsible for operating vessels, managing complex systems and responding to emergencies in challenging environments. Protecting their rights, ensuring their welfare and supporting their professional development are essential for maintaining safety standards and operational reliability across the maritime sector.

A balanced approach that integrates **technological innovation with human-centred governance frameworks** will be essential for building a maritime ecosystem that is not only efficient and sustainable but also fair and resilient.

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