“Good morning ladies and gentlemen.”

At the outset, I would like to thank **Kongsberg Maritime** for organising this Hydrodynamics and Propulsion Seminar and for bringing together a strong community of **industry stakeholders** here today.

The maritime sector globally is at a point where **technology, propulsion choices and sustainability objectives are converging**. As shipping moves through this transition decade, efficiency, performance and operational reliability are no longer incremental improvements — they are becoming **strategic requirements**.

India’s maritime transition is being shaped around this very premise. Whether we are looking at **newbuild vessels or existing fleets**, the focus increasingly is on **hydrodynamic efficiency, propulsion optimisation, lifecycle performance and reduced environmental footprint**.

It is therefore particularly relevant that today’s seminar covers a comprehensive range of technical themes — from **core ship hydrodynamics**, **propeller design and cavitation**, **shaftline systems**, and **propulsion upgrades**, to **thrusters, harbour tugs, podded and rim-driven propulsion, waterjets**, and **special-purpose vessel requirements** such as noise, vibration and manoeuvrability.

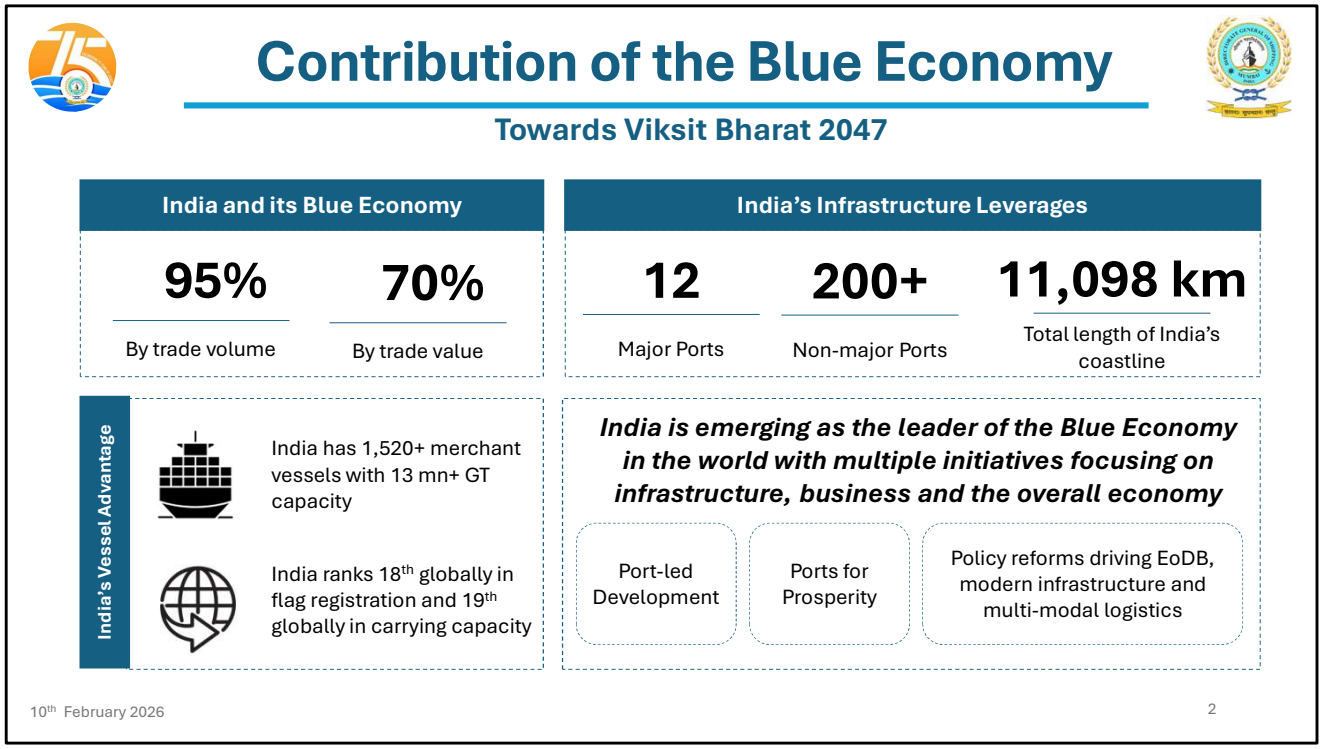
These are not isolated technical topics. They directly underpin India's ongoing efforts on **green shipping, port decarbonisation and cleaner harbour craft**, including initiatives such as the **Green Tug Transition Program**, where propulsion efficiency and manoeuvrability are critical.

I see today's discussions as an important opportunity to **connect policy direction with engineering solutions**, and to exchange practical insights on how advanced hydrodynamics and propulsion technologies can support a **safe, efficient and sustainable maritime transition**.

With that context, I once again welcome all participants and look forward to the technical deliberations during the day.

"I wish the seminar every success."

Jai Hind!



Contribution of the Blue Economy

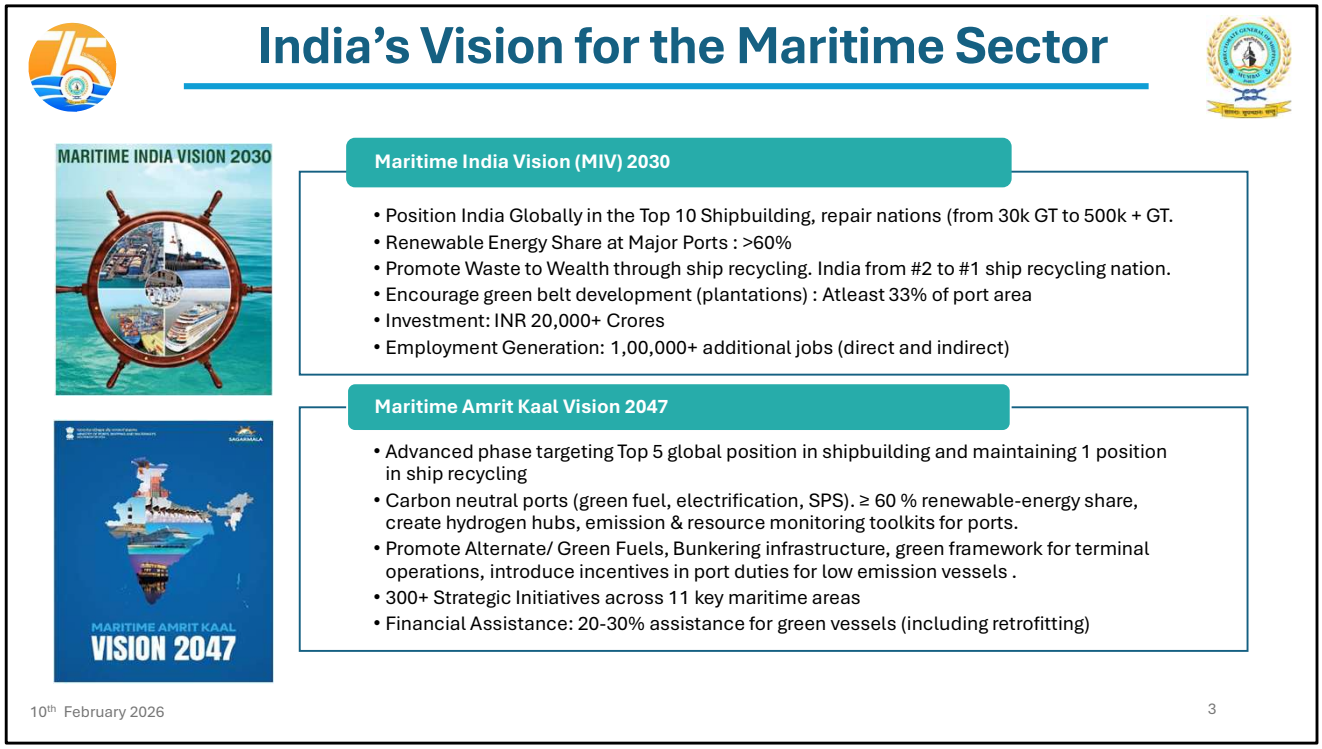
The Blue Economy lies at the heart of India's economic and strategic rise, accounting for **95% of trade by volume and 70% by value**. With **12 major ports, 200+ non-major ports, and an extensive coastline of 11,098 km**, India possesses one of the largest maritime infrastructures in the world, giving it a natural advantage in connecting markets and enabling prosperity.

India's fleet strength has also grown steadily, with **1,520+ merchant vessels aggregating over 13 million GT capacity**. On the global stage, India now ranks **18th in flag registration and 19th in carrying capacity**, underscoring its expanding role in global shipping while contributing significantly to supply chain resilience.

The Government has positioned the Blue Economy as a **pillar of Viksit Bharat 2047**, with a strong emphasis on **port-led development, multimodal logistics, and ease of doing business reforms**. Initiatives under Sagarmala, Harit Sagar, and Maritime India Vision 2030 have transformed ports into hubs of efficiency, green practices, and integrated logistics.

Thus, India's Blue Economy is not just about scale, but about direction, moving towards sustainability, competitiveness, and strategic influence. As the world transitions towards cleaner and more resilient maritime operations, India's leadership in the Blue Economy offers

a model of how infrastructure, business, and policy can be aligned to deliver long-term growth and global impact.



India's Vision for the Maritime Sector

Focus: Decarbonization & Sustainability – MIV 2030 and MAKV 2047

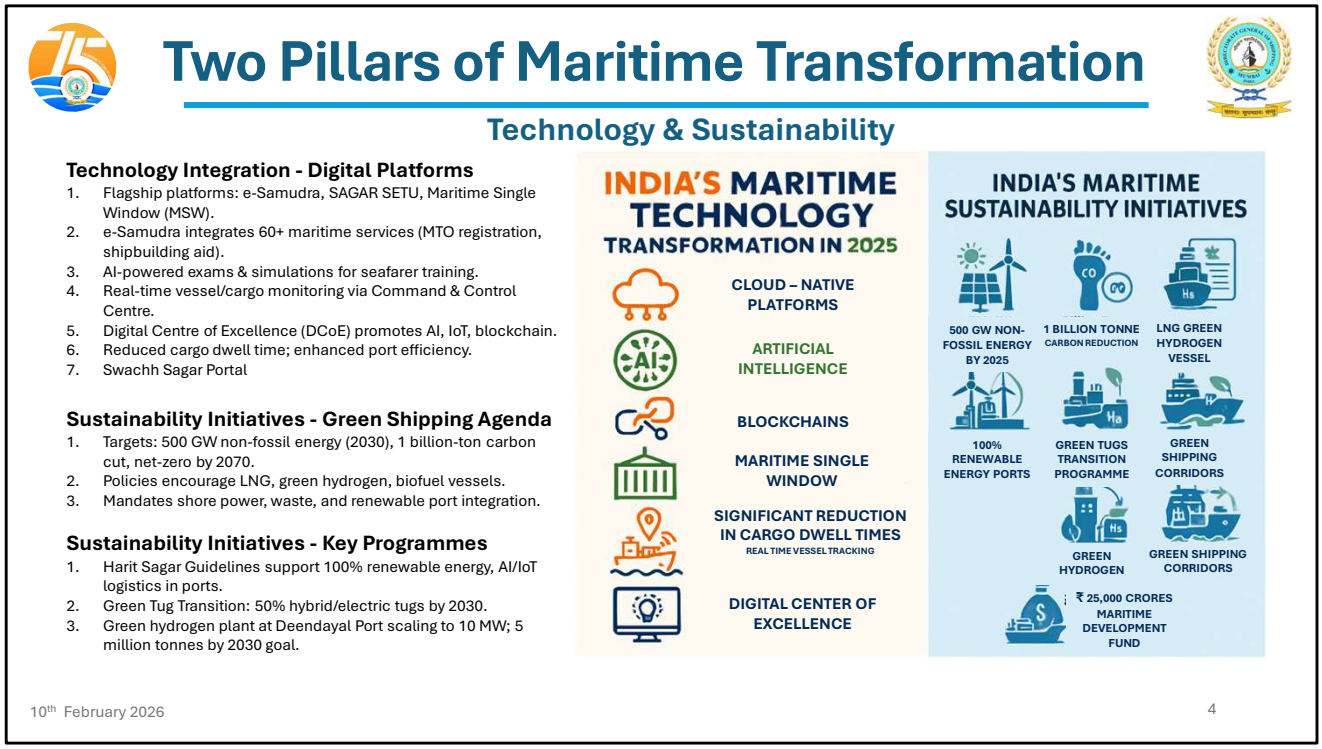
India's maritime growth strategy is deeply anchored in sustainability and green transition. Both the *Maritime India Vision 2030* and *Maritime Amrit Kaal Vision 2047* outline clear, actionable pathways to decarbonize the sector.

Under **Maritime India Vision 2030**, the focus is on immediate-term transformation, positioning India among the world's top ten shipbuilding nations while driving sustainability across ports and shipping. The plan calls for achieving **over 60% renewable energy share at Major Ports**, promoting **Waste-to-Wealth** through ship recycling, and **green belt development covering at least 33% of port areas**. These measures are aimed at reducing emissions, improving air quality, and making ports self-reliant in clean power.

Moving forward, **Maritime Amrit Kaal Vision 2047** builds on this foundation to deliver **carbon-neutral ports** powered by **green fuels, electrification, and shore power supply**. It envisions the creation of **Hydrogen hubs**, **emission and resource monitoring toolkits**, and strong **incentive mechanisms** such as **port dues discounts for low-emission vessels**.

Both MIV & MAKV, emphasizes the integration of **alternate fuels**, including **LNG, biofuels, hydrogen, ammonia** and plan to extend **20–30% financial assistance for green vessels and**

retrofitting initiatives. Together, these steps ensure that India's maritime sector transitions towards a low-carbon, resilient, and future-ready ecosystem , aligned with IMO's Net Zero 2050 ambition and India's national climate commitments.



Two Pillars of Maritime Transformation

India's maritime transformation is being led through two parallel and reinforcing pillars, Technology integration and Sustainability adoption. On the technology front, flagship digital platforms such as e-Samudra, SAGAR SETU and the Maritime Single Window are reshaping port, fleet and regulatory services. These platforms integrate over sixty maritime functions, from vessel registration to shipbuilding support, while AI-powered exams, simulations and real-time command centres are modernising training and operational visibility.

The Digital Centre of Excellence is now promoting advanced technologies such as AI, IoT and blockchain, targeting reduced cargo dwell times, predictive logistics and enhanced transparency. Initiatives like the Swachh Sagar Portal and automated monitoring systems are creating a unified digital maritime ecosystem.

Parallel to this, India's sustainability pillar is anchored in national commitments — 500 GW of non-fossil energy by 2030 and one billion tonnes of carbon reduction. Maritime policies now actively promote LNG, green hydrogen and biofuel-based vessels, alongside mandatory adoption of shore power, waste reception and renewable port integration.

Through programmes such as the Harit Sagar Guidelines, Green Tug Transition and the planned 10 MW hydrogen facility at Deendayal Port, India is aligning port infrastructure with

future fuel readiness. Together, these two pillars position India not only to meet regulatory compliance but to emerge as a global leader in green, intelligent and future-ready maritime operations.

Green Shipping – The Big Picture

- Shipping is the **backbone of global trade** – carrying 80% of goods worldwide.
- Shipping contributes to ~3% of global CO_2 emissions.
- Green Shipping = *making ships, ports, and supply chains cleaner, smarter, and future-ready.*
- It's not just about compliance — it's about **staying competitive in a low-carbon economy.**
- **Vision & Commitments:**
  - Aligned with *Maritime India Vision 2030 & Maritime Amrit Kal Vission 2047*.
  - Supports IMO's **Net Zero 2050** ambition.
  - Anchored in India's **Panchamrit Pledge** – 500 GW non-fossil capacity by 2030, Net Zero by 2070.

"The future of shipping is green — by necessity, not by choice."

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Green Shipping – The Big Picture

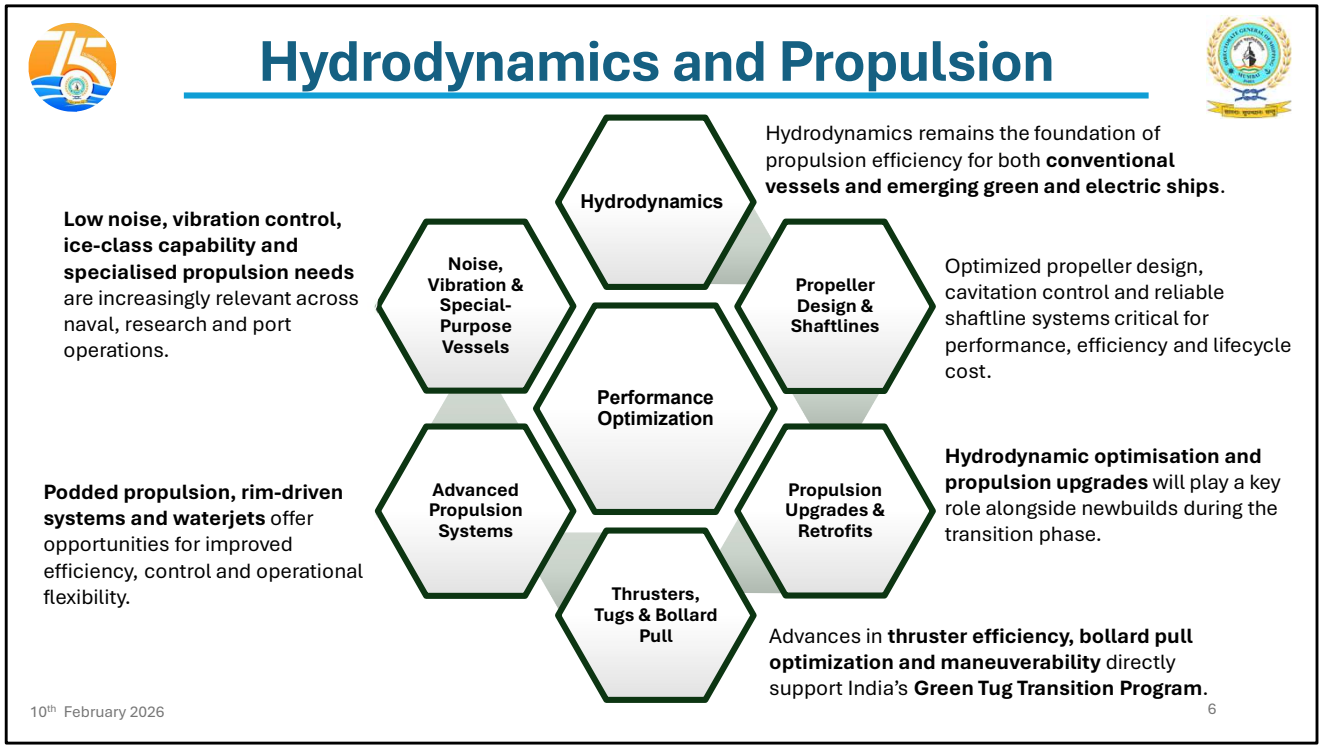
Shipping is the backbone of world trade, carrying nearly **80% of global goods**. But it is also responsible for **~3% of global CO_2 emissions**, making decarbonisation one of the most pressing challenges of our time.

Green Shipping is not just about compliance, it is about transforming **ships, ports, and supply chains into cleaner, smarter, and future-ready systems**. In a low-carbon economy, sustainability is synonymous with competitiveness, and the maritime sector cannot afford to lag behind.

India's approach aligns ambition with action:

Maritime India Vision 2030 and **Maritime Amrit Kaal Vision 2047** embed sustainability into long-term growth strategies.
India supports the **IMO's Net Zero 2050** ambition, strengthening its role as a responsible maritime nation.
Through the **Panchamrit Pledge**, India has committed to 500 GW of non-fossil capacity by 2030 and Net Zero by 2070, anchoring maritime decarbonisation within the national clean energy agenda.

The **future of shipping is green by necessity, not by choice.** Green shipping is not a burden but an opportunity: to reduce costs, attract green finance, and ensure India remains at the forefront of global maritime competitiveness.



Hydrodynamics and Propulsion

*"Before we move into today's technical sessions, I would like to briefly highlight the **key technical themes that will be covered through the course of today's seminar**."*

Hydrodynamics remains the **foundation of propulsion efficiency**, whether we are discussing conventional vessels or the emerging generation of **green and electric ships**. As energy systems evolve and operating profiles change, the importance of hull–propeller–propulsion interaction becomes even more critical.

Several sessions today will focus on **propeller design, cavitation control and shaftline systems**, which are central not only to vessel performance, but also to **efficiency, reliability and lifecycle cost**.

For a large existing fleet such as India's, **propulsion upgrades and hydrodynamic optimisation** will be as important as newbuilds during the transition phase. Retrofitting and upgrading existing vessels allows immediate efficiency gains while newer technologies mature.

A major focus area today is **thrusters, tugs and bollard pull performance**. Advances in **thruster efficiency, manoeuvrability and bollard pull optimisation** directly support India's

Green Tug Transition Program, which seeks to modernise and green harbour tug operations.

The programme also covers **advanced propulsion configurations**, including podded propulsion, rim-driven systems and waterjets, which offer opportunities for improved efficiency, control and operational flexibility across specialised vessel types.

Finally, themes related to **low noise and vibration, ice-class capability and specialised propulsion requirements** are increasingly relevant across **naval, research and port operations**, and form an important part of today's discussions.

"These themes together underline why hydrodynamics and propulsion remain central to both operational efficiency and the maritime transition ahead."

National Green Shipping Policy (NGSP)

The **National Green Shipping Policy (NGSP)** represents **India's comprehensive maritime decarbonisation roadmap**, designed to align the shipping and port ecosystem with global climate imperatives while simultaneously safeguarding economic growth, trade competitiveness and industrial development. As articulated in the consultative framework, NGSP is **not merely an environmental initiative**, but a **strategic transformation agenda** intended to position India as a **global hub for green ships, green fuels, green ports and maritime innovation**.

The policy draws momentum from **international drivers** such as the **IMO 2023 GHG Strategy** and India's **COP-26 Panchamrit commitments**, while remaining anchored in domestic maritime priorities. It adopts a **value-chain approach**, embedding sustainability across vessel design, fuel transition, port infrastructure, ship recycling, digital governance and financial mechanisms. Importantly, NGSP does not operate in isolation; it is structurally aligned with **Maritime India Vision 2030, Maritime Amrit Kaal Vision 2047, Sagarmala, and Harit Sagar guidelines**, thereby creating a **unified and forward-looking national maritime strategy** rather than fragmented initiatives.

Key Transition Pillars

Green Ships

Focuses on **energy-efficient vessel design, retrofitting of existing fleets, adoption of zero- and low-emission propulsion systems, and progressive green certification norms**. The long-term intent is to establish India as a **shipbuilding and retrofit hub** for next-generation low-carbon vessels serving both domestic and international markets.

Green Ports

Targets **port decarbonisation through shore power (OPS), electrification of cargo-handling equipment, renewable energy integration, emission monitoring systems, green corridors, and alternate fuel bunkering infrastructure**. Ports are envisioned as **multi-energy maritime hubs** supporting both operational efficiency and environmental stewardship.

Green Fuels

Promotes a **phased transition toward alternative marine fuels** including **biofuels, LNG, methanol, hydrogen and ammonia**, coupled with domestic production ecosystems and bunkering networks. The objective is to evolve India from a fuel importer to a **future global supplier of green marine fuels**.

Green Technology & Innovation

Encourages **digitalisation, data-driven maritime operations, hybrid propulsion systems, energy-saving devices, automation and indigenous technology development**, ensuring that innovation becomes a cross-cutting enabler across ships, ports and regulatory systems.

Green Recycling

Envisions **modernisation of ship recycling clusters such as Alang** through **Hong Kong Convention-compliant practices**, strengthened hazardous-waste management, circular-economy principles and safe labour standards, positioning India as a **global leader in environmentally sound ship recycling**.

Green Financing & Collaboration

Calls for **dedicated green maritime funds, ESG-linked financing, fiscal incentives, blended finance models, PPP structures and international cooperation frameworks** to de-risk investments and ensure equitable transition pathways for both large enterprises and MSMEs.

Green Skill Development & Capacity Building

Recognises that technological transition must be matched by **human capital readiness**, through structured training programmes, certification reforms, institutional strengthening and continuous professional development across seafarers, port personnel, recyclers and regulators.

Strategic Intent

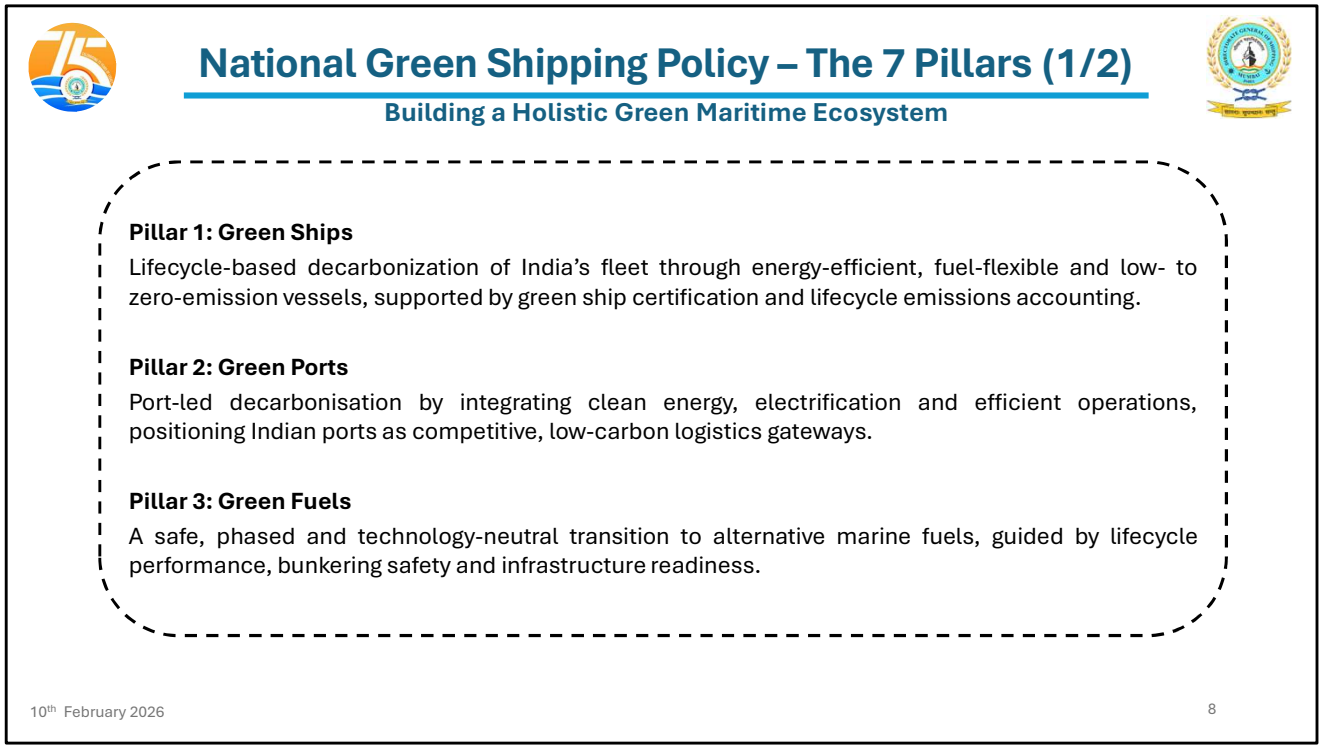
At its core, NGSP seeks to **shift India's maritime sector from reactive regulatory compliance to proactive global leadership**. The emphasis is on creating a maritime ecosystem that **exports technology, services and green solutions rather than**

environmental externalities. The policy underscores a **just and inclusive transition**, ensuring that industry stakeholders, labour forces, coastal communities, MSMEs and emerging enterprises are integrated into the transformation journey.
In summary, NGSP functions as **India's national reference framework for green maritime transformation**—linking sustainability with competitiveness, innovation with governance and environmental responsibility with long-term economic resilience.

Maritime INDIA @ Net Zero – Multi-Stakeholder Workshop

To operationalise the vision of the National Green Shipping Policy and translate policy intent into implementation-ready pathways, the **Maritime INDIA @ Net Zero Workshop** was convened on **14–15 January 2026 at the India Habitat Centre, New Delhi (Hybrid Mode)**. The workshop was jointly organised by the **Directorate General of Shipping (DGS)** and the **National Centre of Excellence for Green Ports & Shipping (NCoEGPS) at TERI**, bringing together ministries, regulators, industry leaders, ports, shipping companies, fuel providers, financial institutions, academia and international partners.

The two-day engagement served as a **high-level action-planning and governance platform**, enabling session-wise deliberations across all NGSP pillars including green ships, ports, fuels, recycling, finance, technology and capacity building.



National Green Shipping Policy – The 7 Pillars

"To briefly place today's technical discussions in a broader policy context, I would like to touch upon the upcoming National Green Shipping Policy, which provides India's overarching framework for maritime decarbonisation."

The National Green Shipping Policy is structured around **seven integrated pillars**, designed to build a **holistic green maritime ecosystem**, rather than addressing decarbonisation in isolation.

The first pillar focuses on **Green Ships**, where the emphasis is on **lifecycle-based decarbonisation**. This includes energy-efficient vessel design, fuel flexibility and low- to zero-emission ships, supported by green ship certification and lifecycle emissions accounting. The objective is to ensure that efficiency and emissions are addressed across the **entire life of a vessel**, not just at the point of operation.

The second pillar addresses **Green Ports**, recognising that ports are critical enablers of maritime decarbonisation. This pillar focuses on integrating **clean energy, electrification and efficient operations**, positioning Indian ports as competitive and low-carbon logistics gateways. Initiatives such as electrification of port craft, shore power and green port guidelines directly align with this pillar.

The third pillar relates to **Green Fuels**, which adopts a **safe, phased and technology-neutral approach** to alternative marine fuels. The focus here is on lifecycle performance, bunkering safety and infrastructure readiness, ensuring that fuel transition progresses in a structured and operationally viable manner.

"Together, these first three pillars establish the foundation for the technical themes being discussed today — efficiency, propulsion performance, fuel readiness and port integration."

National Green Shipping Policy – The 7 Pillars

"The remaining pillars of the National Green Shipping Policy focus on enabling implementation and ensuring that the transition is safe, inclusive and sustainable."

The fourth pillar addresses **Green Ship Recycling**, recognising the importance of closing the lifecycle loop. India is advancing **safe, environmentally sound and circular ship recycling**, aligned with the **Hong Kong Convention**, while strengthening worker safety, material recovery and digital transparency across recycling yards.

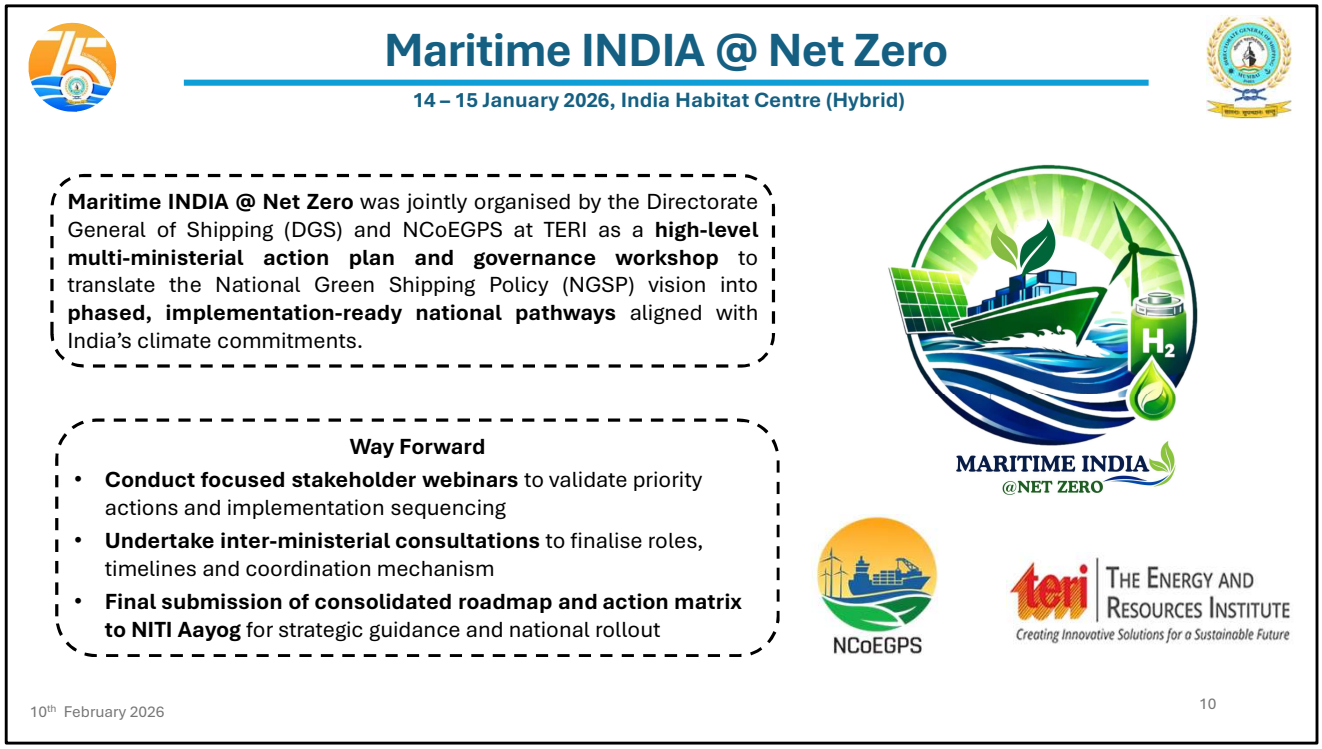
The fifth pillar focuses on **Green Finance**, which is critical for translating ambition into action. This pillar aims to **de-risk maritime decarbonisation** by mobilising affordable, long-term capital through blended finance, risk-sharing mechanisms and ESG-aligned investment frameworks, particularly for first movers.

The sixth pillar relates to **Green Skill Development and Capacity Building**. As new fuels, technologies and regulatory requirements emerge, preparing the **maritime workforce and institutions** becomes essential to ensure a just, inclusive and execution-ready transition.

The seventh pillar emphasises **Green Technology and Innovation**, encouraging the adoption and indigenisation of advanced maritime technologies. This includes the use of **digitalisation,**

pilot projects and innovation sandboxes to enhance efficiency, safety and competitiveness across the sector.

"Together, these pillars ensure that decarbonisation is supported by strong institutions, skilled people, accessible finance and innovation-led implementation."



Maritime INDIA @ Net Zero

This slide sets the overall context of the *Maritime INDIA @ Net Zero* initiative, which was conducted on **14–15 January 2026 at India Habitat Centre in hybrid mode**. The workshop was **jointly organised by the Directorate General of Shipping and NCoEGPS at TERI**, and it was designed not merely as a conference but as a **high-level, multi-ministerial action and governance platform**.

The primary objective of the workshop was to **translate the National Green Shipping Policy vision into phased, implementation-ready national pathways**. In other words, the focus was on moving from policy intent to actionable roadmaps aligned with **India's broader climate and sustainability commitments** rather than remaining at a conceptual discussion stage.

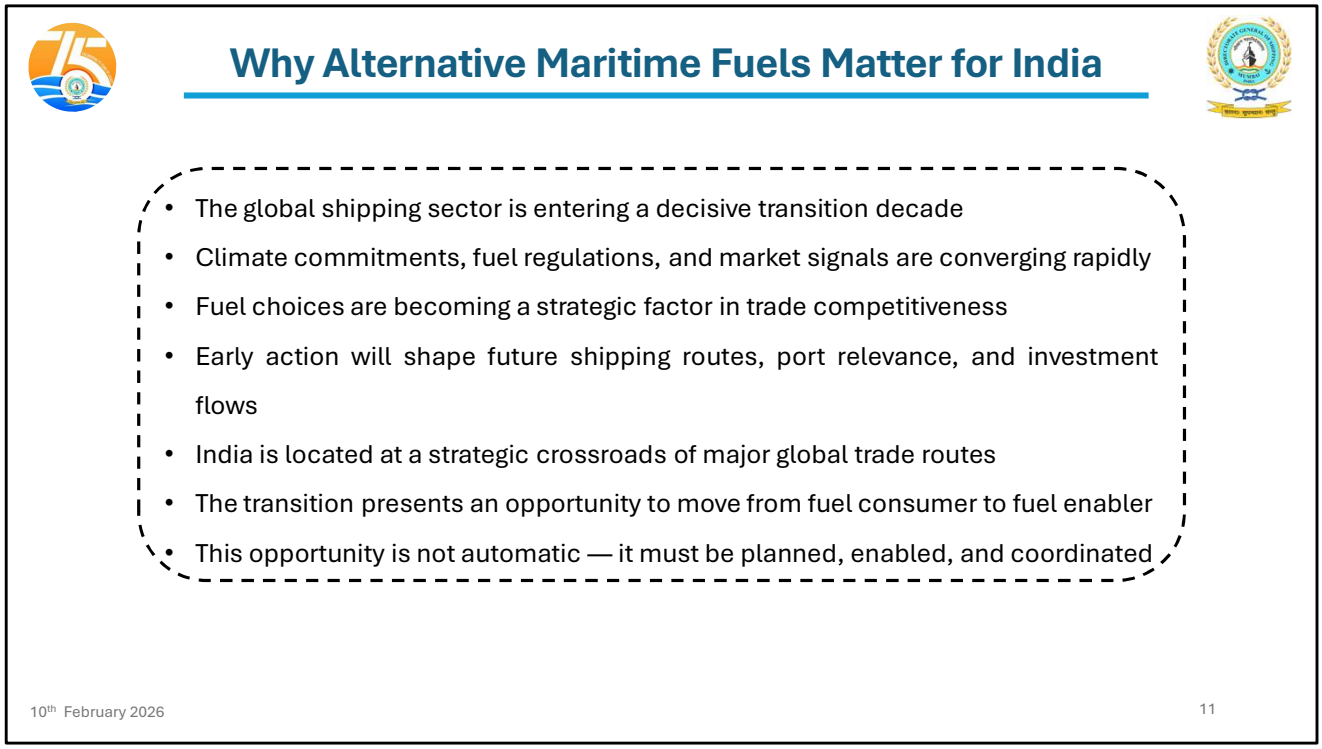
A key strength of the workshop was the **diversity of participation**. It brought together representatives from multiple ministries, regulatory bodies, ports, shipping companies, fuel providers, financial institutions, recycling stakeholders and international partners. This ensured that discussions covered the **entire maritime value chain — ships, ports, fuels, recycling, finance and international collaboration** — instead of addressing them in isolation.

The workshop therefore functioned as a **coordination and convergence mechanism**,

enabling different stakeholders to align priorities, identify gaps and accelerate India's transition toward a **sustainable and low-carbon maritime ecosystem**. It marked a shift from fragmented green initiatives toward a **structured and nationally coordinated decarbonisation pathway** for the maritime sector.

Moving to the **Way Forward**, the next steps are clearly sequential and execution-oriented:
First, the immediate priority is to **distil the workshop outcomes into session-wise action points and develop a consolidated implementation matrix**. This converts discussions into a structured planning tool.
Second, **focused stakeholder webinars** will be conducted to validate priorities, refine sequencing and ensure alignment before formal adoption.
Third, **inter-ministerial consultations** will be undertaken to finalise roles, timelines and coordination mechanisms. This step is critical to avoid siloed execution and ensure accountability.
Fourth, the **consolidated roadmap and action matrix will be submitted to NITI Aayog** for strategic guidance and national-level alignment, effectively linking maritime decarbonisation with broader national policy directions.
Finally, the emphasis shifts to **operationalising a governance and monitoring framework**, ensuring that implementation is measurable, coordinated and continuously reported rather than remaining policy intent on paper.

Overall, this slide reflects a transition from **dialogue to structured execution**, supported by institutional mechanisms and defined next steps.



Why Alternative Maritime Fuels Matter for India

"Let me now briefly explain why alternative maritime fuels are strategically important for India at this point in time."

The global shipping sector is entering a **decisive transition decade**, where climate commitments, emerging fuel regulations and market signals are converging rapidly. Fuel choices are no longer a technical afterthought — they are becoming a **strategic determinant of competitiveness** in global trade.

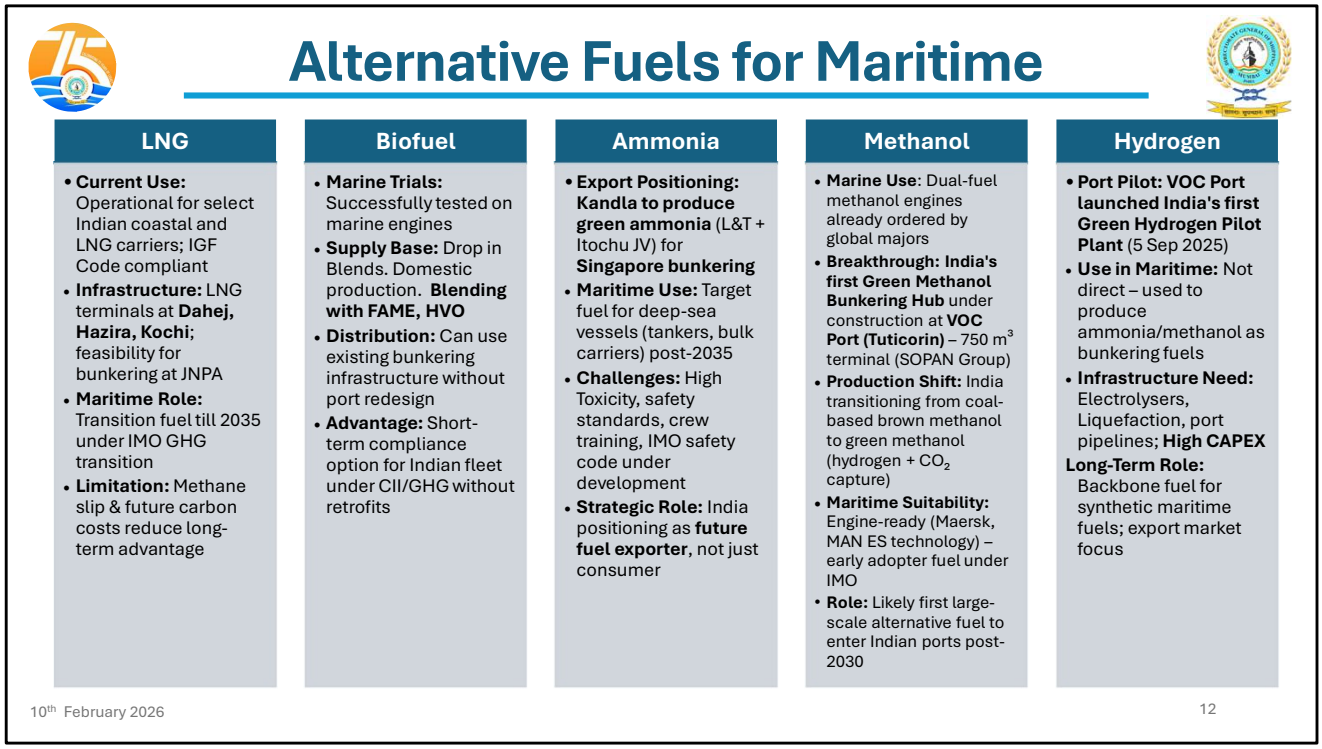
For shipping nations and ports, early decisions on fuels will increasingly influence **future shipping routes, port relevance and investment flows**. Vessels will call where fuels are available, safe and competitively priced, and ports that are prepared early will shape the emerging green trade corridors.

India's geographic position places it at a **strategic crossroads of major global trade routes**, creating a unique opportunity in this transition. With the right planning, India can move beyond being a passive fuel consumer to becoming an **enabler of green marine fuels** for domestic and international shipping.

However, this opportunity is **not automatic**. It requires a **planned, phased and coordinated**

approach across ports, shipping, energy providers and regulators, ensuring that fuel adoption is aligned with safety, infrastructure readiness and long-term viability.

"This is the context in which India is approaching alternative marine fuels — not as a single fuel choice, but as a strategic transition that must be carefully enabled."



Alternative Fuels for Maritime

India's maritime fuel transition will not be "one fuel for all," but a **sequenced multi-fuel pathway** that matches IMO's Net-Zero Framework and the Green Fuel Intensity (GFI) curve. Near-term compliance will lean on drop-in **biofuels** and limited **LNG**; the first scalable alternative expected in Indian ports is **green methanol**; **ammonia** follows for deep-sea ships post-2035; and **green hydrogen** underpins methanol/ammonia production and long-term export play. The strategy links three levers: (i) **domestic fuel manufacture**, (ii) **bunkering hubs & safety codes**, and (iii) **demand signals** created by IMO pricing (RUs) and India's NGSP/Harit Sagar policies.

1) LNG - Transitional Fuel

Current role : Deployed on select Indian coastal/LNG carriers; compliant under IGF Code.
Infrastructure : Import/LNG terminals at **Dahej, Hazira, Kochi**; feasibility for marine bunkering studied at **Kochi & JNPA**.
Why transitional : LNG reduces CO_2 but faces **methane-slip.**
Methane slip is the escape of unburned methane gas into the atmosphere, typically from engines running on natural gas, where incomplete combustion occurs. This phenomenon is a significant concern because methane is a potent greenhouse gas, with a much higher global warming potential than carbon dioxide over the short term. It can occur in a wide range of

applications, including marine engines, stationary engines, and across the entire natural gas supply chain

2) Biofuels - Immediate, Drop-in Compliance
Technical fit : Blends (B20–B100) run on existing marine engines; trials by **Indian Navy & fleet operators** demonstrate operational feasibility.
Supply base : Domestic streams from **ethanol, biodiesel, HVO , FAME** under the National Biofuel Policy; strongest near-term pathway to lower well-to-wake GHG without retrofits.
Ports : Minimal infrastructure change. can use current bunkering networks with sustainability certification.
Role : Near-term CII/GFI relief for Indian fleets; ideal for tugs, OSVs, coastal and inland segments while methanol/ammonia scale up.

3) Methanol
Breakthrough project : India's first Green Methanol Bunkering & Refuelling Hub is **under construction at VOC Port, Tuticorin - 750 m³ terminal (SOPAN Group)**. This is the country's first dedicated maritime methanol node and a key plank of the **Coastal Green Shipping Corridor (Kandla–Tuticorin)**.
Why methanol first : Dual-fuel engines are commercially available (MAN ES, widely ordered by global liners), handling is simpler than ammonia/hydrogen, and safety codes are mature.
Production shift : India must pivot from **coal-based "brown" methanol** to **green methanol** (renewable H_2 + captured CO_2). VOC's **port-based green hydrogen pilot** is a feeder step.
Role & Timing : Likely the **first large-scale alternative marine fuel** to appear regularly in Indian ports **post-2030**, enabling ships to meet tightening GFI thresholds at competitive abatement cost.

4) Ammonia (Green Ammonia)
Strategic positioning : Kandla is being developed by **L&T Energy GreenTech with ITOCHU** to produce **green ammonia (~300 KTPA)** with **offtake for bunkering in Singapore**. ITOCHU is also developing a **5,000 m³ ammonia bunkering vessel (2027) ,** evidence of real demand creation in the region.
Maritime use : Target fuel for deep-sea tankers/bulkers **post-2035**, once IMO's dedicated **safety code** and crew-training standards are finalised.
Challenges : High toxicity handling, new port safety zones, emergency response, and specialised storage/transfer systems.
India's role : Strong **export economics** (renewables + electrolyser scale). India can be a **fuel supplier to Asian bunkering hubs** while gradually enabling domestic

corridors.

5) Hydrogen (Green H_2)
Port pilot : VOC Port commissioned **India's first port-based Green Hydrogen pilot (10 Nm^3/hr)** on **5 Sep 2025**; foundation stone also laid for the **750 m^3 methanol facility**.
Maritime : Direct shipboard hydrogen (LH_2 at −253 °C or high-pressure gas) is niche in the near term; the **primary role is upstream**, as feedstock for **green methanol and green ammonia**.
Infrastructure : Electrolysers, renewable power, desalination, compression/liquefaction and pipelines. H**igh CAPEX** but central to India's export ambition under the **National Green Hydrogen Mission**.
Role : Backbone energy for synthetic maritime fuels; supports India's positioning as a **net green energy exporter**.

Cross-cutting Enablers India Must Move On
Standards & Safety : Fast-track Indian codes (storage, transfer, firefighting, crew competence) harmonised with IMO/IGF; publish methanol and ammonia bunkering SOPs for pilot ports.
Fuel Certification : Well-to-wake sustainability verification to claim **GFI reductions** and generate **Surplus Units (SU)** under the IMO scheme.
Finance : Use **green/blue bonds**, viability-gap/interest subvention, and **PPP** to de-risk first terminals; align with **NGSP** and **Harit Sagar** incentives.
Domestic Manufacture : Anchor **H_2, CO_2 capture, and e-fuel plants** near high-renewables clusters and port industrial estates to reduce delivered fuel cost.
Early-Mover Demand : Government-linked charters (PSU cargoes, coastal programs) to specify **biofuel/methanol blends** from FY26–27 to seed predictable offtake.

How This Meets IMO GFI Trajectory
2028–2030: Biofuels and limited LNG provide immediate GFI relief; pilots for methanol bunkering (VOC) mature.
2030–2035: Methanol scales in Indian ports; India begins **green ammonia exports**; OPS and efficiency measures cut berth emissions.
Post-2035: Ammonia fuels deep-sea segments; hydrogen-based derivatives dominate; India emerges as a **regional bunker/export hub** for future fuels.

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/m^3)	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

Data Source : MARIKO (2022) Ammonia as ship fuel, DLR (2023) PtX Fuels in Shipping

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Alternative Fuels Properties Comparison

This slide provides a **technical comparison of four key alternate marine fuels — E-LNG, Methanol, Ammonia and Hydrogen — across storage, safety and energy performance parameters.**
The purpose here is to highlight that **each fuel pathway comes with distinct trade-offs**, and there is no single universal solution.

Starting with **physical storage properties**,
E-LNG requires cryogenic storage at **–162°C**, ammonia at **–33°C**, while methanol can remain liquid at near-ambient conditions up to about **65°C**, making it comparatively easier from a storage handling perspective.
Hydrogen presents the most demanding storage requirement — either **compressed at very high pressures above 250 bar** or **liquefied at –253°C**, which significantly increases infrastructure complexity.

In terms of **fuel tank size for equivalent energy compared to Marine Diesel Oil**, E-LNG requires about **1.8 times** the volume, methanol **2.5 times**, ammonia **3 times**, and hydrogen between **5 to 7 times**.
This directly affects vessel design, cargo space availability and retrofitting feasibility.

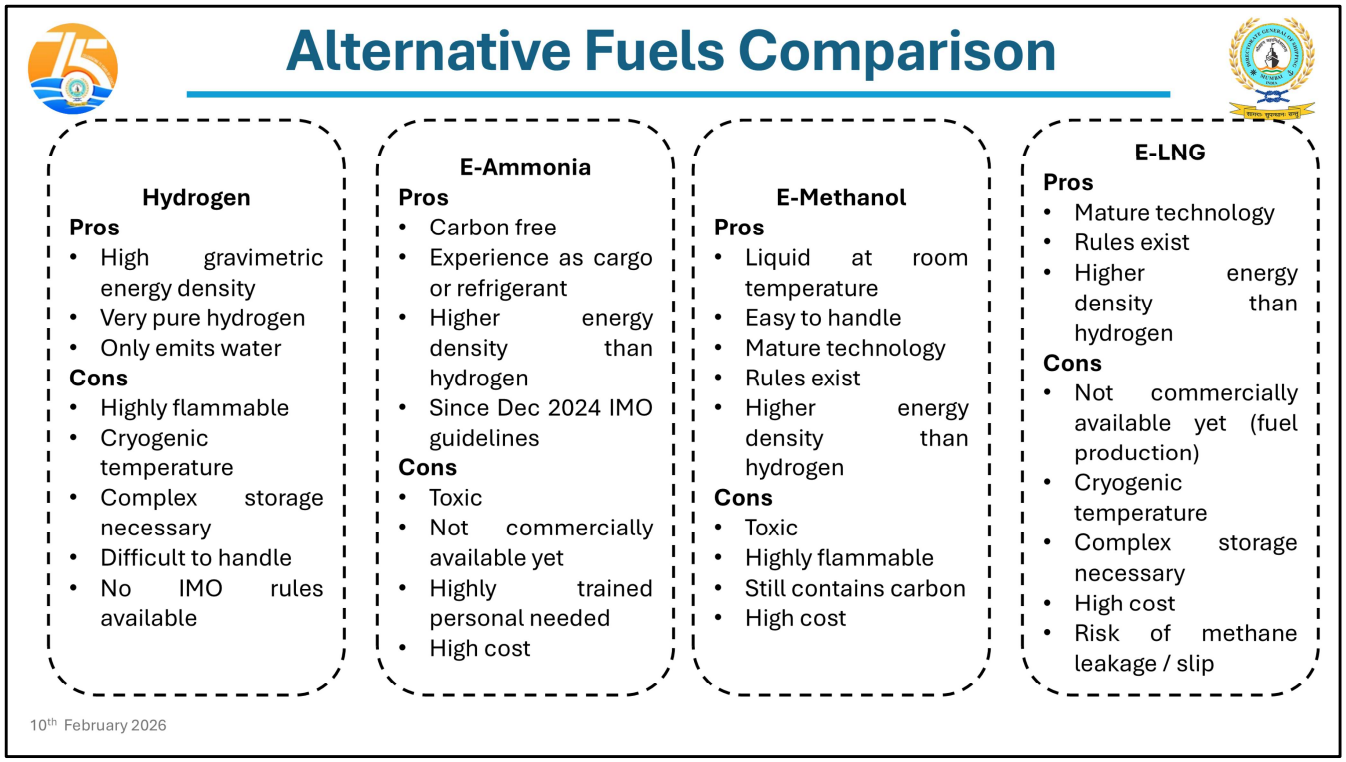
Looking at **flammability limits**, hydrogen has the **widest range at 4% to 75%**, indicating higher ignition risk if leakage occurs. Methanol and ammonia fall in moderate ranges, while methane in LNG is narrower but still significant. This underlines the need for **fuel-specific safety systems and ventilation design**.

For **ignition temperatures**, ammonia is the highest at **630°C**, making it harder to ignite unintentionally, while methanol is lower at **464°C**, indicating relatively higher susceptibility.
Flashpoint values further reinforce safety considerations — ammonia at **132°C** is comparatively safer, methanol at **12°C** is flammable at ambient conditions, while LNG has an extremely low flashpoint of **–188°C**. Hydrogen typically does not have a conventional flashpoint due to its gaseous nature.

From an **energy perspective**, hydrogen shows the **highest lower calorific value at 120 MJ/kg**, but because of its very low density, its **energy per litre is the lowest at 8.5 MJ/L**.
E-LNG provides a balanced profile with **50 MJ/kg LCV and 21.2 MJ/L energy density**, making it volumetrically more efficient. Methanol and ammonia fall in the mid-range but require larger storage volumes.

Overall, this comparison demonstrates that **fuel choice is not purely an emissions decision — it is a combined assessment of storage feasibility, safety characteristics, vessel design implications and energy efficiency.**

Data Sources for this comparison are MARIKO (2022) – *Ammonia as Ship Fuel* and DLR (2023) – *PtX Fuels in Shipping*.



Alternative Fuels Comparison (Pros & Cons Slide)

A **qualitative comparison of four major alternate marine fuels — Hydrogen, E-Ammonia, E-Methanol and E-LNG — focusing on operational advantages and practical challenges.**
The intent is to show that fuel transition decisions are **multi-dimensional**, involving safety, maturity, infrastructure readiness, cost and regulatory alignment.

Hydrogen
Hydrogen offers the **highest gravimetric energy density**, meaning per kilogram it carries more energy than any other fuel here. It is also extremely pure and **emits only water during combustion**, making it environmentally attractive from a tailpipe-emission perspective.
However, the operational challenges are significant. Hydrogen is **highly flammable**, requires **cryogenic or very high-pressure storage**, and demands complex tank and piping systems. Handling protocols are stringent, and at present **comprehensive IMO regulatory frameworks are still evolving**, which adds uncertainty for large-scale deployment.

E-Ammonia
E-Ammonia is **carbon-free at point of use** and benefits from existing global experience in handling ammonia as a **cargo and refrigerant**, giving it some industrial familiarity. It also offers **better volumetric energy density than hydrogen**, and IMO guidelines for ammonia as a fuel pathway have begun emerging, improving regulatory clarity.
On the downside, ammonia is **toxic**, requires specialised crew training, and large-scale green ammonia production is **not yet commercially widespread**. Safety infrastructure, detection systems and emergency response capacity are critical, and the overall **cost remains high**.

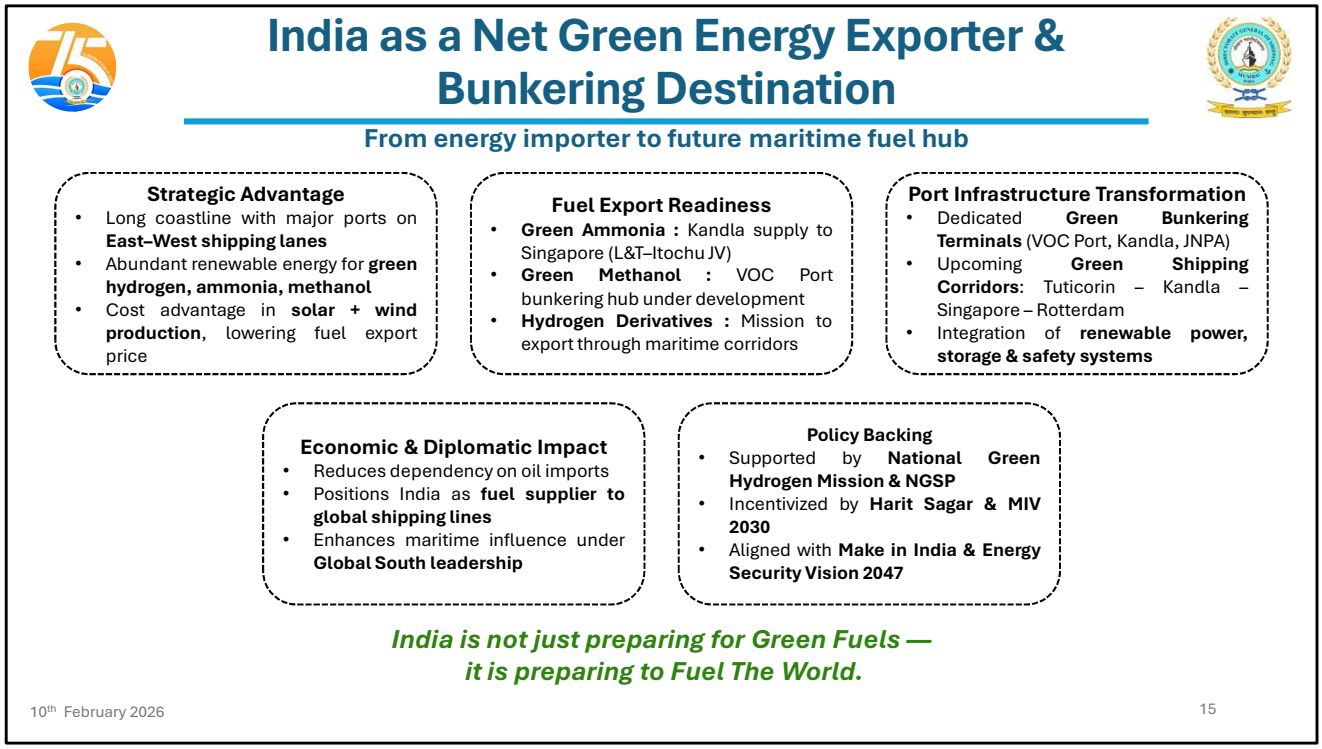
E-Methanol
E-Methanol stands out for being **liquid at near room temperature**, which simplifies storage, bunkering and onboard fuel system design compared to cryogenic fuels. It is **easier to handle**, benefits from **mature engine technologies**, and regulatory rules are already available. Its **energy density is higher than hydrogen**, making it more practical for certain vessel categories.
However, methanol is **toxic and highly flammable**, still **contains carbon in its molecular structure**, and therefore lifecycle emissions depend heavily on the production pathway. Additionally, the **cost of green methanol remains relatively high**.

E-LNG
E-LNG benefits from **technological maturity and existing global LNG infrastructure**, making near-term deployment easier. Rules and classification standards are already well-established, and it provides **better volumetric energy density than hydrogen**, supporting longer voyages without excessive tank space penalties.
The constraints include **continued dependence on cryogenic storage**, **high infrastructure and fuel production costs**, and the risk of **methane slip or leakage**, which can undermine greenhouse gas reduction benefits if not properly controlled. Availability of truly green or synthetic LNG at scale is also still developing.

This comparison reinforces that **no single alternate fuel is universally optimal.** Each option involves a trade-off between **environmental benefit, safety profile, infrastructure readiness, regulatory maturity, cost and vessel suitability.**

Future maritime decarbonisation is therefore likely to follow a **multi-fuel pathway**,

aligned to ship type, voyage profile and regional infrastructure capability rather than a one-fuel transition model.



India as a Net Green Energy Exporter & Bunkering Destination

India is at the crossroads of a major strategic shift, from being one of the world's largest **importers of fossil fuels** to emerging as a **future global supplier of green maritime fuels** such as **green ammonia, green methanol, and hydrogen derivatives**. This transition is not isolated; it is rooted in domestic policy reforms, renewable energy leadership, and a geopolitical push for *energy independence by 2047* and *Net Zero by 2070*.

1. Strategic Maritime Advantage

With its extensive coastline and central position on **major East–West shipping corridors**, India is geographically primed to become a bunkering and refueling hub for global shipping. India has one of the world's largest solar and wind power expansion programmes, which provides a **cost advantage in producing green fuels**, making exports competitive.

2. Fuel Export Capacity in Motion

India is already laying the groundwork for maritime fuel exports:

Green Ammonia (Export-Oriented Production)

At **Kandla**, a JV between **L&T and Itochu (Japan)** is setting up a large-scale green ammonia plant (~300 KTPA), with committed offtake to Singapore's bunkering market.

Green Methanol (First Bunkering Hub in India)
At **VOC Port, Tuticorin**, construction of a **750 m³ green methanol bunkering terminal** is underway (SOPAN Group). This is India's first dedicated alternative fuel facility for shipping.
Hydrogen Derivatives for Maritime Corridors
Under the **National Green Hydrogen Mission**, India targets **5 MMT green hydrogen** by 2030, largely to convert into **exportable derivatives** (ammonia/methanol) through maritime corridors like **Kandla–Singapore**, **Tuticorin–Rotterdam**, etc.

3. Port Infrastructure Transformation
Ports are evolving from cargo hubs to **energy export platforms**:
Dedicated **green fuel terminals** at **VOC Port, Kandla, JNPA**
Coastal **Green Shipping Corridors** being piloted (Tuticorin–Kandla–Singapore–Rotterdam)
Integration of **renewable power, desalination, safety systems**, and bunkering pipelines into port estates under **Harit Sagar Guidelines** and **NGSP**

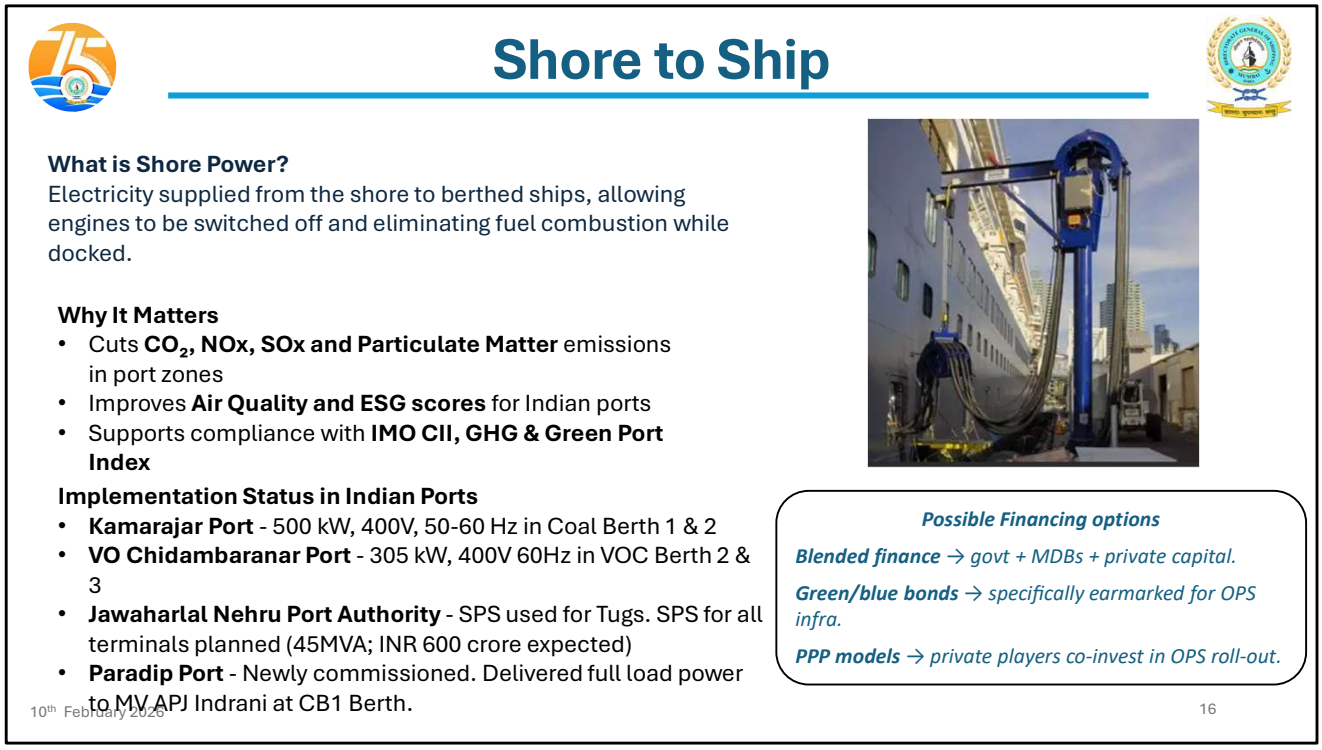
4. Economic & Diplomatic Impact
India's leadership in green fuel exports has a threefold strategic impact:
Reduces dependence on crude oil imports (currently 85% import-driven energy market)
Positions India as a fuel supplier to global shipping lines transitioning under IMO Net-Zero framework
Strengthens India's diplomatic role as a provider of clean energy to the **Global South**, reinforcing leadership at forums such as OPEC, G20, and COP

5. Strong Policy Backing
Backed by **National Green Hydrogen Mission** and **Draft National Green Shipping Policy (NGSP)**
Incentives via **Harit Sagar**, **Maritime India Vision 2030**, and **Make in India–Energy Security 2047**
PIB statements (July 2025, OPEC Summit):
"India will not only be energy independent by 2047, but will also fuel the world with green energy exports."

Conclusion
India is not simply decarbonizing its ports and ships, it is **building a green energy export economy** around its maritime sector. With methanol bunkering, ammonia

export hubs, and hydrogen corridors already initiated, India is setting the stage to become the **refuelling station of a net-zero maritime world.**

India is not just preparing for Green Fuels…… It is preparing to Fuel the World.



Shore-to-Ship Power (OPS)

Shore-to-Ship Power (Onshore Power Supply – OPS), commonly referred to as *cold ironing*, enables vessels to switch off their diesel auxiliary engines and draw electricity directly from port infrastructure while berthed. This significantly reduces emissions of **CO_2, NO_x, SO_x and Particulate Matter**, addressing one of the most concentrated sources of pollution in port cities.

OPS is central to India's maritime decarbonisation strategy under *Harit Sagar*, supporting compliance with IMO's CII and aligning with national climate commitments under the Panchamrit and Net Zero 2070 vision. Beyond emissions reduction, OPS improves **ESG scores, port sustainability ratings**, and promotes health benefits for coastal communities.

Implementation Progress in Indian Ports

Kamarajar Port (Ennore) – 2024 Commissioning
Commissioned OPS facility in **November 2024**, at a cost of **₹20.5 crore**.
Capacity: **500 kW, 400V, 50–60 Hz**, serving **Coal Berths 1 & 2**
Developed under **Harit Sagar Guidelines**, promoting green port practices.
KPL is actively encouraging vessels to retrofit and connect, supported by trials and

coordination with Paradip Port for a **Green Shipping Corridor (Paradip–Ennore)**.

VO Chidambaranar Port (Tuticorin)
OPS installed at **Berths 2 & 3** (305 kW units), supporting auxiliary load supply and positioning VOC as a green maritime pilot port.

Jawaharlal Nehru Port Authority (JNPA)
Currently uses OPS for port tugs.
₹600 crore, 45 MVA national terminal OPS plan under formulation to become India's largest cold ironing hub.

Paradip Port –
Newly commissioned.
Delivered full load power to MV APJ Indrani at CB1 Berth.

Challenges & Opportunities
While ships are currently hesitant due to retrofitting and administrative costs, OPS offers long-term operational benefits:
- Reduced fuel consumption and engine wear
- Lower carbon intensity scores (CII/GHG Index compliance)
- Eligibility for global green incentives and carbon credits

Financing the Transition
- **Blended Finance** – Government + MDBs + private capital
- **Green/Blue Bonds** – Infrastructure-specific debt mechanisms
- **PPP Models** – Terminal operators & energy companies co-investing

Green Ports

Driving Sustainable Maritime Growth

Concept of Green Ports

- Ports designed & operated with minimal environmental impact.
- Integration of clean energy, efficiency, and circular economy practices.

Key Initiatives in India

- Harit Sagar Guidelines (2023): National framework for green port development.
- Proposed National Port Sustainability Council (NPSC): Metrics for emissions, energy, waste, and community impact.
- Onshore Power Supply (OPS): Cut ship emissions at berth by connecting to shore electricity.
- Waste & Plastics Management: Port reception facilities for MARPOL Annex V compliance.

Sustainable Indicators for Ports

- Green Port Index (GPI)
- Green Port Readiness Level (GPRL)
- Shore Power Readiness Indicator (SPRI)
- Environmental Ship Index (ESI)

10th February 2026

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Green Ports – Driving Sustainable Maritime Growth

"Ports are the beating hearts of global trade, but they are also significant contributors to emissions. The idea of 'Green Ports' is to transform these engines of growth into anchors of sustainability."

The **concept of Green Ports** focuses on designing and operating ports with **minimal environmental impact**. This means integrating **clean energy**, **resource efficiency**, and **circular economy practices** into every aspect of port planning, operation, and logistics.

India has already taken pioneering steps in this direction through several flagship initiatives.

The **Harit Sagar Guidelines**, launched in 2023, provide a **national framework** for green port development, setting out principles for clean energy adoption, pollution control, waste management, and biodiversity protection.

Building upon this, the **National Port Sustainability Council (NPSC)** , **envisaged**, will establish measurable **metrics for emissions, energy use, waste, and community impact**, ensuring that environmental performance becomes a benchmark for all Indian ports.

The next major enabler is **Onshore Power Supply (OPS)**, which allows ships at berth to

connect directly to the grid and switch off their auxiliary engines. This single intervention can drastically reduce **CO_2, NOx, and SOx emissions** in port zones, improving air quality and public health in surrounding cities.

Complementing this, the Directorate is driving **Waste and Plastics Management** under **MARPOL Annex V compliance**, ensuring that port reception facilities can handle ship-generated waste and prevent marine pollution.

Together, these efforts yield tangible benefits:
Reduction in greenhouse gas emissions and pollution,
Improved air quality in port-adjacent areas, and
A major boost to India's **Blue and Green Economy transition**.
Importantly, these initiatives are fully aligned with **IMO's decarbonisation goals** and India's long-term national vision , **Viksit Bharat 2047**.

"In essence, Green Ports are not just an environmental necessity — they are the next competitive advantage for India's maritime sector. They signal that economic growth and ecological responsibility can, and must, advance together."

Sustainable Indicators for Indian Ports

To translate the sustainability vision into measurable action, a structured set of indicators has been developed to evaluate and benchmark the environmental and operational performance of Indian ports.

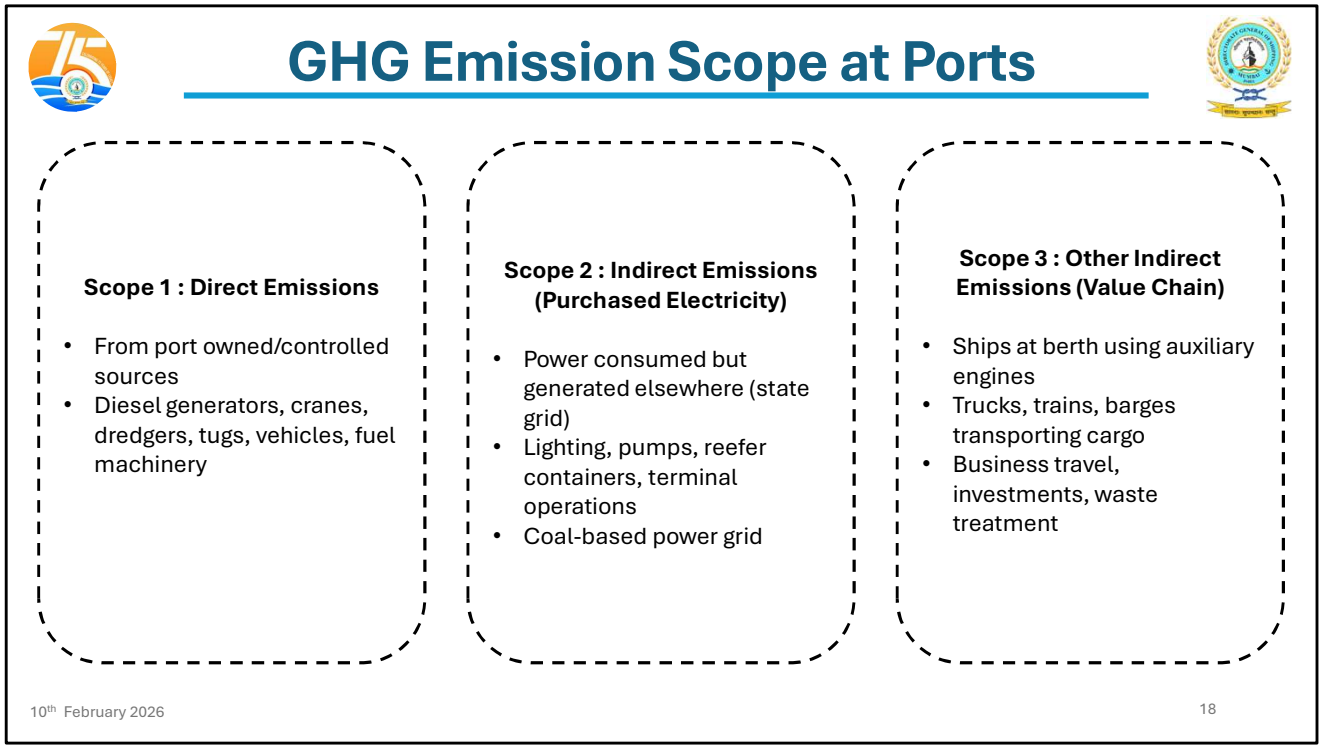
*The first is the **Green Port Index**, which assesses ports on their overall carbon footprint, energy efficiency, use of alternative fuels, and adoption of sustainable logistics and waste management practices. This index provides a clear picture of how each port contributes to reducing emissions and improving environmental stewardship.*

*The **Green Port Readiness Level**, or GPRL, measures how prepared ports are for the transition to cleaner energy systems and digital operations. It evaluates their compliance with global environmental standards and their readiness to adopt emerging technologies.*

*The third parameter is the **Shore Power Readiness Indicator**, which reflects the extent to which ports are equipped with shore-to-ship power infrastructure. This is a crucial enabler in reducing emissions from berthed ships, allowing vessels to draw renewable electricity instead of using onboard auxiliary engines.*

*Finally, the **Environmental Ship Index** encourages ship operators to voluntarily reduce emissions by adopting cleaner fuels and technologies. It introduces a transparent rating system that accounts for NOx, SOx, and CO_2 performance, rewarding environmentally responsible operations.*

Collectively, these four indicators form a comprehensive framework for driving measurable sustainability across the Indian port ecosystem. By institutionalising these benchmarks, India is positioning its ports as global frontrunners in green logistics and opening pathways for participation in international green shipping corridors under its long-term Net Zero vision."



GHG Emission Scope at Ports

"To address decarbonization effectively, it is essential that we first understand where emissions actually come from within the port ecosystem."

The **Greenhouse Gas (GHG) emission inventory** at ports is categorized under three internationally recognized scopes - **Scope 1, Scope 2 and Scope 3,** as per global reporting standards.

Scope 1 – Direct Emissions:
These are emissions that originate from **port-owned or controlled sources**.
They include **diesel generators, cranes, dredgers, tugs, vehicles, and other fuel-based machinery** operating within the port premises.
Essentially, these are emissions under the port authority's **direct operational control**, and therefore, the easiest to measure, monitor, and manage.

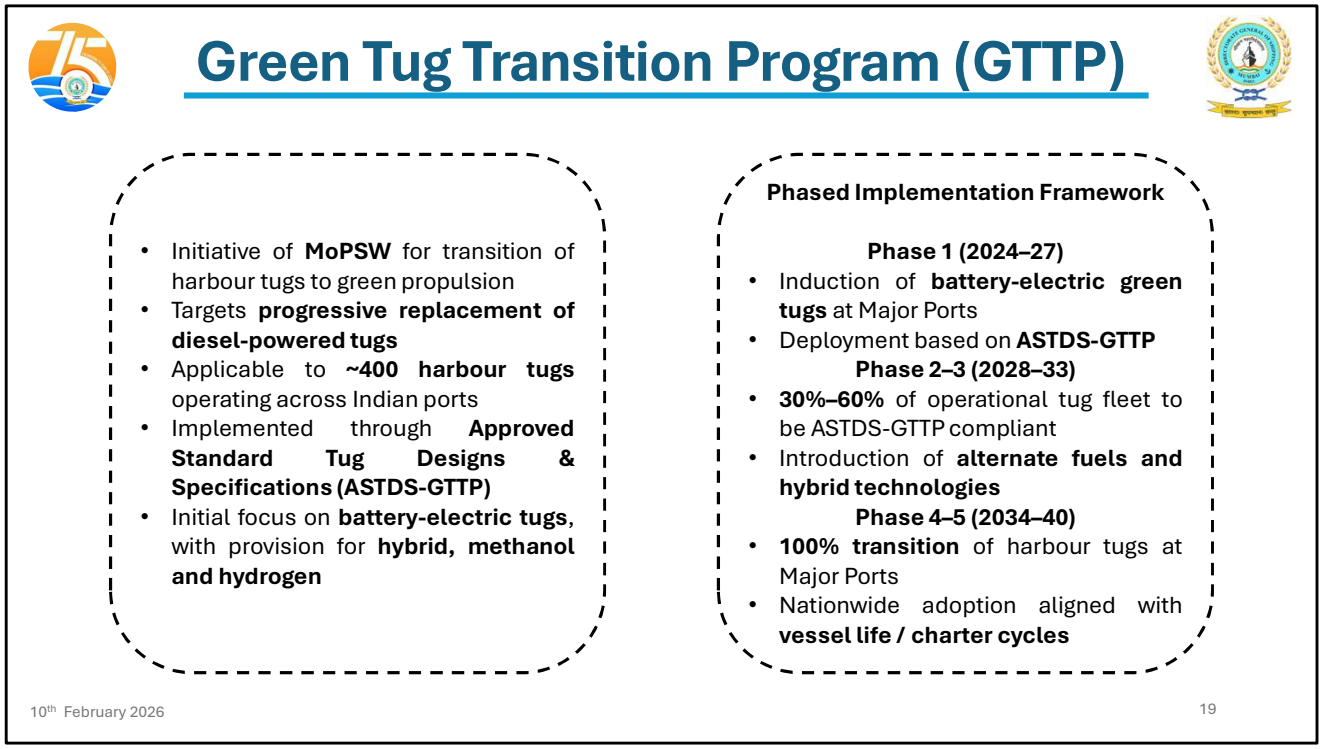
Scope 2 – Indirect Emissions:
These arise from the **purchase of electricity** that is generated elsewhere, typically from the **state grid**.
Although the port does not produce these emissions directly, they are linked to the **energy consumed for lighting, pumping systems, refrigerated containers, and terminal**

operations.
In countries where grid power is largely **coal-based**, Scope 2 emissions form a substantial part of the port's total carbon footprint — highlighting the importance of shifting towards **renewable energy and solar-based supply** for port operations.

Scope 3 – Other Indirect Emissions (Value Chain):
These are the most complex and far-reaching.
They include emissions from **ships at berth using auxiliary engines**, **trucks, trains, and barges transporting cargo**, as well as **business travel, waste treatment, and upstream investments** associated with port operations.

Though these emissions occur outside the direct boundary of the port, they represent the **largest share of overall carbon impact** — making stakeholder coordination and value-chain partnerships crucial for achieving real decarbonisation.

"Recognizing these three scopes allows ports to move from a fragmented to a holistic approach — one where emissions are mapped, mitigated, and monitored across the entire logistics chain."



Green Tug Transition Program (GTTP)

"Let me now briefly highlight one specific initiative that brings together many of the themes we are discussing today — technology, propulsion efficiency and implementation at scale."

The **Green Tug Transition Program**, or GTTP, is an initiative of the **Ministry of Ports, Shipping and Waterways** aimed at enabling the **systematic transition of harbour tugs to green propulsion**. Harbour tugs are critical port assets, and at the same time, they offer one of the **most practical and scalable starting points** for maritime decarbonisation.

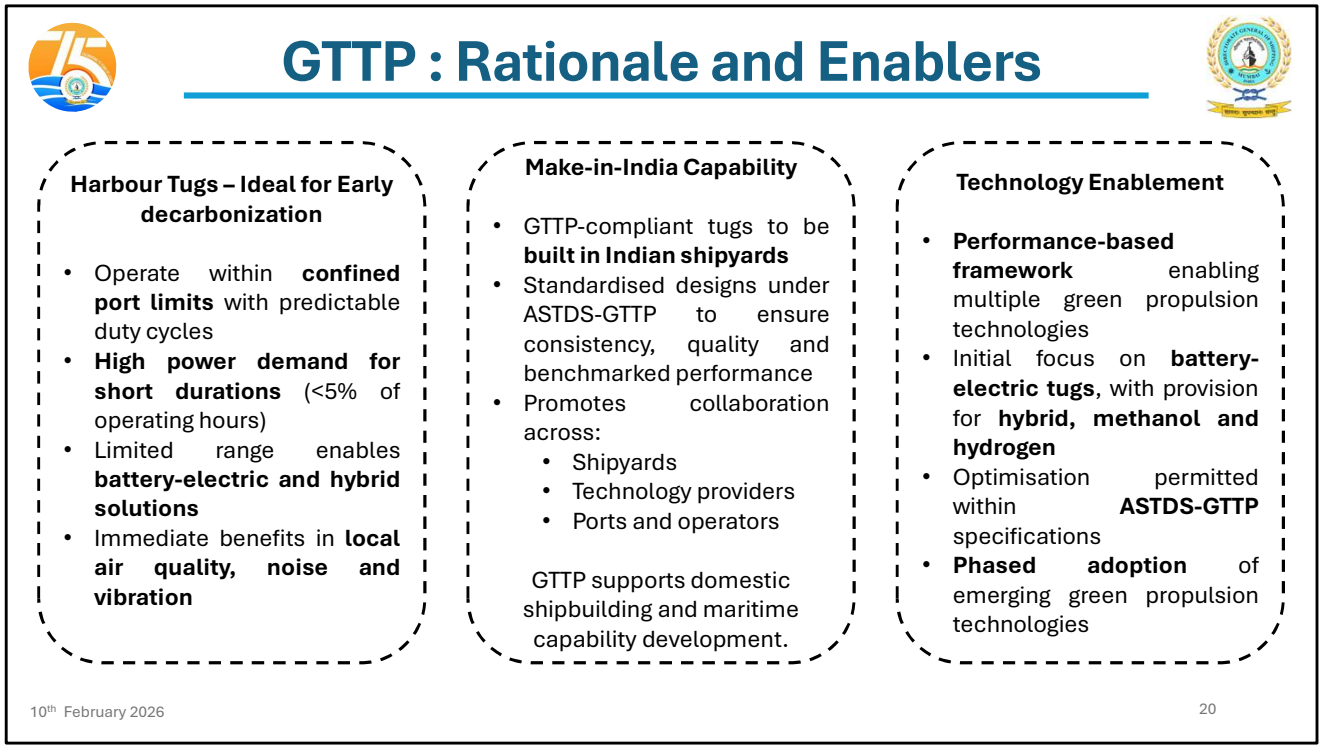
The programme targets the **progressive replacement of diesel-powered harbour tugs**, and applies to approximately **400 tugs operating across Indian ports**. A key feature of GTTP is the use of **Approved Standard Tug Designs and Specifications**, which provide a consistent, performance-based framework while allowing innovation within defined standards.

In the initial phase, the focus is on **battery-electric tugs**, recognising their suitability for harbour operations with predictable duty cycles. At the same time, the framework retains flexibility, with provision for **hybrid, methanol and hydrogen-based technologies** as they mature.

GTTP follows a **phased implementation pathway**. The first phase focuses on induction of

battery-electric tugs at Major Ports. Subsequent phases progressively scale compliance across the fleet, with **30 to 60 percent adoption in the medium term**, and a **full transition at Major Ports by 2034–40**, aligned with vessel life and charter cycles.

"What is important is that GTTP is not a pilot programme, but a structured transition framework — one that directly links advances in propulsion efficiency, thruster performance and manoeuvrability to real-world implementation in Indian ports."



GTTP – Rationale and Enablers

"Let me briefly explain why harbour tugs have been identified as a priority segment under the Green Tug Transition Program, and what enables this transition in practice."

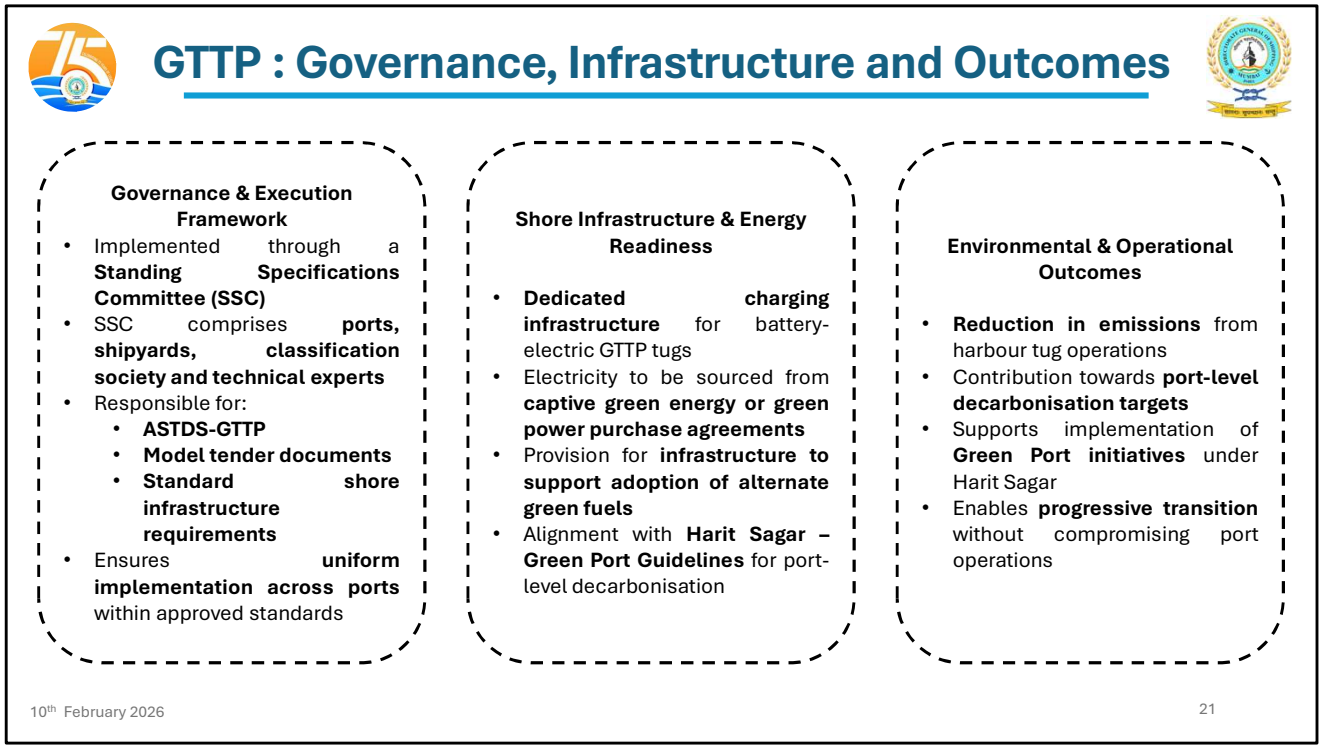
Harbour tugs are particularly well-suited for **early-stage decarbonisation**. They operate within **confined port limits**, follow **predictable duty cycles**, and require **high power only for short durations**. These operational characteristics make them especially compatible with **battery-electric and hybrid propulsion solutions**, while also delivering immediate improvements in **local air quality and reduced noise and vibration** in port areas.

An important enabler under GTTP is the focus on **Make-in-India capability**. GTTP-compliant tugs are to be **built in Indian shipyards**, using **standardised designs under ASTDS-GTTP**. This approach ensures consistency, quality and benchmarked performance, while also promoting collaboration between **shipyards, technology providers, ports and operators**. In doing so, the programme supports the strengthening of domestic shipbuilding and maritime capability.

The third enabling element is **technology enablement through a performance-based framework**. While the initial focus is on **battery-electric tugs**, the programme retains flexibility, with provision for **hybrid, methanol and hydrogen-based technologies** as they

mature. Optimisation is permitted within the approved specifications, allowing innovation while maintaining safety and performance standards.

"Together, these elements ensure that GTTP is not just a decarbonisation initiative, but a structured and execution-ready transition framework that aligns operational realities, industrial capability and technological evolution."



GTTP – Governance, Infrastructure and Outcomes

"For a programme of this nature, clarity of governance and readiness of supporting infrastructure are as important as the technology itself."

The Green Tug Transition Program is implemented through a **structured governance framework**, anchored by a **Standing Specifications Committee**. The Committee brings together **ports, shipyards, classification society and technical experts**, ensuring that standards are technically robust and operationally practical.

The role of the Committee is to put in place **Approved Standard Tug Designs and Specifications**, along with **model tender documents** and **standard shore infrastructure requirements**. This approach ensures **uniform implementation across ports**, while allowing optimisation and innovation within clearly defined standards.

Equally important is **shore infrastructure and energy readiness**. GTTP provides for **dedicated charging infrastructure** for battery-electric tugs, with electricity sourced from **captive green energy or green power purchase agreements**. The framework also keeps provision for infrastructure to support the **future adoption of alternate green fuels**, aligned with the **Harit Sagar –**
Green Port Guidelines.

In terms of outcomes, GTTP enables a **progressive reduction in emissions from harbour tug operations**, contributes directly to **port-level decarbonisation objectives**, and supports the broader implementation of **Green Port initiatives**. Importantly, this transition is designed to be **phased and operationally stable**, ensuring that port efficiency and reliability are not compromised.

"Taken together, these elements ensure that GTTP moves beyond intent to implementation, delivering measurable outcomes through a structured and coordinated approach."

Ship Recycling – India's Global Leadership

Ship recycling is not just an industry - it is a **strategic pillar of India's maritime economy** and the global circular economy. The process dismantles end-of-life ships to recover steel and other valuable materials, reducing the demand for virgin raw inputs while cutting costs and emissions.

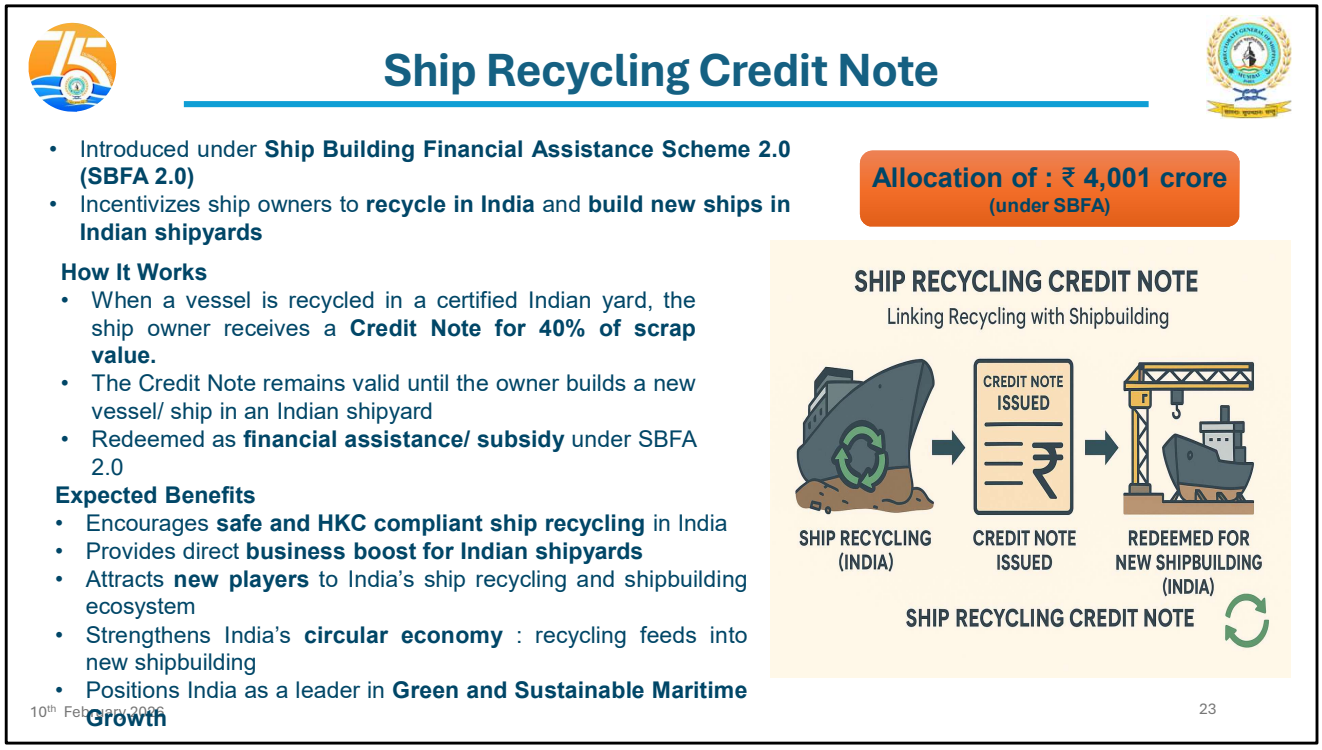
India today stands as the **global leader in ship recycling**, with the Alang–Sosiya cluster in Gujarat being the world's largest ship recycling facility. The entry into force of the **Hong Kong Convention (HKC) on 26 June 2025** has further elevated India's role, as it is the **only nation with more than 100 HKC-compliant yards (115 facilities)**.

This sector contributes significantly to India's industrial ecosystem by:
Handling **30–35% of global ship recycling tonnage annually**, consolidating India's leadership.
Meeting **20–25% of India's ferrous scrap demand**, reducing import dependency and saving valuable forex.
Feeding the **Green Steel ecosystem**, providing low-carbon inputs that align with India's net-zero ambitions.

The impact is equally socio-economic. Ship recycling directly employs **15,000+ workers**,

while creating indirect livelihood opportunities for thousands more in logistics, scrap processing, and allied services. The industry has become a driver of **inclusive growth**, while embedding high safety and environmental standards under HKC compliance.

By anchoring itself as the hub of HKC-compliant recycling, India not only ensures **sustainable resource recovery** but also strengthens its position as a **global leader in maritime sustainability**.



Ship Recycling Credit Note

The **Ship Recycling Credit Note (SRCN)** is one of the most innovative financial instruments introduced under the **Shipbuilding Financial Assistance Scheme 2.0 (SBFA 2.0)** with an allocation of **₹4,001 crore**. It directly links India's ship recycling strength with the growth of its shipbuilding industry.

How It Works

When a vessel is dismantled in a **certified Indian ship recycling yard**, the shipowner is issued a **Credit Note worth 40% of the vessel's scrap value**.
This Credit Note remains valid until the shipowner invests in building a **new vessel in an Indian shipyard**.
The note is then **redeemed as financial assistance/subsidy** under SBFA 2.0, lowering the effective cost of new builds in India.

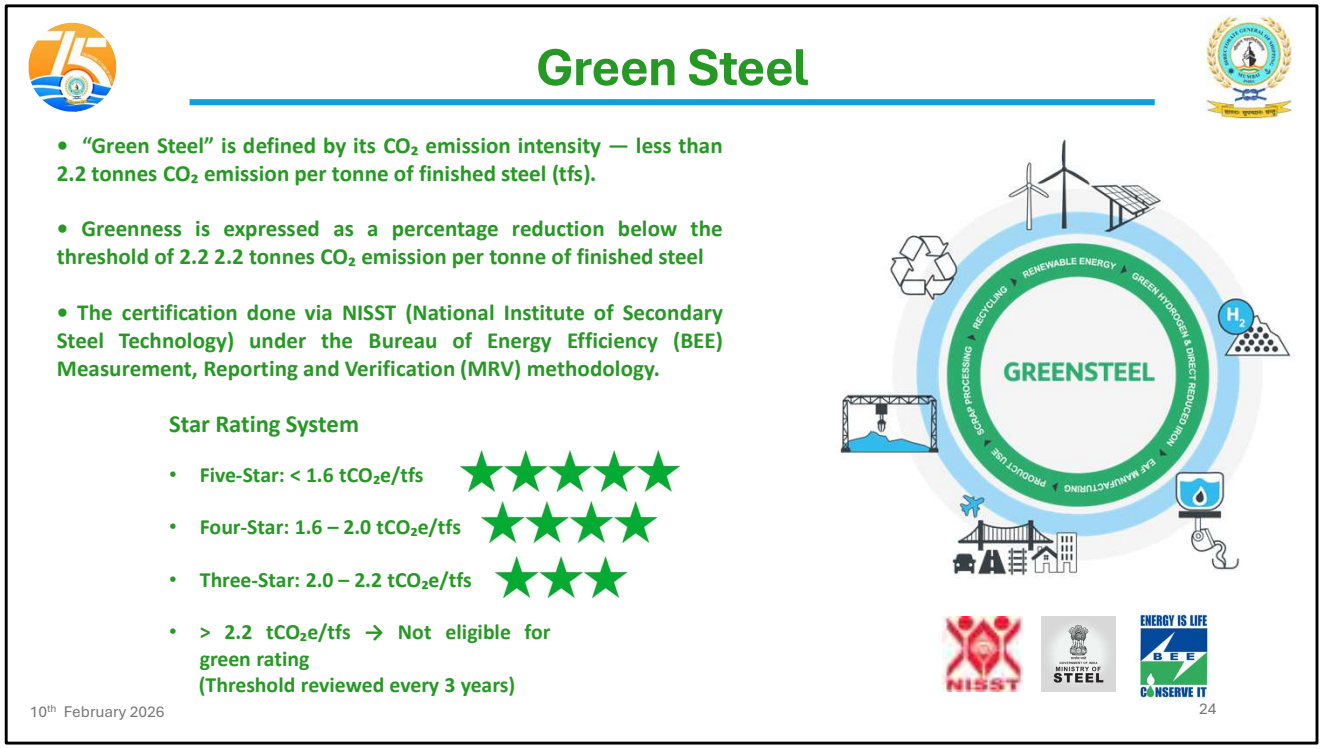
Expected Benefits

Boosts HKC-compliant recycling: Encourages safe, environmentally sound, and **Hong Kong Convention (HKC) aligned ship recycling** practices.
Strengthens shipbuilding: Directly channels recycling activity into **new orders for Indian shipyards**, ensuring business continuity.
Expands ecosystem participation: Incentivizes **new players**—both domestic and foreign—

to engage with India's recycling and shipbuilding ecosystem.
Promotes circular economy: Scrap steel and materials from recycling feed into the production of new ships, cutting raw material dependence.
Sustainability leadership: Positions India as a **global leader in green and sustainable maritime growth**, combining recycling, green steel, and shipbuilding.

Strategic Importance
SRCN acts as a **bridge policy**, ensuring that India's dominance in recycling (30–35% of global share) translates into a **thriving shipbuilding industry**.
It enhances India's image as the **only country with over 100 HKC-compliant yards** while simultaneously supporting its ambition to become a **shipbuilding hub**.
By tying together **scrap recovery, circular economy, and green shipbuilding**, it creates a **self-sustaining maritime growth cycle**.

The Ship Recycling Credit Note is a **game-changer**, as it uniquely integrates recycling with new construction, creating a **virtuous cycle of sustainability, industrial growth, and employment**.



Green Steel : Driving Low-Carbon Industrial Transition

Steel is the backbone of infrastructure and shipbuilding, but it is also one of the most carbon-intensive industries. The concept of **"Green Steel"** aims to transform this challenge into an opportunity by reducing the **CO_2 emission intensity below 2.2 tonnes of CO_2 per tonne of finished steel (tfs)**.

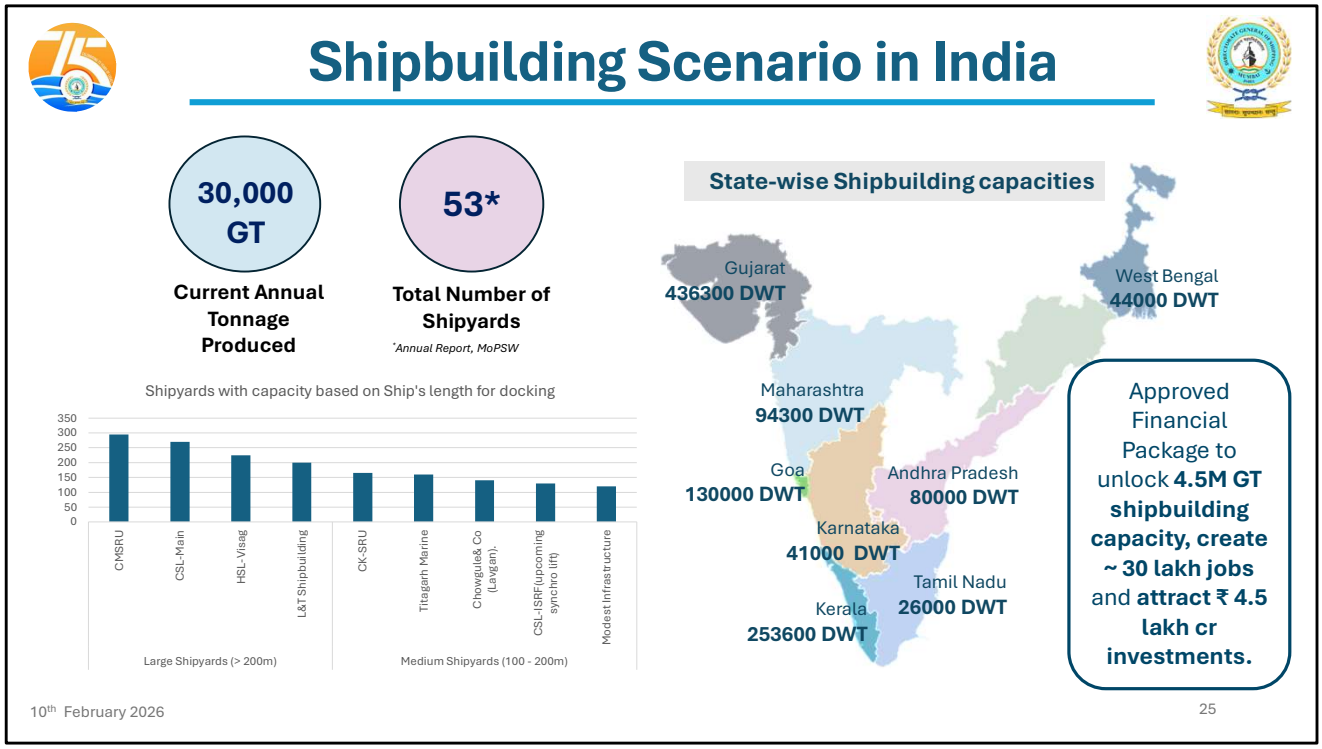
Greenness is measured as the percentage reduction in emissions below this threshold. Certification is carried out by the **National Institute of Secondary Steel Technology (NISST)** under the **Bureau of Energy Efficiency (BEE)**, using global-standard **Measurement, Reporting and Verification (MRV) methodologies**.

A **star rating system** makes this framework transparent and globally competitive:
Five-Star: < 1.6 tCO_2e/tfs
Four-Star: 1.6 – 2.0 tCO_2e/tfs
Three-Star: 2.0 – 2.2 tCO_2e/tfs
Above 2.2 tCO_2e/tfs: Not eligible for green certification

The threshold will be reviewed every three years, ensuring constant ambition in line with climate goals.

Green Steel is not just about lowering emissions,it is about **embedding recycling, renewable energy, hydrogen and energy efficiency** into steel production, linking ship recycling and scrap recovery directly with India's **circular economy vision**. This makes India's maritime sector a critical contributor to the **Green Steel ecosystem**, reinforcing both industrial competitiveness and sustainability.

Emissions Covered :
Scope 1 : Direct emissions from steel making
Scope 2 : Indirect emissions from purchased electricity
Scope 3 : Agglomeration, pellet making, coke making, beneficiation, raw materials



Shipbuilding Scenario in India

India's shipbuilding sector is at a **nascent but strategically critical stage**. Despite having a long coastline and 53 shipyards (as per MoPSW Annual Report), the country currently produces only **30,000 GT annually**, which is a small fraction compared to global leaders like China, South Korea, and Japan.

State-wise Capacities
Gujarat leads the sector with **436,300 DWT**, thanks to strong industrial clusters and its coastal industrial base.
Kerala (253,600 DWT) and **Goa (130,000 DWT)** follow, with a mix of public and private yards catering to both defence and commercial orders.
Other contributors include **Maharashtra (94,300 DWT)**, **Andhra Pradesh (80,000 DWT)**, **West Bengal (44,000 DWT)**, **Karnataka (41,000 DWT)**, and **Tamil Nadu (26,000 DWT)**. This distribution highlights both the **geographic spread of capacity** and the under-utilisation of existing infrastructure.

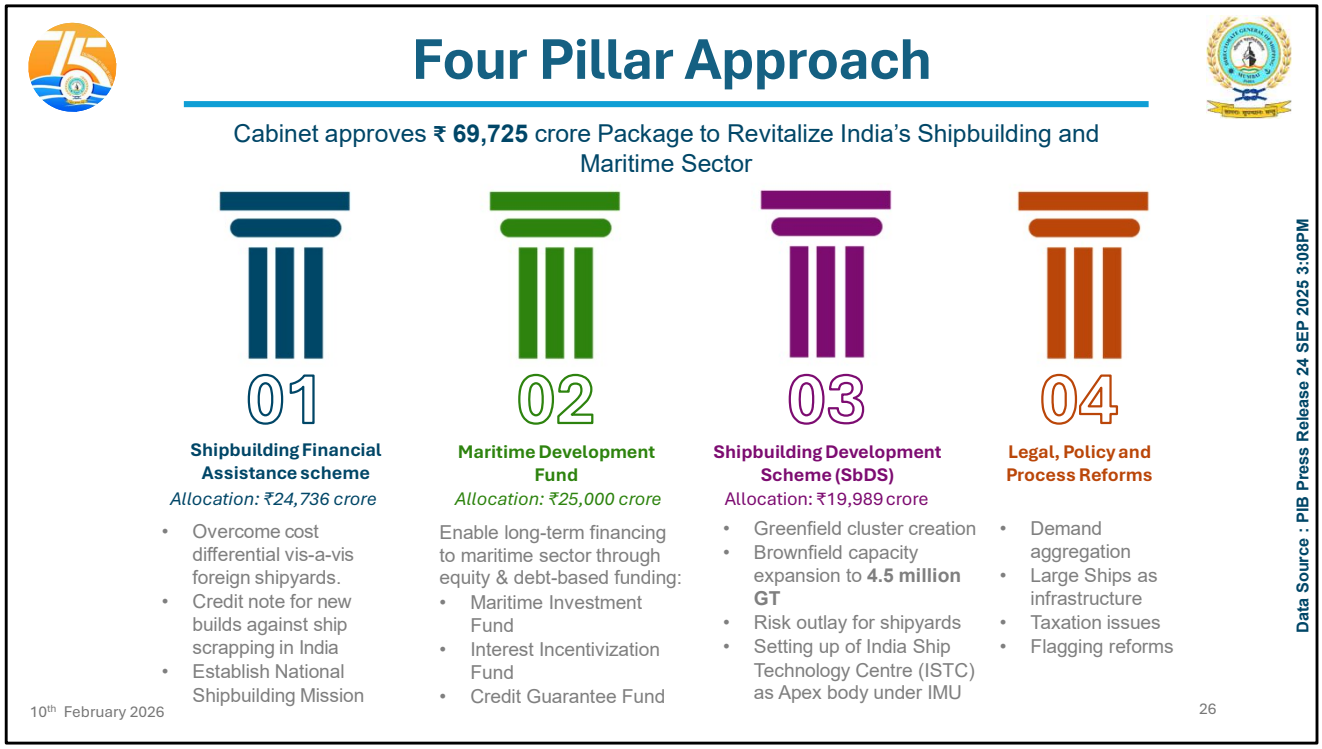
Yard Capacities & Capabilities
India has a handful of large shipyards capable of handling vessels >200m in length — such as **Cochin Shipyard Limited (CSL), Hindustan Shipyard Ltd. (HSL), L&T Shipbuilding, and**

Central/State-run units like CMSRU and CKSRU.
Medium shipyards like **Timblo, Chowgule, Titagarh Marine, CSL's smaller yards** and others handle repair, retrofits, and mid-sized vessels.
However, compared to international peers, India suffers from **low productivity, high financing costs, and limited scale economies**.

Policy & Investment Push
The Government has approved a **financial package to unlock 4.5 million GT of shipbuilding capacity**, with the potential to:
Generate **~30 lakh direct and indirect jobs**,
Attract **₹4.5 lakh crore in investments**,
Enable India to become a **competitive global player** while reducing dependence on foreign-built ships.

Strategic Importance
Shipbuilding is not just an industrial sector, it is a **strategic enabler**:
Strengthens national security by ensuring **domestic capacity for defence and merchant fleets**.
Boosts **exports of vessels and green technology** in the long run.
Creates linkages with allied industries — **steel, engineering, design, marine electronics**, and services.
Positions India to capture a share of the **$70 billion global shipbuilding market**.

India's shipbuilding potential is large but untapped. With policy support, financing reforms, and capacity unlocking, the sector can shift from a marginal 30,000 GT output today to millions of GT tomorrow, creating jobs, saving forex, and boosting strategic autonomy.



Four Pillar Approach

The Government of India has approved a **₹69,725 crore revitalization package** for the shipbuilding and maritime sector. This approach rests on **four strategic pillars**, each addressing a critical gap in India's maritime ecosystem- finance, infrastructure, capacity building, and regulatory reform.

Pillar 1: Shipbuilding Financial Assistance Scheme (₹24,736 crore)
Designed to **bridge the cost differential** between Indian and foreign shipyards, ensuring domestic yards remain competitive.
Provides **credit notes** for new shipbuilding linked to ship recycling in India, integrating sustainability with incentives.
Includes the establishment of a **National Shipbuilding Mission** to provide long-term policy continuity.

Pillar 2: Maritime Development Fund (₹25,000 crore)
Aims to enable **long-term, low-cost financing** for the maritime sector via equity and debt funding.
Includes sub-funds such as:

Maritime Investment Fund – to channel capital into greenfield projects.

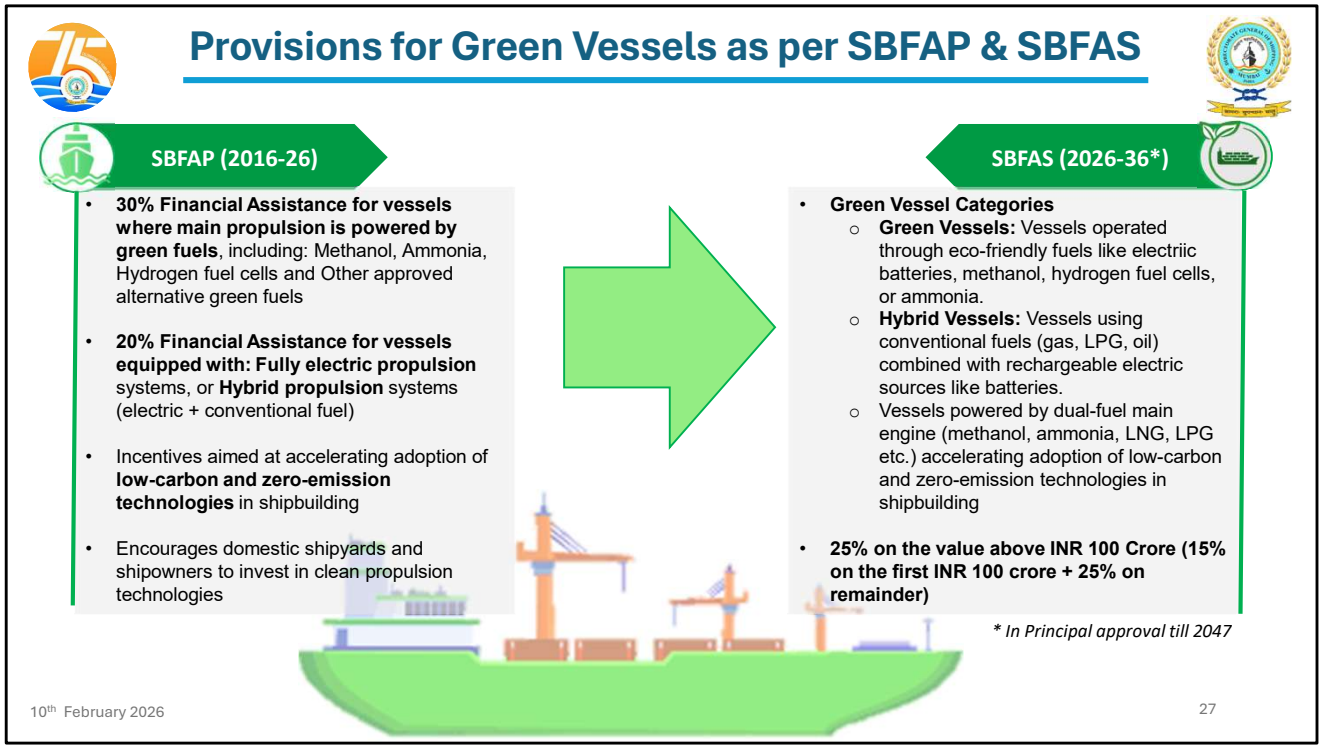
Interest Incentivization Fund – to reduce borrowing costs for shipyards.
Credit Guarantee Fund – to reduce lender risk and unlock financing for vessel owners and builders.

Pillar 3: Shipbuilding Development Scheme (SbDS) (₹19,989 crore)
Focused on **capacity expansion and technology development**:

Establishment of **greenfield shipbuilding clusters**.
Brownfield expansion to raise capacity to **4.5 million GT**.
Risk outlay provision to protect shipyards from financial exposure.
Setting up the **India Ship Technology Centre (ISTC)** under IMU as an apex R&D and training body for advanced shipbuilding technologies.

Pillar 4: Legal, Policy, and Process Reforms
Demand aggregation across PSU, defence, and private shipping to secure consistent order books for Indian shipyards.
Recognition of **large ships as infrastructure**, unlocking easier access to long-term credit and incentives.
Addressing **taxation anomalies** and simplifying GST/customs regimes for shipbuilders.
Flagging reforms to incentivize Indian ownership of ships and reduce outflow of foreign exchange.

The four-pillar approach provides a **holistic framework** for India's shipbuilding revival. With financing support, capacity expansion, institutional R&D, and regulatory reforms, the package seeks to transform India into a **globally competitive shipbuilding hub**, aligned with Maritime India Vision 2030 and Maritime Amrit Kaal Vision 2047.



Provisions for Green Vessels under SBFAP & SBFAS

This slide highlights the evolution of financial support mechanisms specifically aimed at promoting green and low-emission vessels in India's shipbuilding sector.
It reflects a transition from an initial incentive framework to a more structured and forward-looking assistance model.

Under the earlier Shipbuilding Financial Assistance Policy, the focus was on encouraging early adoption of alternative fuels and electric propulsion systems. Higher financial assistance was extended to vessels whose primary propulsion was based on green fuels such as methanol, ammonia and hydrogen fuel cells. Additional support was also provided for fully electric and hybrid propulsion systems. The intent at that stage was primarily catalytic — to signal policy direction, reduce initial investment risks and create market confidence for emerging propulsion technologies.

These incentives played an important role in familiarising domestic shipyards and shipowners with low-carbon and zero-emission solutions. They also laid the groundwork for technological learning, supply-chain readiness and skill development within the industry.

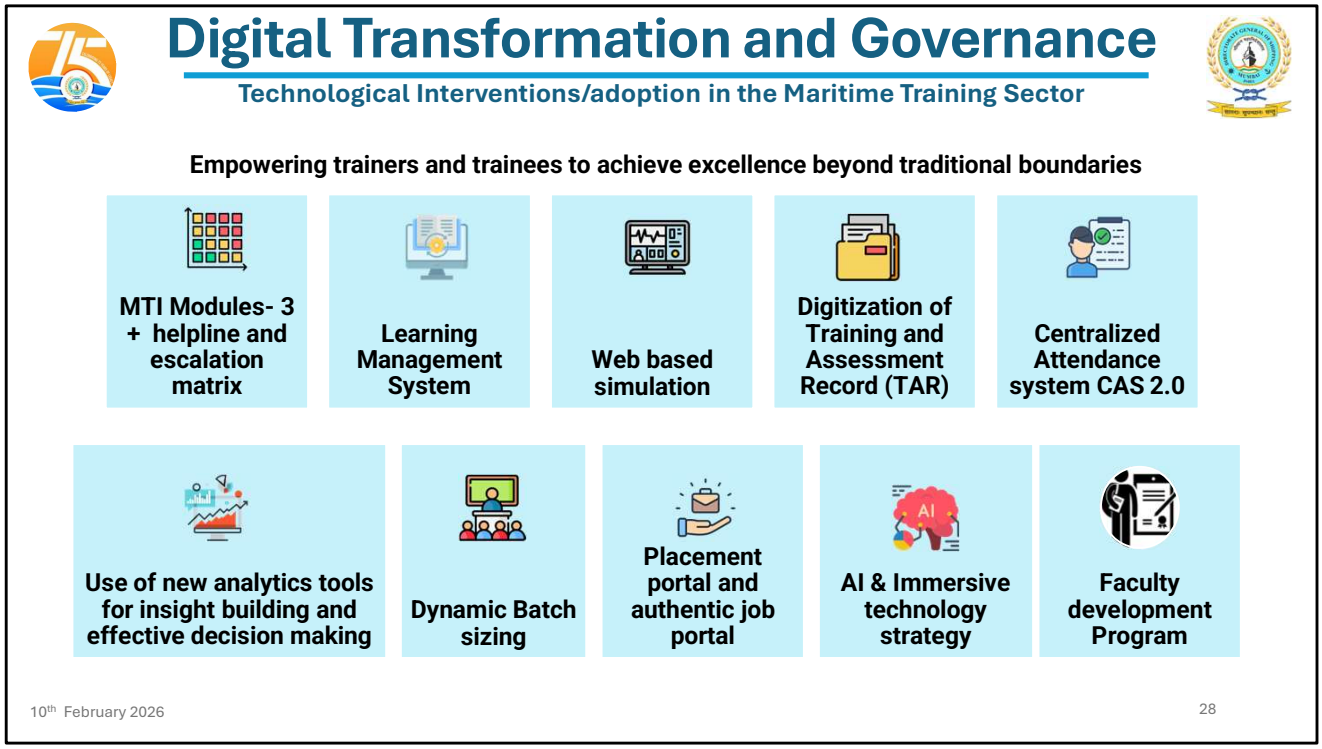
Building upon this foundation, the Shipbuilding Financial Assistance Scheme represents a more comprehensive and structured approach. Instead of focusing only on propulsion type, it

introduces clear vessel categorisation, distinguishing between fully green vessels, hybrid vessels and dual-fuel configurations. This classification allows for more precise targeting of incentives and better alignment with international decarbonisation pathways.

The revised assistance structure also increases financial support for higher-value vessels, thereby encouraging the construction of technologically advanced and larger capacity ships within India. This ensures that the policy is not limited to smaller segments but is capable of influencing mainstream commercial shipbuilding as well.

What is important here is the policy continuity combined with policy evolution. The earlier framework initiated the transition, while the current scheme strengthens and scales it. Together, they send a consistent signal that green propulsion and low-emission shipbuilding are not short-term initiatives, but a sustained national priority aligned with long-term environmental and industrial objectives.

In essence, these provisions aim to de-risk investment, accelerate adoption of clean propulsion technologies and position Indian shipyards to compete in the global market for next-generation vessels.



Digital Transformation and Governance

Technological Interventions in Maritime Training

This slide presents the **digital and governance reforms being undertaken to modernize India's maritime training ecosystem**, with the objective of **empowering both trainers and trainees to achieve excellence beyond traditional boundaries**.

Core Digital Platforms and Systems

At the top row, the focus is on **foundational digital infrastructure**:

MTI Modules 3 + Helpline & Escalation Matrix –

Establishes structured grievance redressal, monitoring and accountability for Maritime Training Institutes. It ensures that institutions remain compliant and issues are addressed through a **transparent escalation chain** rather than informal channels.

Learning Management System (LMS) –

Acts as the **central academic backbone**, enabling standardized course delivery, e-content, progress tracking and assessment management across institutes.

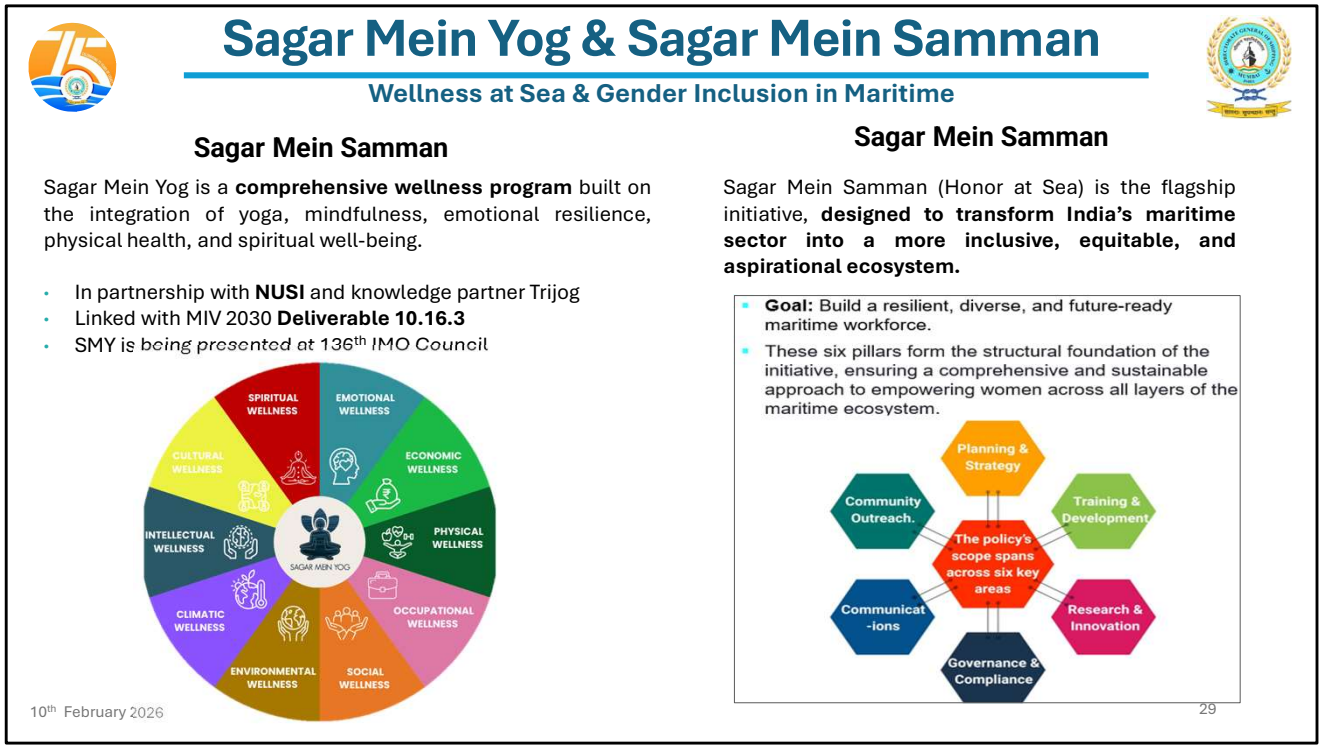
Web-Based Simulation –

Provides **remote and virtual training environments**, allowing cadets to practice operational scenarios without physical constraints. This is particularly relevant for cost-intensive shipboard simulations.

Digitization of Training and Assessment Record (TAR) –
Converts manual TAR books into **secure digital records**, reducing delays, eliminating forgery risks and enabling faster certification validation.
Centralized Attendance System (CAS 2.0) –
Ensures **real-time attendance tracking and authenticity**, linking biometric or digital verification to institutional records and regulatory oversight.

Data, Intelligence and Governance Tools
The second row moves beyond infrastructure to **decision-making and ecosystem strengthening tools**:
Analytics Tools for Insight Building –
Supports policy makers and regulators with **data-driven dashboards**, enabling forecasting of seat capacity, pass-out ratios, placement trends and compliance gaps.
Dynamic Batch Sizing –
Allows institutes to **optimize intake based on demand, infrastructure and faculty strength**, avoiding both overcrowding and underutilization.
Placement Portal and Authentic Job Portal –
Bridges the **gap between training and employment**, ensuring verified job opportunities and reducing the risk of fraudulent placements.
AI & Immersive Technology Strategy –
Introduces **next-generation training approaches** such as VR-based ship operations, AI-assisted assessment and adaptive learning systems to align Indian maritime training with global best practices.
Faculty Development Program (FDP) –
Strengthens the **human capital side of digital transformation**, ensuring that instructors are technologically competent and pedagogically updated.

Key Message
The slide collectively conveys that digital transformation in maritime training is not limited to software adoption. It is a **holistic governance reform combining technology, analytics, institutional accountability and human capacity building**. The intent is to move from **paper-based, fragmented and reactive systems** to a **connected, transparent and intelligence-driven ecosystem**, thereby enhancing credibility, efficiency and global competitiveness of India's maritime education and certification framework.



Sagar Mein Yog

This slide introduces **Sagar Mein Yog (SMY)** as a **holistic wellness initiative for the maritime sector**, designed not merely as a yoga programme but as a **comprehensive mental, physical and emotional well-being framework** for seafarers and maritime professionals.

Concept and Rationale

Sagar Mein Yog integrates **yoga, mindfulness, emotional resilience, physical fitness and spiritual well-being** into a structured programme tailored for maritime life.
The maritime profession involves **long isolation at sea, irregular work cycles, high stress, fatigue and mental health challenges**, and SMY is positioned as a preventive and corrective wellness mechanism rather than a recreational activity.
It is therefore framed as a **structured capacity-building and human sustainability initiative**, not a standalone fitness module.

Institutional Linkages

Implemented **in partnership with NUSI** with **Trijog as the knowledge partner**, bringing domain expertise in counselling and mental wellness.
Linked to Maritime India Vision (MIV) 2030 – Deliverable 10.16.3, which focuses on

seafarer welfare and well-being.
The programme is also being **presented at the 136th IMO Council**, indicating international visibility and positioning India as a leader in seafarer wellness frameworks.

Wellness Dimensions Covered
The circular graphic on the right illustrates that SMY is not limited to physical yoga but covers **multi-dimensional wellness**, including:
Emotional wellness – stress management and psychological balance
Physical wellness – fitness, stamina and lifestyle discipline
Occupational wellness – work satisfaction and fatigue management
Social wellness – interpersonal relations and onboard harmony
Environmental and climatic wellness – adaptability to sea conditions
Intellectual and cultural wellness – cognitive engagement and awareness
Spiritual wellness – inner balance and mindfulness
Economic wellness – financial awareness and long-term security mindset

This makes SMY a **360-degree human performance and resilience model** for maritime professionals.

Way Ahead / Implementation Path
The next steps are structured and regulatory-aligned:
Formal STCW approvals for both **Training of Trainers (ToT)** and Yoga curriculum to ensure global acceptability.
Conduct of ToT programmes for MTIs, covering both **pre-sea and post-sea phases**, so trainers are standardised.
Integration of yoga and wellness modules into existing maritime training curricula, rather than creating parallel systems.
Phased rollout plan – starting with **pre-sea institutes**, then **post-sea courses**, and eventually **at-sea deployment**.
Monitoring and evaluation mechanisms to measure impact, collect feedback and allow course correction.

Sagar Mein Yog is positioned as a **human-centric maritime reform**, aiming to improve **seafarer mental health, productivity, safety performance and long-term career sustainability**.
It signals a shift from purely technical competency frameworks to **balanced human wellness and resilience in the maritime ecosystem**.

Sagar Mein Samman - Gender Inclusion in Maritime

This slide highlights the **progress and policy direction of gender inclusion in the Indian maritime sector**, with a specific focus on the **rise in women seafarer participation** and the institutional initiatives driving this change.

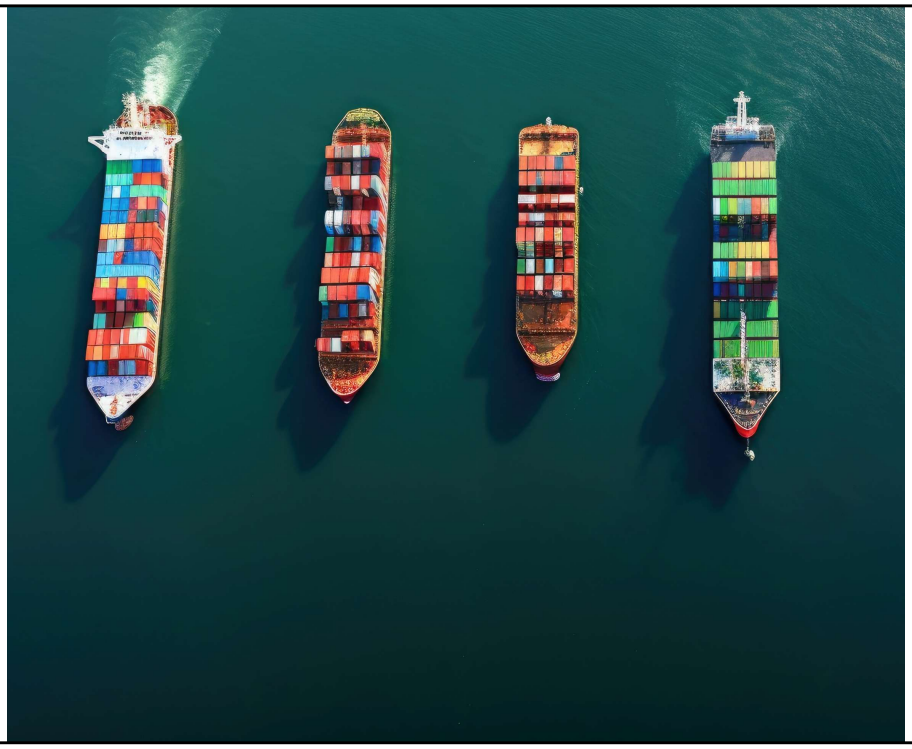
Overall Seafarer Growth Context
On the left side, we see the **year-on-year growth of total Indian seafarers** from 2013 to 2024.
The numbers indicate a **steady expansion of India's maritime workforce**, crossing **30 thousand seafarers by 2024**.
This broader growth is important because gender inclusion is not happening in isolation — it is occurring alongside **overall sectoral expansion**, which provides more employment opportunities and capacity for diversification.

Women Seafarer Growth Trend
The central chart specifically captures **women seafarer growth**:
2021 – 1.6 thousand
2022 – 3.3 thousand
2023 – 4.8 thousand
2024 – 5.9 thousand
This shows **almost a four-fold rise in just four years**, indicating that targeted policy measures and awareness programmes are producing **visible and measurable impact**.
A key statistic reinforcing this trend is the **739% increase in registered women seafarers**, rising from **1,699 in 2015 to 14,255 in 2024**.
This reflects not just participation, but a **structural shift toward inclusivity and acceptance** within the maritime ecosystem.

Institutional Financial Support
To actively encourage entry into maritime careers, the Directorate General of Shipping provides **₹1,00,000 financial assistance** through the **Maritime Training Trust** for women cadets and ratings enrolling in pre-sea courses.
This is significant because financial barriers are often the **primary deterrent**, and this incentive directly addresses accessibility and affordability.

Sagar Mein Samman – Structural Inclusion Initiative
On the right side, the slide introduces **Sagar Mein Samman (Honor at Sea)** as the **flagship inclusion initiative** designed to transform India's maritime sector into a **more inclusive, equitable and aspirational ecosystem**.
Its goal is to build a **resilient and diverse maritime workforce**, and it operates through **six structural pillars**:
Planning & Strategy
Training & Development
Research & Innovation
Governance & Compliance
Communications
Community Outreach
These pillars ensure that gender inclusion is not treated as a one-time programme but as a **continuous, system-wide reform** embedded in policy, training, industry engagement and monitoring.

Key Message
The slide collectively conveys that **gender inclusion in maritime is transitioning from awareness to institutionalisation**.
Through **data-backed growth trends, financial incentives and structured initiatives like Sagar Mein Samman**, India is positioning its maritime workforce to be **diverse, future-ready and globally competitive**, rather than merely compliant with equality norms.



संगच्छध्वं
संवदध्वं
सं वो मनांसि
जानताम्।

"Move together,
speak together,
may your minds
be in harmony."
(Rigveda 10.191.2)

सत्यमेव जयते
Ministry of Ports,
Shipping & Waterways
Government of India