

An aerial photograph of a port area. On the left, a large cargo ship is docked, its deck filled with stacks of colorful shipping containers in shades of red, white, blue, and yellow. To the right, a smaller tugboat is positioned near a yellow gantry crane structure. The water is a deep blue, and the overall scene depicts a busy maritime logistics hub.

Green Skill Development & Green HR - Implementation Roadmap

Document control

Revision history

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List of Abbreviations

Acronym	Full Form
CPD	Continuing Professional Development
DG Shipping	Directorate General of Shipping
ESG	Environmental, Social and Governance
GHG	Greenhouse Gas
HR	Human Resources
IMO	International Maritime Organization
IMU	Indian Maritime University
IWT	Inland Waterways Transport
MoEFCC	Ministry of Environment, Forest and Climate Change
MoPSW	Ministry of Ports, Shipping and Waterways
MoU	Memorandum of Understanding
MRV	Monitoring, Reporting and Verification
MSDE	Ministry of Skill Development & Entrepreneurship
MSME	Micro, Small and Medium Enterprises
NGSP	National Green Shipping Policy
PSU	Public Sector Undertaking
R&D	Research and Development

Contents

1	5
2	17
3	27
4	28
5	30

1. Introduction

Green skill development and green human resource (HR) transformation are foundational enablers of India's maritime decarbonisation agenda under the National Green Shipping Policy (NGSP). As the policy progressively reshapes shipbuilding, ship repair, ports, fuels, and vessel operations, the availability of appropriately skilled human capital will determine the speed, safety, and credibility of implementation. Decarbonisation in the maritime sector is not solely a technology transition; it is equally a workforce transition that requires new competencies, redefined job roles, and institutional capacity to absorb evolving regulatory, operational, and environmental requirements.

The NGSP recognises that emerging green maritime technologies—ranging from energy-efficient ship design and retrofit practices to alternative fuels, digital monitoring systems, and lifecycle compliance frameworks—demand skills that go beyond traditional maritime engineering and operations. Naval architects, shipyard engineers, technicians, surveyors, port personnel, and ship crews will increasingly be required to understand energy-efficiency principles, emissions measurement and reporting, safety protocols for new fuels, and digital performance management tools. Without targeted skilling and reskilling interventions, these technological and regulatory shifts risk creating execution bottlenecks, safety concerns, and uneven adoption across the maritime ecosystem.

From a lifecycle perspective, green skills are required across all stages of maritime activity. At the design and construction stage, competencies in energy-efficient hull forms, alternative-fuel readiness, and digital design tools become critical. During ship repair and retrofit, skills related to efficiency upgrades, hybrid systems, emissions monitoring, and safe handling of new materials are essential. In operations and compliance, crews and shore-based staff must be equipped to manage data-driven optimisation, MRV obligations, and evolving international regulatory requirements. The NGSP therefore frames skill development not as a standalone training activity, but as an integrated enabler that supports regulatory compliance, industrial competitiveness, and environmental performance across the maritime value chain.

Green HR frameworks play a complementary role by institutionalising this transition within organisations. As job profiles evolve, shipping companies, shipyards, ports, and maritime institutions must adapt workforce planning, recruitment, performance management, and certification systems to reflect green competencies. This includes recognising new roles linked to environmental compliance, digital systems, and lifecycle management, as well as redefining existing roles to incorporate sustainability responsibilities. Embedding green competencies into HR systems ensures that decarbonisation objectives are translated into organisational capability rather than remaining policy-level aspirations.

The NGSP also emphasises the importance of alignment between skill development initiatives and broader national priorities, including industrial transformation, domestic manufacturing, and technology innovation. By strengthening green maritime skills, India can reduce dependence on external expertise, enhance safety and reliability during the transition phase, and position its workforce to support both domestic decarbonisation and export-oriented maritime services. In this context, green skill development and green HR are not only enablers of environmental compliance but also strategic levers for employment generation, industrial resilience, and long-term competitiveness of India's maritime sector.

Collectively, the Green Skill Development and Green HR pillar under the NGSP provides the human capital foundation required to operationalise green shipping ambitions. By systematically building skills, certification pathways, and workforce governance aligned with emerging technologies and regulations, this pillar ensures that India's maritime decarbonisation pathway is implementable, safe, and economically sustainable over the short, medium, and long term.

1.1. India's Approach to Green Skill Development & Green Human Resources for Maritime Decarbonisation

India's approach to Green Skill Development and Green Human Resources under the National Green Shipping Policy is premised on the understanding that the transition to green shipping is not solely a technological or regulatory exercise, but a systemic transformation of maritime capabilities, institutions, and workforce practices. As the NGSP seeks to embed sustainability at the core of India's maritime ecosystem, the availability of appropriately skilled human

capital is recognised as a critical determinant of safe, credible, and scalable decarbonisation.

The NGSP emphasises that emerging green shipping pathways—spanning energy-efficient ship design, low-carbon shipbuilding processes, green ship repair and retrofitting, lifecycle emissions management, digital monitoring and reporting, and environmentally responsible ship recycling—introduce new operational, safety, and compliance requirements across the maritime value chain. These requirements necessitate a deliberate shift from traditional skill sets toward multidisciplinary competencies that integrate engineering, environmental management, digital systems, and regulatory compliance. Green Skill Development is therefore positioned as a foundational enabler that allows policy intent to translate into on-ground implementation across shipyards, repair facilities, shipping companies, ports, and regulatory bodies.

Consistent with the NGSP’s phased implementation philosophy, India’s approach to green skills adopts a progressive, time-bound, and adaptive pathway. In the initial phase, the focus is on awareness creation, baseline capacity building, and familiarisation of the workforce with evolving international and domestic green shipping standards. As policy measures mature, the medium-term emphasis shifts toward structured training, formal certification, and institutionalisation of green competencies within maritime education, vocational training, and professional development systems. Over the long term, green skills are envisaged to become embedded as standard occupational competencies, supported by continuous upskilling frameworks that evolve alongside global technological and regulatory developments.

A key feature of India’s approach is the integration of Green Human Resource (Green HR) principles into maritime organisations. The NGSP recognises that workforce transformation cannot be achieved through training alone and must be supported by changes in organisational structures, role definitions, recruitment practices, and performance management systems. Green HR frameworks are therefore intended to align workforce planning and career progression with sustainability objectives, ensuring that environmental responsibilities are embedded within job roles rather than treated as external compliance functions. This organisational integration is particularly important for shipbuilding and ship repair entities, where design decisions, material choices, process controls, and operational practices directly influence lifecycle emissions and environmental outcomes.

The policy further highlights the importance of institutional coordination and alignment in green skill development. Maritime universities, training institutes, industry bodies, classification societies, and regulators are expected to play complementary roles in shaping curricula, certification pathways, and competency standards that are consistent with NGSP objectives and international conventions. By aligning skill development initiatives with regulatory reforms, technology deployment, and industrial policy, the NGSP seeks to avoid fragmentation and ensure coherence between what is required by regulation and what is delivered through workforce development systems.

Importantly, the NGSP frames Green Skill Development and Green HR not only as a risk-mitigation or compliance measure, but as a strategic opportunity for India’s maritime sector. Developing domestic expertise in green shipbuilding, ship repair, and lifecycle management reduces reliance on external technical support, strengthens safety and operational confidence during transition, and enhances India’s competitiveness in global maritime markets. In this context, green skills are positioned as a long-term investment in industrial capability, employment resilience, and export readiness, supporting India’s ambition to emerge as a leader in sustainable maritime services.

Taken together, India’s approach to Green Skill Development and Green Human Resources establishes the human capital backbone required to deliver the NGSP’s broader decarbonisation objectives. By embedding skills, safety, and sustainability into the core of maritime institutions and operations, the policy ensures that the green shipping transition is technologically robust, environmentally credible, and institutionally sustainable, reinforcing India’s long-term vision for a resilient and globally competitive maritime sector.

Key Considerations under the Green Ships (Shipbuilding and Ship Repair) Pillar:

A. Green skill development must be synchronised with the phased rollout of green technologies and regulatory requirements

The NGSP highlights that technological maturity and regulatory clarity will evolve over time, particularly for green ships, green technologies, and lifecycle compliance systems. Skill development initiatives must therefore be sequenced in line with short-, medium-, and long-term policy actions, ensuring that training programmes respond to actual implementation needs rather than anticipated or speculative technologies. Misalignment between policy timelines and workforce readiness risks either premature skilling or operational bottlenecks during critical transition phases.

B. Workforce strategies must explicitly account for heterogeneity across the maritime value chain

As identified in the NGSP's assessment of cross-cutting challenges, India's maritime ecosystem spans large shipyards, MSME repair facilities, ports, inland waterways, recycling yards, and regulatory bodies, each facing different capability constraints. Green skill frameworks must therefore be modular and role-specific, allowing differentiated pathways for designers, yard engineers, technicians, inspectors, ship crews, port personnel, and recycling workers, while maintaining common baseline competencies in safety, environmental compliance, and digital reporting.

C. Safety and operational risk management must be integral to all green skill initiatives

The NGSP emphasises that emerging technologies and practices—such as alternative propulsion systems, new materials, digital monitoring tools, and environmentally sound recycling—introduce unfamiliar operational and safety risks. Green skill development must embed safety awareness, emergency preparedness, and risk management as core elements, rather than treating them as supplementary modules. This is particularly critical in shipbuilding, repair, and recycling environments where workforce exposure to new hazards is highest.

D. Institutional capacity and trainer readiness represent a binding constraint on scale

The policy recognises gaps in specialised expertise and limited domestic experience with advanced green maritime technologies. Strengthening green skills will therefore require parallel investment in trainer development, curriculum modernisation, and industry-academia collaboration. Without capable institutions and instructors, green skill programmes risk remaining theoretical and disconnected from real-world operational requirements in shipyards, ports, and vessels.

E. Green HR frameworks must be embedded within organisational systems to drive behavioural and cultural change

The NGSP identifies fragmentation and siloed decision-making as recurring barriers across the maritime sector. To address this, green competencies must be formally integrated into workforce planning, recruitment, appraisal, certification, and career progression systems within shipyards, shipping companies, ports, and regulatory bodies. Treating green skills purely as training outputs, without HR integration, would limit their influence on day-to-day operational decisions and long-term organisational capability.

F. Alignment with international standards and recognition mechanisms is essential

Given the global nature of shipbuilding, ship repair, and maritime services, Indian green maritime skills must be aligned with international conventions, classification society requirements, and best practices referenced in the NGSP. International alignment enhances regulatory credibility, supports workforce mobility, and strengthens India's ability to participate in global green shipping value chains, particularly in design, retrofit, and recycling services.

G. Long-term uncertainty must be managed through adaptive and continuous upskilling models

The NGSP highlights stakeholder concerns around long-term technology pathways, evolving standards, and investment risks. Green skill development must therefore move beyond one-time training interventions toward continuous learning and adaptive certification frameworks that can evolve as technologies, regulations, and market conditions change. This adaptability is critical to maintaining workforce relevance and confidence over the multi-decade transition horizon.

1.2. Green Skill Development & Green HR Across the Maritime Value Chain

Green Skill Development & Green HR Across the Maritime Ecosystem



Continuous Upskilling | Digital Literacy | Safety Integration | Global Alignment | Lifecycle Competency

1.3. Green Skill Development & Green HR for India's Green Shipping Transition

Green Skill Development and Green Human Resource transformation are recognised in the NGSP as structural enablers of maritime decarbonisation, operating alongside technology deployment, regulatory reform, and green finance. The consultative framework acknowledges that achieving lifecycle emissions reduction across ships, ports, fuels, and recycling cannot be realised through infrastructure and regulation alone; it requires institutional capacity, specialised competencies, and workforce systems capable of adapting to evolving international standards under the IMO and related global mechanisms.

The NGSP's policy architecture — spanning green collaboration, green regulations, green reporting, and green finance — implicitly positions human capital as a cross-cutting enabler. Skill development and workforce transformation are therefore not treated as auxiliary capacity-building activities, but as integral components of regulatory compliance, certification credibility, and technology absorption.

International experience indicates that maritime decarbonisation is being enabled through a dual human-capital strategy: rapid upskilling of the existing workforce to meet near-term compliance and safety requirements, alongside long-term institutionalisation of green competencies through education, certification, and career frameworks. The NGSP reflects this logic by framing green skill development and green HR as complementary levers—supporting immediate transition needs while embedding sustainability into the long-term architecture of maritime employment and governance.

In the Indian context, this lifecycle-oriented approach is particularly relevant. India's maritime workforce spans legacy vessels, conventional shipyards, emerging green technologies, and expanding regulatory responsibilities. Fleet turnover and infrastructure transformation will be gradual, requiring sustained coexistence of conventional and green systems over an extended transition period. Green skill development is therefore framed as an adaptive and phased process, ensuring that personnel across shipbuilding, ship repair, shipping operations, ports, classification, and regulatory bodies can safely manage hybrid operational environments without disruption to safety or trade.

Vessel segmentation further reinforces the need for differentiated skilling pathways. Coastal and inland shipping segments, which dominate domestic operations, require practical competencies in retrofit execution, hybrid propulsion management, digital optimisation, and emissions monitoring. In contrast, ocean-going and export-linked segments demand advanced design, certification, and lifecycle assessment skills aligned with international benchmarks. The NGSP therefore treats green skills as segment-specific yet system-integrated, avoiding a one-size-fits-all approach. From an institutional perspective, the NGSP extends the scope of workforce transformation beyond training to include Green Human Resource (Green HR) frameworks. These frameworks encompass workforce planning, role definition, recruitment, certification, performance management, and career progression aligned with sustainability objectives. Green HR is positioned as the mechanism through which environmental responsibility is embedded into organisational decision-making rather than treated as a standalone compliance activity. This is particularly significant for shipyards, repair facilities, regulatory authorities, and port institutions, where operational decisions have direct lifecycle emissions implications.

The policy also recognises knowledge institutions, training bodies, and international collaboration as critical enablers. Partnerships with global maritime institutions, classification societies, research centres, and industry leaders are encouraged to facilitate technology transfer, curriculum modernisation, and harmonisation of competency standards. This aligns with the NGSP's broader emphasis on green collaboration and global integration, ensuring that India's maritime workforce remains interoperable with international regulatory and operational ecosystems.

The Green Skill Development and Green HR component of the NGSP therefore adopts a systems-based and lifecycle-aligned approach, integrating skilling pathways, institutional reform, certification mechanisms, and workforce governance within the broader maritime decarbonisation framework. Its intent is not to prescribe specific job roles or training modules, but to establish an enabling ecosystem that supports phased adoption, technology neutrality, and risk-managed human-capital transition in line with evolving international standards and domestic priorities.

Key Policy Signals on Green Skill Development & Green HR from NGSP:

- Skill Development & Knowledge Sharing are explicitly embedded within the Green Ships pillar, linking workforce capability with decarbonisation outcomes.
- Green Talent Fund mechanisms are proposed to support specialised training programs, scholarships, and workforce development initiatives aligned with green maritime technologies.
- International collaboration is treated as a critical pathway for technology transfer, institutional learning, and regulatory alignment, reinforcing workforce readiness for evolving IMO standards.
- Certification, monitoring, and reporting frameworks under MRV-type systems implicitly require trained

professionals capable of emissions data management, environmental auditing, and compliance verification.

- Green HR transformation is aligned with financial instruments and policy incentives, ensuring that workforce capability evolves alongside green finance deployment and industrial modernisation efforts.
- The framework integrates skill development within the broader maritime ecosystem — spanning shipyards, ports, ship recycling facilities, regulatory institutions, and coastal communities — reinforcing the NGSP’s whole-of-sector transition model.

1.3.1 Maritime Education & Curriculum Reform

Maritime education reform under the NGSP is positioned as a structural enabler of compliance-driven decarbonisation. As international regulatory instruments increasingly tie vessel viability to demonstrable efficiency and emissions performance, maritime education must evolve from conventional engineering training to lifecycle-based sustainability integration.

The reform agenda centres on embedding the following capability layers within mainstream maritime education pathways:

- **Lifecycle emissions integration into core engineering disciplines:**
Emissions performance is taught as a function of design configuration, operational behaviour, maintenance cycles, and end-of-life handling — not solely fuel selection. Curriculum incorporates baseline emissions establishment, performance benchmarking logic, and the linkage between design-stage efficiency and cumulative lifecycle emissions outcomes.
- **Institutionalisation of efficiency design and retrofit engineering competencies:**
Naval architecture, marine engineering, and repair programmes integrate applied modules on hull optimisation, propulsion efficiency, energy-saving devices, retrofit feasibility assessment, and performance validation. Training reflects practical shipyard realities, including class approvals, downtime constraints, materials availability, and post-retrofit verification processes.
- **Digital compliance and MRV capability as core technical skillsets:**
Emissions data capture, reporting workflows, and performance analytics are embedded within education and professional training streams. Programmes include structured exposure to monitoring systems, reporting templates, and compliance documentation practices aligned with performance-based regulatory frameworks.
- **Ecosystem-based curriculum delivery across institutions:**
Reform is implemented through coordinated engagement between maritime universities, vocational institutes, shipyard training centres, classification bodies, and regulators. This ensures consistency of competencies across design, construction, retrofit, operations, and compliance stages within the maritime lifecycle.

Through this structured integration, green shipping competencies are institutionalised as mainstream maritime capabilities rather than elective environmental specialisations. The objective is to build a national talent pipeline aligned with phased NGSP implementation, reducing dependence on external technical expertise and strengthening India’s long-term regulatory and industrial preparedness.

Key NGSP Signals on Maritime Education Reform

- **Green skills are treated as an implementation enabler (not an optional add-on):** the draft explicitly

calls for skill development and knowledge sharing in green shipping through structured training linkages and partnerships, indicating that workforce capability is a prerequisite for delivery of the Green Ships agenda (including shipbuilding/repair readiness).

- **Training is expected to be delivered through global capability partnerships (not only domestic curriculum tweaks):** the draft’s direction is to form partnerships with global institutions, shipbuilders, and the IMO to train professionals in green technologies—signalling an “import best practice + localise” model for maritime education and upskilling.
- **A dedicated ‘Green Talent Fund’ is positioned as the financing backbone for education reform:** the draft proposes a Green Talent Fund to support specialised training programmes, scholarships, and workforce development initiatives—this is a clear policy signal that skills will be funded as a structured national programme, not left to ad-hoc capacity building.
- **Skills policy is connected to innovation policy (education + R&D pipeline):** the draft also proposes a Green Innovation Fund for research, pilots, and technology development—implying education reform should be tied to practical demonstration, applied R&D, and technology absorption (i.e. training people on what is being piloted and scaled).

1.3.2 Professional Certification & Green Compliance Capacity

As the NGSP advances toward performance-based regulation, emissions transparency, and lifecycle accountability, professional certification systems become central to maritime decarbonisation. The transition from prescriptive compliance to performance-verified compliance — reflected in international efficiency and carbon-intensity instruments — requires specialised institutional capacity capable of interpreting, validating, and auditing emissions data and vessel performance.

Professional certification frameworks must therefore evolve from traditional inspection-based models toward integrated compliance systems that support digital reporting, lifecycle documentation, and technology verification. The NGSP’s emphasis on monitoring, reporting, and verification (MRV), alongside certification-linked green finance and compliance credibility, implies a structural shift in professional competency requirements across regulators, classification societies, shipyards, and fleet operators.

The certification and compliance capacity agenda centres on the following institutional strengthening measures:

- **Institutionalisation of emissions verification and lifecycle documentation competencies:** Professional certification systems must incorporate structured training in emissions baseline establishment, performance validation, and lifecycle documentation practices. This ensures that compliance with evolving carbon-intensity and efficiency thresholds is technically credible and internationally defensible.
- **Alignment of classification and surveyor training with performance-based regulatory instruments:** Surveyors, auditors, and classification personnel require structured exposure to digital performance analytics, retrofit verification methodologies, and efficiency benchmarking systems. Certification bodies must evolve in tandem with technology adoption and reporting requirements.
- **Integration of digital MRV workflows into professional accreditation:** Competency standards should include proficiency in data capture systems, emissions reporting protocols, audit documentation processes, and compliance submission procedures. This strengthens institutional readiness for transparent, data-driven regulation.
- **Strengthening compliance capacity within shipyards and fleet operators:** Shipyard engineers, retrofit planners, and fleet technical managers must be certified in performance validation, post-retrofit testing, and regulatory reporting alignment to ensure emissions-reduction measures translate into measurable compliance outcomes.

Key Policy Signals on Ship Retrofit from NGSP:

- Green compliance capability is to be embedded within formal professional accreditation frameworks, ensuring that emissions verification, lifecycle documentation, and performance validation are treated as core regulatory competencies rather than supplementary administrative functions.
- Certification systems must evolve in parallel with performance-based regulatory instruments, aligning surveyor, auditor, and classification training with digital reporting, retrofit verification methodologies, and carbon-intensity benchmarking requirements.
- MRV literacy and emissions data governance are recognised as foundational institutional capabilities, necessary to ensure credible reporting, international regulatory acceptance, and access to sustainability-linked finance.
- Shipyards, fleet operators, and regulatory bodies are to develop structured internal compliance expertise, reducing dependence on external validation and strengthening national capacity for lifecycle-based maritime governance.
- Professional certification reform is positioned as enabling infrastructure within the Green Ships pathway, supporting transparency, investor confidence, and phased implementation of efficiency and decarbonisation measures.

1.3.3 Workforce Upskilling for Retrofit & Transitional Technologies

The NGSP recognises that India's fleet profile is characterised by gradual asset turnover, with existing vessels expected to dominate operational activity over the coming decades. As a result, near-term decarbonisation is driven primarily through retrofit, efficiency upgrades, hybridisation, and operational optimisation rather than immediate fleet replacement. Workforce capability within ship repair yards, fleet technical teams, and onboard engineering functions therefore becomes a decisive factor in achieving compliance with evolving efficiency and carbon-intensity instruments.

Retrofit implementation requires specialised technical competence that goes beyond conventional maintenance activity. Installation of energy-saving devices, propulsion modifications, digital performance systems, and hybrid configurations demands structured planning, regulatory coordination, and post-installation validation. Without targeted upskilling, retrofit pathways risk inefficiency, safety gaps, or regulatory non-alignment.

The NGSP's lifecycle framing implies that workforce upskilling must support the following operational capabilities:

- **Institutionalisation of emissions verification and lifecycle documentation competencies:** Professional certification systems must incorporate structured training in emissions baseline establishment, performance validation, and lifecycle documentation practices. This ensures that compliance with evolving carbon-intensity and efficiency thresholds is technically credible and internationally defensible.
- **Alignment of classification and surveyor training with performance-based regulatory instruments:** Surveyors, auditors, and classification personnel require structured exposure to digital performance analytics, retrofit verification methodologies, and efficiency benchmarking systems. Certification bodies must evolve in tandem with technology adoption and reporting requirements.
- **Integration of digital MRV workflows into professional accreditation:** Competency standards should include proficiency in data capture systems, emissions reporting protocols, audit documentation processes, and compliance submission procedures. This strengthens institutional readiness for transparent, data-driven regulation.
- **Strengthening compliance capacity within shipyards and fleet operators:** Shipyard engineers, retrofit planners, and fleet technical managers must be certified in performance validation, post-retrofit testing, and regulatory reporting alignment to ensure emissions-reduction measures translate into

measurable compliance outcomes.

Key Policy Signals on Workforce Upskilling for Retrofit & Transitional Technologies:

- Retrofit-oriented technical competencies are to be institutionalised across ship repair and fleet engineering functions, recognising retrofit and efficiency upgrades as primary near-term compliance pathways within India's fleet profile.
- Workforce capability must align with phased decarbonisation instruments, ensuring that installation, commissioning, and validation of efficiency and hybrid systems meet evolving regulatory performance thresholds.
- Ship repair yards are positioned as implementation platforms within the Green Ships pathway, requiring structured technical capacity to execute emissions-reduction interventions consistent with lifecycle compliance objectives.
- Feasibility assessment and post-retrofit performance validation skills are to be embedded within technical teams, ensuring that efficiency measures translate into measurable regulatory outcomes rather than theoretical design improvements.
- Upskilling initiatives are treated as industrial capability strengthening measures, reinforcing national execution capacity and reducing reliance on external technical validation.

1.3.4 Digital & MRV Competency Integration

The NGSP's emphasis on transparency, monitoring, and performance-based compliance places digital capability at the centre of maritime decarbonisation. As regulatory frameworks increasingly depend on emissions measurement, data reporting, and performance benchmarking, digital systems evolve from operational efficiency tools into regulatory infrastructure. Workforce readiness in digital and MRV (Monitoring, Reporting and Verification) domains therefore becomes essential to ensuring credible and scalable implementation of green shipping measures.

Digital competency integration is required across ship operators, shipyards, ports, and regulatory authorities to support real-time performance tracking, emissions reporting, retrofit validation, and compliance documentation. Without structured digital capability, the effectiveness of efficiency improvements and retrofit interventions cannot be transparently demonstrated or internationally recognised.

The NGSP's lifecycle approach implies that digital integration must support:

- **Structured emissions data capture and reporting workflows:** Personnel must be trained in the collection, management, and submission of fuel consumption data, efficiency indicators, and carbon-intensity metrics in formats aligned with national and international reporting frameworks.
- **Performance analytics and operational optimisation tools:** Workforce capability must include interpretation of vessel performance dashboards, route optimisation systems, and energy management platforms that reduce fuel demand while supporting regulatory benchmarking requirements.
- **Digital validation of retrofit and efficiency outcomes:** Post-installation verification of energy-saving devices and hybrid systems requires structured data analysis skills to demonstrate measurable improvements under carbon-intensity or efficiency instruments.
- **Data governance and compliance documentation management:** Institutions must build competency in maintaining audit trails, ensuring data integrity, and aligning internal reporting systems with classification and regulatory submission requirements.

Key Policy Signals on Digital & MRV Competency Integration:

- Digital emissions monitoring and reporting capability is to be embedded across maritime institutions, recognising MRV systems as regulatory infrastructure within the green shipping transition.
- Workforce proficiency in emissions data governance and performance analytics is essential for credible compliance under performance-based frameworks.
- Digital validation of retrofit and efficiency measures is positioned as a prerequisite for demonstrating measurable decarbonisation outcomes.
- Alignment of reporting systems with international regulatory instruments strengthens transparency, market confidence, and access to green finance mechanisms.
- Digital competency development supports phased implementation by enabling continuous performance tracking rather than episodic compliance verification.

1.3.5 Green HR & Organisational Transformation Frameworks

The NGSP's systems-based approach to maritime decarbonisation implies that technological upgrades and regulatory reforms must be accompanied by institutional transformation. Green Human Resource (Green HR) frameworks therefore function as governance enablers, embedding sustainability responsibilities within organisational structures, workforce planning, and performance management systems across maritime entities.

Decarbonisation obligations increasingly influence operational decisions, capital allocation, retrofit scheduling, compliance documentation, and performance reporting. As a result, sustainability considerations must transition from peripheral environmental units into mainstream management functions. Green HR integration ensures that emissions accountability is institutionalised within shipyards, fleet operators, regulatory bodies, and port authorities.

The organisational transformation agenda centres on the following structural measures:

- **Embedding sustainability-linked responsibilities within core job roles:**
Engineering, operations, compliance, and management functions incorporate defined accountability for efficiency performance, emissions reporting, and lifecycle compliance. Environmental responsibility is institutionalised as a routine operational mandate rather than an external reporting exercise.
- **Alignment of workforce planning with phased decarbonisation pathways:**
Human resource planning anticipates evolving regulatory thresholds, technology integration timelines, and retrofit execution requirements. This ensures that workforce composition evolves in parallel with the NGSP's staged implementation framework.
- **Integration of sustainability metrics into performance management systems:**
Organisational performance indicators incorporate efficiency improvements, emissions-reduction outcomes, and compliance adherence, reinforcing accountability across managerial and technical hierarchies.
- **Structured continuous professional development for evolving technologies:**
Green HR frameworks institutionalise periodic upskilling and re-certification pathways to maintain workforce readiness as propulsion systems, digital tools, and reporting frameworks evolve.

Through these measures, Green HR functions as an internal governance mechanism that strengthens compliance credibility, reduces transition friction, and supports long-term competitiveness within the green shipping ecosystem.

Key Policy Signals on Digital & MRV Competency Integration:

- Sustainability responsibilities are to be embedded within mainstream organisational structures, aligning workforce governance with decarbonisation objectives under the Green Ships pathway.
- Human resource planning must evolve in tandem with phased regulatory tightening and technology deployment timelines.
- Performance management systems are to incorporate emissions and efficiency indicators consistent with lifecycle compliance requirements.
- Continuous professional development is positioned as a structural requirement to maintain regulatory and technological readiness.
- Green HR integration strengthens institutional resilience, transparency, and long-term industrial competitiveness within India’s maritime sector.

1.4 Possible Solutions and Key Opportunities

The table below outlines key solutions and opportunities for green skill development & green HR.

Solution	Key Opportunity (India-focused action pathway)
A. National Green Maritime Curriculum Reform	Establish a National Green Maritime Curriculum Framework integrating lifecycle emissions logic, retrofit engineering, digital MRV systems and alternative propulsion fundamentals across maritime universities and technical institutes.
	Mandate inclusion of efficiency design, carbon-intensity compliance, and retrofit feasibility modules within naval architecture, marine engineering and ship-repair diploma programmes.
	Introduce industry-embedded training semesters within shipyards executing green retrofits to align classroom learning with operational practice.
B. Green Professional Certification & Compliance Accreditation Reform	Create structured green certification pathways for surveyors, yard engineers, retrofit planners and fleet compliance managers aligned with performance-based regulatory frameworks.
	Integrate emissions monitoring, lifecycle documentation and digital MRV competencies into professional licensing and periodic re-certification systems.
	Introduce a 'Green Compliance Accredited Professional' credential to strengthen domestic verification capacity and reduce reliance on external technical validation.

C. National Retrofit Skills Acceleration Programme	Launch a targeted upskilling programme focused on energy-saving devices, propulsion optimisation, hybrid integration and post-retrofit performance validation.
	Develop standardised training modules for retrofit feasibility assessment, lifecycle cost modelling and regulatory alignment consistent with India's fleet profile.
	Establish retrofit excellence clusters within major repair hubs to serve as demonstration and advanced training centres.
D. Digital & MRV Workforce Integration Framework	Develop a national MRV competency standard covering emissions data capture, reporting workflows, performance analytics and audit documentation.
	Embed digital emissions monitoring training across ship operators, ports and regulatory agencies to strengthen compliance credibility.
	Establish simulation-based labs for emissions analytics and operational optimisation within maritime institutions.
E. Green HR Transformation Framework for Maritime Institutions	Develop model Green HR guidelines embedding sustainability-linked responsibilities within engineering, operations and management roles across shipyards and fleet operators.
	Align workforce planning with phased decarbonisation pathways to anticipate technology integration and regulatory tightening.
	Integrate emissions and efficiency indicators within organisational performance management systems.
F. Green Talent Fund for Maritime Decarbonisation	Operationalise a Green Talent Fund to support specialised training programmes, scholarships, international exchange and shipyard upskilling initiatives linked to certification levels.
	Provide co-financing support for shipyard training infrastructure related to hybrid propulsion, efficiency systems and digital monitoring tools.
	Align fund allocation with priority decarbonisation segments such as retrofit-heavy clusters and digital compliance teams.
G. Global Knowledge Partnerships & Technology Transfer Platforms	Establish structured partnerships with leading maritime universities, shipbuilders and IMO-linked institutions for advanced green technology training.
	Create joint certification and applied research programmes focused on efficiency optimisation, retrofit standardisation and digital compliance systems.
	Facilitate industry-academia consortia to accelerate absorption of emerging propulsion and performance technologies.
H. Shipyard Training & Industrial Coordination Mechanisms	Develop green technology training centres within major shipbuilding and repair clusters to support hands-on demonstration and industrial integration.
	Use industry association platforms to forecast skill demand, standardise retrofit competency requirements and coordinate supply-chain training initiatives.

	Integrate workforce transformation into yard modernisation and financial assistance frameworks.
I. Coastal & Inland Green Skills Fast-Track Programme	Develop specialised training for electric and hybrid vessel integration across ferries, harbour craft and inland waterways.
	Combine vessel electrification projects with battery management and shore-interface certification modules.
	Use early deployments to build domestic capability in maintenance, charging infrastructure integration and lifecycle compliance for electric fleets.

2 Indicative Action Pathway

The NGSP sets out a phased, implementation-led pathway to institutionalise Green Skill Development and Green HR as a core enabler of India’s maritime decarbonisation transition. In the short term, the focus is on establishing the structural backbone - nationally harmonised green competency standards, modular certification tracks, targeted retrofit and MRV skill pilots, and an initial Green Talent Fund framework - to rapidly activate workforce capability aligned with immediate implementation needs.

In the medium to long term, the pathway shifts from activation to institutionalisation and permanence. Green competencies are embedded into accreditation, licensing, and reporting frameworks; certification delivery is scaled through accredited networks and digital platforms; and the Green Talent Fund evolves into a structured, multi-year co-funding mechanism. Over time, a standing governance mechanism with periodic review cycles is established, green workforce forecasting is integrated into maritime capacity expansion planning, international recognition pathways are strengthened, and workforce metrics are embedded within NGSP monitoring - ensuring green capability becomes a permanent pillar of India’s maritime transition architecture.

Below is a representation of the actions summarized as high level outcomes:

2.3 Short-term Action Plan (0-6 Months)

A. Establish National Green Maritime Skills Task Force

In the short term, the Government must operationalise Green Skill Development & Green HR under the Draft NGSP through a central coordination mechanism that translates policy intent into implementable, role-linked competencies across India’s maritime value chain. The Draft NGSP calls for industry-wide skill partnerships, certified training programmes, and a structured knowledge-sharing mechanism to standardise green training modules and accelerate adoption of decarbonisation technologies.

Given India’s fragmented training ecosystem — spanning DG Shipping-approved institutes, IMU-affiliated universities, private maritime academies, shipyard training centres, and industrial clusters — the immediate priority is to create a single national framework that avoids duplication, inconsistent certification pathways, and delays in workforce readiness for retrofits, emissions monitoring, alternative fuels, and green compliance obligations.

Implementation Approach (0–6 Months):

The short-term objective under this action is to **constitute and operationalise** a National Green Maritime Skills Task Force that defines priority green competencies aligned to **retrofit execution, MRV/data readiness, efficiency standards, and emerging green technologies**, and issues a national skills framework that can be adopted by training providers and industry in a uniform way.

- Define priority green capability outcomes linked directly to implementation needs under NGSP — including retrofit execution, alternative fuel system handling, emissions measurement and reporting (MRV readiness), energy-efficiency optimisation, digital monitoring tools, and ESG/sustainability reporting competencies.
- Develop a role-linked competency mapping across Indian maritime job families — shipbuilding engineers, yard

workforce, marine engineers, surveyors, compliance officers, port personnel, auditors, and management cadres — ensuring uniform interpretation of “green skills” nationwide.

- Design a modular, stackable training architecture that can be adopted by IMU, DG Shipping–approved institutes, shipyard academies, and industrial training centres, including Tier 1 baseline green competencies and specialised modules for advanced decarbonisation pathways.
- Establish a nationally recognised certification and endorsement mechanism aligned with DG Shipping approval processes and consistent with international safety and technical standards, enabling portability of certification across Indian maritime employers.
- Publish Framework Version 1.0 and initiate an early-adopter rollout with selected institutions and shipyard clusters (e.g., major repair hubs and public sector shipyards), creating immediate implementation pilots while enabling structured feedback before nationwide scaling.

B. Develop National Green Competency Standards + Modular Certification Tracks

In the short term, once the National Green Maritime Skills Task Force is constituted (Action A), the immediate requirement is to convert policy intent into **structured, nationally harmonised competency standards and certification tracks** that can be implemented without waiting for long curriculum redesign cycles.

The Draft NGSP explicitly recommends developing **certified courses** in partnership with leading institutes and shipbuilders, and forming collaborations with IMO and global maritime institutions for specialised green technology training and certification. Without standardised competency definitions and recognised certification pathways, green training efforts risk fragmentation, limited industry uptake, and weak signalling to regulators, financiers, and international stakeholders.

The short-term goal is therefore to produce **Version 1.0 National Green Competency Standards and a Modular Certification Architecture** that:

- Defines role-based skill requirements aligned to NGSP decarbonisation pathways
- Establishes stackable certification tracks
- Embeds assessment and verification logic
- Creates a credible recognition mechanism for early adoption

Implementation Approach (0–6 Months):

The objective is not to create long academic programmes immediately, but to establish a **nationally consistent certification backbone** that can be deployed through existing universities, training institutes, shipyard centres, and industry platforms.

- Notify Role-Based National Green Competency Standards aligned to NGSP implementation priorities (retrofits, alternative fuels, MRV/emissions reporting, energy efficiency, ESG reporting), mapped across Indian maritime job families and structured into Foundational, Practitioner, and Advanced proficiency tiers.
- Issue a Stackable Modular Certification Framework deployable through IMU, DG Shipping–approved institutes, shipyard training centres, and vocational platforms, enabling phased upskilling without curriculum overhaul delays.
- Standardise Assessment and Verification Protocols including practical evaluations (retrofit simulations, emissions data exercises, MRV workflow demonstrations) with nationally defined rubrics and minimum proficiency thresholds.
- Establish a Recognition and Endorsement Mechanism including common certificate templates, industry endorsement guidance, and a voluntary national registry to strengthen employer confidence and future linkage with NGSP incentive mechanisms.
- Pilot Priority Modules and Release Framework v1.0, incorporating structured feedback from selected institutions and shipyard clusters before wider rollout.

C. Conduct National Baseline Review of Maritime Curricula and Training Ecosystem

In the short term, alongside the development of competency standards and certification tracks (Action B), it is essential to assess the current state of India's maritime education and training ecosystem. The Draft NGSP calls for strengthening skill development partnerships, expanding specialised training programmes, and aligning institutions with green shipping priorities.

However, without a structured baseline review, reforms risk duplication, uneven adoption, and misalignment between institutional capacity and decarbonisation requirements. Many maritime programmes were designed around conventional propulsion, legacy compliance models, and static regulatory environments. A national diagnostic is therefore required to identify where green competencies already exist, where gaps persist, and where rapid modular upgrades can be introduced without full curriculum overhaul.

The objective in the short term is to conduct a coordinated national review of maritime curricula, vocational training programmes, and shipyard training systems, and to produce a Green Curriculum Gap Assessment Report that informs medium-term reform.

Implementation Approach (0–6 Months):

MoPSW and DG Shipping, through the National Green Maritime Skills Task Force, will conduct a coordinated national review of maritime curricula, vocational training programmes, and shipyard training systems using a standardised assessment template.

- **Benchmark Existing Curricula** across IMU, DG Shipping–approved institutes, vocational centres, and shipyard academies against NGSP priority green skills (alternative fuels, retrofit systems, energy efficiency, MRV/emissions analytics, ESG literacy), and consolidate findings into a national curriculum mapping dashboard.
- **Assess Faculty and Infrastructure Readiness**, including trainer capability, laboratory/simulation facilities, digital emissions tools, and yard-based exposure capacity, identifying immediate training-of-trainers and infrastructure gaps.
- **Identify Rapid-Integration Modules** that can be inserted into current programmes without full curriculum overhaul, aligned to the national green certification framework.
- **Publish a National Green Maritime Education & Training Baseline Assessment Report** outlining coverage gaps, institutional strengths, and priority intervention areas to guide medium-term reform.

D. Launch Targeted Retrofit & MRV Skills Acceleration Pilots

In the short term, alongside competency standard development (Action B) and curriculum mapping (Action C), it is critical to move beyond framework design and demonstrate practical workforce readiness through focused pilot programmes. The Draft NGSP emphasises specialised training for green propulsion systems, energy-saving devices, smart shipping technologies, and emissions tracking tools.

Given that India's near-term decarbonisation pathway will be heavily retrofit-driven and increasingly dependent on monitoring, reporting and verification (MRV) systems, workforce capability in these areas must be validated early. Pilot programmes provide an opportunity to test training content, assessment methods, cost structures, and industry uptake before scaling nationally.

The objective under this short-term action is to launch 2–3 high-impact skills acceleration pilots focused specifically on retrofit execution capability and MRV compliance readiness.

Implementation Approach (0–6 Months)

MoPSW and DG Shipping, through the National Green Maritime Skills Task Force, will initiate focused pilot programmes in partnership with selected shipyard clusters, fleet operators, and maritime training institutions.

- **Pilot a Retrofit Practitioner Programme** targeting retrofit engineers, yard supervisors, and technical managers.

The module will cover retrofit feasibility assessment, energy-saving device integration, hybrid system interface considerations, and compliance documentation protocols. Applied simulations and yard-based scenarios will validate execution capability under real project conditions.

- **Pilot an MRV & Emissions Reporting Programme** delivered in collaboration with fleet operators and compliance teams.
The module will focus on emissions data capture, carbon-intensity indicator interpretation, digital monitoring tools, and audit-ready reporting workflows, using structured reporting simulations aligned to actual compliance cycles.
- **Pilot an Executive-Level ESG & Sustainability Module** for shipyard leadership, fleet management, and regulatory personnel, focusing on linking retrofit investments to performance outcomes, lifecycle emissions interpretation, and integration of ESG metrics into operational decision-making.
- **Consolidate Pilot Findings and Issue a Scaling Advisory**, analysing training feasibility, cost implications, assessment robustness, and industry recognition feedback.
The findings will inform refinement of the national modular certification framework and define a phased rollout roadmap.

E. Establish Green Talent Fund & Incentive Linkages

In the short term, alongside competency standardisation (Action B), curriculum diagnostics (Action C), and pilot skill acceleration (Action D), it is essential to create an enabling financial and institutional mechanism that sustains green skill development beyond pilot phases. The Draft NGSP explicitly proposes the creation of a **Green Talent Fund** to support training, scholarships, and shipyard upskilling initiatives linked to green maritime technologies and compliance requirements.

Without a dedicated funding and incentive structure, green skill development risks remaining dependent on institutional goodwill or project-based initiatives. Workforce transformation requires sustained financial backing, especially for specialised training in hybrid systems, retrofit execution, digital MRV workflows, and ESG governance.

The short-term objective is therefore to operationalise a Green Talent Fund framework and clearly define how certification, institutional adoption, and industry participation link to financial and policy incentives.

Implementation Approach (0–6 Months)

MoPSW, in coordination with DG Shipping and relevant ministries, will define and operationalise the Green Talent Fund framework, aligned to the National Green Competency Standards and Modular Certification Architecture.

- **Notify the Structure and Governance of the Green Talent Fund**, defining funding sources (public allocation and/or industry participation), eligible beneficiaries (students, working professionals, shipyard employees, faculty), priority training categories aligned to NGSP decarbonisation pathways, and transparent disbursement mechanisms.
- **Link Funding Eligibility to National Certification Standards**, requiring institutions and shipyards to adopt approved competency standards and modular certification tracks in order to qualify for financial support, thereby preventing fragmented or non-aligned training initiatives.
- **Launch Targeted Scholarship and Upskilling Support Schemes** prioritising retrofit engineers, MRV/compliance professionals, shipyard technicians, and faculty upskilling for specialised green modules, including co-funding models with shipyards where feasible.
- **Establish a Green Skills Monitoring and Reporting Mechanism**, requiring funded entities to report on certification numbers, completion rates, workforce deployment, and module effectiveness, supported by a pilot monitoring dashboard.
- **Formally Link Certification to Policy and Incentive Instruments**, recognising completion of national green certifications as a positive eligibility factor for participation in future retrofit programmes, green classification pathways, and related NGSP incentive mechanisms.

2.4 Medium-term Action Plan (Upto 2 Years)

A. Institutionalise Green Competency Standards within Maritime Education & Accreditation Frameworks

In the short term, national green competency standards and modular certification tracks were defined and piloted. The medium-term objective is to move from voluntary adoption to system-level institutionalisation. The Draft NGSP emphasises strengthening specialised training programmes, certified courses, and institutional partnerships to support green technology adoption and sustainability integration across the maritime ecosystem. However, unless green competencies are embedded into formal curriculum accreditation, professional licensing pathways, and institutional evaluation systems, adoption will remain uneven and dependent on early adopters. The medium-term priority under this action is therefore to integrate the National Green Competency Standards into maritime education regulation, accreditation criteria, and professional certification frameworks so that green capability becomes a structural requirement rather than an optional enhancement.

Implementation Approach (6–24 Months)

MoPSW and DG Shipping will initiate structured regulatory integration of the National Green Competency Standards into accreditation, certification, and faculty development frameworks.

- Revise Maritime Accreditation Guidelines to mandate minimum green competency coverage (lifecycle emissions, retrofit analysis, energy efficiency, MRV workflows, ESG literacy) as a condition for course approval and accreditation renewal, with a defined transition window for compliance.
- Integrate Green Certification Tiers into Professional Pathways, formally recognising selected green competency levels within existing engineering, compliance, surveyor, and maritime management certification and career progression frameworks.
- Roll Out Structured Faculty Upskilling Programmes to build instructional capacity in hybrid systems, retrofit execution, emissions analytics, and digital MRV tools, linking advanced certification delivery to trained faculty availability.
- Introduce a Green Competency Monitoring Framework, requiring periodic institutional reporting on integration status, certified cohorts, and curriculum updates, supported by structured compliance review cycles.

B. Scale National Green Certification and Establish a Maritime Green Skills Registry

In the short term, modular certification tracks were developed and piloted. The medium-term objective is to move from controlled pilots to **structured national scaling**, while preserving quality, credibility, and alignment with NGSP implementation priorities.

The Draft NGSP emphasises industry-wide training partnerships, specialised green technology certification, and knowledge-sharing mechanisms to accelerate adoption of green shipping practices. Scaling certification nationally must therefore be accompanied by quality assurance, structured oversight, and transparent recognition systems. Without a controlled scaling strategy, certification risks becoming uneven, diluted, or inconsistently recognised across shipyards and fleet operators.

The medium-term priority under this action is to expand delivery capacity, institutionalise quality control, and create a transparent National Maritime Green Skills Registry that strengthens labour-market signalling and workforce planning.

Implementation Approach (6–24 Months)

MoPSW and DG Shipping will transition the Green Certification Framework from pilot delivery to structured national scaling with embedded quality control and registry oversight.

- **Establish an Accredited Green Training Provider Network**, approving maritime universities, DG Shipping–approved institutes, and selected shipyard training centres as authorised certification providers. Providers will be required to follow national module templates, standardised assessment rubrics, and periodic quality audits.
- **Deploy a National Digital Learning and Assessment Backbone**, including standardised e-learning modules for foundational certifications, secure digital assessment platforms, retrofit/MRV case libraries, and hybrid delivery formats to enable nationwide scalability.
- **Launch the National Maritime Green Skills Registry (Phase 1)** to record certified professionals, certification tiers, validity periods, and renewal status. The registry will enable public verification of credentials, employer validation, and aggregated workforce capability monitoring for policy purposes.
- **Introduce Continuing Professional Development (CPD) Requirements** for Advanced-tier certification holders, linking renewal to approved workshops, updated modules, and knowledge-sharing participation to ensure skills remain aligned with evolving regulations and technologies.
- **Publish a National Green Workforce Capability Benchmark Report** by month 24, using registry data to quantify certified workforce distribution across regions and sectors, identify capability gaps, and support NGSP progress reporting.

C. Expand Green Talent Fund into Structured Workforce Transition & Co-Funding Mechanism

In the short term, the Green Talent Fund was conceptualised and launched in pilot form to support scholarships and initial certification roll-out. The medium-term objective is to transform this from a limited support instrument into a structured workforce transition mechanism aligned with India’s green shipping implementation trajectory. The Draft NGSP proposes the establishment of a Green Talent Fund to support training, scholarships, and shipyard upskilling linked to green maritime technologies and compliance systems. In the medium term, this Fund must evolve from supporting individual training events into a strategic tool that enables:

- Systematic re-skilling of existing workforce segments
- Industry co-investment in green capability
- Long-term workforce transition planning aligned with decarbonisation pathways

The focus shifts from pilot funding to **structured co-funded workforce transformation**.

Implementation Approach (6–24 Months)

- MoPSW, in coordination with DG Shipping and relevant ministries, will expand the Green Talent Fund from pilot support into a structured workforce transition and co-funding mechanism aligned with NGSP decarbonisation priorities.
- **Introduce a Structured Industry Co-Funding Model**, including matching grants and shared financing mechanisms for shipyards, fleet operators, and repair clusters that upskill defined workforce segments in alignment with National Green Competency Standards. Participation will require reporting on certified personnel and integration of green roles within HR structures.
- **Launch Targeted Workforce Transition Programmes** for priority segments such as retrofit engineers, hybrid system technicians, MRV/compliance professionals, and ESG oversight roles, with particular focus on small and medium repair clusters to prevent regional capability gaps.
- **Shift to Outcome-Linked Funding Disbursement**, tying financial support to measurable indicators such as certification volumes, workforce conversion rates, deployment in green roles, and retention outcomes, supported by an expanded monitoring dashboard.
- **Establish Faculty and Technical Expert Fellowship Schemes**, enabling industry secondments, specialised fellowships in hybrid propulsion and digital MRV systems, and structured knowledge transfer

programmes to deepen institutional capability.

- **Publish a Green Workforce Transition Impact Report by Month 24**, summarising re-skilling volumes, certified workforce growth, regional distribution, industry participation rates, and identified capability gaps under the NGSP framework.

D. International Collaboration & Global Certification Alignment

In the short term and early medium term, India establishes national competency standards, certification tracks, and scaling mechanisms. The next logical progression is to ensure that these frameworks are aligned with evolving international decarbonisation norms and training standards.

The Draft NGSP explicitly encourages collaboration with IMO and global maritime academies to provide specialised training and certification in green technologies. In the medium term, India must move beyond domestic standard-setting and position its green maritime certification ecosystem within a globally credible framework.

The objective under this action is to align national green skill standards with international training benchmarks, enable cross-recognition of certifications, and position India as a regional hub for green maritime skill development.

Implementation Approach (6–24 Months)

MoPSW and DG Shipping will align India's National Green Competency and Certification Framework with international maritime training benchmarks and establish structured global recognition pathways.

- **Benchmark National Green Competency Standards Against International Frameworks**, including relevant IMO guidance, classification society training modules, global MRV practices, and leading maritime academy curricula, and publish an International Alignment Report with identified gap-closure actions.
- **Develop Structured Cross-Recognition Mechanisms**, including MoUs with selected global maritime institutions, alignment of Advanced-tier certifications with recognised international training credits, and technical endorsement pathways for specialised modules (e.g., hybrid propulsion, advanced MRV systems).
- **Designate Selected Institutions as Regional Green Maritime Training Centres**, positioning India as a hub for advanced-level certification, train-the-trainer programmes, and digital green maritime training delivery for the Indian Ocean and developing maritime economies.
- **Integrate Evolving Global Regulations into Certification Renewal and CPD Frameworks**, ensuring periodic updates to modules in line with IMO instruments, alternative fuel safety standards, and carbon-intensity reporting requirements.

E. Integrate Green Workforce Metrics into Maritime Governance & Reporting Frameworks

In the short term, national green competency standards and certification tracks are established and piloted. In the medium term, the focus shifts from training design to systemic integration.

The Draft NGSP emphasises sustainability integration, certified training, and structured knowledge-sharing mechanisms across the maritime ecosystem. To ensure that green skill development becomes a measurable national capability rather than a series of training initiatives, workforce metrics must be incorporated into governance, reporting, and regulatory oversight systems.

The objective under this action is to embed green workforce indicators within national maritime governance frameworks so that skill development becomes an accountable component of green shipping implementation.

Implementation Approach (6–24 Months):

MoPSW and DG Shipping will integrate green workforce capability metrics into maritime governance, reporting, and incentive frameworks to ensure that skill development becomes a measurable component of NGSP implementation.

- **Issue National Advisory Guidance on Green-Critical Roles**, identifying priority role categories (retrofit engineering, MRV compliance, hybrid system integration, ESG oversight) and recommending mapping of these roles to National Green Certification tiers to ensure reporting consistency across shipyards and fleet operators.
- **Incorporate Green Workforce Indicators into Maritime Reporting Templates**, introducing advisory metrics such as percentage of certified green-critical roles, number of certified professionals, green training hours delivered, and workforce re-skilling levels aligned to retrofit and MRV implementation.
- **Align Workforce Metrics with Incentive and Funding Instruments**, linking participation in national certification and workforce reporting frameworks to eligibility or positive evaluation under Green Talent Fund schemes, retrofit support programmes, and voluntary green recognition initiatives.
- **Consolidate and Publish a National Green Workforce Capability Progress Report by Month 24**, aggregating registry data, institutional reporting, and funding outcomes to quantify certified workforce growth, regional distribution, and sectoral capability trends under NGSP tracking mechanisms.

2.5 Long-term Action Plan (Upto 5 Years)

A. Institutionalise Periodic Green Competency Review & Update Mechanism

By the five-year horizon, India's green maritime workforce framework must transition from programme-based implementation to permanent institutional architecture. The Draft NGSP emphasises sustained training, structured certification, and long-term industry–institution partnerships to support maritime decarbonisation. To maintain alignment with evolving IMO instruments, alternative fuel technologies, and digital compliance systems, green competency standards must be periodically reviewed and formally governed under a standing mechanism rather than ad-hoc task forces.

The objective under this action is to institutionalise green maritime competency governance within the national maritime regulatory architecture.

Implementation Approach (By Year 5):

MoPSW and DG Shipping will institutionalise green maritime competency governance within the national maritime regulatory framework through a permanent oversight mechanism.

- **Formally Constitute a Standing Green Maritime Competency Council** through notification, transitioning from the initial task force model to a permanent regulatory advisory body embedded within the maritime governance architecture.
- **Mandate a Structured 3-Year Review Cycle** for National Green Competency Standards, certification syllabi, assessment frameworks, and CPD requirements, ensuring systematic updates aligned with evolving IMO instruments, alternative fuel safety requirements, MRV systems, and hybrid propulsion technologies.
- **Embed Industry Consultation into Review Processes**, requiring structured engagement with shipyards, fleet operators, maritime universities, classification societies, and repair clusters before each standards revision.
- **Introduce Formal Change-Management and Version Control Protocols**, including public consultation windows, documented impact assessments, and controlled issuance of updated competency versions to prevent regulatory fragmentation.

B. Integrate Green Workforce Planning into National Maritime Capacity Expansion Strategy

By the five-year horizon, India's maritime decarbonisation investments — including retrofit expansion, hybrid vessel deployment, MRV compliance scaling, and green shipyard modernisation — will begin to reshape workforce demand structurally. The Draft NGSP underscores structured industry partnerships and capacity development to support green shipping implementation.

To prevent skill shortages in critical segments, green workforce planning must be formally integrated into national maritime capacity expansion strategies rather than treated as a parallel training initiative.

The objective under this action is to align green workforce forecasting with national shipbuilding, repair, retrofit, and compliance investment roadmaps.

Implementation Approach (By Year 5):

MoPSW, in coordination with DG Shipping and relevant planning bodies, will integrate green workforce demand forecasting into national maritime capacity expansion and decarbonisation planning frameworks.

- **Embed Green Skill Demand Projections into National Maritime Workforce Forecasting**, covering retrofit engineers, hybrid and energy-efficiency technicians, MRV compliance professionals, emissions analysts, and alternative fuel-trained personnel as pathways mature.
- **Align Workforce Forecasting with Shipbuilding, Repair, Retrofit, and Compliance Investment Roadmaps**, ensuring skill supply evolves in parallel with yard modernisation, hybrid vessel deployment, and MRV scaling under NGSP implementation phases.
- **Map Regional Skill Demand Clusters**, identifying projected workforce needs across major shipbuilding yards, repair hubs, coastal vessel segments, and inland waterways, and use this data to guide training seat expansion and institutional strengthening.
- **Link Forecasting Outputs to Policy Instruments**, including targeted Green Talent Fund allocations, expansion of accredited training centres, and regional capacity development initiatives.

C. Stabilise and Formalise the Green Talent Fund as a Permanent Workforce Financing Instrument

In the short and medium term, the Green Talent Fund functions as an enabling mechanism to accelerate green certification, re-skilling, and workforce transition across shipbuilding and ship repair. By the five-year horizon, this instrument must evolve from pilot-stage facilitation into a permanent and predictable component of India's maritime industrial and decarbonisation architecture.

The Draft NGSP emphasises structured funding mechanisms, certified training pathways, and long-term industry-institution partnerships to sustain green transition. Given the cyclical nature of the maritime sector and the evolving trajectory of fuel technologies and regulatory regimes, workforce financing must be institutionalised with stability safeguards rather than treated as episodic support.

The objective under this action is to embed the Green Talent Fund within India's formal maritime policy, budgetary, and industrial competitiveness framework as a stable, performance-linked, and counter-cyclical financing instrument.

Implementation Approach (By Year 5):

MoPSW, in coordination with DGS, financial authorities, and industry bodies, will formalise the Green Talent Fund as a permanent workforce financing mechanism integrated into national maritime development strategy.

- **Issue Formal Policy Notification Institutionalising the Green Talent Fund**, clearly defining governance structure, eligibility criteria, funding categories, disbursement procedures, monitoring protocols, audit mechanisms, and regulatory anchoring within maritime development policy frameworks.
- **Introduce Multi-Year Funding Cycles**, providing predictable allocation envelopes for certified green training programmes, structured workforce re-skilling linked to retrofit and hybrid adoption, alternative fuel competency development, and MRV/compliance capability expansion.
- **Institutionalise Structured Industry Co-Funding Mechanisms**, enabling shared financing models for large-scale workforce transition initiatives in major shipbuilding and repair clusters, including cluster-based skilling compacts and yard-led transition partnerships.
- **Align Fund Allocation with Updated National Green Competency Standards and Workforce Forecasting Outputs**, ensuring funding priorities reflect evolving decarbonisation pathways, projected skill demand across vessel segments, and regional industrial expansion plans.

- **Establish Contingency Buffers and Counter-Cyclical Stability Mechanisms**, including ring-fenced reserve allocations, minimum disbursement guarantees, or trigger-based stabilisation provisions that protect workforce re-skilling and transition programmes during maritime demand downturns or fiscal stress periods.
- **Implement Transparent Performance Monitoring, Impact Evaluation, and Stability Reporting Frameworks**, including periodic publication of fund utilisation, certification outcomes, regional workforce transition metrics, co-funding leverage ratios, and buffer adequacy assessments during industry slowdowns.

D. Strengthen International Recognition & Workforce Mobility Architecture

By the five-year horizon, India's green maritime training and certification ecosystem should not only support domestic implementation but also carry internationally credible recognition. The Draft NGSP recommends collaboration with IMO and global maritime academies to deliver specialised training and certification in green technologies. Over time, these collaborations must evolve into structured recognition pathways that strengthen India's position in global shipbuilding, repair, and maritime services markets.

The objective under this action is to ensure India's green maritime certification and competency framework is globally comparable, mutually recognisable where feasible, and supports workforce mobility and export competitiveness.

Implementation Approach (By Year 5):

MoPSW, in coordination with DG Shipping and designated training institutions, will institutionalise structured international alignment and recognition mechanisms for India's green maritime certification ecosystem.

- **Formalise Strategic International Collaboration Arrangements** with selected global maritime academies, technical institutions, and classification bodies, building on medium-term benchmarking and alignment exercises.
- **Align Advanced-Tier Certification Modules with Globally Recognised Practices**, particularly in hybrid and low-emission technology integration, retrofit engineering and energy-efficiency validation, digital MRV workflows, and compliance documentation standards.
- **Establish Cross-Recognition and Credit Equivalence Pathways**, including MoUs for module recognition, potential co-branded advanced modules where appropriate, and structured participation of international subject-matter experts in periodic competency review cycles.
- **Designate Select Indian Institutions as Regional Green Maritime Training Nodes**, capable of hosting international cohorts, delivering advanced certifications, and conducting train-the-trainer programmes for the Indian Ocean and developing maritime economies.

E. Integration of Green Workforce Capability into National Maritime Governance and Decarbonisation Reporting

By the five-year horizon, green workforce capability should no longer be tracked as an internal programme metric but as a structured component of national maritime transition reporting. The Draft NGSP emphasises structured monitoring, reporting, verification, and transparency mechanisms across green shipping pillars. Extending this logic to human capital ensures that workforce capability becomes a measurable and publicly accountable component of decarbonisation progress.

The objective under this action is to institutionalise transparent reporting of green workforce development indicators within the national NGSP implementation framework.

Implementation Approach (By Year 5):

MoPSW and DG Shipping will formally integrate green workforce capability metrics into the national NGSP monitoring, reporting, and verification architecture.

- **Embed Green Workforce Indicators within NGSP Progress Reporting Cycles**, consolidating data

from the National Green Certification Registry, Green Talent Fund records, accredited training institutions, and enterprise-level workforce disclosures.

- **Standardise a National Green Workforce Indicator Set**, including certified professionals by tier, sectoral distribution (shipbuilding, repair, fleet operations), regional capacity trends, certification renewal rates, and measurable re-skilling outcomes linked to retrofit and MRV deployment.
- **Establish a Structured Annual or Biennial Publication Cycle**, ensuring workforce capability metrics are released as part of formal NGSP implementation tracking rather than ad-hoc reporting.
- **Issue a Workforce Reporting Methodology Note**, defining data sources, validation logic, aggregation protocols, and version control mechanisms to ensure transparency and comparability over time.

3 Responsibility Mapping

The implementation of the Green Skill Development and Green HR pillar under the NGSP requires coordinated action across policy authorities, regulatory bodies, training institutions, industry actors, and financing entities. Unlike infrastructure-centric pillars, this pillar focuses on building human capital capability to execute green shipbuilding, retrofit, compliance, digital MRV systems, and lifecycle decarbonisation pathways.

Clear allocation of responsibilities is essential to ensure that competency standards, certification systems, funding mechanisms, enterprise integration, and international alignment evolve in a structured and coherent manner.

This responsibility mapping framework identifies the key stakeholders responsible for policy direction, competency standard-setting, accreditation, workforce scaling, financing, reporting, and international collaboration under the Green Skill Development & Green HR roadmap.

Category	Stakeholder	Primary Role
Policy & Governance	Ministry of Ports, Shipping and Waterways (MoPSW)	Apex policy authority for Green Skill Development under NGSP; strategic direction for maritime green workforce transformation; oversight of funding mechanisms and national reporting
	Directorate General of Shipping (DG Shipping)	Regulatory alignment of green competency standards with maritime safety and compliance requirements; integration with certification and MRV frameworks
	Ministry of Skill Development & Entrepreneurship (MSDE)	Alignment of maritime green competencies with national skill qualification frameworks and certification architecture
	Ministry of Environment, Forest and Climate Change (MoEFCC)	Alignment of workforce training with lifecycle emissions, sustainability, and environmental compliance frameworks

Standards & Accreditation	National Green Maritime Competency Council (Standing Body)	Periodic review and update of green competency standards; governance of certification tiers and syllabus evolution
	Indian Maritime University (IMU)	Curriculum development, academic integration of lifecycle decarbonisation, delivery of advanced green certification programmes
	Accredited Maritime Training Institutes	Delivery of Foundation and Practitioner-level green certification modules; implementation of modular training pathways
	Classification Societies (Training Arms)	Technical validation support for advanced-level training modules (retrofit, hybrid systems, MRV compliance)
Workforce Enablement & Scaling	Shipyards & Repair Clusters	Identification of green-critical roles; participation in certification programmes; coordination with national training frameworks
	Indian Shipowners' Association	Demand aggregation for certified professionals; feedback on operational skill gaps; support for workforce transition planning
	Public Sector Vessel Operators	Demonstration of green skill integration in fleet operations; pilot workforce transition initiatives
Finance & Incentive Alignment	Green Talent Fund (MoPSW-led Mechanism)	Financial support for certified training, re-skilling programmes, and workforce transition initiatives
	Shipping Ministry Financing Bodies / PSU Lenders	Alignment of financing eligibility with workforce capability indicators in green projects
	Multilateral & Development Finance Institutions	Technical assistance and concessional support for large-scale workforce transition programmes
Governance, Reporting & Transparency	DG Shipping (Reporting Division)	Integration of green workforce indicators within maritime reporting frameworks
	MoPSW (NGSP Monitoring Unit)	Publication of periodic Green Maritime Workforce Capability Reports; consolidation of certification data
International Collaboration	MoPSW & DG Shipping (International Cooperation Wing)	Alignment of national certification with international training benchmarks; facilitation of recognition arrangements
	Global Maritime Academies & IMO-linked Institutions	Knowledge exchange, benchmarking support, and collaborative programme development
Research & Knowledge Support	Research Institutions & Think Tanks	Workforce demand forecasting; skill gap analysis; policy advisory support; impact assessment of training initiatives

4 Critical Barriers

The Green Skill Development & Green HR roadmap under the NGSP introduces structured reforms including a

National Task Force, a harmonised competency framework, tiered certification architecture, Green Talent Fund, registry systems, reporting mechanisms, and international benchmarking.

While the framework is implementable, several structural and operational barriers may affect rollout, sequencing, and scale-up. These barriers are not conceptual gaps, but practical constraints that may arise during execution.

4.1 Risk of Institutional Fragmentation During Task Force Operationalisation

The roadmap begins with the establishment of a National Green Maritime Skills Task Force. However, responsibility for maritime education, safety regulation, skill certification, and environmental alignment spans multiple ministries and institutions.

In practice:

- Overlapping mandates between MoPSW, DG Shipping, and skill authorities may slow decision-making.
- Maritime universities and industry associations may seek representation balance.
- Without clearly defined custodianship, ownership of competency standards may remain diffused.

If governance clarity is not locked early, the Task Force may become consultative rather than decisive.

4.2 Limited Institutional Capacity to Deliver Advanced-Level Certification at Scale

While Foundation-level awareness training can be rolled out rapidly, Advanced-level certification in retrofit engineering, hybrid system integration, and MRV compliance requires:

- Trainers with subject-matter expertise
- Updated laboratory or simulation infrastructure
- Access to real project case studies

Currently, such specialised delivery capacity is limited to select institutions. Rapid scale-up may be constrained by:

- Shortage of qualified trainers
- Limited industry-academia exposure
- Uneven regional infrastructure

Without phased scaling, Advanced certification may remain concentrated in a few hubs.

4.3 Slow Institutional Reform Cycles within Academic Bodies

Curriculum updates within universities and technical institutes require internal approvals, academic council reviews, and accreditation alignment.

Even if competency standards are finalised:

- Syllabus integration may take multiple academic cycles
- Faculty reorientation may be phased
- Infrastructure upgrades may require budget approvals

This may delay visible alignment between policy announcement and academic output.

4.4 Low Early Adoption by Enterprises in Voluntary Phase

In the absence of mandatory requirements:

- Enterprises may delay participation in green certification programmes
- Smaller yards may prioritise operational stability over structured upskilling
- Mid-career professionals may hesitate without clear incentives

Without early industry uptake, the certification system may lack credibility and scale.

4.5 Sustaining Funding Stability for the Green Talent Fund

Workforce transformation requires multi-year funding continuity.

Long-term risks include:

- Budget fluctuations
- Competing fiscal priorities
- Reduced industry co-funding participation during economic downturns

If funding becomes inconsistent, training institutions may reduce capacity expansion, affecting long-term pipeline stability.

4.6 Maintaining Relevance of Competency Standards Amid Technological Evolution

Green shipping technologies will evolve over the five-year horizon.

If competency standards are not periodically updated:

- Certification content may become outdated
 - Emerging technologies may not be reflected in training modules
 - International comparability may weaken
- Long-term credibility depends on structured review mechanisms.

5 Conclusion

The Green Skill Development and Green HR pillar of the National Green Shipping Policy establishes a structured and phased framework for strengthening the human capital foundation required to implement India's maritime decarbonisation transition. Recognising that green shipbuilding, retrofit execution, digital MRV compliance, and lifecycle-based sustainability cannot be delivered without corresponding workforce capability, this pillar positions skill development and institutional HR reform as central enablers of the Green Shipping agenda. It adopts a systems-based approach aligned with evolving regulatory requirements, industrial transformation pathways, and international performance expectations.

The short-, medium-, and long-term roadmap translates strategic intent into actionable institutional reforms, including the establishment of a National Green Maritime Skills Task Force, development of harmonised competency standards, rollout of tiered certification pathways, operationalisation of a Green Talent Fund, integration of green competencies within enterprise HR systems, and alignment of workforce forecasting with industrial expansion plans. These measures are supported by a clearly defined responsibility mapping across ministries, regulators, training institutions, industry bodies, and financial entities, ensuring coordinated execution and accountability.

The framework also acknowledges practical implementation risks, including limited trainer capacity for advanced modules, uneven regional skill distribution, funding continuity challenges, slow curriculum reform cycles, and low early adoption in voluntary phases. Addressing these barriers through structured governance, phased scaling, and stable financing mechanisms will be critical to maintaining momentum and credibility. Sustained alignment with international benchmarks and periodic review of competency standards will further ensure long-term relevance and global comparability.

Taken together, the Green Skill Development and Green HR pillar provides a coherent and practical foundation for building a future-ready maritime workforce capable of supporting low- and zero-carbon transition pathways. By embedding lifecycle sustainability, compliance literacy, and structured Green HR practices within India's maritime ecosystem, this pillar strengthens national capacity, enhances industrial competitiveness, and reinforces India's ambition to emerge as a globally credible and sustainable maritime nation in the evolving low-carbon shipping economy.