



Green Ships Recycling - Implementation Roadmap



Document control

Revision history

Revision No.	Date	Revision
1.0	xx	First Draft

List of Abbreviations

Abbreviation	Full Form
AI	Artificial Intelligence
CAGR	Compound Annual Growth Rate
CO₂e	Carbon Dioxide Equivalent
EPC	Engineering, Procurement and Construction
EPR	Extended Producer Responsibility
ESG	Environmental, Social and Governance
EU	European Union
EUSRR	European Union Ship Recycling Regulation
FSDF	Ferrous Scrap Development Fund
GHG	Greenhouse Gas
GMB	Gujarat Maritime Board
GT	Gross Tonnage
GSRC	Green Ship Recycling Compliance
HKC	Hong Kong International Convention
IHM	Inventory of Hazardous Materials
IMU	Indian Maritime University
IoT	Internet of Things
IRS	Indian Register of Shipping
MDBs	Multilateral Development Banks
MEA	Ministry of External Affairs
MNRE	Ministry of New and Renewable Energy
MoEFCC	Ministry of Environment, Forest and Climate Change
MoPSW	Ministry of Ports, Shipping and Waterways
NABL	National Accreditation Board for Testing and Calibration Laboratories
NCoEGPS	National Centre of Excellence in Green Port and Shipping
NLP-Marine	National Logistics Portal – Marine
NSDC	National Skill Development Corporation
PPE	Personal Protective Equipment
R&D	Research and Development
SCGJ	Sagarmala Centre of Excellence for Green Ports
SMBs	State Maritime Boards
SPCBs	State Pollution Control Boards
SRCAM	Ship Recycling Carbon Accounting Methodology
SRCARP	Ship Recycling Carbon Accounting & Reduction Program

SRP	Ship Recycling Plan
SRTRS	Ship Recycling Transparency and Reporting System
STPs	Sewage Treatment Plants
TERI	The Energy and Resources Institute
TSDF	Treatment, Storage and Disposal Facility

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1 Introduction

Ship recycling is a critical component of the maritime sector's sustainability efforts, ensuring that end-of-life vessels are dismantled in an environmentally responsible manner. The industry has traditionally faced challenges related to hazardous waste disposal, unsafe working conditions, and inefficient material recovery. However, with the adoption of green recycling practices, the sector can significantly reduce its environmental footprint while promoting circular economy principles.

Regulatory frameworks such as the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (HKC) and the EU Ship Recycling Regulation (EUSRR) are driving improvements in recycling standards. Additionally, advancements in automation, waste management, and material recovery technologies offer new opportunities to enhance efficiency and reduce emissions. Collaboration among shipowners, recycling yards, and regulatory bodies is essential to ensure compliance and create a sustainable recycling ecosystem.

1.1 India's Approach to Green Ship Recycling

India is among the top three ship recycling nations globally, holding 33% of global gross tonnage dismantled in 2023, second only to Bangladesh (leading at 46%). At times, India's share has exceeded 40%, reaffirming its leadership.

- **Projected Growth:** The ship recycling sector is expected to reach 3.8–4.2 million GT by 2025, up from 2.3–2.6 million GT in 2024, with a 10% CAGR projected till 2028.
- **Competitive Edge:** Indian ship recycling yards benefit from established infrastructure, increasing supply of ageing ships, and improving environmental compliance making them more competitive than counterparts in Pakistan or Bangladesh.

Green Ship Recycling in India refers to the process of dismantling end-of-life ships in compliance with the Recycling of Ships Act, 2019, the Hong Kong International Convention, and other international/domestic standards. It prioritizes worker safety, environmental protection, and resource recovery, supported by a framework of certification, hazardous material control, and regulatory oversight.

Green ship recycling requires strict adherence to international standards, robust facility management, and strong regulatory oversight. However, significant challenges remain, particularly in regions with weak governance and economic pressures that undermine sustainable practices. Addressing these challenges is essential for the ship recycling industry to minimize its environmental footprint and protect workers' safety worldwide.

The Sustainable Ship Recycling pillar of NGSP seeks to strengthen safety, environmental, and compliance aspects of ship recycling within the existing legal framework. In alignment with the Recycling of Ships Act, 2019, the HKC, and evolving global expectations on ESG disclosure and lifecycle emissions, this pillar emphasizes:

- Phase-wise yard modernization (e.g. impermeable flooring, enclosed dismantling sheds, stormwater control etc.).
- Worker welfare systems including certified training, medical, insurance and PPE.
- Deployment of digital portals for Inventory of Hazardous Materials (IHM), Ship Recycling Plans (SRP), and compliance audits.

- Integration with India’s carbon registry and circular economy roadmap (e.g. steel rerolling, EPR guidelines etc.).

India is currently placed second in the world in ship recycling by capacity, but the future of this industry lies in aligning with global standards and redefining leadership not merely by capacity, but also by including metrics of sustainability, safety, and transparency. The NGSP establishes a Green Ship Recycling Certification Scheme, digital tracking under the NLP-Marine architecture, and linkages to carbon credit systems to monetise avoided emissions through material recovery.

1.2 Possible Solutions and Key Opportunities

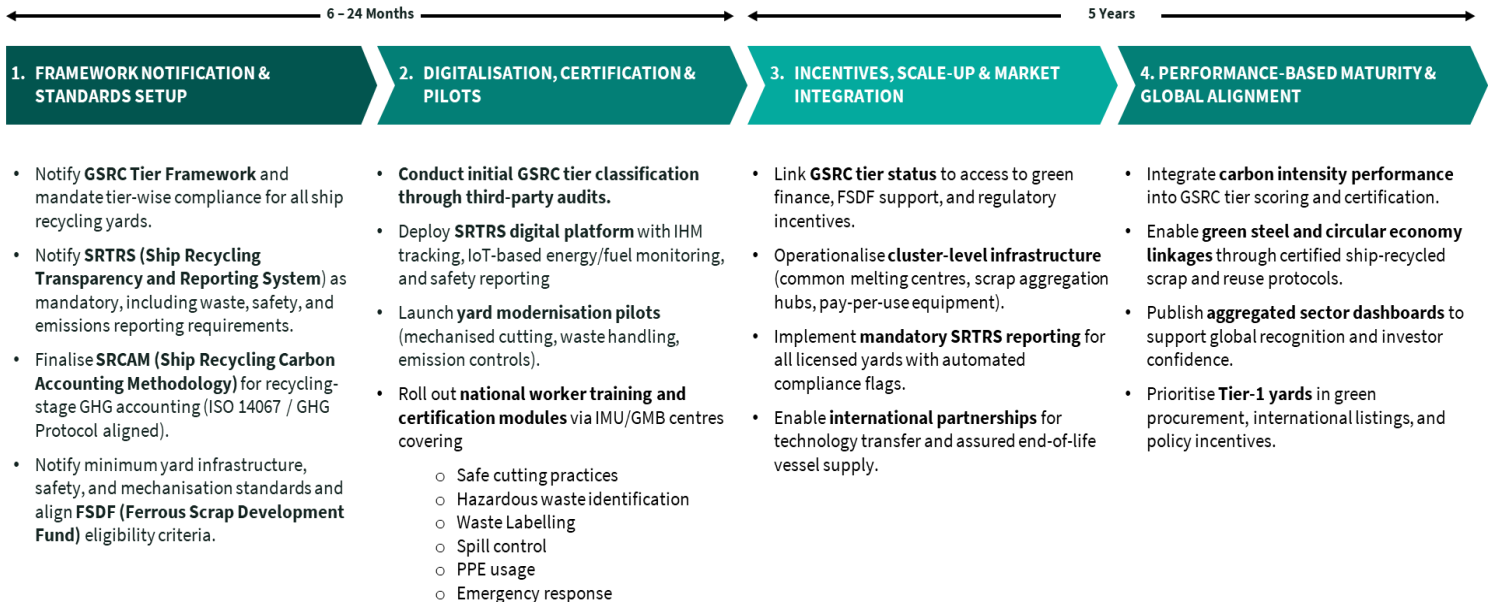
The following table lists out some key solutions and opportunities for green ship recycling that can be adopted for the Indian Context

Solutions	Key Opportunities
Regulatory Compliance	Ensuring adherence to international regulations like the Hong Kong Convention (HKC) and the EU Ship Recycling Regulation (EUSRR) to improve safety and environmental performance.
Sustainable Dismantling Practices	Adoption of environmentally sound methods such as safer cutting techniques, hazardous waste management, and spill prevention to minimize pollution.
Material Recovery & Circular Economy	Enhancing the recovery and reuse of steel, non-ferrous metals, and other recyclable materials to support circular economy initiatives and reduce demand for virgin materials.
Automation & Technology Integration	Implementing robotic dismantling, AI-driven waste sorting, and advanced monitoring systems to improve efficiency and worker safety.
Worker Safety & Training	Providing enhanced training programs and protective equipment to ensure safe working conditions in recycling yards.
Green Certifications & Incentives	Incentivizing beyond compliance through financial mechanisms such as green finance or sustainability-linked ship disposal schemes.
Infrastructure Development	Upgrading ship recycling facilities to meet global environmental standards and investing in proper waste disposal infrastructure.
Extended Producer Responsibility (EPR)	Encouraging shipbuilders and owners to consider end-of-life disposal in the design phase, promoting eco-friendly materials and modular construction for easier recycling.
Lifecycle Environmental Impact Management (Beyond GHG)	Incorporating Life Cycle Assessment (LCA)-based evaluation of ship recycling impacts beyond greenhouse gas emissions, including marine and soil contamination, toxicity from hazardous substances (e.g., asbestos, PCBs, heavy metals), water pollution, particulate matter, and resource depletion.

2 Indicative Action Pathway

The NGSP sets out a phased and outcome-oriented implementation pathway for green ship recycling, aligned with India's maritime decarbonisation goals and evolving international regulatory requirements.

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



2.1 Action Plan

2.1.1 Tiered Green Compliance Framework

- NGSP will institutionalize a tier-based Green Ship Recycling Compliance Framework, distinguishing facilities based on their adherence to HKC/EUSRR protocols, occupational safety standards, and environmental safeguards.
- To incentivize progressive modernization, regulatory adherence, and environmental transparency in India's ship recycling industry, the National Green Shipping Policy (NGSP) 2025 will implement a tiered classification system for all registered recycling yards.
- This Green Ship Recycling Compliance Tier (GSRC-Tier) framework will serve as the basis for:
 - Regulatory oversight,
 - Access to national/international green finance,
 - Inclusion in the EU and global approved shipyard lists,
 - Targeted incentives under schemes like the Ferrous Scrap Development Fund (FSDF),
 - Strategic prioritization in national-level green procurement and circular economy initiatives.
- **Green Ship Recycling Compliance Tiers (GSRC-Tiers)**

Green Tier	Compliance Criteria	Key Features	Support and Benefits
Tier 1	Full compliance with HKC, EU SRR, and national laws (Recycling of Ships Act, 2019); Advanced environmental infrastructure	- Impermeable floors, enclosed drainage, stormwater treatment - Digital IHM & SRP system - Verified CO ₂ avoidance metrics (e.g tCO ₂ e avoided per LDT cut)	- Highest access to green finance instruments (green bonds, ESG loans) - FSDF eligibility for advanced automation - National “Green Yard” certification
Tier 2	Full HKC compliance with partial adoption of digital and environmental upgrades	- Functional IHM review and SRP mechanisms - Partial digital reporting - Basic stormwater & effluent systems - Segregated waste zones	- Targeted grant/loan access under FSDF - Technical support for Tier 1 transition - Training and digital onboarding via SCGJ/NSDC - Inclusion in domestic circular economy value chains
Tier 3	Basic HKC requirements met. Limited infrastructure and digitalization	- Manual dismantling methods - Minimal pollution control infrastructure - Basic waste segregation - Worker PPE provided but not certified	- Conditional registration under NGSP - Mandated modernization roadmap (5–7 years) - Limited access to public finance - Linked to skill upgrade and compliance-based funding

- **Applicability:** The framework should cover all shipbreaking yards in India, ensuring compliance with both national and international environmental regulations.
- **Certification & Enforcement:** Shipyards must undergo regular audits and third-party certification to qualify for Green Ship Recycling Compliance status.
- **Oversight Agency:** DG Shipping and MoPSW, in partnership with State Maritime Boards.
- **Verification:** Third-party audits (biennial) + online self-reporting dashboard.
- **Upgradation Support:** Access to tools under Harit Sagar, FSDF, and SENSREC partnership.
- **Implementation Plan**
 - Phase 1 – Framework Operationalisation (0–6 months)
 - ✓ Notify the GSRC-Tier framework under NGSP and define Tier 1, Tier 2, and Tier 3 compliance requirements aligned with HKC, EU SRR, and national regulations.
 - ✓ Finalise tier-wise eligibility criteria, audit frequency, and compliance documentation requirements.

- ✓ Establish linkages between GSRC-Tier status and regulatory oversight, financial incentives, and access to green finance instruments.
- Phase 2 – Certification & Digital Reporting Rollout (6–18 months)
 - ✓ Mandate initial GSRC-Tier classification for all registered ship recycling yards based on third-party audits.
 - ✓ Deploy a centralized digital reporting system (SRTRS) for IHM, SRP, environmental safeguards, and safety compliance.
 - ✓ Enable online self-reporting supported by periodic third-party verification to ensure transparency and consistency.
- Phase 3 – Incentive Alignment & Yard Upgradation (18–36 months)
 - ✓ Link GSRC-Tier status to access to FSDF support, Harit Sagar tools, and other financial and technical assistance mechanisms.
 - ✓ Require Tier 3 yards to submit and implement time-bound modernization roadmaps with defined infrastructure, safety, and environmental milestones.
 - ✓ Provide targeted technical assistance and capacity-building support to facilitate progression from Tier 3 to Tier 2 and Tier 1.
- Phase 4 – Integration & Continuous Improvement (Post-36 months)
 - ✓ Use GSRC-Tier classification as the primary reference for international yard recognition, green procurement prioritization, and circular economy initiatives.
 - ✓ Periodically update tier criteria to incorporate advanced environmental controls, digital traceability, and carbon performance parameters.

2.1.2 Ship Recycling Transparency and Reporting System (SRTRS)

A mandatory reporting platform to be introduced to track hazardous waste flows, worker safety practices, and carbon intensity in dismantling.

- The SRTS will ensure:
 - Standardized data collection on emissions, waste management, and worker safety in shipbreaking yards.
 - Increased accountability and improved compliance with international regulations.
 - Availability of verifiable data to support green certification and investment decisions.
- SRTRS will be expanded to mandate quantification of GHG emissions generated during the recycling stage, covering deconstruction, waste removal, disposal, and transport phases. The methodology will account for:
 - Clearing hazardous loose items.
 - Handling and processing of oils, liquids, and sludge.
 - Sequential dismantling (non-metal followed by metal structures).

- Oxy-LPG torch cutting and associated energy/fuel usage.
- Hazardous material removal, packaging, secure storage, and authorized disposal.
- Machinery dismantling for reuse/recycling.
- Size-reduction cutting of steel plates for transport.

This will be standardized via a national Ship Recycling Carbon Accounting Methodology (SRCAM) developed by MoPSW, GMB, and technical partners such as TERI and NIOT, in alignment with ISO 14067 and GHG Protocol standards.

- Implementation Plan

- Phase 1 – System Design & Standards Finalisation (0–6 months)
 - ✓ Notify SRTRS as a mandatory reporting requirement for all registered ship recycling yards.
 - ✓ Finalise standard data parameters covering hazardous waste flows, worker safety practices, and energy/fuel use during dismantling.
 - ✓ Standardise GHG accounting boundaries for recycling-stage activities through the Ship Recycling Carbon Accounting Methodology (SRCAM) aligned with ISO 14067 and the GHG Protocol.
- Phase 2 – Digital Platform Deployment & Pilot Reporting (6–15 months)
 - ✓ Deploy a centralized digital SRTRS platform with modules for IHM tracking, emissions reporting, and waste and safety compliance.
 - ✓ Enable real-time data capture through IoT-based electricity and fuel meters at pilot yards.
 - ✓ Conduct pilot reporting across representative yards to validate data formats, reporting frequency, and verification workflows.
- Phase 3 – Mandatory Reporting & Monitoring Rollout (15–30 months)
 - ✓ Mandate SRTRS reporting for all licensed ship recycling yards as a condition for continued registration.
 - ✓ Require yard-level quantification of GHG emissions covering dismantling, hazardous material handling, cutting operations, waste transport, and disposal.
 - ✓ Enable automated compliance flags and exception reporting to support regulatory monitoring and enforcement.
- Phase 4 – Integration with Certification & Finance (Post-30 months)
 - ✓ Integrate SRTRS data into Green Ship Recycling Compliance Tier (GSRC-Tier) certification and audit processes.
 - ✓ Use verified SRTRS data to support green certification, international due-diligence requirements, and access to green finance instruments.
 - ✓ Publish aggregated, anonymised sector-level dashboards to enhance transparency and

investor confidence.

2.1.3 Technology Modernization and Infrastructure Support

- Infrastructure and environmental compliance gaps in India's ship recycling industry will be addressed through a phased upgradation program for shipbreaking yards. This will include mandatory adoption of safer and mechanized cutting techniques, establishment of certified hazardous waste collection, storage and disposal systems, and installation of spill-prevention and containment infrastructure to minimize soil, air, and marine pollution.
- To enable this transition, dedicated green finance mechanisms will be deployed to support yard-level investments in clean technologies, low-emission processes, and worker health and safety infrastructure. These mechanisms will include access to concessional finance, blended capital instruments, and performance-linked incentives, with disbursement tied to verified environmental and occupational safety compliance. Implementation will be supported through technical guidelines, capacity-building programs, and third-party monitoring to ensure effective and timely execution.
- To address non-mechanized and energy-intensive processes, NGSP will:
 - Promote robotic dismantling, AI-based waste sorting, and hot-work emission control systems.
 - Facilitate common melting centres near recycling clusters (e.g., Bhavnagar)
 - Offer Pay-per-Use advanced equipment to reduce CAPEX burdens on recyclers.
- Utilisation of the Ferrous Scrap Development Fund (FSDF) :

In alignment with the Ministry of Steel's *Steel Scrap Recycling Policy* and MoPSW's FSDF, the NGSP recommends:

- Allocation of FSDF grants/loans for upgrading Indian shipbreaking yards with mechanized cutting, pollution control systems, and material sorting facilities.
 - Funding joint R&D between recycling yards and secondary steel producers for green steel loops.
 - Developing a certification framework for ship-recycled ferrous scrap to ensure quality and traceability, making it eligible for green procurement and steelmaker use.
 - Pilot ferrous scrap aggregation and pre-processing hubs adjacent to Alang and other clusters.
 - FSDF-supported upgrades must also include energy-efficiency improvements in dismantling processes to reduce emissions intensity per tonne of recovered material.
- Circular Economy and Green Steel Linkages:

- The policy will introduce reuse protocols for select machinery/components (e.g., engines, pumps, compressors, valves, STPs etc.) and collaborate with steelmakers to establish green steel recovery loops, supported by guidelines on safe rerolling and EPR-based traceability.
- Implementation Plan
 - Phase 1 – Standards & Financial Enablement (0–6 months)
 - ✓ Notify mandatory infrastructure upgradation requirements covering mechanised cutting, hazardous waste handling, spill prevention, and pollution control systems.
 - ✓ Operationalise green finance access for ship recycling yards through concessional loans, blended finance, and performance-linked incentives, with eligibility linked to verified environmental and safety compliance.
 - ✓ Align FSDF utilisation guidelines for ship recycling–specific upgrades, energy-efficiency improvements, and material recovery systems.
 - Phase 2 – Technology Deployment & Cluster Infrastructure (6–18 months)
 - ✓ Support deployment of mechanised and low-emission dismantling technologies, including robotic cutting, hot-work emission controls, and AI-based material sorting.
 - ✓ Establish shared infrastructure in major recycling clusters, including certified hazardous waste facilities, common melting centres, and pay-per-use advanced equipment to reduce yard-level CAPEX.
 - ✓ Initiate FSDF-funded pilots for scrap aggregation and pre-processing hubs near Alang and other clusters.
 - Phase 3 – Circular Economy & Green Steel Integration (18–36 months)
 - ✓ Implement certification and traceability protocols for ship-recycled ferrous scrap to enable its use in green procurement and steelmaking.
 - ✓ Enable green steel recovery loops through collaboration between recycling yards and secondary steel producers, supported by joint R&D and energy-efficient processing.
 - ✓ Introduce reuse protocols for select ship machinery and components, supported by EPR-based traceability and market linkage mechanisms.
 - Phase 4 – Performance Monitoring & Scale-up (Post-36 months)
 - ✓ Link continued financial support and incentive access to demonstrated improvements in emissions intensity, energy efficiency, and material recovery rates.
 - ✓ Scale successful technology, finance, and circular economy models across all ship recycling clusters.

2.1.4 International Partnerships for Sustainable Ship Recycling:

- NGSP will facilitate strategic global partnerships to strengthen India’s capabilities in sustainable ship recycling through technology transfer, best practices sharing, and regulatory alignment.

- It will also facilitate bilateral agreements with key ship-owning countries (EU, Japan, Korea, UAE) for assured supply of ships.
- Replication of frameworks like the SENSREC project¹ (Norway–IMO–Bangladesh) can support policy alignment, worker training, and waste infrastructure upgrades.
- Implementation plan
 - ✓ Establish targeted **bilateral cooperation arrangements** with key ship-owning regions (EU, Japan, Korea, UAE) to support technology transfer, regulatory alignment, and assured end-of-life vessel supply to compliant Indian yards.
 - ✓ Facilitate **structured knowledge partnerships** with international agencies and maritime administrations to adopt global best practices in green dismantling, waste management, and safety systems.
 - ✓ Replicate and adapt **successful international models** (e.g., SENSREC-type frameworks) to strengthen policy alignment, worker training systems, and hazardous waste infrastructure in Indian recycling clusters.
 - ✓ Use international partnerships to **enhance global recognition** of Indian- green-certified yards and improve access to international finance and shipowner contracts.

2.1.5 Worker Welfare, Skill Development and Safety Training:

- A national-level training module will be introduced under the Green Skills pillar, building competencies in safe cutting techniques, hazardous waste handling and labeling, and spill prevention. Partnerships with IMU and GMB Training Centres will be leveraged for rollout.
- NGSP will consider performance-linked incentives based on safety and environmental records, while encouraging uptake of occupational hazard insurance and welfare funds for shipyard workers.
- Implementation plan
 - ✓ Introduce a national ship recycling training curriculum under the Green Skills pillar covering safe cutting practices, hazardous material handling, labeling, spill prevention, and emergency response.
 - ✓ Roll out training through IMU, GMB Training Centres, and accredited institutes, with mandatory certification linked to yard licensing and compliance tiers.
 - ✓ Implement performance-linked incentives for yards demonstrating strong safety, training coverage, and environmental compliance records.

¹ International Maritime Organization (IMO). “Safe and Environmentally Sound Ship Recycling in Bangladesh (SENSREC).” <https://www.imo.org/en/OurWork/Environment/Pages/SENSREC.aspx>.

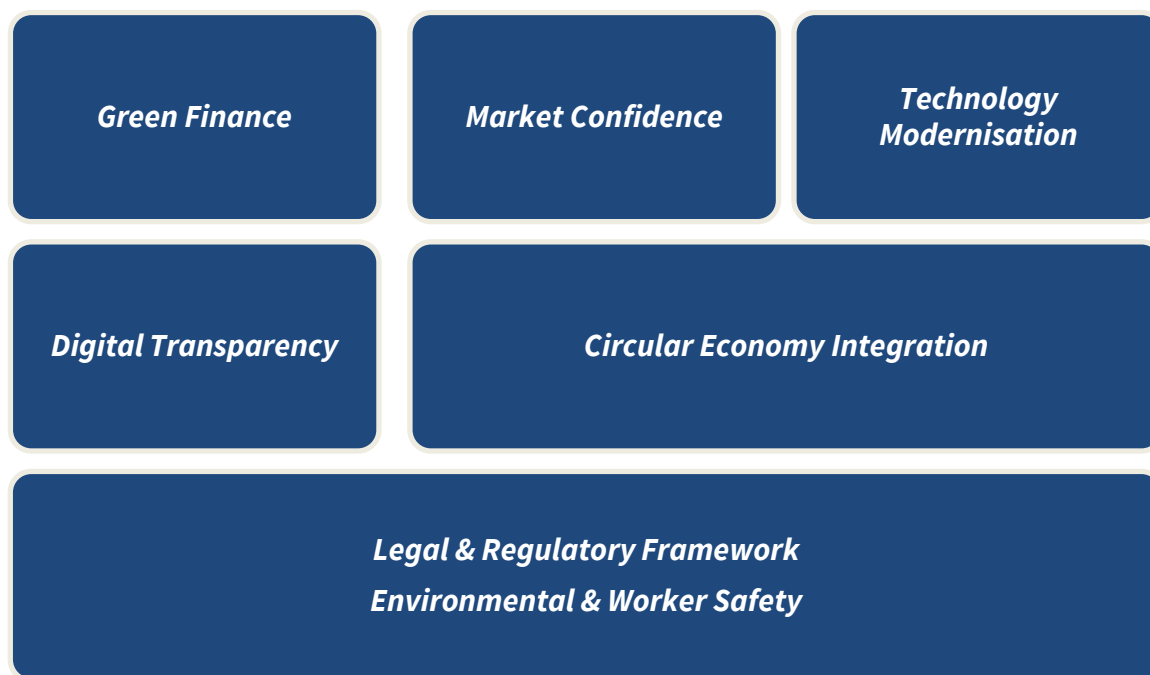
- ✓ Promote worker welfare mechanisms, including occupational hazard insurance, health coverage, and welfare funds, as a prerequisite for access to NGSP-linked incentives and finance.

2.1.6 Ship Recycling Carbon Accounting & Reduction Program

- NGSP recommends to launch the **Ship Recycling Carbon Accounting & Reduction Program (SRCARP)** which will establish India's first dedicated carbon accounting and reduction framework for the ship recycling sector, with the following initial priorities:
 - ✓ **Baseline Mapping:** Conduct a one-year, sector-wide emissions baseline study for Alang and other recycling clusters, capturing energy/fuel use, cutting processes, waste transport, and disposal-related emissions.
 - ✓ **Emission Intensity Targets:** Establish voluntary yard-level reduction targets (e.g., kg CO₂e per LDT processed) to be progressively integrated into the Green Ship Recycling Certification (GSRC) Tier Framework.
 - ✓ **MRV Integration:** Deploy IoT-enabled real-time fuel and electricity consumption meters at participating yards, with automated data uploads to the Ship Recycling Tracking and Reporting System (SRTRS).
 - ✓ **R&D Support:** Fund and test renewable-powered dismantling systems and alternative low-carbon cutting technologies.
- Implementation Plan
 - Phase 1 – Program Formation (0–6 Months)
 - ✓ Constitute SRCARP Steering Committee under NGSCC with GMB, IRS, NABL-accredited labs, SRIA and technical support by academia.
 - ✓ Finalise carbon accounting methodology (aligned with ISO 14067 and GHG Protocol).
 - ✓ Design SRTRS digital platform architecture.
 - Phase 2 – Baseline Study (7–18 Months)
 - ✓ Conduct year-long monitoring of pilot and control yards across all major clusters.
 - ✓ Collect energy/fuel data, cutting process logs, transport emissions, and waste handling records.
 - ✓ Publish the National Ship Recycling Carbon Baseline Report.
 - Phase 3 – Target Setting & MRV Rollout (19–30 Months)
 - ✓ Establish voluntary emission intensity targets by yard category (manual, semi-mechanised, mechanised).
 - ✓ Roll out IoT meters and SRTRS connectivity to all licensed yards.
 - ✓ Begin quarterly digital reporting with automated verification flags.

- Phase 4 – R&D and Reduction Projects (Parallel to Phase 3 onwards)
 - ✓ Fund pilots for: Renewable-powered plasma cutting systems.
 - ✓ Heat recovery integration in dismantling processes.
 - ✓ Shared compressed-air systems to replace diesel compressors.
 - ✓ Document operational and carbon performance impacts for sector-wide scale-up.
- Phase 5 – Integration into GSRC Tiers (Post-36 Months)
 - ✓ Incorporate verified carbon intensity performance into GSRC tier scoring.
 - ✓ Recognise top-tier performers with green tender priority, and financial incentives yard certification.

To summarize, the building blocks for the Green Fuel pillar implementation are as indicated in the diagram below:



3 Responsibility Mapping

The implementation of the Green Ship Recycling pillar under the National Green Shipping Policy (NGSP) requires coordinated action across multiple ministries, regulatory authorities, state agencies, and industry stakeholders. Given the regulatory, environmental, financial, and operational complexity of ship recycling, clear allocation of roles and responsibilities is essential to ensure effective compliance, avoid overlaps, and enable timely implementation. This responsibility mapping framework identifies the key stakeholders involved in green ship recycling and defines their roles across policy formulation, infrastructure development, compliance enforcement, financing, capacity building, and international coordination. The framework is intended to support accountability, inter-agency coordination, and phased execution of green ship recycling initiatives under the NGSP.

Category	Stakeholder	Primary Role
Policy & Governance	Ministry of Ports, Shipping and Waterways (MoPSW)	Overall policy owner for green ship recycling under NGSP; inter-ministerial coordination and oversight
	Directorate General of Shipping (DG Shipping) – National Authority for Ship Recycling	Regulatory authority for HKC compliance, yard authorisation, certification, and enforcement
	Ministry of Environment, Forest and Climate Change (MoEFCC)	Environmental safeguards, hazardous waste regulations, emissions and pollution control alignment
	State Maritime Boards (GMB / SMBs)	State-level implementation, licensing, monitoring, and cluster coordination
Ports & Recycling Infrastructure	Gujarat Maritime Board / State Maritime Boards	Development and management of ship recycling clusters, common facilities, and park infrastructure
	EPC Contractors & Utilities Providers	Design and execution of mechanised cutting systems, waste facilities, utilities, and pollution control infrastructure
Environmental Management & Waste Handling	State Pollution Control Boards (SPCBs)	Consent management, wastewater/effluent compliance, hazardous waste authorisation
	TSDF Operators	Treatment, storage, and disposal of hazardous waste generated from ship recycling
Digital Systems & Transparency	DG Shipping (Lead)	Oversight of SRTRS, digital compliance systems, and national recycling database
	NCoEGPS / Technology Partners	Digital platform development, IoT integration, monitoring systems, and analytics
Circular Economy & Green Steel	Ministry of Steel	Integration of ship-recycled scrap into steel recycling and green steel initiatives
	Steel Re-rollers & Secondary Steel Producers	Use of certified ship-recycled ferrous scrap and participation in green steel recovery loops
Carbon Accounting & Climate Reporting	DG Shipping (Lead)	Carbon accounting framework implementation and emissions disclosure oversight

	NABL-accredited Auditors / Verifiers	Third-party verification of emissions, compliance data, and performance metrics
Finance & Market Enablement	Ministry of Finance	Policy support for green finance instruments and fiscal incentives
	NITI Aayog	Strategic guidance on blended finance, innovation, and long-term sector transition
	Ferrous Scrap Development Fund (FSDF)	Financial support for yard modernisation, energy efficiency, and scrap aggregation
	Financial Institutions & MDBs	Concessional finance, ESG-linked lending, and technical assistance
Workforce Safety & Skills	Indian Maritime University (IMU)	Design and delivery of national training and certification modules
	SCGJ / GMB Training Centres	Worker training, skill certification, and safety capacity building
	Yard Operators	Implementation of safety systems, training compliance, and worker welfare
International Cooperation	MoPSW / DG Shipping	Bilateral and multilateral cooperation on green ship recycling
	Ministry of External Affairs (MEA)	Facilitation of international agreements and cooperation frameworks
	Flag States & Shipowners	Assured end-of-life vessel supply to compliant Indian yards
Monitoring, Auditing & Disclosure	Accredited Third-Party Auditors	Environmental, safety, and GSRC-Tier audits
	Certification Bodies	Green Ship Recycling certification and public disclosure
Technology & Innovation	Equipment OEMs	Supply of mechanised, robotic, and low-emission dismantling technologies
	Recycling Yards (High-volume)	Adoption of advanced monitoring, automation, and digital twin systems

4 Critical Barriers

The implementation of green ship recycling under the National Green Shipping Policy faces several structural, financial, and operational challenges that may affect the pace and consistency of execution. These barriers need to be addressed through coordinated policy action and phased implementation to ensure effective outcomes. Regulatory compliance requirements, infrastructure readiness, and access to affordable finance vary significantly across ship recycling yards, creating uncertainty in timelines and investment decisions. In addition, evolving international expectations

and data-driven compliance requirements may pose challenges for consistent adoption, particularly for smaller and transitioning facilities.

1. **Fragmented institutional ownership and coordination gaps** across central ministries, state authorities, and regulators may delay decision-making and dilute accountability during implementation.
2. **High upfront capital requirements and limited access to affordable green finance** may constrain yard-level investments in mechanisation, pollution control, and digital systems, particularly for Tier-2 and Tier-3 yards.
3. **Capacity and skill constraints** within the workforce and among enforcement agencies may affect consistent adoption of advanced technologies, safety practices, and reporting requirements.
4. **Data reliability and compliance enforcement challenges**, especially during early stages of digital reporting and carbon accounting, may limit transparency and investor confidence.
5. **Market and international alignment risks**, including uncertainty in assured end-of-life vessel supply and evolving EU/HKC compliance expectations, could impact long-term viability and global acceptance of Indian green-certified yards.

5 Conclusion

The Green Ship Recycling implementation roadmap under the National Green Shipping Policy provides a structured and actionable pathway to transform India's ship recycling sector into a globally competitive, environmentally responsible, and worker-safe industry. By integrating regulatory reform, digital transparency, targeted financial support, technology modernisation, workforce development, and international collaboration, the roadmap enables a phased transition aligned with international conventions and market expectations. Effective implementation of this framework will strengthen compliance, enhance circular economy outcomes, improve access to green finance and global shipowner markets, and reinforce India's position as a leading hub for sustainable ship recycling.