

MARITIME DECARBONIZATION IN THE EASTERN MEDITERRANEAN

SHIPPING COMPANIES & SEAFARERS SURVEY REPORT



1st WAVE SURVEY PERIOD: JUNE - NOVEMBER 2024

metavasea



WMU



Methodological Reasoning and Limitations

This report presents findings from a stakeholder perception survey within the East Mediterranean maritime sector, conducted as part of the METAVASEA project. The survey had two main goals: (i) to identify current and emerging skill needs for training, retraining, reskilling, and upskilling in line with evolving industry demands; and (ii) to understand stakeholder perspectives on decarbonization and the use of alternative fuels, including perceived challenges, risks, and technology availability.

Insights are based on responses from seafarers, shipping companies, and other relevant stakeholders, aiming to inform regional capacity-building, especially where formal data on workforce readiness and fuel transition feasibility is limited or inconsistent.

Due to the exploratory nature of the study, lack of centralized contact databases, and logistical barriers in reaching a mobile and diverse population, a convenience sampling approach was used. This method prioritized accessibility and inclusiveness over statistical representativeness, reflecting the survey's diagnostic and agenda-setting intent.

Survey design was informed by a targeted (non-systematic) literature review, industry focus groups, and input from METAVASEA partners. Key themes included skill gaps and barriers/enablers to adopting low- and zero-emission fuels.

Key methodological limitations include:

- **Geographic and Sampling Scope:** The East Mediterranean focus provides localized insights but limits broader applicability. The use of self-selected, non-random respondents introduces selection bias and lowers representativeness.
- **Bias and Lack of Weighting:** No demographic or occupational quotas were applied, and no weighting adjustments were possible due to the absence of a population baseline and limited analytical capacity. Findings may overrepresent more reachable groups.
- **Analytical Constraints:** No multivariate analysis or representativeness testing was conducted; results are descriptive and exploratory.
- **Scope of Interpretation:** As the survey reflects perceptions rather than objective measures, findings are not statistically generalizable but offer directional insights into stakeholder views on skills development and decarbonization.

In light of these considerations, **the findings presented in this report should be viewed as indicative rather than definitive**. They offer a useful snapshot of stakeholder views to support policy dialogue, program design, and further research, including more representative or mixed method approaches in the future.

Executive Summary

The transition to maritime decarbonization represents one of the most significant transformations facing the global shipping industry today. Regulatory momentum, technological advances, and shifting market expectations are accelerating change, particularly in regions like the Eastern Mediterranean, where dense shipping activity intersects with complex operational and environmental conditions. As the International Maritime Organization (IMO) and the European Union roll out more ambitious climate policies, the sector is undergoing a rapid adaptation to meet evolving demands.

This report presents the consolidated findings of the initial phase of the METAVASEA survey, conducted between June and November 2024. It targets shipping companies and seafarers operating in the Eastern Mediterranean region and offers a snapshot of industry perspectives prior to the adoption of the IMO Net-Zero Framework at [MEPC 83 \(April 2025\)](#). As such, the findings serve as a valuable baseline for understanding how the sector was positioned ahead of this notable regulatory development.

The survey assesses industry readiness for low-emission solutions, identifies critical skills gaps, and explores region-specific pathways for aligning with decarbonization targets set by the International Maritime Organization (IMO) and the European Union.

Data was collected through structured digital questionnaires, whose final structure was shaped by focus group discussions with mid- and senior-level maritime professionals and seafarers from HELMEPA's membership. These focus groups also contributed qualitative insights that helped identify and refine key themes and priorities. The questionnaires were circulated across HELMEPA's member network, and the results were jointly analyzed by HELMEPA and Premium Consulting. The draft report was then shared widely with METAVASEA's maritime stakeholders to validate findings and incorporate additional input. This collaborative, multi-stage process was designed to ensure the report is as methodologically sound and representative as possible.

This report focuses specifically on responses from **77 representatives of shipping companies and 531 seafarers**, offering insights into their operational challenges and capacity-building needs in relation to decarbonization. Key focus areas include the adoption of alternative fuels, emissions compliance strategies, port infrastructure capabilities, and the evolving training requirements of both onboard and shore-based personnel.

Key Findings

- **Strategic alignment with IMO climate regulations is progressing but uneven**, with 74% of respondents stating that their companies are either already aligned or have planned to align with IMO net-zero targets.
- **Awareness of the need for robust emissions management is increasing** among shipping companies, with a focus largely on direct (Scope 1) emissions (73%), while 9% and 4% of companies monitor Scope 2 (indirect energy use) and Scope 3 (supply chain) emissions, respectively.
- **Biofuels lead the transition, but uncertainty remains.** Biofuels are the most widely adopted or planned fuel alternative (62%), with green hydrogen (25%) and ammonia (19%) gaining interest. Still, 42% of respondents express concerns about fuel compatibility and infrastructure gaps.
- **Technological immaturity, high costs, vessel compatibility and regulatory complexity are the main barriers to wider adoption of technology upgrades.** Novel technologies like onboard carbon capture, wind and solar power, and air lubrication face additional skepticism due to uncertain performance and safety concerns.
- **Crew fatigue tops seafarer concerns.** Crew fatigue, driven by regulatory pressure and added workload, is ranked as the top safety concern by a staggering 70% of respondents. This is followed by inadequate training (27%) and unfamiliarity with new fuels (26%). Engineers and less experienced crew report the highest levels of concern.
- **Widespread training gaps identified.** 64% of seafarers reported no decarbonization-related training in the past two years. Among those trained, only a small fraction had exposure to content on alternative fuels, emissions monitoring, or new digital systems.
- **In-house training prevails, but external providers play a role.** 61% of training is delivered in-house, reflecting companies' active role. However, among the 39% who trained through external providers, satisfaction rates were significantly higher, especially for courses on new fuels and technology.
- **Soft and technical skills are evolving in parallel**, with both seafarers and shipping company staff equally prioritizing safety skills such as risk assessment and management, understanding decarbonization technologies and energy management systems, organizational skills like planning and prioritization, as well as soft skills including leadership, teamwork, and critical thinking, underscoring the need for a holistic approach to prepare for the safety and operational challenges of maritime decarbonization.
- **Fleet size shapes sustainability readiness.** Large fleets (>50 vessels) are more advanced in emissions tracking (over 80%), ESG strategy implementation, and uptake of new technologies. Small fleets (<10 vessels) focus primarily on compliance and basic awareness, often citing limited resources.
- **Support for tailored upskilling is critical.** The need for specialized training varies significantly by vessel type and role. LNG and tanker crews prioritize fuel handling and safety, while passenger vessel personnel call for training in environmental awareness and

life cycle assessments. Office staff increasingly require cross-functional skills in decarbonization strategy and compliance. By consolidating diverse stakeholder input, this report contributes to a shared understanding of the decarbonization process and supports the development of a skilled, adaptive, and environmentally responsible maritime workforce in the Eastern Mediterranean.

- Looking ahead, the METAVASEA survey confirms that while the Eastern Mediterranean maritime sector is making measurable progress toward decarbonization, **persistent gaps remain — particularly in scaling advanced technologies and preparing the workforce**. Alignment with IMO and EU frameworks is setting the direction, but success will require sustained investment in training, infrastructure, and cross-sector collaboration. Tailored reskilling and upskilling programs will be essential to ensure not just compliance, but long-term competitiveness and safety in a rapidly evolving maritime landscape.

The survey will continue throughout the METAVASEA project until September 2027, enabling ongoing analysis and updates that reflect evolving trends, challenges, and capacity-building needs in the region.

Conducted within the framework of the METAVASEA project, which adopts a people-centered approach to maritime decarbonization in the Eastern Mediterranean — a region of strategic importance due to its dense shipping traffic and dynamic port systems — this study forms part of a broader effort to map the infrastructure and skills required for the green transition. Launched in 2023, METAVASEA (Greek for “transition”) is a five-year initiative running through 2027, coordinated by the Hellenic Marine Environment Protection Association (HELMEPA) and supported by Lloyd’s Register Foundation. The project brings together six partners, twelve associate partners, and more than sixty contributing stakeholders across the region, a network that continues to grow.

Part I: Insights from Shipping Companies

In this research, no restriction was placed on the participation of more than one executive per shipping company, allowing for a broader and more pluralistic sample. However, this may have led to interpretive distortions, especially when questions concerned official policies or onboard practices, due to differing perceptions or levels of awareness.

In the next wave of research, the questionnaire will be restructured to clearly separate questions on official company or vessel policies from those capturing individual opinions and experiences, aiming to enhance validity and reduce intra-company bias.

1.1 Company Profiles and Fleet Characteristics

A total of 77 representatives of shipping companies participated in the survey. Of these, 47% represented managing companies/operators of merchant vessels, 32% represented mixed companies (both owning and managing), and 21% represented shipowning companies.

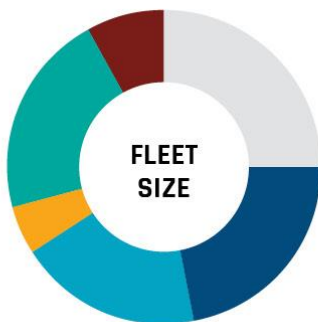
The participating companies represent a diverse range of fleet sizes. The majority (66%) operate fleets of 30 vessels or fewer. Within this group, 41% manage 10 to 30 vessels, while 25% manage fewer than 10 vessels. Companies operating larger fleets—more than 30 vessels—make up 34% of respondents, of which 29% above 50 vessels, indicating a substantial presence of large-scale operators.

Most of the participating companies reported operating bulk carriers (55%), followed by tankers (43%) and container vessels (22%). LNG carriers were reported by 13% of companies, while 10% operated other vessel types such as LPG carriers, LCO₂ carriers, VLACs, PSVs, and offshore vessels. Additionally, 8% reported operating mixed fleets of bulk carriers and tankers, and 6% operated passenger vessels.

SHIPPING COMPANIES

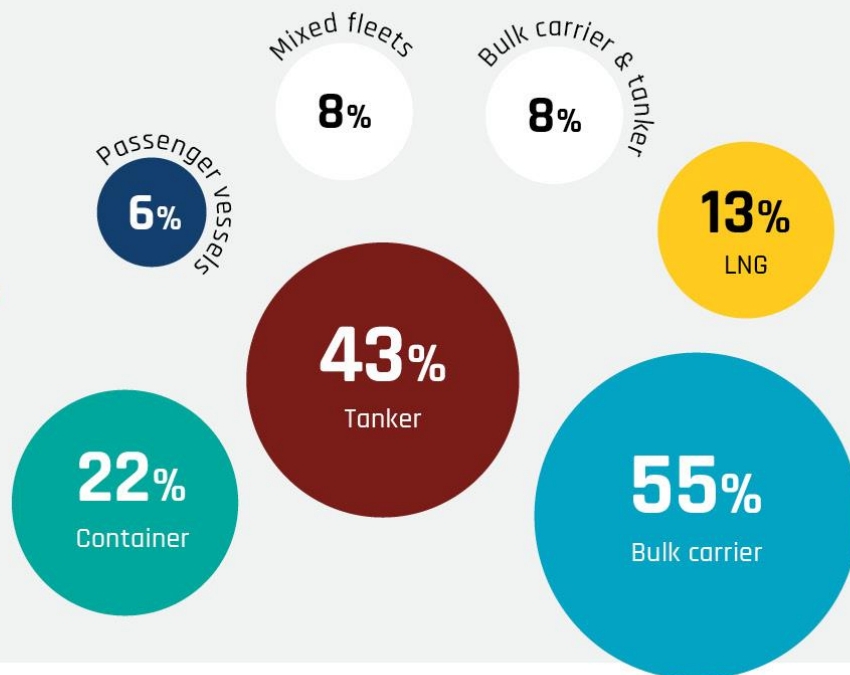
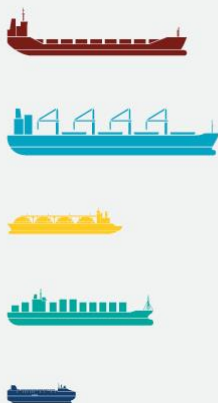
TYPE OF COMPANY

- 47%** Managing company/operator of merchant vessels | 36
- 21%** Owning company of merchant vessels | 16
- 32%** Mixed (owning and managing) | 25



- 25%** <10 vessels
- 22%** 11 - 20 vessels
- 19%** 21 - 30 vessels
- 5%** 31 - 50 vessels
- 21%** 51 - 100 vessels
- 8%** > 100 vessels

VESSEL TYPES



The **average age of vessels** reported by participating companies varied by vessel type, reflecting differing replacement cycles, operational demands, and investment strategies across segments:

Tankers: 12.3 years

Passenger vessels (cruise ships, ferries): 12.2 years

Bulk carriers: 11.5 years

Container vessels: 9.2 years

Mixed fleets: 5.2 years

LNG carriers: 5 years

The **most used fuel types** among participating companies were Very Low Sulphur Fuel Oil (VLSFO) at 77% and Marine Gas Oil (MGO) at 74% followed by High Sulphur Fuel Oil (HSFO) (49%). Alternative fuels were used to a lesser extent, with LNG reported by 18%, biofuels by 8%, and other fuels (including LPG, LSMGO, and LSGO) by 4%.

Among the participating companies, 27% indicated that most of their fleet complies with **Tier II standards**, while 19% reported primary compliance with **Tier I** standards. 13% stated that most of their fleet complies with **Tier III** standards. Notably, 40% of companies did not provide a response to this question.

The widespread **use of performance monitoring tools by participating companies (92%)** indicates that performance tracking is a central element of their operational strategy. In contrast, auxiliary battery systems (9%) and other technologies (8%) are far less commonly implemented, highlighting areas where application remains limited.

In terms of environmental compliance and excellence systems, most participating companies **(75%) reported having adopted an environmental management system**. Additionally, one in two companies (51%) operate vessels fitted with scrubbers, and 47% have implemented sustainability and ESG-related standards and frameworks. An eco fleet (i.e. vessels compliant with NO_x Tier II or Tier III and equipped with an electronic main engine) was reported by 43% of participants.

Among companies that reported adopting an environmental management system, the vast majority (86%) have implemented ISO 14001. Far fewer reported using EMAS (7%) or other systems such as ISO 50001 (3%). 10% of respondents did not provide an answer to this question.

Among the participating companies that reported **scrubber use**, 31% indicated that up to 25% of their fleet is fitted with scrubbers. 18% reported installations on 26–50% of their fleet, while 28% have retrofitted 51–99% of their vessels. A further 17% reported that 100% of their fleet is equipped with scrubbers, and 6% of the specific participants did not respond to this question.

The main **sustainability and ESG-related standards and frameworks** reported by participating companies include GRI Standards 38%, United Nations Sustainable Development

Goals (SDGs) 22%, SASB Standards 14%, United Nations Global Compact 13%, Task Force on Climate-related Financial Disclosures (TCFD) 9%, and Science-Based Targets 8%.

1.2 Strategic Readiness and Emission Management

Respondents were asked to indicate which statements best described their company's decarbonization and net-zero strategies. A clear trend emerged: **the clear majority of shipping companies are aligning their plans with the decarbonization targets set by the International Maritime Organization (IMO).**

Specifically, 14% of respondents said their companies already have a net-zero strategy aligned with IMO targets. An additional 5% reported having adopted a strategy that goes beyond the IMO's level of ambition, which can be considered as front-runners, while another 8% plan to develop an even more ambitious strategy within the next year.

Another 22% of respondents reported that their companies have already established intermediate goals directly aligned with the IMO Strategy, while 7% reported having intermediate goals that go beyond the IMO targets.

Approximately 18% of respondents indicated that their companies plan to develop a net-zero strategy in line with the IMO within the next year while 17% stated that, although a formal strategy is not yet in place, internal discussions are actively underway, signaling strategic intent in that direction.

In total, 74% of respondents stated that their companies are either already aligned with the IMO decarbonization framework or have plans to align.

Only 9% of respondents reported that their companies have not yet developed a net-zero strategy nor have they initiated discussions to develop such a strategy.

Overall, the data indicates that the IMO Strategy serves as a central reference point, with many companies either aligned, aligning, or exploring alignment with its targets.

These results also highlight the need for continued support and guidance, particularly for companies still in the early stages of developing their decarbonization strategies. Nevertheless, the overall trajectory points to growing alignment with the IMO's climate objectives across the shipping sector.

Most participating companies (73%) reported measuring Scope 1 emissions, which refer to direct emissions from company-owned or controlled buildings, vessels, or vehicles. Only 9% indicated that their companies measure Scope 2 emissions (indirect emissions from purchased electricity), and just 4% reported tracking Scope 3 emissions, which include other indirect emissions from upstream and downstream activities. 14% of participants stated that their organizations do not measure carbon emissions under any scope.

Most companies (66%) seek third-party verification for their carbon emissions data.

Meanwhile, 13% stated that their company does not pursue such verification, and 21% were unsure whether it takes place.

Approximately 53% of respondents believe that regional legislation and regulations on shipping emissions are required as they help accelerate the pace of maritime decarbonization, while 31% view such regulations as adding complexity, confusion, and cost to the sector. The remaining 16% replied “I don’t know”.

Regarding handling sustainability and ESG issues, nearly **one in two companies surveyed (49%) have established a dedicated Sustainability Manager or department**. Another 31% manage sustainability through individuals embedded in other departments, while 19% reported having no formal sustainability role.

Among companies without dedicated sustainability teams, responsibility for ESG and decarbonization typically falls to departments such as HSQE (Health, Safety, Quality, and Environment), technical, operations, legal, compliance, innovation, or environmental and energy units. HSQE was the most frequently cited department.

Most companies (57%) develop their sustainability and ESG strategies and reports internally. Another 30% follow a hybrid approach, combining in-house efforts with support from external consultants, while 13% fully outsource these activities.

The findings reveal a broad spectrum of ESG maturity across the industry. While formalized sustainability structures are becoming more common, many companies continue to manage ESG responsibilities across multiple departments. This may reflect either a deliberate cross-functional approach or a lack of centralized coordination.

Regarding company practices on sustainability and decarbonization collaborations, 51% of respondents indicated that their companies form partnerships with other companies within the shipping sector. Participation in international partnerships was reported by 36%, while 21% collaborated with companies from other sectors. Additionally, 17% engage with partners across their value chain, and 16% participate in national partnerships. These figures reflect a range of collaborative approaches used to support decarbonization and sustainability efforts.

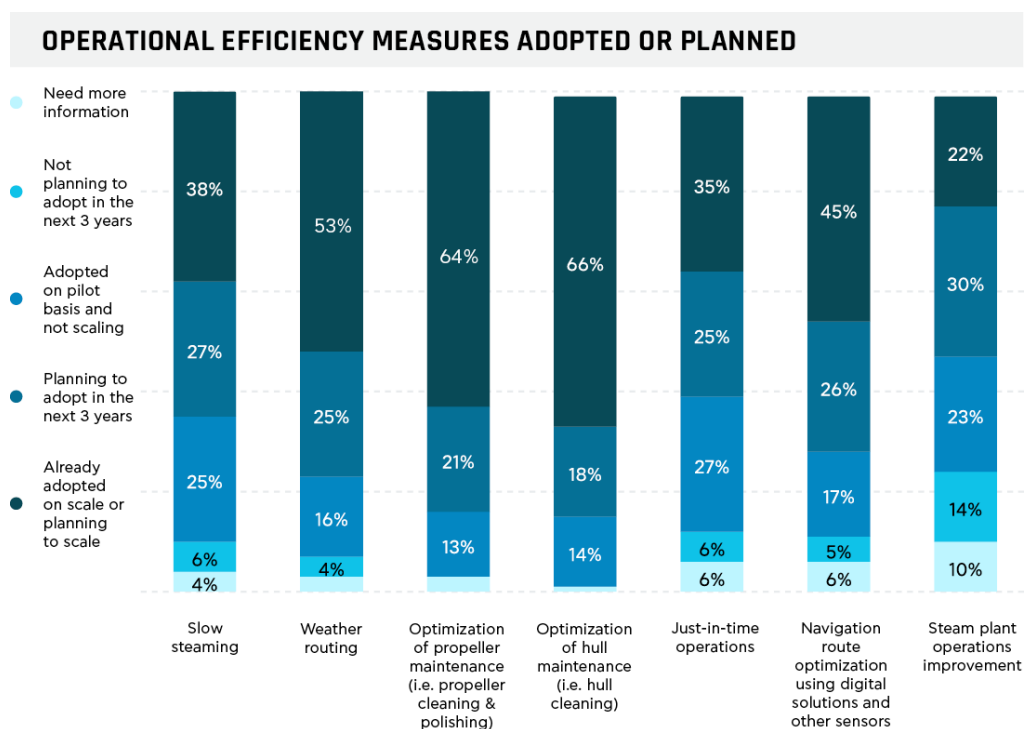
Regarding fleet size, this appears to influence environmental compliance practices, sustainability governance, and verification approaches:

- Small fleets (<10 vessels) tend to implement basic environmental compliance measures (e.g. ISO 14001), have lower adoption of scrubbers, limited use of third-party verification, and more often outsource sustainability reporting activities.
- Medium fleets (11–50 vessels) report greater adoption of scrubbers, eco-fleets compliant with NOx Tier II/III, and emerging sustainability departments; they use a mix of in-house and external ESG reporting aligned with frameworks like GRI and UN SDGs.
- Large fleets (>50 vessels) report comprehensive compliance, advanced technologies (scrubbers, hybrid systems), regular third-party verification, dedicated sustainability teams, and advanced ESG reporting aligned with Science-Based Targets and TCFD.

The effects of economies of scale are therefore observed, as larger fleets provide the capacity (economic feasibility) for a higher degree of compliance and a more comprehensive organization and administration in their management.

1.3 Operational & Technological Efficiency Measures for Shipping Decarbonization

The survey provides insights into the adoption of operational efficiency measures as part of decarbonization strategies. **Hull and propeller maintenance optimization, along with weather routing, appear to be the most widely adopted or planned strategies.** Digital navigation tools are also gaining momentum. Slow steaming and just-in-time operations show moderate uptake, while steam plant operations improvement currently sees more limited adoption.



Hull maintenance optimization (hull cleaning) is the most widely adopted measure, with 66% of respondents having implemented it at scale or planning to scale it. An additional 18% plan to adopt it within the next three years.

Propeller maintenance optimization (cleaning & polishing) is adopted or planned for scaling by 64% of participants, with 21% intending to adopt it in the near future.

Weather routing is already adopted or planned for scaling by 53% of respondents, with 25% planning adoption within three years.

Navigation route optimization using digital solutions is adopted or planned to scale by 45% of companies, with 26% planning for adoption in the near future.

Slow steaming is adopted or planned to scale by 38%, while 27% plan to adopt it in the next three years. About a quarter have only piloted this measure without scaling.

Just-in-time operations are adopted or planned to scale by 35%, with 25% planning adoption in the near term and 27% having piloted them without scaling.

Steam plant operations improvement is less widely adopted, with 22% implementing or planning to scale, while 30% plan to adopt it within the next three years.

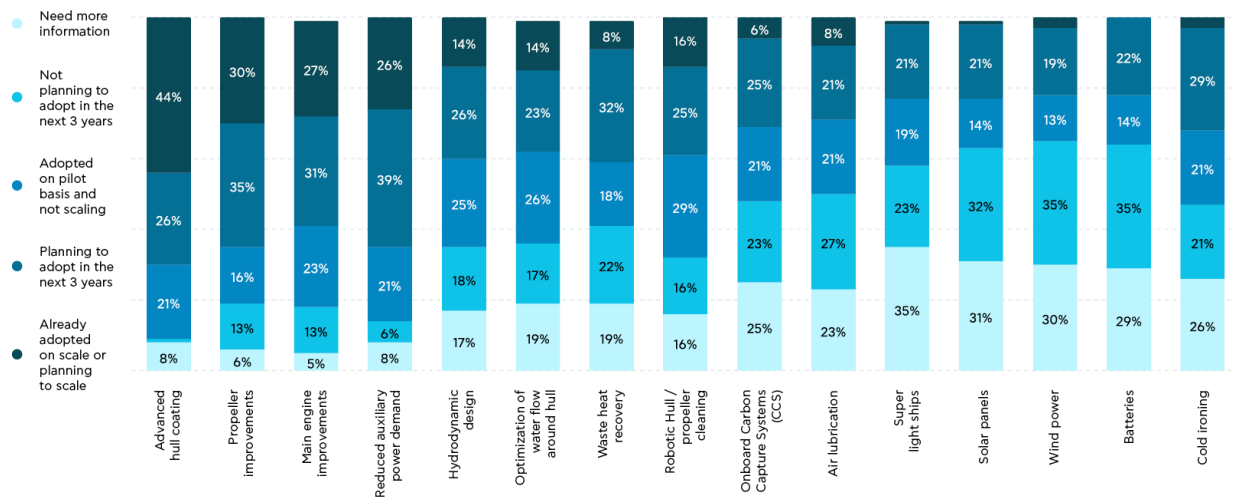
Overall, the data reflects a diverse range of approaches aimed at improving vessel efficiency across the sector.

Across all categories, only a small minority of respondents indicated that they do not plan to adopt these measures within the next three years or that they require additional information. Other operational efficiency initiatives mentioned by participants include onboard energy management, trim optimization, propeller re-blading, the use of silicon and nano paints, biofuels, and broader energy optimization strategies.

Advanced hull coating (44%) is the only technological efficiency measure reported as widely adopted at scale among participating companies. Several other technologies such as reduced auxiliary power demand, improvements to propellers and main engines, waste heat recovery, and cold ironing are primarily in the planning phase, with many companies intending to adopt them within the next three years. Measures like robotic cleaning and water flow optimization remain mainly at the pilot stage.

Technologies such as wind-assisted propulsion, batteries, solar panels, air lubrication, and super light ship designs face higher levels of uncertainty or reluctance, with a significant share of respondents indicating that they either do not plan to adopt these measures or require more information before proceeding.

TECNOLOGICAL EFFICIENCY MEASURES ADOPTED OR PLANNED



Specifically, the main technological efficiency measures rated by companies include:

Advanced Hull Coating: The most widely adopted technological measure, with 44% of respondents having already implemented it at scale or planning to scale, and an additional 26% planning adoption within the next three years.

Propeller Improvements: Adopted or planned to scale by 30% of respondents, with 35% intending to adopt within three years.

Reduced Auxiliary Power Demand: 26% reported adoption or plans to scale, while 39% plan to adopt this measure within the next three years.

Main Engine Improvements: 27% have adopted or plan to scale, and another 31% plan adoption in the near term.

Waste Heat Recovery: Currently adopted or planned to scale by 8% of companies, while 32% plan to adopt within three years.

Cold Ironing: Reported adoption or scaling by 4%, with 29% planning to adopt within the next three years.

Measures mainly on the pilot stage include:

Robotic Hull/Propeller Cleaning: 29% of respondents have piloted this measure without scaling, while 25% plan to adopt it soon.

Optimization of Water Flow Around Hull: 26% reported piloting without scaling, and 23% is planning adoption.

Measures with Significant Uncertainty or Low Adoption include:

Hydrodynamic Design: Only 14% have adopted or plan to scale; 26% plan to adopt; 17% require more information; 18% do not plan to adopt.

Onboard Carbon Capture Systems (CCS): 6% have adopted; 25% plan to adopt; 25% require more information; 23% do not plan to adopt.

Air Lubrication: 8% have adopted or plan to scale; 21% plan to adopt; 23% require more information; 27% do not plan to adopt.

Super Light Ships: 1% have adopted or plan to scale; 21% plan to adopt; 35% require more information, the highest across all measures.

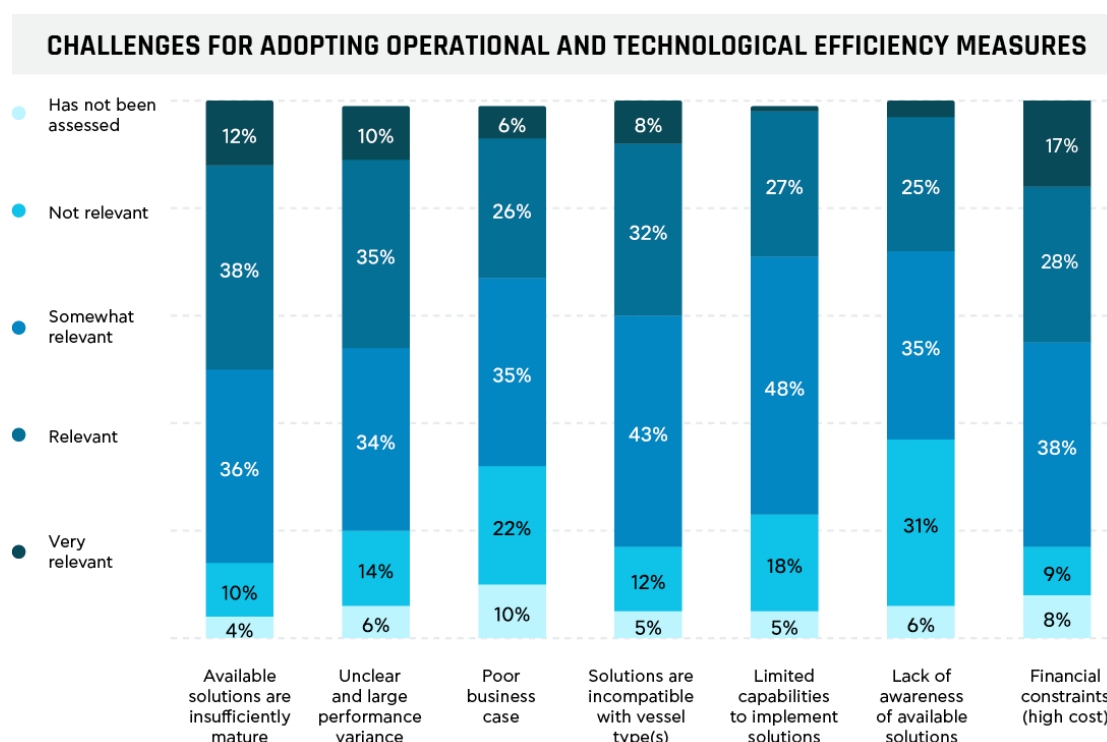
Solar Panels: 1% have adopted or plan to scale; 21% plan to adopt; 31% require more information; 32% do not plan to adopt.

Wind Power: 3% have adopted or plan to scale; 19% plan to adopt; 30% require more information; 35% do not plan to adopt.

Batteries: 14% have piloted without scaling; 22% plan to adopt; 29% require more information; 35% do not plan to adopt.

Respondents also cited the use of Variable Frequency Drives (VFDs) applied to main cooling seawater pumps and engine room / accommodation fans as additional energy efficiency improvements.

The most reported **challenges in adopting operational and technological efficiency measures include the immaturity of available solutions, financial constraints, and uncertain or inconsistent performance**. Respondents also cited additional barriers such as incompatibility with vessel types, limited implementation capacity, and insufficient awareness of available solutions. Regulatory and workforce-related challenges, along with safety concerns, were also mentioned.



Specifically, respondents evaluated the relevance of various challenges their companies face when adopting such measures, as follows:

Maturity of Available Solutions: Half of the respondents (50%) identified the insufficient maturity of available solutions as a highly relevant challenge (38% rated it as relevant, and 12% as very relevant). Additionally, 36% considered it somewhat relevant, 10% did not find it relevant, and 4% had not assessed this challenge.

Unclear Performance and High Variance: A significant portion (45%) rated "unclear and large performance variance" as a highly relevant challenge (35% relevant, 10% very relevant). Another 34% found it somewhat relevant, 14% did not consider it relevant, and 6% had not assessed it.

Poor Business Case: The challenge of a poor business case was considered somewhat relevant by 35% of respondents. An additional, 32% considered it highly relevant (26% relevant, 6% very relevant), 22% did not find it relevant, and 10% had not assessed this issue.

Incompatibility with Vessel Types: The statement "solutions are incompatible with vessel type(s)" was considered somewhat relevant by 43% of respondents. An additional 40% viewed it as highly relevant (32% relevant, 8% very relevant). Meanwhile, 12% did not find it relevant, and 5% did not assess this challenge.

Limited Implementation Capabilities: Limited capacity to implement solutions was considered somewhat relevant by 48% of respondents. An additional 28% viewed it as highly relevant (27% relevant, 1% very relevant). Meanwhile, 18% did not find it relevant, and 5% had not assessed this challenge.

Lack of Awareness of Available Solutions: A lack of awareness of available solutions was considered somewhat relevant by 35% of respondents. Another 28% viewed it as highly relevant (25% relevant, 3% very relevant). Meanwhile, 31% did not consider it relevant, and 6% had not assessed this challenge.

Financial Constraints (High Cost): Financial constraints were identified as a highly relevant challenge by 46% of respondents (29% relevant, 17% very relevant). Another 38% considered them somewhat relevant, while 9% did not view them as relevant, and 8% did not assess this challenge.

Other challenges mentioned by respondents include regulatory frameworks, crew or operator constraints, and safety issues.

Overall, decarbonization strategies vary by vessel type, reflecting operational and technological preferences:

- *Bulk carriers* emphasize operational measures like slow steaming and weather routing, combined with hull optimization.
- *LNG vessels* prioritize advanced technologies such as air lubrication, onboard carbon capture, and specialized hull coatings.

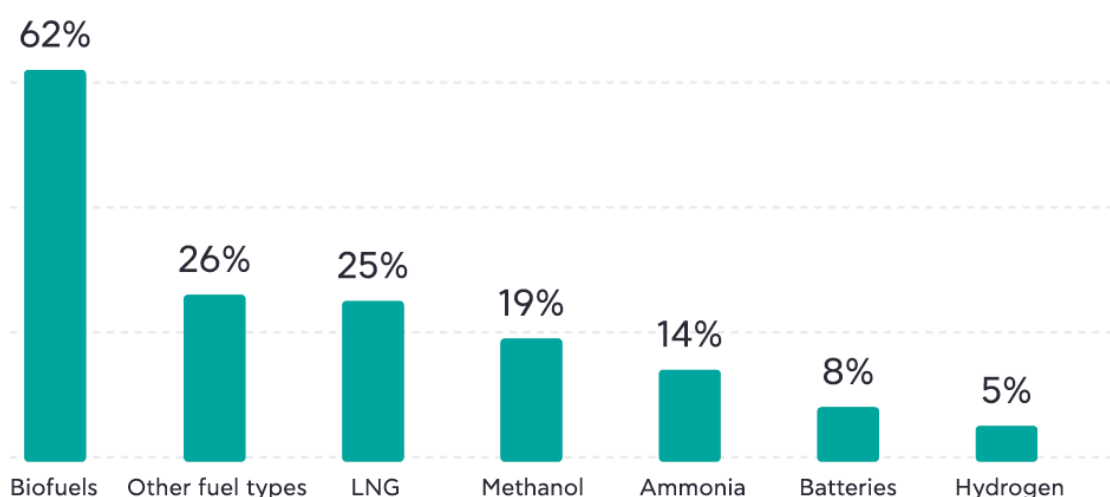
- Tankers focus on energy efficiency upgrades, including main engine improvements and hydrodynamic enhancements.
- Passenger vessels integrate renewable energy, cold ironing, and waste heat recovery.
- Container ships have adopted hull and propeller maintenance optimization, advanced hull coating and engine improvement, and plan to implement waste heat recovery and auxiliary power demand reduction, while slow steaming is less widely adopted.
- Mixed Fleets employ a broad mix of operational and technological measures tailored to vessel diversity.

1.4 Alternative Fuels and Port Infrastructure

Survey respondents were asked which alternative or transitional fuels their companies are currently using or planning to adopt. The distribution of responses shows that **biofuels were the most frequently reported option (62%)**, largely due to their compatibility with existing infrastructure and engines. LNG followed at a lower rate (25%), while methanol and ammonia were also chosen, reflecting interest in cleaner alternatives.

Biofuels also appear to be the best alternative to fossil fuels with a long-term potential for the decarbonization of merchant shipping according to most respondents, despite the fact that

ALTERNATIVE OR TRANSITIONAL FUELS USED OR PLANNED TO BE ADOPTED



biofuel supply sustainability and scalability remain uncertain, especially for large deep-sea segment.

With regards to ports, respondents identified several types of **port infrastructure** as the most effective for supporting the transition to alternative fuels:

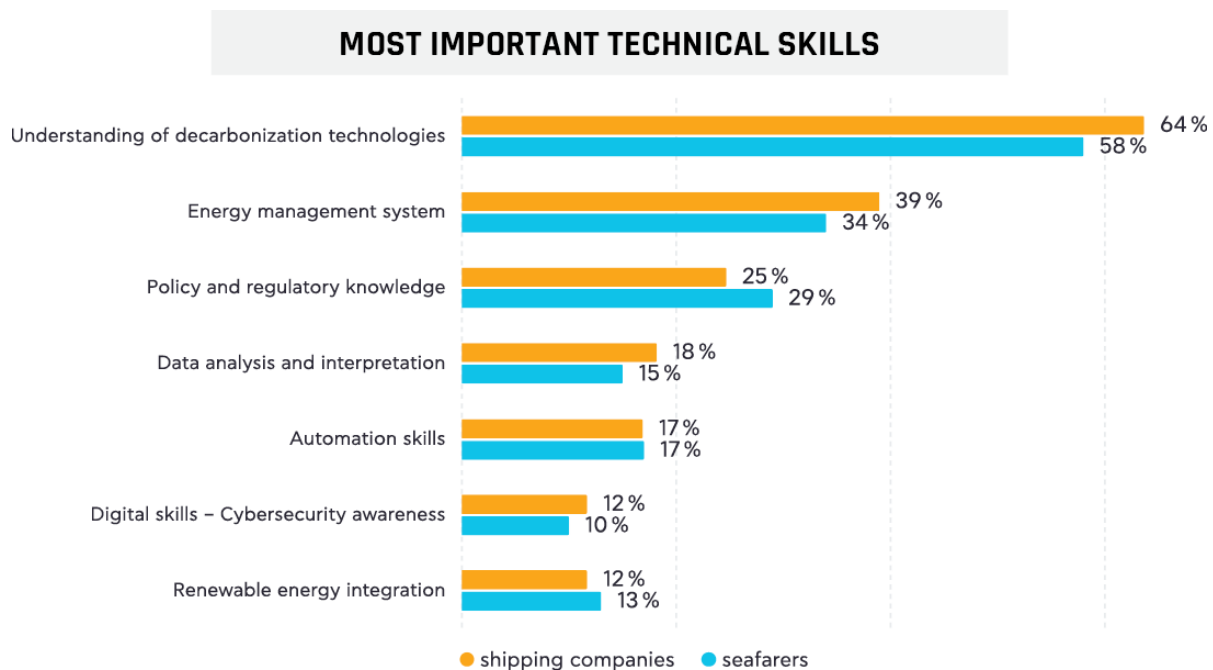
- Onshore Power Systems (cold ironing): 29%

- Alternative fuel bunkering stations: 21%
- Renewable energy sourcing and storage: 19%
- Carbon capture and disposal: 12%
- Other alternatives: 6%

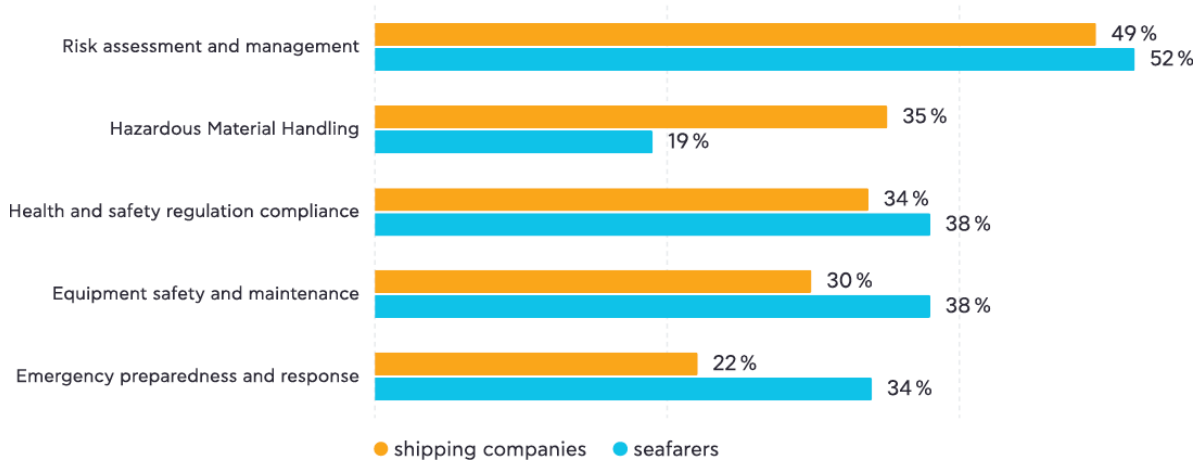
1.5 Key Skillsets for Seafarers

Survey respondents identified a range of technical, safety-related, sustainability, organizational, and soft skills that they consider important for seafarers in the context of decarbonization.

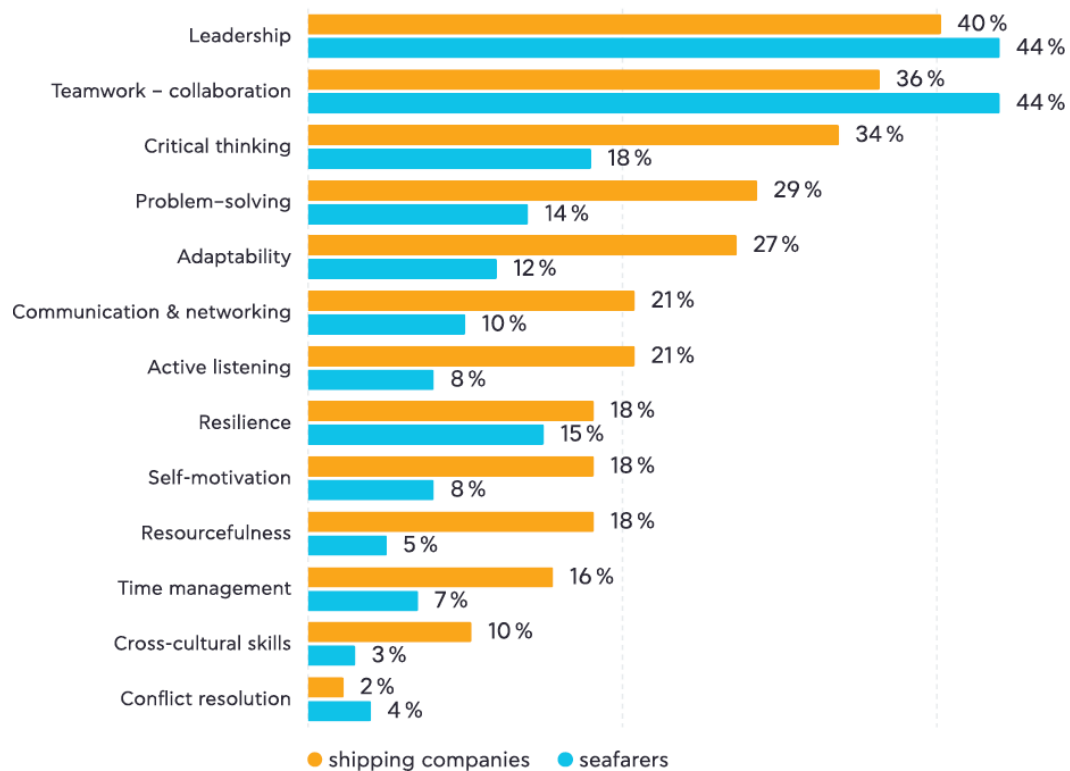
For matters of comparison, the following section includes the priority given to the above-mentioned skills by respondents from shipping companies and seafarers, the wider perspectives of whom are included in Part II of the report.



MOST IMPORTANT SAFETY SKILLS



MOST IMPORTANT SOFT SKILLS



ORGANIZATIONAL SKILLS	ACCORDING TO SHIPPING COMPANIES	ACCORDING TO SEAFARERS
Planning and Prioritization	64%	70%
Attention to Detail	36%	14%
Workflow Optimization	29%	30%
Information Management	27%	25%
Stress Management	21%	30%
Task Delegation	19%	12%
Open Reporting	19%	-

SUSTAINABILITY SKILLS	ACCORDING TO SHIPPING COMPANIES	ACCORDING TO SEAFARERS
Marine Environmental Awareness	68%	38%
Understanding of Environmental Regulations	-	57%
Understanding of Decarbonization Strategies	64%	45%
Adaptability	32%	-
Life Cycle Assessment	12%	12%
Business Acumen	9%	-
Waste Management	-	25%

The survey analysis reveals both convergences and divergences in the prioritization of skills among seafarers and shipping company staff across the five key categories, namely technical, safety, sustainability, organizational, and soft skills, in the context of maritime decarbonization.

Both groups agree on the critical importance of **safety skills**, particularly **risk assessment and management**, which are universally regarded as essential for ensuring onboard safety amidst new fuel types and operational hazards associated with decarbonization. **Health and safety regulation compliance** and **equipment safety** are also highly prioritized, underscoring a shared focus on maintaining safety standards during this transition.

In the **technical domain**, there is a consensus on the necessity of **understanding decarbonization technologies** and **energy management systems**, although shipping staff tend to emphasize these skills slightly more than seafarers. This indicates a recognition of the importance of technical proficiency for operational success and regulatory compliance. Regarding **sustainability**, both groups highlight **environmental awareness** and **understanding of decarbonization strategies** as key skills, with shipping staff giving slightly higher priority to these areas. This alignment reflects a collective acknowledgment of the importance of environmental stewardship in future seafaring roles, while seafarers also rate highly the understanding of environmental regulations (not included in the shipping companies' questionnaire).

Organizational skills, especially **planning and prioritization**, emerge as vital across both groups, emphasizing the need for effective management of decarbonization initiatives onboard.

Soft skills such as **leadership, teamwork-collaboration** and **critical thinking** are universally valued, indicating their pivotal role in facilitating change management and fostering a culture of safety and innovation onboard. Resilience and adaptability also feature prominently, emphasizing the unpredictable and evolving nature of decarbonization efforts.

Despite differences in emphasis, there is a widespread consensus that a holistic approach — combining technical, safety, organizational, sustainability and soft skills — is essential for equipping seafarers to handle the technical complexity and safety challenges of decarbonization. This integrated skill development will be vital for a successful transition, ensuring safety, operational efficiency, and environmental compliance are maintained throughout the industry’s decarbonization journey.

1.6 Key Skillsets for Shore-based Personnel

This section highlights the key skillsets that office personnel will need in the coming years to effectively support decarbonization efforts. The skills are categorized into technical, safety, sustainability, organizational, and soft skills.

The most important technical, safety and soft skills needed for office personnel to support decarbonization, according to participants are displayed in the following graphs.



MOST IMPORTANT SOFT SKILLS FOR OFFICE PERSONNEL TO SUPPORT DECARBONIZATION



The most important sustainability and organizational skills needed for office personnel to support decarbonization, according to participants are as follows:

Organizational skills

- **Planning and prioritization (79%)**
- Information management (42%)
- Attention to detail (40%)
- Workflow optimization (27%)
- Stress management (16%)
- Task delegation (10%)

Sustainability skills

- **Understanding of decarbonization strategies (84%)**
- Adaptability (45%)
- Life cycle assessment (36%)
- Business acumen (13%)

The survey findings suggest that decarbonization is perceived not only as a technical challenge

but also as an organizational and strategic one—requiring a wide range of skills across office-based personnel. Among technical competencies, understanding of decarbonization technologies was most frequently identified as a priority (75%), followed by data analysis, energy management systems, and regulatory knowledge.

In the area of safety skills, risk assessment and management ranked highest (69%). These findings reflect the increasing need for staff who can engage with emissions data, new technologies, and compliance frameworks with confidence and clarity, while possessing critical risk assessment and management qualities.

Regarding sustainability-related expertise, a solid understanding of decarbonization strategies was the most valued (84%), while at the organizational level, planning and prioritization skills were emphasized (79%). In terms of soft skills, leadership (49%) and collaboration (48%) were seen as important, highlighting the role of office-based personnel in supporting internal coordination, change management, and cross-departmental communication as decarbonization becomes more embedded in business operations.

Overall, the results reflect a sector in transition: companies are recognizing the need to build not only technical and compliance know-how but also strategic thinking and team-based problem-solving capabilities among their staff. This supports a strong case for structured, multidisciplinary upskilling programs tailored to the evolving demands of maritime decarbonization.

1.7 Priority Training Themes for Reskilling/Upskilling seafarers

Respondents were asked to assess the **importance of various training themes for reskilling and upskilling their company's seafarers**. All themes were considered highly important by at least 65% of respondents.

- Emergency Preparedness: Drills - 88%
- Pollution Prevention (MARPOL) - 87%
- Emergency Preparedness: Fire Detection and Extinction - 87%
- Safe Navigation - 87%
- Safety at Sea (SOLAS) - 86%
- Crew Wellness (Mental Health – Stress and Fatigue Management) - 86%
- Marine Environmental Awareness - 86%
- Soft Skills – 83%
- Operational Handling of Alternative or New Fuels – 83%
- Emergency preparedness: first aid and e-health – 82%
- Risk-based planning of works and simultaneous Operations (SIMOPS) – 82%
- Maintenance of critical equipment – practical tips – 82%
- Skills and use of alternative fuels – 82%
- Operational & technological solutions to improve energy efficiency – 79%
- IMO Regulations on energy efficiency – 78%
- Incident Investigation and Reporting – 78%
- HNS incidents' preparedness & response – 75%
- IT & automation on board – 73%
- Digital Transition of Shipping/ Basic digital awareness – 69%
- Operational issues for Electrotechnical Officers (ETOs) – 69%
- Operational Issues on ship to port interconnection (PRF's, Cold Ironing, Berth Allocation, etc.) – 68%
- Specific issues for LNG as marine fuel – 68%
- EU ETS & FuelEU – 65%

The survey results indicate a strong and widespread consensus among respondents regarding the need for comprehensive training to support seafarers through the maritime industry's green and digital transitions. All 22 proposed training themes were rated as important by at least 65% of participants, with the highest priorities focused on emergency preparedness, safety, and environmental protection. Leading the list were topics such as emergency drills (88%), pollution prevention (MARPOL – 87%), and fire detection and extinction (87%),

highlighting the enduring relevance of traditional safety competencies even in an era of technological transformation.

Equally prominent were crew wellness (86%), marine environmental awareness (86%), and soft skills (83%), reflecting growing recognition of the human element in decarbonization and operational resilience. Technical themes such as alternative fuel handling, energy efficiency solutions, and IMO and EU regulatory compliance (e.g., EU ETS, FuelEU) also featured strongly, demonstrating that seafarers are increasingly expected to understand and apply sustainability-focused technologies and procedures. Notably, digitalization themes like IT & automation (73%) and digital awareness (69%) received slightly lower, but still significant, support, suggesting that digital upskilling is seen as an emerging rather than fully embedded need.

1.8 Company-reported Best Practices

These are company best practices shared by survey participants for HELMEPA's maritime community and METAVASEA partners and associate partners. **Crew welfare** emerged as the most frequently reported area of best practice, followed by **training and skills development initiatives**. This distribution highlights a strong focus on workforce well-being and capacity building within the maritime sector.

- **Crew welfare (51%)**
- **Training programs and reskilling/upskilling initiatives (44%)**
- Operational efficiency measures to reduce GHG emissions (32%)
- Waste management (30%)
- Technological efficiency measures to reduce GHG emissions (23%)
- Improving port/ship interface (14%)
- ESG/CSR initiatives (12%)
- New alternative fuels (9%)

Examples of best practices cited by survey participants include:

- Development of high-quality training materials for both office staff and seafarers by internal training teams.
- Linking crew performance appraisals to key performance indicators (KPIs).
- Provision of comprehensive support systems, such as 24/7 hotlines, family assistance, and in-house competence assessment centers.
- Establishment of in-house training centers and involvement of experienced senior officers as instructors.

- Implementation of operational measures such as speed optimization, weather routing, and technical upgrades (e.g., reblading, burner upgrades, energy-efficient lighting) to enhance efficiency and reduce emissions.
- Waste reduction initiatives such as use of zero-waste systems in office premises.
- Adoption of policies addressing systemic human rights challenges to safeguard seafarers' rights and ensure healthy, safe, and secure working conditions.
- Structured onboarding programs to support the integration and skills development of new personnel.

The responses indicate that many companies are adopting a proactive approach to workforce development, operational efficiency, and sustainability. The combination of technical, environmental, and human-centered practices points to a strategy that addresses both performance and social responsibility.

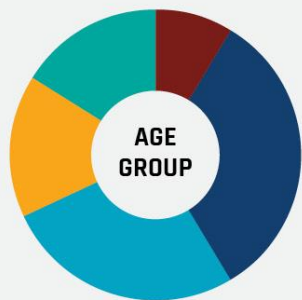
Part II: Perspectives from Seafarers

2.1 Seafarer Profiles

SURVEY REPORT

SEAFARERS

metavasea



10% 18 - 25

37% 26 - 35

30% 36 - 45

18% 46 - 55

18% 56 +

RANK

56% Deck officer

32% Engine officer

5% Other seafarer

2% Former seafarer

0%

Naval officer

0%

Coast Guard officer

5%

Other

SEAGOING EXPERIENCE

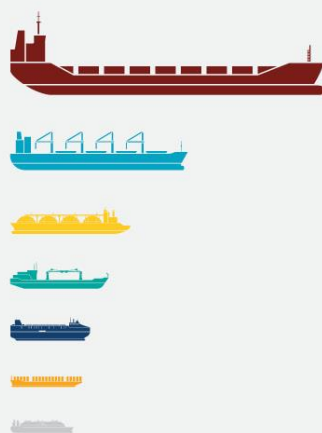
25% 0 - 5 years

27% 6 - 10 years

21% 11 - 15 years

27% 16+ years

VESSEL TYPES



Cruise ships
1%

General Cargo
2%

Passenger ships (Ro-Ro)
3%

Container ships
4%

LNG / LPG
5%

17%
Dry Bulk
Carriers

69%
Tankers

Age Distribution: Out of 531 respondents, the largest age group was 26–35 years, comprising 37% of participants. This was followed by the 36–45 age group at 30%. Smaller proportions included 18% aged 46–55, 10% aged 18–25, and 5% aged 56 or older.

Education Level: Regarding education, 38% of participants hold a bachelor's degree, making it the most common qualification. This was followed by 22% with a master's degree and 16% with an associate's degree (e.g., Community College, Vocational School). Another 16% reported having a High School Diploma or equivalent. "Doctorate or Professional Degrees" accounted for 2%, while 6% selected "Other."

Gender: The vast majority of respondents identified as male (96%), with females representing a mere 4% of participants.

Rank: Deck Officers constituted the largest group at 56%, followed by Engine Officers at 32%. Other Seafarers made up 5%, Former Seafarers 2%, and a small number identified as Naval Officers (1 participant). No Coast Guard Officers participated. Additionally, 5% selected "Other." Together, Deck and Engine Officers represented over 87% of respondents.

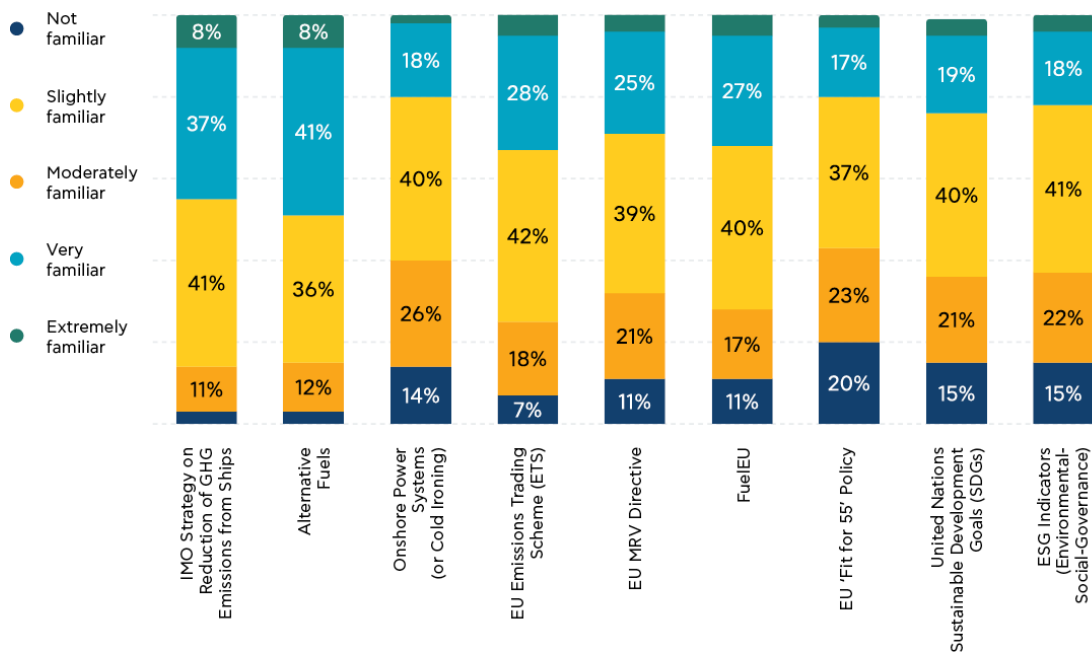
Years of Seagoing Experience: Experience levels were distributed, with the largest group (27%) having over 16 years at sea. Close behind were participants with 6–10 years (27%) and 0–5 years (25%) of experience. The smallest group had 11–15 years of experience (21%).

Vessel Types Served On: Most participants (69%) reported serving on Tankers. Other vessel types included Dry Bulk (17%), LNG/LPG vessels (4%), Container Ships (4%), Passenger Ships/Ro-Ro (3%), General Cargo Ships (2%), and Cruise Ships (1%).

2.2 Maritime Decarbonization Familiarization

Participants demonstrate high familiarity with established topics such as the IMO Strategy and Alternative Fuels. In contrast, newer policies like the EU 'Fit for 55' and technologies such as Onshore Power Systems showed notably lower familiarity, highlighting key areas for targeted awareness and education efforts.

FAMILIARIZATION WITH TOPICS RELATING TO DECARBONIZATION

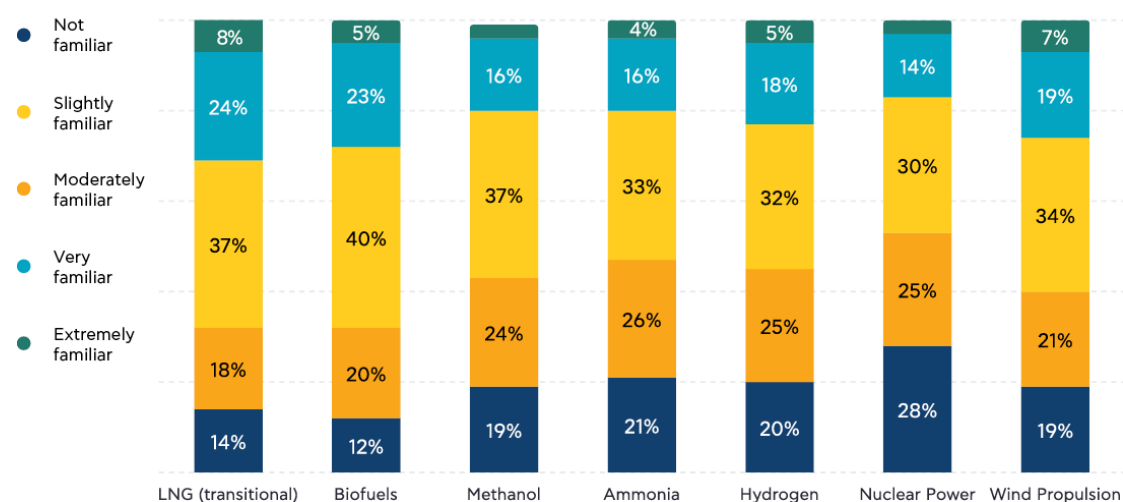


- IMO Strategy on Reduction of GHG Emissions from Ships: This topic showed the highest overall familiarity, with 45% of participants reporting they were very or extremely familiar, 41% moderately familiar, and only 14% not or slightly familiar.
- Alternative Fuels: Similarly, awareness was strong here, with half of respondents very or extremely familiar, 36% moderately familiar, and 15% less familiar.
- Onshore Power Systems (Cold Ironing): Familiarity was more mixed, with 40% not or slightly familiar, another 40% moderately familiar, and 20% very or extremely familiar.
- EU Emissions Trading Scheme (ETS): A majority showed good understanding, with 42% moderately familiar, 34% very or extremely familiar, and 25% less familiar.
- EU MRV Directive: Familiarity was balanced with 39% moderately familiar, 31% less familiar, and 30% very or extremely familiar.
- FuelEU Regulation: Awareness was relatively high, with 40% moderately familiar, 33% very or extremely familiar, and 27% less familiar.
- EU 'Fit for 55' Policy: This newer initiative had lower recognition, with 43% not or slightly familiar, 38% moderately familiar, and only 20% very or extremely familiar.
- United Nations Sustainable Development Goals (SDGs): Moderate awareness was evident, with 40% moderately familiar, 36% less familiar, and 23% very or extremely familiar.
- ESG Indicators (Environmental-Social-Governance): Familiarity was decent but varied, with 41% moderately familiar, 37% less familiar, and 22% very or extremely familiar.

Respondents' familiarity with various alternative and transitional fuels (or power sources) showed considerable variation, reflecting differing levels of exposure and understanding. LNG and biofuels lead to familiarity, particularly at moderate levels. Wind propulsion is emerging as a recognized renewable alternative. Methanol, ammonia, hydrogen, and nuclear power show considerable unfamiliarity, suggesting these fuels or power sources require further education and exposure within the maritime sector.

- LNG (Transitional Fuel): The most familiar fuel, with 38% moderately familiar, and 31% very or extremely familiar

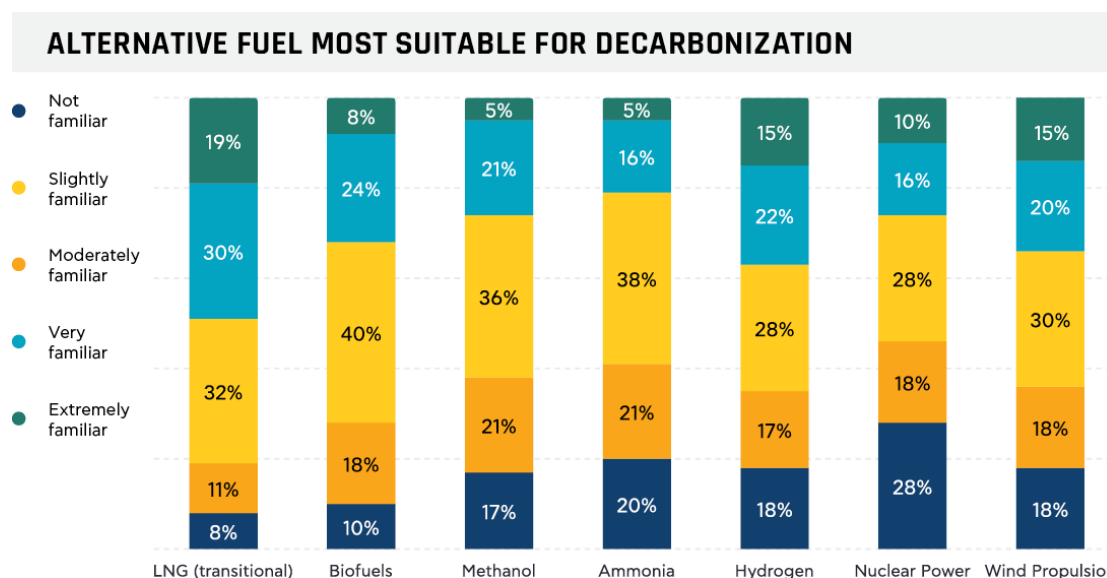
FAMILIARIZATION WITH ALTERNATIVE OR TRANSITIONAL FUELS



extremely familiar, though 31% reported limited familiarity.

- Biofuels: Moderate familiarity was common (40%), with 28% very or extremely familiar, and 33% less familiar.
- Methanol: Exhibited the highest unfamiliarity, with 43% not or slightly familiar, 38% moderately familiar, and only 19% very or extremely familiar.
- Ammonia: Also less familiar, with 48% limited familiarity, 33% moderate, and 20% high familiarity.
- Hydrogen: Showed moderate recognition, with 45% less familiar, 32% moderately familiar, and 22% very or extremely familiar.
- Nuclear Power: The least familiar fuel type, with 53% limited familiarity, 32% moderate, and only 17% high familiarity.
- Wind-assisted Propulsion: Demonstrated growing interest, with 40% less familiar, 34% moderate, and 26% very or extremely familiar.

LNG and biofuels were the most frequently recognized as suitable fuels for maritime decarbonization. Hydrogen and wind propulsion showed emerging recognition, while ammonia, methanol, and nuclear power are less commonly selected or perceived as viable options.



- LNG was rated most familiar: 49% very or extremely familiar, 32% moderately familiar, and 19% less familiar.
- Biofuels also showed high recognition, with 32% very or extremely familiar, 40% moderately familiar, and 28% less familiar.
- Methanol showed less familiarity overall, with 26% very or extremely familiar, 36% moderately familiar, and 38% less familiar.
- Ammonia is less widely recognized as a suitable option, with only 21% very or extremely familiar, 38% moderately familiar, and 41% less familiar.
- Hydrogen showed more mixed familiarity, with 37% very or extremely familiar, 28% moderately familiar, and 35% less familiar.
- Nuclear Power was the least familiar overall, with 46% less familiar, 28% moderately familiar, and 25% very or extremely familiar.
- Wind-assisted Propulsion showed balanced familiarity, with 35% very or extremely familiar, 30% moderately familiar, and 35% (187) less familiar.

Overall, the survey reveals a clear familiarity hierarchy among seafarers regarding maritime decarbonization topics and fuels. Established strategies and fuels, such as the IMO GHG reduction strategy and LNG, are more widely recognized, while newer policies and emerging fuels show more varied levels of awareness. These findings point to the need for targeted education and communication initiatives to address knowledge gaps and support a well-informed transition toward low-and-zero carbon maritime operations.

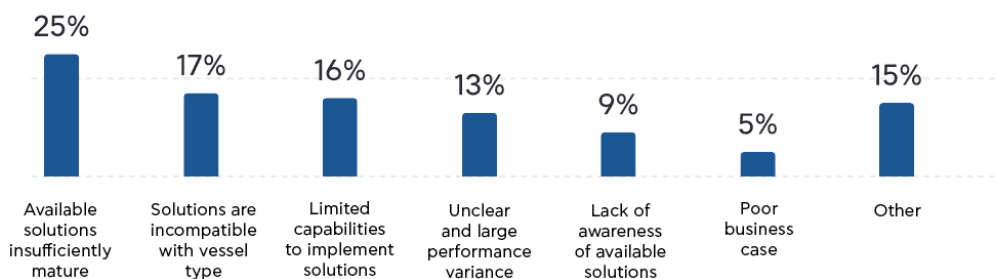
2.3 Operational and Technological Efficiency and Safety Challenges

This section presents seafarers' perceptions of the main challenges their companies face in adopting operational and technological efficiency levers, as well as safety concerns on handling new fuels onboard and in ports. While seafarers may have limited access to detailed corporate strategies or risk assessments, their views are informed by company communications, training, and professional experience.

The most frequently cited challenge their companies face in adopting operational and technological efficiency levers was the **insufficient maturity of available solutions**, reported

by 25% of participants. This was followed by concerns about solution incompatibility with vessel types (17%) and limited capabilities to implement solutions (16%). Other notable challenges included unclear and large performance variance (13%) and lack of awareness of available solutions (9%). A smaller proportion (5%) pointed to a weak business case for these technologies, while 15% selected "Other".

CHALLENGES COMPANIES FACE IN ADOPTION OF OPERATIONAL / TECHNOLOGICAL EFFICIENCY LEVERS

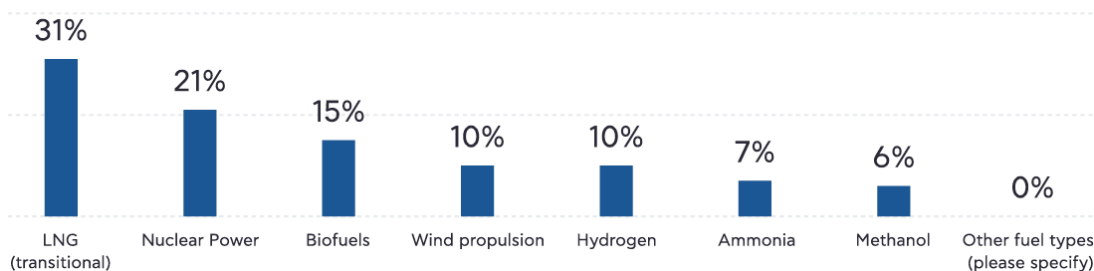


participants. This was followed by concerns about solution incompatibility with vessel types (17%) and limited capabilities to implement solutions (16%). Other notable challenges included unclear and large performance variance (13%) and lack of awareness of available solutions (9%). A smaller proportion (5%) pointed to a weak business case for these technologies, while 15% selected "Other".

LNG and Nuclear Power are perceived as the fuels associated with the highest safety concerns, highlighting the need for robust safety protocols and targeted training when handling alternative fuels.

Specifically, LNG (as a transitional fuel) was identified by 31% of respondents as raising the most safety concerns. Nuclear Power followed at 21%, noted for its significant perceived risks. Other fuels such as Biofuels (15%) and Hydrogen (10%) were also mentioned, while Ammonia

FUELS WITH MOST SAFETY CONCERNS FOR HANDLING ONBOARD AND IN PORT



Methanol (6%) were considered less concerning. Notably, Wind Propulsion, a renewable

energy option, was identified by 10% of respondents as posing safety concerns, which may reflect unfamiliarity rather than fuel-related risks.

Preference for Renewable Energy Sources: 49% of respondents identified renewable sources (including solar, geothermal, wind, wave energy etc.)—as the most appropriate alternatives to support port decarbonization. Other options included:

- Alternative Fuel Bunkering Stations (22%), highlighting the importance of infrastructure to support fuels such as LNG, hydrogen, and biofuels.
- Cold Ironing (Onshore Power Systems) (19%), recognized for its role in reducing emissions during berth by enabling shore-based electrical power.
- Uncertainty (10%), with respondents selecting "I don't know," suggesting a need for greater awareness and guidance on port decarbonization options.

The data highlights strong preference among respondents for sustainable energy initiatives at ports. At the same time, the level of uncertainty expressed by some participants suggests a need for further education and clearer strategic direction.

Overall, seafarers perceive the limited maturity and compatibility of operational and technological solutions as the key barriers to wider adoption. Safety concerns, particularly around LNG and nuclear power, underscore the importance of robust safety protocols and training. When it comes to ports, renewable energy integration emerged as the most favored decarbonization measure, supported by infrastructure for alternative fuels and cold ironing.

2.4 Training Participation

Most participants indicated moderate awareness of their company's decarbonization strategy, with 47% describing themselves as moderately informed, 33% as well informed, and 7% as completely informed. However, 14% reported not being informed at all.

35% of participants reported receiving training on decarbonization-related topics within the past two years, while 65% had not. This suggests that the frequency of decarbonization-related training may not be sufficient to keep the seafaring workforce updated.

Training efforts concentrate on key regulatory and technological areas such as Alternative Fuels and the EU ETS, while emerging topics like Fit for 55 and UN SDGs appear less emphasized. Among those who received training, the most frequently covered areas were:

- Alternative Fuels: The most common topic, selected by 70% of responding seafarers, reflecting its central role in maritime decarbonization.
- EU Emission Trading Scheme (ETS): Selected by 34% of seafarers, underlining the importance of regulatory compliance.
- Monitoring, Reporting, and Verification (MRV): Selected by 29% of seafarers.

- FuelEU Regulation: Chosen by 27% of respondents, reflecting its growing relevance in European maritime policy.
- Onshore Power Systems (Cold Ironing): Selected by 14% of seafarers, indicating a more specialized training focus.
- Fit for 55 and United Nations Sustainable Development Goals (UN SDGs): Selected by 8% and 6% of seafarers respectively, suggesting these newer topics have yet to be widely integrated into training curricula.
- Environmental, Social, and Governance (ESG): Chosen by 12% of seafarers, signaling emerging interest.

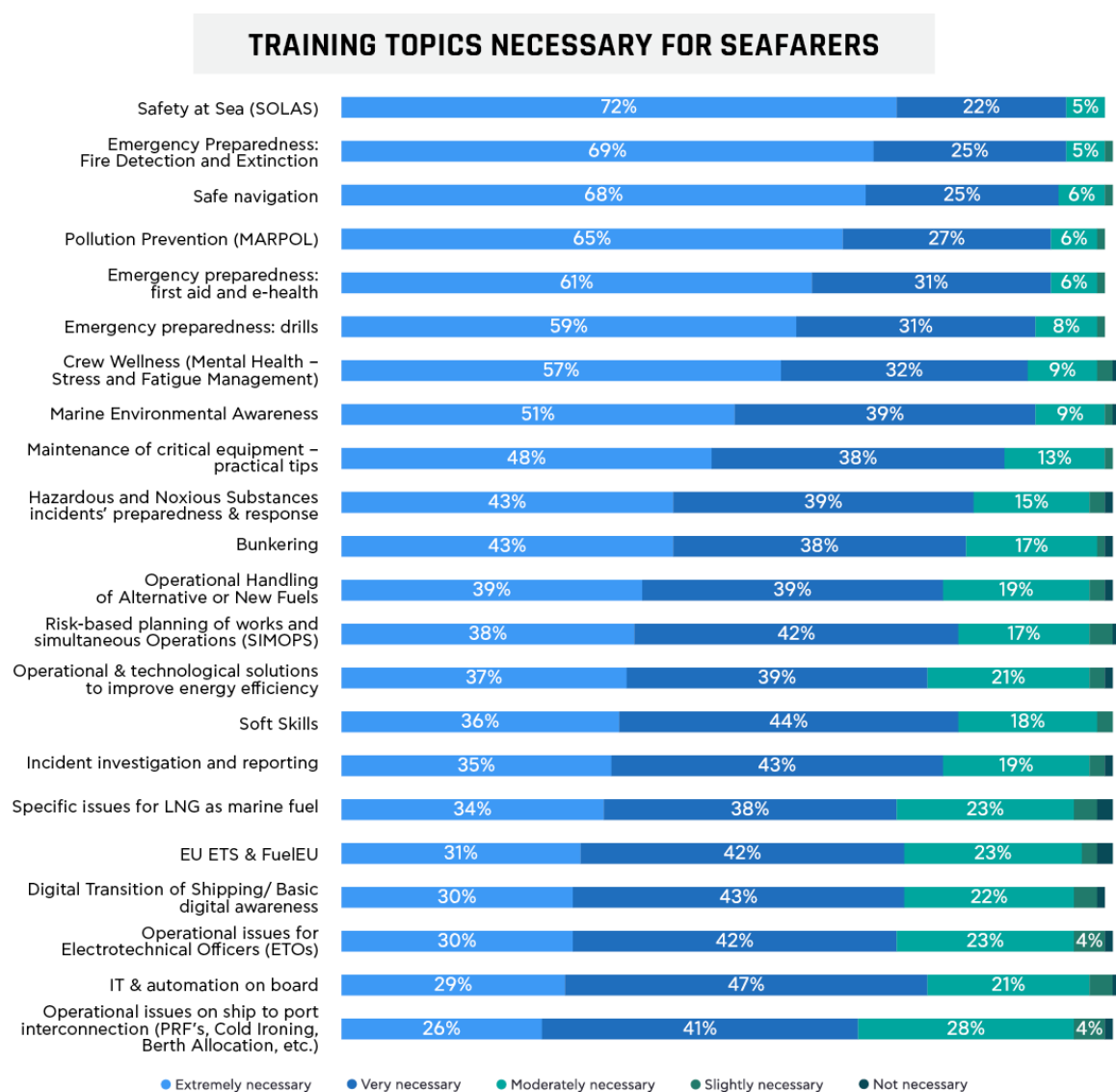
Regardless of whether the seafarers had received training in the past two years:

- the majority of training (61%) was delivered in-house, showing the companies' active role in supporting employee learning. Meanwhile, 39% of participants received training through external providers, highlighting the complementary role of specialized training centers in developing decarbonization-related skills.
- most participants expressed satisfaction with the training received, though the responses indicate areas for potential refinement. A combined 52% reported being very or extremely satisfied, suggesting high perceived value. Another 34% were moderately satisfied, indicating general contentment with room for improvement. A smaller proportion of 11% slightly satisfied and 3% not satisfied, points to specific aspects of training content or delivery that may benefit from further enhancement.

Overall, the survey reveals a mixed but generally positive picture of employee knowledge and training related to company decarbonization strategies. While many participants reported feeling informed and expressed satisfaction with the training received, a notable portion (61%) indicated limited awareness or lack of relevant training. These findings suggest that enhanced communication and broader training coverage, particularly on emerging regulatory and sustainability topics, could further support workforce readiness in advancing decarbonization efforts.

2.5 Training Needs and Critical Skills

The survey results highlight that **seafarers widely consider safety and emergency preparedness as the most critical training topics**. Nearly all respondents identified SOLAS-related training, fire detection and extinction, safe navigation, and pollution prevention (MARPOL) as very or extremely necessary. Similarly, training in first aid, e-health, and regular drills received strong support, underscoring the industry’s commitment to maintaining high standards of safety and readiness at sea.



In addition to these core areas, respondents emphasized the importance of training in environmental awareness, crew wellness, and the handling of new fuels such as LNG. There is also emphasis on the development of soft skills, digital competencies, and knowledge of regulatory frameworks like the EU ETS and FuelEU. Overall, the findings point to a broad-based training demand that combines established safety practices with emerging needs in environmental protection, mental health, and technological adaptation, supporting a well-prepared and resilient maritime workforce.

With regards to **skill-specific areas of priority**, as also analyzed in Section 1.5: Key Skillsets for Seafarers:

Seafarers identified **Understanding of Decarbonization Technologies** as the most critical technical skill (58%), followed by Energy Management Systems (34%) and Policy and Regulatory Knowledge (29%). Skills in Automation (17%), Data Analysis (10%), Renewable Energy Integration (13%), and Digital Skills including Cybersecurity Awareness (10%) were also recognized as important. These priorities reflect the increasing complexity and digitalization of onboard operations as the maritime industry advances toward more sustainable practices.

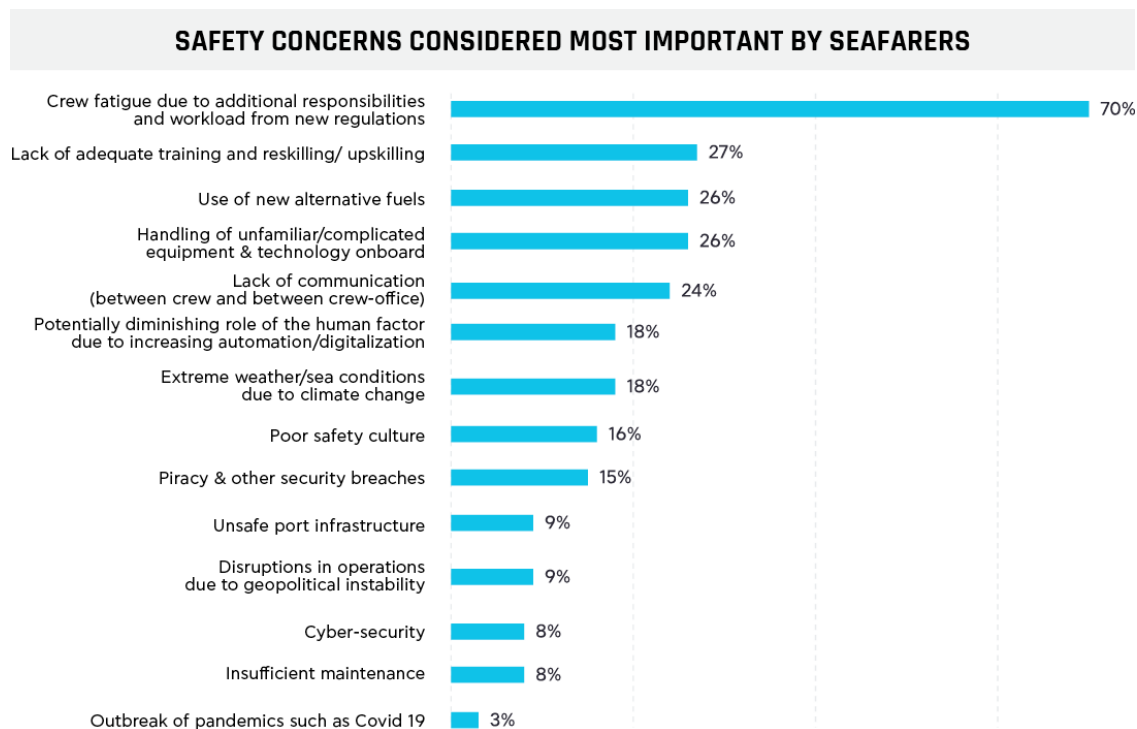
Risk Assessment and Management emerged as the top safety skill (52%), with Health and Safety Regulation Compliance and Equipment Safety and Maintenance both prioritized by 38%. Emergency Preparedness and Response (34%) and Hazardous Material Handling (19%) were also important, highlighting the emphasis on maintaining operational safety amid new technologies and fuels.

The most valued sustainability skill was **Understanding of Environmental Regulations** (57%), followed by Understanding of Decarbonization Strategies (45%) and Basic Marine Environmental Awareness (38%). Waste Management (25%) and Life Cycle Assessment of Fuels (12%) were also noted, underscoring the importance of environmental stewardship onboard.

Planning and Prioritization was considered the most essential organizational skill (70%), followed by Workflow Optimization and Stress Management (30%). Information Management (25%), Attention to Detail (14%), and Task Delegation (12%) were also recognized as important, supporting efficient and focused operations.

Leadership (44%) and **Teamwork and Collaboration** (44%) were identified as the most important soft skills. These were followed by Critical Thinking (18%), Resilience (15%), and Problem-Solving (14%). Adaptability (12%), Communication & Networking (10%), and other interpersonal skills were also acknowledged. These skills are vital for navigating the challenges of decarbonization and fostering effective crew dynamics.

The survey identified several **safety concerns for seafarers** today with the most critical one being by far **Crew Fatigue due to Increased Regulatory Demands (70%)**. Other concerns included Lack of Adequate Training and Reskilling/Upskilling (27%), Use of New Alternative Fuels and Handling Unfamiliar or Complex Equipment and Technology and Communication Gaps between crew and office (each at 26%).



Overall, the findings emphasize that as the maritime industry transitions toward decarbonization, seafarers need to develop a broad set of technical, safety, sustainability, organizational, and soft skills. **Addressing key safety concerns and particularly crew fatigue, as well as training gaps, and the safe integration of alternative fuels, is essential to ensuring safe, efficient, and sustainable onboard operations.**

Composition of Results – Key Findings

The METAVASEA survey delivers a robust, data-driven analysis of the Eastern Mediterranean maritime sector's current landscape and its evolving trajectory in the context of decarbonization. The findings highlight a sector in transition: operationally diverse, increasingly responsive to regulatory demands, experimenting with new technologies, and facing notable workforce development challenges. Below is a synthesis of the main findings, based on the most recent data and insights.

Strategic Readiness and Emission Management

The momentum is building around the IMO's decarbonization strategy: 74% of respondents stated that their companies are either already aligned with the IMO decarbonization framework or have plans to align. Notably, 14% have already implemented a net-zero strategy, 22% have set intermediate goals, and 18% are planning to develop a net-zero strategy within the next year. A smaller but significant group (12%) is pursuing even more ambitious targets, while another 8% plan to develop an even more ambitious strategy within the next year, signaling the rise of climate leadership by front runners within the sector.

The survey shows growing awareness among shipping companies about the need for structured emissions management, though efforts largely focus on direct (Scope 1) emissions. While 73% of companies track Scope 1 emissions, only 9% and 4% monitor Scope 2 (indirect energy use) and Scope 3 (supply chain) emissions, respectively. This suggests a gap in lifecycle emissions oversight that will become more critical as regulatory and market expectations increase.

Third-party verification of emissions is gaining momentum, with 66% of companies using external auditors. However, internal communication remains an issue: over 20% of respondents were unaware of their company's verification status, pointing to a need for clearer internal processes.

Fleet Size and Sustainability Integration

Fleet size emerges as a key determinant of sustainability maturity.

- Small fleets (<10 vessels) focus on basic compliance and environmental awareness, often lacking resources for advanced sustainability initiatives.
- Medium fleets (11–50 vessels) show growing adoption of scrubbers, ESG frameworks, and hybrid reporting models.
- Large fleets (>50 vessels) lead in technological integration, advanced emissions monitoring, and comprehensive ESG reporting, often aligned with international standards such as the Science-Based Targets initiative. This differentiation underscores the need for tailored support and capacity-building across fleet sizes.

Operational and Technological Measures

Operational efficiency remains the most widely adopted near-term strategy for maritime decarbonization:

Common operational measures include hull maintenance (66%), propeller maintenance (64%), weather routing (53%), and digital navigation optimization (45%).

Technological upgrades show more limited uptake. Advanced hull coatings (44%) are the only efficiency technology adopted at scale. Other solutions, such as reduced auxiliary power demand, waste heat recovery, cold ironing, and engine or propeller upgrades, are largely in the planning phase for the next three years.

Key barriers to adoption include technological immaturity, high investment costs, regulatory uncertainty, and vessel compatibility issues. Technologies like onboard carbon capture and wind or solar power integration face skepticism due to safety and performance concerns.

Operational measures vary by vessel type:

- Bulk carriers focus on slow steaming and hull optimization.
- LNG vessels emphasize adoption of advanced technologies.
- Tankers prioritize engine upgrades and hydrodynamic improvements.
- Passenger vessels prioritize renewable energy integration and shore power.

Fuel Transition and Infrastructure

Biofuels have emerged as the dominant transitional fuel, with 62% of companies currently using or planning to adopt them. Other alternatives under consideration include LNG (25%), Methanol (19%), Ammonia (14%), Batteries (8%) and Hydrogen (5%).

When asked about the most promising long-term fuel, 52% of respondents identified biofuels, followed by green hydrogen (25%) and green ammonia (19%). Synthetic LNG, green methanol, and batteries were less commonly favored, but their presence highlights a diversification of strategies.

On the port side, onshore power supply (cold ironing, 29%) and infrastructure for alternative fuel bunkering (21%) are seen as enablers of decarbonization. disparities in the availability of renewable energy sources and alternative fuel bunkering.

Safety, Skills Development, and Training Imperatives

The human element emerges as both a challenge and an opportunity for enabling the transition:

Top concerns for seafarers include crew fatigue from increased workload due to new regulations (70%), inadequate training (27%), and unfamiliarity with new fuels (26%).

Skill priorities for both seafarers and shipping companies' staff include a combination of technical, safety & soft skills such as Understanding Decarbonization Technologies, Risk

Assessment and Management and Leadership and Teamwork-Collaboration, as well as organizational skills such as Planning and Prioritization and sustainability skills such as Marine Environmental Awareness.

Technical training gaps are notable: 64% of seafarers reported no decarbonization training in the past two years, with training focusing mainly on traditional safety themes.

Key Takeaways

Regulatory Alignment: The sector is moving towards alignment with IMO climate goals, but implementation is uneven, particularly among smaller companies.

Operational Efficiency: Widely adopted as a near-term decarbonization lever, but technological upgrades face significant barriers.

Fuel Transition: Biofuels dominate current plans, but a broader portfolio of alternatives is under consideration. Infrastructure readiness remains a critical bottleneck.

Training and Skills Gaps: There is an urgent need for targeted reskilling and upskilling, especially in decarbonization technologies, alternative fuels, and regulatory compliance.

Tailored Support: Differentiated strategies are essential across fleet sizes and vessel types, with a focus on building capacity in small and medium enterprises.

The METAVASEA survey confirms that the Eastern Mediterranean maritime sector is at a pivotal moment. Ambitious policies and emerging technologies play a key role—but the success of the transition will ultimately depend on the ability of the workforce to adapt, acquire new skills, and operate safely and sustainably. Ongoing survey waves through 2027 will allow this evolving landscape to be monitored and updated, supporting timely and informed decisions across the maritime ecosystem.

Appendix - Glossary of Terms

Advance Hull Coatings: Specialized coatings applied to ship hulls to reduce friction and biofouling, leading to lower fuel consumption and emissions compared to traditional coatings.

Air Lubrication: A technology that releases air bubbles under a ship's hull, creating a thin layer that reduces friction between the hull and water, thereby improving fuel efficiency and lowering emissions.

Alternative Fuel Bunkering Stations: Facilities at ports designed to safely supply ships with alternative fuels (e.g., LNG, ammonia, biofuels) instead of traditional marine fuels, supporting the transition to cleaner energy sources.

Ammonia Fuel: Ammonia used as a zero-carbon marine fuel. It emits no CO₂ when burned, but requires special handling due to toxicity and is seen as a promising option for future shipping decarbonization.

Batteries: Energy storage systems used on ships, either as a primary or auxiliary power source, enabling hybrid propulsion and supporting zero-emission operations. Shipping batteries are subject to strict safety and packaging regulations.

Biofuels: Renewable fuels derived from biological sources (e.g., vegetable oil, waste). They can be used as drop-in replacements or blends with conventional marine fuels to reduce shipping's carbon footprint.

Cold Ironing: Also known as shore power, this process involves ships turning off their engines while docked and connecting to an onshore electricity supply, significantly reducing emissions in port.

ESG (Environmental, Social, Governance): A framework for evaluating a company's performance on environmental, social, and governance criteria, increasingly used by shipping companies to guide sustainability strategies and reporting.

EU ETS (Emissions Trading System): The EU's carbon market, which as of 2024 includes shipping. Large ships must monitor, report, and pay for their greenhouse gas emissions on voyages to, from, and within the EU.

EU Fit for 55 Policy: A legislative package aiming to reduce EU greenhouse gas emissions by 55% by 2030. For shipping, it includes stricter fuel standards, expanded ETS coverage, and infrastructure requirements for alternative fuels.

EU MRV Directive: The Monitoring, Reporting, and Verification regulation requiring ships above a certain size to track and report their CO₂ (and soon methane and N₂O) emissions on EU-related voyages. It underpins the EU ETS and other climate policies.

Eco Fleet: A fleet of ships or vehicles optimized for minimal environmental impact, often using advanced route planning, alternative fuels, and electrification to reduce emissions. Often associated with vessels compliant with NO_x Tier II or Tier III and equipped with an electronic main engine

FuelEU: An EU regulation effective from 2025 that sets limits on the greenhouse gas intensity of energy used by ships, mandates shore power use in port, and penalizes non-compliance, driving the adoption of cleaner fuels and technologies.

GRI Standards: The Global Reporting Initiative's standards, which guide organizations in disclosing their sustainability impacts, including sector-specific topics for shipping.

High Sulphur Fuel Oil (HSFO): Marine fuel with sulphur content above 0.5%. Its use is now heavily restricted due to environmental regulations, unless ships use scrubbers to clean exhaust gases.

Hybrid Systems: Ship propulsion systems that combine conventional engines with batteries or other energy sources, enabling improved fuel efficiency, reduced emissions, and flexible operations.

Hydrodynamic Design: The process of designing ship hulls and appendages to minimize resistance and maximize efficiency in water, improving speed and reducing fuel consumption.

Hydrogen Fuel: Hydrogen used as a marine fuel, typically in fuel cells, offering zero emissions at the point of use. Challenges include storage, infrastructure, and safety.

IMO (International Maritime Organization): The UN agency responsible for regulating international shipping, including safety, security, and environmental standards.

IMO GHG Strategy: The IMO's plan to reduce greenhouse gas emissions from shipping, aiming for net-zero emissions by 2050 and significant milestones in 2030 and 2040.

ISO14001: An international standard for environmental management systems, helping organizations systematically reduce their environmental impact and improve resource efficiency.

ISO50001: An international standard for energy management systems, guiding organizations to improve energy efficiency, reduce costs, and lower greenhouse gas emissions.

Just-in-time Operations: A logistics strategy where ships and cargo arrive at ports exactly when needed, minimizing waiting times, reducing fuel use, and cutting emissions.

LNG Fuel (Liquefied Natural Gas): Natural gas cooled to a liquid state for use as a marine fuel. LNG produces lower emissions than traditional fuels and is seen as a transitional solution for shipping decarbonization.

LPG (Liquefied Petroleum Gas): A cleaner-burning alternative marine fuel, consisting mainly of propane and butane, used in some ships to reduce emissions compared to traditional fuels.

LSGO (Low Sulphur Gas Oil) & LSMGO (Low Sulphur Marine Gas Oil): Marine fuels with low sulphur content (typically $\leq 0.1\%$), compliant with emission control area (ECA) regulations.

Low Sulphur Fuel Oil (LSFO): Marine fuel with sulphur content $\leq 0.5\%$, compliant with IMO 2020 regulations.

Main Engine Improvements: Upgrades or modifications to a ship's main engine to improve efficiency, reduce fuel consumption, and lower emissions.

Marine Gas Oil (MGO): A refined distillate marine fuel with lower sulphur content than heavy fuel oil, commonly used in ECAs and for auxiliary engines.

Methanol Fuel: Methanol used as a marine fuel, offering lower emissions and compatibility with existing engine technology after modifications.

Net-Zero: Achieving a balance between greenhouse gas emissions produced and removed from the atmosphere, a key target for shipping decarbonization.

Nuclear Power: The use of nuclear reactors to power ships, mainly in naval vessels and some icebreakers, offering zero direct emissions but with unique safety and regulatory challenges.

Onboard Carbon Capture Systems: Technologies installed on ships to capture CO₂ from exhaust gases before they are emitted, enabling continued use of fossil fuels while reducing net emissions.

Optimization of Hull/Propeller Maintenance: Regular cleaning and maintenance of ship hulls and propellers to minimize drag, maintain efficiency, and reduce fuel consumption.

Optimization of Water Flow Around Hull: Design and operational measures to ensure smooth water flow around the hull, reducing resistance and improving efficiency.

Propeller Improvements: Upgrades to propeller design or materials to enhance propulsion efficiency and reduce energy consumption.

Reduced Auxiliary Power Demand: Measures to lower the energy required by a ship's auxiliary systems (lighting, HVAC, etc.), reducing overall fuel use.

Robotic Hull/Propeller Cleaning: The use of robotic devices to clean ship hulls and propellers, maintaining efficiency and reducing the need for dry-docking.

SASB Standards: Sustainability Accounting Standards Board guidelines for industry-specific sustainability disclosures, including for shipping.

Science-based Targets: Emissions reduction targets aligned with climate science and the goals of the Paris Agreement, adopted by companies to demonstrate climate leadership.

Scope 1, 2, and 3 Emissions: Scope 1: Direct emissions from owned or controlled sources (e.g., ship engines). Scope 2: Indirect emissions from purchased energy. Scope 3: All other indirect emissions in the value chain (e.g., cargo handling, supply chain).

Scrubbers: Exhaust gas cleaning systems that remove sulphur oxides from ship emissions, allowing continued use of high sulphur fuels while meeting regulations.

Slow Steaming: The practice of operating ships at lower speeds to reduce fuel consumption and emissions.

Solar Panels: Photovoltaic panels installed on ships to generate electricity from sunlight, reducing reliance on fossil fuels.

Steam Plant Operations Improvement: Enhancements to steam systems on ships (where used) to improve efficiency and reduce energy waste.

Super Light Ships: Ships constructed with lightweight materials or design innovations to reduce weight, improve fuel efficiency, and lower emissions.

Sustainability: The practice of meeting current needs without compromising future generations, encompassing environmental, social, and economic aspects.

TCFD Recommendations: Guidelines from the Task Force on Climate-related Financial Disclosures, helping companies report climate risks and opportunities.

Third-party Verification: Independent assessment of a company's environmental data or sustainability claims to ensure accuracy and credibility.

Tier I, II, and III Standards: IMO emission standards for nitrogen oxides (NO_x) from ship engines, with Tier III being the strictest, especially in emission control areas.

UN SDGs (Sustainable Development Goals): The United Nations' 17 global goals for sustainable development, including climate action and responsible consumption.

Very Low Sulphur Fuel Oil (VLSFO): Marine fuel with sulphur content $\leq 0.5\%$, compliant with IMO 2020 regulations.

Waste Heat Recovery: Systems that capture and reuse heat from ship engines or exhaust, improving overall energy efficiency.

Weather Routing: The practice of planning ship routes based on weather forecasts to optimize safety, fuel efficiency, and voyage time.



PROACTIVE COLLECTIVE INITIATIVE



SHIPPING COMPANIES & SEAFARERS SURVEY REPORT

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