

MARITIME DECARBONIZATION IN THE EASTERN MEDITERRANEAN **SURVEY REPORT**



2nd WAVE SURVEY PERIOD: DECEMBER 2024 – NOVEMBER 2025

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This report presents the results of Wave 2 of the METAVASEA survey, conducted between December 2024 and November 2025. The survey is part of the METAVASEA project, a multistakeholder collaborative initiative promoting a people-centred transition in the East Mediterranean region, coordinated by HELMEPA between 2023 and 2027 in cooperation with 18 partners and associate partners, with the strategic and financial support of Lloyd's Register Foundation.

The survey follows the methodological process of Wave 1 (W1: June-November 2024) including structured questionnaires shaped by stakeholder focus groups and broad sectoral consultation. This dynamic survey is ongoing, and its findings will be enriched during Wave 3 running through to April 2027 to capture evolving trends, challenges and capacity-building needs.

Methodological Reasoning and Limitations

This report presents the Wave 2 (W2) findings of the METAVASEA survey conducted between December 2024 and November 2025, following Wave 1 (W1, June to November 2024). Where a comparison with Wave 1 is materially useful, it is provided; otherwise, the findings present the Wave 2 evidence as the primary reference.

The survey has two aims: (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 climate change, decarbonization and the use of alternative fuels, including perceived challenges, risks and technology availability. Insights are based on responses from shipping companies and seafarers, port administrations, service providers and suppliers, and members of civil society and port cities.

Wave 2 sample composition

Stakeholder group	Wave 2	Wave 1	Combined	Base of %
Seafarers	592	531	1,123	individual seafarers
Civil society and port cities	507	244	751	individual residents
Shipping companies (responses)	54	77	131	company representatives
Service providers and suppliers	28	36	64	respondents
Port administrations	1	10	11	port entities
TOTAL	1,182	898	2,080	

Every percentage in this report explicitly states its base. For seafarer questions the base is individual seafarers, for company questions the base is company representatives, and for civil society questions the base is individual residents. Where sub-samples apply the base is stated at the point of use.

Note on Wave 2 shipping company sample

In Waves 1 and 2, no restriction was placed on the participation of more than one executive per shipping company. This has allowed for a broader and more pluralistic sample but may have led to interpretive distortions, particularly where questions concerned official company policies or onboard practices. In Wave 3, currently under way, a limit of one representative per company has been set, aiming to increase representativeness, enhance validity and reduce intra-company bias.

Wave comparison approach

Wave 2 findings are presented as the primary reference throughout this report. Wave 1 is referenced only where the change or continuity between waves is materially relevant.

Limitations

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

- Geographic and sampling scope. The East Mediterranean focus provides localised insights but limits broader applicability. Self-selected, non-random respondents introduce selection bias and lower 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. Findings may over-represent more reachable groups, particularly HELMEPA's membership network.
- Multi-respondent effect (shipping companies). In Wave 2, no cap was placed on the number of respondents per shipping company. The 54 responses correspond to 30 distinct entities. From Wave 3, one respondent per company is enforced.
- Sample-size variability across groups. Some sub-groups, notably port administrations (Wave 2, n=1) and service providers (Wave 2, n=28), are too small to support firm quantitative conclusions in isolation. Findings for these groups are directional and, where indicated, are supplemented by the combined Wave 1 and Wave 2 dataset. For port administrations specifically, Wave 2 received a single response (Port of Tripoli, Lebanon); port findings in Part A.III are therefore presented based on the combined dataset of 11 ports.
- Analytical constraints. No multivariate analysis or representativeness testing was conducted; results are descriptive and exploratory.
- Scope of interpretation. The survey reflects perceptions rather than objective measures. Findings are not statistically generalisable 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 will be complemented by Wave 3 (December 2025 to April 2027) to capture evolving trends over time.

Executive Summary

This Executive Summary presents the main findings of the Wave 2 survey conducted between December 2024 and November 2025 across five stakeholder groups in the Eastern Mediterranean: seafarers (n=592), shipping companies (n=54), port administrations (n=1), service providers and suppliers (n=28) and civil society and port cities (n=507). Where wave-to-wave context is relevant, Wave 1 (W1, June to November 2024) figures are cited for comparison.

Crew fatigue remains the leading safety concern among seafarers.

69% of seafarers selected crew fatigue due to additional responsibilities and workload from new regulations as their most important safety concern, essentially unchanged from W1 (70%). It is the most cited safety concern by a wide margin. Other top five concerns include lack of adequate training (25%), lack of communication (24%), handling of unfamiliar equipment (24%) and use of new alternative fuels (22%).

Familiarity with maritime decarbonization topics rose across every topic measured.

EU ETS familiarity rose from 34% (W1) to 47%, FuelEU from 33% to 45%, EU MRV from 30% to 41%, ESG indicators from 22% to 34%, OPS and cold ironing from 20% to 31%, and EU Fit for 55 from 20% to 29%. The IMO GHG Strategy crossed the 50% familiarity threshold, rising from 45% to 56%. Wave 2 data were collected in the period surrounding and following the adoption of the IMO Net-Zero Framework at MEPC 83 in April 2025.

Seafarer decarbonization training participation rose between waves, but the majority still report no such training.

45% of seafarers reported receiving decarbonization-related training in the past two years, up from 36% in W1. Those reporting no such training declined from 64% to 55%. Among those trained, satisfaction (very or extremely satisfied) rose from 56% to 65%. Training content remains concentrated in alternative fuels (66%), EU ETS (36%), MRV (25%) and FuelEU (24%). Coverage of ESG (5%), Fit for 55 (3%) and UN SDGs (3%) remains limited.

Companies and seafarers align on core skills but diverge on resilience and adaptability.

Between waves, shipping companies significantly increased their prioritization of leadership (from 40% to 50%), teamwork (from 36% to 50%), resilience (from 18% to 30%) and adaptability (from 27% to 37%) as required seafarer competencies. Seafarers' own priorities moved in the opposite direction on resilience, declining from 15% to 9%, and held flat on adaptability at 12% and leadership at 44%. On teamwork, seafarers declined slightly from 44% to 42%. Among soft skills, the widest gaps between the two groups in W2 are on adaptability (companies 37%, seafarers 12%) and resilience (companies 30%, seafarers 9%). Both groups reduced their prioritization of understanding decarbonization technologies (companies from 64% to 52%; seafarers from 58% to 52%).

Strategic alignment is improving, but implementation gaps are widening.

22% of shipping company representatives reported a net-zero strategy aligned with the IMO target (W1: 14%), and 9% reported a more ambitious strategy. 13% reported no strategy at all (W1: 9%). 59% reported a dedicated Sustainability Manager or department (W1: 49%), and Scope 1 emissions monitoring rose to 78% (W1: 73%). At the same time, three barriers saw sharp increases between waves: financial constraints (from 46% to 59%), limited implementation capabilities (from 29% to 50%) and lack of awareness of available solutions (from 27% to 50%).

Biofuels remain the leading transitional fuel.

Biofuels are the most used or planned alternative fuel for shipping companies at 59%. LNG fell from 25% to 9%, methanol from 19% to 11%, and ammonia from 14% to 7%. On long-term potential, biofuels lead at 46%, followed by green hydrogen at 20%, green methanol at 17% and green ammonia at 15%. Among service providers, LNG remained the most identified effective fuel at 25% (W1: 36%), with onshore power and cold ironing rising from 6% to 18%.

Digitalization is operationally embedded but not yet strategic.

70% of shipping companies' representatives reported using performance monitoring tools (W1: 92%; the decline reflects sample composition change, with proportionally fewer large operators in W2). 79% of seafarers rated digital transition and basic digital awareness as very or extremely necessary training (W1: 73%). Digital and cybersecurity skills as a core seafarer competency were prioritised by only 17% of shipping companies (W1: 12%), 16% of seafarers (W1: 10%) and 11% of service providers (W1: 6%). Cybersecurity as a safety concern rose from 8% to 11% among seafarers between waves.

Public concern about maritime decarbonization remains high, and shipping is viewed as a significant GHG contributor.

73% of civil society respondents rated the importance of maritime decarbonization for the East Mediterranean marine environment as high or very high (W1: 78%), and 78% were very or extremely concerned about local environmental impacts (W1: 87%). 41% reported no awareness of any GHG reduction initiatives in maritime transport, and 35% were uncertain which alternative fuel holds the most promise. For shipping, 55% rated its GHG contribution very or extremely significant. This rating does not estimate the sector's emissions share. For context, the maritime share of global CO₂ emissions is approximately 3%.

Port decarbonization readiness remains at an early stage.

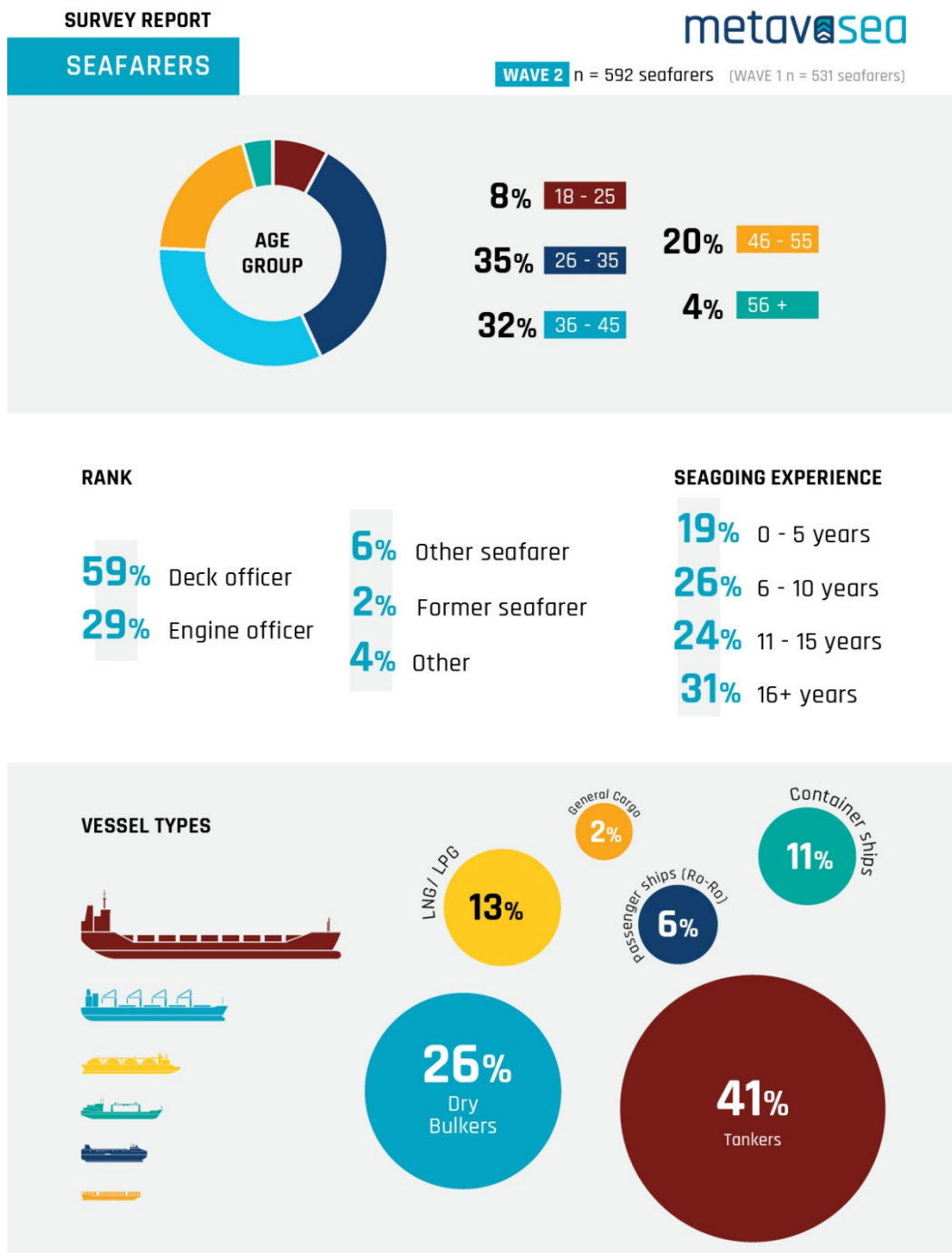
Wave 2 received a single response from a port administration (Port of Tripoli, Lebanon). Port findings in Part A.III are presented on the basis of the combined W1 and W2 sample (n=11). Across that combined sample, 73% of ports did not report low-carbon fuel infrastructure in place, 45% have no ship emissions monitoring capability, and 36% report no planned decarbonization interventions.

Part A: Stakeholder Insights (Wave 2)

Part A presents the W2 findings by stakeholder group in the following order: seafarers, shipping companies, port administrations, service providers and suppliers, and civil society and port cities. Each section presents the Wave 2 findings as the primary reference and refers to W1 only where a change or continuity between waves is relevant.

Part A.I: Insights from Seafarers

Wave 2 of the seafarers' questionnaire generated 592 valid responses, compared with 531 in W1. The demographic structure remains broadly consistent, supporting comparability, while the operational profile is more diversified. The sample is concentrated in the 26-35 and 36-45 age groups, which together represent roughly two-thirds of respondents. The education profile remains consistent, with bachelor's degree holders forming the largest group, followed by Master's degree holders. The sample is 97% male, broadly consistent with W1.



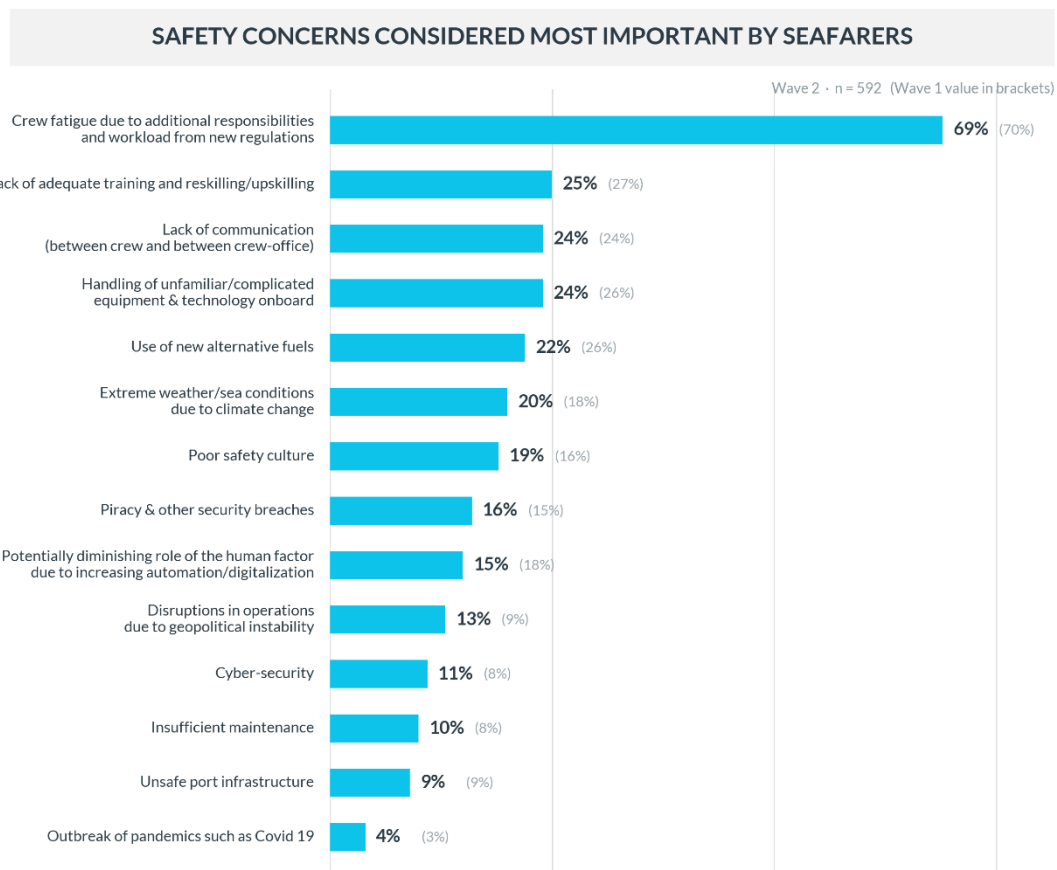
In terms of rank, the distribution remains stable, with deck officers at 59% and engine officers at 29%. Seagoing experience is well distributed: the largest group has 16 or more years of experience at 31% (W1: 27%), followed by 6-10 years at 26%, 11-15 years at 24% and 0-5 years at 19% (W1: 25%).

The most significant compositional change compared with W1 is in vessel type. Tanker representation fell from 68% to 41%, while dry bulk rose from 16% to 26%, LNG/LPG from 5% to 13%, container ships from 4% to 11%, and passenger and Ro-Ro vessels from 3% to 6%. W2 is therefore more operationally diverse than W1, with direct implications for findings on fuel familiarity, safety concerns and training priorities.

Key Findings

Key Finding 1. Crew fatigue remains the most-cited seafarer safety concern.

Crew fatigue due to additional responsibilities and workload from new regulations is the leading safety concern in W2, at 69% of 592 respondents, essentially unchanged from W1 (70%). It is rated more than twice as high as the next-ranked concern.

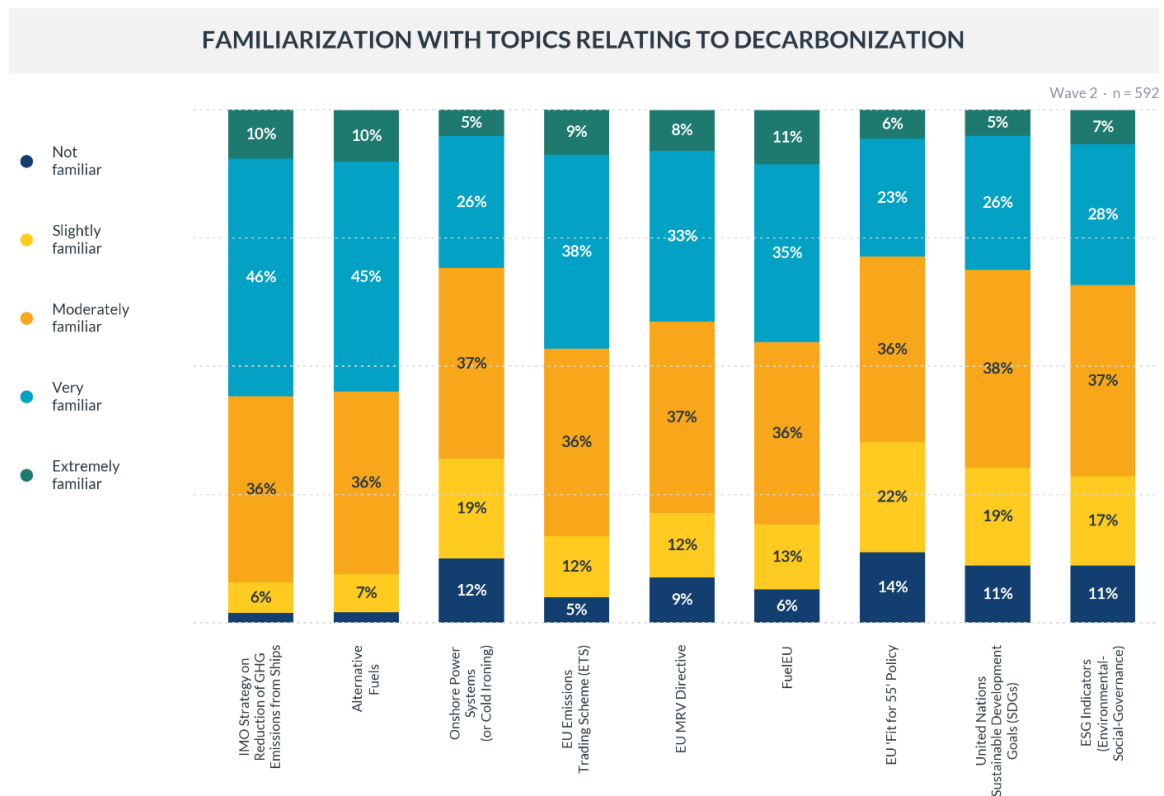


Other top five concerns are more or less stable between waves: lack of adequate training at 25%, lack of communication (between crew and between crew-office) and handling of unfamiliar/complicated equipment & technology onboard both at 24%, and use of new alternative fuels at 22%.

Beyond the top five, extreme weather conditions stand at 20%, poor safety culture stands at 19%, piracy at 16%, disruptions to operations due to geopolitical instability has risen between waves from 9% to 13% and cybersecurity rose from 8% in W1 to 11% in W2.

Key Finding 2. Familiarity with maritime decarbonization topics rose across all topics measured.

Familiarity with maritime decarbonization topics increased across every topic measured in W2 compared with W1. In W2, the IMO GHG Strategy leads at 56% very or extremely familiar, followed by alternative fuels at 55%, EU ETS at 47%, FuelEU at 45%, EU MRV at 41%, ESG indicators at 34%, UN SDGs at 31%, OPS and cold ironing at 31% and EU Fit for 55 at 29%.



The sharpest increases compared with W1 are in EU regulatory instruments, which recorded the lowest familiarity in W1:

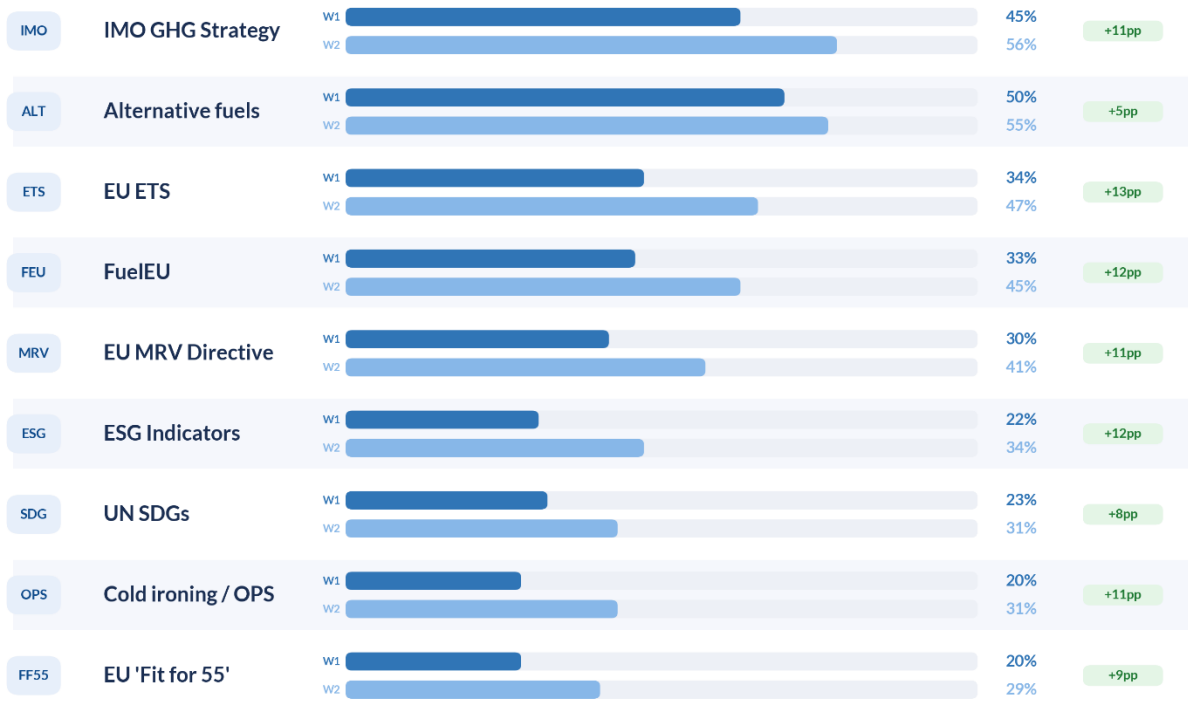
- EU ETS: from 34% to 47%
- FuelEU: from 33% to 45%
- EU MRV: from 30% to 41%
- ESG indicators: from 22% to 34%
- OPS and cold ironing: from 20% to 31%
- UN SDGs: from 23% to 31%
- EU Fit for 55: from 20% to 29%
- Alternative fuels: from 50% to 55%
- IMO GHG Strategy: from 45% to 56%



Familiarity with decarbonization & regulatory topics

% "very" or "extremely" familiar • Seafarers • Wave 1 n=531 | Wave 2 n=592

Wave 1 (n=531) Wave 2 (n=592)

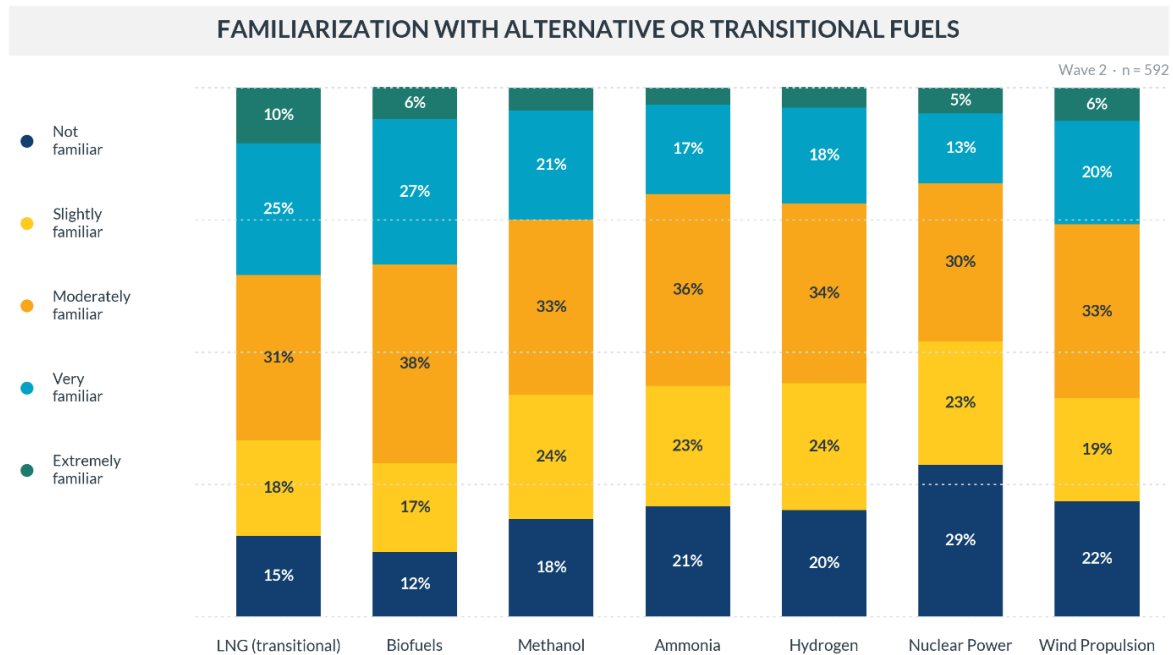


Key takeaway: Familiarity rose on every topic between waves, led by EU ETS (+13pp), FuelEU (+12pp), ESG Indicators (+12pp) and EU MRV (+11pp). The IMO GHG Strategy crossed the 50% majority threshold in Wave 2 for the first time (45% to 56%). EU 'Fit for 55' and Cold ironing / OPS remain the least familiar topics and are priority areas for targeted training.

Source: METAVASEA – HELMEPA Seafarers Survey • Wave 1 n=531 | Wave 2 n=592

W1 data were collected between June and November 2024, prior to the adoption of the IMO Net-Zero Framework at MEPC 83 in April 2025. W2 data were collected from December 2024 onwards, with a significant portion of respondents completing the survey in the period surrounding or following this regulatory development.

For alternative fuel familiarity, the W2 picture is more varied. LNG leads at 36%, followed by biofuels at 33%, wind propulsion at 26% (no change compared with Wave 1), methanol at 25%, hydrogen at 22%, ammonia at 20% and nuclear at 18%. Familiarity improved primarily for fuels with established commercial presence: LNG, biofuels and methanol.



On company strategy awareness, 45% of W2 seafarers describe themselves as well or completely informed about their company's decarbonization strategy (W1: 40%), while 46% are moderately informed and 9% not informed at all (W1: 14%). 55% of W2 seafarers remain at moderate or no awareness of their company's decarbonization strategy.

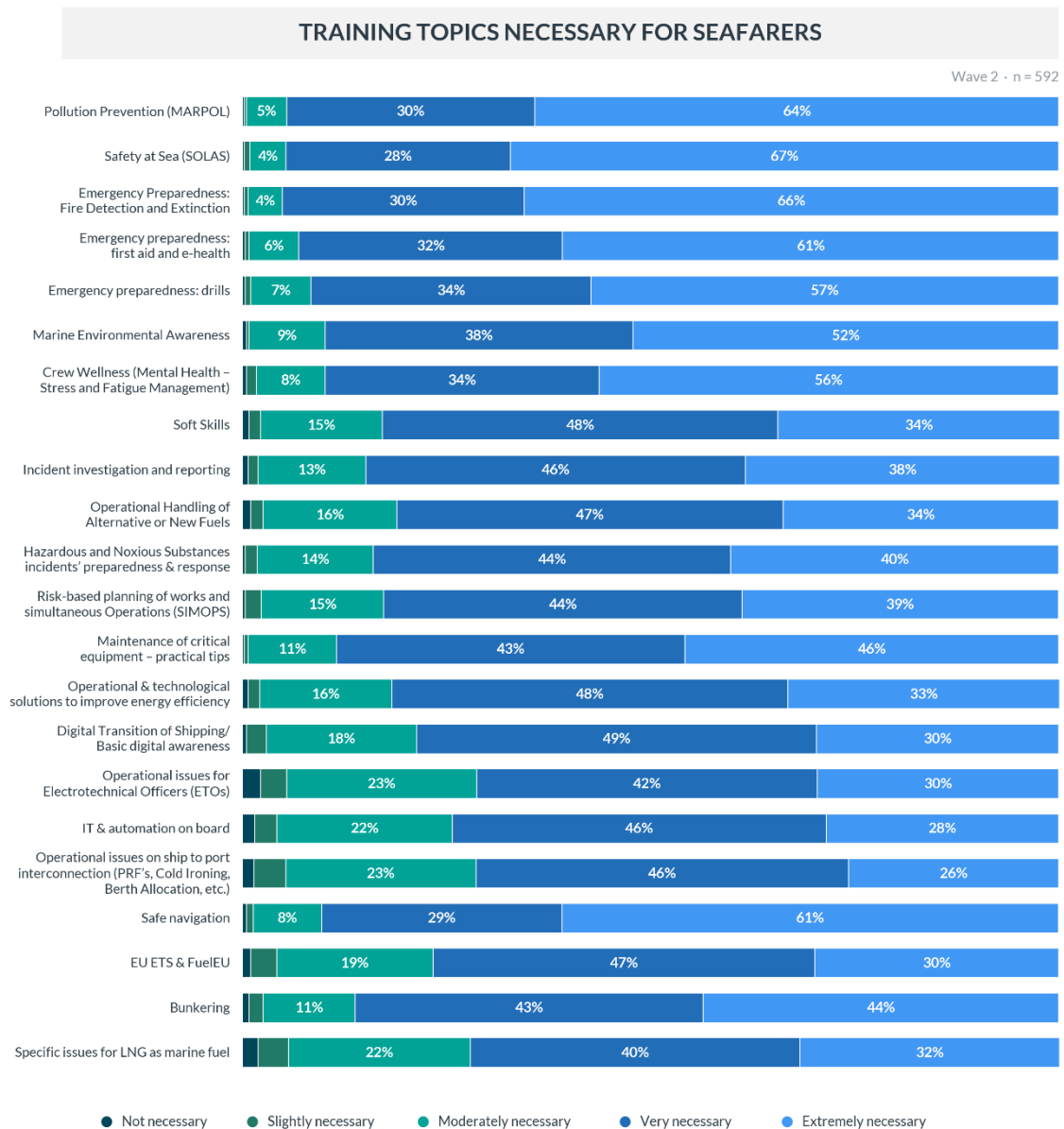
Key Finding 3. Safety-led topics remain the top-rated training necessities; a second tier of applied and regulatory topics rose between waves.

Safety, emergency preparedness and environmental protection dominate W2 training priorities, essentially unchanged from W1. SOLAS, fire detection and extinction, and MARPOL each lead at 95%, followed by first aid and e-health at 93%, emergency drills at 92%, crew wellness and marine environmental awareness each at 90%, safe navigation at 90%, maintenance of critical equipment at 89% bunkering at 86%, and HNS preparedness at 84%.

A second tier of applied and regulatory topics rose more noticeably between waves:

- Incident investigation and reporting: from 78% to 85%
- Bunkering: from 81% to 86%
- Energy efficiency operations: from 75% to 82%
- Digital transition / basic digital awareness: from 73% to 79%
- EU ETS and FuelEU: from 73% to 77%
- Port interconnection: from 67% to 72%

This second tier, currently rated very or extremely necessary by 72% to 86% of respondents, is approaching the perceived necessity levels of established safety topics.



Key Finding 4. Seafarer decarbonization training participation rose between waves, but the majority still report no such training.

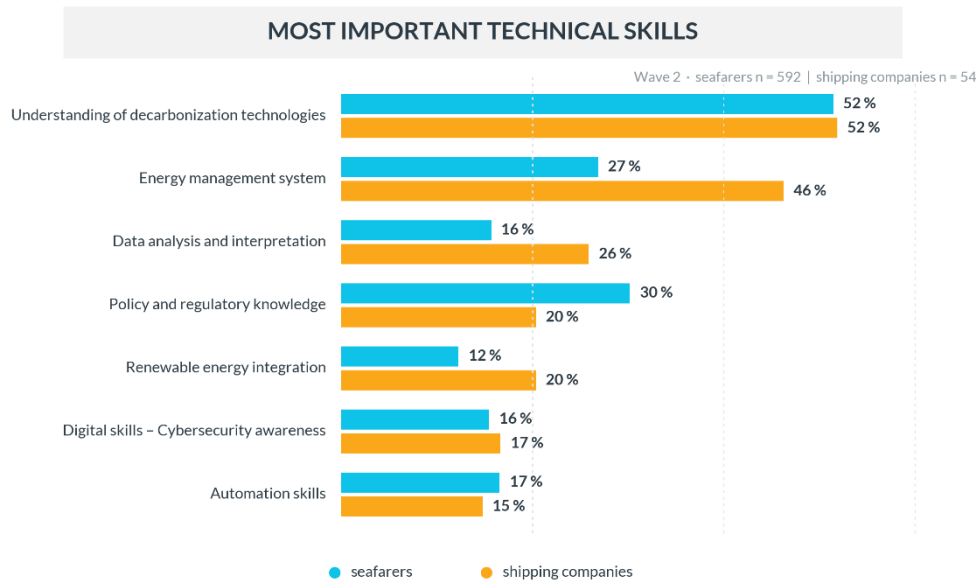
In W2, 45% of seafarers received decarbonization-related training in the past two years, up from 36% in W1. Those reporting no such training declined from 64% to 55%.

Of those who received training, 63% did so through in-house provision (W1: 61%) and 37% through external training centres (W1: 39%). Satisfaction among those trained rose from 56% very or extremely satisfied in W1 to 65% in W2.

Training content in W2 is concentrated in alternative fuels at 66%, EU ETS at 36%, MRV at 25% and FuelEU at 24%. Coverage of OPS and cold ironing (7%), ESG (5%), Fit for 55 (3%) and UN SDGs (3%) remains limited, with no notable shifts compared with W1.

Key Finding 5. Companies and seafarers align on core skills but diverge on resilience and adaptability.

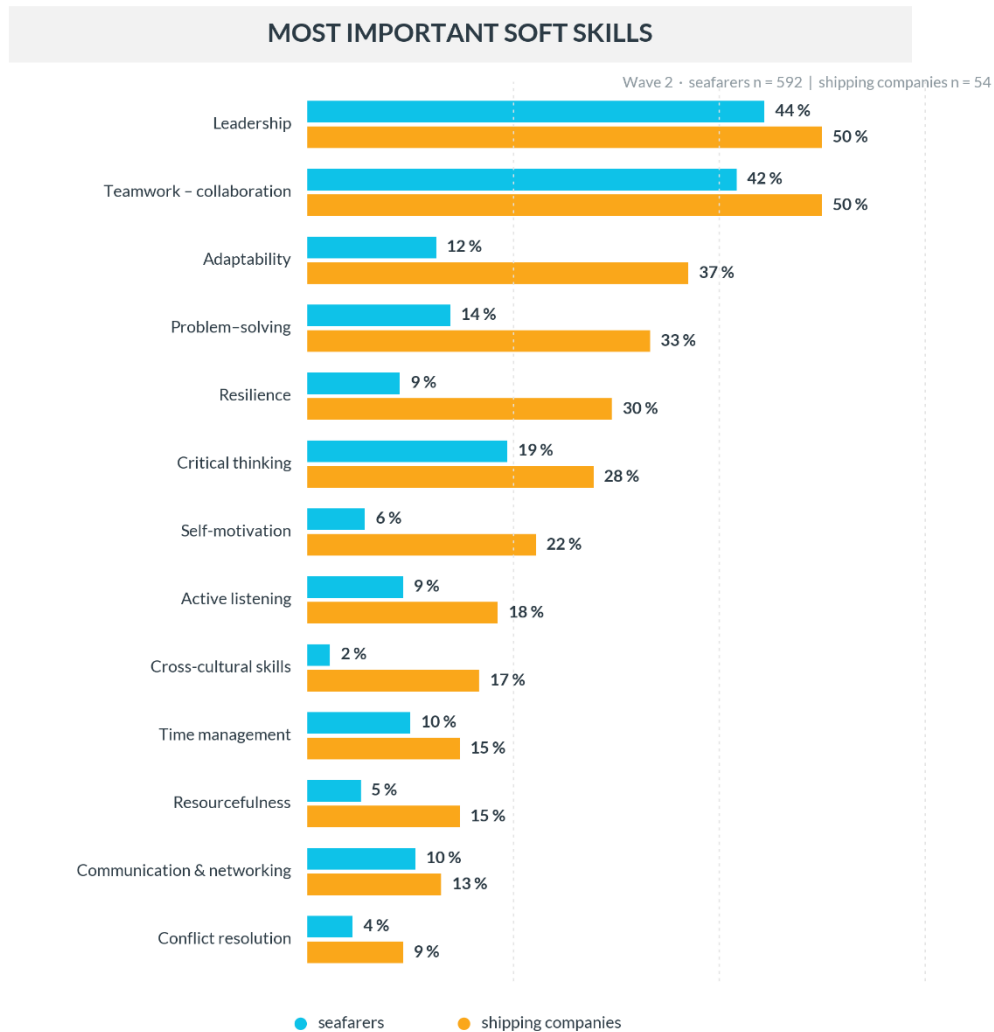
W2 data show both alignment and divergence between shipping companies and seafarers on skills priorities for the decarbonization transition.



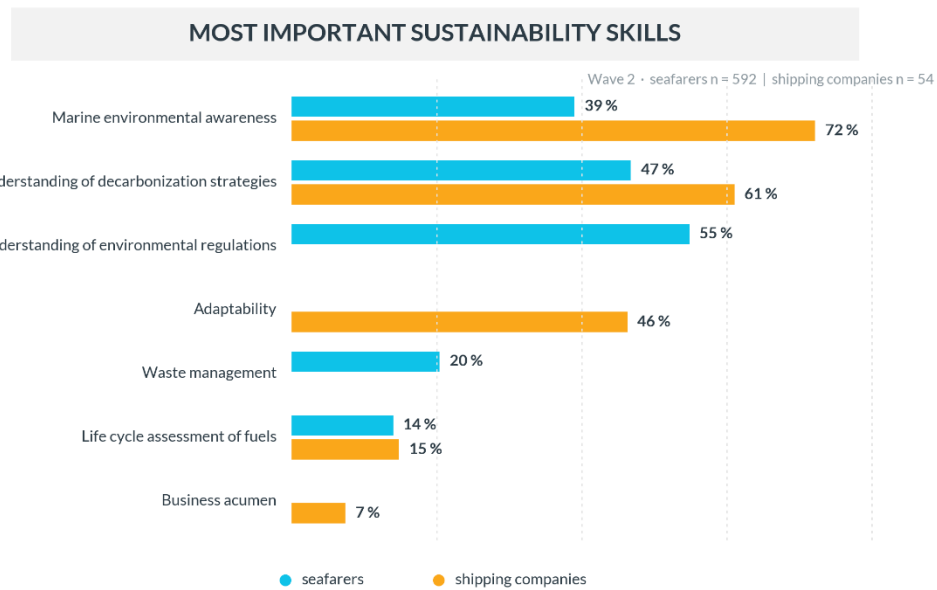
Both groups place understanding of decarbonization technologies at the top of the technical skills hierarchy, at 52% in W2, and both reduced their prioritization of this skill between waves, companies by 12% and seafarers by 6%. Convergence is also present on risk assessment (companies 50%, seafarers 55%) and on planning and prioritization (companies 68%, seafarers 67%). Digital and cybersecurity skills show comparable low bases across both groups, at 17% for companies and 16% for seafarers. On equipment safety, companies rose from 30% to 44% between waves while seafarers declined from 38% to 33%.



Divergence between waves is most pronounced on soft and adaptive competencies. Companies increased their prioritization of leadership from 40% to 50%, teamwork from 36% to 50%, resilience from 18% to 30% and adaptability from 27% to 37%. Seafarers' priorities on these skills moved differently: leadership held at 44%, teamwork declined from 44% to 42%, resilience declined from 15% to 9% and adaptability held at 12%. Among soft skills, the widest W2 gaps are on adaptability (companies 37%, seafarers 12%) and resilience (companies 30%, seafarers 9%).



The widest single divergence anywhere in the skills data is on marine environmental awareness: whereas shipping companies' representatives prioritize it at 72%, seafarers place a much lower priority at 39%. This is a 33pp gap, wider than adaptability or resilience.



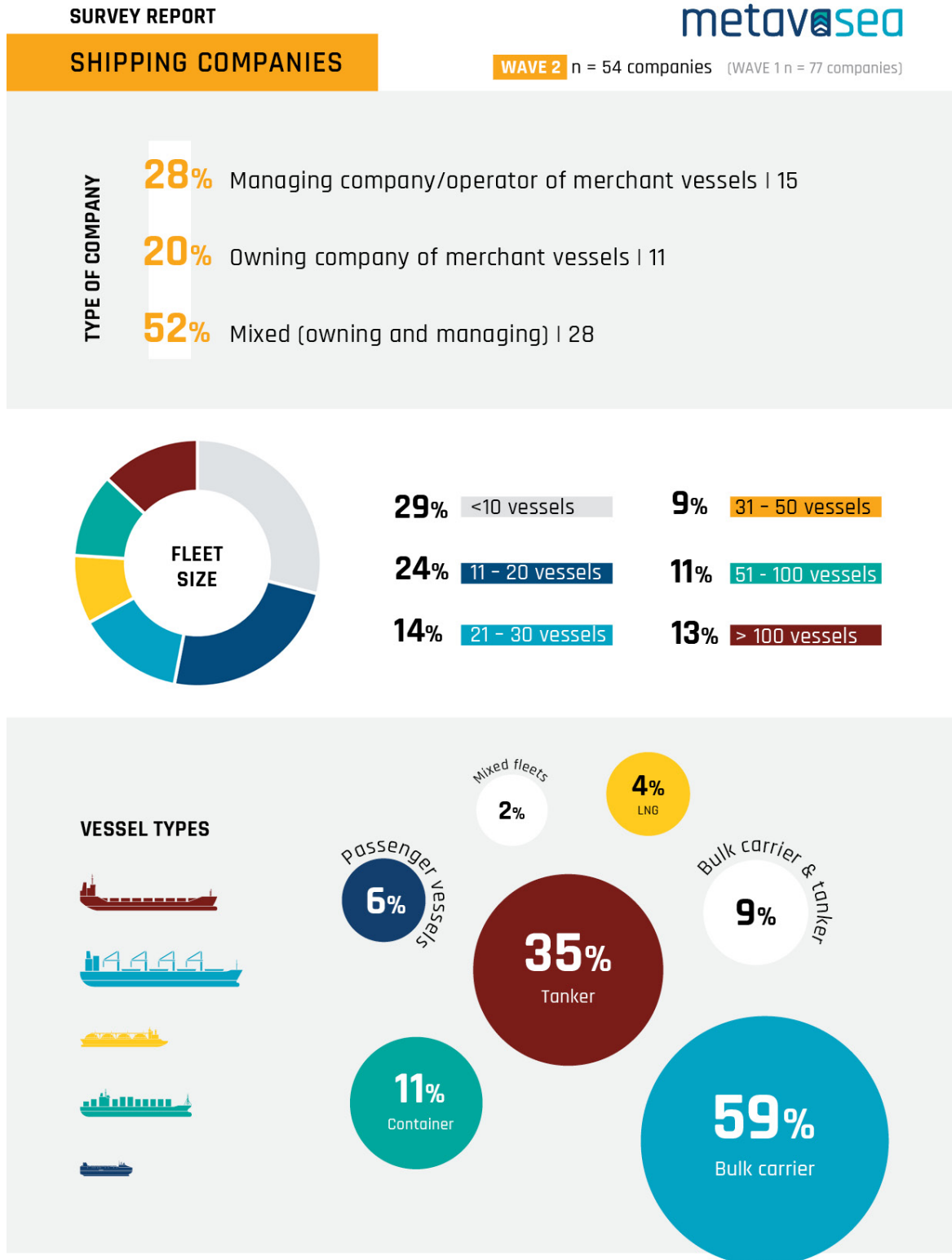
Key Finding 6. Digital training necessity rose between waves; cybersecurity is emerging as a seafarer safety concern.

Cybersecurity as a safety concern rose from 8% in W1 to 11% in W2. The concern that increasing digitalization diminishes the human role onboard declined from 18% in W1 to 15% in W2.

In training, digital transition and basic digital awareness is rated very or extremely necessary by 79% of W2 seafarers (W1: 73%), overtaking IT and automation onboard at 74% (W1:75%). Both companies and seafarers independently increased their prioritization of digital skills between waves by 5 and 6 percentage points, respectively.

Part A.II: Insights from Shipping Companies

W2 of the shipping companies questionnaire received 54 valid responses, compared with 77 in W1.



The W2 sample is dominated by small and medium-sized operators, with companies managing 30 vessels or fewer accounting for 67% of respondents. Mixed owning and managing companies represent 52% of the W2 sample, managing companies 28% and owning companies 20%. Bulk carriers are the most common vessel type at 59%, followed by tankers at 35%.

Compared with W1, two compositional shifts are relevant to the interpretation of subsequent findings. Representation of mixed-owning and managing companies rose from 32% to 52%, while managing companies fell from 47% to 28%. LNG carrier operators declined from 13% to 4% and container vessel operators from 22% to 11%. These shifts are particularly relevant for findings on fuel strategy, technology adoption and operational measures, where fleet type significantly influences response patterns.

Key Findings

Key Finding 1. Strategic alignment is improving, but implementation gaps are widening.

In W2, 22% of shipping company representatives reported a net-zero strategy aligned with the IMO Strategy, while 9% reported a more ambitious strategy. A further 15% plan to develop an IMO-aligned strategy within the next year and 6% plan a more ambitious one. On intermediate targets, 20% reported goals aligned with the IMO Strategy and 4% more ambitious intermediate goals.

Taken together, 76% of respondents reported an existing strategy, plans to develop one, or defined intermediate goals. The remaining 24% comprised 13% with no net-zero strategy and 11% where discussions remain at a preliminary internal stage.

Compared with W1, the share reporting a confirmed IMO-aligned net-zero strategy increased from 14% to 22% and the share reporting a more ambitious strategy rose from 5% to 9%. At the same time, the proportion reporting no strategy increased from 9% to 13%.

On regional legislation and regulations on shipping emissions, 41% of respondents consider them necessary to accelerate decarbonization (W1: 53%), 41% view them as adding complexity and cost (W1: 31%), and 18% are uncertain (W1: 16%).

Key Finding 2. Emissions management remains focused mainly on Scope 1.

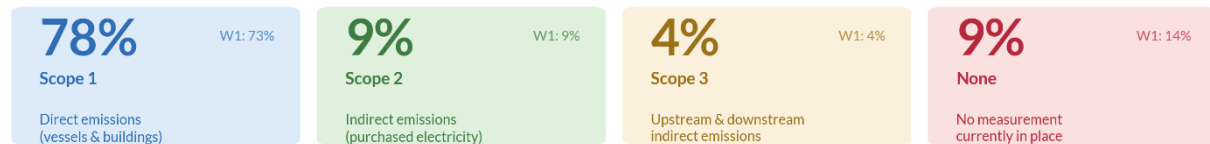
78% of W2 shipping company representatives reported measuring Scope 1 emissions (W1: 73%). Scope 2 monitoring remains at 9% and Scope 3 at 4%. 9% report no emissions measurement under any scope (W1: 14%).

Third-party verification of emissions data is used by 61% of W2 respondents (W1: 66%), while “I don't know” rose from 21% to 28%.

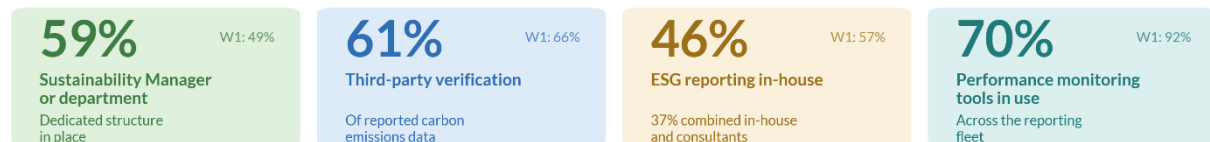
Emissions measurement & sustainability governance

Shipping Companies · Wave 2 · n=54 (Wave 1: n=77) · Eastern Mediterranean

Emissions measurement by scope



Sustainability governance & assurance



Scope 3 tracking (where measured): business travel, purchased goods, transportation & distribution · Multiple scopes may be reported by the same company.

Source: METAVASEA – HELMEPA Shipping Companies Survey · Wave 1 n=77 | Wave 2 n=54

Key Finding 3: Sustainability governance is becoming more formalized.

59% of W2 companies report a dedicated Sustainability Manager or department (W1: 49%). A further 19% manage sustainability through individuals focused on specific aspects (W1: 31%), and 22% have no dedicated structure (W1: 19%).

On ESG reporting, in-house strategy and reporting is the most common approach at 46% (W1: 57%), while hybrid internal-external approaches rose from 30% to 37%.

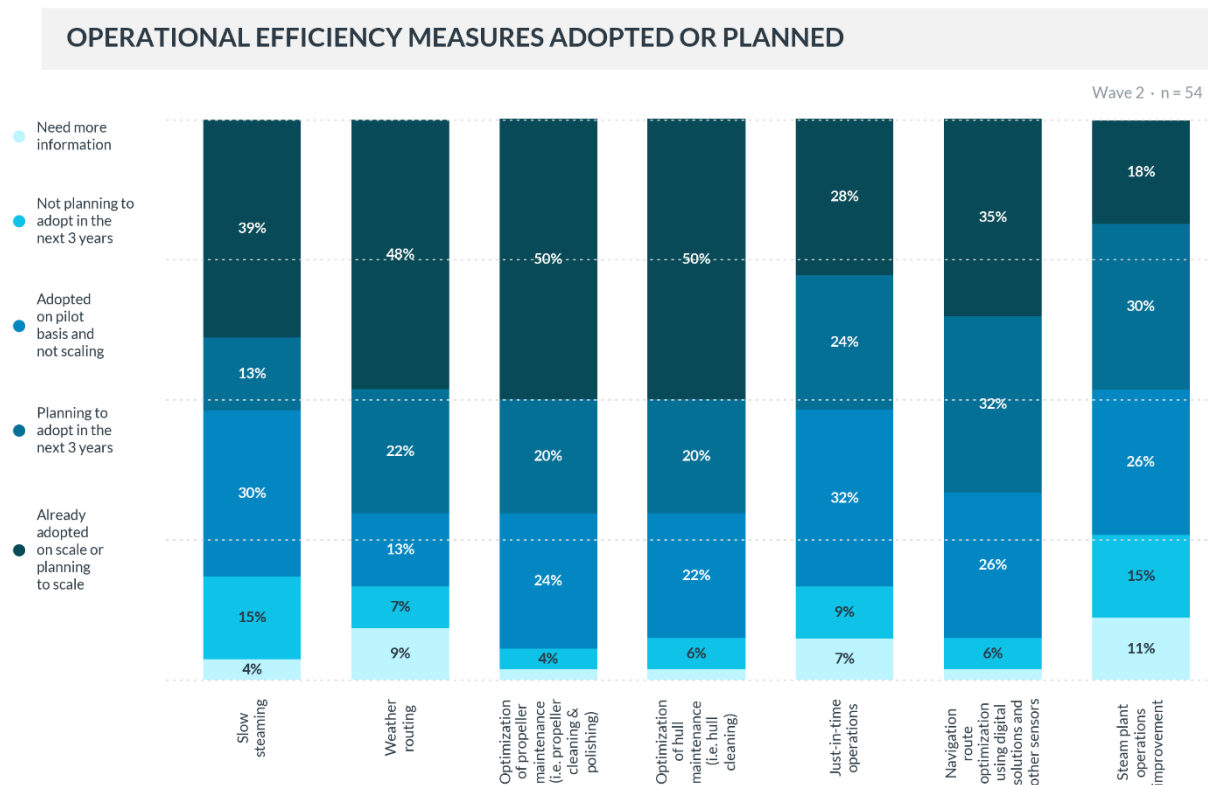
Performance monitoring tool use stands at 70% in W2 (W1: 92%). The decline reflects sample composition change, with W2 containing proportionally fewer large operators with comprehensive monitoring infrastructure.

Key Finding 4: Operational efficiency remains the dominant decarbonization path.

In W2, hull maintenance optimization and propeller maintenance are the most widely adopted or planned-to-scale operational measures, each at 50%, followed by weather routing at 48%, slow steaming at 39%, navigation route optimization at 35% and just-in-time operations at 28%.

Compared with W1, hull and propeller maintenance both declined from 66% and 64% respectively to 50%, navigation route optimization fell from 46% to 35%, weather routing from 53% to 48%, just-in-time operations from 35% to 28% and steam plant operations improvement from 22% to 18%. Slow steaming remained essentially stable. These declines reflect the sample composition shift in W2, with proportionally fewer large operators who were early adopters of these measures.

Across the combined W1 and W2 dataset, hull maintenance optimization leads at 60%, followed by propeller maintenance at 58%, weather routing at 51%, navigation route optimization at 41%, slow steaming at 38% and just-in-time operations at 32%.



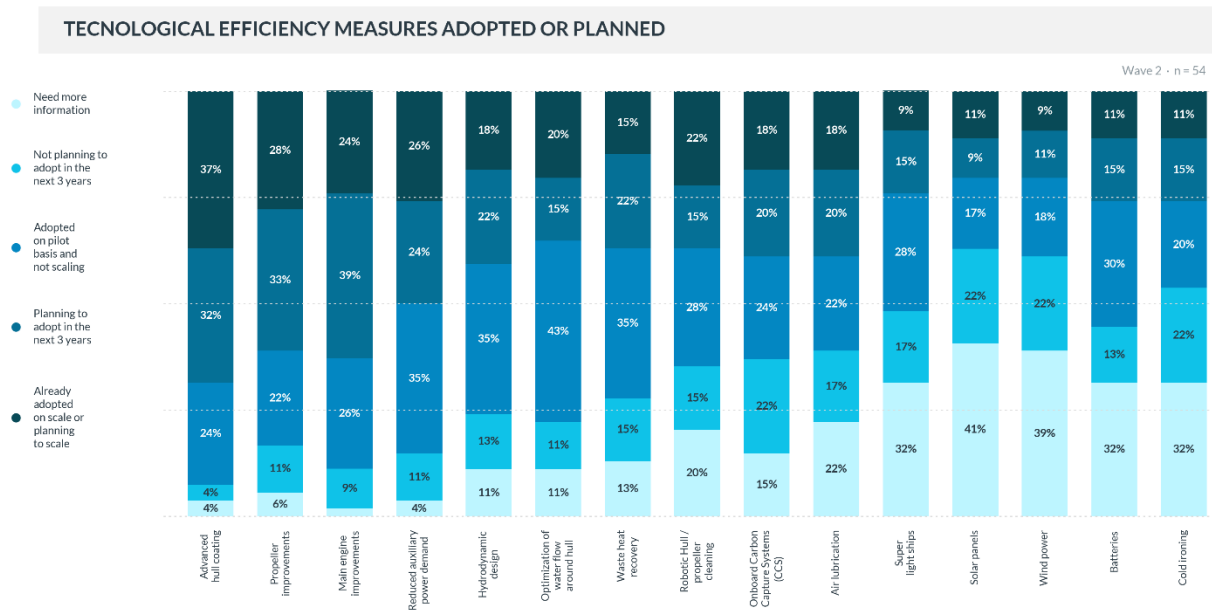
Key Finding 5. Advanced technologies remain limited, but emerging options show growth.

Advanced hull coating is the most widely adopted technological measure at 37%, followed by propeller improvements at 28%, reduced auxiliary power demand at 26% and main engine improvements at 24%.

Compared with W1, a cluster of these previously marginal technologies recorded notable increases:

- Onboard Carbon Capture Systems: from 7% to 18%
- Air lubrication: from 8% to 18%
- Robotic hull/propeller cleaning: from 16% to 22%
- Waste heat recovery: from 8% to 15%
- Batteries: from 0% to 11%
- Solar panels: from 1% to 11%
- Cold ironing: from 4% to 11%
- Hydrodynamic design: from 14% to 18%
- Water-flow optimization: from 14% to 20%

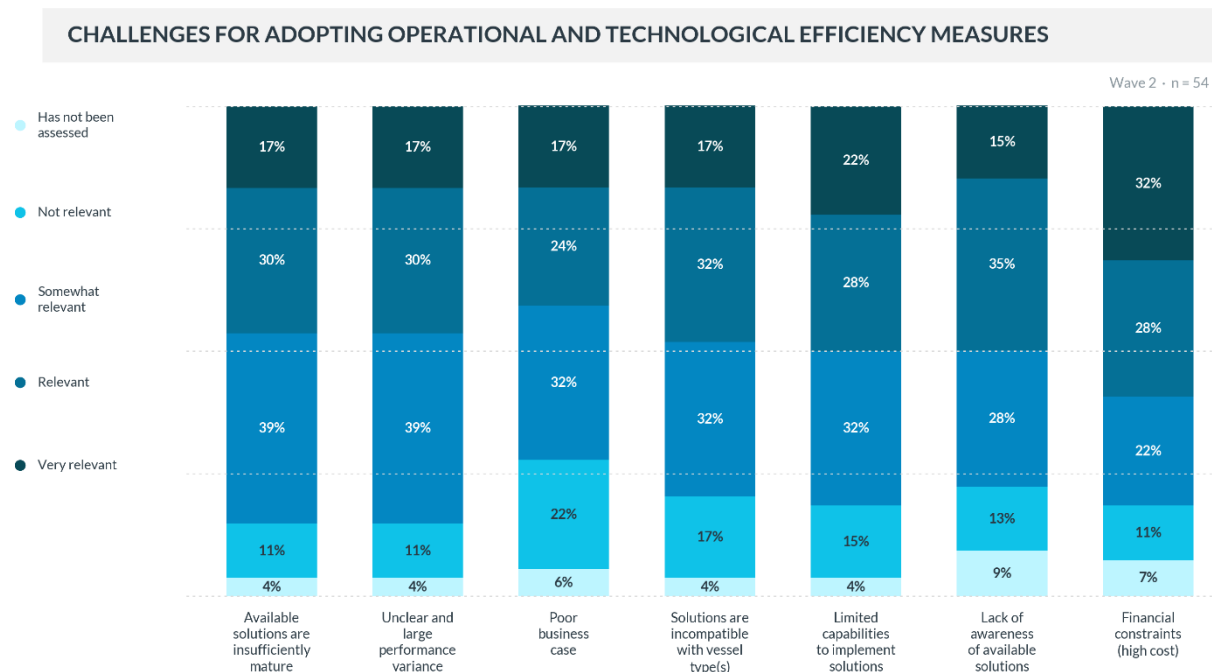
These increases are present irrespective of the sample composition shift in W2.



Across the combined W1 and W2 dataset, advanced hull coating remains the most widely adopted technological measure at 41%, followed by propeller improvements at 29% and reduced auxiliary power demand and main engine improvements each at 26%.

Key Finding 6. Financial constraints, limited implementation capabilities and lack of awareness recorded the sharpest increases between waves.

In W2, the most cited barriers to adopting decarbonization solutions are financial constraints at 59%, limited implementation capabilities at 50%, vessel incompatibility at 48%, and technology immaturity and performance variance each at 46%.

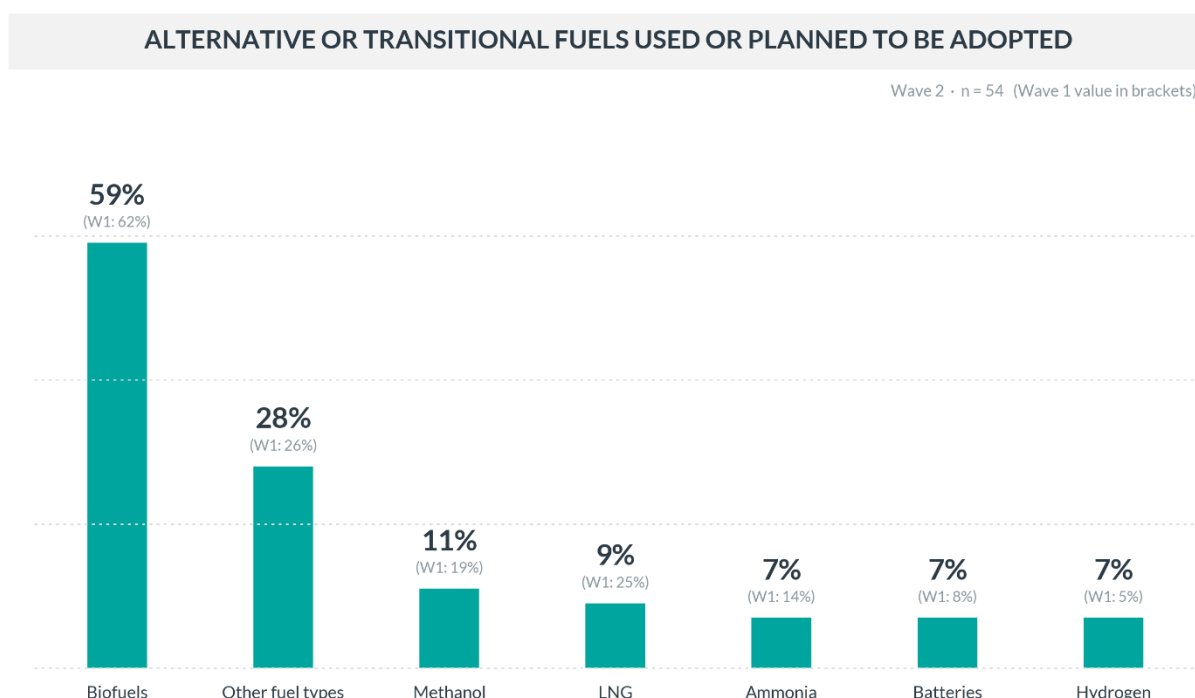


Compared with W1, three barriers reached or rose above 50% of respondents for the first time: financial constraints (from 46% to 59%), limited implementation capabilities (from 29% to 50%) and lack of awareness of available solutions (from 27% to 50%). Other increases include vessel incompatibility (from 40% to 48%) and poor business case (from 33% to 41%). Technology immaturity remained broadly stable between waves.

Across the combined W1 and W2 dataset, the most cited barriers are financial constraints at 51%, technology immaturity at 48%, performance variance at 46%, vessel incompatibility at 44% and limited implementation capabilities at 37%.

Key Finding 7. Biofuels remain the leading transitional fuel.

In W2, biofuels are the most commonly used or planned alternative fuel at 59%, followed by other fuel types at 28%, methanol at 11%, LNG at 9%, and ammonia, hydrogen and batteries at 7%.



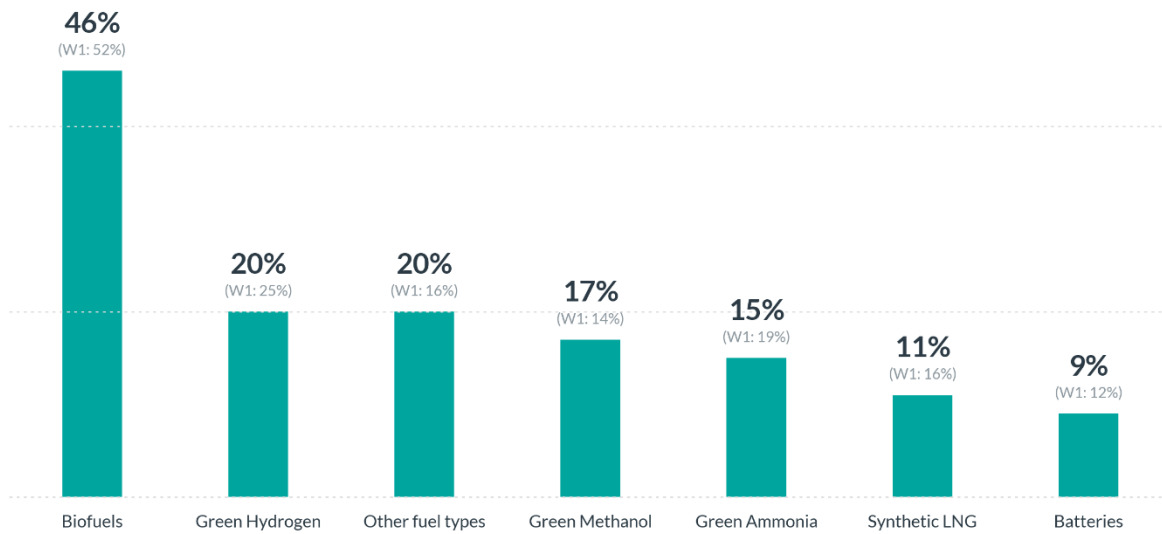
On long-term potential, biofuels lead at 46%, followed by green hydrogen and other fuel types at 20%, green methanol at 17% and green ammonia at 15%.

Compared with W1, LNG fell from 25% to 9%, methanol from 19% to 11% and ammonia from 14% to 7%. The decline in LNG partly reflects the reduced share of LNG carrier operators in the W2 sample. Biofuels remained stable as the leading choice.

Across the combined W1 and W2 dataset, biofuels remain the most used or planned alternative fuel at 61%, followed by other fuel types at 27%, LNG at 18%, methanol at 16%, ammonia at 12% and hydrogen at 6%. On long-term potential, biofuels lead at 50%, followed by green hydrogen at 23%, green ammonia at 18%, green methanol at 15%, synthetic LNG at 14% and batteries at 11%.

BEST LONG-TERM ALTERNATIVE TO FOSSIL FUELS

Wave 2 · n = 54 (Wave 1 value in brackets)



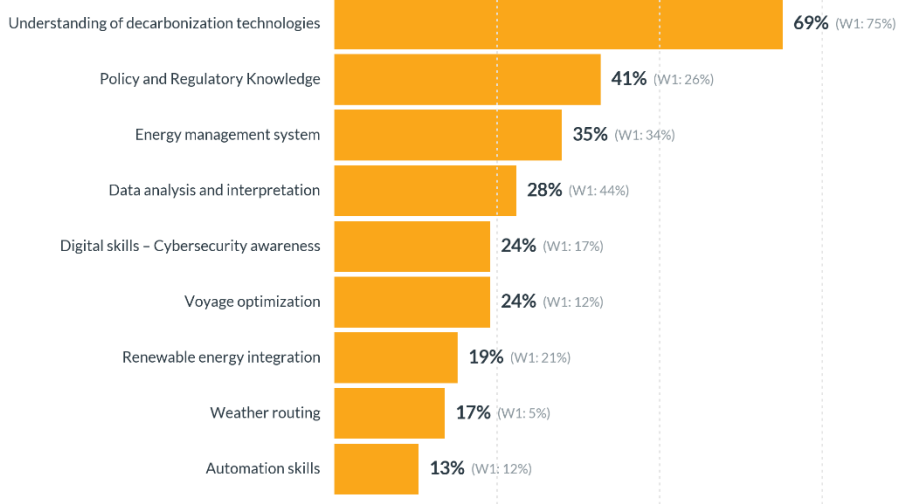
On port-side decarbonization measures, shipping company respondents ranked cold ironing and onshore power supply first at 33%, followed by renewable energy sourcing and storage at 19%, alternative fuel bunkering infrastructure at 17% and other solutions at 15%. Cold ironing also ranked first in W1.

Key Finding 8. Office staff skill priorities shifted toward operational, regulatory and adaptive competencies.

Technical skills. Understanding of decarbonization technologies remains the top priority at 69% (W1: 75%). Policy and regulatory knowledge rose from 26% to 41%. Voyage optimization rose from 12% to 24% and weather routing from 5% to 17%. Data analysis declined from 44% to 28%.

MOST IMPORTANT TECHNICAL SKILLS FOR OFFICE PERSONNEL TO SUPPORT DECARBONIZATION

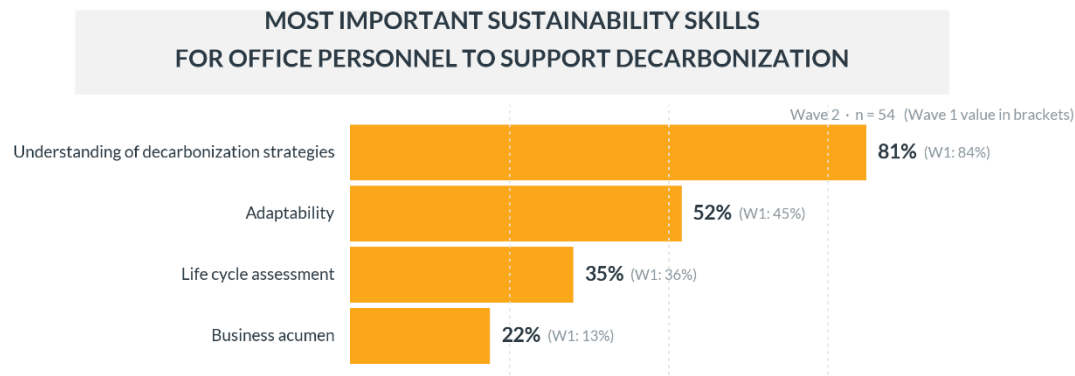
Wave 2 · n = 54 (Wave 1 value in brackets)



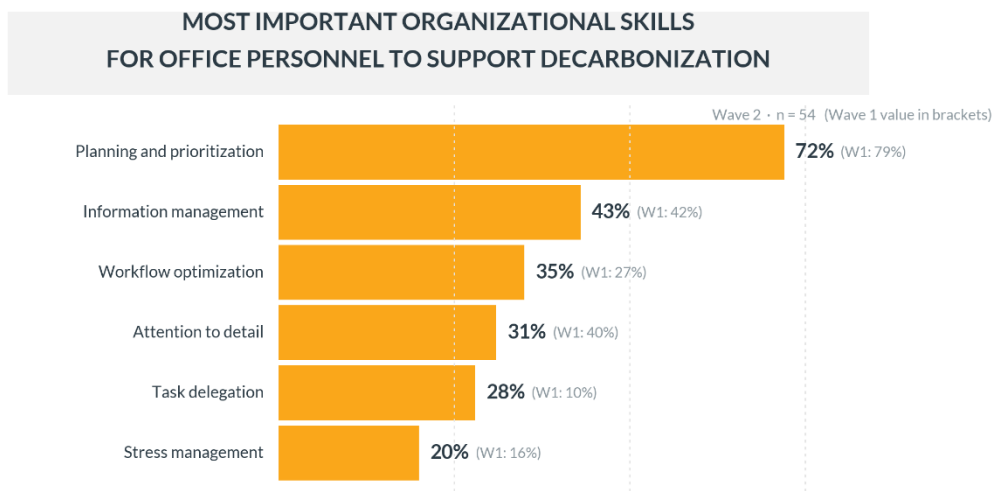
Safety skills. Risk assessment and management remains the leading safety skill at 61% (W1: 69%). Equipment safety and maintenance rose from 23% to 39%, alternative fuel handling from 35% to 37% and health and safety compliance from 45% to 48%.



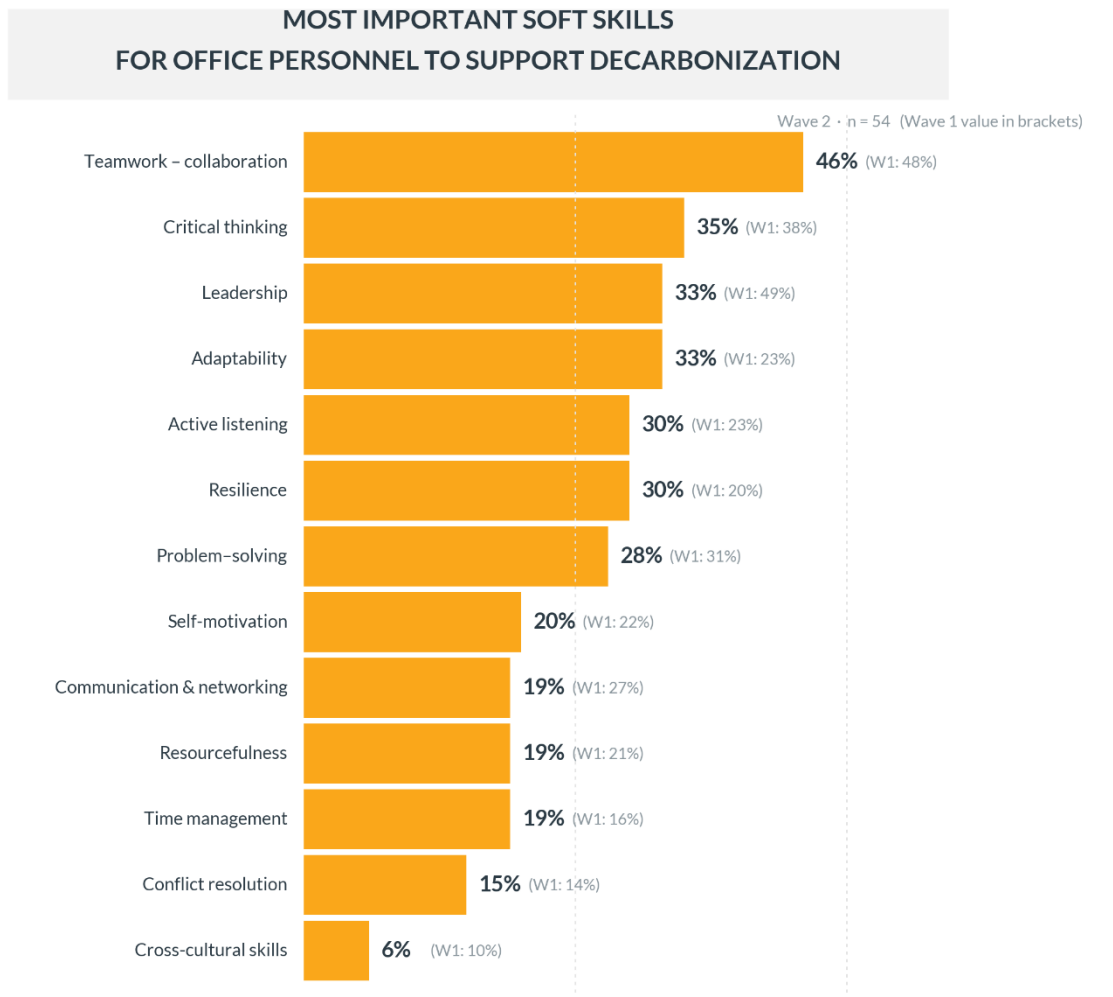
Sustainability skills. Understanding of decarbonization strategies remains dominant at 81% (W1: 84%). Business acumen rose from 13% to 22%.



Organizational skills. Planning and prioritization remain the top priority at 72% (W1: 79%). Task delegation rose from 10% to 28% and workflow optimization from 27% to 35%.



Soft skills. Teamwork remains the leading soft skill at 46% (W1: 48%). Leadership declined from 49% to 33%. Resilience rose from 20% to 30% and adaptability from 23% to 33%.



Key Finding 9. Digitalization is operationally embedded but not yet strategic

Performance monitoring tools are in use at 70% of W2 companies (W1: 92%; the decline reflects sample composition change as noted in Key Finding 3). Navigation route optimization is adopted or being scaled at 35% (W1: 46%). IT and automation onboard is rated very or extremely necessary by 72% of company respondents (W1: 73%). Digital transition as a training priority stands at 76% (W1: 69%).

Digital and cybersecurity skills as a core seafarer competency are prioritised by 17% of shipping company respondents (W1: 12%).

Part A.III: Insights from Port Administrators

Note: Wave 2 received a single response from a port administration (n=1). Findings reported for ports in Wave 2 in isolation are directional only. The findings below are presented on the basis of the combined Wave 1 and Wave 2 dataset of 11 ports.

The combined sample includes the 10 W1 respondents, predominantly publicly owned and located in Greece, with one port from the Southern Mediterranean (La Goulette, Tunisia), and the single W2 response from the Port of Tripoli, Lebanon. Participating ports range from major commercial hubs such as Thessaloniki and Heraklion to smaller island and coastal ports including Mykonos, Thira (Santorini), Rafina and Antikyra. Approximately 73% of respondents are publicly owned ports.

PORTS

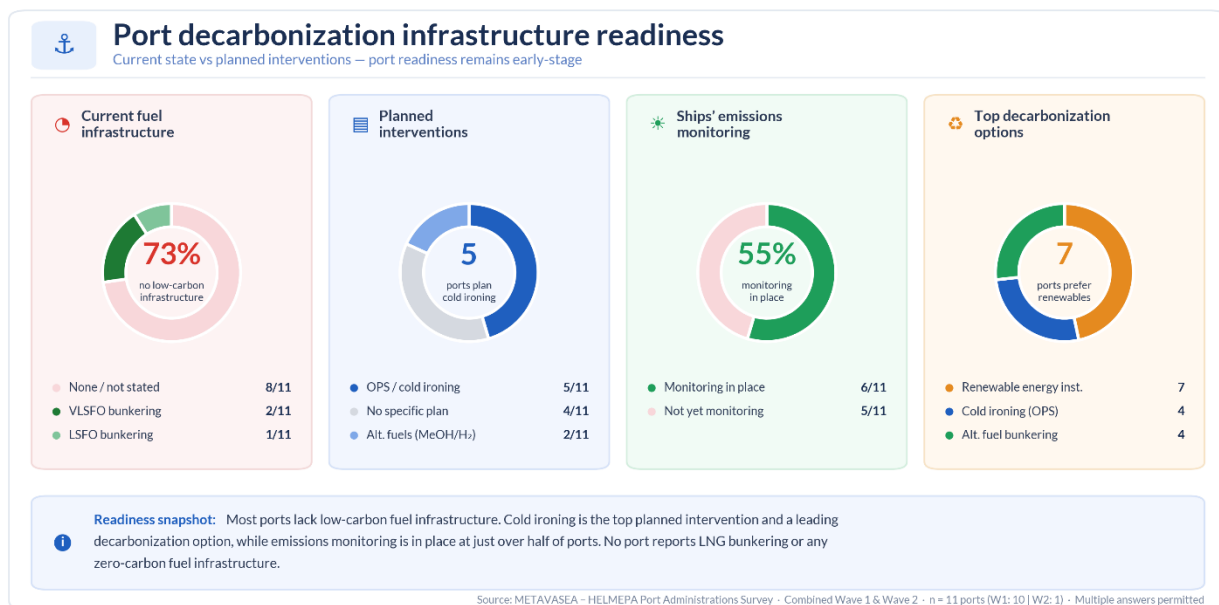


Key Findings

Key Finding 1. Port decarbonization readiness remains at an early stage.

Across the combined sample of 11 ports, 73% did not report low-carbon fuel infrastructure in place. VLSFO bunkering is available at 18% of ports and LSFO at 9%, covering 27% of the sample. No port reports LNG bunkering or any zero-carbon fuel infrastructure.

On planned interventions, 45% of ports plan to install OPS or cold ironing systems and 18% are planning some form of alternative fuel infrastructure. 36% report no planned interventions of any kind.



Key Finding 2: Environmental management systems are in place, but emissions monitoring is a consistent gap.

Environmental management frameworks are present across most participating ports. ISO 14001 is the most widely adopted standard at 64% of the combined sample, ISO 9001 at 64%, other green port certifications at 27% and EMAS at 9%. Additional certifications cited include the Green Award Incentive Provider scheme, ISO 14064-1:2018 for greenhouse gas verification and the Port Environmental Review System.

Ship emissions monitoring is in place at 55% of the combined sample; 45% have no monitoring capability in operation. Among those not yet monitoring, reasons cited include being in an adaptation phase and procuring a suitable system. The Port of Thessaloniki reported active ship emissions monitoring as one of the few participating ports to do so.

Key Finding 3: Infrastructure priorities are clear, but implementation remains uneven.

Across the combined sample, renewable energy installation is the most widely selected decarbonization priority at 64%, followed by cold ironing and alternative fuel bunkering stations each at 36%. This ranking is consistent across port sizes and ownership types.

OPS is the most common planned intervention at 45%, and 18% are planning some form of alternative fuel infrastructure. 36% of the combined sample report no planned interventions of any kind.

Key Finding 4. Port worker skill priorities span technical, safety and soft competencies.

Across the combined dataset, understanding decarbonization technologies is the top technical priority at 91%, followed by energy management systems and renewable energy integration each at 27%, and data analysis and interpretation at 18%. On sustainability skills, understanding decarbonization strategies was selected by 91% of respondents and marine environmental awareness by 82%. Safety skills are led by risk assessment and management at 64% and hazardous material handling at 45%; health and safety regulation compliance stands at 27%. Organizational skills are led by planning and prioritization at 45%, followed by a three-way tie between attention to detail, workflow optimization and information management each at 36%. Soft skills are led by teamwork and collaboration at 64% and critical thinking at 45%. These priorities are consistent across port sizes and ownership types in the combined sample.



Key Finding 5: Port participation remains low and is a methodological priority for Wave 3.

The combined sample of 11 ports represents a limited share of port administrations operating across the Eastern Mediterranean. W2 received a single port response, accounting for 9% of the combined sample.

Planned adjustments for Wave 3 include a shorter and more targeted questionnaire, structured interviews or hybrid data collection formats, and direct coordination with port associations such as the Hellenic Ports Association and equivalent bodies in partner countries. Geographic coverage will be extended to include ports in Cyprus, Egypt and other Eastern Mediterranean countries.

Part A.IV: Insights from Service Providers and Suppliers

W2 of the service providers and suppliers questionnaire received 28 valid responses, compared with 36 in W1. The most represented categories in W2 were vessel supplies (36%), machinery and equipment (32%), training providers (32%), digital services (29%) and port agencies and crewing services (25% each).



Compared with W1, where crewing services (36%), training providers (33%) and class societies (28%) dominated, the W2 sample includes a higher proportion of equipment, digital and port-related services. This compositional shift is relevant to the interpretation of subsequent findings.

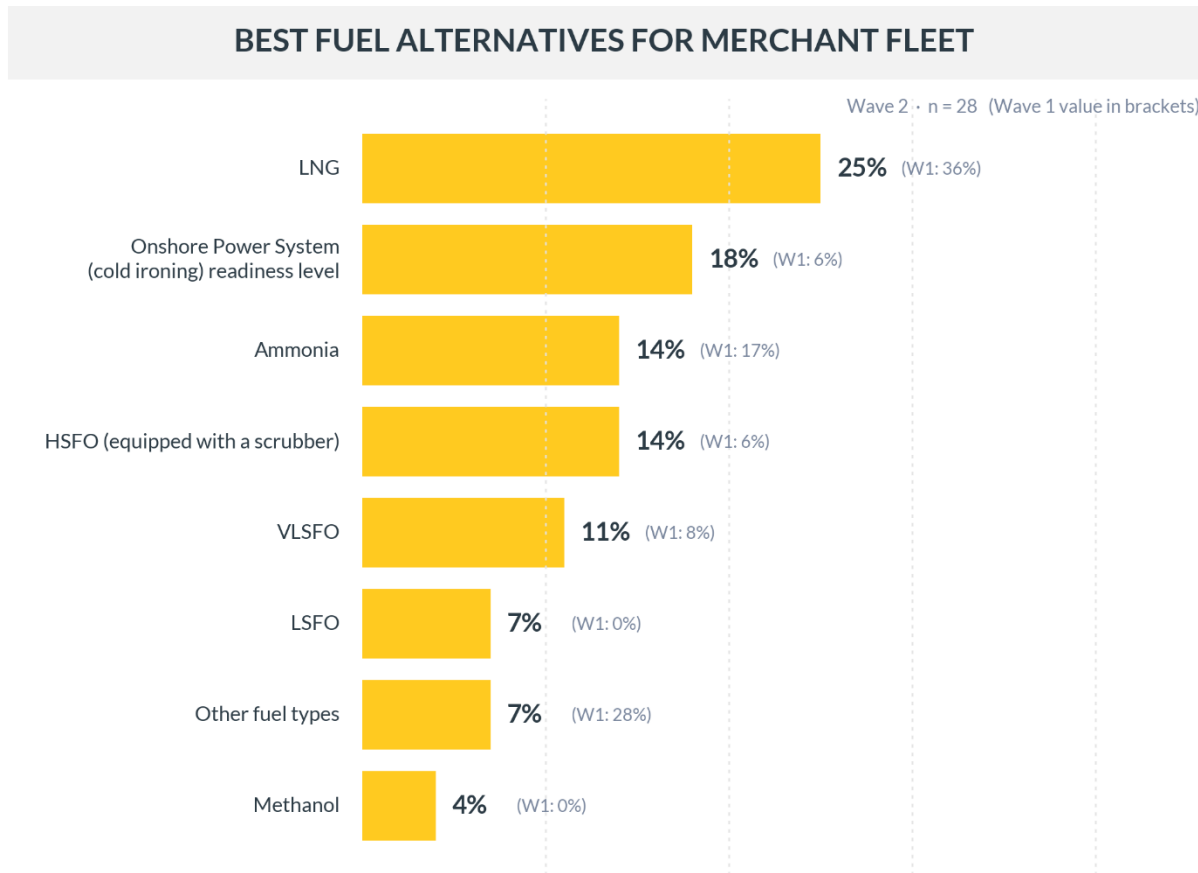
Key Findings

Key Finding 1. Environmental management is stable but not strengthening.

54% of W2 service providers and suppliers have an Environmental Management System in place (W1: 56%). 46% have no EMS in place (W1: 44%).

Key Finding 2. Fuel preferences are becoming fragmented.

In W2, LNG is the most commonly identified effective fuel for decarbonizing shipping at 25%, followed by onshore power and cold ironing readiness at 18%, ammonia and HSFO with scrubber at 14%, VLSFO at 11%, LSFO and other fuel types at 7% and methanol at 4%.



Compared with W1, the main movements are LNG declining from 36% to 25%, other fuel types declining from 28% to 7%, onshore power and cold ironing rising from 6% to 18% and HSFO with scrubber rising from 6% to 14%.

Key Finding 3. Renewable energy leads port infrastructure priorities.

In W2, service providers and suppliers identified renewable energy sources as the most effective port infrastructure solution at 57% (W1: 47%), followed by cold ironing and alternative fuel bunkering each at 21%.

Key Finding 4. Training provision remains widespread.

68% of W2 service providers and suppliers offer decarbonization-related training (W1: 78%). Of those providing training, sustainability in shipping and ESG were each referenced in 47% of cases, followed by alternative fuels and EU ETS each at 42%.

Key Finding 5. Skill priorities for seafarers shifted between waves, as assessed by service providers and suppliers.

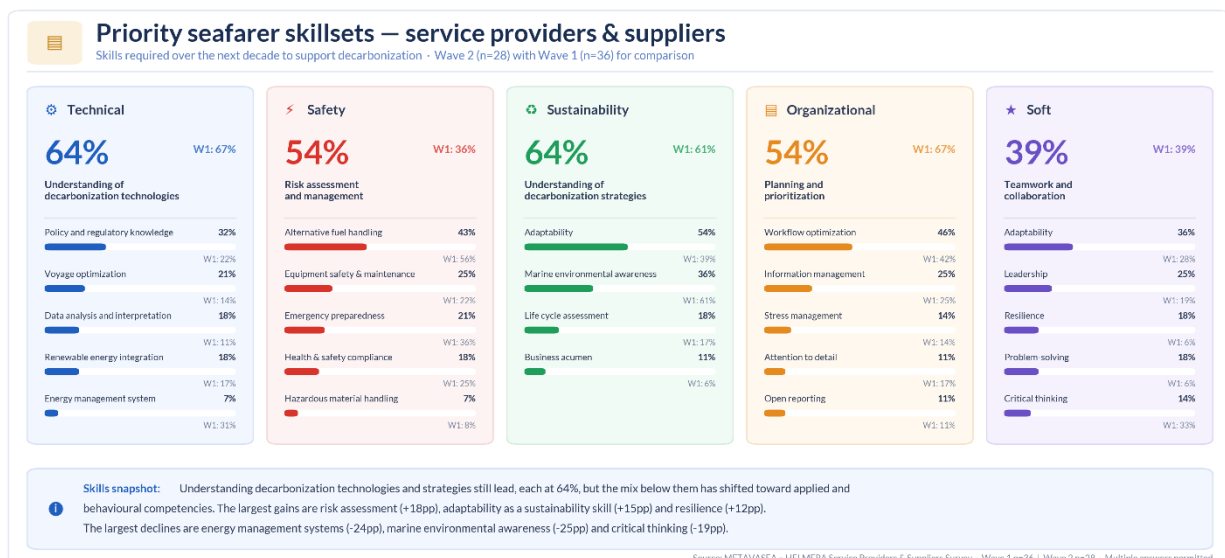
Technical skills: Understanding decarbonization technologies remains the top priority at 64% (W1: 67%). Policy and regulatory knowledge rose from 22% to 32%. Energy management systems collapsed from 31% to 7% and is the lowest technical skill displayed in the chart.

Safety skills: Risk assessment and management rose to 54% (W1: 36%). Alternative fuel handling declined from 56% to 43% and emergency preparedness from 36% to 21%.

Sustainability skills: Understanding decarbonization strategies stands at 64% (W1: 61%). Marine environmental awareness declined from 61% to 36%, the single largest movement in the whole skills dataset.

Organizational skills: Planning and prioritization stands at 54% (W1: 67%). Workflow optimization rose from 42% to 46%. Information management remained at 25%.

Soft skills: Adaptability rose from 28% to 36%. Leadership stands at 25% (W1: 19%). Teamwork and collaboration remained stable at 39%. Critical thinking declined from 33% to 14%.

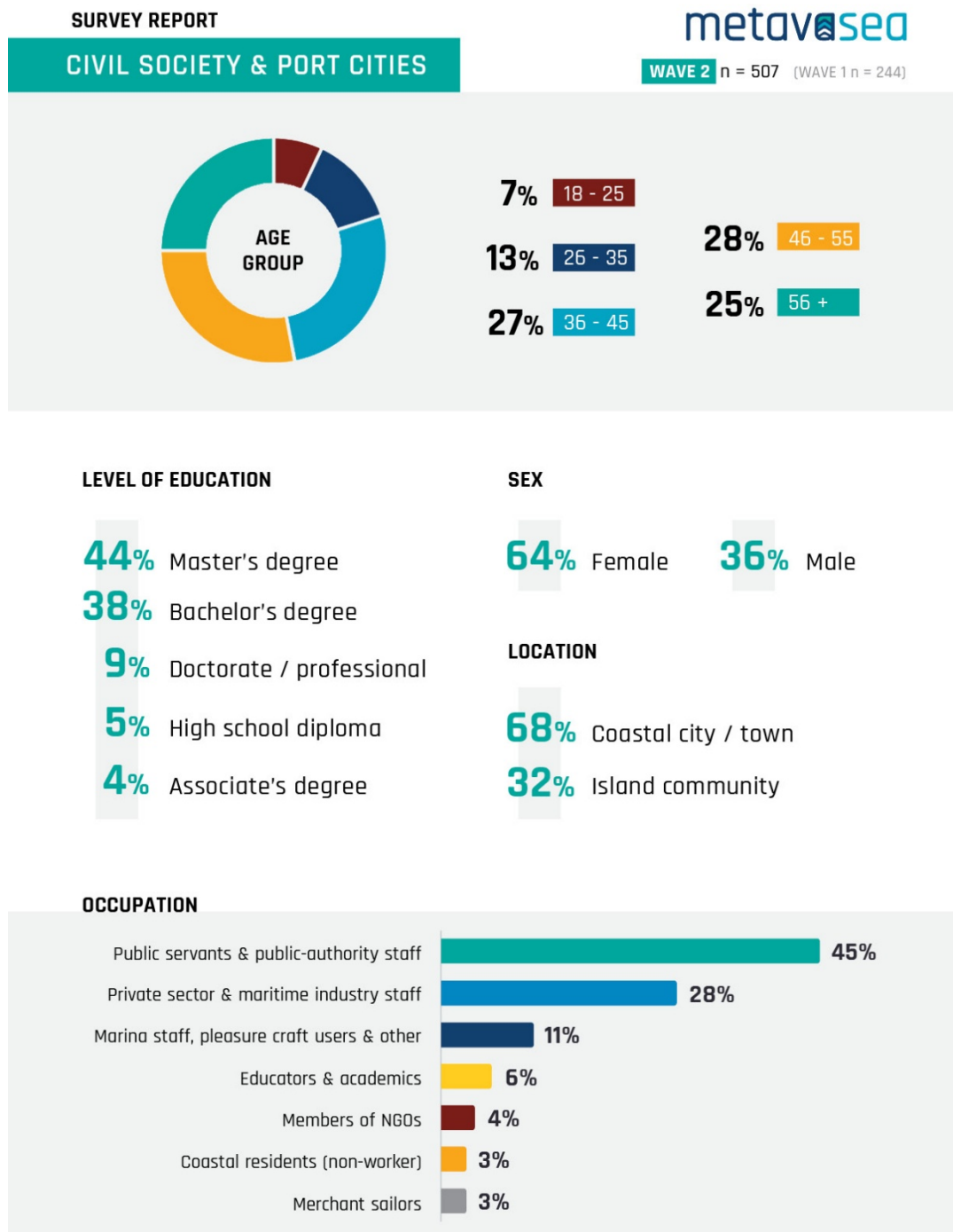


Key Finding 6. Digitalization is embedded but under-recognized as a skill priority.

29% of W2 respondents represent digital service providers. Digital and cybersecurity skills are identified as a key seafarer competency by 11% of respondents (W1: 6%). Data analysis stands at 18% and policy and regulatory knowledge at 32% as skill priorities. Voyage optimization stands at 21%.

Part A.V: Insights from Civil Society and Port Cities

The W2 civil society and port cities survey covers 507 respondents, compared with 244 in W1. The sample spans coastal residents, civil servants, NGO members, maritime professionals, marina workers and pleasure craft users across the Eastern Mediterranean. 64% of respondents are female and 36% male. Age distribution is concentrated in the 46 to 55 cohort at 28%, followed by 36 to 45 years at 27%, 56 years or older at 25%, 26 to 35 years at 13% and 18 to 25 years at 7%, up from 3% in W1. 44% hold a master's degree and 38% have a bachelor's degree.



Most respondents are public servants (45%), followed by private sector and maritime industry staff (28%), while NGO members have dropped from 23% to 4%, with coastal residents, maritime professionals and marina administrators making up smaller shares. 68% reside in coastal cities or towns and 32% in island communities, rising from 22% in W1.

The W2 sample is larger and more diverse than W1, which should be considered when comparing findings between waves.

Key Findings

Key Finding 1. Public concern about climate change remains high.

65% of W2 respondents are very or extremely familiar with global warming (W1: 71%), 65% with its causes and impacts (W1: 69%), and 78% are very or extremely concerned about local environmental impacts (W1: 87%).

The most significant impacts of global warming on coastal and marine ecosystems identified by W2 respondents are increased frequency of extreme weather events at 79% (W1: 81%), unbearable living conditions at 73% (W1: 80%), loss of biodiversity at 65% (W1: 75%) and wildfires at 64% (W1: 61%). Economic impact on agriculture declined from 59% to 48% and economic impact on tourism from 37% to 26%.

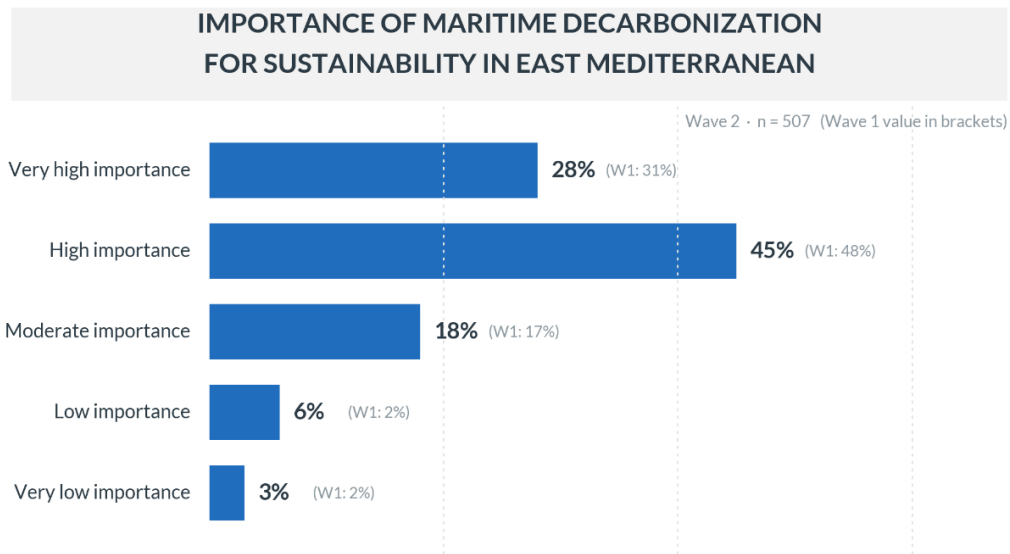
Key Finding 2: Shipping's GHG contribution is widely regarded as significant.

Most listed sectors are rated very or extremely significant GHG contributors by a majority of W2 respondents; agriculture is below 50%. Aviation leads at 68% (W1: 77%), followed by land transportation at 64% (W1: 74%), manufacturing at 63% (W1: 67%), shipping at 55% (W1: 60%), tourism at 54% (W1: 53%) and agriculture at 42% (W1: 54%). Shipping's actual share of global anthropogenic CO₂ emissions is less than 3%, according to the IMO Fourth GHG Study (2020).

Awareness of initiatives aimed at reducing GHG emissions in maritime transport stands at 59% in W2 (W1: 64%), with 41% reporting no such awareness.

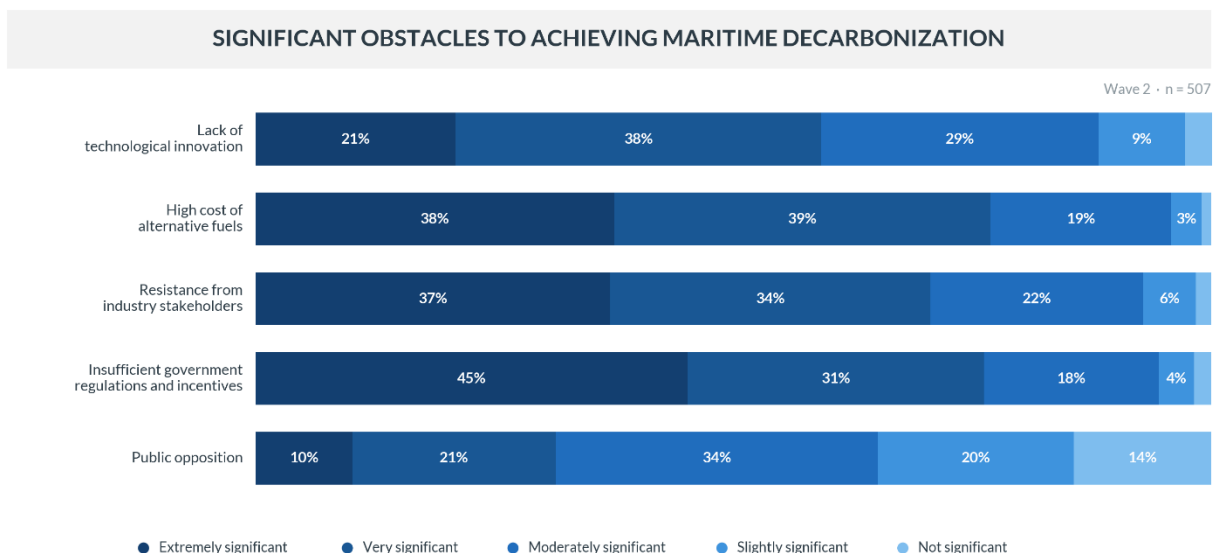
Key Finding 3. Support for maritime decarbonization remains positive but declined between waves.

73% of W2 respondents rate the importance of maritime decarbonization for the East Mediterranean marine environment as high or very high (high importance: 45%, very high: 28%), compared with 78% in W1. Moderate importance stands at 18%, low at 6% and very low at 3%. The share rating importance as low or very low rose from 5% in W1 to 9% in W2.



Key Finding 4. High fuel cost, insufficient regulation, and industry resistance remain the top-rated barriers.

In W2, high cost of alternative fuels is the leading perceived barrier at 77% very or extremely significant (W1: 76%), followed by insufficient government regulation and incentives at 76% (W1: 85%), industry resistance at 71% (W1: 82%), lack of technological innovation at 59% and public opposition at 31%.

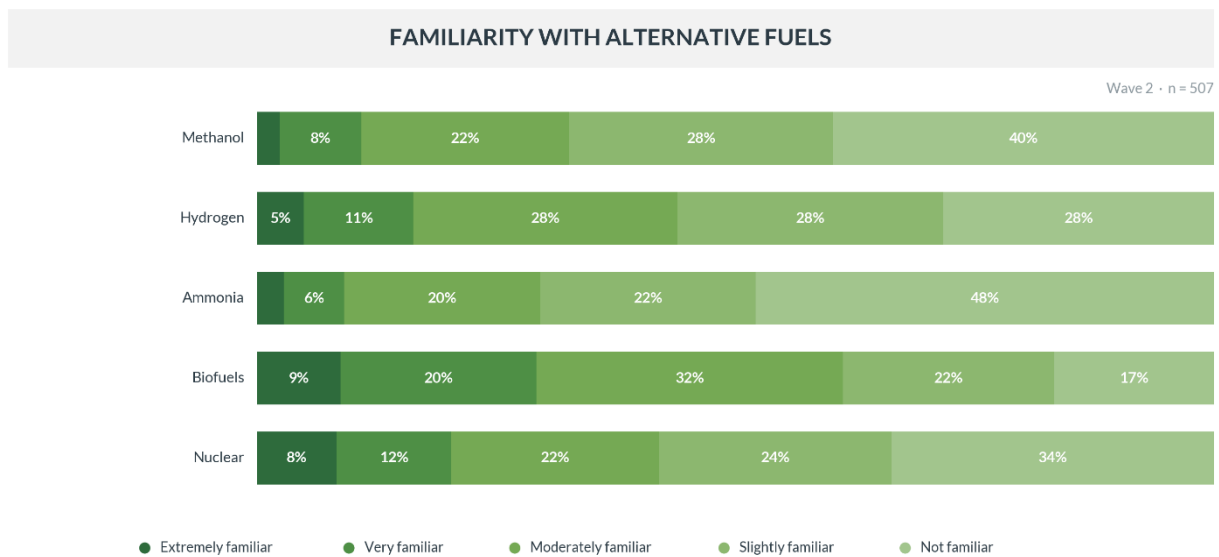


The main movements between waves are insufficient government regulation and incentives declining from 85% to 76% and industry resistance from 82% to 71%.

Key Finding 5: Alternative and transitional fuel knowledge remains uneven.

Biofuels are the most familiar alternative fuel among civil society respondents, with 61% moderately to extremely familiar (W1: 57%), followed by LNG at 53% (W1: 59%), hydrogen at 44% (W1: 45%), nuclear at 42% (W1: 41%), methanol at 33% (W1: 33%) and ammonia at 30% (W1: 28%).

On the most promising future fuel, 'not sure' leads at 35% (W1: 38%), followed by hydrogen at 20% (W1: 24%), biofuels at 20% (W1: 20%), nuclear at 13% (W1: 9%), ammonia at 5% (W1: 2%) and methanol at 3% (W1: 3%).



When selecting factors for fuel investment decisions, respondents prioritised environmental impact at 39% (W1: 47%), followed by safety at 27% (W1: 24%) and cost effectiveness at 27% (W1: 22%). Infrastructure availability stands at 6% and vessel compatibility at 3%.

Part B: Thematic Focus on Digitalization

Part B draws together evidence on digitalization from across all five stakeholder groups surveyed in W1 and W2.

METAVASEA survey findings indicate that digital solutions are already embedded in several areas of maritime activity, including performance monitoring, voyage/route optimization, emissions reporting, regulatory compliance, training and ship-to-port coordination. The key findings below examine the extent to which digital capability, governance and skill development are keeping pace with this operational embedding.

The first METAVASEA spin-off survey, titled "[Can We Trust the Machine?](#)", was designed and carried out by HELMEPA Youth Ambassador Leader Sotiris Salamouris, aged 16, engaging 236 maritime professionals on AI and autonomous systems in shipping. The survey was conducted between June and July 2026 under the supervision of Professor Dimitris Lyridis of the National Technical University of Athens. A poster of the survey findings is included in this report as Annex I. The full results are available at [Metavasea | HELMEPA](#)

Key Finding 1. Digital tools are widely adopted, but digital capability has not kept pace.

Across the combined W1 and W2 dataset, 83% of shipping company representatives report using vessel performance monitoring tools. 41% have adopted or are scaling digital navigation route optimization. 75% of seafarers rate IT and automation onboard as very or extremely necessary training and 76% rate digital transition and basic digital awareness at the same level.

Between waves, digital transition as a training priority rose among shipping companies from 69% to 76% and among seafarers from 73% to 79%. The increases were 7 and 6 percentage points, respectively.

Only 17% of shipping companies identify digital and cybersecurity skills as a key seafarer competency (W1: 12%). Seafarers select digital skills as a core technical priority at 16% (W1: 10%). This gap between operational tool adoption and digital skill prioritization remains substantial in W2.

Key Finding 2. Digital skills remain a low stated priority among seafarers, shipping companies and service providers.

Digital and cybersecurity competency is selected as a priority by 16% of seafarers, 17% of shipping company respondents and 11% of service providers in W2. 45% of ports in the combined sample have no emissions monitoring capability. 41% of civil society respondents are unaware of maritime GHG reduction initiatives. The port and civil society figures concern monitoring and awareness rather than direct measures of digital skills.

Closing Note

This report presents an interim set of findings from an ongoing survey, not a set of final conclusions. The findings across the five stakeholder groups and the thematic focus on digitalization are presented for expert dialogue at forthcoming events including the 3rd European Conference on Shipping, Intermodalism and Ports (ECONSHIP) in Chios (25.09.2026) and the METAVASEA International Workshop on "People-Centred Maritime Decarbonization: From East Mediterranean Findings to Global Pathways" at the World Maritime University in Malmö (02.10.2026). HELMEPA, together with Lloyd's Register Foundation and the METAVASEA partnership, invites the expert community to interpret and refine them.

The ongoing Wave 3 (December 2025 to April 2027) will complete the METAVASEA survey cycle with three methodological adjustments: one respondent per shipping company to improve representativeness, a shorter and interview-based approach for port administrations to address the participation gap identified in this report, and extended geographic reach across Cyprus, Egypt and other Eastern Mediterranean countries.

Annex I – Poster of survey findings "Can We Trust the Machine?"



project
coordinator



ΕΛΛΗΝΙΚΗ ΕΝΩΣΗ ΠΡΟΣΤΑΣΙΑΣ
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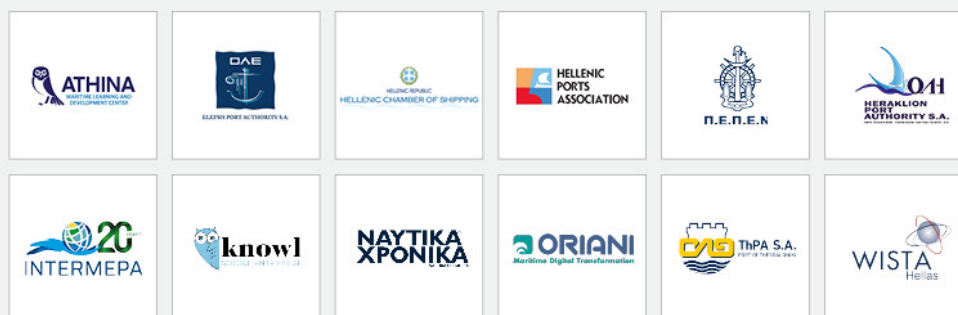


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SURVEY REPORT

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