



News & updates vol.3

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Charting the Course: SAFeCRAFT Milestones Toward Sustainable Maritime Fuels

Welcome to the third edition of the SAFeCRAFT Newsletter!

As our project progresses steadily, we are entering a decisive stage where collaborative research and technical development begin to converge into tangible results. Over the past months, the consortium has been working intensively on advancing sustainable alternative fuels for the maritime sector, with a strong focus on conceptual design studies for hydrogen and ammonia systems, life cycle assessments and cost analyses, comprehensive risk and safety evaluations, and system integration strategies.

This edition brings you highlights from recent milestones, including the ongoing Life Cycle Cost Assessment (LCCA) of alternative fuel systems, the development of operational and safety guidelines, and progress in demonstration and testing activities. We also share outcomes from key events such as the Mid-Term Review in Brussels, the Hazard and Operability (HAZOP) Workshop in Glasgow, and our Failure Mode and Effects Analysis (FMEA) training session, along with partner contributions and upcoming

conference engagements.

Together, these updates showcase how SAFeCRAFT is not only delivering on its technical objectives but also fostering collaboration, knowledge exchange, and strong representation at the international level. As we move toward full-scale demonstrations and validation, each step brings us closer to our shared goal: a safe, sustainable, and economically viable future for maritime transport.

We thank all partners for their continued commitment and invite you to explore the stories, achievements, and next steps presented in this newsletter.

Warm regards,
The SAFeCRAFT Team



Source: Seanergy

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Meet the Consortium



The SAFeCRAFT consortium brings together a diverse group of experts dedicated to advancing Sustainable Alternative Fuels (SAFs) in maritime transport. Our team includes:

- Two major classification societies/IACS members: ABS and RINA
- Four technical universities: NTUA, UoS, UPAT, and TUD
- Three industry partners: HYDRUS, MOTOR OIL, and SEANERGY
- One network association: WEGEMT

The core team of SAFeCRAFT, including HYDRUS, ABS, UoS, RINA, NTUA, WEGEMT, TUD, and UPAT, also plays a pivotal role in two additional prominent HORIZON Europe initiatives: the LH2CRAFT and NH3CRAFT projects. These projects are closely linked, and this collaboration facilitates the seamless transfer of technologies and expertise to the SAFeCRAFT project, significantly contributing to our goals.

Our partners bring extensive experience in various fields such as shipping, naval architecture, marine engineering, tank manufacturing, hydrogen production and handling, safety and risk assessment, marine classification, and material science. Together, we are working towards the implementation of SAFs in full transnational operations on a 180,000 DWT Capesize Bulk Carrier.

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Project updates

Spotlight on Task 3.4 – Powertrain Evaluation for SAF Integration from NTUA

The SAFeCRAFT project is driving the safe and practical adoption of Sustainable Alternative Fuels (SAFs) in maritime transport by combining integration, validation, and real-world demonstrations. A key highlight will be the retrofit of a hydrogen-fuelled generator set (H₂ GenSet) on a 180,000 DWT Capesize Bulk Carrier – a major step toward decarbonising large vessels.

At the core of this effort, Task 3.4, led by the School of Naval Architecture and Marine Engineering-National Technical University of Athens (NTUA), delivers a holistic evaluation of SAF powertrain solutions across multiple vessel types in line with the EU's 2040 FuelEU Maritime targets. Building on earlier tasks that explored ammonia, hydrogen, and liquid organic hydrogen carriers (LOHC), this work integrates insights with advanced design concepts and quality function deployment (QFD) analysis.

The task began with a desktop screening of 180 fuel-powertrain-ship type combinations, covering containerships, RoPax ferries, cruise ships, and bunkering tankers. Three powertrain architectures were considered:

- Fuel cells with marine batteries,
- Hydrogen-fed internal combustion engines,
- Hydrogen-fed generators with shaft motors alongside conventional engines.

Using metrics such as safety, feasibility, environmental performance, operational suitability, and bunkering practicality, the analysis narrowed the options down to six high-potential scenarios. These will now undergo deeper process modelling and case studies, feeding into the engineering studies of WP4 (HYDRUS) and into the Multi-Criteria Decision-Making platform developed in WP5 (University of Patras).

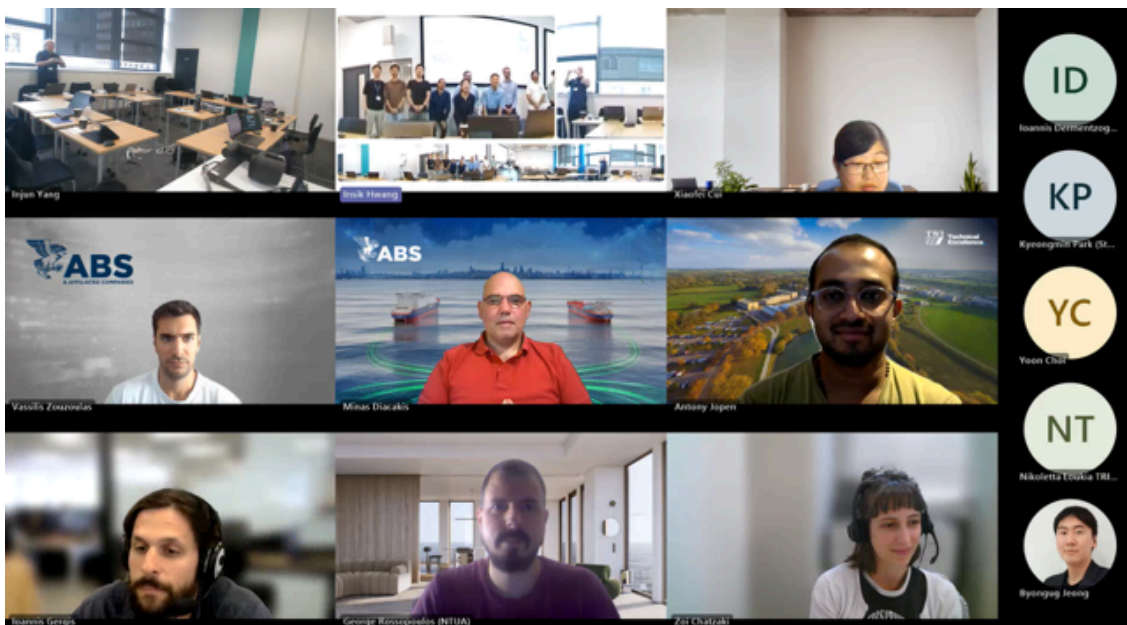
Task 3.4 will provide the consortium and wider industry with robust, data-driven guidance on the most promising SAF powertrain pathways for a greener maritime future.

[Read more](#)

Highlights from SAFeCRAFT's HAZOP Workshop



SAFeCRAFT consortium partners at the HAZOP Workshop



SAFeCRAFT consortium members participating online at the HAZOP Workshop

From 9–11 July 2025, the University of Strathclyde hosted a hybrid Hazard and Operability (HAZOP) workshop in Glasgow, bringing together SAFeCRAFT partners to rigorously examine the safe

implementation of compressed hydrogen systems for maritime applications.

During these three days, participants systematically analysed 12 operational modes to identify and evaluate potential safety risks. The workshop fostered strong collaboration across the consortium, with a focus on critical system components including:

- Hydrogen storage systems
- Fuel supply unit
- Bunkering unit
- Vent mast
- Generator engine combustion section

This joint safety analysis provided a vital platform to challenge technical assumptions, uncover hidden hazards, and drive design improvements based on operational realism. Key actions emerging from the workshop included:

- Refining bunkering operational modes to reflect real-world procedures more accurately.
- Redesigning the vent mast pipeline network to reduce hydrogen dispersion risks and improve emergency venting.
- Modifying the fuel supply unit design to mitigate identified hazards and enhance system resilience.

These outcomes underline SAFeCRAFT's commitment to proactive safety engineering and continuous system optimisation, ensuring hydrogen technologies are developed with the highest standards of safety and efficiency.

We extend our thanks to the University of Strathclyde for their excellent organisation and warm hospitality, which contributed greatly to the success of this important project milestone.

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SAFeCRAFT Mid-Term Review Meeting in Brussels

On Thursday, 17 July 2025, the SAFeCRAFT consortium convened in Brussels, Belgium for the project's Mid-Term Review (RV1) Meeting, hosted at the premises of Kooperationsstelle EU der Wissenschaftsorganisationen (KoWi) – the EU Office of the German Research Organisations.



Consortium members with Project Officer Gerd Muyesewinkel at SAFeCRAFT's Mid-Term Review Meeting

The review was held in a hybrid format, with several partners participating in person and others joining remotely, ensuring broad representation across the consortium. This milestone event provided a valuable opportunity to reflect on progress from Month 1 to Month 18, align with the European Commission on

achievements and challenges, and set the course for the project's next phase.

The meeting opened with a high-level overview of SAFeCRAFT's objectives, achievements, and coordination efforts over the first 18 months. This was followed by a full day of technical presentations and discussions, with work package leaders delivering detailed updates on:

- WP1 – Project Management
- WP2 – Demonstration Implementation Plan
- WP3 – Comparative Analysis of Alternative Systems for Desktop Studies
- WP4 – Engineering Design of Demonstrator and Desktop Studies
- WP5 – Smart Digitalisation Process for Monitoring & Operations
- WP6 – Demonstrator Installation and Testing
- WP7 – Safety Evaluation on Risk-Based Designs and Demonstrations
- WP8 – Technical and Economic Assessment of KPIs and LCA
- WP9 – Dissemination, Exploitation, and Communication

Each block was followed by interactive Q&A sessions, encouraging open dialogue and collaborative reflection among partners and the EU Project Officer.

The review concluded with a dedicated feedback session with the European Commission, offering valuable insights that will help guide SAFeCRAFT into its next stage — full-scale demonstrations and technology validation.

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Task 3.1 – Exploring Ammonia Pathways for Maritime Decarbonisation

Task 3.1 of the SAFeCRAFT Project, led by METACON, has reached a key milestone in advancing ammonia-based solutions for clean maritime propulsion. The task explored how ammonia can be used both directly as a fuel and as a hydrogen carrier, supporting multiple routes toward decarbonising the shipping sector.

The work assessed technological readiness, safety considerations, and infrastructure needs for the adoption of ammonia-powered systems. Findings indicate strong progress in the development of next-generation technologies capable of achieving significant reductions in greenhouse-gas emissions compared with conventional marine fuels.

These results reinforce ammonia's potential role as a versatile energy vector for future shipping, contributing to global efforts to achieve a sustainable and low-emission maritime industry.

[Read more](#)

Task 3.2 – Advancing Hydrogen Pathways for Maritime Decarbonisation

Within Task 3.2, led by the School of Naval Architecture and Marine Engineering-NTUA, the SAFeCRAFT Project is advancing the integration of hydrogen technologies to support the maritime sector's transition toward sustainable alternative fuels. The work focuses on developing conceptual designs for hydrogen-based systems, assessing safety considerations, and aligning technological innovation with evolving international regulations.

The task explores how hydrogen can be effectively deployed in future shipboard energy systems while addressing key enablers such as regulatory readiness, storage solutions, and power system design. The findings highlight steady progress in shaping the next generation of marine propulsion concepts capable of reducing emissions and supporting upcoming FuelEU Maritime 2040 objectives.

By bridging technical innovation with safety and policy development, Task 3.2 contributes to defining a clear pathway for the safe, efficient, and scalable adoption of hydrogen in shipping. These efforts form a crucial part of SAFeCRAFT's broader mission to deliver integrated solutions for a sustainable maritime future.

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Advancing Safety: Preliminary Risk Evaluation Completed

SAFeCRAFT has successfully completed the Preliminary Risk Evaluation of Alternative Systems (Task 7.2), a crucial step in ensuring the safe integration of sustainable alternative fuels (SAFs) into maritime applications.

Led by School of Naval Architecture and Marine Engineering-NTUA, with strong input from the University of Strathclyde, this task examined potential hazards linked to fuels such as hydrogen, ammonia, and liquid organic hydrogen carriers at the early design stage. The evaluation combined data collection with a structured worksheet that formed the basis of a HAZID workshop held in Athens in February 2025.

During the workshop, the demonstrator bulk carrier was analysed across six system nodes — from bunkering and storage to the hydrogen genset and power take-in/out systems. More than 200 hazards were identified, and mitigation measures were proposed to strengthen safety.

The findings will be consolidated in the Preliminary Risk Evaluation Report (Final Version), which will feed directly into the demonstrator's design process.

This milestone underlines SAFeCRAFT's commitment to preventing accidents, enhancing safety, and paving the way for the wider adoption of SAFs in maritime transport.

This milestone underlines SAFeCRAFT's strong commitment to accident prevention, enhanced safety, and the responsible integration of sustainable alternative fuels into maritime transport.

We would like to sincerely thank the School of Naval Architecture and Marine Engineering- National Technical University of Athens (NTUA) for leading Task 7.2, with valuable contributions from all project partners who provided expertise, data, and constructive input throughout the risk evaluation and HAZID process.

[Read more](#)

Milestone Achieved: Life Cycle Cost Assessment Completed

SAFeCRAFT has reached another important milestone with the completion of the Life Cycle Cost Assessment (LCCA) for the demonstrator bulk carrier. The study, led by the University of Strathclyde, provides a detailed economic evaluation covering capital (CAPEX), operational (OPEX), maintenance (MTEX), and end-of-life (ELEX) expenditures.

The analysis compared conventional fuels such as heavy fuel oil (HFO) and marine diesel oil (MDO) with alternatives including hydrogen (H₂), ammonia (NH₃), and Liquid Organic Hydrogen Carrier (LOHC). It also considered maintenance costs for key onboard systems and explored recycling strategies to assess end-of-life cost-effectiveness.

Results show that hydrogen demonstrates a more promising long-term economic outlook as a marine fuel. These findings not only guide shipowners and fuel suppliers but also support research and policy development, ensuring vessel design and operations are aligned with future sustainability goals.

[Read more](#)

Task 8.1 – Life Cycle Assessment of Alternative Fuel Systems for Maritime Decarbonisation

A key objective of the SAFeCRAFT Project is to demonstrate four innovative technologies that enable Sustainable Alternative Fuels (SAFs) across oceangoing and short-sea vessels, for both newbuilds and retrofits. Central to this effort is the use of Compressed Gaseous Hydrogen (CGH₂) in full transnational operations on a 180,000 DWT Capesize bulk carrier, complemented by desktop studies investigating SAF integration in three different powertrain configurations.

Led by the School of Naval Architecture and Marine Engineering-NTUA, Task 8.1 conducts a comprehensive Life Cycle Assessment (LCA) to quantify the environmental impacts of the developed SAF solutions from production to end-of-life. The study applies the CML-IA Baseline method, using 1 MWh of powertrain energy output as the functional unit to enable a consistent comparison of alternative fuel systems.

The analysis assumes hydrogen production via alkaline water electrolysis powered by an on-site wind farm, with data collected on electrolyser materials and energy requirements. Each fuel pathway includes its distinct pre-treatment and post-treatment steps:

- CGH₂: compression and storage
- LH₂: liquefaction, storage, compression, and evaporation
- LOHC: hydrogenation, storage, and dehydrogenation
- LNH₃: synthesis, storage, and cracking

A sensitivity analysis was performed for fuel transportation distances of 0, 250, and 500 km, supported by detailed data on NO_x emissions from the hydrogen GenSet and end-of-life material recovery. The results identified marine aquatic, freshwater, and terrestrial ecotoxicity as the most significant environmental categories. Furthermore, a Monte Carlo uncertainty analysis revealed that acidification and eutrophication are strongly influenced by variations in NO_x emissions linked to stoichiometric ratios.

Future work will extend the model to include containment system materials and other powertrain components, enabling a complete comparison of SAF–powertrain combinations. This comprehensive dataset will strengthen understanding of environmental performance and guide decisions toward the most sustainable decarbonisation pathways in shipping.

[Read more](#)

Task 8.2 – Life Cycle Cost Analysis of Alternative Systems: Assessing the Economic Viability of Sustainable Marine Fuels

Another milestone has been reached in the SAFeCRAFT Project with the completion of the Life Cycle Cost Assessment (LCCA) for the demonstrator bulk carrier vessel, led by the University of Strathclyde. This analysis complements the environmental evaluation from Task 8.1 by quantifying the economic performance of the same sustainable fuel systems.

The study accounts for four major cost components — Capital Expenditure (CAPEX), Operational Expenditure (OPEX), Maintenance Expenditure (MTEX), and End-of-Life Expenditure (ELEX) — providing a complete view of vessel life cycle economics.

- CAPEX includes purchase and installation costs for new systems.
- OPEX analyses fuel consumption, comparing Heavy Fuel Oil (HFO) and Marine Diesel Oil (MDO) against Hydrogen (H₂), Ammonia (NH₃), and LOHC.
- MTEX considers the long-term maintenance of major onboard equipment.
- ELEX evaluates recycling and disposal strategies, including cost-effectiveness under circular economy principles.

The results show that hydrogen demonstrates a more favourable long-term economic outlook as a marine fuel, particularly when aligned with upcoming regulatory frameworks and decarbonisation targets. The assessment supports strategic decision-making for shipowners, fuel suppliers, and R&D stakeholders aiming to align vessel design and operations with future sustainability and policy goals.

[Read more](#)

SAFeCRAFT at the International Maritime Association of the Mediterranean (IMAM) 2025

The SAFeCRAFT consortium participated in the International Maritime Association of the Mediterranean (IMAM) 2025 Conference, held in Crete, Greece, from 28 September to 3 October 2025. IMAM is a long-established scientific and technical forum that brings together researchers, academics, and industry professionals to exchange knowledge and promote innovation in the fields of naval architecture and marine engineering.

SAFeCRAFT at IMAM 2025: Advancing Decarbonisation Pathways

As part of the conference programme, representatives from Hydrus Engineering S.A., the National Technical University of Athens (NTUA), and the University of Patras (UPAT) delivered a presentation titled: *“A Multi-Criteria Decision-Making Approach for the Assessment of Various Decarbonization Pathways Considering Multiple SAFs, Powertrain and Vessel Type Configurations.”*

The presentation outlined the methodology and results of a multi-criteria decision-making (MCDM) framework developed within SAFeCRAFT to evaluate and compare decarbonisation pathways for different vessel types.

The study examined 180 combinations of Sustainable Alternative Fuels (SAFs) and powertrain configurations, systematically narrowing them down to the most promising options for further desktop assessment. Key evaluation criteria included safety, installation feasibility, environmental performance, technical compatibility, and FuelEU Maritime 2040 compliance. The analysis identified optimal retrofit and new-build solutions integrating hydrogen, ammonia, and LOHC-based fuel systems with various propulsion technologies, such as internal combustion engines, fuel cells, and hybrid configurations.



“A Multi-Criteria Decision-Making Approach for the Assessment of Various Decarbonization Pathways Considering Multiple SAFs, Powertrain and Vessel Type Configurations” presentation at IMAM 2025

The presentation outlined the methodology and results of a multi-criteria decision-making (MCDM) framework developed within SAFeCRAFT to evaluate and compare decarbonisation pathways for different vessel types. The study examined 180 combinations of Sustainable Alternative Fuels (SAFs) and powertrain configurations,

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Key evaluation criteria included safety, installation feasibility, environmental performance, technical compatibility, and FuelEU Maritime 2040 compliance. The analysis identified optimal retrofit and new-build solutions integrating hydrogen, ammonia, and LOHC-based fuel systems with various propulsion technologies, such as internal combustion engines, fuel cells, and hybrid configurations.

The presentation was delivered by representatives from Hydrus Engineering S.A., the National Technical University of Athens (NTUA), and the University of Patras (UPAT). Their joint contribution demonstrated how interdisciplinary collaboration within the SAFeCRAFT consortium is enabling the development of data-driven tools and methodologies that support the maritime sector's transition towards safe, sustainable, and efficient decarbonisation.

[Read more](#)

SAFeCRAFT at IMAM 2025: Strengthening Hydrogen Safety

Focusing on the safety dimension of hydrogen integration, experts from the University of Strathclyde (UoS), in collaboration with Hydrus Engineering S.A. and the National Technical University of Athens (NTUA), delivered a second presentation titled *"Hazard Identification for Quantitative Risk Assessment of Compressed Hydrogen as a Marine Fuel in the SAFeCRAFT Project."*

The presentation focused on the systematic identification and assessment of hazards associated with the use of compressed hydrogen as a marine fuel, forming the basis for a robust Quantitative Risk Assessment (QRA) within SAFeCRAFT. This research supports the development of a risk-based design framework for hydrogen systems onboard ships, providing technical insights to guide safe design and ensure compliance with emerging regulations and class requirements.



"Hazard Identification for Quantitative Risk Assessment of Compressed Hydrogen as a Marine Fuel in the SAFeCRAFT Project" presentation at IMAM 2025

A key component of the study was the HAZID workshop held in Athens from 10–12 February 2025, where consortium experts identified 161 hazards across six system nodes: bunker station (30), fuel storage (35), fuel supply unit (20), generator engine (38), gas and vent system (16), and PTI/PTO (22). These findings form the foundation for the next stage of the QRA and inform design recommendations for safer hydrogen systems.

Building on the HAZID outcomes, the planned QRA scenarios address representative hydrogen-related risks, including H₂ releases at vent masts, leaks in fuel preparation spaces, emergency shutdown (ESD) activations, storage damage during cargo operations, jet-fire and detonation events, and the definition of safe bunkering zones.

These analyses will guide design validation and regulatory alignment, with a particular focus on venting configurations and safe distance evaluations using computational fluid dynamics (CFD).

The presentation was delivered by representatives from University of Strathclyde, from the School of Naval Architecture and Marine Engineering-NTUA and representatives from Hydrus Engineering S.A.

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Key Insights from the SAFeCRAFT Failure Mode and Effects Analysis (FMEA) Workshop in Chania

From 29 September to 1 October 2025, the SAFeCRAFT consortium held a three-day Failure Mode and Effects Analysis (FMEA) Workshop in Chania, Greece, aimed at strengthening safety strategies and improving the reliability of hydrogen-based maritime applications. Led by the University of Strathclyde, the workshop brought partners together to examine critical safety issues, assess operational risks, and further refine the system designs for the project's demonstrator and hydrogen processing systems.



FMAE Workshop 29/09-1/10/ 2025 in Chania- Greece

Key discussions explored significant system updates, including the removal of a compressor and simplification of pressure reduction processes to improve operational efficiency and safety.

The workshop also examined pressure management and leak prevention strategies, the importance of redundancy and robust control protocols, and innovative detection technologies such as thermal imaging and ultrasound.

Outcomes from the workshop include proposals for updating the FMEA framework and strengthening SAFeCRAFT's overall safety approach. These insights will guide future design decisions and support the project's mission to enable the safe, reliable, and sustainable integration of hydrogen technologies in maritime transport.

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Highlights from SAFeCRAFT's 3rd General Assembly

The SAFeCRAFT consortium held its 3rd General Assembly Meeting on the 2nd and 3rd of October 2025 in Chania, Greece, bringing together all partners to review progress, share results, and plan the next steps towards the safe and efficient use of sustainable fuels in maritime transport.



SAFeCRAFT's 3rd General Assembly in Chania-Greece

The meeting featured updates from across all work packages, including project management, conceptual design of alternative fuel systems (ammonia, hydrogen, and LOHC), holistic assessments, and engineering design for the demonstrator.

Partners also advanced discussions on life cycle and cost analysis of alternative systems, offering valuable insights into both environmental and economic performance.

Safety evaluation remained a central focus, with dedicated sessions on preliminary and qualitative safety assessments, probabilistic and deterministic risk analysis, and a workshop presenting key findings from the Failure Mode and Effects Analysis (FMEA).

The meeting also explored the role of digitalisation in decision-making, highlighting advanced analytical tools and simulation techniques to support fuel selection and assess system performance under realistic operational conditions.

Beyond the technical agenda, the General Assembly emphasised strong collaboration, providing opportunities for partners to strengthen cooperation through networking and joint discussions. The event reaffirmed SAFeCRAFT's commitment to delivering innovative, safe, and sustainable solutions for the maritime sector and set a clear course for the next phase of the project.

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SAFeCRAFT at IMAM 2025 in Chania-Greece

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The overall goal of SAFeCRAFT is to develop, demonstrate the safety and viability and accelerate the adoption of SAFs in waterborne transport.

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Contact us

For more information about the SAFeCRAFT project, please feel free to contact us at

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