MEDITERRANEAN ACTION PLAN (MAP)
REGIONAL MARINE POLLUTION EMERGENCY RESPONSE CENTRE FOR THE MEDITERRANEAN SEA (REMPEC)

Sixteenth Meeting of the Focal Points of the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC)

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Agenda Item 8: Reduction of GHG emissions from ships

Relevant studies published by EMSA on the decarbonization of shipping

REMPEC
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Note by EMSA

This document provides an overview of different series of studies that the European Maritime Safety Agency has been performing related to the use of non-fossil fuels by shipping.

Background

1 Under the European Green Deal, the European Union (EU) has pledged to become climate neutral by 2050, with an intermediate goal of a 55% reduction of greenhouse emissions by 2030. Maritime transport, which has traditionally relied on the use of conventional fossil fuels, is preparing for such a transformation to meet both the EU and the international climate targets.

2 EMSA, within its activities to support the European Commission, national administrations, and industry in the ongoing decarbonisation of the maritime sector, has produced a series of reports, studies, and guidance on alternative fuels and sources of power. After investigating the potential of alternative sources of power or promising technologies for shipping, EMSA has launched a second series of studies focusing on onboard safety. A third study has investigated crew training requirements. Finally, the Agency has also begun assessing response techniques for potential substance releases into the marine environment.

3 These studies are all available on EMSA's website. This document highlights the main outcome of the studies.

Studies on the potential of new fuels or promising technologies for shipping

4 Biofuels offer medium- and long-term marine fuel alternatives that can quickly enter the market, potentially reducing carbon output if sustainability criteria are met. Their 'drop-in' nature allows them to replace conventional fuels without significant modifications to engines, fuel tanks, or systems, offering a cost-effective solution for the existing fleet. EMSA's report updates a previous study on ethyl and methyl alcohol as alternative fuels, exploring the full range of biofuels, including production capacity, storage infrastructure, power-generation technologies, and incorporates techno-economic analyses and risk-based case studies.

Full details on the report can be found at Latest News - Update on Potential of Biofuels for Shipping [updated] - EMSA - European Maritime Safety Agency

5 Synthetic fuels or e-fuels could provide a promising medium- and long-term alternative for reducing carbon emissions to near zero. Among synthetic fuels, e-ammonia, e-hydrogen, e-diesel, e-methane, and e-methanol are expected to see the highest adoption in shipping. As e-ammonia and e-hydrogen were analysed in previous EMSA studies, this study focuses on e-diesel, e-methane, and e-methanol.

Full details on the study can be found at Publications - Synthetic fuels for shipping - EMSA - European Maritime Safety Agency

6 Anhydrous ammonia (NH_3) is a potential long-term marine fuel offering near-zero carbon emissions. While marine use is limited and key technologies like engines are still in development, extensive land-based experience and liquefied-gas carrier regulations provide a foundation for its adoption. However, ammonia's toxicity adds complexity to ship design and may limit its suitability to deep-sea cargo ships rather than smaller vessels. This study examines production capacity, regulations, storage, supply, and power generation, identifying key challenges, advantages over other fuels, regulatory gaps, and incentives for adoption.

Full details on the report can be found at Latest News - Potential of Ammonia as Fuel in Shipping - EMSA - European Maritime Safety Agency

7 Green hydrogen has been identified as a promising near-zero carbon solution, though shipping has limited experience with its use, and key technologies are still in development. Challenges include low energy density, high equipment costs, and the need for expanded production and distribution. This study explores hydrogen's potential as a marine fuel by analysing production capacity, regulations, storage, supply, power technologies, techno-economic factors, and risk-based case studies.

Full details on the study can be found at Publications - Potential of hydrogen as fuel for shipping - EMSA - European Maritime Safety Agency.

8 Wind-assisted propulsion systems (WAPSs) offer a viable solution for reducing fuel consumption and emissions in shipping. Six main technologies—rotor sails, hard sails, suction wings, kites, soft sails, and hull technology vary in maturity, cost, and suitability for different ships. While wind turbines for onboard electricity are also being developed, this study focuses on WAPSs that directly contribute to ship propulsion, drawing on literature, research, industry data, and input from the International Windship Association (IWSA).

Full details on the study can be found at Publications - Potential of wind-assisted propulsion for shipping - EMSA - European Maritime Safety Agency.

9 The European Union, through the European Green Deal, aims for a carbon-free economy, with EMSA supporting maritime stakeholders by studying alternative fuels and power solutions for shipping. Nuclear power has primarily been used for military vessels and Arctic icebreakers but is now recognized in Europe as a sustainable energy source supporting the EU's zero-emission goal. Potential use of nuclear power in shipping could aid decarbonization but faces challenges in production, safety, security, training, liability, and insurance.

Full details on the report can be found at Latest News - Potential use of nuclear power for shipping - EMSA - European Maritime Safety Agency

Studies on the safety aspects of alternative fuels

10 EMSA has delivered a report examining the safety of using hydrogen as fuel on ships. Part 1 analyses hydrogen's characteristics, safety hazards, and risks, using natural gas as a benchmark. It reviews mitigation principles and lessons learned from hydrogen accidents. It also validates hydrogen modelling techniques and reviews relevant regulations, classification rules, and best practices. Part 2 focuses on the reliability and safety analysis of equipment and safety-critical systems in hydrogen-fuelled ships, identifying failure modes and developing a risk modelling framework for future tasks in the study.

Full details on the report can be found at Publications - Study investigating the safety of hydrogen as fuel on ships - EMSA - European Maritime Safety Agency

11 Study investigating the safety of ammonia as fuel on analyzes ammonia's properties as a marine fuel, highlighting toxicity and corrosivity as key hazards. Ammonia poses occupational risks at low concentrations and becomes life-threatening at higher levels. The study compares toxicity limits across regulations and examines ammonia's reactions with air, water, and materials. The report reviews existing onshore and offshore regulations, noting gaps in addressing ammonia's safety risks. Additionally, the study identifies critical equipment, failure modes, and evaluates system reliability through expert interviews and fault tree analysis. Reliability models were adapted from LPG applications to assess ammonia fuel systems.

Full details on the report can be found at Publications - Study investigating the safety of ammonia as fuel on ships - EMSA - European Maritime Safety Agency

Guidance

12 The EMSA Guidance on the Safety of Battery Energy Storage Systems (BESS) On-board Ships aims to help maritime administrations and the industry implements uniform safety standards for batteries on ships. Developed with input from experts, it covers requirements of classification societies, industry standards, and available research. The guidance is divided into two parts: equipment and technology, and planning, operations, and safety. It also includes a Quick-Reference Guide for Shore-Side Electricity (SSE) and Onshore Power Supply (OPS), offering a detailed technical guide for planning, installation, and operation.

Full details on the guidance can be found at Ship Safety Standards - Battery Energy Storage Systems (BESS) - EMSA - European Maritime Safety Agency

13 The EMSA Guidance for the Safe Bunkering of Biofuels provides checklists for each bunkering phase (pre-bunkering, connection, transfer, disconnection, and simultaneous operations), based on the findings from previous study tasks conducted by EMSA.

Full details on the guidance can be found at Publications - Study on Safe Bunkering of Biofuels - EMSA - European Maritime Safety Agency

14 The Shore-Side Electricity (SSE) Guidance is structured into two sections: equipment and technology, and planning, operations, and safety. It is accompanied by an SSE/OPS Quick-Reference Guide, offering a step-by-step technical overview on planning, installing, and utilizing Shore-Side Electricity (SSE), with a particular emphasis on Onshore Power Supply (OPS).

Full details on the guidance can be found at Publications - Shore-Side Electricity (SSE) - EMSA - European Maritime Safety Agency

Study on additional training competences on alternative fuels

15 The maritime industry is shifting towards decarbonized shipping, requiring seafarers to undergo specialized training to safely operate and maintain ships using alternative fuels and energy systems. However, current STCW standards do not fully address these new technologies. TRAINALTER report outlines a two-part study. The first part defines key competencies and training requirements in knowledge, understanding, and proficiency for the safe operation of ships powered by alternative fuels. The second part suggests evaluation methods for competency assessment and details training programs and curricula for seafarers and instructors.

Full details on the guidance can be found at Publications - TRAINALTER: Study on the identification of specific competences for seafarers on ships using alternative fuels and energy systems - EMSA - European Maritime Safety Agency

Response techniques to accidental releases

16 Current studies on alternative fuels focus on safety but lack insight into environmental impacts. To address this, a procurement procedure launched in May 2024 will fund up to five studies on responses to accidental fuel releases of alternative fuels in the marine environment. These studies will examine biofuels identified by EMSA as promising for maritime use, their blends with conventional marine fuels, ammonia, and other alternatives. The research will cover legal frameworks, risk assessment, contingency planning, response strategies, technologies, and liability. It will also provide insights into adapting EMSA's pollution response tools to future risks. Each study will follow a structured approach, analysing fuel properties, hazards, regulatory guidelines, response measures,

and final recommendations. The first study on biodiesels blends with conventional marine fuel oils will be released by end of 2025.

Actions requested by the Meeting

17 **The Meeting is invited to**:

.1 **take note** of the information provided in the present document; and

.2 **comment** as deemed appropriate.

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