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# REDUCTION OF GHG EMISSIONS FROM SHIPS

## Wind propulsion solutions

**Submitted by Comoros**

**SUMMARY**

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|---|---|
| *Executive summary:* | The decarbonization of shipping is the defining issue of the coming decade; however, currently, one of the leading decarbonization technologies, direct wind propulsion, is receiving only very limited consideration in this critical debate over the future of shipping. Direct thrust from wind propulsion technologies offers a technically and commercially viable near-term solution that can already save 5% to 20% of fuel and associated emissions as wind assistance, with the potential for much higher benefits as the technology develops or is deployed on optimized newbuild ships. Wind solutions are cost-effective, do not depend on alterations to port infrastructure and ensure shipowners have improved operational autonomy in mitigating the risks and uncertainties of being commercially dependent on the unknown cost and availability of alternative fuels. Therefore, the adoption of wind solutions will greatly assist the global fleet in reducing net emissions in the short-term, reducing the carbon intensity of the whole fleet, and better enable to meet IMO GHG reduction targets. |
| *Strategic direction, if applicable:* | 3 |
| *Output:* | 3.7 |
| *Action to be taken:* | Paragraph 27 |
| *Related documents:* | Resolution MEPC.304(72); MEPC 68/21 and resolution A.1110(30) |

## Introduction

1 MEPC 72 adopted resolution MEPC.304(72) on *Initial IMO Strategy on reduction of GHG emissions from ships* and this is designated as the first milestone set out in the Roadmap for developing a comprehensive IMO Strategy on reduction of GHG emissions from ships (the Roadmap) approved at MEPC 70. The Roadmap identifies that a revised Strategy is to be

adopted in 2023 and it is vital that all promising energy efficiency, alternative fuels and alternative means of propulsion be considered equitably and with the latest and best information at hand.

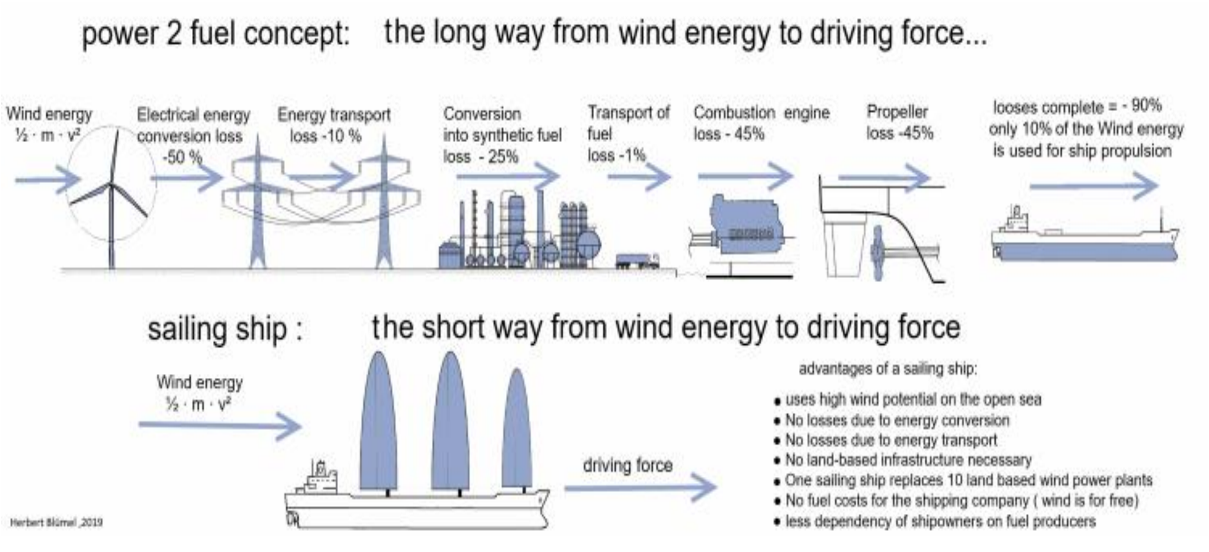
2 On 27 November 2019, during the thirty-first IMO Assembly, a statement was delivered by the Comoros Permanent Representative to sessions of IMO, Professor Orestis Schinas, that highlighted the significance and potential for wind propulsion technologies, raising awareness among IMO delegates, and insisted on the need to assess these promising technologies alongside other propulsion systems and alternative fuels to help achieve the ambitious goals set out by the Initial IMO GHG Strategy.

3 The Wind Propulsion Conference held on 15 and 16 October 2019 at the Royal Institution of Naval Architects (RINA) in association with the International Windship Association (IWSA) saw the delivery of 17 high quality technical presentations from around the world, outlining the great potential and opportunities that these wind-assist and primary wind propulsion technologies provide to all types of ocean-going ships. Key technology developments and current installations, barriers to uptake, innovative financial approaches and facilitation issues were all discussed.

4 Wind propulsion is a viable near-term retrofit emissions reduction technology offering significant reductions in greenhouse gas (GHG) emissions in line with the Initial IMO GHG Strategy and is fully aligned with the goals and objectives of the UN SDGs. In the medium- to long-term, these technologies offer even greater potential savings when deployed on optimized newbuild ships.

5 When deployed on suitable ships, wind reduces the overall demand for alternative, costly, zero-emission fuels and can be used in hybrid combination with new zero-emission fuels to reduce overall operational costs for shipowners. There are a number of regulatory and non-regulatory barriers that can be addressed to remove unnecessary restrictions on the uptake of this innovative and highly beneficial technology grouping.

6 The use of primary renewable energy (wind) delivered directly to the ship is arguably the most efficient use of renewable energy. In an energy-constrained future, it makes sense to optimize the use of energy directly where possible. With zero emissions or extremely low emissions in operation, a stable zero (or extremely low) fuel cost for its propulsive contribution during the operational life of the ship and with no additional infrastructure required, this is a critically important technology option in the development of a resilient and flexible low-carbon fleet.




**Graphic 1: Deployment comparison of primary versus secondary renewable energy. Source: Hebert Blümel, 2019**

7 Graphic 1 above clearly demonstrates the overall efficiency approach and upstream costs and savings associated with using direct wind propulsion. However, the comprehensive analysis of all technical considerations and operational constraints on the deployment of wind-assist and primary wind propulsion systems is very important to verify savings and validate the technology; and this work is ongoing (in part through the projects listed in paragraphs 23 to 25 of this document). Further technical submissions will comprehensively cover all aspects of the deployment of these solutions.

8 As noted, these wind technology solutions are increasingly available today, with a growing number of demonstrator ships already in commercial operation, sea trialling or in late R&D stage. These systems are fully automated and will be integrated into the energy management systems of the ships. Wind propulsion can be deployed either as wind-assist for primarily motor vessels or as a primary propulsor for newly built ships outfitted with auxiliary engines. It is important to demonstrate different types of wind propulsion to stimulate technical and commercial competitiveness to ensure the market can access the best options.

9 There are seven categories of wind propulsion technology: rotors, hard or rigid sails, suction wings, kites, soft sails, turbines and hull form. There are substantial technical variations within these categories with over 30 technology providers and developers at present across the categories (see Table 1 below).

**Table 1: Wind technology categories**

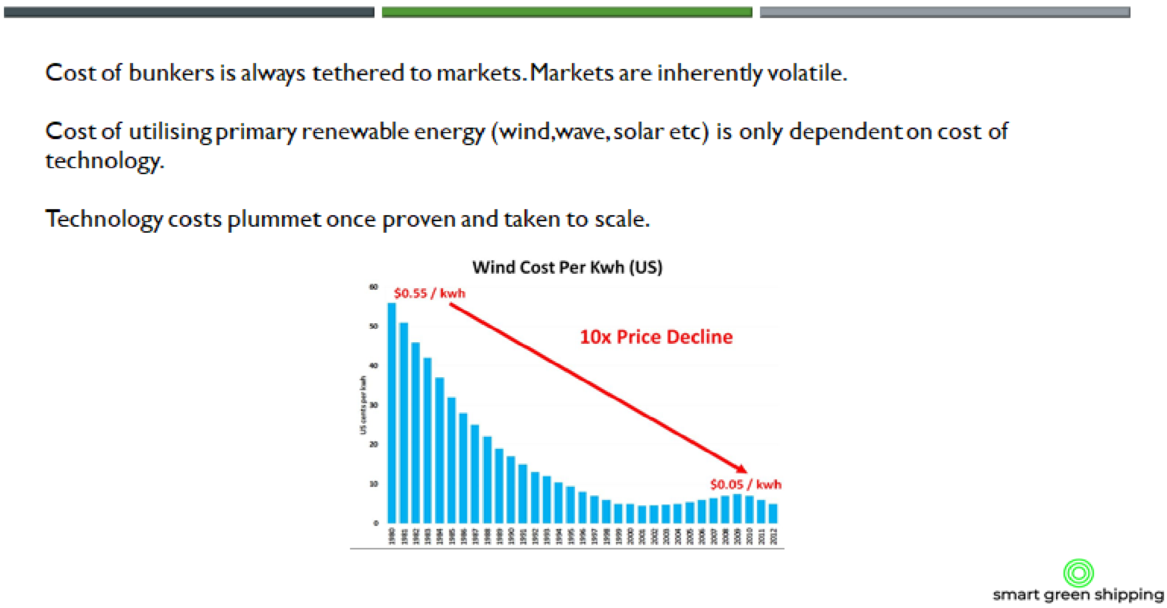
| Category | Description | Current deployment | New developments |
|---|---|---|---|
| Rotor | Rotating cylinders operated by low power motors. Magnus effect (air pressure difference on different sides of a spinning object) generates thrust | Six vessels (14 rotors) installed. Tanker, bulker, ferry, ro-ro, two general cargo | New ferry installation early 2020.<br>Recent AiPs for large bulker and tanker. |
| Hard sail | Wingsails, foils and JAMDA style rigs. Some rigs have solar panels for added ancillary power generation. | One VLCC with dual-sail configuration.<br>Number of installations on small ferries. | Five sea trials in 2020.<br>One bulker installation in 2021/2022.<br>One cruise ship in 2022. |
| Suction wing | Non-rotating wing with vents/internal fan (other device) using boundary layer suction for max. Lift effect. | Three sea trials on general cargo ships and ferry | Three scheduled installations - 2020 |
| Kites | Dynamic or passive kites off the bow of the ship to assist propulsion or to generate a mixture of thrust and electrical energy. | Two installations | Two sea trials: ro-ro and bulker in 2020/2021.<br>Order option – 50 units 2021+ |
| Soft sail | Traditional canvas sail and new designs of Dynarig, etc. (also used on 20+ large sail training vessels and mega yacht systems). | Three new sea trials.<br>Traditional small sail cargo/ferry usage.<br>3+ cruise ships. | New build of 3 ro-ro ships – launch 2021-2022 |
| Turbine | Marine adapted wind turbines to generate electrical energy or electrical energy/thrust combination. | R&D | |
| Hull form | Redesign of ship's hulls to capture the power of the wind to generate thrust. | R&D | |

Note: smaller vessels traditional soft sails are often operated manually or have manual operation as a safety/redundancy option.
Source: International Windship Association, Dec. 2019.

**Discussion: wind propulsion – innovative technology and primary renewable**

10 The installation of wind propulsion technologies reduces the overall demand for both fossil fuels and new alternative, zero-emissions fuels (hydrogen, ammonia, power-to-X, biofuels, batteries etc.). These alternative fuels will also be in demand from all other economic sectors and all research suggest that they will have significantly higher cost than fossil fuels, therefore negatively impacting the commercial performance of ships and increasing costs of shipping to the consumer. Wind thus helps mitigate these costs, and the uncertainty and availability risks associated with the adoption of these alternative fuels.

11 The cost of the wind is only pegged to the cost of the technology itself and all innovation developments reduce its cost and improve its efficiency (see Graph 2 below), and thus it can be stated with certainty that the costs of maritime wind technology will follow the same cost reduction trajectory once this has crossed the initial "innovation hump".




**Graph 2: Example of Marginal Abatement Cost Curve of Wind turbine power generation (Source: Smart Green Shipping Alliance, 2020)**

***Classification societies***

12 Support for designers, shipowners and yards from classification societies has been growing, especially over the last year, with a growth in both wind technologies available, demonstrator ships in operation and interest among large ship operators. At the end of 2019, two sets of wind-assist guidelines were published by leading classifications societies.

***Facilitating and support technologies and projects***

13 Along with the development of wind propulsion systems, there has also been steady progress in the development of new testing procedures and performance criteria, energy management systems, weather routeing software development, and further work is underway including new digital/satellite-enabled wind data and routing systems, etc.

***Fleet segments and operations***

14 Almost all segments of the world fleet can immediately benefit from installing wind propulsion technologies. Each segment will have its own challenges such as limited deck space on containerships, loading/unloading requirements for geared bulkers, air draft restrictions for cruise ships, etc. In the retrofit market, the bulker and tanker segments offer sizeable deck space for fixed installations and their operations are not as time dependent. However, each segment implies requirements on the systems deployed and these are incorporated in the various designs available with wind propulsion technology developers working closely with the relevant stakeholders to develop appropriate systems.

***Proven savings***

15 As stated, the current fleet of large demonstrator ships have provided confirmed performance data, averaged out over the full operating profile over periods of 12 months. Publicly available results already confirm the projected savings, e.g. 6.1% savings for two small retrofitted rotors on a ro-ro ship in operation since 2014, 8.2% savings for two larger rotors installed on an LR2 product tanker and approximately 20% savings achieved with a relatively large single rotor installed on a small general cargo ship. These results are scalable and will be further optimized over time. Other wind-assist technology category sea trials are reporting similar expected results and there is a need to secure further demonstrators in the market to demonstrate the diverse eco-system of solutions (source: International Windship Association, December 2019).

***Small island developing States (SIDS) and least developed countries (LDCs)***

16 These technology solutions also have the important potential for enabling SIDS and other developing countries to provide far more economical and sustainable shipping services both domestically and internationally. The need to consider the impacts of measures on States, including developing countries, in particular on LDCs and SIDS as noted by MEPC 68 (MEPC 68/21, paragraphs 4.18 to 4.19) and their specific emerging needs, was recognized in the IMO Strategic Plan for the period 2018 to 2023 (resolution A.1110(30)). The use of established and well-understood wind technologies with their inherent low operating costs holds a significant opportunity for these regions to mitigate the costs of decarbonization while operating better and more resilient shipping services.

***Additional considerations***

17 With increases in range, less restrictions around bunkering for fuel and lower operational costs afforded to ship operators by wind propulsion installations, there is the opportunity to change the economic dynamics surrounding speed reductions or lowering engine power requirements at existing speeds. Also, these dynamics impact existing less economical routes and hold the potential to reopen previously uneconomical ones, possibly relieving congestion, opening up additional trade opportunities and increasing the total volume of trade moved by the world fleet. The increased resilience, reduction in fuel insecurity, the reduction of upstream and downstream emissions and the potential for modular or leasing options for installations of wind propulsion technologies are all important considerations. These highly visible technology choices will also be viewed as a very public statement of intent to decarbonize, telling a positive shipping story to a wider audience.

**Market projections and forecasts**

18 The following market projection and forecast reports are indicative but do not constitute an exhaustive list of market projections for wind propulsion technologies.

19 The EU commissioned a report produced by CE Delft and associates entitled *Study on the analysis of market potentials and market barriers for wind propulsion technologies for ships*, published in 2016 prior to detailed deliberations on IMO 2020 and well before the adoption of the Initial IMO GHG Strategy in April 2018, with the following headline findings: "Should some wind propulsion technologies for ships reach marketability in 2020, the maximum market potential for bulk carriers, tankers and container vessels is estimated to add up to around 3,700-10,700 installed systems until 2030, including both retrofits and installations on newbuilds, depending on the bunker fuel price, the speed of the vessels, and the discount rate applied. The use of these wind propulsion systems would then lead to $CO_2$ savings of around 3.5-7.5 Mt $CO_2$ in 2030 [...]", and noting that this forecast covers only three key fleet segments and assessed only a small selection of technologies available (four rig systems selected). The study is available online on the following address:
https://www.cedelft.eu/publicatie/study_on_the_analysis_of_market_potentials_and_market_barriers_for_wind_propulsion_technologies_for_ships/1891

20 The United Kingdom Government's *Clean Maritime Plan* (July 2019) has assessed the global market for wind propulsion systems, and this is estimated to grow from a conservative £300 million per year in the 2020s to around £2 billion per year by the 2050s worldwide. This is rated as the second most important propulsion technology field behind alternative fuels (estimated at £8 billion per year in 2050s). The *Clean Maritime Plan* is available online on the following address:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/815664/clean-maritime-plan.pdf

**Technical challenge and barrier considerations**

21 There is a need to create an international level playing field in regulation to enable a more "wind friendly" environment so that all propulsion systems and alternative fuels can be effectively assessed and compared and thus generate the proper decarbonization market conditions.

22 A number of technical, regulatory and policy documents and proposals will be submitted at subsequent MEPC meetings for consideration, and these will deal with proposed adjustments to EEDI, operational indicators and IMO Data Collection System (DCS) among others.

**Wind propulsion facilitation projects and organisations**

23 There are a number of multi-stakeholder projects and organisations that are currently working on these issues and the following list is indicative of the activity in the field, but not an exhaustive list. These projects will be generating wind propulsion technical output and reports, delivering third party validation of performance and support facilitation activities and technologies.

24 The Wind Assisted Ship Propulsion (WASP) project was launched in October 2019 and is funded by the EU Interreg North Sea Europe programme as part of the European Regional Development Fund (ERDF). The project brings together universities, wind-assist technology providers with shipowners to research, trial and validate the operational performance of a selection of wind propulsion solutions on five vessels. More information can be found on: https://northsearegion.eu/wasp

25 The WISP Joint Industry Project was launched in July 2019 with the objective to overcome barriers to the uptake of wind-assisted propulsion, specifically to improve methods for transparent performance prediction, use these improved methods to provide

shipowners/operators with fast low-cost predictions for their fleet and to review the regulatory perspective including status of rules and regulations, identifying gaps, making recommendations and providing examples on establishing compliance. More information can be found on https://www.marin.nl/jips/wisp

26 The International Windship Association (IWSA), a not-for-profit association, was established in 2014 and has currently over 100 industry members and associates with the objective to facilitate and promote wind propulsion for commercial shipping and bring together all parties in the development of the wind ship sector. Activities include the development of wind propulsion regional hubs worldwide, communications, policy work, education program, etc. along with support for specific initiatives undertaken by members. More information can be found on http://wind-ship.org

**Action requested of the Committee**

27 The Committee is invited to note the information provided and that further technical documents will be submitted at subsequent MEPC meetings.

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