Sustainable Maritime Transport: Wind propulsion for ships

Paper produced by our working group dedicated to wind propulsion

In collaboration with

Wind Ship association

NEW ENERGIES

The energies coalition for transport & logistics

Foreword

The wind is the only renewable energy source, abundant at sea, immediately available, and directly usable to propel very large ships over long distances.

Maritime transport, essential to global trade, currently accounts for 2.89% of global greenhouse gas emissions, a figure that underscores the importance of this sector in the global decarbonization challenge. The International Maritime Organization (IMO), which aims for net zero by 2050, has set ambitious intermediate targets, particularly for 2030. The energy transition of the maritime sector, although necessary, poses major financial and energy challenges, requiring colossal investments and significant production of decarbonized energy. Among the levers to be activated, wind propulsion stands out as being immediately available, free, and without competition with other sectors to be decarbonized.

This publication by the **New Energies Coalition**, constitutes the first deliverable of the working group (initiated by Michelin) focused on wind propulsion. Created in close collaboration with the **Association Wind Ship**, **this document synthesizes our current knowledge on the subject** and highlights the available technologies, concrete examples of ships in operation, prospects, and the necessary actions to support the sector.

About

New Energies

The NEW ENERGIES Coalition, initiated in 2019 by CMA CGM, is a consortium of key players in international supply chains, working across various sectors and industries.

Through a collaborative approach, they aim to develop innovative technologies and energy solutions to decarbonize maritime, air, and road activities worldwide.

Additionally, to address the need for a regulatory framework that encourages the recognition and development of new energies and low-carbon and renewable fuels, the members of the NEW ENERGIES Coalition produce studies and manifestos for public and private representatives in the transportation and logistics sector.

NEW ENERGIES thus operates on two levels: solutions and mobilization.

Wind Ship

Wind Ship is a French association founded in 2019 with the goal of accelerating the transition to cleaner, decarbonized maritime transport through the development and deployment of wind propulsion for ships. It currently brings together more than fifty companies.

Wind Ship works at the local and national levels to position wind-assisted solutions as a major, already available pathway to decarbonize maritime transport and fishing. Internationally, Wind Ship is an executive member of the International WindShip Association, a network of 180 members and supporters active with the International Maritime Organization and the European Union.

Among its achievements, Wind Ship published the White Paper on Wind Propulsion for Ships (available online) and co-led the VENFFRAIS study with the Jules Verne Technological Research Institute, with support from MEET2050. This study defined the structural project for the French wind propulsion sector and engaged the State and economic stakeholders in the Wind Propulsion Pact.

Table of content

1 - The environmental impact of maritime transport

Practically all the objects around us have been transported at least once by sea. Indeed, maritime transport is currently the main mode of transporting goods and accounts for 90% of global trade by volume. In 2023, 12.4 billion tons of goods were transported aboard 109,000 ships (Clarksons Research, 2024).

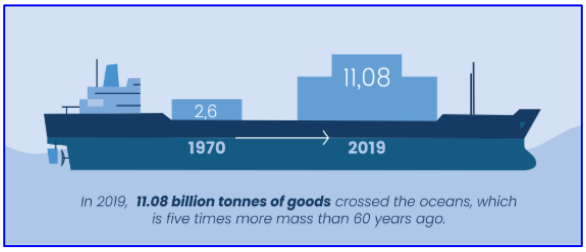
Today, International maritime transport accounts for

2,89%

of global CO2 emissions

In 2050*

17%



** By 2050, if no action is taken and current growth trends continue, shipping could account for 17% of global CO2 emissions*

International maritime transport accounted for 2.89% of global CO2 emissions in 2018 compared to 2.76% in 2012, according to the fourth greenhouse gas (GHG) study by the International Maritime Organization (IMO). This United Nations agency, responsible for regulating maritime safety and pollution issues, estimates that these emissions could increase by 90% to 130% by 2050 compared to the reference year 2008.

2 - Strong ambitions for the energy transition of maritime transport imposed by regulations

In 2018, the IMO adopted a strategy to reduce greenhouse gas (GHG) emissions from international maritime transport. In July 2023, it set the ambition to achieve net zero emissions by around 2050. The adoption of technologies, fuels, and/or energy sources with zero or near-zero GHG emissions must represent at least 5%, striving to reach 10% of the energy consumed by ships by 2030.

IMO objective: a reduction to achieve

Net Zero

greenhouse gas emissions by 2050

Meanwhile, the European Union has just included maritime transport in the EU Emissions Trading System (EU ETS). This measure is part of the "Fit for 55" package, which includes the FuelEU Maritime regulation that requires shipowners to improve the environmental performance of their vessels, with a goal of progressively reducing GHG emissions from maritime transport by up to 80% (compared to 2020) by 2050.

3 - Major financial and energy challenges

Very few propulsion technologies are sufficiently mature today to address this decarbonization challenge, and the cost of the maritime transition is estimated to be between $1,000 and $1,400 billion by 2050 (UMAS 2020), or $40 to $60 billion each year.

For illustration, it would take $75 to $100 billion to finance the energy transition of the maritime sector in France.

(Source: French maritime sector decarbonization roadmap, 2023)

The energy challenge is immense: the number of production units needed to meet the current demand for decarbonized synthetic fuels in international maritime transport has been estimated by the MEET 2050 institute to be 600 nuclear reactors of 1500 MW (440 currently in service – source: IAEA 2024) or 4,000 wind farms of 500 MW (1TW of capacity worldwide in 2023 – source: GWEC, April 2024).

1500 MW
Nuclear
reactors

≃

500 MW
Wind farms

Orders of magnitude taking into account a load capacity of 75% for nuclear and 32.5% for wind

Moreover, access to this decarbonized energy will be highly competitive because terrestrial uses (industry, mobility, etc.) also need to reduce their GHG emissions.

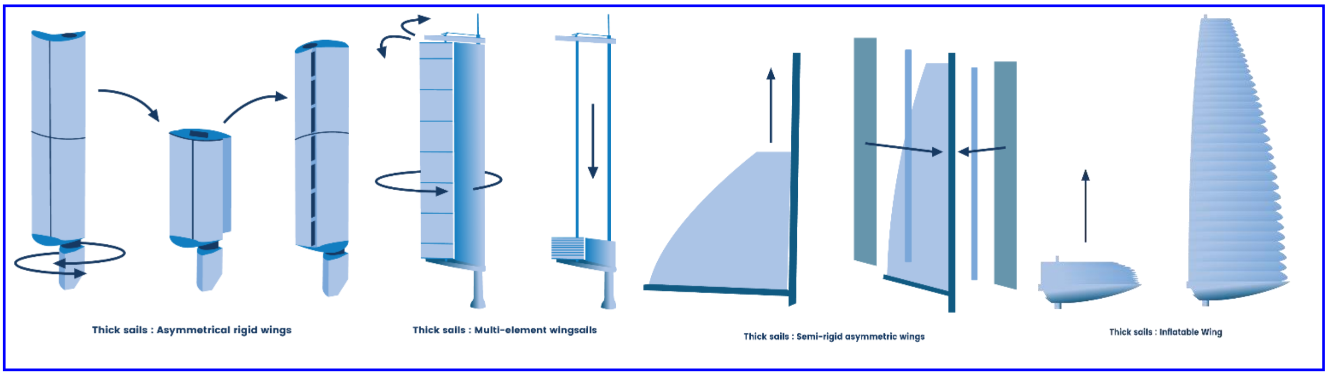
Any reduction in the energy needed to propel ships is crucial. Harnessing the free and immediately available energy of the wind on maritime routes is an opportunity.

4 – Overview of Wind Propulsion Solutions

Different technological solutions are being developed by industrial companies to harness wind energy on board merchant ships. These innovative systems are robust, reliable, and automated products designed to be easily integrated into commercial vessels without disrupting operations. These technologies are compatible with all forms of complementary propulsion, including all types of decarbonized fuels. The Wind Ship Association's white paper (2022) provides a description that allows for an understanding of the main principles behind the design of the major families of technologies.

Thin sails

Thick sails

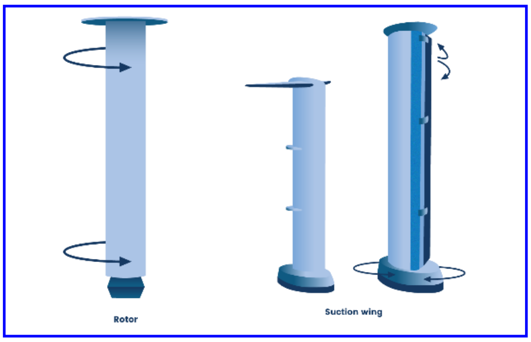


On-deck technologies are similar either to sails or wings, with a thicker profile (seen in longitudinal section). Their aerodynamic properties vary depending on the thickness but also to the camber or the symmetry of the sail or wing. Thick sails have good "aerodynamic efficiency," meaning they perform well when travelling upwind.

Wings and sails also differ in materials and stiffness. A flexible fabric material is easier to lower or reef (reduction of sail area) but wears out more quickly due to exposure to ultraviolet rays and luffing (sails beating in the wind). Some wings made in fabric membrane are rendered more robust through inflation which stiffens them. Rigid systems are built for sturdiness and the ability to orient the wings optimally in relation to the wind.

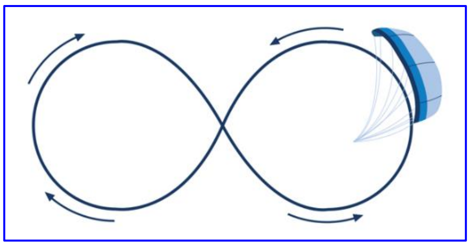
Other characteristics can complement this categorization, such as the number of elements in articulated wings, the type of articulation (slot, flap), etc.

Rotor and Suction wings



The rotor and the suction wings are very compact systems, but they require external energy to start rotating, turn, or draw in air. Their optimal performance is achieved within a generally narrower range of apparent wind compared to other systems.

Kite



The kite has the advantage of not cluttering the deck and of reaching higher for stronger and more stable winds. It operates optimally on downwind courses.

5 - An environmental and economic opportunity

Environment

Wind propulsion is the only current technological solution capable of significantly reducing both energy consumption and emissions.

• New ships: 30 to 80% reduction in fuel consumption and associated emissions

• Retrofit: 5 to 20% reduction in fuel consumption and associated emissions (depending on trade, sea conditions and vessel operations).

Its operation produces no greenhouse gas emissions and does not require extensive infrastructure for production, transport, or land-based storage, nor does it involve bunkering or onboard storage. As a free resource, harnessed directly and locally, its use at sea does not compete with terrestrial applications.

Economic

Weather models and routing tools developed in recent years, particularly thanks to offshore racing, ensure a reliable transportation service. Wind propulsion reduces operational costs and frees the vessel from the volatility of fuel costs, as well as the energy dependence of ships since it significantly reduces the need for bunkering.

Wind propulsion solutions provide significant power, which in some cases can cover up to 90% of the needs on certain routes and depending on the vessel.

Furthermore, a new industrial sector is emerging today, creating added value and jobs.

For illustration: The French wind propulsion sector has hired 1,100 employees over the past 3 years. It forecasts an annual revenue of €1.5 billion by 2030 (more than €4 billion in cumulative revenue by 2030), and more than 4,600 direct jobs.

By 2050, the wind propulsion sector could represent 13,000 to 23,500 jobs in the French civil naval industry (compared to the current 50,000 jobs in the latter) and an annual revenue of €7.7 billion.

6 - A solution applicable to all fleet segments

Wind propulsion technologies are suitable for all fleet segments: bulk transport, oil, gas or chemical transport, container transport, as well as the transport of rolling equipment, ferries and passenger transport, or even fishing fleets and service vessels.

The choice of the most suitable technology for a ship should be guided by its structural and operational needs: ship tonnage, deck space, operating conditions (speed, available wind resource – angle and speed of the wind) and the desired level of decarbonization during transport.

Some operational or route constraints will require the ability to fold the rigs (foldable, telescopic, etc.) such as passing under a bridge or loading and unloading using cranes or gantries in ports. Meteorological routing tools are used both upstream to plan navigation and during navigation to optimize the route taken by the ship, thus reconciling operational, economic, and ecological constraints.

Containerships

Rolls on/Roll off, car carrier...

Chemicals tankers

General cargo, gas carriers, bulk carriers, tankers

Service Ship

Passengers transport, ferries

Fishing vessels

7 – A booming industrial production

The equipment manufacturers are industrializing the production of their equipment and have been carrying out installations for 4 years, thus testing the first series.

The production of the SolidSail rigging by Chantiers de l'Atlantique illustrates this growth. This system measures 80 meters high with a total surface area of 1500 m². After being tested on land for a year between 2023 and 2024, it is now being integrated onto the 136-meter ro-ro ship Neoliner Origin currently being built in Turkey. This ro-ro ship will be operated on transatlantic routes. Wind will be its main source of propulsion. It will then be installed on two cruise ships ordered by the Orient Express company.

	SolidSail 1500	SolidSail 800
Fuel economy (per year per rig)	1000 t*	500 t*
CO_2 emissions avoidance (per year per rig)	3200 t*	1600 t*
Overall Sail surface	1500m²	800 m²
Height above deck	74m (28m (tilted))	49m
Vessels compatibility	Vessel length above 150m	Vessel length above 60m
Main materials / manufacturing place	Fiber glass and carbon manufactured in France	

*Calculation over trans atlantic routing

The Chantiers de l'Atlantique, who develop and manufacture this system, have built, in collaboration with other industrial companies, a new production plant in Lanester. The SolidSail Mast factory will enable the equipment manufacturer to ensure the production of its large-sized masts.

8 - First conclusive results

Roll-on/roll-off ship Canopée

The ship Canopée, 121 meters long, operated by the French company Alizés (Jiffmar Offshore Service and Zéphyr & Borée) has been chartered since 2023 by ArianeGroup for the transport of Ariane 6 rocket parts between Europe and the Kourou base in French Guiana. The French equipment manufacturer OceanWings, which installed 4 wings of 363 m2 each, presented initial key figures after 6 crossings, showing 25% to 50% fuel savings measured in 24-hour periods, equivalent to 1.3 tons of fuel saved per wing per day.


Cargo Sailing Ships

The ships Anemos and Grain de Sail II, measuring 81 and 52 meters in length respectively, are equipped with sail systems that allow the vessel to be primarily propelled by wind energy. The ships, designed to optimize sail areas of 3000 m2 and 1500 m2, save an average of 90% on fuel.


Tanker Ship Maersk Pelican

The 244-meter ship has been equipped since 2018 with two Flettner rotors, each 30 meters high and 5 meters in diameter. Developed by the Finnish equipment manufacturer Norsepower, these propulsion systems have enabled a reduction in fuel consumption by at least 8.2% and the related emissions.

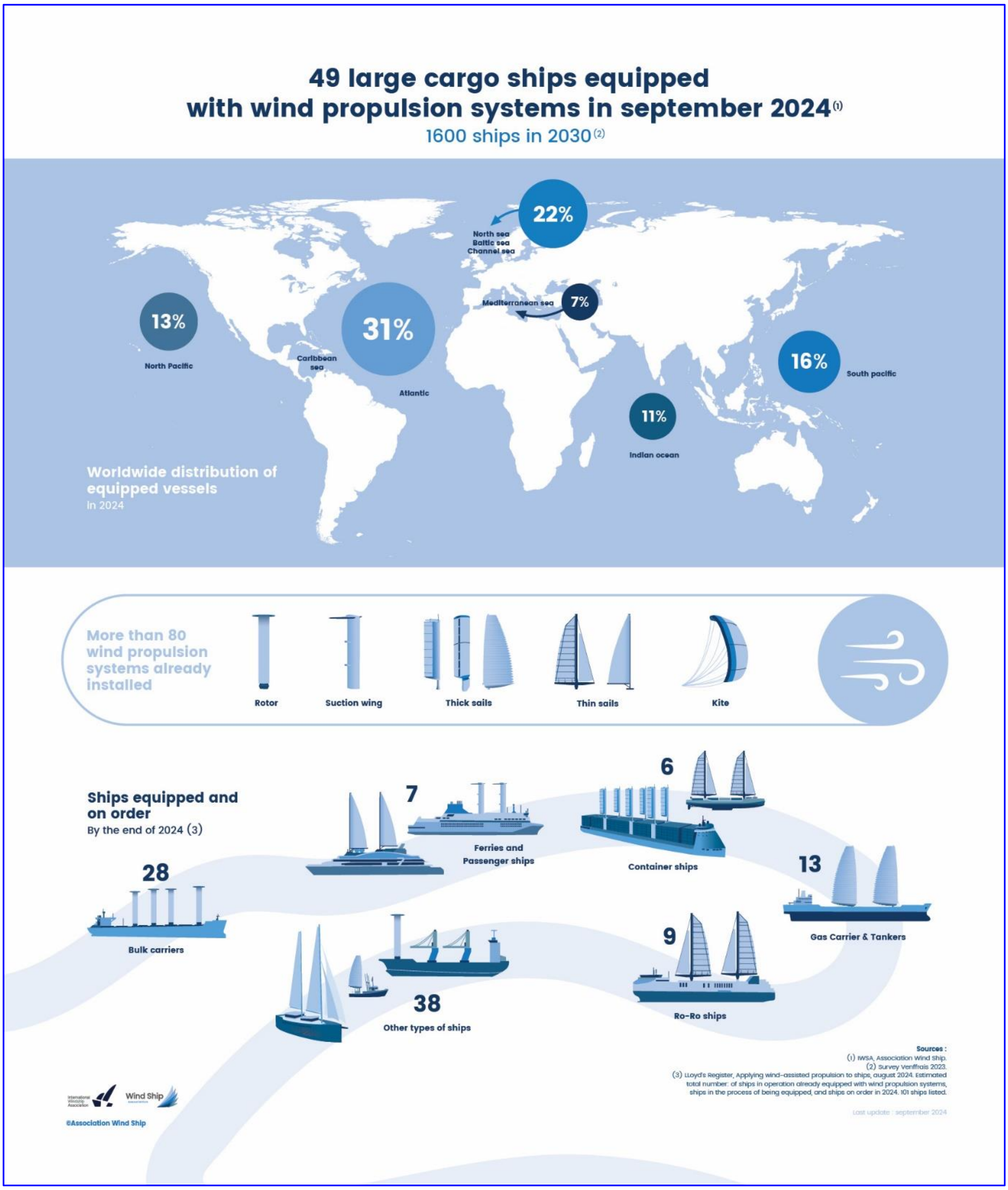
Norsepower has also won Airbus's tender for 3 RoRo ships operated by Louis Dreyfus Armateur, each equipped with 6 rotors measuring 35 meters in height and 5 meters in diameter.


.

9 - Promising future prospects

More than 50 ships are now equipped, and there will be around a hundred in a few months according to the order books – marking the transition of a "tipping point" that allows for the acceleration of installations to reach 1,600 ships by 2030.

The interest in wind energy for merchant ships is highlighted by the work of various research institutes and classification societies: TU Delft, Lloyd's Register, Bureau Veritas, Maersk Mc-Kinney Moller Center for Zero Carbon Shipping, and the Global Center for Maritime Decarbonisation now refer to it as an essential alternative to meet the need for decarbonization and to maintain the economic balance of ship operations.



10 – All in Action: How to Get Onboard and Support the Industry

The development of wind-powered propulsion for merchant ships is essential to achieve the energy transition goals of maritime transport.

In France, a wind propulsion pact has been signed between the French government and economic stakeholders to facilitate the industrial-scale implementation of this solution and fully engage its maritime deployment.

This example of active and constructive collaboration could inspire the establishment of a similar commitment at the European level. Indeed, this pact initiates practices with a strong leverage effect for the wind propulsion sector. These can be further amplified with the engagement of new entrants, starting with the actions proposed below:

SHIPPERS

• Commit to longer-term contracts than the current practice for loading wind-powered ships
• Participate in events dedicated to wind-powered maritime transport (such as Wind for Goods, June 19-20, 2025, in Saint Nazaire)

SHIPOWNERS

• Test wind propulsion systems in development
• Systematically and thoroughly study the integration of wind propulsion in any project where it is technically feasible

FINANCIERS, INSURERS

• Propose analysis criteria and products adapted to the specifics of wind propulsion to facilitate the development of a wind-powered maritime transport service offering
• Value the non-financial performance of wind propulsion projects (decarbonization, underwater noise, ship life cycle analysis, etc.)
• Propose innovative financing methods via pay-as-you-save or leasing

INSTITUTIONS AND STATE

• Implement or expand financing mechanisms for wind propulsion to encourage the deployment of this energy-efficient transport (such as the CEE – energy savings certificate – in France, taking into account a percentage of the savings achieved when the routes are not national)

ENERGY COMPANIES

• In collaboration with wind propulsion equipment manufacturers, propose hybrid propulsion models integrating wind energy

PORT OPERATORS

• Facilitate the reception of wind-powered ships.

To learn more

- Wind Ship white paper (French, English)
- IWSA white paper
- Bureau Veritas Wind Propulsion Report
- Lloyds Register report

NEW ENERGIES
The energies coalition for transport & logistics

Images sources

1. Canopée Ship – © Tom Van Oossanen
2. Illustrations of sail technologies from the White Paper– © Wind Ship Association
3. Williwaw Containership– © Zéphyr & Borée link
4. Neoliner Origin Ship– © Neoline link
5. Piriou Longliner Ship – © Piriou
6. Meltem Containership: © Zéphyr & Borée link
7. Service Ship - © Stena Bulk link
8. Passenger Transport - © STX France link
9. Conventional Cargo - © Boomsma Shipping link
10. Chemical Tanker – © Terntank Rederi A/S link
11. SolidSail 1500 - © Chantiers de l'Atlantique
12. Usine Solidsail Mast Factory - © Architectes Andreatta-Le Pavec link
13. Solidsail Masts under Construction – © Véronique Couzinou link
14. Canopée photos - © Tom Van Oossanen link
15. Maersk Pelican – © Norspower ltd link
16. Airbus RoRos equipped with rotors – © Louis Dreyfus Armateur link
17. Anemos Ship - © Ronan Gladu link
18. Grain de Sail II Ship– ©LoysLeclercq L2Onaval link
19. « 49 Large Cargo Ships », Wind Ship Exhibition Tarp - © Wind Ship Association

NEW ENERGIES

The energies coalition for transport & logistics

www.newenergiescoalition.com