Sure as the wind blows

by Aude Leblanc, *Technology Leader – Sustainable Shipping, Bureau Veritas Marine & Offshore*

A contemporary challenge, the drive to decarbonise shipping, has resurfaced a century-old idea: using wind to propel ships. From wings to sails and kites, we see a new generation of wind propulsion technologies emerge at an impressive pace. But to successfully incorporate those hyper-modern systems on board, we need a holistic approach that addresses their impacts on the vessel's stability, structural integrity, and manoeuvrability.

We are seeing a boom in the development of cutting-edge wind propulsion systems, with fixed & tiltable Flettner rotors, kites, suction sails, and rigid & soft wing sails all making global headlines in the past few years. The new age of sail has thus begun.

This renewed enthusiasm for wind is powered by the need to curb greenhouse gas emissions from seaborne transportation. The International Maritime Organization has adopted a net-zero target for the middle of the century as part of its Revised Strategy that calls for emission reductions of "20%, striving for 30%" by 2030. In addition, the IMO's Carbon Intensity Indicator and the European Union's Emissions Trading System are increasing pressure on shipping to reduce its environmental footprint in the short term.

In addition to turning to low- and zero-carbon fuels, many owners are contemplating wind propulsion, considered a strong contender for achieving significant emission reductions. As a result, technology adoption is progressing at speed. Today, about 30 large vessels of different types are equipped with wind propulsion systems, and the number of installations is set to surpass 50 in 2024, according to the International Windship Association. About 30,000 merchant ships are projected to use wind propulsion by mid-century.

Holistic approach

But making these installations a reality comes with a series of design challenges. For naval architects and engineers, enabling a ship to harness wind power is far more complex than simply adding new equipment on board.

Equipping a ship with a wind propulsion system inevitably impacts a wide range of design and operational aspects, from weight and structural strength to stability and manoeuvrability. Furthermore, each wind propulsion solution is designed for a specific set of conditions and limitations, dependent on the technology chosen as well as the characteristics of the ship itself and the routes where it is operated.

These projects require a holistic approach, addressing the safety risks associated with wind propulsion systems, the management of operations in various environments, as well as the broader impact of the set-up on the ship's structure and weight and how it will interact with other onboard systems. This is a prerequisite to seizing the enormous potential of wind propulsion to help decarbonise shipping while ensuring safety at all times.

Safe innovation framework

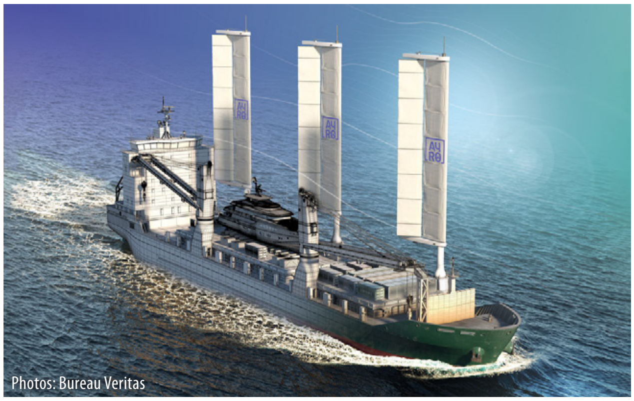
A critical technical consideration for any wind propulsion installation is ship stability. The heel induced by wind propulsion systems, as well as the impact of the additional weight on the vessel's load lines and tonnage, must be assessed thoroughly. This is essential because a ship's stability profile may limit the conditions in which the wind propulsion system can be used, also varying relative to the ship's type and unique characteristics. For instance, tankers and bulkers generally have sufficient stability margins; then again, using wind can be trickier for ferries, which tend to have a smaller stability reserve.

Another challenge for installing wind systems is ensuring that any structure placed at the front of the ship won't restrict visibility to comply with current regulations. This is generally easier to achieve for newbuilds, which offer the option of installing the bridge at the front.

However, this doesn't mean that retrofitted wind propulsion systems can't be an interesting option for shipowners. The first step is to determine the number of systems that can be installed on the vessel whilst meeting visibility and stability requirements and to pinpoint the optimal locations to maximise deck space and ensure the best performance.

The next step is to consider the integration of the system's foundations with the ship's hull, which may require structural modifications to reinforce the hull, including changes to the ship's anchor and chains, stabilising elements, and steering and manoeuvrability equipment.

Photo: Zéphyr et Borée/Tom Van Oossanen


Photos: Bureau Veritas

It is important to note that regulatory bodies, including IMO, have yet to produce industry-wide regulations and incorporate wind in relevant existing legislation. As specific criteria have not yet been developed for commercial vessels, compliance is assessed on a case-by-case basis. This is where classification rules, such as **Bureau Veritas' Rule Note for Wind Propulsion Systems** (NR 206), play a critical role. As the key classification framework for wind-assisted propulsion, the NR 206 details requirements to ensure the safety of those systems on board, providing a framework for safe innovation. This is essential to support developers of wind propulsion technologies while giving shipowners confidence in these innovative solutions.

From concept to reality

A recent example of wind propulsion installation is *Canopée*, a freighter built to transport satellite launcher components from Europe to French Guyana. Jointly chartered by Zéphyr et Borée and Jifmar Offshore Services, the 120-meter ship has been equipped with four automated articulated vertical wing sails – each covering 363 m^2 and supported by a 30-meter mast. It is one of the first 21^{st}-century merchant ships designed explicitly for wind propulsion and was also the first time that BV's NR 206 was applied to a real-life newbuild vessel.

As the classification society responsible for *Canopée*, we supported the owner and shipyard through all steps of integrating the wind propulsion solution on the ship. In line with our Rule Note, we validated the vessel's stability and the structural integration of the system on the ship's hull. All key aspects (including stability, visibility, and structure) were addressed during the vessel's design, leading to the landmark installation in August 2023. The success of the project demonstrates the importance of adopting an all-round approach when installing wind propulsion.

BV is also involved in retrofit projects, including the upcoming installation of Bound4Blue suction sails on the ro-ro vessel *Ville de Bordeaux*, owned by the French shipowner Louis Dreyfus Armateurs. In addition to validating stability, BV's role is to validate all the modifications that need to be made to the ship before the installation, including structural deck reinforcement and anchoring and mooring equipment. We will also verify the electrical balance of the vessel, among others, the energy needed for the system's automation and the electric supply required by the suction sails themselves.

Going forward, as more wind propulsion systems are developed, a key area of focus will be to support sea trials, which are essential to ensure that these technologies operate as intended and safely – and performantly.

Another priority will be to build knowledge across the maritime sector. Cross-industry collaborations are already underway to share best practices and develop methods for transparent performance prediction. For example, the NORVENT project aims to carry out an inventory of the needs and approaches used to measure the performance of wind propulsion systems for ships, an essential step to harmonise assessment methods and give strong credibility to those results. This will help owners determine which technology will suit their fleets and operations and consider all design and operational aspects to harness the power of the wind successfully and safely. ■

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