



Decade of Wind Propulsion 2021-2030

Delivery | Optimisation | Facilitation

www.decadeofwindpropulsion.org

IMO-UNEP-Norway Innovation Forum

IMO – 28 September 2023

Gavin Allwright, Secretary General
International Windship Association (IWSA)
www.wind-ship.org

Direct Application of Wind Power

Wind Energy

- Zero - Emissions
- Zero - Cost
- Zero - Volatility
- Zero - Infrastructure
- Zero - Storage

Wind Propulsion Technology

- Zero - Development Time
- Zero - Compatibility Issues
- Zero - Additional Crew
- Zero - CAPEX?

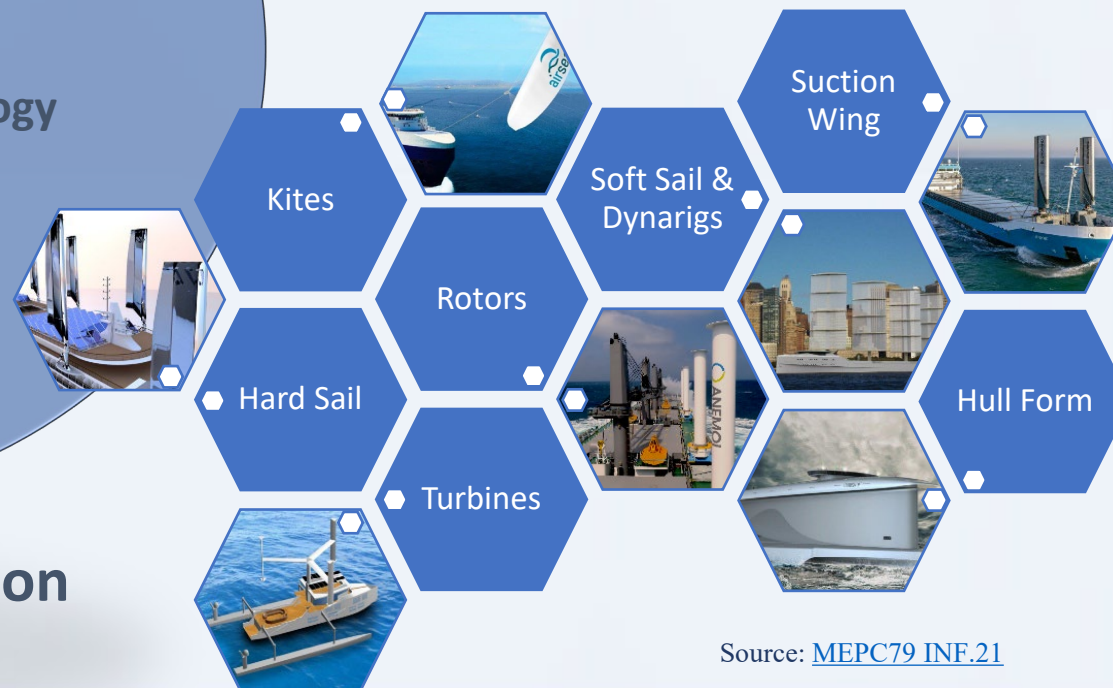
Win-Win-Wind Situation

RETROFIT

5-20% propulsive energy & optimised up to 30%

OPTIMISED NEWBUILD

50-80%+ possible with operational changes

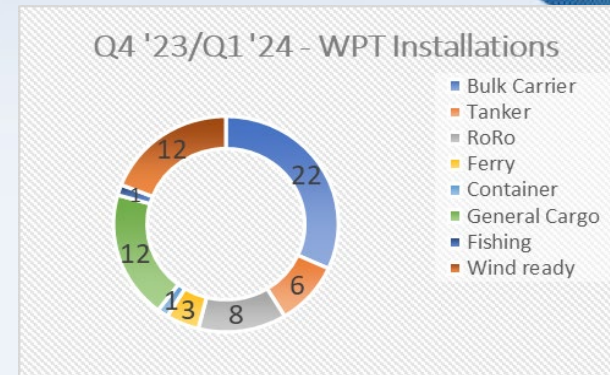


Source: [MEPC79 INF.21](#)

Market Development – 2023+



31 (39) Installations



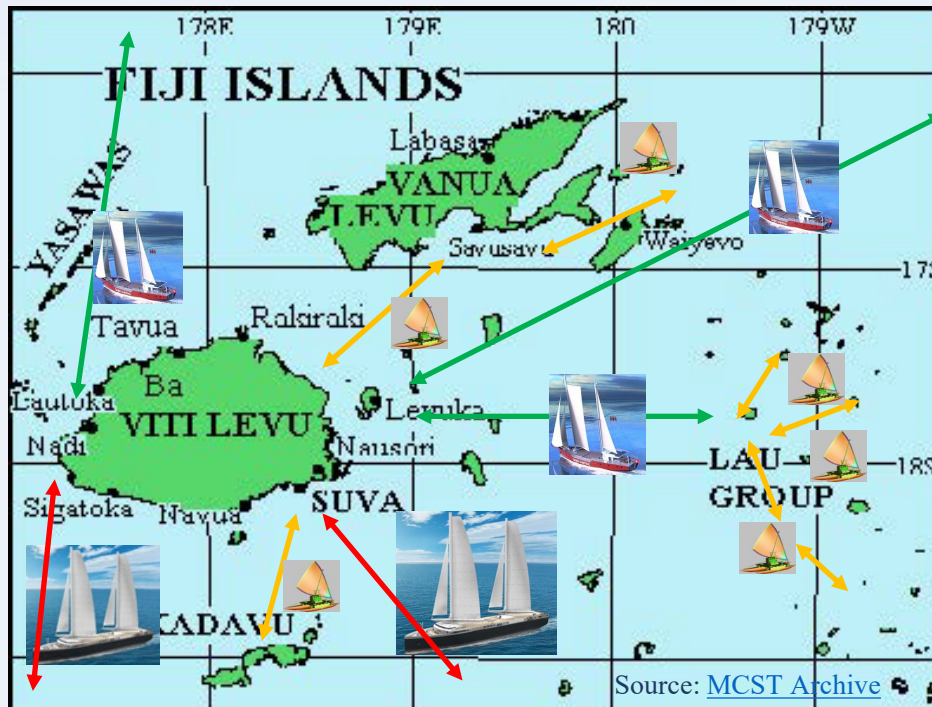
49-53 (65) Installations

2030 - EU Report 2016 ‘...market potential for bulk carriers, tankers & container vessels = **up to 10,700 installed systems** (varied by fuel price, speed, discount rate)

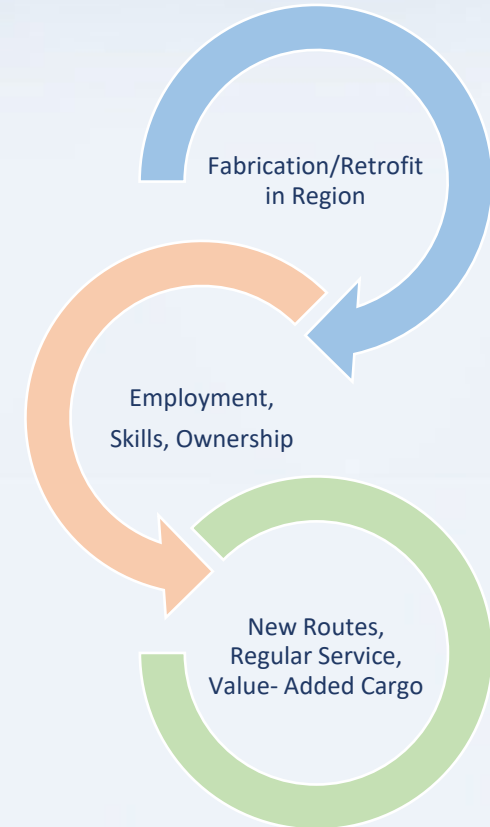
2050 - UK Government Clean Maritime Plan (July 2019), research: **37,000 – 40,000 vessels** with wind propulsion systems installed or roughly **40-45% of the global fleet**.

Sail Cargo - Development Cycle

Example: Fuel prices (MGO/tn) US\$900 → US\$1,100 → US\$1,800+
 (Local Currency/Purchasing Power) (Sing) (Fiji) (Wallis & Futuna)



Virtuous Cycles



- Reduced reliance on Fossil Fuels & lower alternative fuel requirements
- Transfer fuel costs to salary/service improvements
- Reduce/eliminate need for government route/vessel/fuel subsidies
- Improve resilience – fuel cost/availability fluctuations/disaster response etc

Small Vessel & Traditional Sail Developments

Operations: Cargo



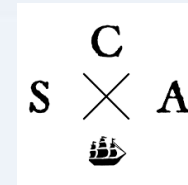
Operations: Fisheries



Operations: Cruise



Technology & Networks



Ship Designs



Builds & Retrofits

Fishing Vessels in Focus



Name: Balueiro Segundo (Bound4Blue)

Size: 593 GT, 41m LOA

Location: Spain (Peru)

System: eSAIL® -fixed suction wing system

Description: This 12m rig is installed in the stern, a stubby, non-rotating wing sail with vents and an internal fan generating suction which pulls in the boundary layer around the wing generating an enhanced effect.

Work Underway: Continued monitoring of commercial fishing activities and further development of the system.



Name: SailLine Fishing

Size: Various small test vessel sizes

Location: Scotland, UK

System: Retractable Balpha Mast Soft Sail

Description: A complete foldable mast system for mast lengths up to 8.5m. The stainless steel mast housing would fit directly onto a mast step and the mast is carbon fibre 100 x 70mm. Length up to 8.5m made to suit vessel requirements.

Work Underway: Continued monitoring of commercial fishing activities and further development for scaled versions.

Name: Grand Lague (Avel Vor Technologies)

Size: 16m trawler

Location: Brittany, France

System: Automated soft sail

Description: Two bipods masts, allowing for retrofit. Three self-steering jibs, with operations of winding/unwinding by an hydraulic roller + automation system for controlling sails.

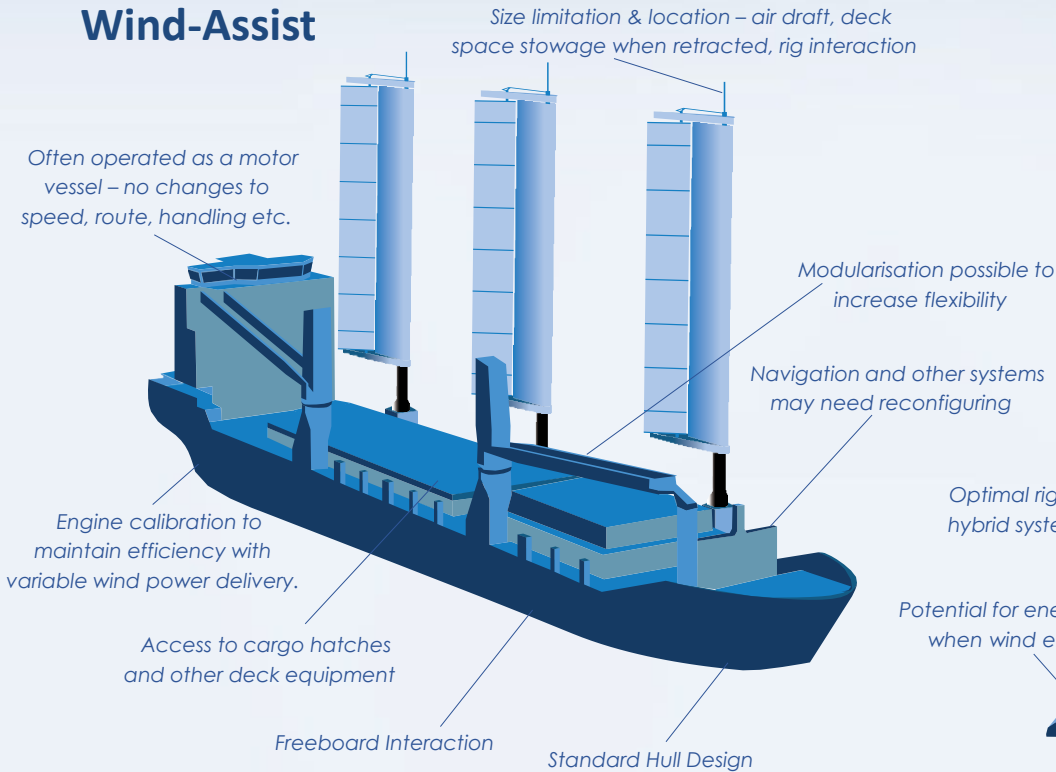
Sea trials: decrease in fuel consumption (wind conditions/route) + decreased rolling consistently.

Work Underway: two generations are using soft sail configurations + rigid wing sails being considered.



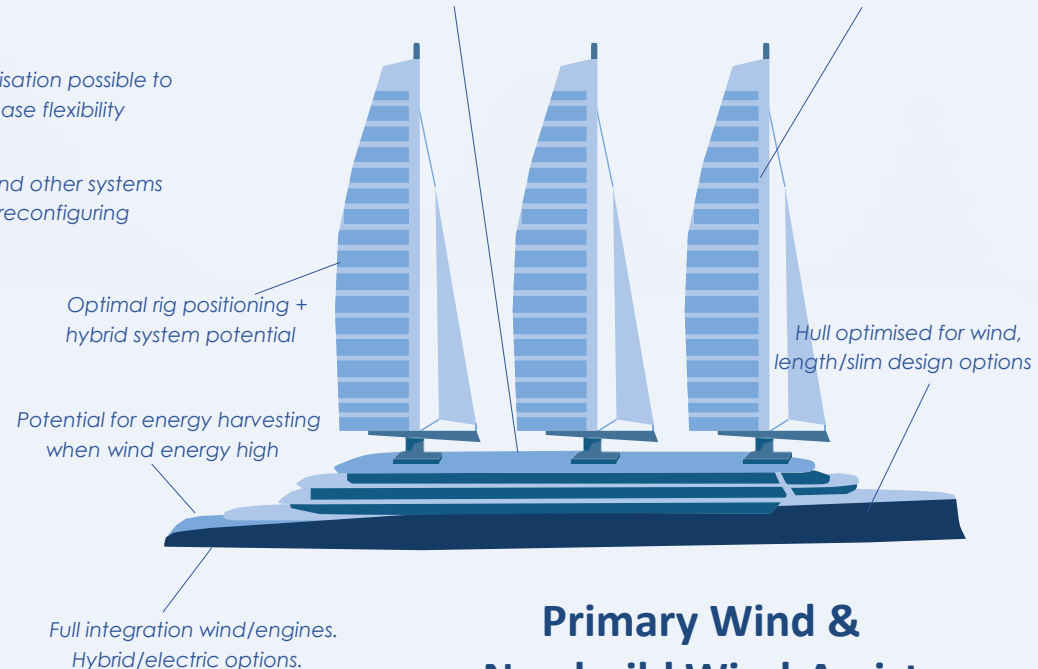
Some Key Considerations Assessing WPT

Wind-Assist

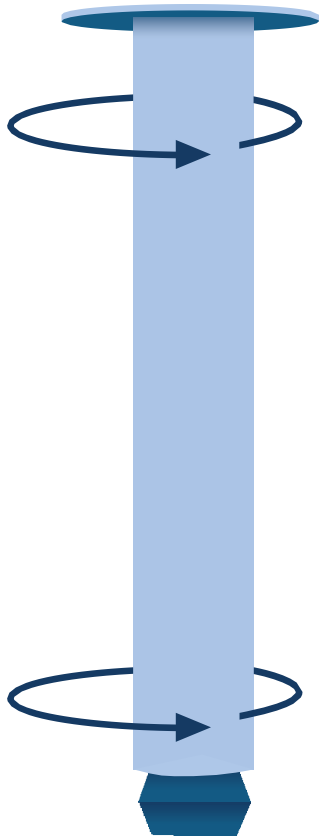


Integrated design elements – access, stability, ballast, cargo/passenger configurations etc.

Weather routing for wind and voyage optimisation lead to substantial increased performance



Primary Wind & Newbuild Wind-Assist



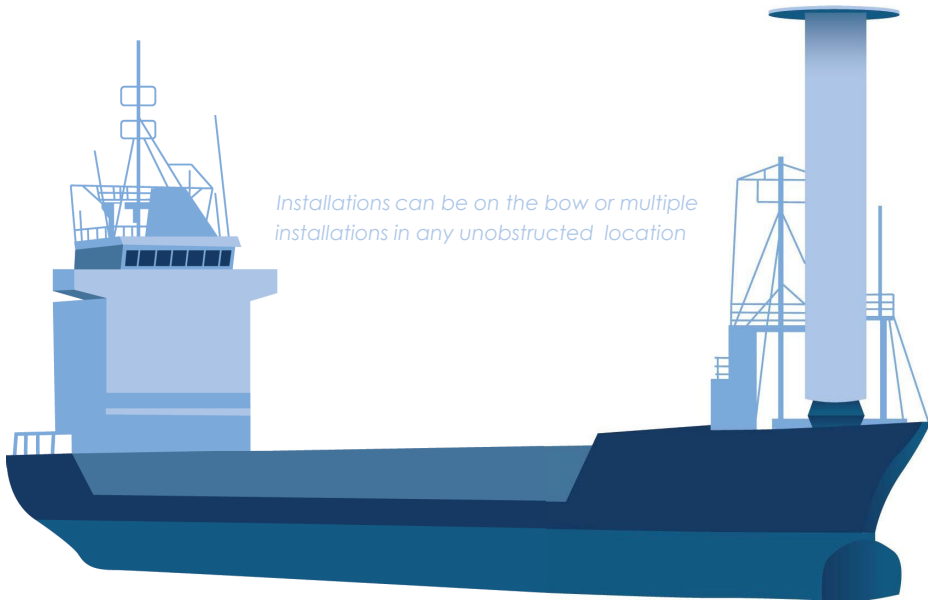
Rotor sail

Flettner Rotor or Rotor Sails are rotating composite cylinders with a top disc and possibly a bottom disc that are rotated at up to 300 rpm (dependent on size/application) by low power motors and as the wind catches the rig, they use the Magnus effect (difference in air pressure on different sides of a spinning object) to generate thrust.

Systems already designed include ones deployed on rail systems, hinged and telescopic versions. The original concept was developed in the 1920's with a small number of installations, however the modern, upgraded version of these sails were first installed on modern vessels in 2010's.

Considerations
Deck space
Retractability
Navigation/Line of Sight
Beam/Head Wind Performance
Vibration/Motor

Installed Sizes (to date)
1m x 18m – 5m x 35m

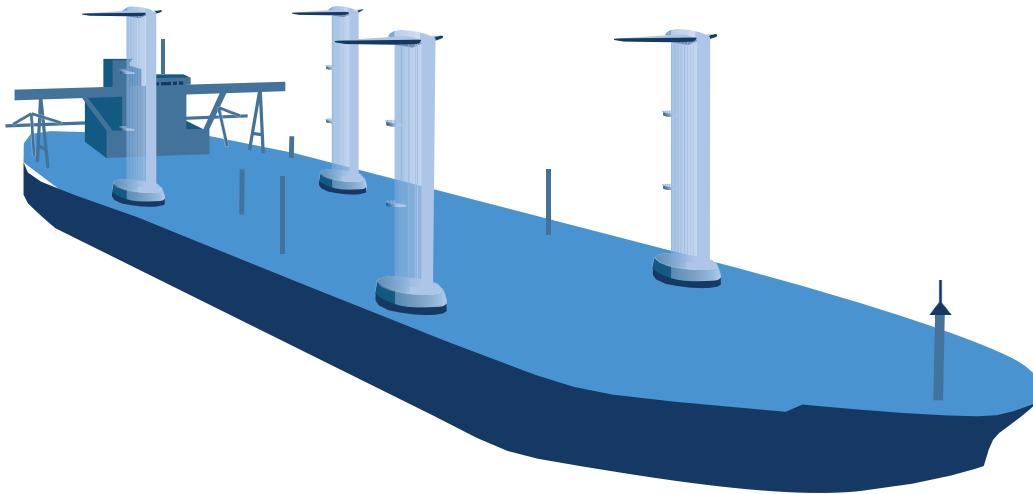


Installations can be on the bow or multiple installations in any unobstructed location

Suction wing

Suction Wings (Ventifoil, Turbosail, eSAIL) are stubby, non-rotating wing sails with vents and an internal fan (or other device) that creates suction which pulls in the boundary layer around the wing generating enhanced effect. Installations to date have been deployed on the bow, stern and as deck containers and flatrack.

The system was originally designed and deployed in the 1980's



Considerations

- Deck space
- Retractability
- Navigation/Line of Sight
- Suction device

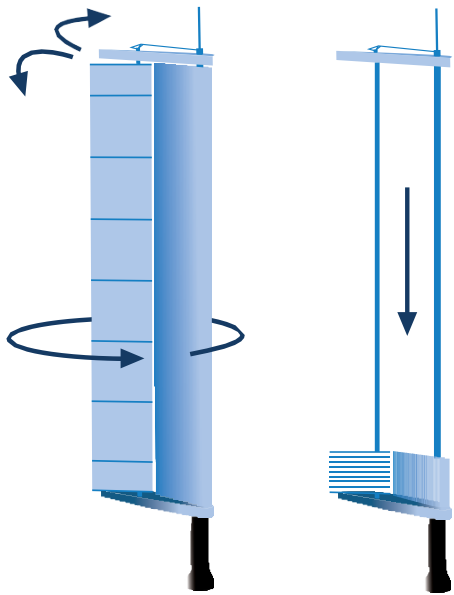
Installed Sizes (to date)
10m-17m

Hard sail & Hybrid sail

Hard or rigid sails are defined by the use of a rigid materials and design and these types of system have been used extensively in the racing world.

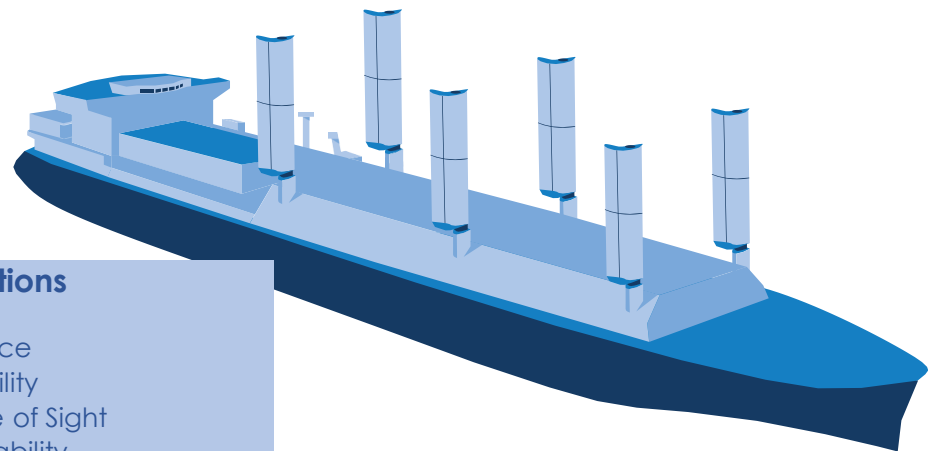
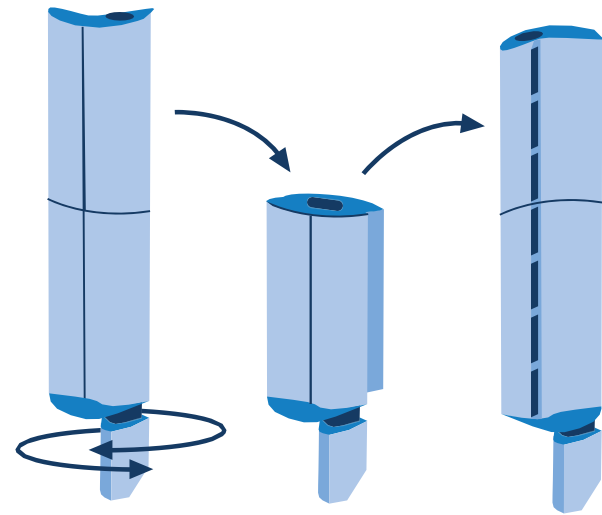
There are quite a variety of different systems from wing sails, foils and JAMDA style rigs, some with single or multiple foils, others deploying movable flaps and some segmented. Some rig designs have solar panels for added ancillary power generation.

Note: There are also hybrid wing sails developed that have a rigid frame, but flexible soft coverings. Rigid sails were first deployed on modern commercial vessels in the 1970s and 1980's.



Hybrid wing sail with flap with soft membrane

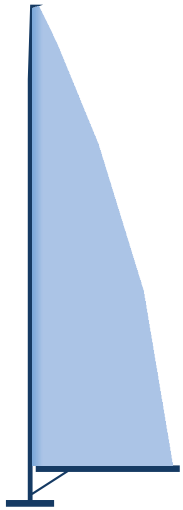
Single wing sail with flap and retractability



Considerations

- Deck space
- Retractability
- Navigation/Line of Sight
- Windage/Stability

Installed Sizes (to date)
2m x 9m - 15m x 35m

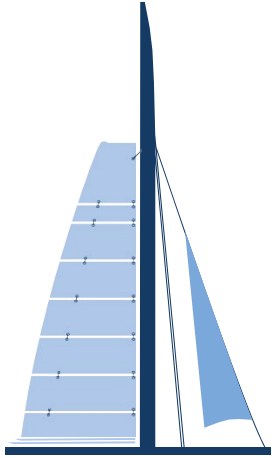


Auto-furling systems are configured for large traditional soft sail installations

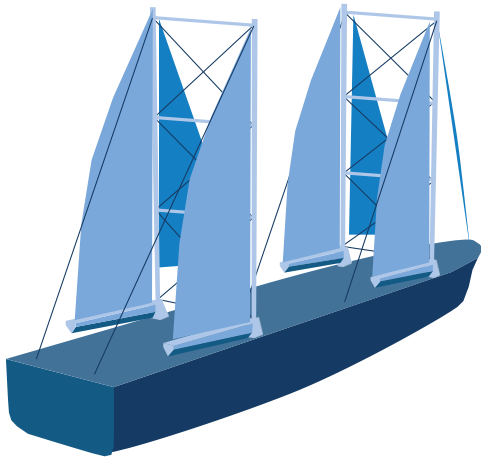
Soft sail & Hybrid sail

Soft sails come in a wide variety of configurations and these include both traditional sail rigs and new designs such as the dynarig system. Many of these systems are well-tested and their use has been extensive throughout the world both commercially and more prevalently in leisure sailing recently.

New robust materials & production techniques are lengthening their usability/lifespan and automated furling systems and control systems reduce the need for additional crew for large installations (smaller rigs can still be handled manually). Commercial applications require masts to be either retractable or foldable.



Hybrid rig design using furlable rigid panels and soft sail combo

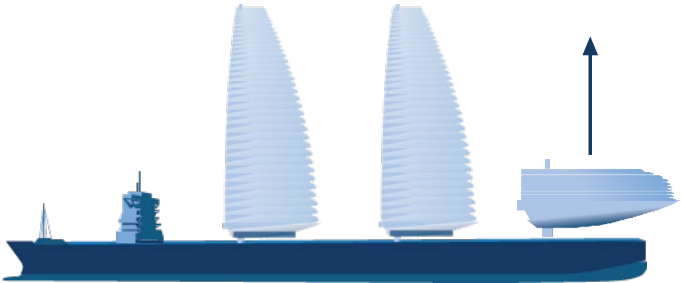
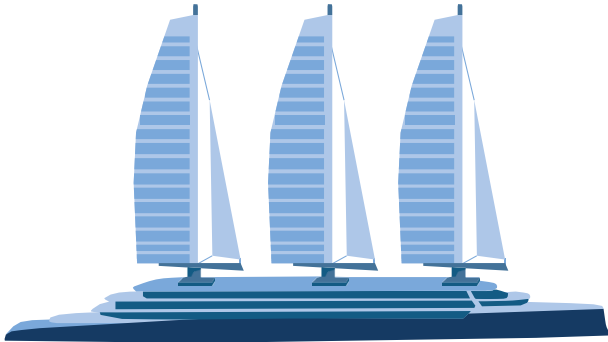


Considerations

- Deck space
- Retractability
- Navigation/Line of Sight
- Windage/Stability
- Material longevity

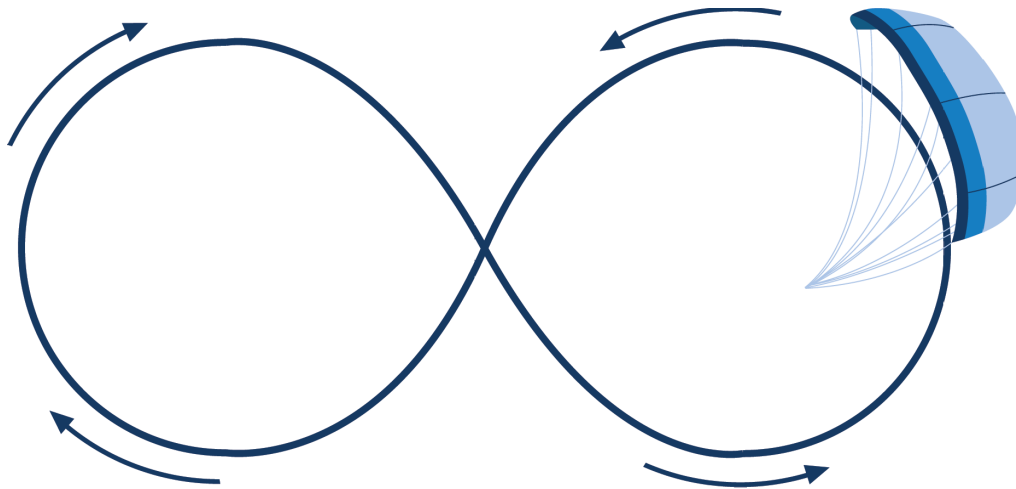
Sizes

highly variable/flexible



One of many new designs, this one is using an inflatable sail system

Dynamic kite example with a figure of eight deployment to enhance power delivered



Considerations

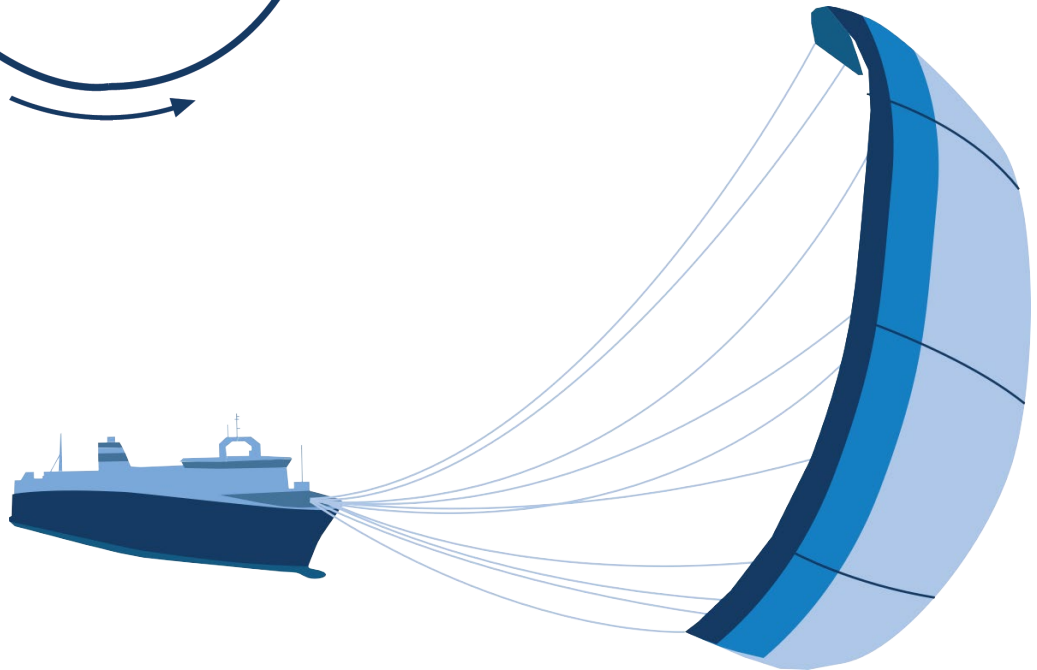
Wind Resources/Direction
Deployment/Retrieval
Control systems
Material longevity

Sizes

(deployed/designed)
500m² – 1000m²

Kite

Kites are deployed at over 200m above the vessel with a tether attached to the bow of the vessel to assist with propulsion. The kites take advantage of constant winds at those high elevations and can either be passive (maintain a single position) or dynamic (controlled deployment in a figure of eight or other configuration to maximise thrust). Kites are primarily generating thrust however the tether could also be used to generate electrical energy. First generation towing kites were first deployed in the 2010's.



Turbine

Turbines using marine adapted wind turbines to either generate electrical energy or a combination of electrical energy and thrust. Turbine systems are being designed that are both vertical and horizontal configurations.



Considerations

Wind Resources/Direction
Mountings/Forces
Vibration/Stability
Material longevity

Sizes

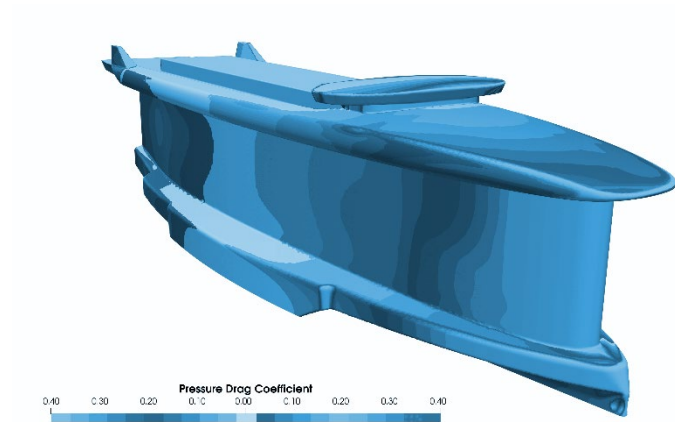
Containerised or Free Standing

Considerations

Stability / Ballast
Extreme Weather Performance
Ship Type / Adaptation

Sizes

Vessel Size



Hull Form

Hull Form designs take the whole of the vessel and adapt the ship's hull itself so that it functions as a large 'sail', capturing the power of the wind to generate thrust. Applicable primarily to newbuilds.