

# Wind Powered Vessels and Norsepower Rotor Sails

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A bit about me

Decade of Wind Propulsion

New sailing ships

Growth in Wind Propulsion Technology (WPT)

Norsepower

Rotor Sail Theory

Trade Routes

Performance

Projects

Future





Built 1974 Newcastle upon Tyne



Built Sunderland 1961





Seafarer, roro, bulk, general cargo  
Lloyd's Register Surveyor- London and Portugal  
Newcastle University, EDC - researcher  
British Steel, business development  
Shell, Naval Architect  
Teekay, Structures, Naval Architect,  
Director, Strategic Development, Global Leadership Team



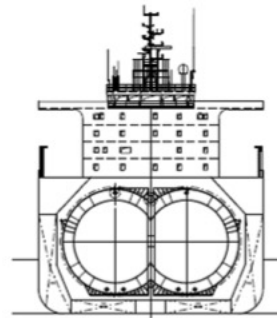
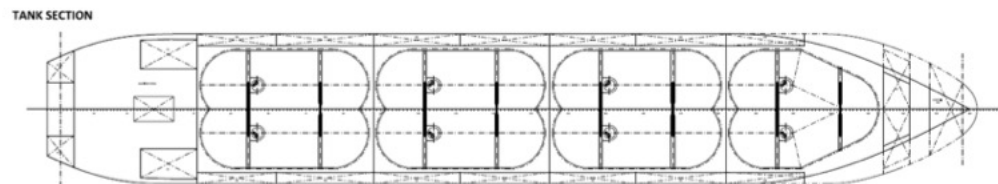
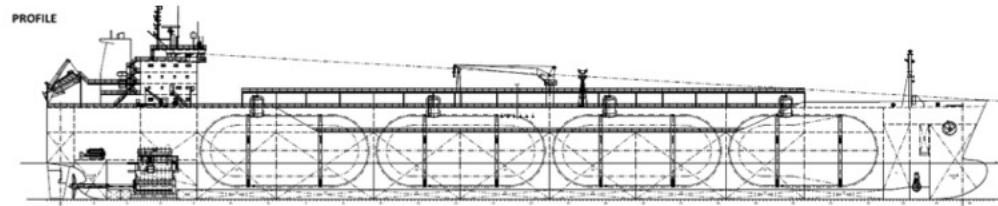
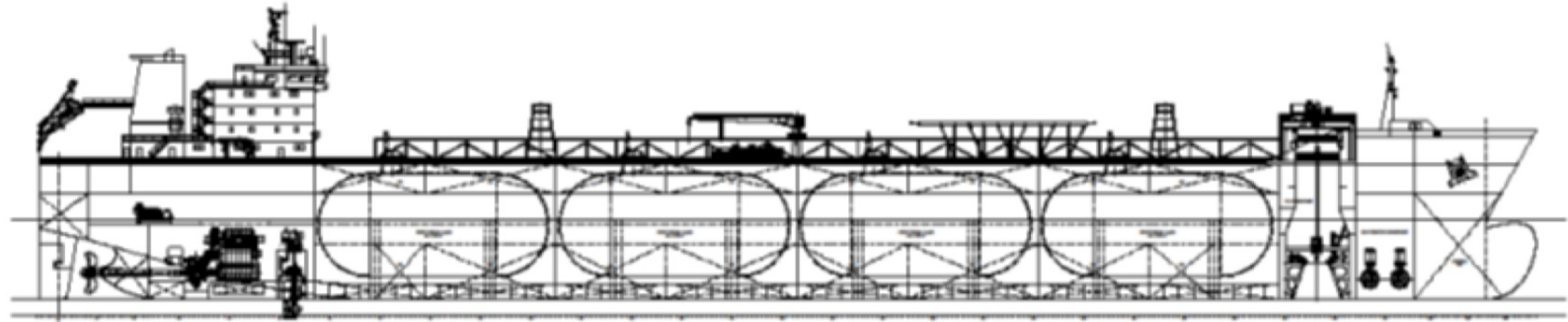
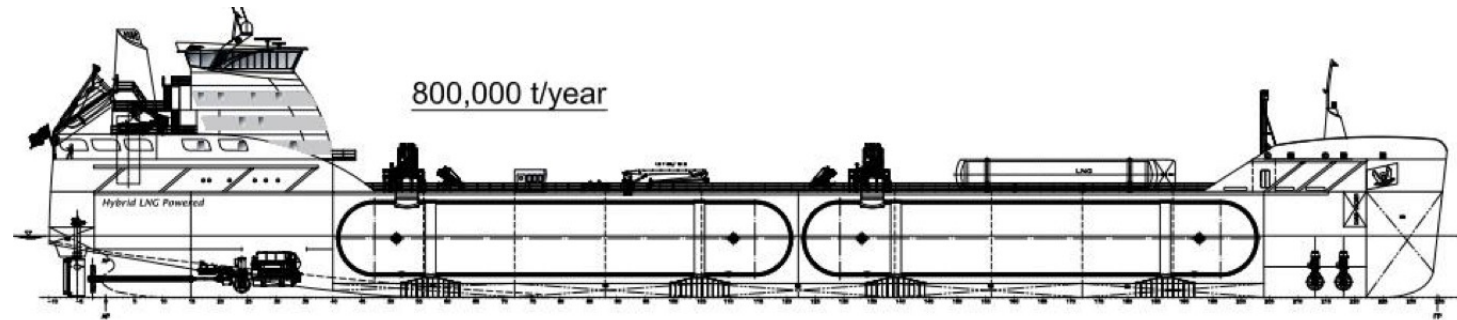


# LNGC



dmitry-v-ch-l.

# LCO2 Designs



GA's for illustrative use only



# Decade of Wind Propulsion 2020-2030

<https://www.decadeofwindpropulsion.org>

IWSA – International Windship Association

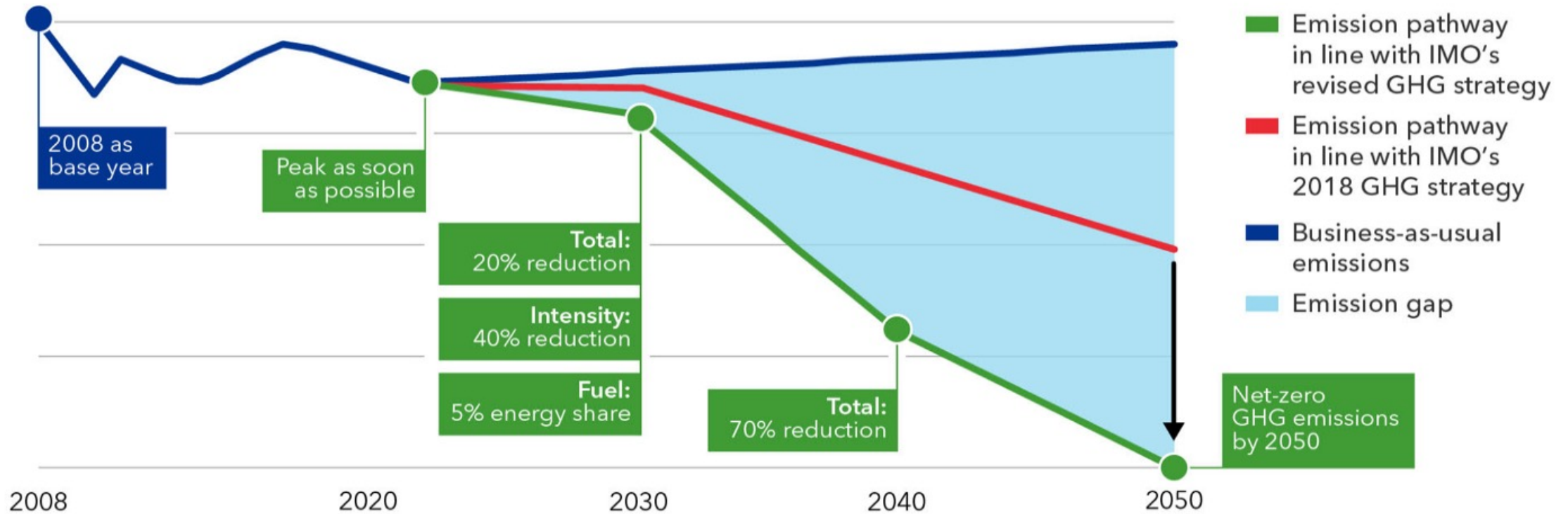
Full Members: 64 (+7.5%)

- Associate Members: 40 (+20%)
- Registered Supporters: 95 (+10%)

The Decade of Wind Propulsion 2021-2030 has been announced by over 130 leading companies, experts and supporters and is a declaration of intent from this growing technology segment of commercial shipping to **Deliver, Optimise and Facilitate** the **decarbonisation** of the current fleet and the vessels of the future.

## Outline of ambitions and minimum indicative checkpoints in the revised IMO GHG strategy

Units: GHG emissions









# Canopée



Launched December 2022, Sails fitted Summer 2023, photos from Bay of Biscay.  
Carries parts for Ariane rocket between Europe and French Guiana



# Oceanbird

The first fully sailing vessel from the Oceanbird concept will be equipped with six Oceanbird Wings.

About 7,000 cars

Length 220 metres

Beam 40 metres

Air draft 70 metres

The ambition is to commence sailing in early 2027.

Photo credit Oceanbird



 **AURELIA**  
| Green Ship Concept Design |

  
**CARISBROOKE SHIPPING**

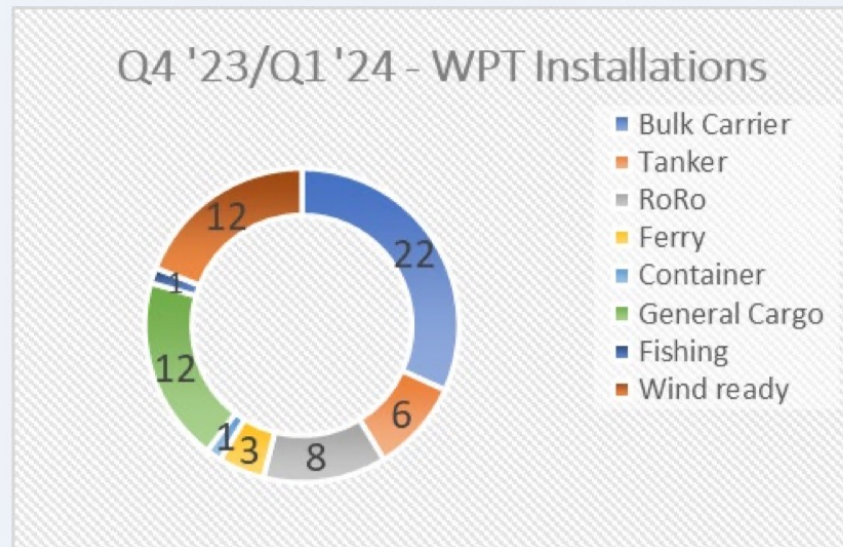
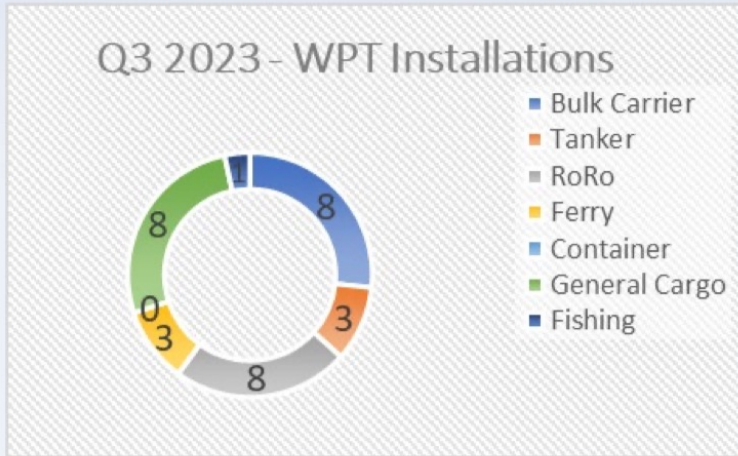


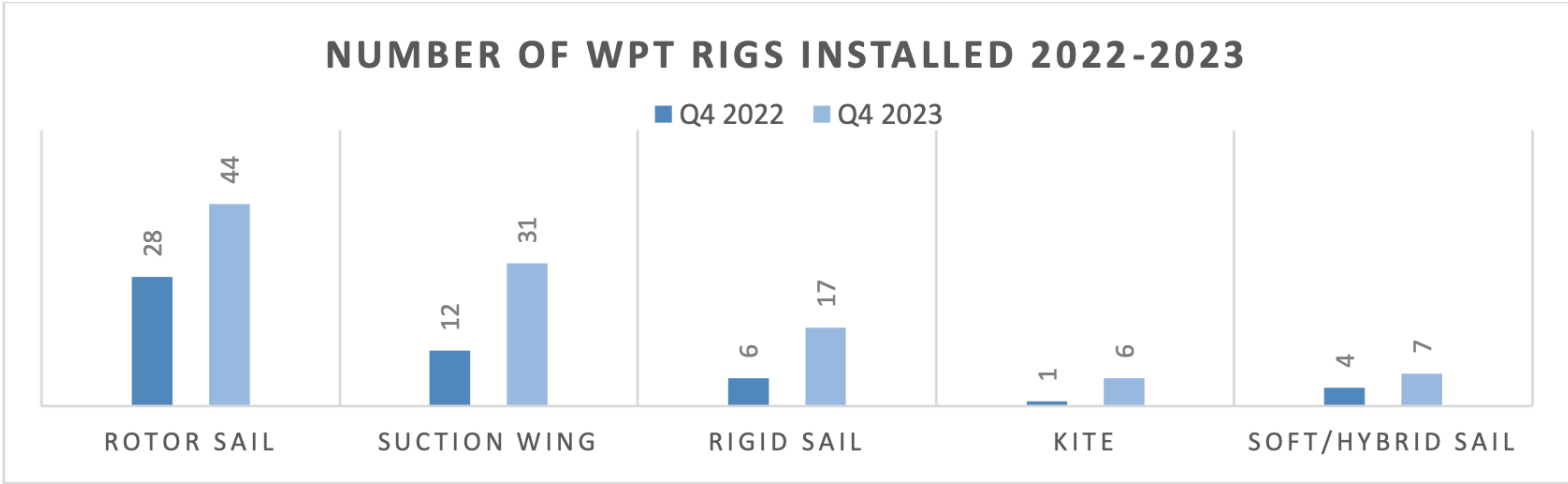
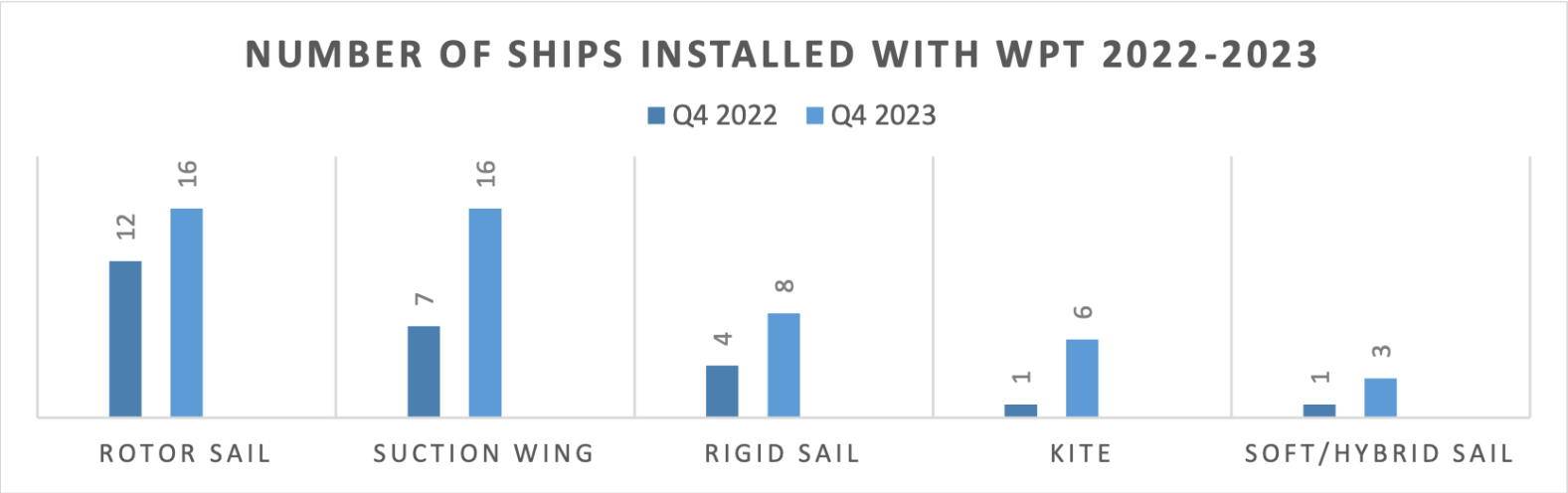




**Blue Wasp Marine and Groot Ship Design team-up for  
WASP**

**1300 TEU Container Ship**



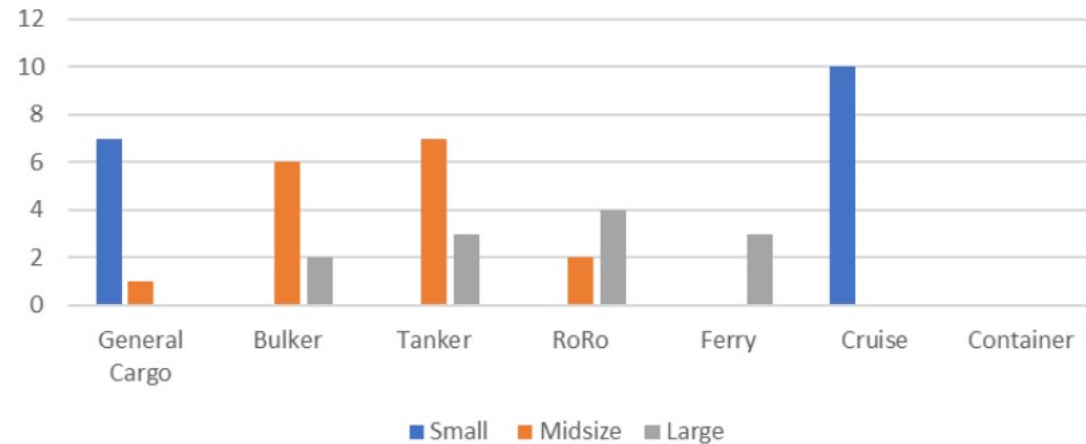




## Commercial WPT Installations on Ships over 400GT



## Vessel Segment & Size (including Wind ready) - 2023



# About Norsepower

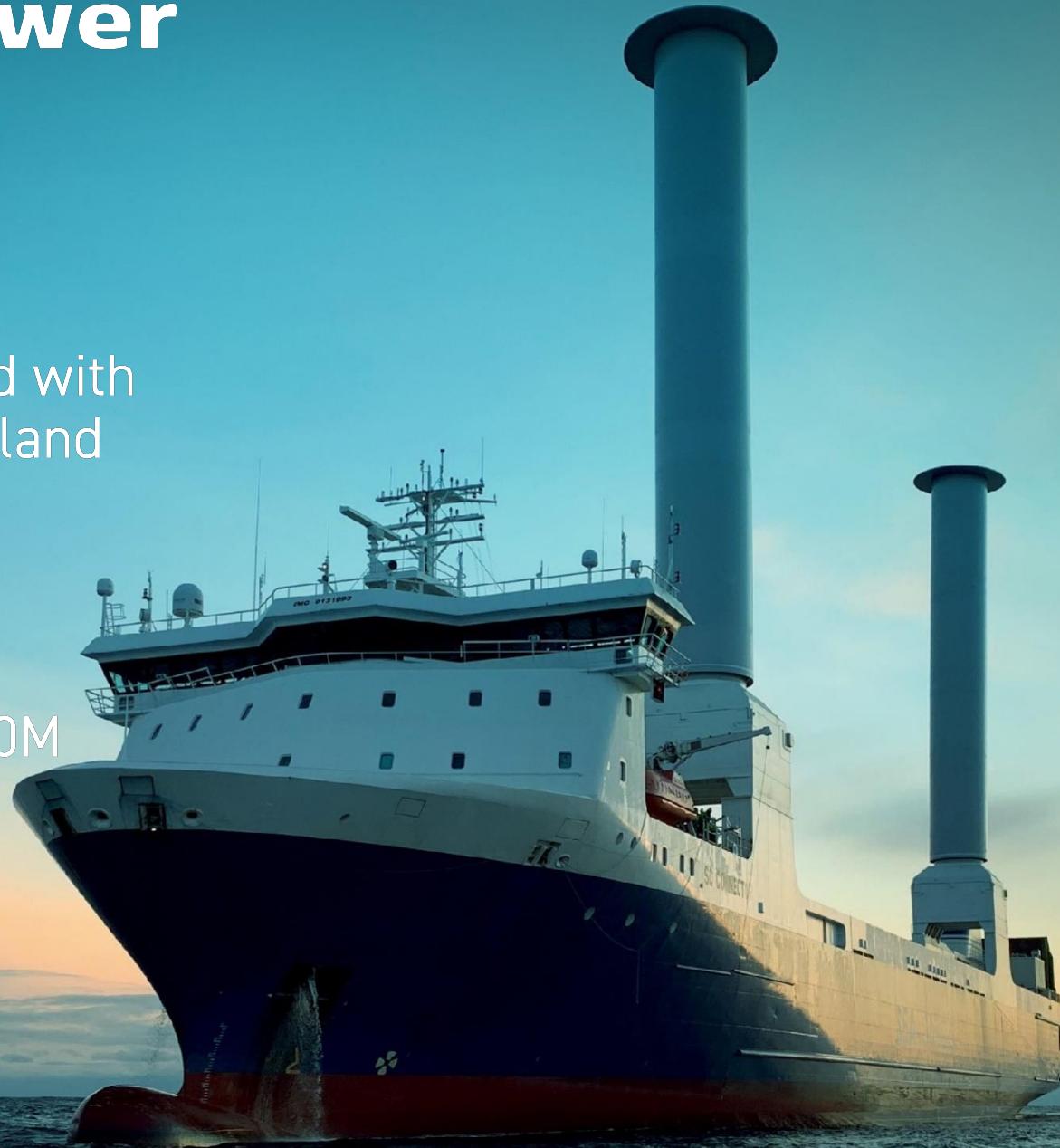
Established 2012

55+ people

HQ in Helsinki, Finland with  
production hubs in Poland  
and China

Revenue target  
100 M€ by 2025

Order backlog >EUR10M





# Bringing sails back to shipping

A high technology product

Modern materials

Fully automatic operation

Reputable supplier network

Simulation tools & data analysis

Continuous development and learning  
with our customers.

Fuel saving performance

Typical average savings 5–25%

Up to 70% in perfect sailing conditions





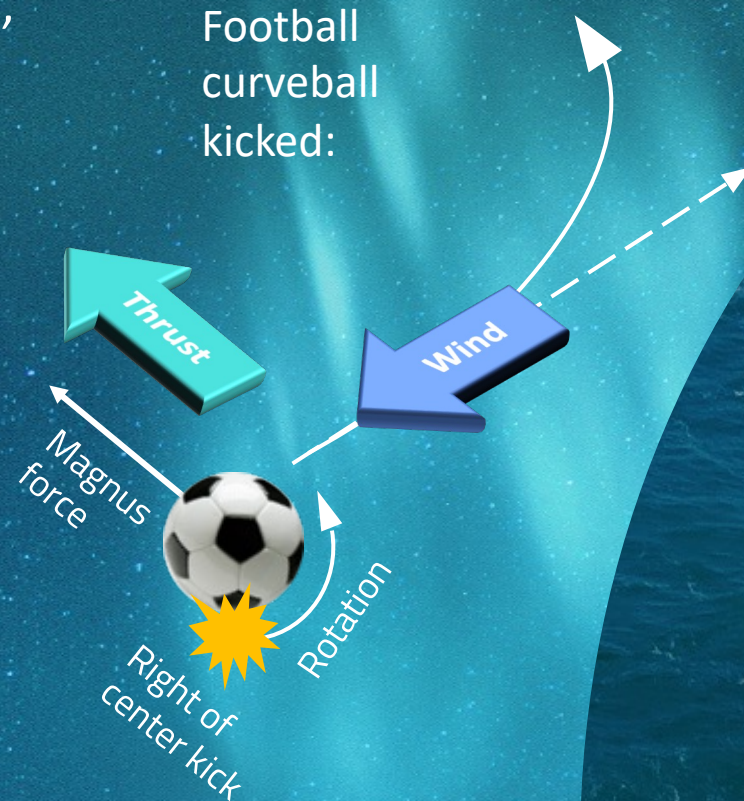
# Norsepower Rotor Sails™ science: Magnus effect

In e.g. curve balls in football, tennis & golf.

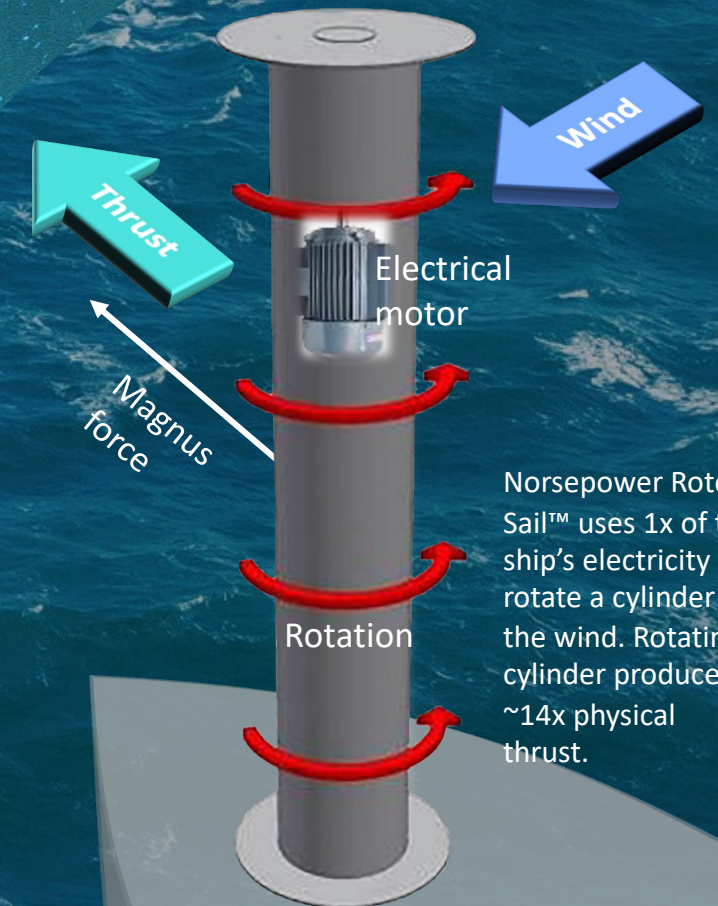
Spinning object + relative wind  
-> pressure differential  
-> thrust at 90° angle to the wind

Norsepower Rotor Sails™ harness wind to maximise ship's fuel efficiency.

Unique technology: high-tech materials, intelligent automation software & relentless testing in real life circumstances.



Norsepower Rotor Sail™ rotated:



Norsepower Rotor Sail™ uses 1x of the ship's electricity to rotate a cylinder in the wind. Rotating cylinder produces ~14x physical thrust.



# Norsepower Rotor Sail™: the most powerful sail in the world

Norsepower Rotor Sails™ provide superior thrust in comparison to other sail technologies.

In relation to surface area, the product produces >12x more thrust than a traditional sailing ship sail!

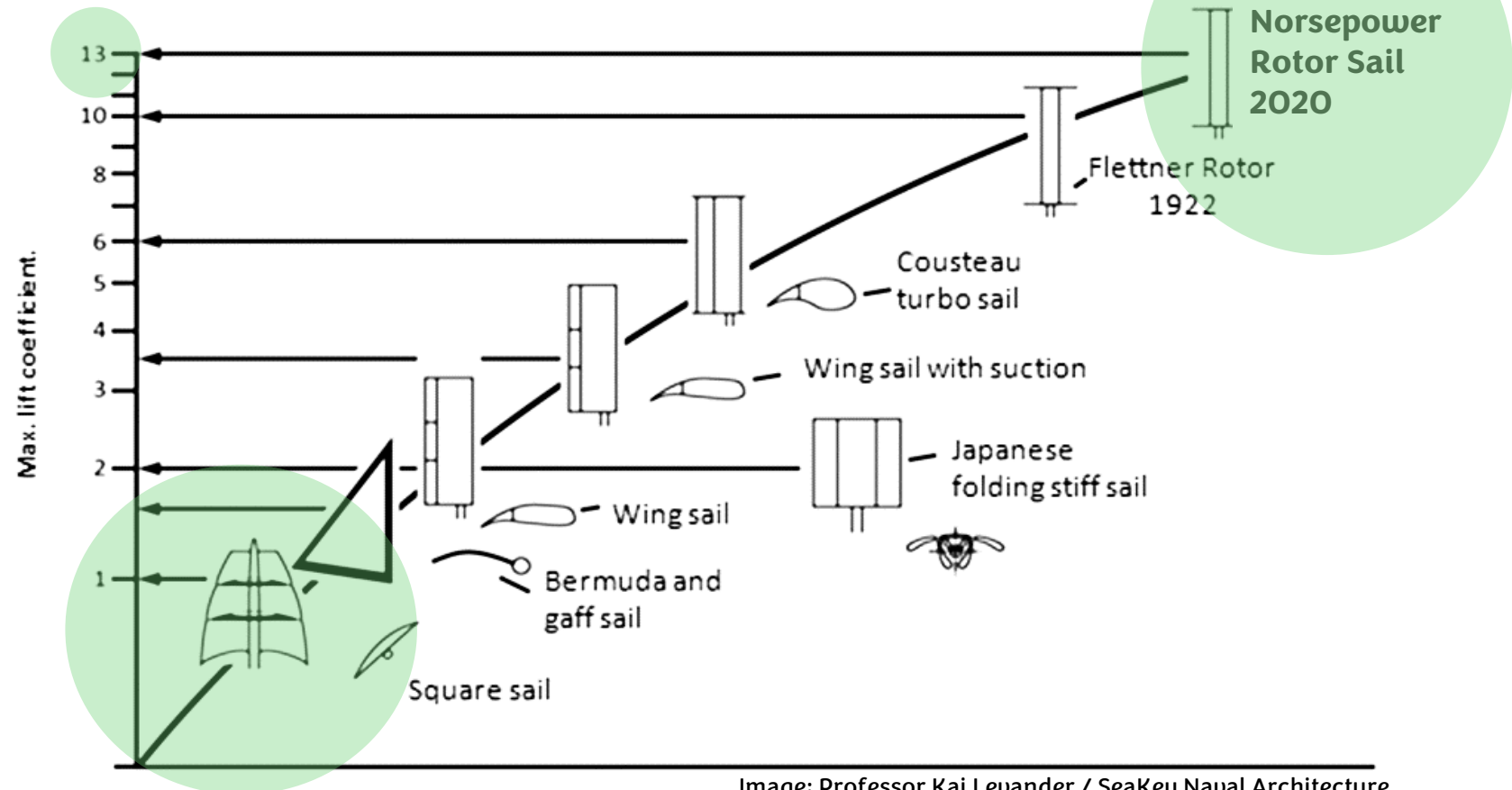


Image: Professor Kai Levander / SeaKey Naval Architecture

# Rotor Sail Polar Diagram

The thrust produced by a Rotor Sail is calculated into main-engine equivalent power for different true wind speeds.

Each colored line represents the corresponding true wind speed in m/s.

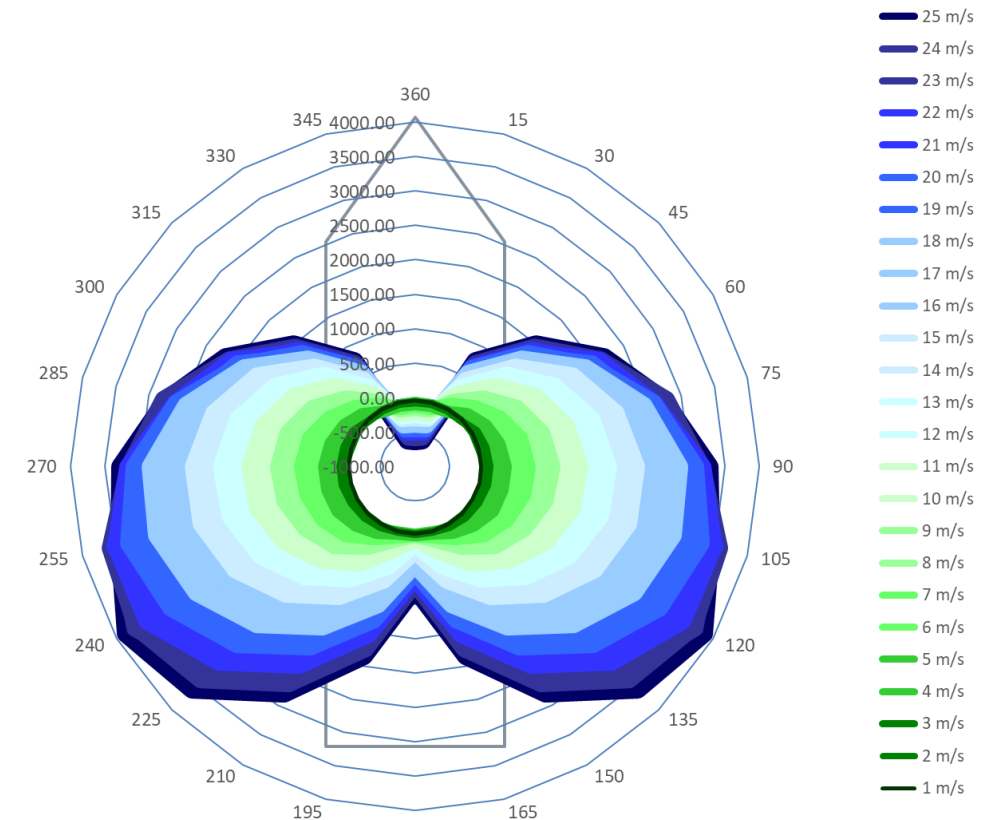
The power produced by the rotor is given in radial direction, the angle from vertical is the true wind angle.

Parameters:

- Service speed: 15 knots
- Assumed total propulsion efficiency: 0.70 (= towing power/brake power)

Examples of the maximum thrust of one Rotor Sail expressed as the propulsion power equivalent:

- 1200 kW (10 m/s wind speed)
- 3850 kW maximum (25 m/s)



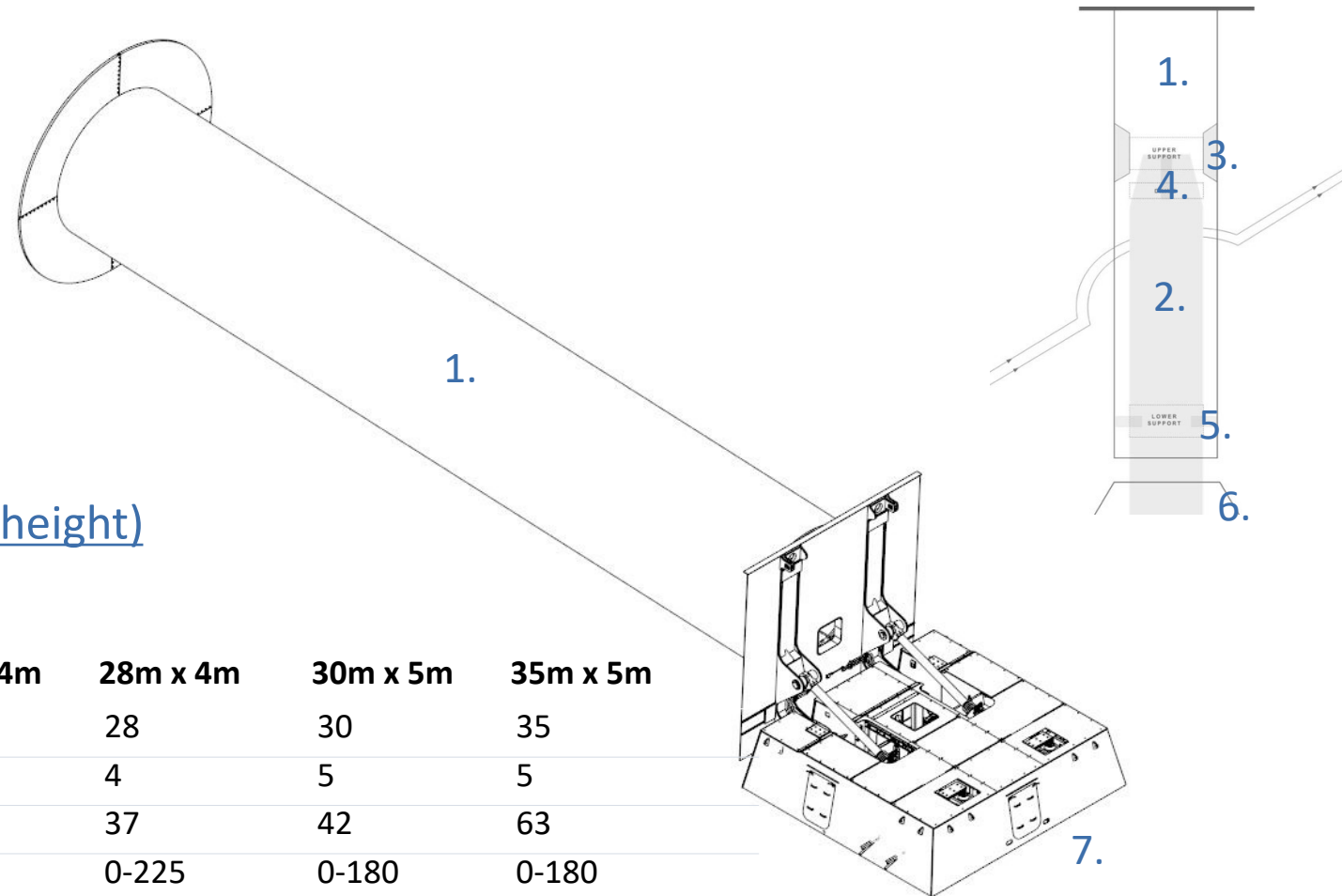
## Polar Diagram

One 35m x 5m Norsepower Rotor Sail™  
Rotor Propulsion Power [kW] &  
True Wind [m/s], STW = 15kn, EFF = 0.7



# Norsepower Rotor Sails™: Main components & properties

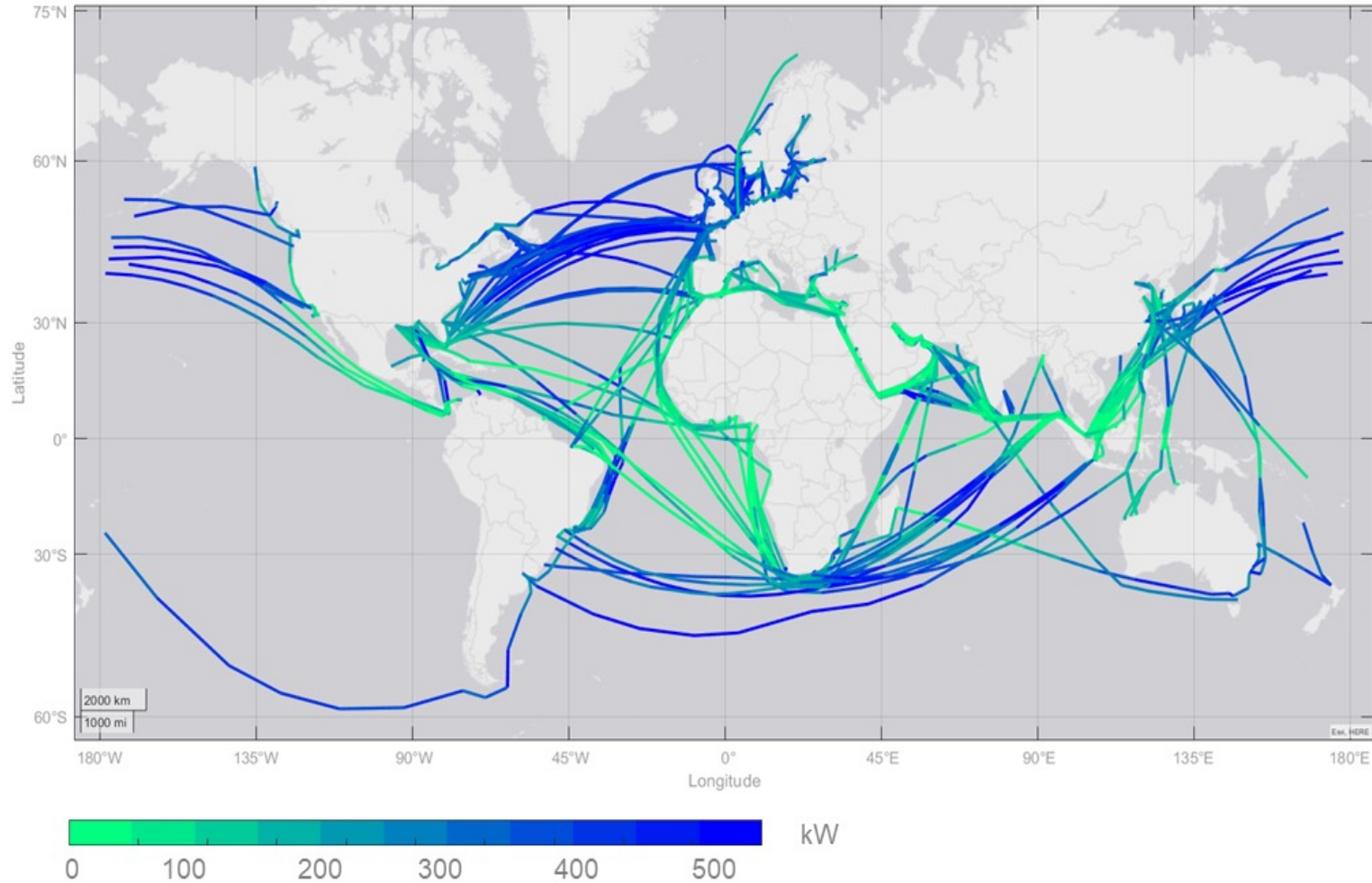
1. Composite rotor
2. Internal support steel tower
3. Upper support main bearing
4. Motor and drive for rotation
5. Lower support rollers
6. Foundation on ship's deck
7. Tilting option to reduce air draft (=ship height)



Properties	18m x 4m	24m x 4m	28m x 4m	30m x 5m	35m x 5m
Rotor height , m	18	24	28	30	35
Rotor diameter, m	4	4	4	5	5
Weight without foundation, tons	27	30	37	42	63
Speed, rpm	0-225	0-225	0-225	0-180	0-180
Electric motor, kW	60	80	100	115	143
Average el. consumption	15...50 kW				

# Most global shipping routes provide strong, favorable winds

Long-term average propulsion power savings for one 30m x 5m Norsepower Rotor Sail™ on a vessel sailing 15 knots



# Weather routing has a potential to double the Norsepower Rotor Sail™ performance

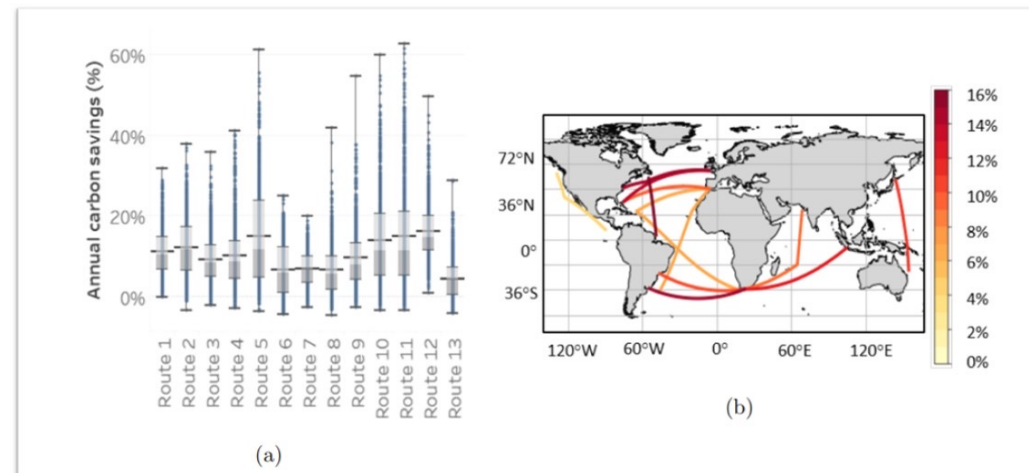
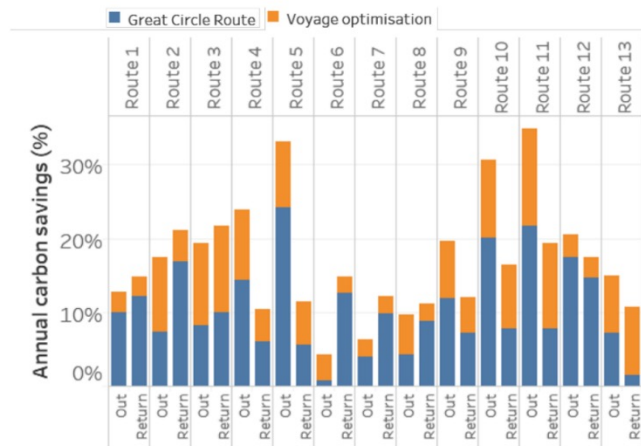


Independent studies, Norsepower simulations:  
Weather routing + Voyage optimization ->  
potential to performance leap on typical long-haul routes

Benefit of weather routing: 20–60%

- Additional performance compared to shortest Great circle route performance

NAPA Voyage Optimization software offered as an option







Ongoing Deliveries for 10 ships



300 000 operating hours



In operation on 7 ships





# Third party verified performance

- The performance of Norsepower Rotor Sails on the first reference vessels has been measured and analyzed by independent third-parties.

Ship name	Third-party verifiers	Measured savings
M/V Estraden	NAPA, VTT	450 kW 440 tons
Epanastasea (ex Maersk Pelican)	LR	8.2%
Viking Grace	ABB, NAPA	230–320 tons
M/V Copenhagen	SSPA	3.9%

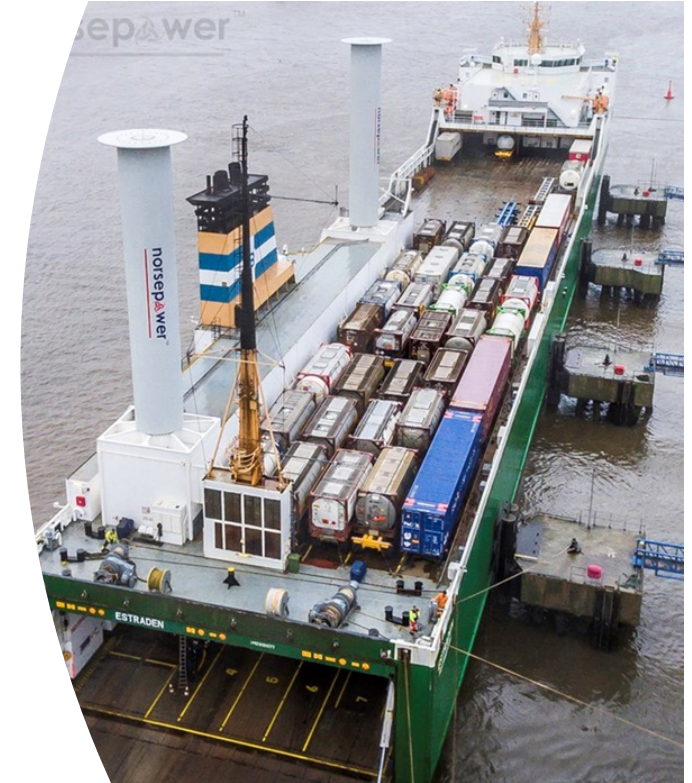
# First installation 2014: M/V Estraden, Bore

## Technical performance

- Thrust performance as expected.
- Noise and vibrations remain at low levels.
- The automation system works as intended.

## Operator experiences

- The rotor has a stabilizing effect on the roll motion of the vessel.
- No recognizable effect on rudder angles or leeway.
- The system is fully automatic, and the crew can use it after short training.
- Average fuel saving 6.1%.





# Epanastasea (ex Timberwolf, ex Maersk Pelican)

In partnership with Maersk Tankers, The Energy Technologies Institute (ETI), and Shell Shipping & Maritime, two Norsepower Rotor Sails™ were installed onboard the Maersk Pelican in August 2018.

The LR-verified fuel savings on actual routes of the ship during a 1-year trial period were **8.2%**.

Two 30m x 5m Norsepower Rotor Sails™ are expected to reduce average fuel consumption on typical global shipping routes by 7 – 10%.



# In operation: Scandlines hybrid ferries, MV Copenhagen & MV Berlin

One 30m x 5m Norsepower Rotor Sail™ installed in May 2020 and May 2022 as a retrofit.

MV Copenhagen and MV Berlin

- Hybrid passenger ferry
- Rostock-Gedser route

Sea trial results, validated by SSPA  
Fuel saved & CO<sub>2</sub> emissions reduced  
by 4–5%.





# Reference: Sea-Cargo SC Connector

Two tiltable 35m x 5m Norsepower Rotor Sails™, installed as a retrofit in Dec 2020.

Ro-Ro vessel SC Connector

- 154.5m x 22.7m, 8843 DWT
- Sailing on the North Sea

Typical average fuel saving 20–25%, up to 70% in good conditions.

Rotor Sails produce up to 8 MW of propulsion power equivalent thrust in optimal conditions.





# In operation: Vale VLOC Sea Zhoushan

Owned by Pan Ocean Ship  
Management.

Chartered by Vale.

340m x 62m, 325 000 DWT

Five 24m x 4m Norsepower  
Rotor Sails™ installed in 2021.

Estimated average fuel savings of 8% and  
CO<sub>2</sub> reduction of 3400 tons/year on Brazil–  
China route.



**8% fuel savings**  
**3400-ton annual CO<sub>2</sub> reduction**







Photo from: Norsepower



# Delivery project for CLdN RoRo MV Delphine

Owned by CLdN.

Two 35m x 5m Norsepower Rotor Sail™ with tilting foundations to be installed in February 2022 as a retrofit.

Targeted fuel saving of 7-10% on the trade between UK and continental Europe.

Installation in Feb. 2023.



# Delivery project for three! CO<sub>2</sub> carriers

Customer: Northern Lights, a joint venture between Total, Equinor and Shell

Shipyard: Chinese Dalian Shipbuilding Industry (DSIC).

One 28m x 4m Norsepower Rotor Sail™ on each vessel.

Estimated fuel savings and CO<sub>2</sub> emissions reduction appr. 5%.



# Delivery project for “M/V Koryu” combination carrier

Charterer BHP

M/V Koryu is operated by Nippon Marine.

Retrofit installation of one model 35m x 5m Norsepower Rotor Sail™ with a tilting foundation.





# Delivery project for MR tanker “Alcyone”

Customer: Socatra

Retrofit installation of two model 35m x 5m Norsepower Rotor Sails™ on the MR tanker Alcyone.

Installation in Q4/2023 – Q1/2024.



# Delivery project for a capesize bulker

Customer: MOL

Charterer: Vale

Retrofit installation of two model 35m x 5m Norsepower Rotor Sails™ with tilting foundations.

Installation in H1/2024.

With Norsepower Rotor Sails™ and voyage optimisation, the vessel is expected to achieve about 6–10% fuel consumption and GHG emissions reduction.





# Delivery project for a VLGC

Customer: Iino Lines

Charterer: Borealis

Retrofit installation of two model  
20m x 4m Norsepower Rotor Sails™.

Installation in Q2/2024.

Norsepower estimates that the ship can achieve at least 8% fuel  
consumption and emission reductions on its route.





# Delivery project for a bulk carrier

Customer: Iino Lines

Charterer: J-Power

Retrofit installation of one model 24m x 4m  
Norsepower Rotor Sail™.

Installation in Q3/2024.



# Near Term

Norsepower have deliveries to new installations on 10 ships, most of them will be completed during the next 12 months so this will double the number of rotor sails in operation.

More projects on the way than mentioned here



# Market potential: newbuildings + retrofits = 30,000 vessels

2M€/ship = 60B€ potential

Typical fuel savings: 5–25%.

Shortest payback periods already ~3 years

CO<sub>2</sub> reduction potential equivalent to 30 million cars

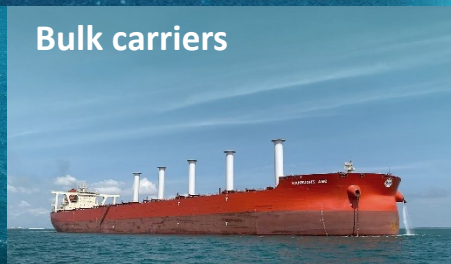
Part of the solution to enable zero carbon shipping

## Market size:

Source: Equasis Statistics, The World Merchant Fleet in 2018



13 000 ships



12 000 ships



1 400 ships



2 000 ships



3 300 ships



# Getting to Zero

Not enough to slow steam

Fuel choices are complicated

Wind assistance and wind propulsion technology provide a real and demonstrated way to progress

Technically reliable and mature technology option





# NORSEPOWER

Thank you!

Please contact [iain.braidwood@navalarchitecture.ca](mailto:iain.braidwood@navalarchitecture.ca) for more information

Tel +1 604 613 2601  
[www.navalarchitecture.ca](http://www.navalarchitecture.ca)

