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NORSEPOWER ROTOR SAILS REDUCE FUEL CONSUMPTION AND EMISSIONS OF SHIPPING

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#### Wind is coming back to shipping

- Wind is a free resource that has historically powered all maritime logistics
- Wind is environmentally friendly with no emissions
  - Regulation is forcing ship owners to substantially reduce emissions
- Wind-assisted technologies have recently developed to enable substantial cost savings in most commercial ship types
  - Norsepower has patented and brought to market the most effective way of harnessing wind for shipping





# Introduction to auxiliary wind propulsion

- Norsepower Rotor Sail produces thrust force (it does not generate electrical power)
- Average savings depend on configuration and on the wind conditions of the route
- Depending on wind conditions the service power is replaced with wind propulsion → HYBRID system
- Norsepower's technology is well suited to almost all ship types
- The technology is compatible with all other ways to save fuel
- Typical payback period range is 3-9 years





#### Physics of the Rotor Sail: Magnus Effect explained

- When a spinning object meets relative wind, it results in a pressure differential, which creates thrust at a 90° angle to the wind
- The phenomenon is most commonly visible in ball games where spin is applied (football, tennis, golf)
- Mr. Flettner (GER) and Mr. Savonius (FIN) discovered the fundamentals of a "Flettner rotor" in the 1920s
- Since then, Norsepower has modernized the technology entirely by introducing hightech materials and automated operation



# What's different today compared to 1926

- Materials  $\rightarrow$  Light weight, durable, energy efficient
- Design tools  $\rightarrow$  Optimised designs, reliability, efficient processes
- Digitalisation  $\rightarrow$  Automatic operation, efficient, easy-to-use
- Connectivity  $\rightarrow$  Remote monitoring and operations support, high availability
- All of the above  $\rightarrow$  Fuel saving and emission reduction leads to a **PROFITABLE INVESTMENT**



Anton Flettner's "Buckau" in 1926.



"Maersk Pelican" in 2018.



# Control system optimizes the net benefit



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#### 5 ships, 4 different Rotor Sail sizes, 140.000+ hrs



# **References: Sea Cargo, SC Connector**

- 2 x 35x5 meter Rotor Sails on tilting foundations
- Rotor Sail mechanical installation was made in Dec 2020
- Vessel size: 154.5 x 22.7 m, 8843 DWT





- *"During testing, the two Rotor Sails on the SC Connector have generated a maximum thrust force equivalent of 7 MW propeller shaft power."*
- "The crew of SC Connector has noted that the Rotor Sails have made the seakeeping ability of the ship considerably better by reducing the roll and by enabling higher speed in harsh weather."
- *"10 tons of fuel were saved during one North Sea passing from Norway. All in all, the expected annual savings are around 25%"*
- *"In perfect wind conditions the vessel will maintain regular service speed by sail alone."*

# References: Vale / Pan Ocean, Sea Zhoushan

- 5 units of model 24x4 Rotor Sails on tilting foundations
- Rotor Sail mechanical installation was made May 2021
- Vessel size: Length 340 m, Breadth 62 m, 325 000 DWT





- Ship is owned by Pan Ocean Ship Management and chartered by Vale.
- Estimated average fuel savings of 8% and annual reduction of 3400 tons of CO2 on the Brazil-China route.
- Sea Trials finalized in May 2021

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# Most of the global shipping routes provide strong and favorable winds for Rotor Sails

Long-term average propulsion power savings for one 30x5m Rotor Sail on a vessel sailing at 15 knots



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#### Market potential and environmental aspects

- Rotor Sail technology is applicable to BOTH newbuilt ships as well as existing 30,000 vessels through retrofits = EUR 60Bn installation potential
- Annual fuel savings between **5-25%**
- Global deployment of Rotor Sail technology would reduce global shipping emissions by nearly 10%
- Global CO<sub>2</sub> emissions reduction potential is equivalent to **30 million cars** (82M tons / year)
- Environmental sustainability compliance requirements drive improvements in efficiency of ship designs. Rotor Sail technology is part of the solution to enable zero carbon shipping.

#### Examples of compatible ship types and market size (> 500 GT)



Source: Equasis Statistics, The World Merchant Fleet in 2018

#### **Future concepts with Rotor Sails**



- Benefits for wind propulsion:
  - Optimized hull form to improve wind flow
  - Autonomous operation with 100% system integration
  - No superstructures to disturb the wind flow
  - No crew on board means no visibility limitations
  - Low free board causes less flow disturbance
  - Slow steaming



#### MISSION

To reduce the environmental impact of shipping through the commercialisation of innovative and modern sail power

#### VISION

To set the standard in bringing sails back to ocean transportation, and empower shipping towards reaching the goal of zero carbon emissions





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# Thank you!



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