



**Dealfeng Marine Rotor Sail System**



01

PART ONE

# Company Overview

## COMPANY OVERVIEW



- Dealfeng New Energy Technology Ltd mainly work on the development of new energy technologies and the design & manufacturing of marine energy saving equipment. Dealfeng company has a team member who have over ten years of working experience in shipping industry.
- Dealfeng company, who owns the full independent intellectual property rights of DEALFENG® marine wind-rotor assisted propulsion system, can conduct the design, manufacturing, installation and modification of rotor sail retrofitting according to the newbuild and the existing ships, also can provide general contracting services (turn-key service) for shipowners.
- At present, DEALFENG® marine wind-rotor assisted propulsion system is available for 3m/4m/5m in diameter and 10m-35m in height as well as matched with fixed, tilting or rail foundation based on different ship types.

# COMPANY DEVELOPMENT



## 2018

DealFeng started research and design marine wind assisted propulsion system - Rotor Sail from 2016, and obtained the first patent of rotor sail system in January, 2019.

## 2021

DealFeng has successfully completed the prototype production and land-based test of 24M X 4M Rotor Sail in December 2021.

## 2022

DealFeng signed a newbuild contract for rotor sail installation on 5,000 DWT Tanker in Oct. 2022, and completed the delivery and installation of Rotor Sail in Nov. 2023.

## 2020

DealFeng started to cooperate with LR in 2020, and obtained the AiP certification of Rotor Sail system from LR in 2021.

## 2022

DealFeng obtained the AiP certification of Rotor Sail system from CCS and ClassNK in 2022.

## 2023

DealFeng obtained the global first Type Approval certificate of Rotor Sail from CCS in Nov. 2023, and completed the Rotor Sails installation on HYSH226 and the delivery in Dec. 2023.



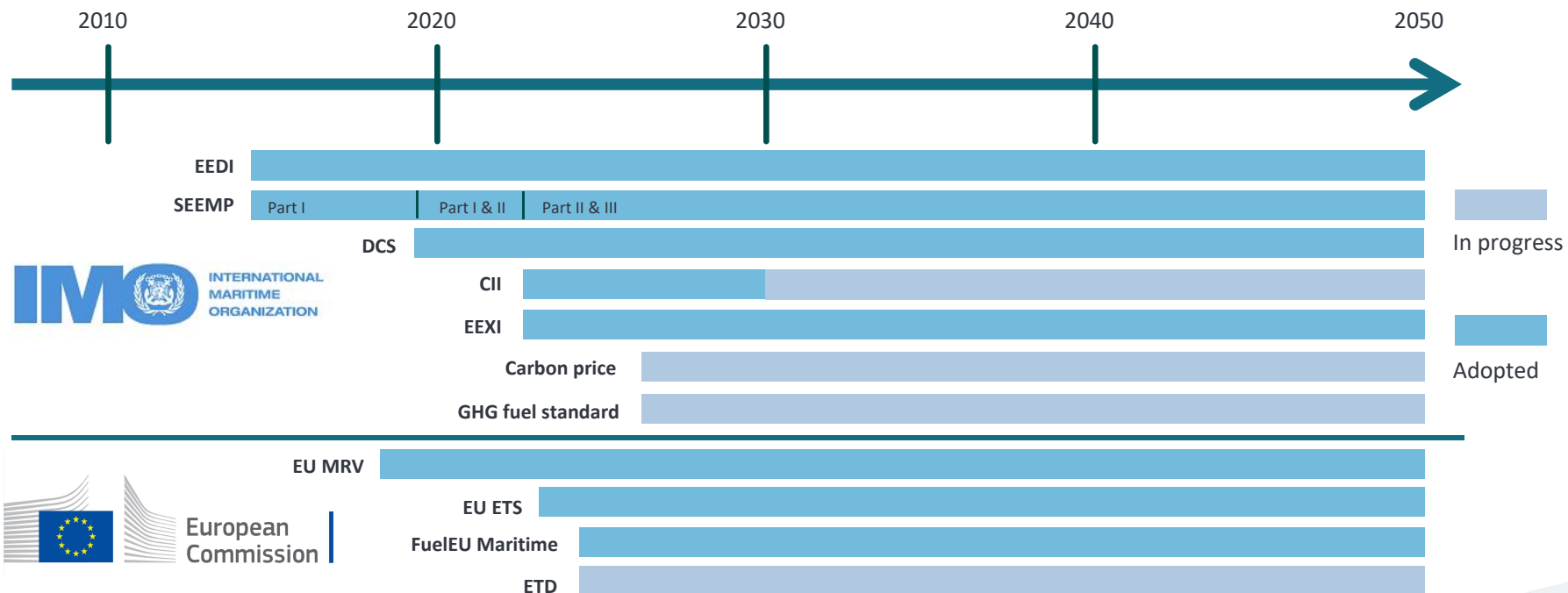


02

PART TWO

# Background and Market

# POLICIES FOR EMISSIONS REDUCTION



EEDI: Energy Efficiency Design Index

SEEMP: Ship Energy Efficiency Management Plan

CII: Carbon Intensity Indicator

MRV: Monitoring, Reporting, Verification

DSC: Data Collection System

EEXI: Energy Efficiency Existing Ship Index

ETS: Emission Trading System

ETD: Energy Taxation Directive

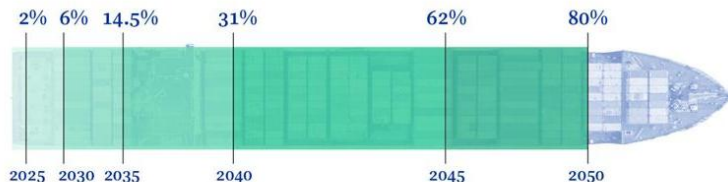
# FuelEU Maritime Regulation



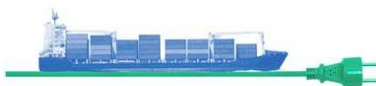
**The FuelEU maritime regulation will oblige vessels above 5000 gross tonnes calling at European ports (with exceptions such as fishing ships):**

→ to reduce the greenhouse gas intensity of the energy used on board as follows

*Annual average carbon intensity reduction compared to the average in 2020*



→ to connect to onshore power supply for their electrical power needs while moored at the quayside, unless they use another zero-emission technology



The FuelEU Maritime Regulation is expected to apply from 1 January 2025 to ships over 5000 GT which use EEA (EU plus Norway and Iceland) ports, the yearly average GHG intensity of the energy used on board by a ship during a reporting period reduction goals set out as:

- 2 % from 1 January 2025;
- 6 % from 1 January 2030;
- 14.5 % from 1 January 2035;
- 31 % from 1 January 2040;
- 62 % from 1 January 2045;
- 80 % from 1 January 2050.

NOTE: These reductions are compared with a 2020 baseline and the reference value 91.16 g of CO2 equivalent per MJ.

Ships entering EEA ports from a non-EEA ports / EU outermost regions or vice-versa will have 50% of the energy used in that voyage subject to the Regulation, whilst intra-EEA voyages will have all the energy used in those voyages subject to the Regulation. All energy used at berth in the EEA will be subject to the Regulation.



## CO-BENEFITS OF WIND



For the purpose of calculating the GHG intensity of the energy used on board by a ship, the following formula, referred to as Equation (1) shall apply:

$\text{GHG intensity} \left[ \frac{\text{gCO}_2\text{eq}}{\text{MJ}} \right] = f_{\text{wind}} \times (\text{WtT} + \text{TtW}) \text{ Equation (1)}$	
WtT	$\frac{\sum_i^n \text{fuel}_{M_i} \times \text{CO}_{2\text{eq, WtT, i}} \times \text{LCV}_i + \sum_k^c E_k \times \text{CO}_{2\text{eq, electricity, k}}}{\sum_i^n \text{fuel}_{M_i} \times \text{LCV}_i \times \text{RWD}_i + \sum_k^c E_k}$
TtW	$\frac{\sum_i^n \text{fuel}_{M_i} \sum_j^m \text{engine}_{M_{ij}} \times \left[ \left( 1 - \frac{1}{100} \text{slip}_j \right) \times (\text{CO}_{2\text{eq, TtW, i, j}}) + \left( \frac{1}{100} \text{slip}_j \times \text{CO}_{2\text{eq, TtW, slip, i, j}} \right) \right]}{\sum_i^n \text{fuel}_{M_i} \times \text{LCV}_i \times \text{RWD}_i + \sum_k^c E_k}$
$f_{\text{wind}}$	Reward factor for wind-assisted propulsion

### Reward factor( $f_{\text{wind}}$ ) for WAPS

Where wind-assisted propulsion is installed on board, a reward factor can be applied, determined as follows:

Reward factor for wind-assisted propulsion – WIND ( $f_{\text{wind}}$ )	$\frac{P_{\text{Wind}}}{P_{\text{Prop}}}$
0,99	0,05
0,97	0,1
0,95	$\geq 0,15$

The use of wind propulsion has many co-benefits which may have a significant impact on the sector and thus should be considered or rated more highly in the assessment of wind's contribution:

**(i) Adopts a limited wind propulsion reward factor of 1-5% while awarding a 2x multiplier for the adoption of RFNBO fuels.**

(ii) Low Impact on Sensitive areas – being a non-toxic and virtually silent form of propulsion, wind can lessen significantly the impact of shipping on MPA's and migratory routes for example, where wind routing could be used to assist with ships powering down when moving through sensitive regions or diverting around them without additional fuel cost.

## Innovative Energy Efficient Technology - Wind Assisted Propulsion System advocated by MEPC77

MEPC 77/WP.8  
Annex 4, page 19

- The EEDI calculation of wind assisted propulsion and the global wind matrix

MEPC 77/WP.8  
Annex 4, page 12

### 2.3 Available effective power of wind assisted propulsion systems (WAPS)

2.3.1 The available effective power of wind assisted propulsion systems as innovative energy efficient technology is calculated by the following formula:

$$(f_{\text{eff}} \cdot P_{\text{eff}}) = \left( \frac{1}{\sum_{k=1}^q W_k} \right) \cdot \left( \left( \frac{0.5144 \cdot V_{\text{ref}}}{\eta_D} \sum_{k=1}^q F(V_{\text{ref}})_k \cdot W_k \right) - \left( \sum_{k=1}^q P(V_{\text{ref}})_k \cdot W_k \right) \right)$$

with  $F_1 - F_k \geq 0 \wedge F_{k-1} - F_k \geq 0$

(sorting all force matrix elements in descending order)

and  $\sum_{k=1}^{q-1} W_k < \frac{1}{2} \wedge \sum_{k=1}^q W_k \geq \frac{1}{2}$

(defining q: the number of elements added in the formula)

- The contribution of wind assisted propulsion on EEDI/EEXI energy efficiency index

As one of the innovative energy-saving technologies, the IMO has included wind-assisted propulsion systems in the calculation of the EEDI energy efficiency index, which also applies to EEXI calculation. (EEDI for newbuilds is in Phrase 3, and EEXI for existing ships is currently in effect from January 1, 2023)

- Wind matrix curves of main global shipping routes

Figure 1 and Figure 2 show the calculation of wind energy matrix in MEPC77 meeting. By the occurrence probability and average wind speed of wind energy in the whole year, it can be found that wind energy resource is very abundant and can be effectively utilized on the main shipping routes around the world.

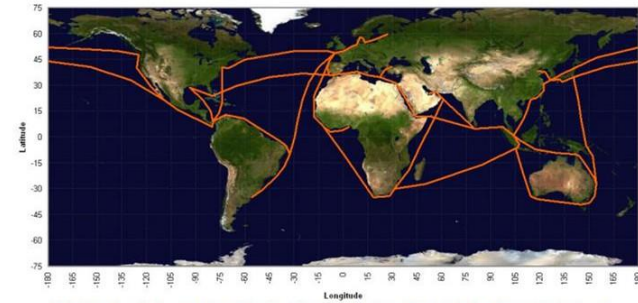


Figure 1 – The main global shipping network used for the wind chart

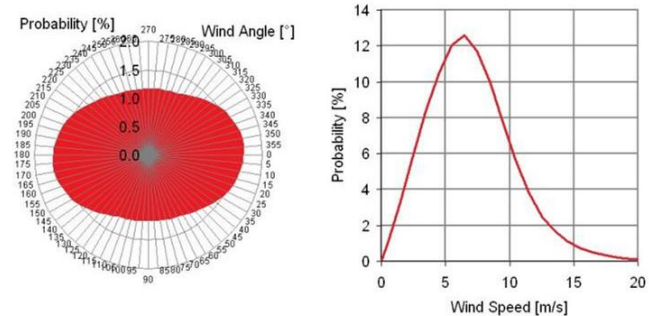


Figure 2 – Resulting wind curves on the main global shipping routes relative to the ship

# MARKET DEVELOPMENT



Update on Potential of Wind-Assisted Propulsion for Shipping

European Maritime Safety Agency

Table 1 provides an overview of companies that are currently providing or developing wind propulsion systems together with the number of ships that have been equipped with such systems so far. Due to the current market dynamics this overview may not be exhaustive.

Table 1. Overview of wind propulsion systems currently applied.

Technology	Company	Project/ company	Name of product	Actual implementations- number of ships	Country	
Rotor Sails	Anemoi	Company	Rotor Sails	2	UK	
	Dealfeng	Company	Dealfeng Rotor Sail System	2	China	
	Enercon	Company	Enercon	1	Germany	
	Magnuss	Company	VOSS	0	Sweden	
	MariGreen	project	Eco Flettner	2	Germany	
Suction wings	Norsepower	Company	Norsepower Rotor Sail	7	Finland	
	bound4blue	Company	eSAIL	3	Spain	
	Crain Technologies	Company	Suction Wing SW270	0	France	
Hard sails	Econowind	Company	Ventifoil, Vertofoil	5	Netherlands	
	AYRO	Company	Oceanwings	1	France	
	BarTech, Yara Marine	Company	WindWing	2	Norway	
	bound4blue	Company	eSAIL	0	Spain	
	Chantier de L'Atlantique	Company	SolidSail	0	France	
	CWS	Company	Computed Wing Sail	0	France	
	DSIC	Company	DSIC	2	China	
	Eco marine power	Company	Aquarius MRE	0	Japan	
	MOL	Company	Wind Challenger	1	Japan	
	NAOS Design	Company	Wind Sail Module	1	Italy	
	Nayam	Company	Nayam Wings	0	Israel	
	Wallenius	Company	Oceanbird	0	Sweden	
	Windship Technology	Company	Windship	0	UK	
	Zephyr & Borée	Company	Windcoop	0	France	
	Kite	Airseas	Company	Seawing	2	France
		Beyond the Sea	Company	LibertyKite	0	France
		Bluewater Engineering	Company	SKYTUG	0	UK
Soft Sail	Michelin	Company	WISAMO sail	1	France	
Hull Sail	Lade AS	Company	Vindskip	0	Norway	
Total				32		

Sources: Websites of the different technology providers together with the latest Newsletters as published by IWSA.

- The wind-rotor assisted propulsion system has been proven to be a simple and effective green energy saving and carbon reducing solution, and has been installed on different ship types around the world.
- After actual verification on more than 30 ships, the comprehensive fuel saving rate of the wind assisted propulsion system is 5% - 25%. The specific fuel saving rate depends on the ship type and the number of installed sails.





03

PART FOUR

# Product Introduction

# PRINCIPLE INTRODUCTION

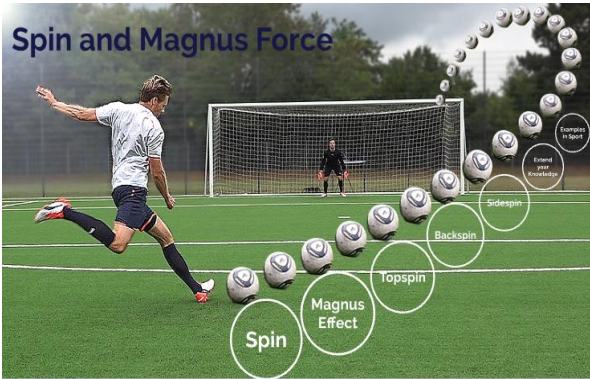
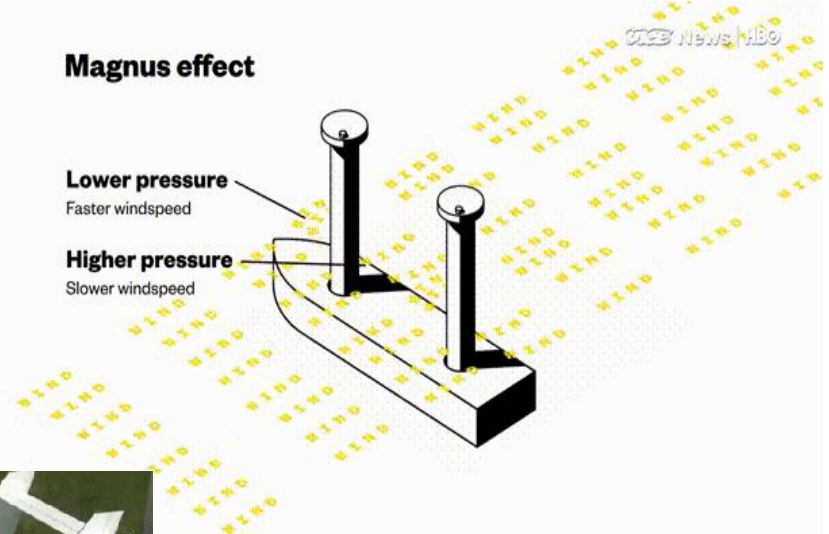
## ● Magnus effect

- When the rotation angular velocity vector of a rotating object does not coincide with the object flight velocity vector, a transverse force will be generated in the direction perpendicular to the plane composed of the rotation angular velocity vector and the translational velocity vector.
- The phenomenon that the flight path of an object deflects under the action of this transverse force is called the Magnus effect. The most commonly visible in ball games where spin is applied (football, tennis, golf).

## Magnus effect

**Lower pressure**  
Faster windspeed

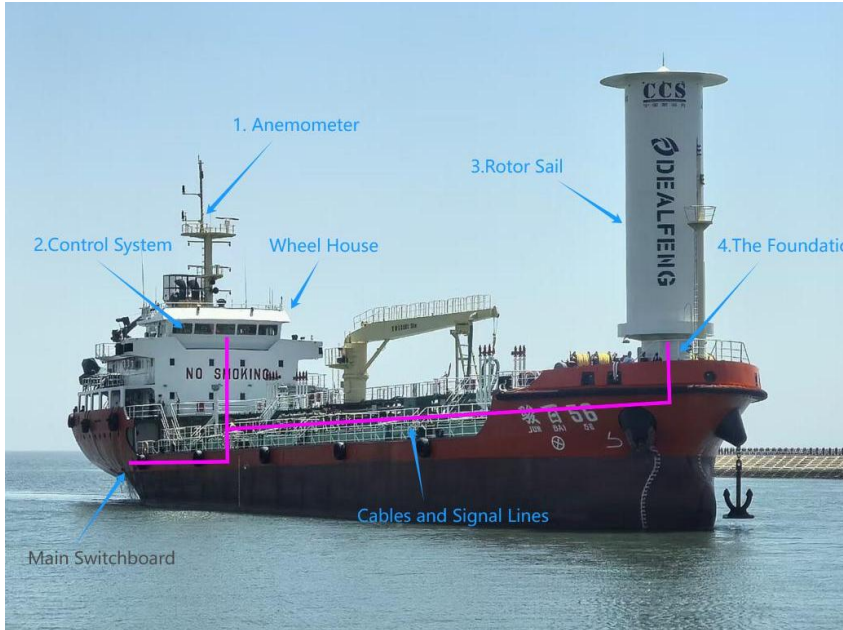
**Higher pressure**  
Slower windspeed



## ● Rotor Sail

Dealfeng Rotor Sail, an energy efficient technology, is a modernized mechanical sail that utilizing Magnus effect to harness the power of wind for providing auxiliary propulsion force for ships, which can achieve fuel savings and carbon reductions for ships, resulting in improving the ship's EEDI, EEXI and CII, etc.

# PRODUCT INTRODUCTION



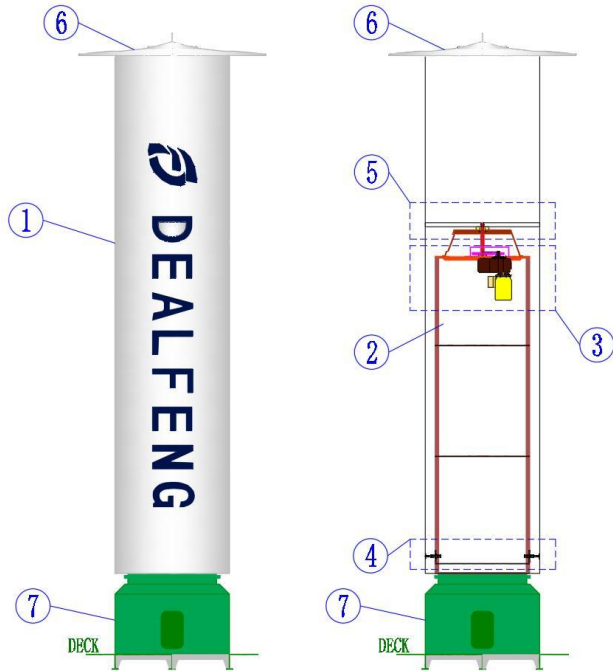
## ● System Composition

1. Multifunctional sensor
2. Central controller
3. Rotor Sail
4. Foundation
5. Electrical cables and signal lines from rotor to the ship

## The material of Rotor Sail and the brand of Main Components

ITEM	DEALFENG
Material of Outer Rotor	Composite material certified by classification society
Material of Inner Tower	Welded steel structure certified by classification society
PLC	Dealfeng® system
Electric Motor	SIEMENS/ABB
Gearbox	SEW
Controller	SIEMENS
Electrical Components	Schneider
Cable	Cable with certificate of marine product by classification society
Wind Sensor	VAISALA/NINGLU
Bearing	NSK
Lower Support Wheels	Customized and certified by classification society

# PRODUCT INTRODUCTION



## ① Rotor Sail Body

Made of composite material, arranged on the open deck of the ship, directly affected by the wind force, and driven to rotate by the drive system③, and the generated thrust is transmitted to the steel inner tower② through the upper support bearing⑤ and the lower bearing④.

## ② Inner Tower

Steel structure, located inside the rotor①, providing access for the installation, inspection and maintenance of the drive system③, and transmitting the thrust generated by the rotor① to the foundation⑦.

## ③ Drive System

Used to drive the rotor① to rotation.

## ④ Lower Bearing

Carries radial loads (no axial loads). Wheels run on racetrack/base ring.

## ⑤ Upper Bearing

Standard roller bearing which connects rotor① to inner tower② that carries all axial and most radial loads.

## ⑥ Top Disc

Made of composite material, located at the upper end of the rotor①, equipped with lightning protection device.

## ⑦ Foundation

The upper end is connected to the inner tower②, and the lower end is connected to the ship deck, transmitting the thrust generated by the rotor sail to the ship

## PRODUCT INTRODUCTION



MODEL *	24 x 4	24 x 5	30 x 5	35 x 5
Rotor diameter (m)	4	5	5	5
Rotor height (m)	24	24	30	35
Rotor typical max speed (RPM)	200	180	180	180
Rotor material	Advanced composite material			
Tower material	Steel structure certified by the Class			
Rotor sail mass (t)	45	55	65	75
Maximum operational AWS	25 m/s (48.69kts)			
Nominal power consumption (kW)	90	110	120	132
Average operating power	~30% of nominal on the IMO Global Route			
Maximum thrust generated (kN)	219	275	343	399

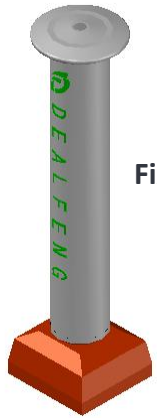
- \* Typical figures for DEALFENG Rotor Sails are shown. Other makers' rotor sails may more motor power consumption or more expensive.
- \* Rotor foundation design above deck is generally customized depending on the size of rotor sails installed and the structural loads of vessel, and air draft above deck is also taken into account.



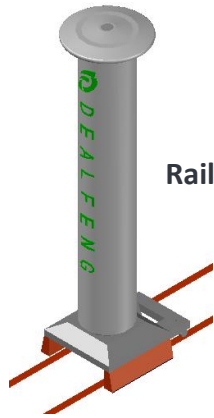
# PRODUCT INTRODUCTION



- In order to be suitable for different ship types, Dealfeng rotor sail system are available in a variety of foundation forms for customer to choose.



Fixed

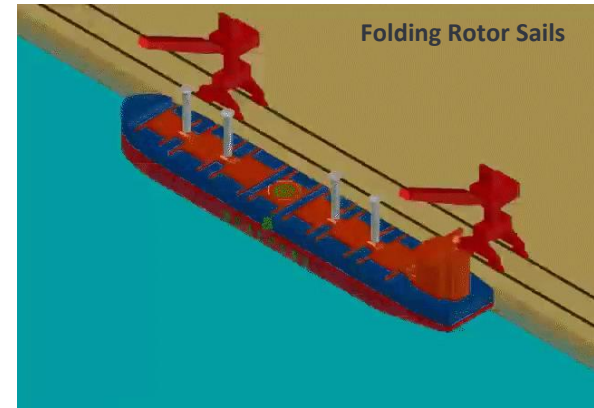
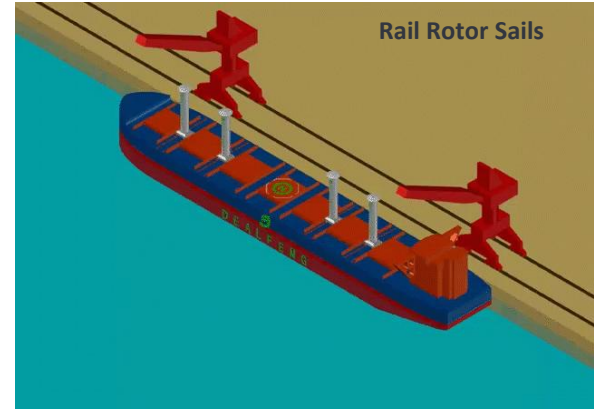


Rail



Tilting

- **Fixed foundation:** suitable for Tankers, RO-Ro cargo, Ro-Ro Pax etc. The cheapest foundation, simple structure and convenient installation, the highest ROI.
- **Rail foundation:** suitable for bulk carrier etc. Cheaper foundation, transversely or longitudinally movable based on deck layout, higher ROI.
- **Tilting foundation:** suitable for the most vessel types, such as bulk carrier, the most expensive foundation, rotor height variable.



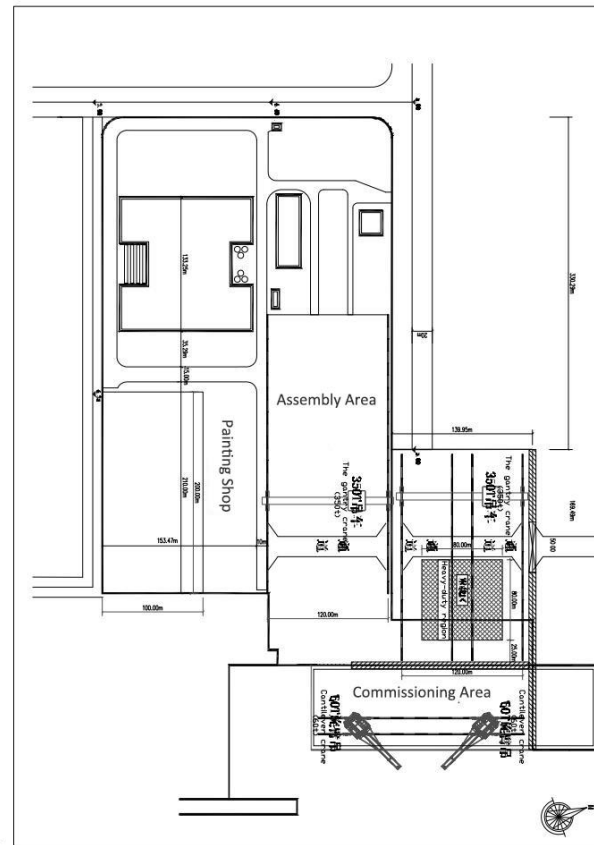
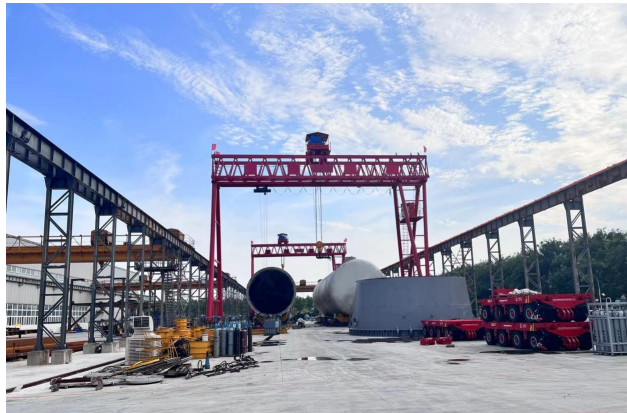
## PRODUCT INTRODUCTION



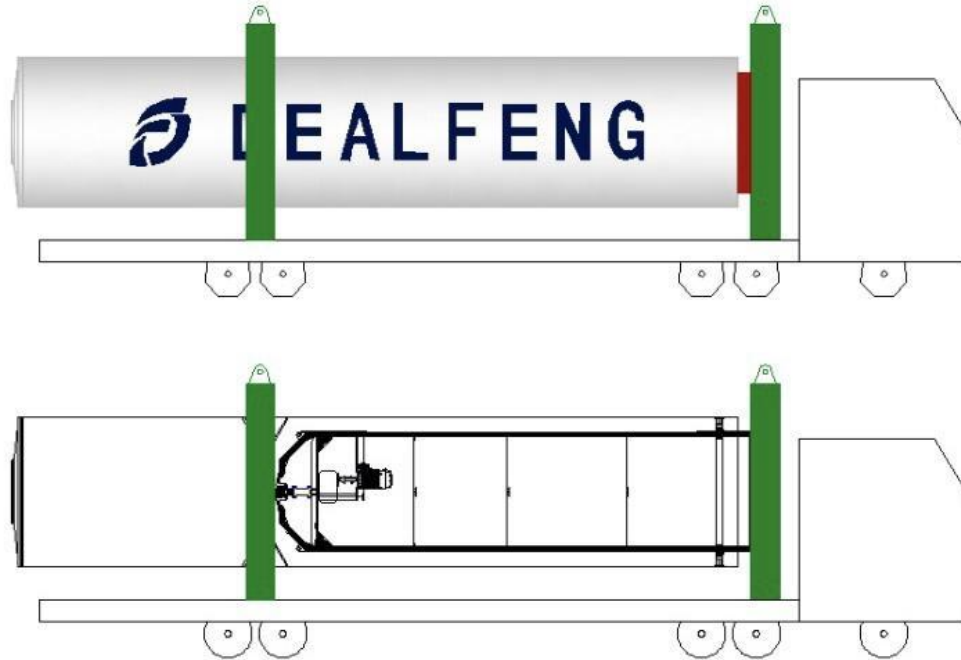
- The assembled rotor sail tilting foundation and the interior hydraulic power unit.



# FACTORY INTRODUCTION

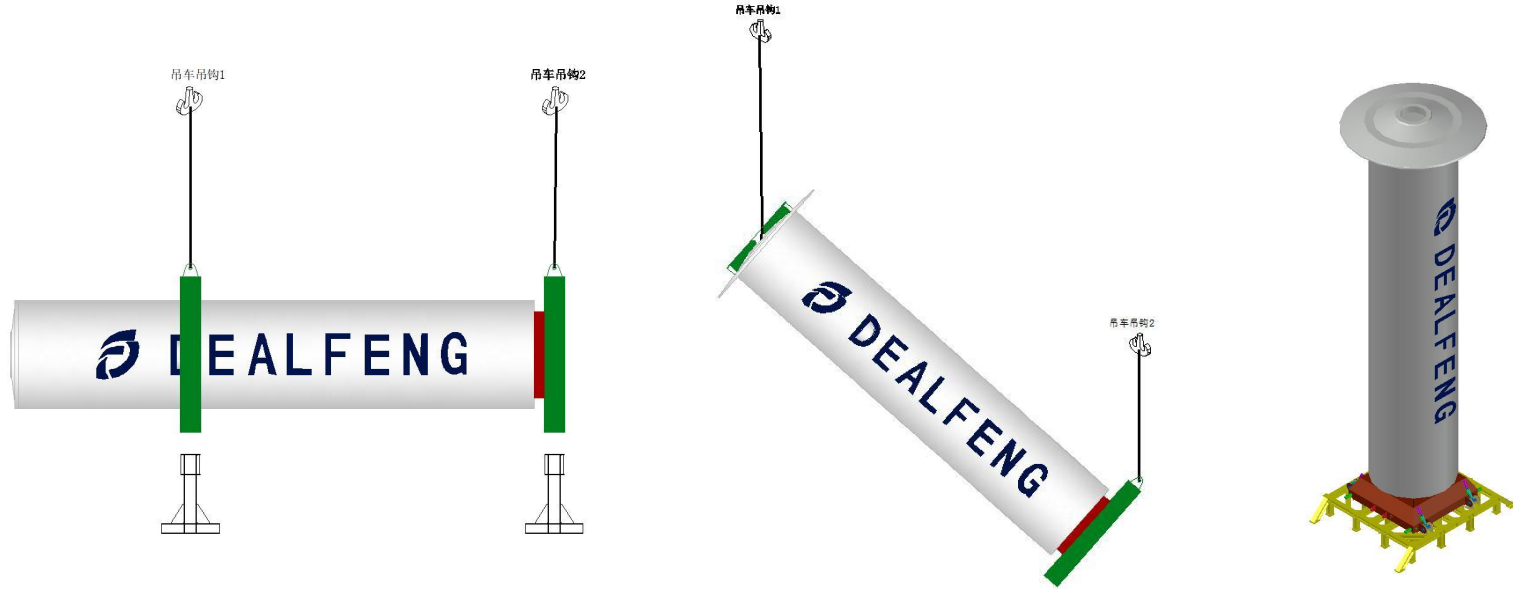


## INSTALLATION INTRODUCTION



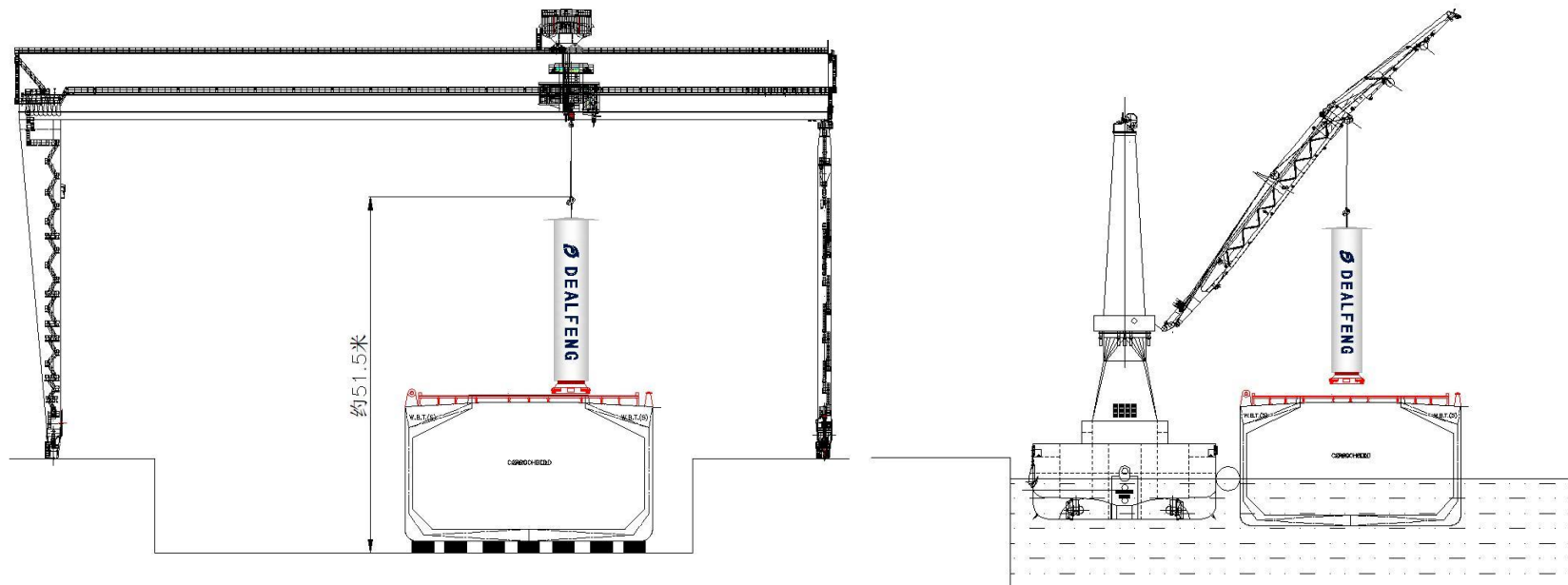
- Dealfeng rotor sail and associated equipment can be transported horizontally using specially designed tooling, saving the cost and time of transportation.

## INSTALLATION INTRODUCTION



- Dealfeng have complete solutions for unloading, storage, commissioning and installation at the shipyard.

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- Dealfeng have complete solutions for unloading, storage, commissioning and installation at the shipyard.

# COMPETITIVE ADVANTAGES

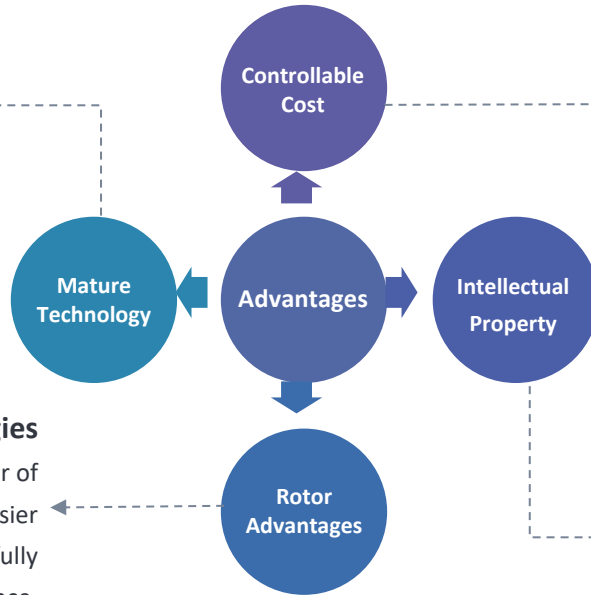


## Comparing with other ship energy-saving equipment

High technical maturity (level 8-9), simple installation and retrofitting on deck, little change to the original design of ship

## Comparing to European companies

Lower about 30~40% price than that of foreign similar products, short payback period of equipment investment, high efficiency of design and installation, more options for shipyards and turnkey solutions.

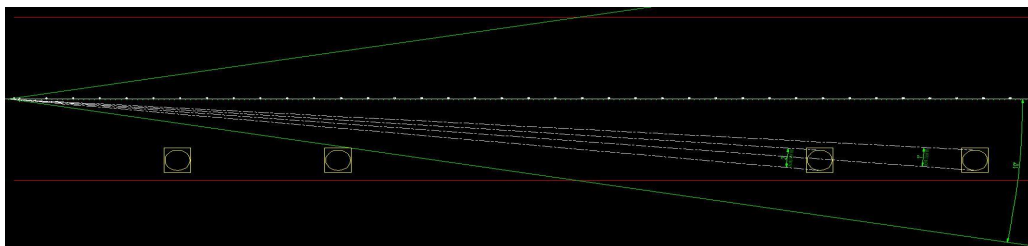


## Comparing to other WAP technologies

Generate more thrust force per square meter of the same sail area, occupy less deck space, easier integration, less obstructed visibility, fully automatic operation and simple maintenance.

## Owning the full IPR

Dealfeng has obtained seven invention patent and more than fifty utility model patents for rotor sails. At the same time, DEALFENG brand has already gained certain reputation in the field of WAPS sector.



- Dealfeng work with its partners to provide customers with one-stop services, including the ship refitting design and strength calculation, the design and manufacture of small wind assisted propulsion ships.

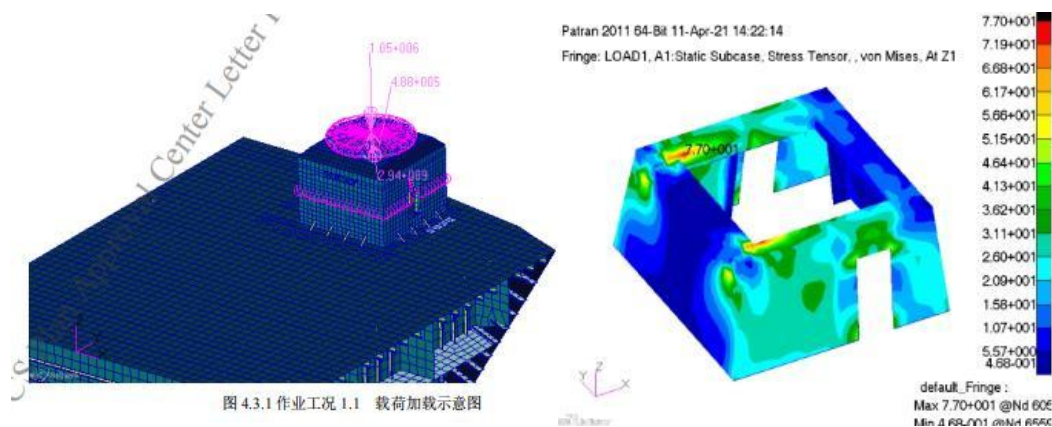


图 4.3.1 作业工况 1.1 载荷加载示意图

- The picture shows a part of the design drawings and FEM analysis report for 82,000 DWT bulk carrier retrofitting. Dealfeng engineers, who are all experts in marine equipment with many years of design experience, can offer professional technical support service.





04

PART FIVE

# Business Cooperation and Cases

## COOPERATION PARTNERS



- **Dealfeng was invited to attend the London International Shipping Week and the WPT Roundtable Meeting held at IMO**

Dealfeng has been invited to attend the London International Shipping Week held at the International Maritime Organization headquarters in Sept. 2023 and WPT roundtable in May 2024. Dealfeng displayed the company's rotor sail and technology at these conferences, which have a good effect on the promotion of Dealfeng Rotor Sail system and will develop more potential customers.

# COOPERATION PARTNERS



## Thank you

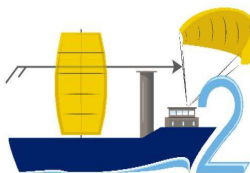


We hope to engage with you in moving wind propulsion forward !

For more info: [marin.nl/jips/wisp-2](http://marin.nl/jips/wisp-2)

Participants so far:

- MARIN
- ABS
- Anemoi
- Norsepower
- DSIC
- CSSRC
- CWS
- Magnus
- Ayro
- BV
- Dealfeng
- BlueWasp
- IWSA
- Undisclosed
- Several pending signature



[www.marin.nl](http://www.marin.nl)

- Dealfeng is a full member of IWSA and ZETSAs. IWSA facilitates and promotes wind propulsion for commercial shipping worldwide and brings together all parties in the development of a windship sector to shape industry and government attitudes and policies. ZETSAs aims to help promote the shipping industry to achieve true net zero emissions in the world.

- Dealfeng participated in the Wisp2 project, which is initiated by MARIN, in cooperation with ABS and together with a large number of participants, to investigate ways to overcome barriers to wind propulsion uptake and promote the decarbonization of wind assisted propulsion system in the shipping industry. "These new findings from WiSP2 will be integrated into the updated performance prediction recommendation method and will serve as a report to MEPC and other IMO committees," said Jan Otto de Kat, Director of the Global Sustainability Center in Copenhagen. D.



ZETSAs board of directors

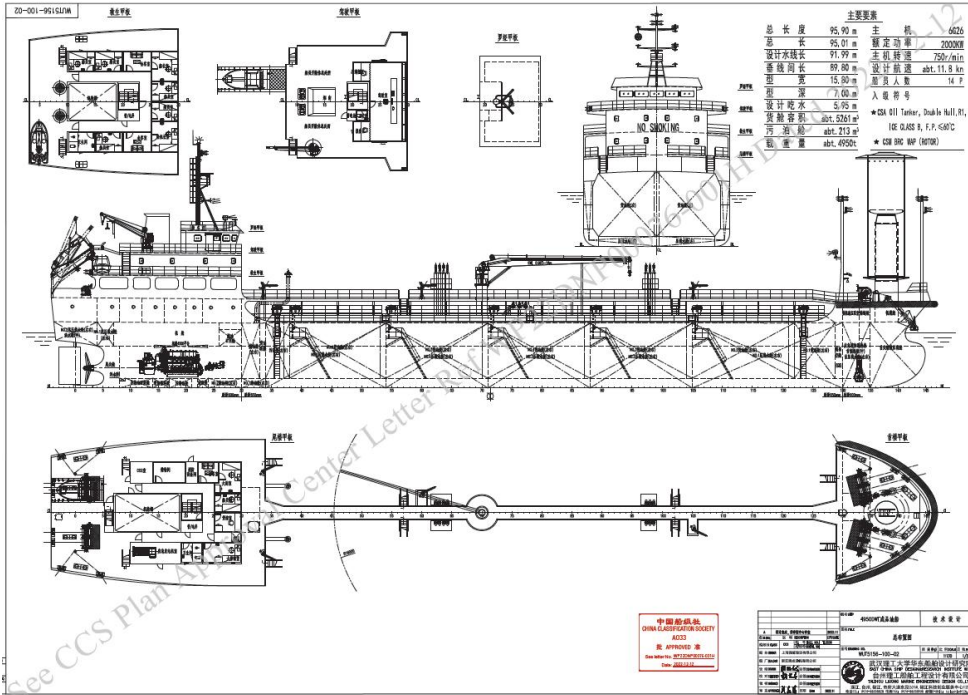
- Jørgen Brønnum**  
Chair  
Jørgen Brønnum is the Chairman of ZETSAs. He is a former Director of the Danish Maritime Authority and has extensive experience in the shipping industry.
- Johan Burgen**  
Vice Chair  
Johan Burgen is the Vice Chairman of ZETSAs. He is a former Director of the Danish Maritime Authority and has extensive experience in the shipping industry.
- Tim Mann**  
Board Member  
Tim Mann is a Board Member of ZETSAs. He is a former Director of the Danish Maritime Authority and has extensive experience in the shipping industry.
- Daniella Southcott**  
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- Silvia Vitralova**  
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- Li Zhi**  
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- Raffaele Frontera**  
Board Member  
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## COOPERATION PARTNERS



- Dealfeng company has established cooperation with many well-known domestic shipyards and reached a strategic cooperation agreement to jointly promote the Dealfeng® Rotor Sail system, including WinKong Marine, SHGSIC, XGSIC, Zhoushan Changhong International Shipyard, Shanghai Waigaoqiao Shipbuilding, COSCO Shipping Heavy Industry, Yangzijiang Shipbuilding, etc.

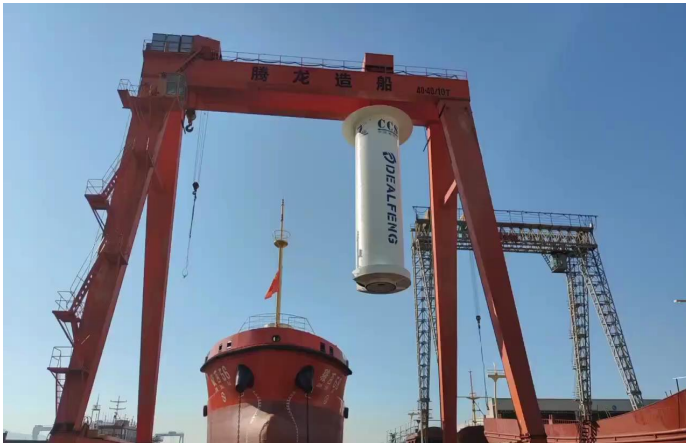
# 5000 DWT 'JUN BAI 56' PRODUCT OIL TANKER



- Dealfeng has completed the installation of Dealfeng® Rotor Sail on a newbuild 5000 DWT product oil tanker (CCS). The ship fitted with the 16m X 4m rotor sail on the bow was delivered in February 2024 and is expected to reduce the fuel consumption and CO<sub>2</sub> emission from the vessel by approximately 9% after preliminary verification.

## 5,000 DWT 'JUN BAI 56' PRODUCT OIL TANKER

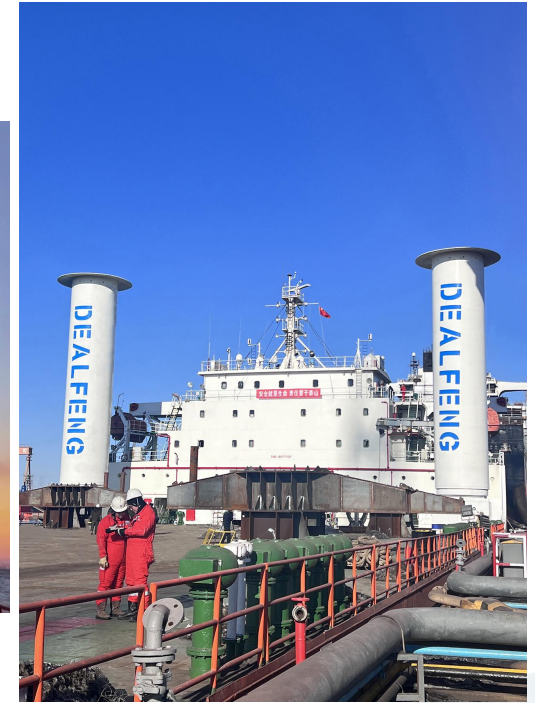
 DEALFENG



- The installation process of DealFeng® Rotor Sail on the vessel and the sea trial along China coastal route.



## 18,000 DWT 'HAI YANG SHI YOU 226' DECK CARRIER



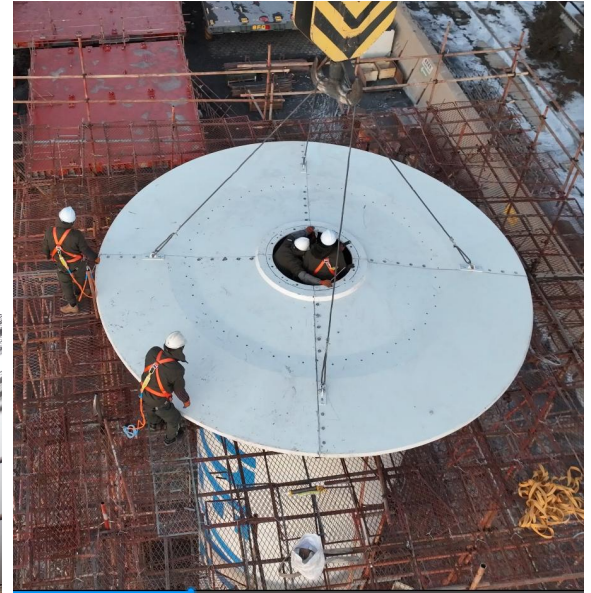
- The installation of Dealfeng Rotor Sails on the vessel doesn't affect the cargo operation and could help improving the energy efficiency and the carbon intensity for the vessel.



# 18,000 DWT 'HAI YANG SHI YOU 226' DECK CARRIER



← Foundation ready for shipment



↑ Simple assembly on shore

Painting for Rotor Sail body →



## 18,000 DWT 'HAI YANG SHI YOU 226' DECK CARRIER



- Rotor Sails were hoisted and installed on the vessel

# 18,000 DWT 'HAI YANG SHI YOU 226' DECK CARRIER

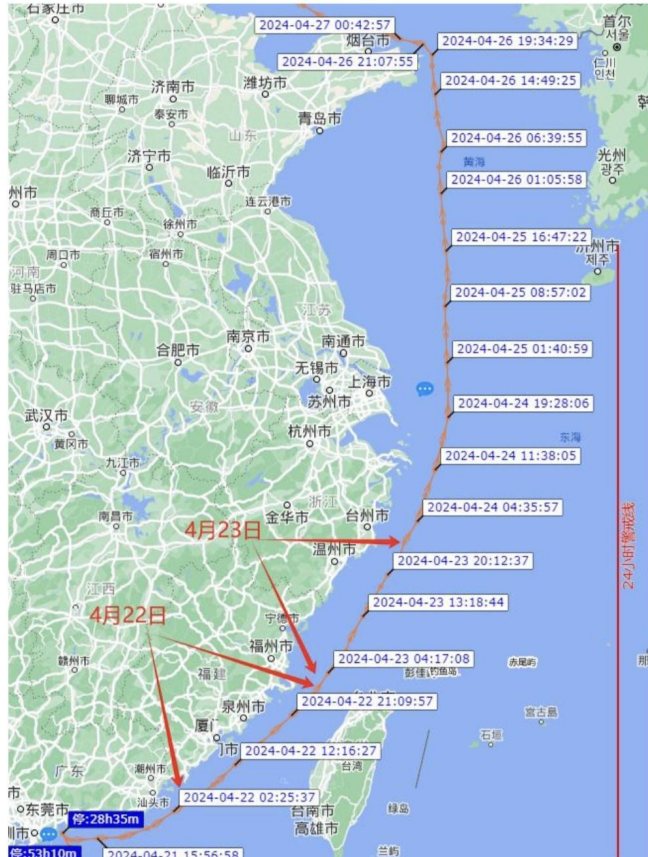


图 4.5 旋筒风帆开启关闭与船舶航速变化的对比图（4月22日-23日）

- The figure right shows *the change of vessel speed* when the Rotor Sails were turned on or turned off.

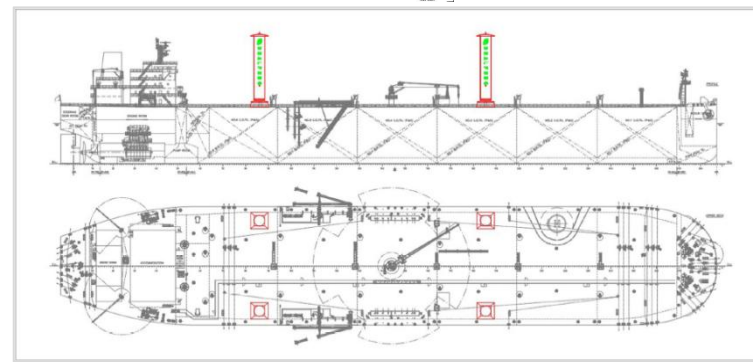
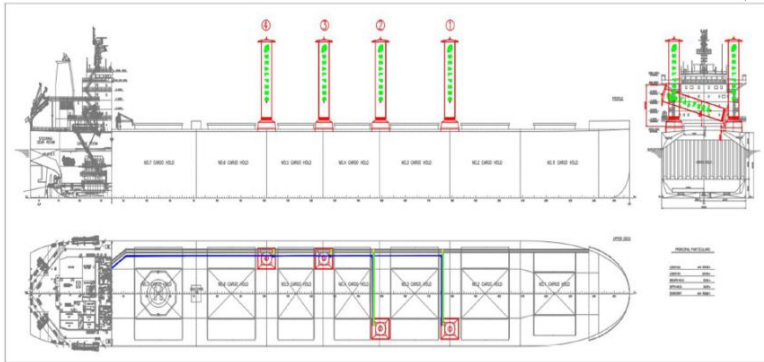
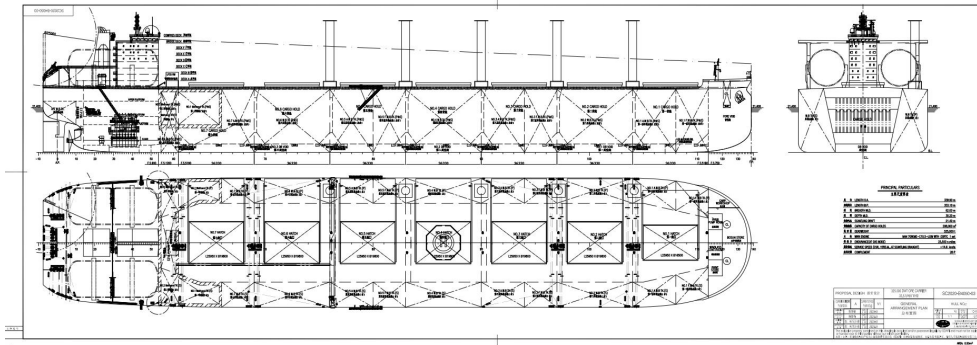
## 18,000 DWT 'HAI YANG SHI YOU 226' DECK CARRIER

 DEALFENG



- The CCTV13 news channel reported on the development of DEALFENG® Rotor Sail and gave high praise.

# ONGOING PROJECTS



- At present, there are many negotiating projects planning to install Dealfeng rotor sails or adopt wind\_ready designs. Additionally, Dealfeng can provide tailored arrangement schemes of Rotor Sail retrofitting in lined with different ship types. The layout schemes provided by Dealfeng is shown in the pictures above.

An aerial view of a ship's deck, showing a tall, cylindrical tower with 'CCS' at the top and 'DEALFENG' written vertically on its side. The ship is moving through the ocean, leaving a white wake. The sky is blue with scattered white clouds. The entire image has a light blue tint.

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