

**Kongsberg Maritime**

# Recent developments in wind propulsion

Tanker Operator Athens 2026



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VP Strategy and BD

Emerging Solutions

**Kongsberg Maritime**

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# New GHG regulations

Times are changing

## ETS (Emissions Trading System)



**Emission cap-and-trade system** that charges shipping companies for their greenhouse gas emissions. Ship owners must purchase emissions allowances (EUAs) for their vessels' voyages inside as well as to and from EU ports.

## FuelEU Maritime



Objective to **increase the share of renewable and low-carbon fuels** in the fuel mix of maritime transport.  
The yearly GHG intensity of energy used on board needs to be below a required level.

## Net-Zero Framework



**First global pricing mechanism for emissions.**  
Ships must reduce their annual greenhouse gas fuel intensity (GFI – how much GHG is emitted for each unit of energy used).  
Ships emitting above GFI thresholds will have to acquire remedial units to balance their deficit emissions, while those using zero or near-zero (ZNZ) GHG technologies will be eligible for financial rewards.

# Impact on shipping

Regulatory take aways

## Uncertainty



- Regulations currently in force are not sufficient to achieve GHG targets
- IMO NZF will be essential to achieve the targets.
  - Will it be adopted?
  - Will the regulation be changed

## Complexity



- Regulatory complexity and overlap
- **New business:**
  - **Emission trading**
  - **Pooling**
  - **Banking**
- New contract models
- Knowing and understanding your emissions data is business critical

## Efficiency is king



- **Fuel saving will be more attractive with higher fuel costs**
- Energy optimization is key
- **Wind propulsion will become very attractive (compliance + savings)**

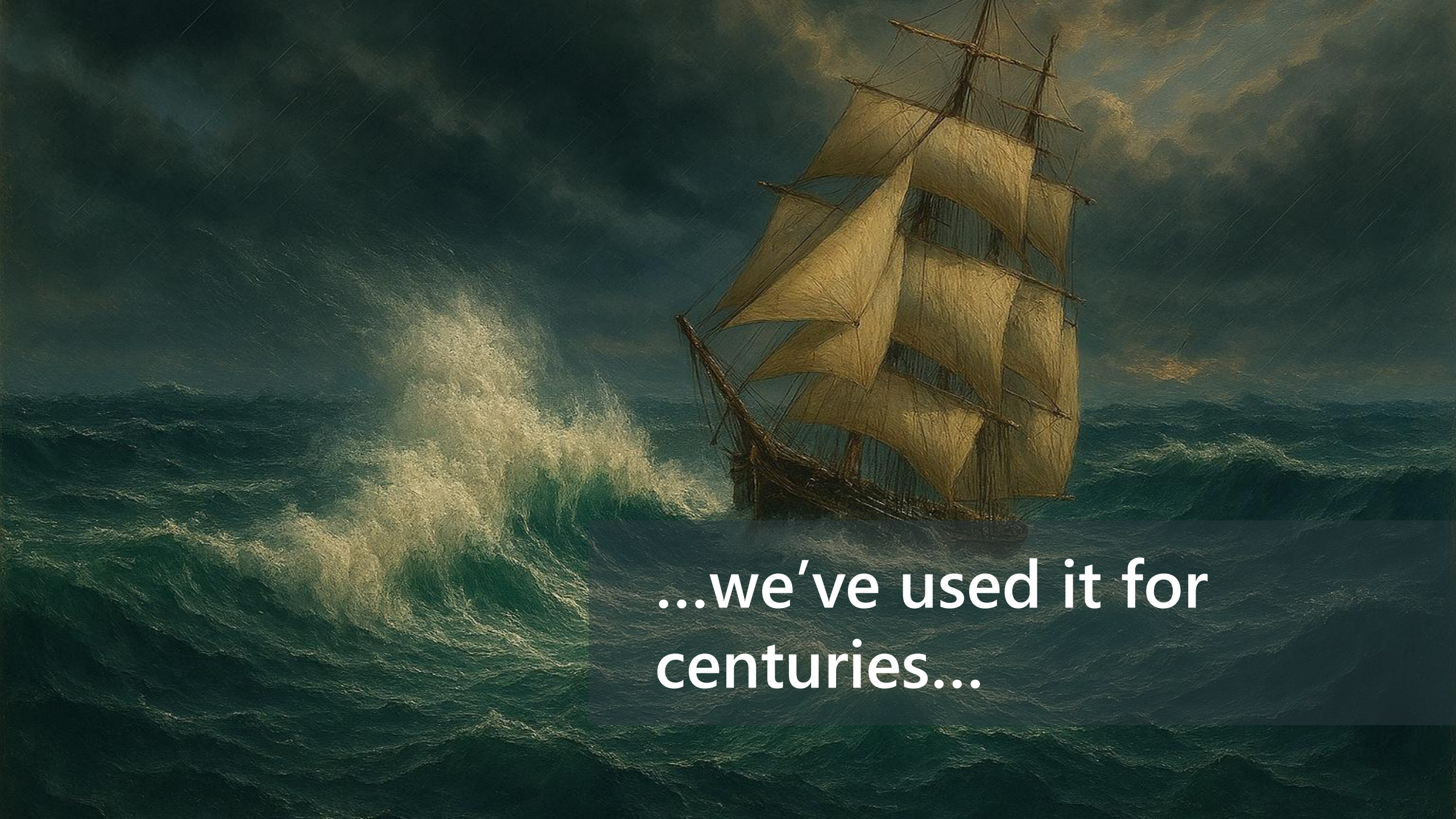
## Alternative energy



- Low carbon fuels will eventually become essential
- Fuel blending will be common
- Bio fuels will play important intermediate role. Availability and supply vs demand is uncertain.
- Future compliancy and access to financing is driving demand for vessel able to use low carbon energy sources



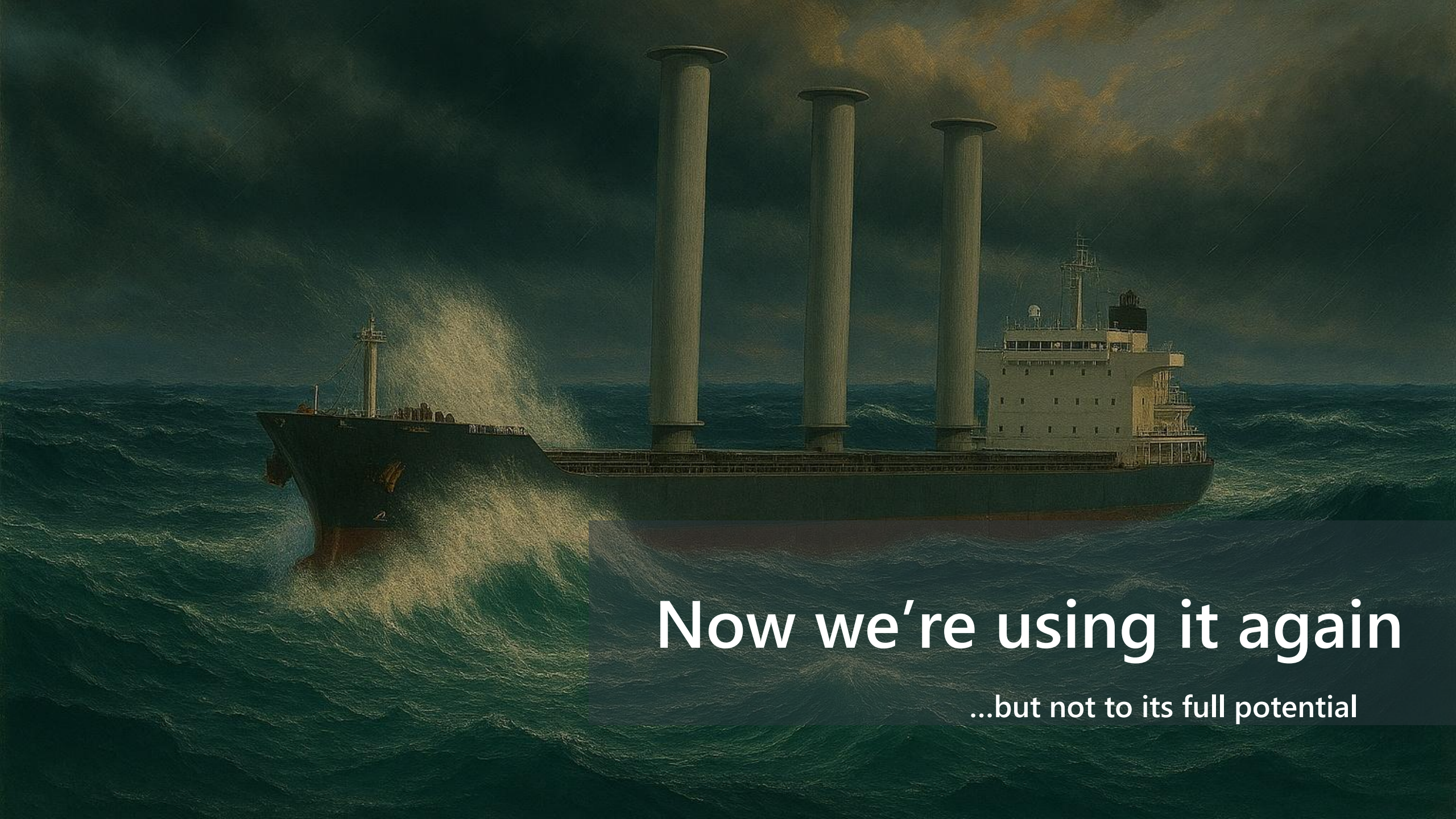
Wind is free energy...



...we've used it for  
centuries...



...until we stopped



Now we're using it again

...but not to its full potential

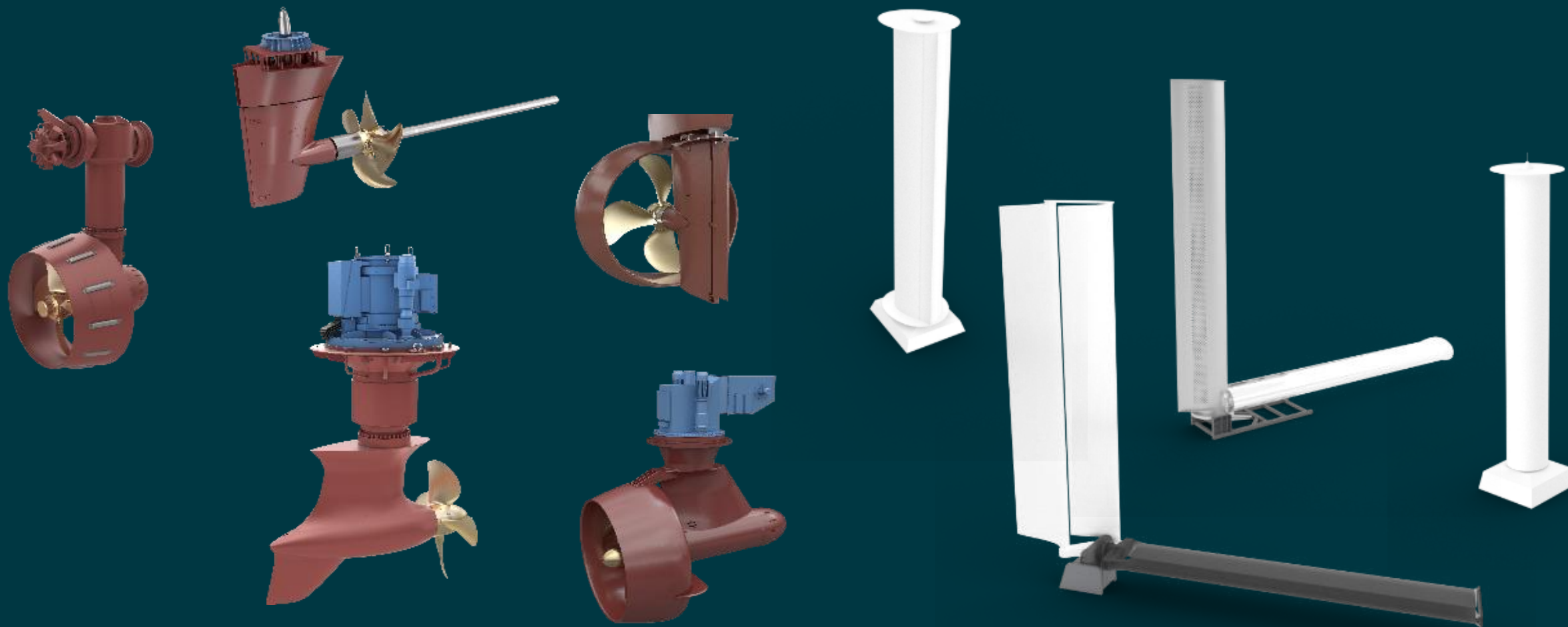
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# Wind Propulsion



# Propulsion devices needs careful consideration

...same goes for wind assist devices



# Wind propulsion technologies

for commercial ships

## Rotor Sails



- + Proven solution
- + Good side wind performance
- + Very high lift coefficient
- + Smaller installation
- Poor headwind performance
- Electric consumption

## Suction Wings



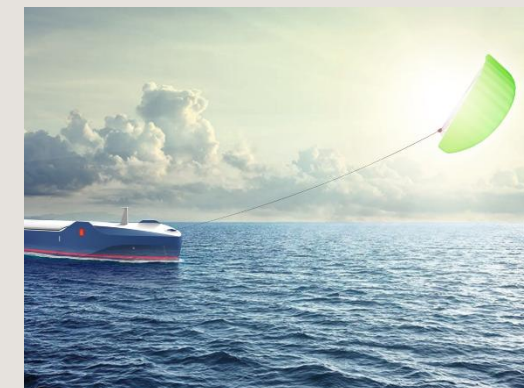
- + Good upwind performance
- + High lift coefficient
- + Attractive investment cost
- Electric consumption

## Wing Sails



- + Good upwind performance
- + No motors or el. power consumption
- Modest performance per area
- Large units
- Expensive

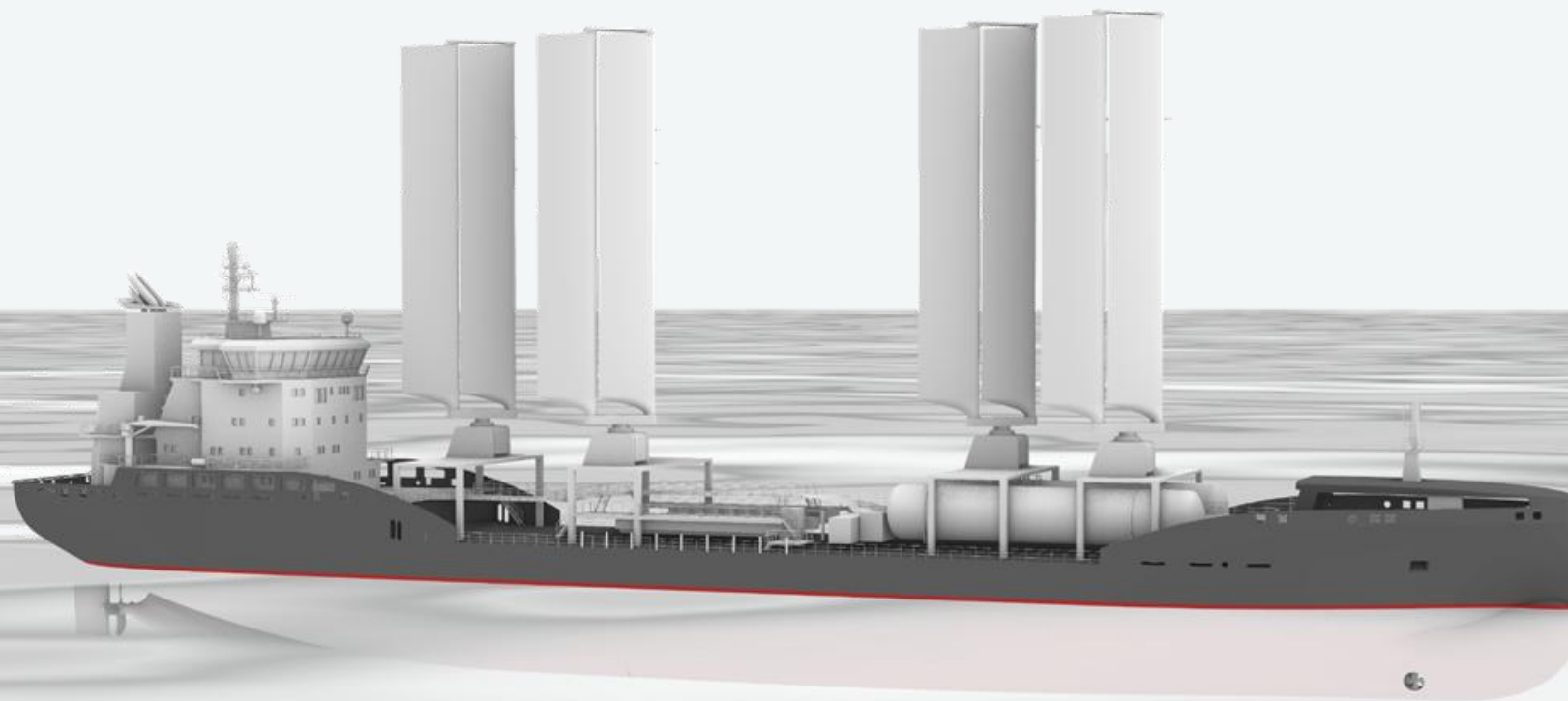
## Kites



- + High power output at favorable conditions
- + Low footprint
- Poor upwind performance
- Expensive
- Unproven

# Three technologies, same average performance\*

Analysis example



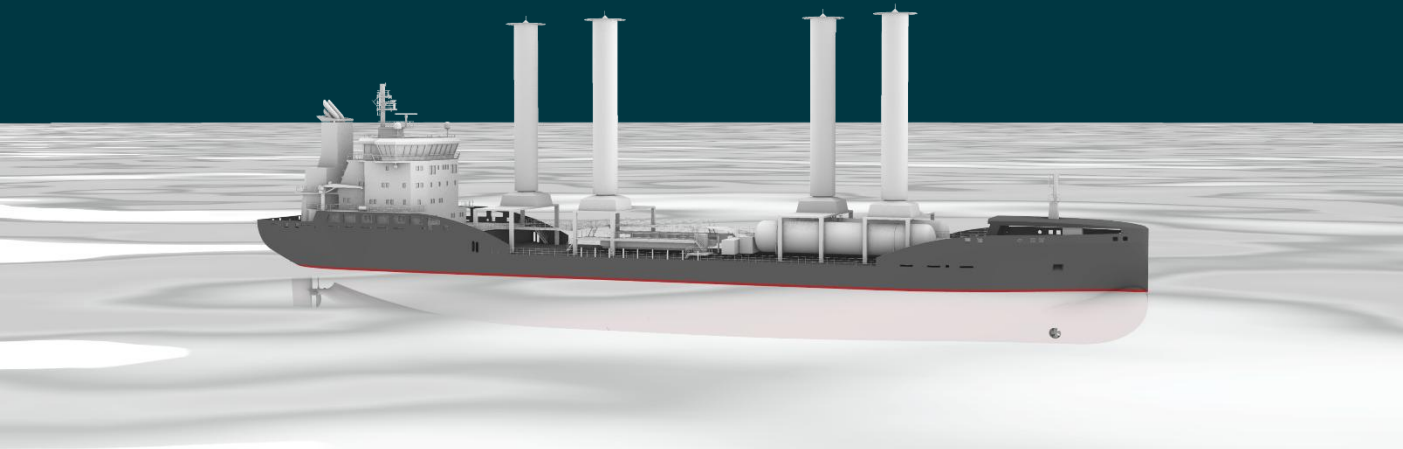
4 x 33x11 Wing-sails

\*Same average forward thrust in kN at 8m/s TWS, TWA 30-180deg

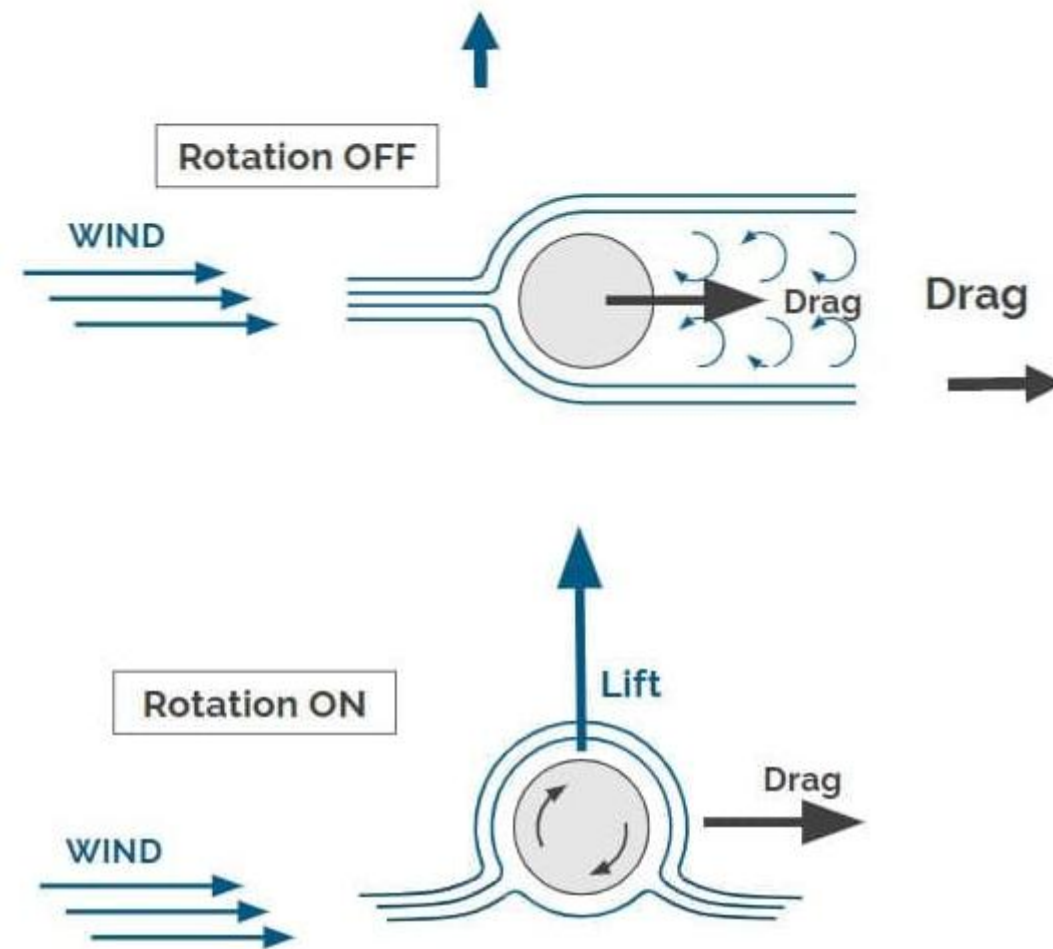
\* Generic data – not sail provider specific

# Rotor sail – 26x4

Technology comparison

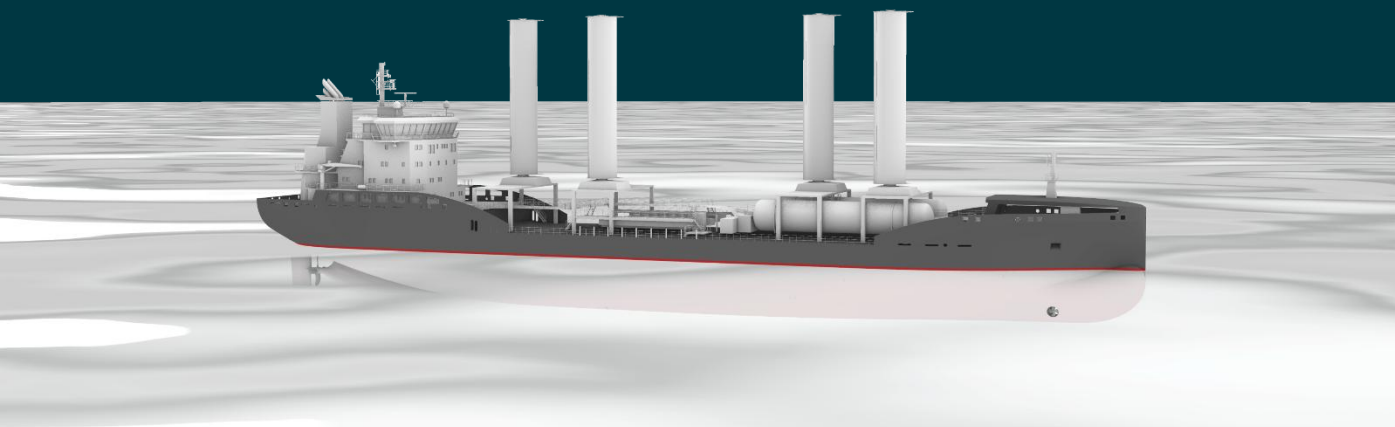


Vessel speed: 12,5kn

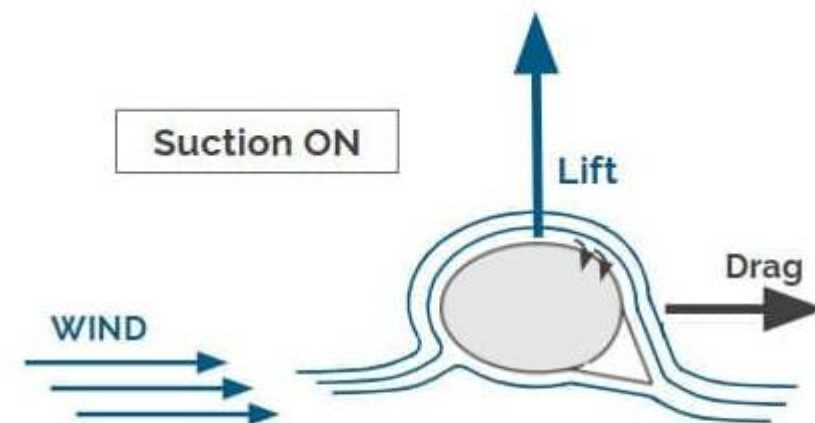
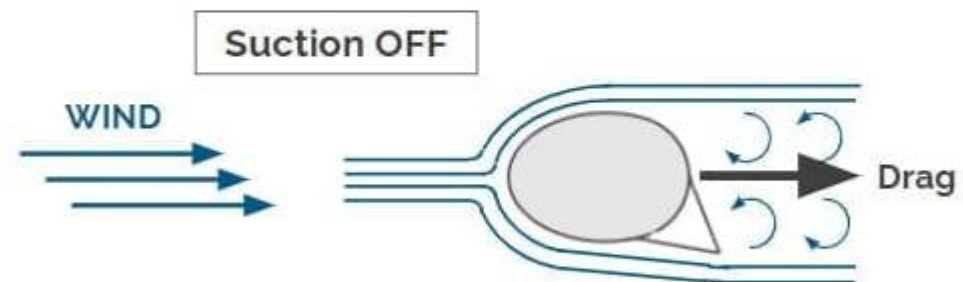


# Suction wing – 29x5

Technology comparison

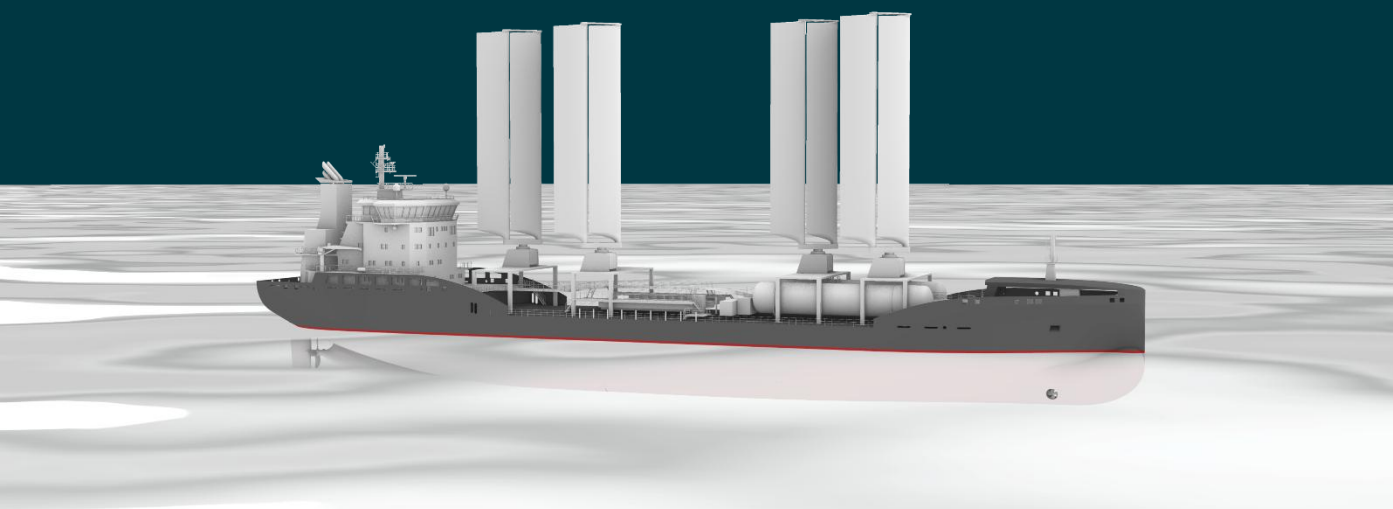


Vessel speed: 12,5kn

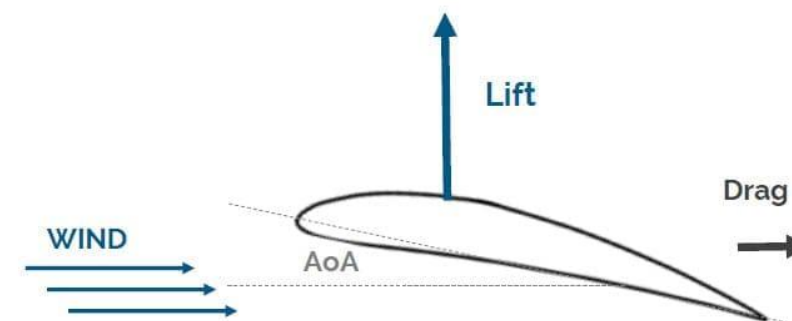


# Wing sail – 33x11

Technology comparison



Vessel speed: 12,5kn



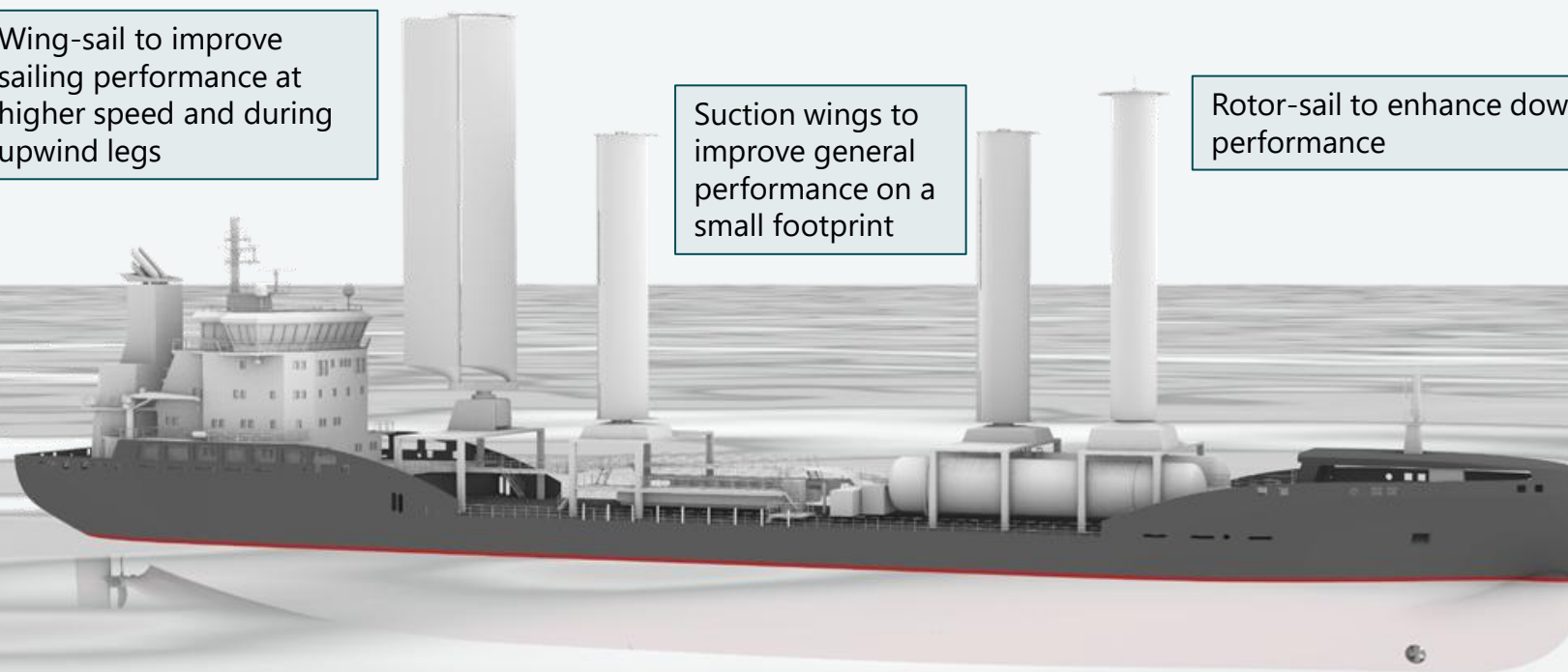
# Mix technologies for best performance

Technology comparison

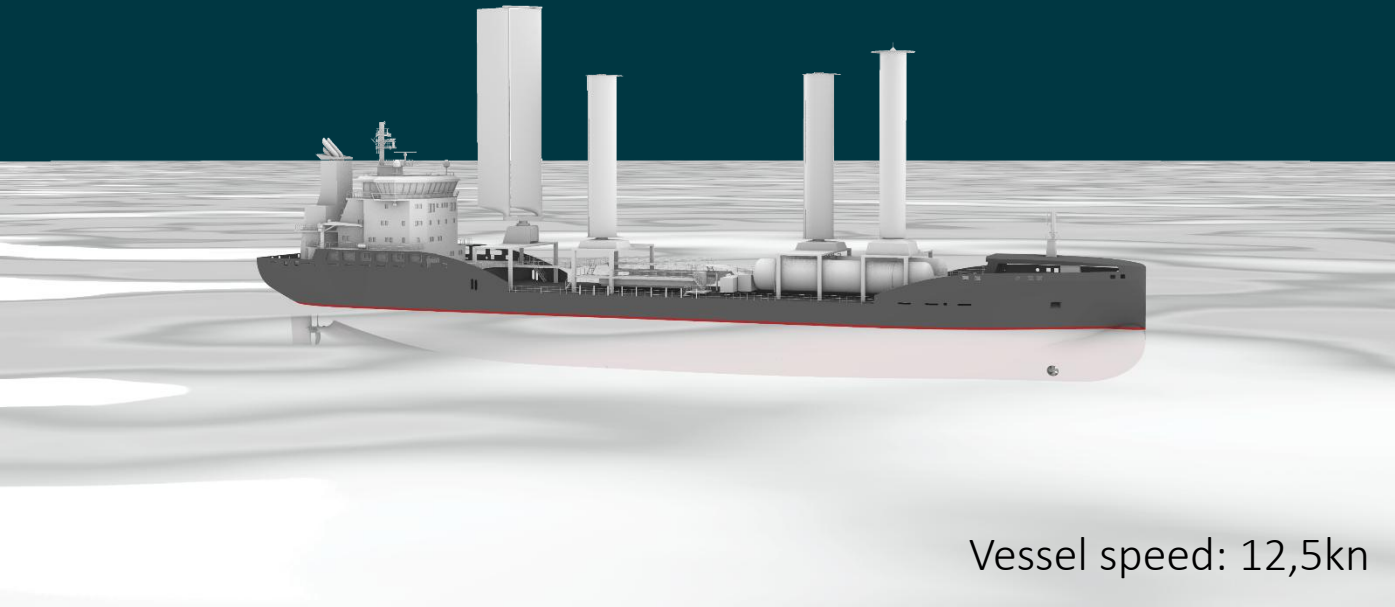
Wing-sail to improve sailing performance at higher speed and during upwind legs

Suction wings to improve general performance on a small footprint

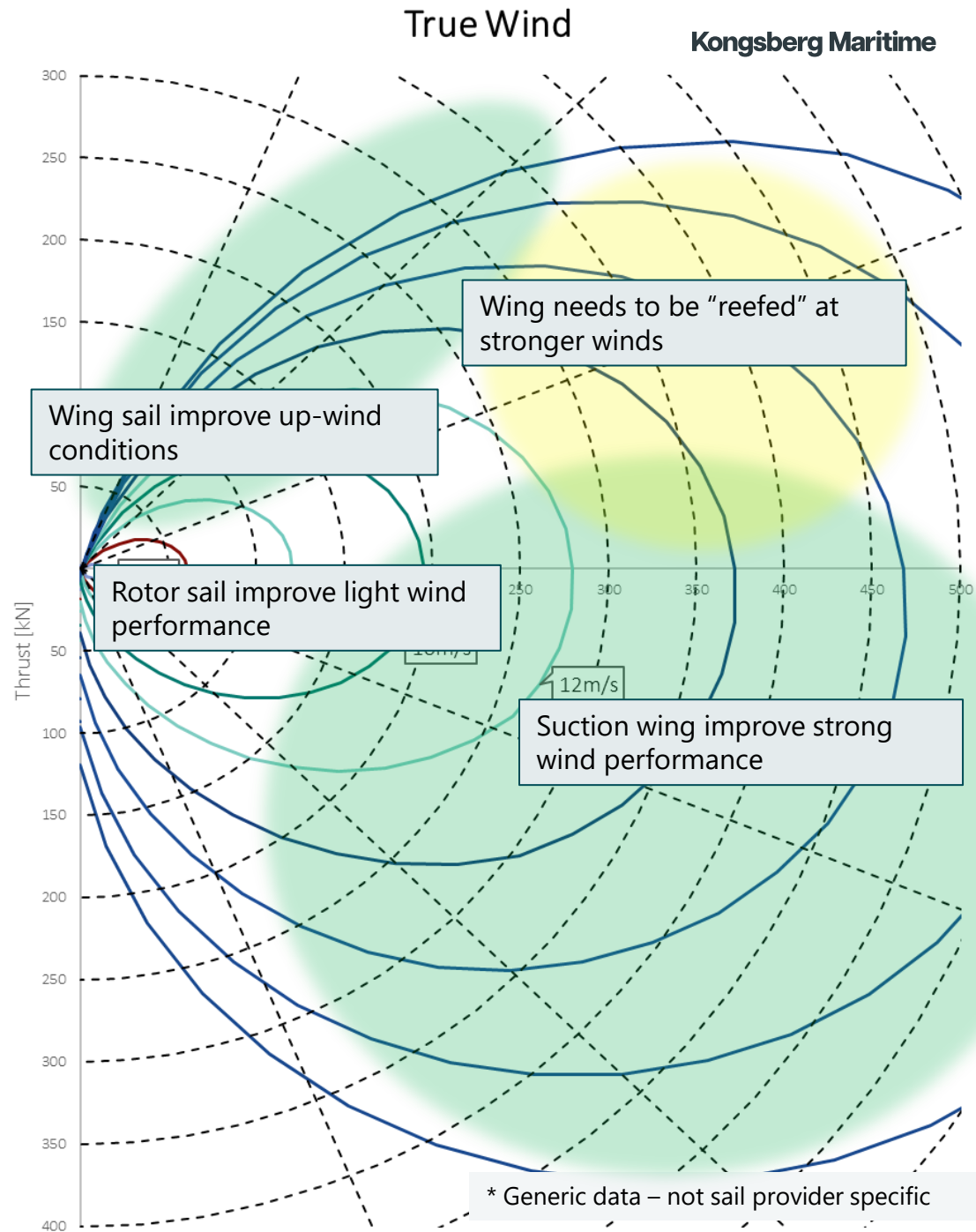
Rotor-sail to enhance downwind performance



1 x Wing sail  
2 x Suction wing  
1 x Rotor sail



Vessel speed: 12,5kn



# Adding wind propulsion means

adding additional thrusters with variable load



# K-Sail – takes control of wind

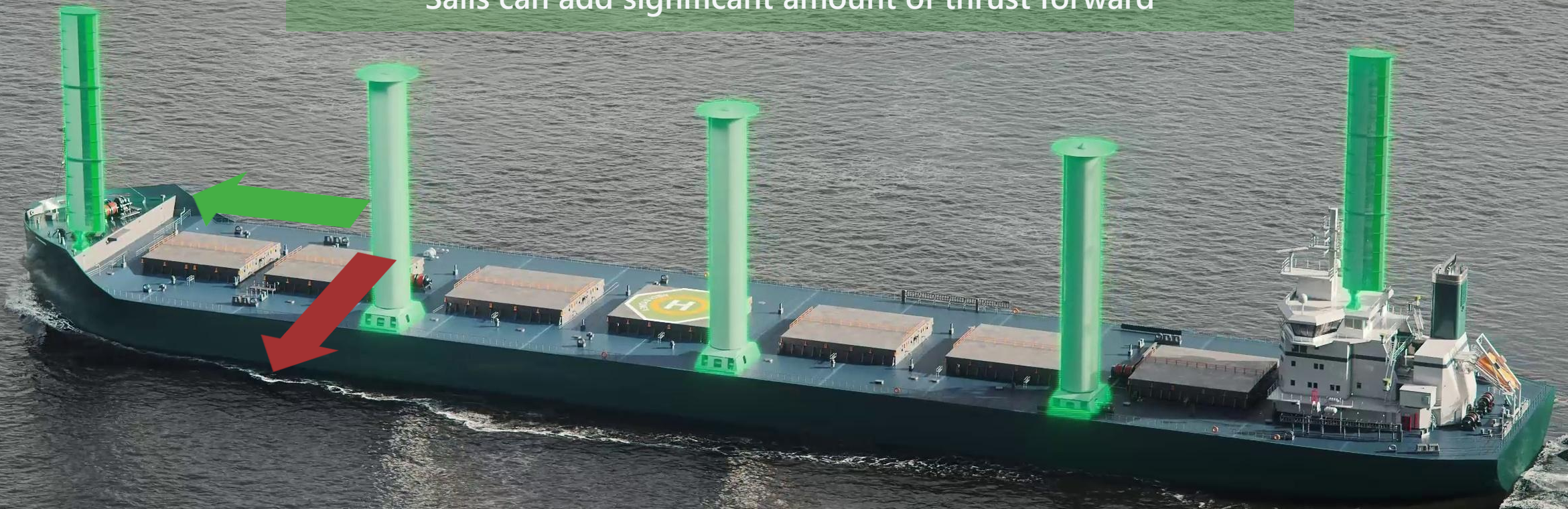
Wind propulsion as an integrated part of the vessel systems



# K-Sail – takes control of wind

Wind propulsion as an integrated part of the vessel systems

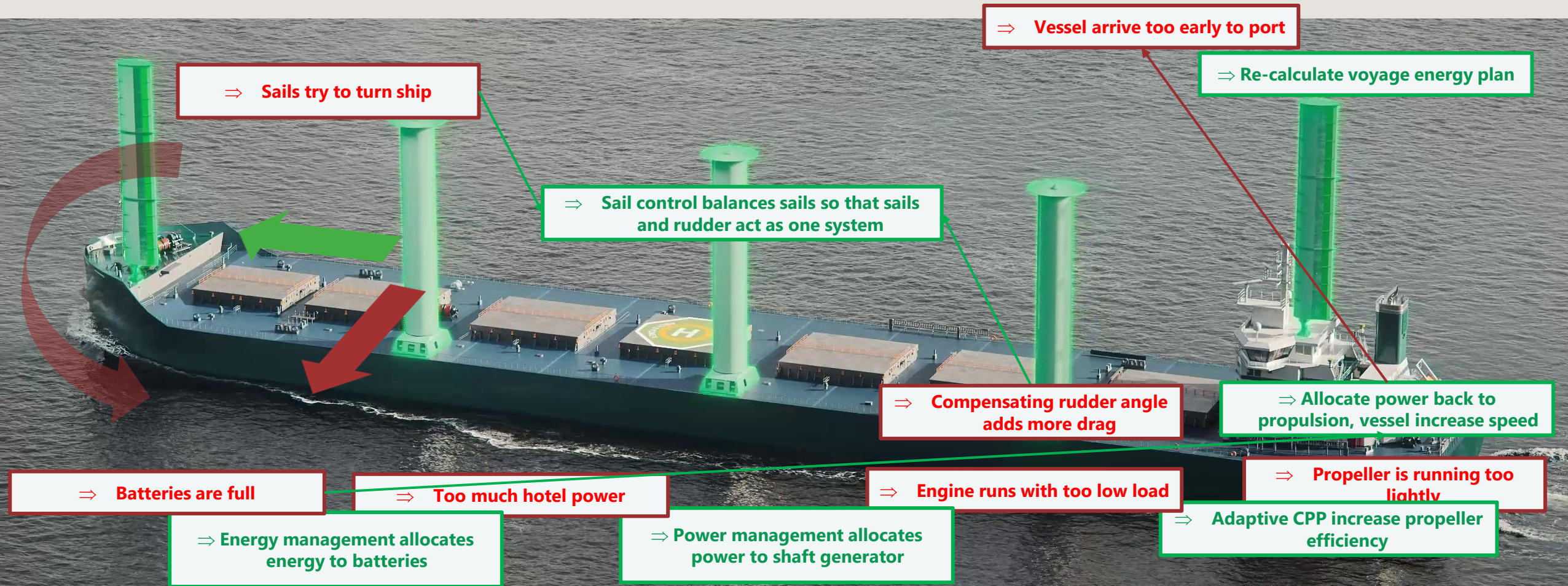
Sails can add significant amount of thrust forward



But they also change the vessel operation and power balance

# K-Sail – takes control of wind

Wind propulsion as an integrated part of the vessel systems



# K-Sail - Voyage plan

ETA

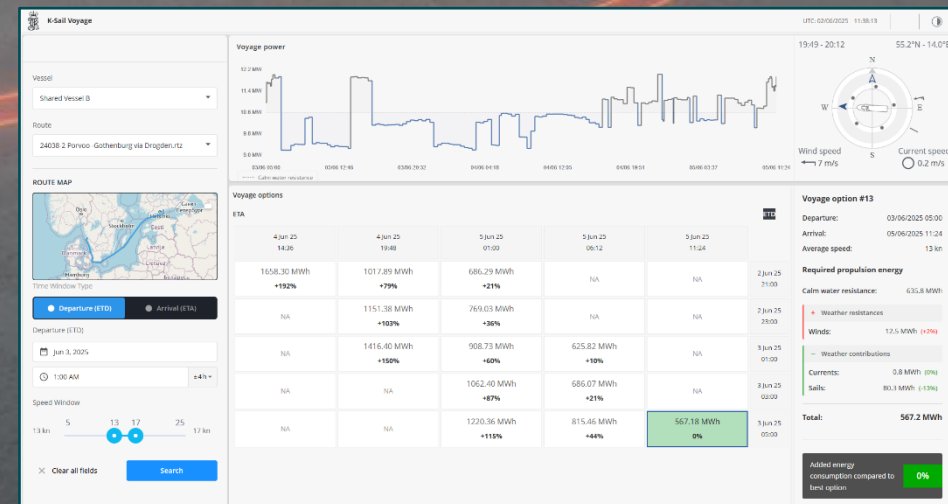
⇒ Re-calculate voyage energy plan

## Variable speed and power over route

⇒ Plan according to forecasts of wind, currents and waves

With wind assist, the energy plan over a route need to consider variation in speed and power over the whole route with regards of environmental variables

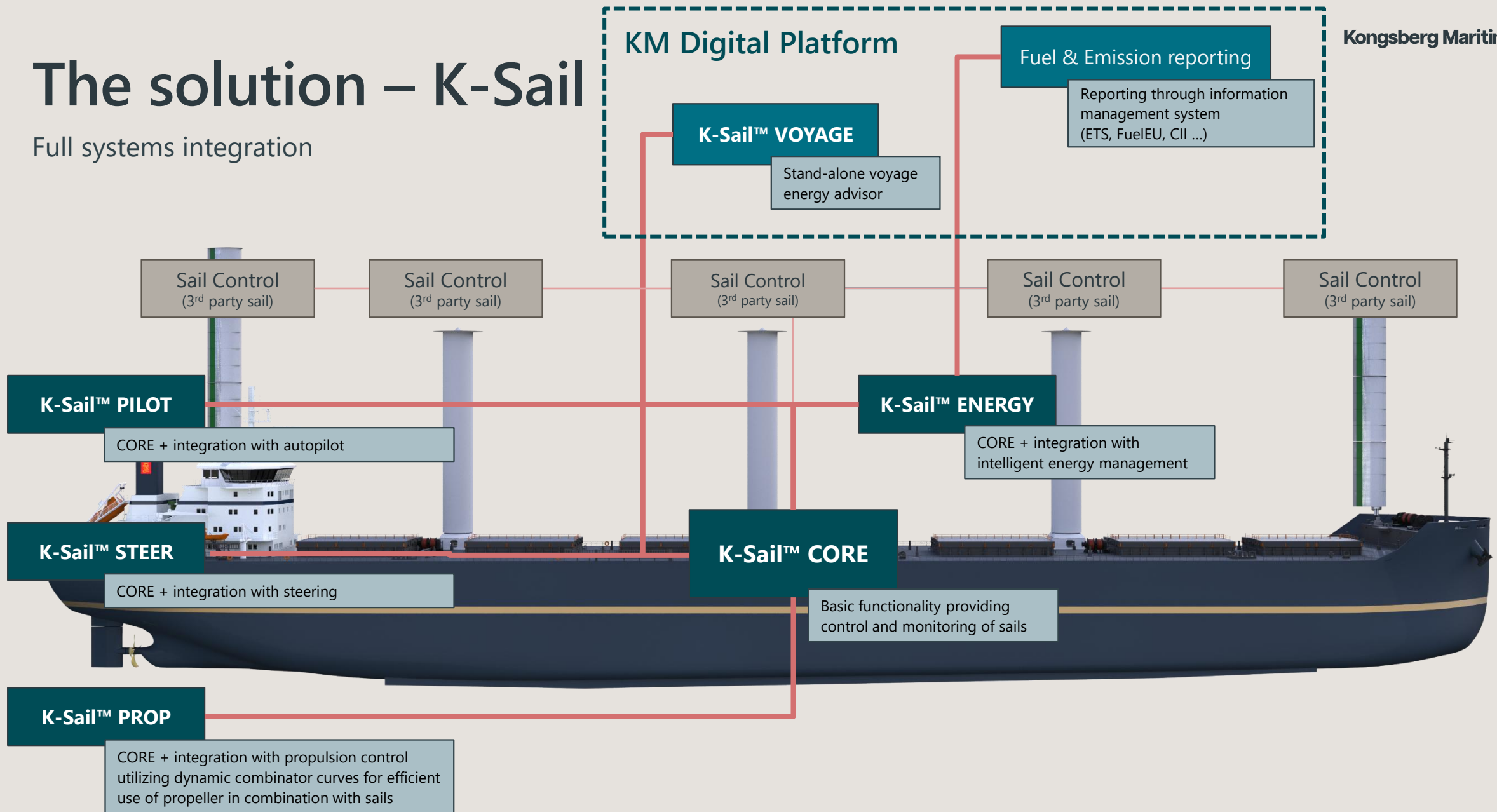
ETD



# The solution – K-Sail

Full systems integration

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# K-Sail performance

Simulation examples



## General Cargo – 12500 DWT

Mediterranean / Europe, west coast  
WAPS: 1x 28m Rotor sail + 1x 36m Suction wing

Wind assist savings: 4-29% @ 13kn



Savings with **K-Sail**: **5-38%** @ avg 13 kn



## Chemical tanker – 15000 DWT

Baltic Sea / North Europe  
WAPS: 4x 16m Suction wing

Wind assist savings: ~9% @ 12,5kn



Savings with **K-Sail**: **~15%** @ avg 12,5kn



## Dry bulk carrier – 82500 DWT

North Atlantic  
WAPS: 3x 35m Rotor sail + 2x 36m Suction wing

Wind assist savings: 20-36% @ 12kn



Savings with **K-Sail**: **25-48%** @ avg 12 kn

# Tern Vik – first vessel with K-Sail

Actual performance in accordance with calculations





# K-Sail™

- Full integration of wind propulsion systems
- Bring added value through advisory, integration and life-cycle support

## Benefits

- Optimised operation
- Reduced pay-back of sails
- Reduced fuel consumption
- Improved compliance

# Hybrid shaft generator (HSG) + CPP

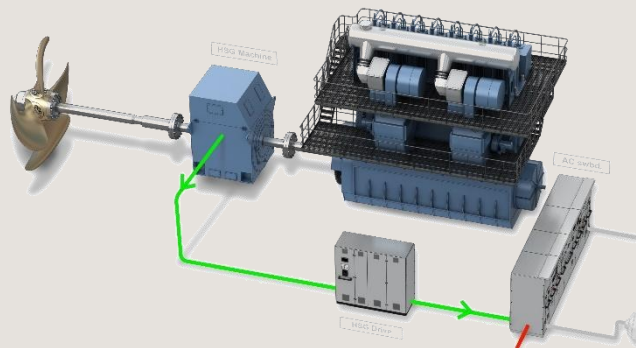
Ideal with wind propulsion

## Hybrid shaft generator (PTO with frequency converter)

The HSG enables cost-effective main engine power generation at variable rpm while keeping fixed frequency to the switchboard

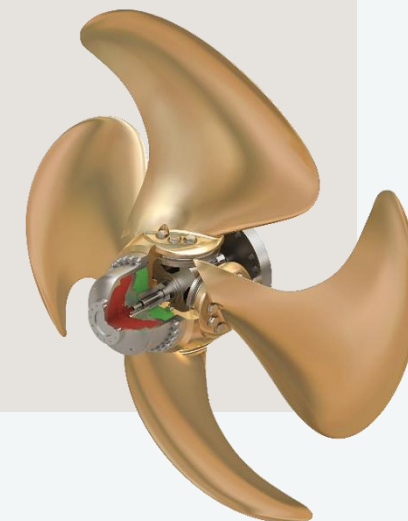
PTO is ideal for a ship with wind propulsion and air lubrication:

- Higher hotel load from compressors and wind devices
- Increased electric load concur with lower propulsion power demand



## Controllable Pitch Propeller (CPP)

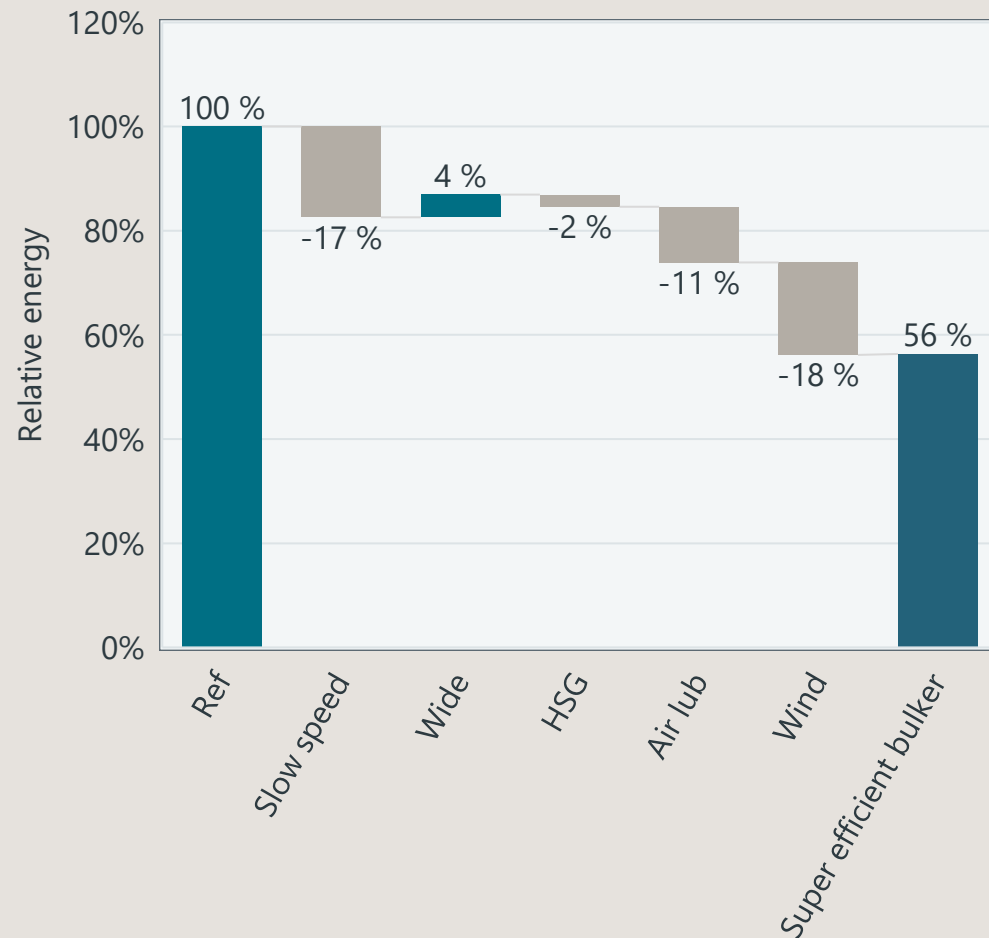
- Better efficiency with CPP than FPP in vessels with wind propulsion
- Variable thrust conditions
- Retain steering performance in all wind conditions
- Ideal for large PTO installations



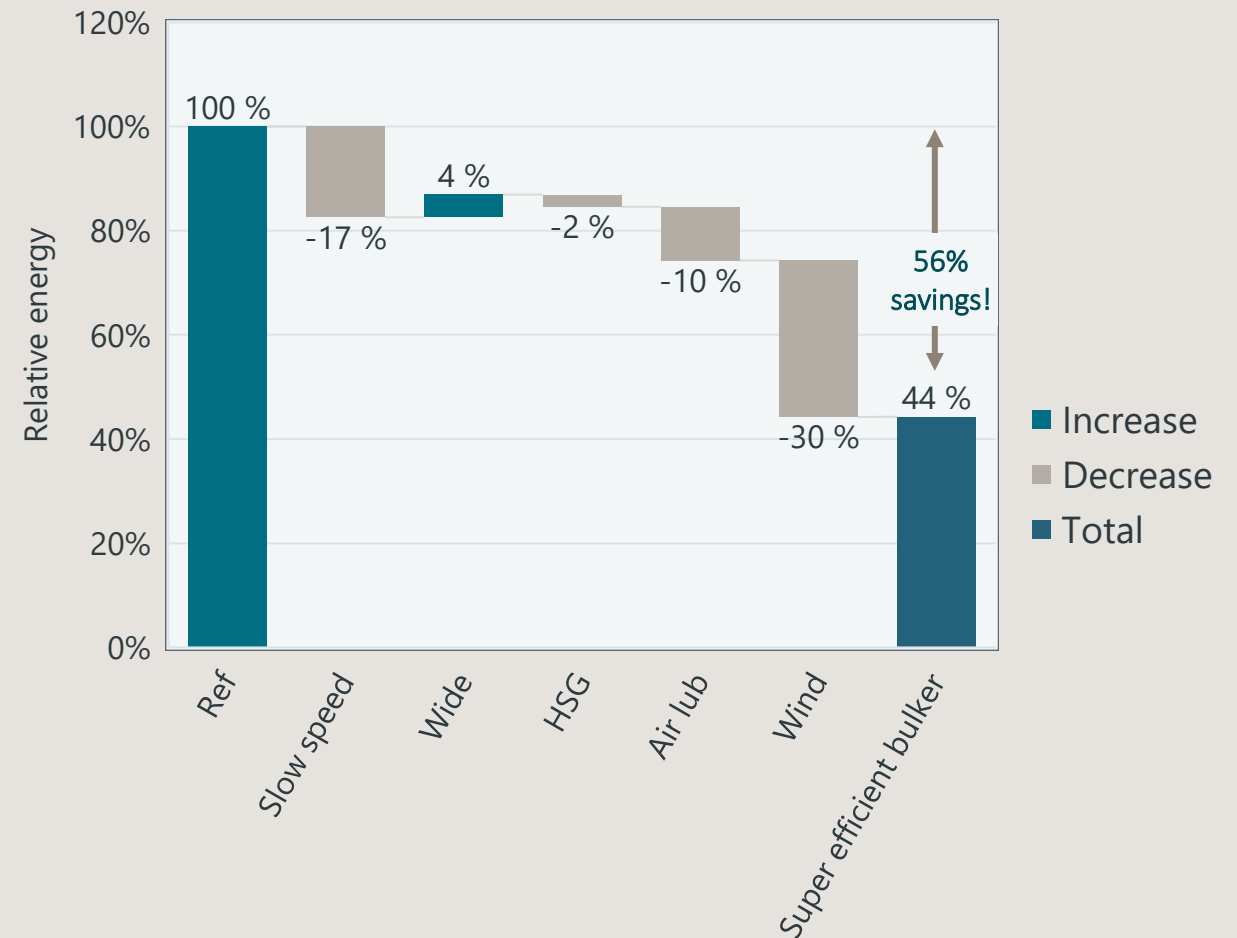
# Large fuel saving potentials

Example study for 80 000 dwt vessel

GLOBAL OPERATION



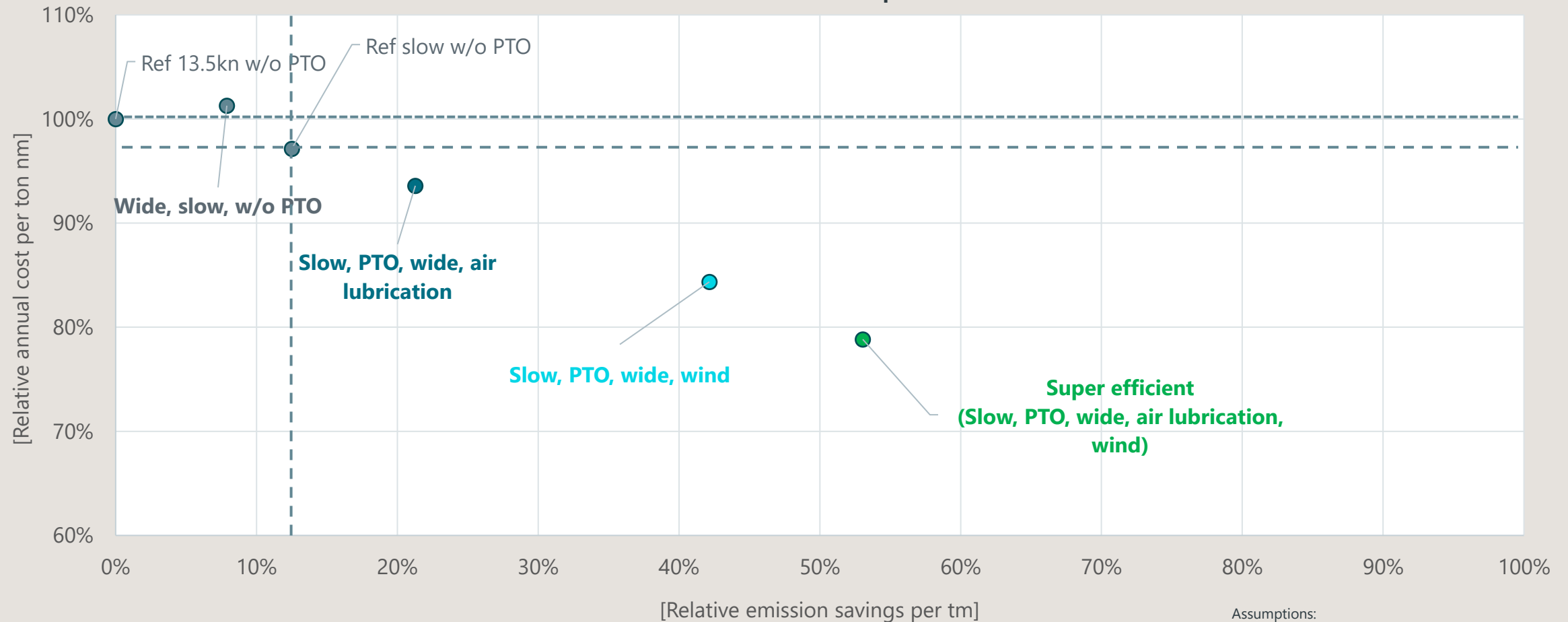
FAVOURABLE WIND ROUTE (ROTTERDAM – SEPT-ILES)



# Annual cost vs emission reduction

Relative annual cost per tm (OPEX+CAPEX) vs CO<sub>2</sub> benefit per tm – favourable route

## Rotterdam – Sept-Iles



Assumptions:

- MGO price 800 \$/ton
- CO2 tax: 100 \$/ton
- Shore power (in ports) 0,15 \$/kWh

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# Conclusions



# Wind Propulsion conclusions

## Drivers

- Wind propulsion help to comply with FEUM, EEDI and NZF
- Regulations increase fuel and emission costs -> wind propulsion business case has become very attractive

## Integration and design

- Design vessel for wind propulsion
- Select the right (combination of) wind technologies
- PTO and CPP are beneficial with wind propulsion

## Optimization

- Both voyage optimization and intelligent onboard energy management is essential to get full potential from wind devices
- Larger savings and shorter payback