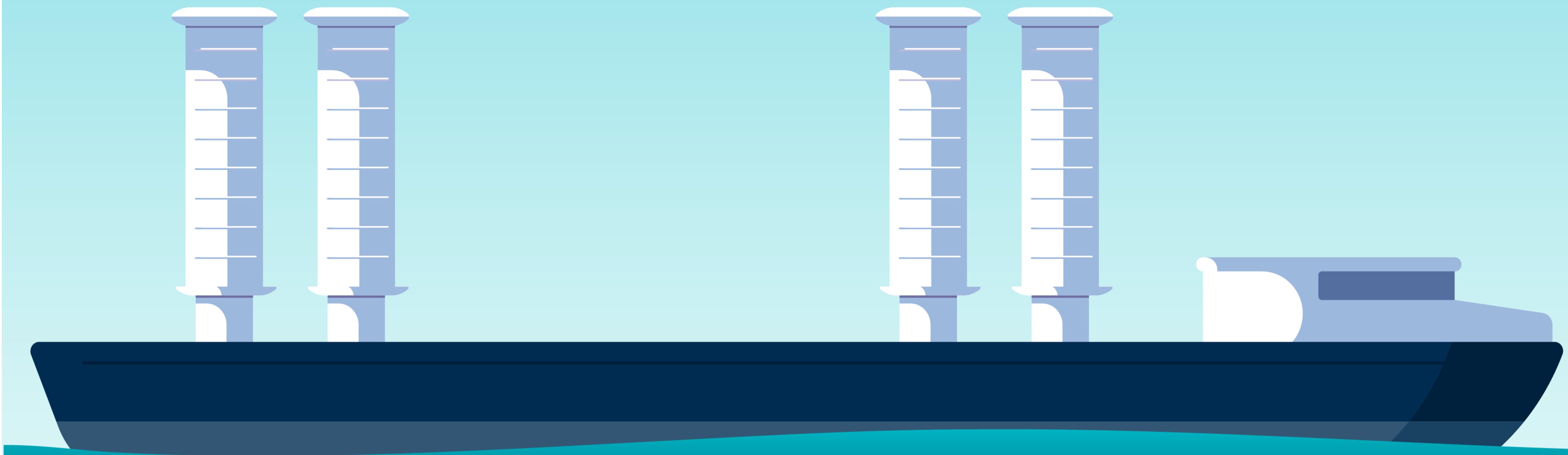


RASANT

Hybrid Sail Cargo Ships

University of Applied Sciences HOCHSCHULE EMDEN·LEER | Fraunhofer IWES | Maritimes Zentrum Hochschule Flensburg | MARIKO

Project idea & framework

Wind as the main propulsion system for cargo ships! What was already common 100 years ago can be an essential part of the decarbonisation of maritime shipping!

The four project partners are developing a ship concept that meets the modern market requirements of sustainable cargo shipping and primarily utilises the power of the free medium of wind. An automated, powerful wind-based main propulsion system is to be supplemented by an auxiliary propulsion system based on renewable, hydrogen-based fuels.

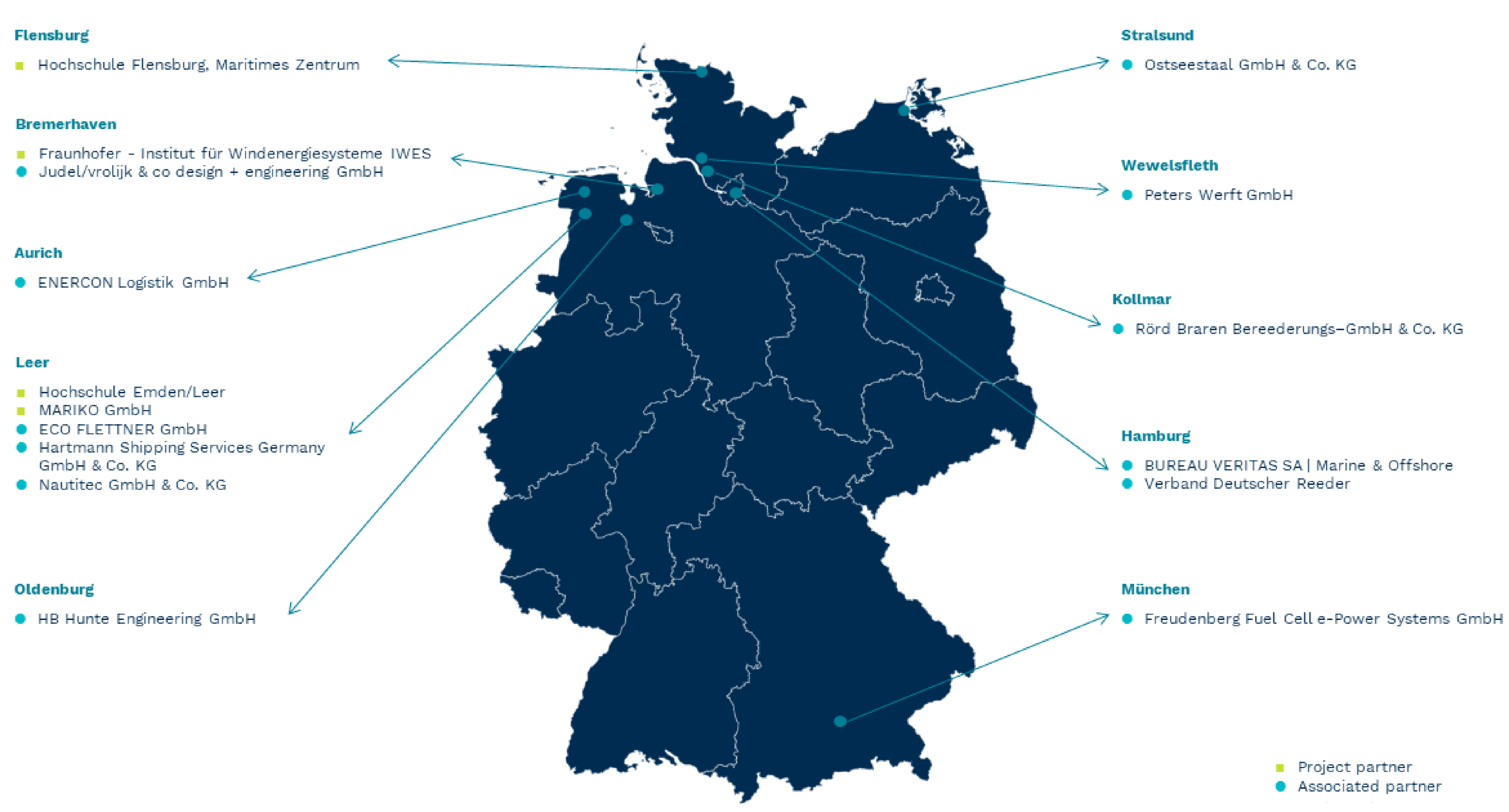
The proportion of the main wind propulsion system is to be maximised as the technology develops, so that ships can be operated as cost-effectively and self-sufficiently as possible.

- Budget: 2.9 million euros
- 4 project partners
- 12 associated partners
- Project period: 01.01.2023 - 30.06.2025

Main goals

1. Marketable ship concept with upscaling potential
2. Cost-effective, self-sufficient ship operation by maximising the main wind propulsion
3. Network building for climate-neutral wind-based ship propulsion concepts

Project network



Status Quo	Auxiliary wind propulsion	Main machine propulsion
RASANT	Main wind propulsion	Auxiliary machine propulsion

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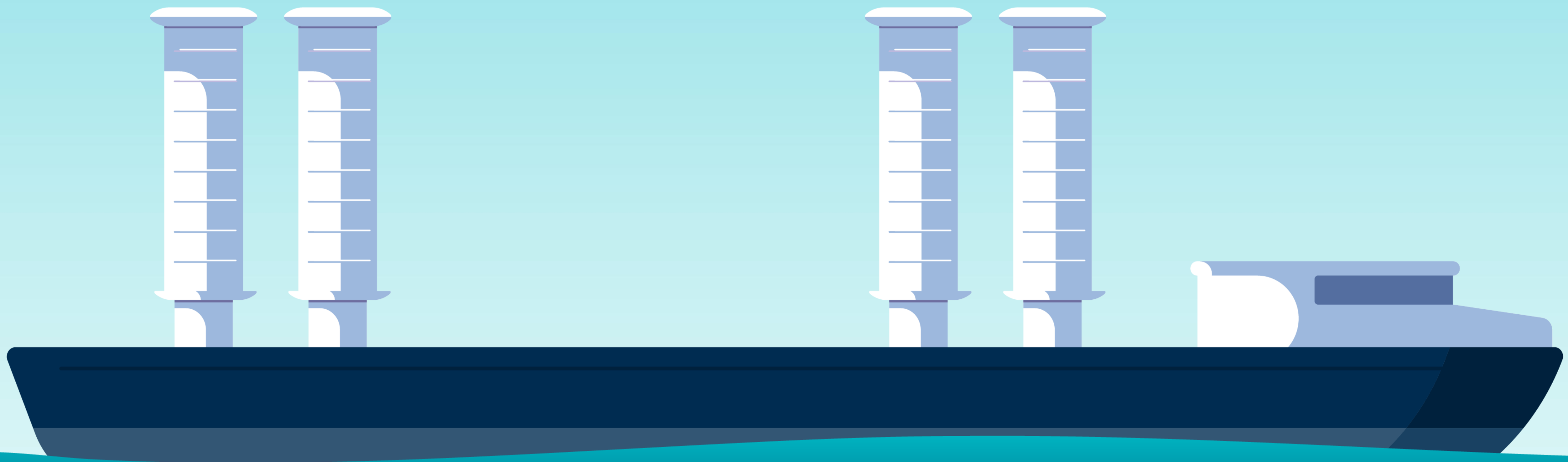

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Hybrid Sail Cargo Ship Design

The RASANT project is currently developing a systematic approach to design modern hybrid sail cargo ships. While the design principles of conventional merchant ships are well understood and optimized, large commercial sailing vessels have not been built for over a century. Among others, following topics are investigated:

- Bridge arrangement (line of sight)
- Placement of sails in relation to cargo handling and aero/hydrodynamic forces
- Effect of different wind propulsion systems (Flettner, suction sail, wing, softsails, . . .) on the ship design
- Effect of the hull design on the drag and side forces at variable speeds, drafts and heel angles
- Effect of stability requirements on the hull shape
- Hull proportions and their effect on hydrodynamic forces and stability

3-D printed towing tank model of the E-Ship 1

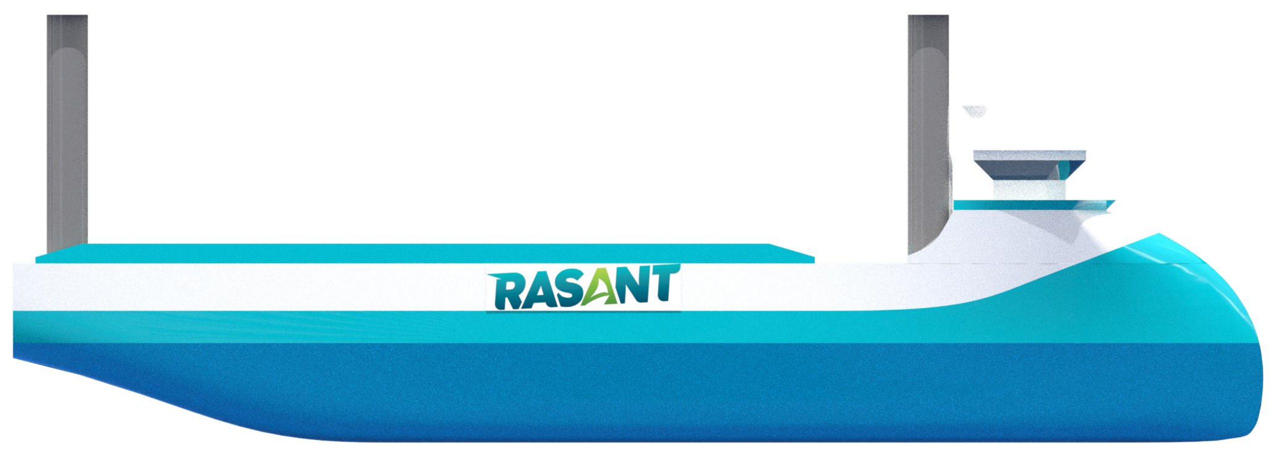
A series of towing tank tests, in particular to optimize hulls and appendages for sailing at a drift angle, is currently under way. 3-D printed models allow to test a wide range of shapes and scenarios in a short time.

Baseline design for a rotor ship E-Ship 1 (Florian Stelling 2022)

Concept Design

The developed design principles are applied to a real ship design. The RASANT team is currently developing the concept design for a 10k tdw sail powered vessel in close collaboration with the shipping industry. The goal is a ship that on an average voyage generates more than 50 % of its propulsion energy from wind power while being economically attractive at the same time:

- Type: general cargo, box shape open top
- Service speed: 10 kn at T max.
- More than 50% sail powered on average voyage
- Length: 120 m
- Breadth: 20-21 m
- Draft: 8 m
- Molded depth: 18 m
- Bridge forward, crew 12



Early concept of a modern hybrid sail cargo ship, in this case with Flettner rotors

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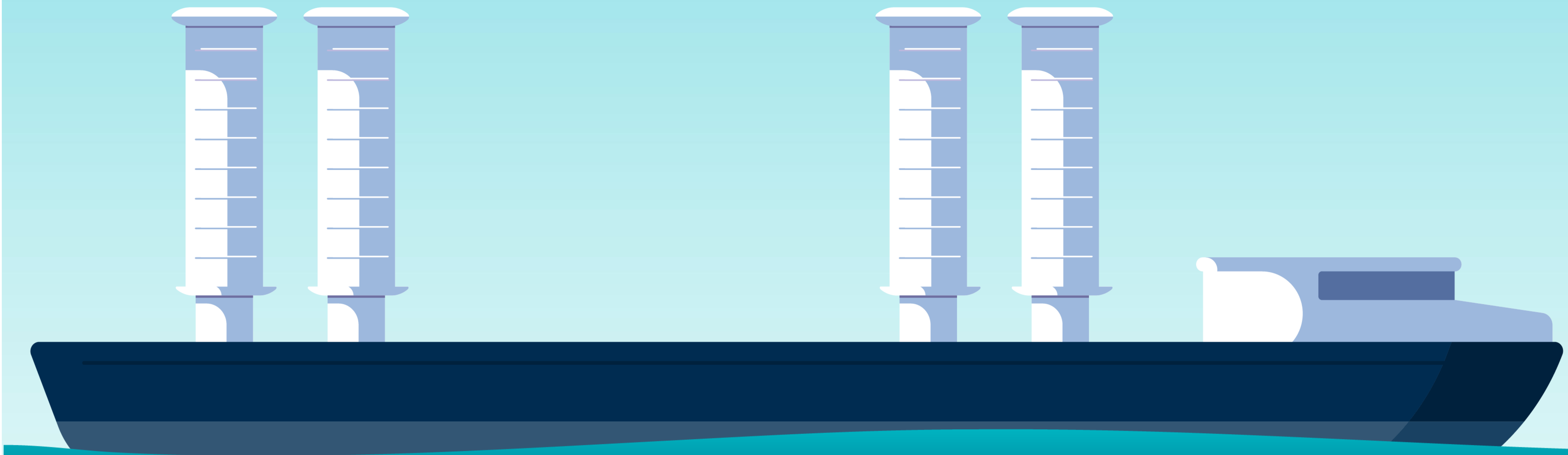

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Introduction

A significant part of this project is to select and design the most suitable propulsion systems for the determined ship type and route profiles. The wind propulsion system as well as the drive and energy concept are being investigated jointly by Fraunhofer IWES and University of Applied Science Flensburg. The results will be used as the design basis for the hybrid ship within the scope of this project.

Objectives

- Develop an overall evaluation scheme including the selection of wind propulsion systems and engine concepts.
- Develop a toolchain allowing an independent assessment of the technologies.

Evaluation scheme

The tool allows a first-level comparison to rule out certain technologies that do not fulfil the design requirements, such as availability of deck space, locations, air draft, etc., according to the given vessel data.

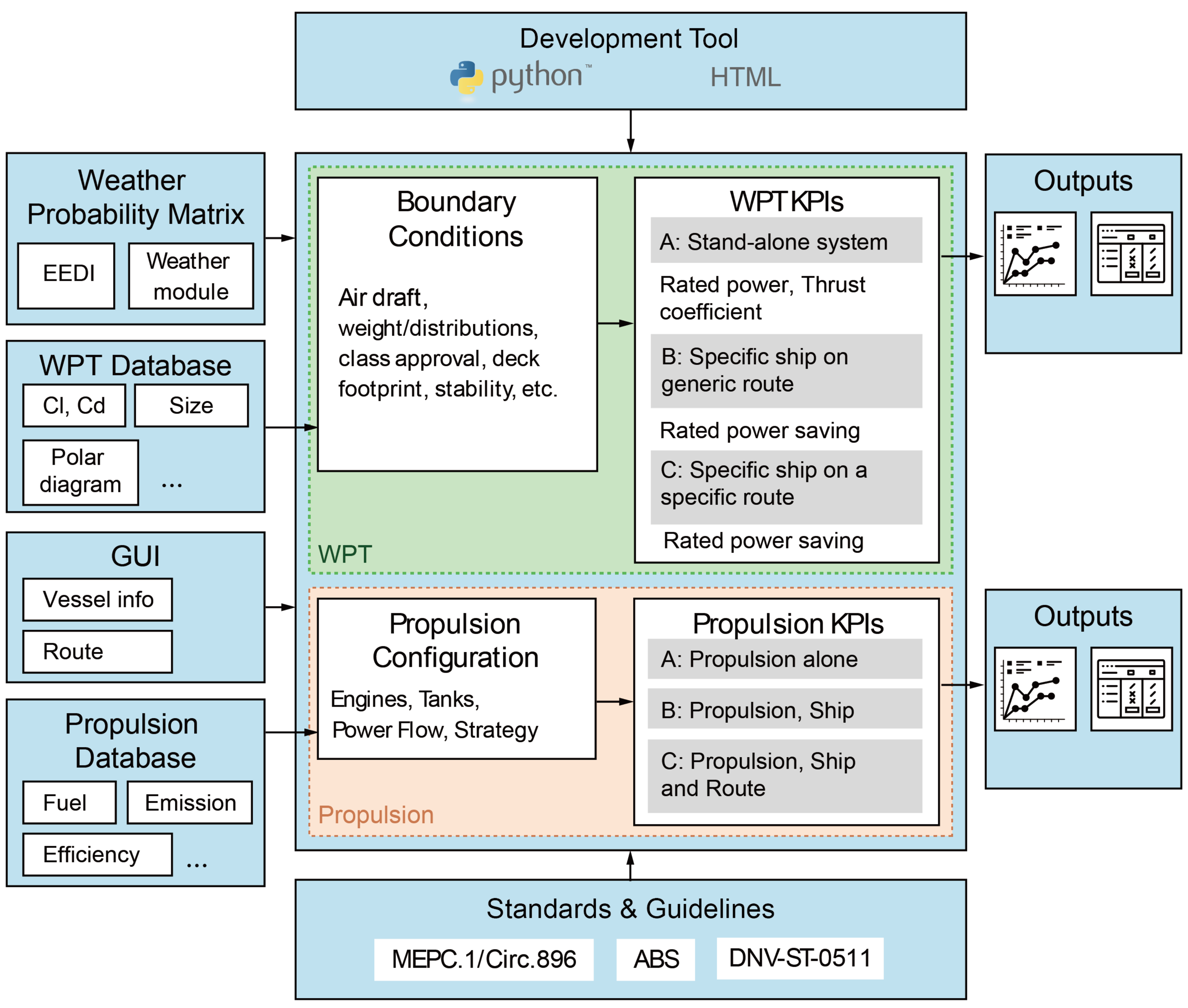

Figure 1 Block diagram of the evaluation scheme

Pre-selected wind propulsion systems will go into second round of comparison by measuring their power-saving potential with key performance indicators (KPIs). The KPI scheme used here is defined according to reference [1]. As illustrated in Fig. 1, the hybrid propulsion system is incorporated into a Python backend development framework with HTML frontend interface.

Route Simulation Tool

After a pre-selection of wind propulsion technology and propulsion concept has been made using the evaluation scheme, a second tool helps with the assessment and performance simulation of the obtained system. Simship is a route simulation tool focused on allowing a detailed propulsion system comparison at an early design stage. Based on main dimensions of the ship, chosen propulsion system, defined route with reanalysed weather data and a given speed profile, the tool simulates the power consumption of the ship, together with emissions and power savings due to the wind propulsion technology.

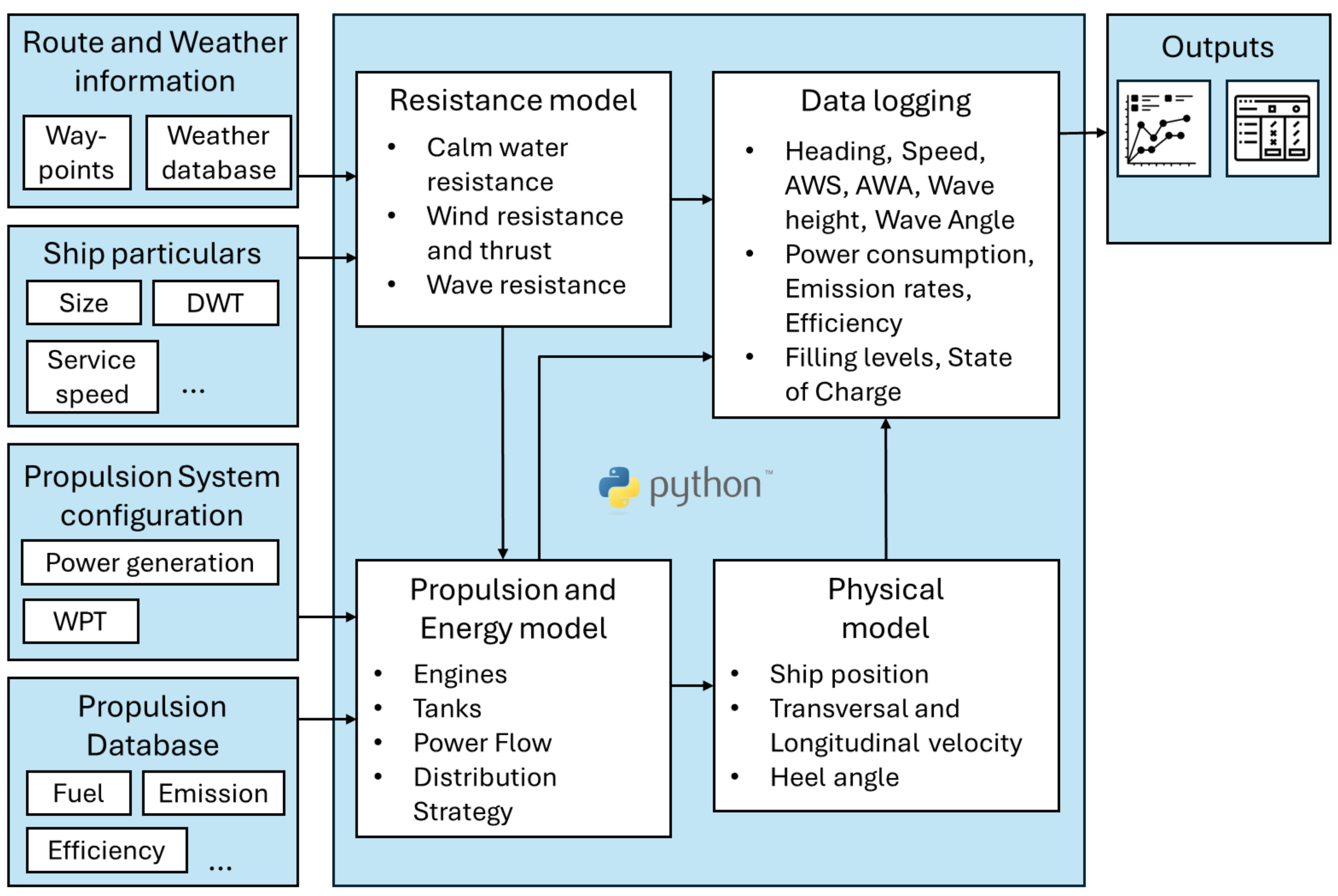

Figure 2 Block diagram of the route simulation tool simship

The structure of the route simulation tool is illustrated in figure 2. The tool is written in python with a modular programming structure.

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References

1. Werner. S, Gerhardt. F. and Kontos, S., 2023, 'technical key performance indicators for wind-powered ships'.

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