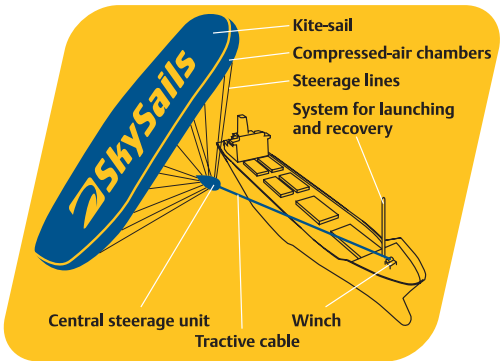


# Smart technology

## Wind power: The driving force

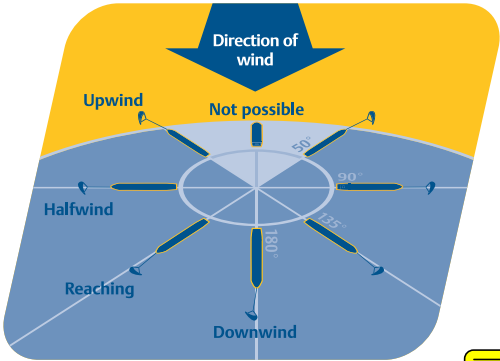
For the first time SkySails utilises wind energy as a powerful and reliable propulsion force. Using this new form of energy intelligently combines hardware and software technology with an eye to the requirements of modern shipping.

## System components



The towing kite of the SkySails propulsion system has an aerodynamically optimised aerofoil-profile, comparable to the wing of an aeroplane. Thus the SkySail is also suited for fast vessels. It can easily be launched and recovered. The towing kite is made of a robust, weatherproof textile, can easily be stored and takes up little space on board.

The power of the towing kite is transferred to the ship via a central tractive cable. The control cables steer and trim the aerofoil. The kite is operated and kept in shape by cords. The cordage is made of light modern synthetic fibres, which provide high resilience and negligible extension under heavy load. A patented mounting system transfers kite power to the ship's body. The variable tractive point guarantees the ideal positioning of the towing kite, regardless of the course or wind direction. Hence courses up to 50 degrees to the wind can be achieved.



In readiness for commercialisation a procedure currently exists which makes it possible to automatically launch and recover a towing kite of arbitrary size from the bow of the ship.

The control of the towing kite is fully automatic and similar to a plane's autopilot. The kite is positioned according to the direction and strength of the wind, as well as the ship's course and speed.

## System component routing

With the aid of routing a constant, powerful propulsion force is achieved. Utilisation of advantageous winds, quick voyages and a punctual time of arrival are made possible. The system component "routing" consists of four modules:

### Weather forecasting

Modern meteorological procedures accurately forecast weather within a timeframe of 5 days. Short-term weather phenomena such as katabatic winds can be predicted more than half a day in advance. The general weather situation can be forecasted within even wider timeframes. As a result route management contributes considerably to avoiding hazards and ensures the security of the system.

### Performance analysis

The data from the weather forecasts is used to make the performance analysis. A prediction for the available power through the

SkySails propulsion system can be made in kilowatts. The performance analysis determines the performance possible using SkySails propulsion under the given weather conditions. Potential routes and power are recommended. The individual ship data is considered in the calculations.

### Decision-making model

The shipping company determines the priorities of the ship. The decision-making model takes into account the requirements of the ship owner as well as parameters, such as maximum fuel consumption and latest time of arrival and automatically calculates the best course.

### Route recommendation

Subsequently the route recommendation is transmitted into a series of way points and given to the ship's master. In this way an optimised and automatic utilisation of the SkySails propulsion system is made possible.

## Systematic high performance

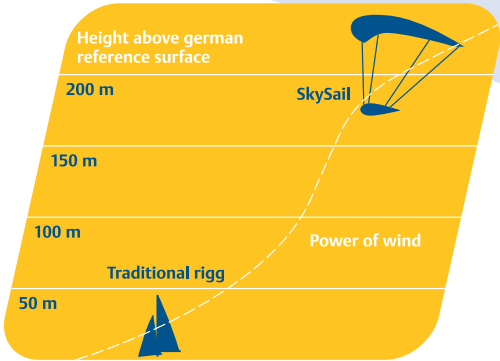
The features of the SkySails technology enable ships to use wind power with entirely new performance characteristics. Thus the hitherto unused potential of wind energy can be exploited profitably.

### High propulsion power and speed

The optimally shaped aerofoil profiles, with sail areas – depending on the ship's propulsion power – of up to 5,000 square metres, in combination with optimised route management guarantee the best possible energy utilisation. The SkySails system can be used for all speeds.

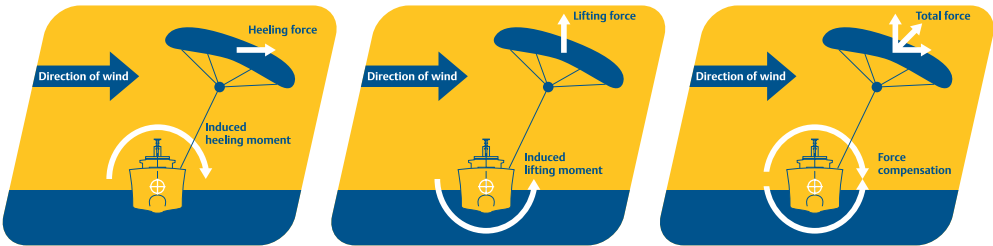
### High reliability and good time keeping

The operating altitude can be freely determined up to 500 metres. Since the speed of the wind increases exponentially even at heights of assumed wind calmness, sufficient wind energy is available. In combination with refined weather route management adherence to schedules is assured.



## Maximum safety

A ship with a SkySails system does not heel, i.e. it does not tilt to the side with the force of the wind like traditional sailing ships. The ship and its crew are not put at risk. Any potential danger to the ship caused by the SkySails-System is excluded by the aerodynamic autopilot force control.



## Low space requirement

As the sail is spatially separated from the body of the ship the reduction of the ship's effective area by the system is economically insignificant. In its packed state the towing kite is easy to stow and takes up very little space.

## No additional staffing costs

The SkySails system operates fully automatically. During flying operations an autopilot controls the handling of the sail. The existing crew is sufficient for the operation of the ship and the sail. Thus, there are no additional staffing costs.



## Advantages

### Reduction of fuel costs by up to 50%.

Up to half of the ship's operating expenses are spent on fuel. Using the SkySails system fuel consumption can be reduced by up to 50%. In addition savings are made on lubricating oil. Hence the ship's operating costs are reduced significantly.

### Increase of ship speed by up to 10%

As an alternative to reducing the ship's operating costs, by increasing the average speed of the ship the transportation performance can be increased by up to 10%. Thus ship owners can transport more cargo and earn higher profits.

### High reliability and good time keeping

A refined weather route management assures the use of the most advantageous winds and adherence to schedules.

### Improved security

The SkySails system improves the seaway performance and manoeuvring capability of the ship significantly. This ensures higher security of the ship. The well-being and performance of the crew is improved. Minimised slamming and torsion force extend the long life cycle of the ship. SkySails as an alternative propulsion system can minimise the negative effects of propelling-engine damage, e.g. a turbo-supercharger damage.

### Retrofit technology

Almost every sea-going ship as well as motor and sailing yachts can be equipped or retrofitted with the SkySails system.

### Rapid amortisation

Adding up the advantages listed above the investment in a SkySails System amortises within two to three years.

### Sustainable strategy

Due to the flexibility of the SkySails system (by either minimising costs or increasing speed) ship owners can improve cost-effectiveness and implement sustainable strategies.

Moreover, savings are made on charges levied on atmospheric emissions. The margin and the competitive advantage are increased.

## Welcome aboard!



SkySails has succeeded in creating a unique network of leading companies of the industry. Among with others, these are the Leer based Oltmann Gruppe, the Germanischer Lloyd, the Hamburg Ship Model Basin (HSVA) and shipping companies like Rickmers Reederei and Briese Schifffahrts GmbH & Co. KG.

**For the rollout, SkySails is looking for additional reference customers.**



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## Shipping's new power!

Overview

## Shipping's new power!

SkySails is developing a world patent pending propulsion system for cargo vessels that enables the utilisation of an enormous energy potential that has been unused for a long time: the wind! As a result the operation of ships will become more profitable, safer and independent of declining oil reserves.



The system consists of a towing kite, an autopilot and wind-optimised route management. With the aid of routing a reliable, powerful propulsion force is achieved. Utilisation of advantageous winds, quick voyages and a punctual time of arrival are made possible.