Future-oriented and cost-efficient propulsion innovations: EnergoProFin & EnergoFlow

Nautisch-Technischer Inspektoren-Kreis E.V

Hamburg, 7/11/2017

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WÄRTSILÄ ENERGOPROFIN AND ENERGOFLOW

Fuel makes up for 25 to 50% of total costs in shipping. It is the largest cost position! This means that despite the recent drop in oil prices, propulsion efficiency is still one of the most effective ways for reduce operating costs.

These fuel savings can be achieved by installing a Wärtsilä energy saving device

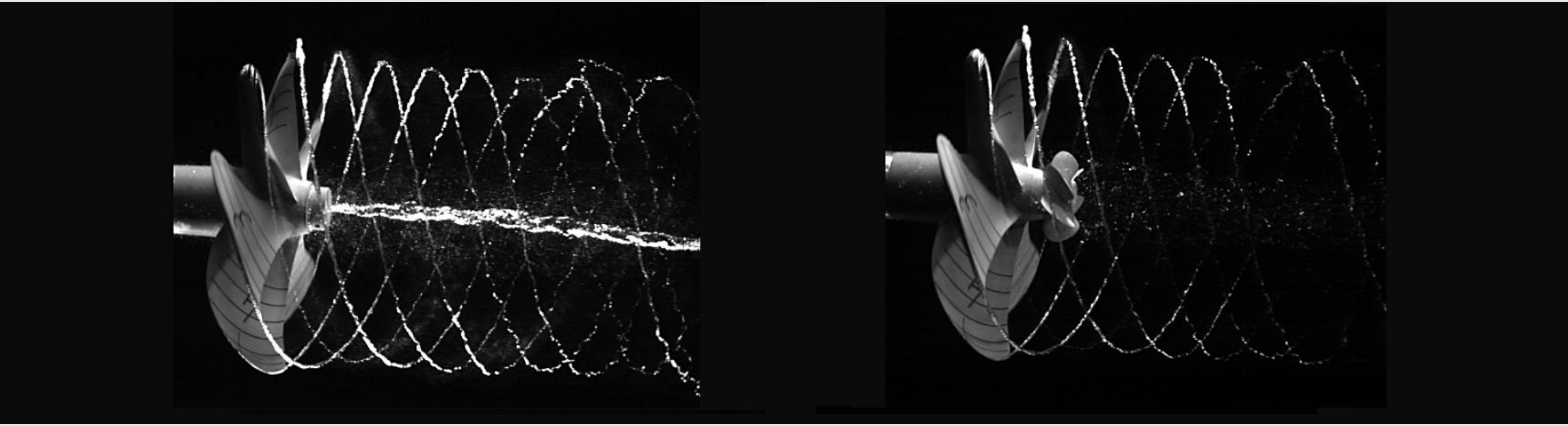
Wärtsilä EnergoProFin for propellers, controllable and fixed

The ProFin to ProFit

BUSINESS BENEFITS

Some of the energy losses of a propeller are related to losses around and after the propeller boss (hub vortex and rotating flow).

The **EnergoProFin** (EPF) improves the propulsive efficiency by weakening the hub vortex. Weakening the hub vortex decreases propeller resistance and manifests itself as increased thrust.



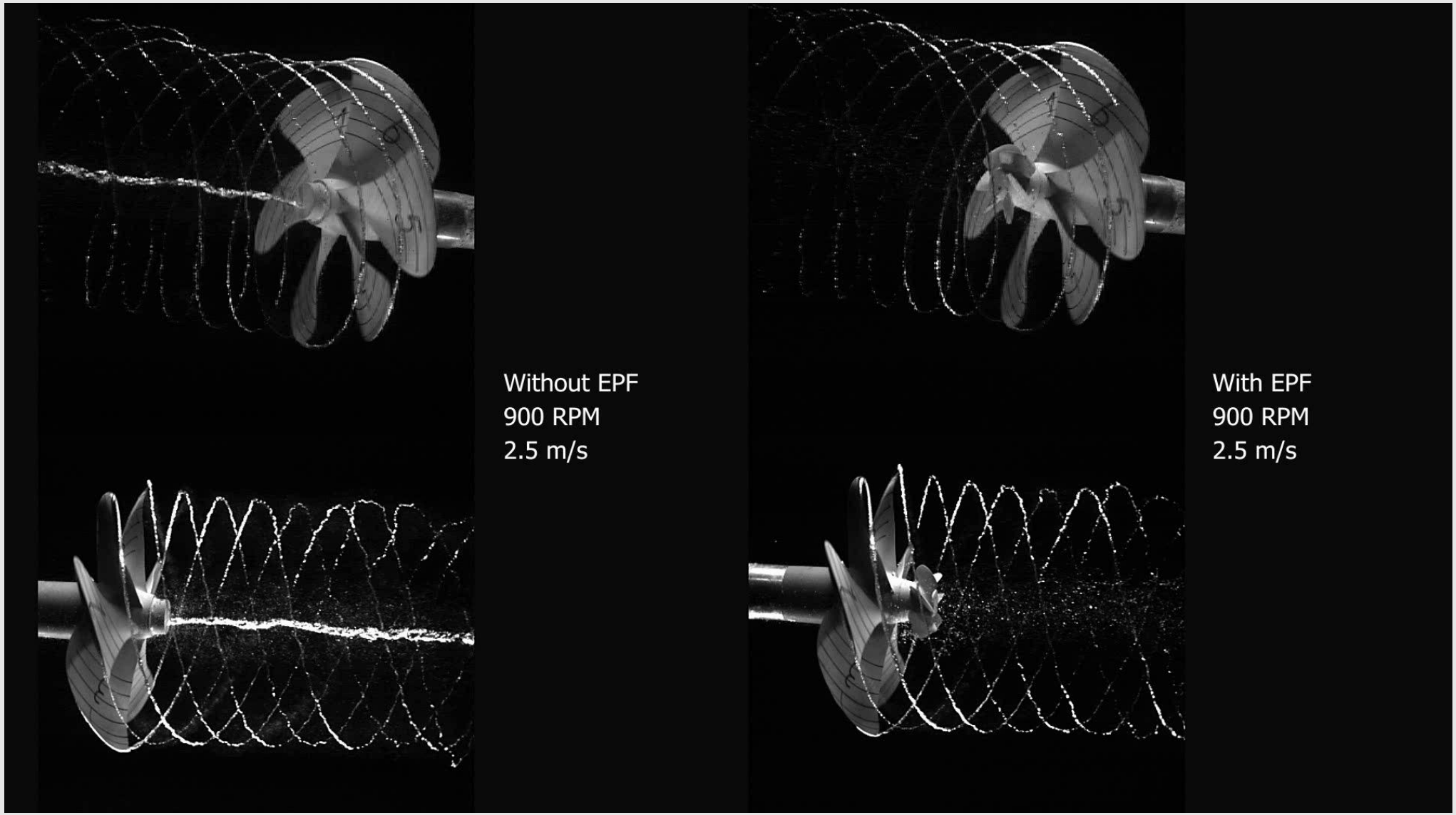
Key benefit:

- Reduction of hub vortex
- Decrease torque
- Increase Thrust
- Average fuel savings of 2%

Additional benefits:

- Reduction of underwater noises
- Reduction of vibrations

COMPARISION VIDEO



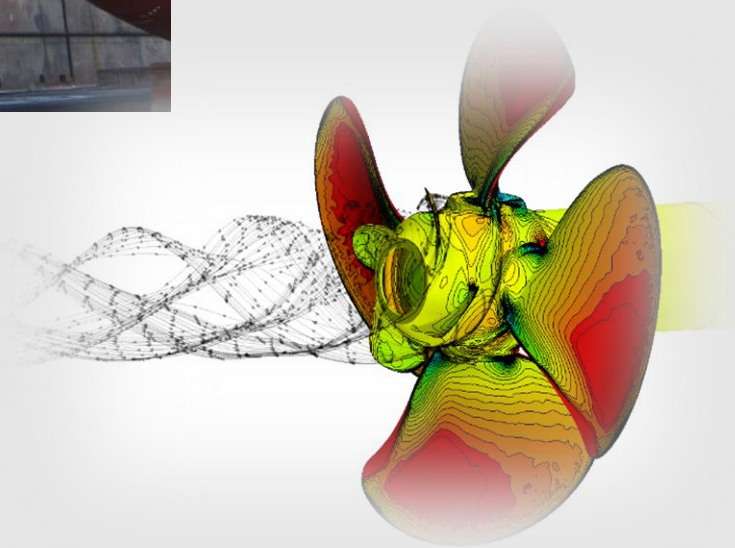
The Wärtsilä EnergoProFin is designed in such way that it becomes an integral part of the propeller. Installation of the EnergoProFin will not affect the maneuverability of the vessel.

Design:
- Consist of small fins attached to the propeller cap
- Number of fins equal to the number of propeller blades
- Fins are modeled as propeller blades

Manufacturing:
- Made from same material as propeller
- FPP; Replaces the normal propeller cap
- CPP; Bolted on the propeller hub

Installation
- in Dry-dock
- Afloat trimmed condition in port
- Dive installation condition in port

Payback time
- Several months to one year



The Wärtsilä EnergoProFin is suitable for new build and existing vessels, for both Fixed and Controllable Pitch Propellers

Cargo Vessels

Cruise

Tankers

Container Vessels.

Ferries

Bulk Carriers

SUCCESSFUL INTRODUCTION

Shortly after the introduction of the Wärtsilä EnergoProFin, Wärtsilä has received multiple EnergoProFin orders from the largest ship operators in the world. All together over 200 EnergoProFins have been sold for all type of vessels operating worldwide.

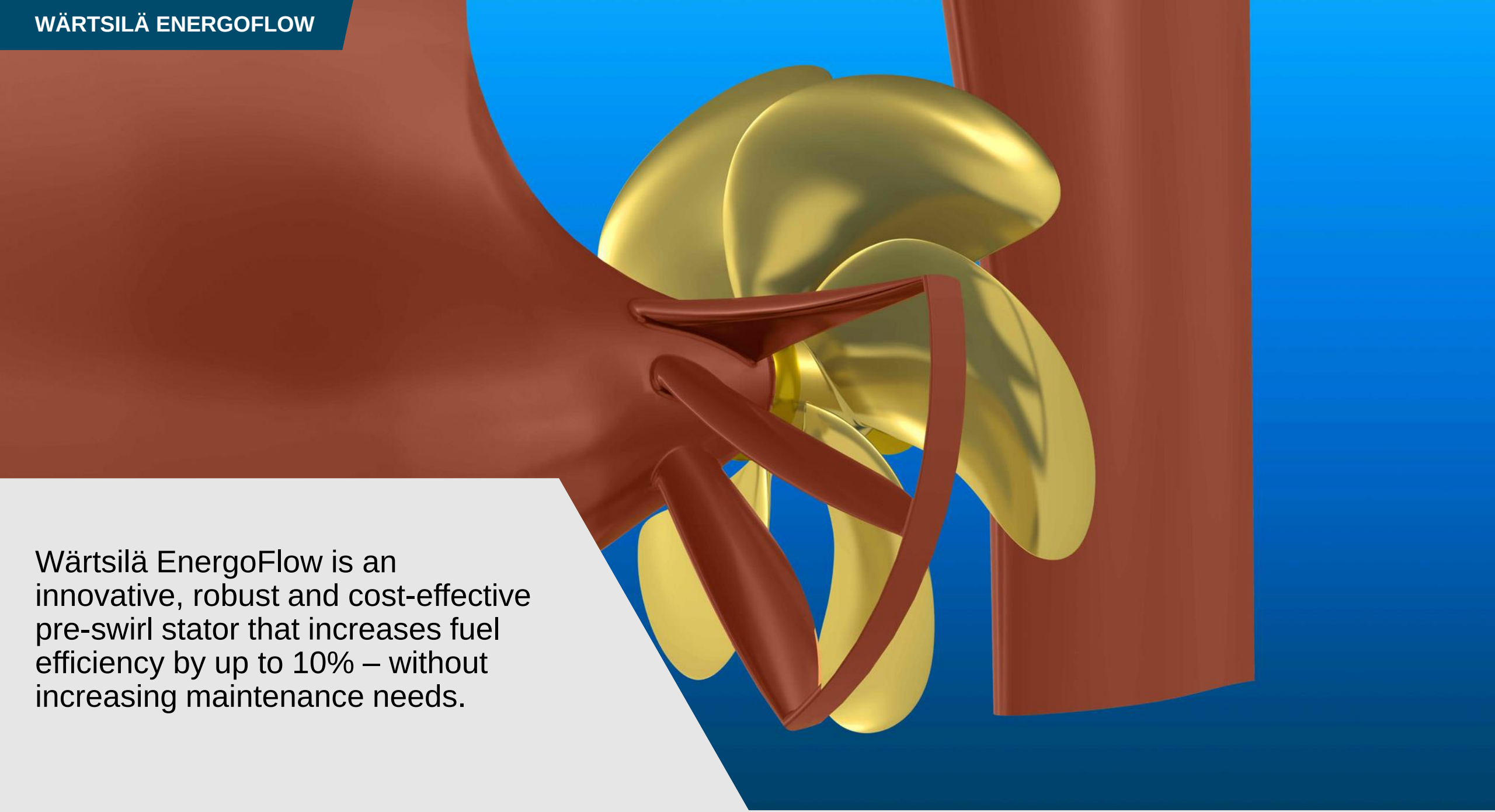
WÄRTSILÄ ENERGOFLOW

THE NEXT-GENERATION PROPULSION EFFICIENCY SOLUTION

INTRODUCTION

In today’s increasingly competitive shipping environment, you need solutions that not only increase your efficiency, but that are also reliable and have a short payback period.

WÄRTSILÄ ENERGOFLOW

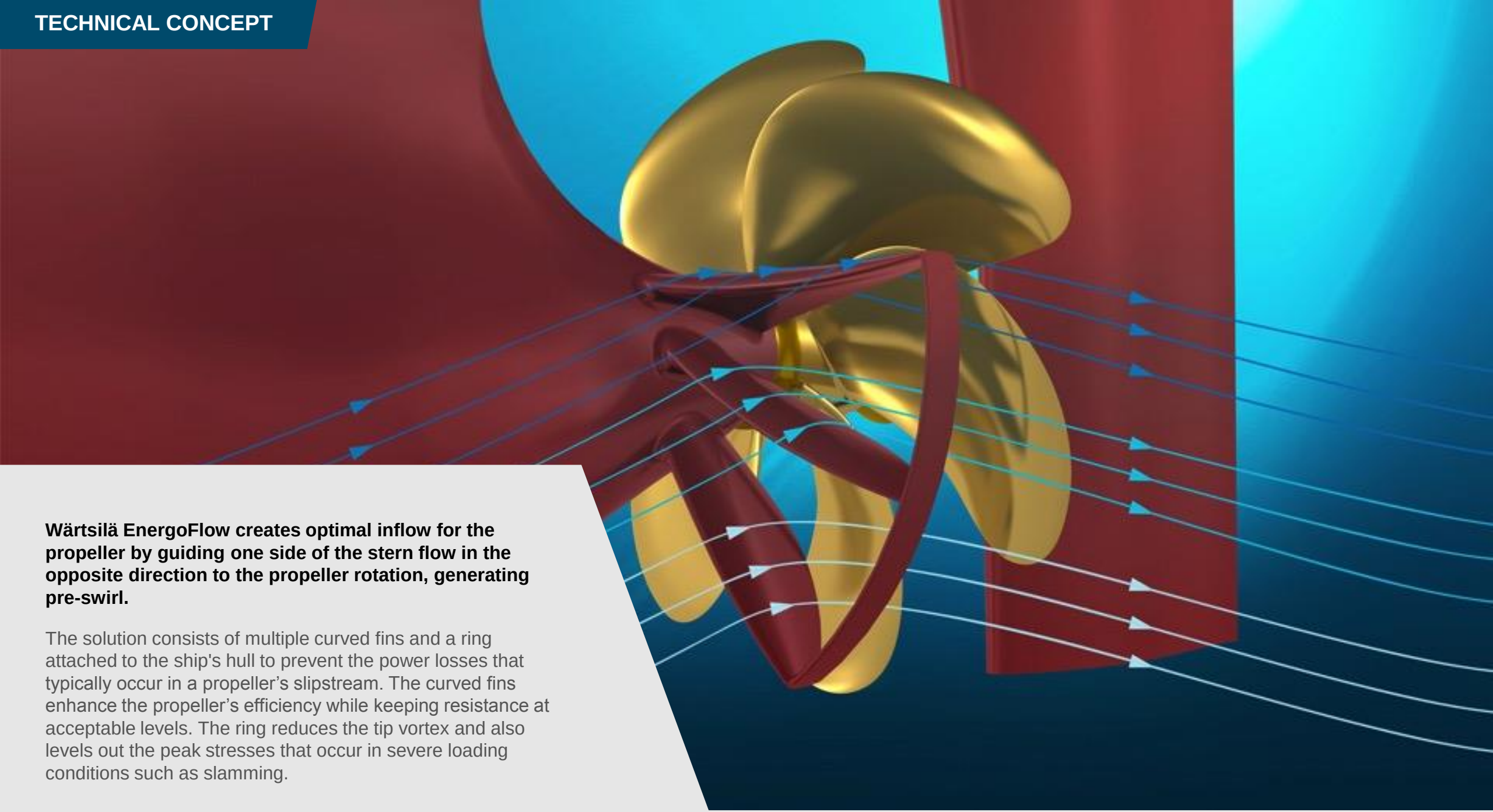


Wärtsilä EnergoFlow is an innovative, robust and cost-effective pre-swirl stator that increases fuel efficiency by up to 10% – without increasing maintenance needs.

BENEFITS

- Improves fuel efficiency by up to 10%
- Reduces NO_x and CO_2 emissions
- Provides a quick return on investment – typically one to two years
- Requires no additional maintenance as the solution has no moving parts

TECHNICAL CONCEPT



Wärtsilä EnergoFlow creates optimal inflow for the propeller by guiding one side of the stern flow in the opposite direction to the propeller rotation, generating pre-swirl.

The solution consists of multiple curved fins and a ring attached to the ship's hull to prevent the power losses that typically occur in a propeller’s slipstream. The curved fins enhance the propeller’s efficiency while keeping resistance at acceptable levels. The ring reduces the tip vortex and also levels out the peak stresses that occur in severe loading conditions such as slamming.

During operation, a propeller experiences non-uniform inflows (fig. 1). The downward-moving blade experiences a counteracting tangential velocity with a positive effect on blade loading. At the upcoming side, the tangential flow has a negative effect on blade loading. A positive effect on blade loading brings higher efficiencies and vice versa.

Ideally, the circumferential velocities should all have the same counteracting direction (fig. 2).

To influence the tangential components, Wärtsilä EnergoFlow guides one side of the stern flow in the opposite direction to the propeller rotation, generating pre-swirl for the propeller (fig. 3).

Fig. 1 Wakefield
Merchant vessel standard

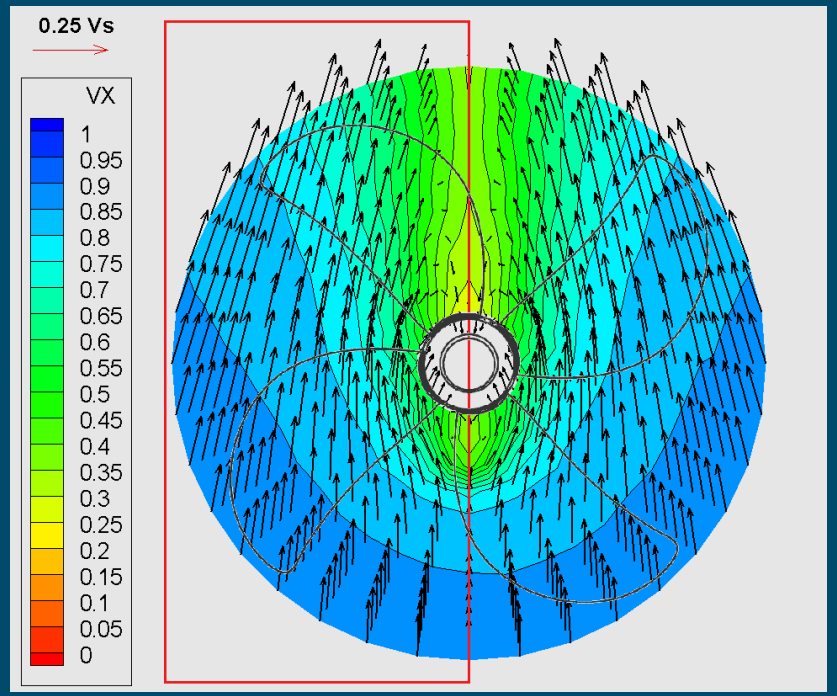


Fig. 2 Wakefield
Ideal tangential counter flow

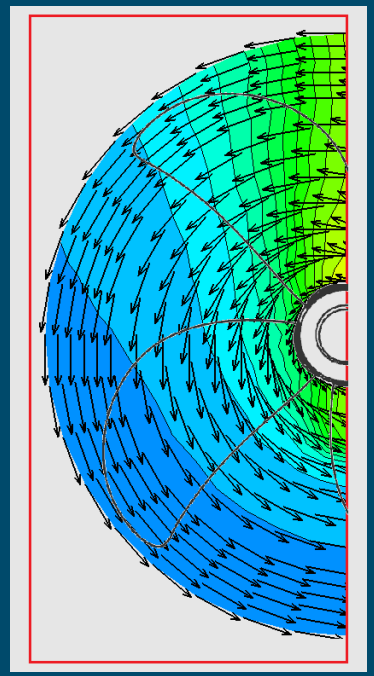
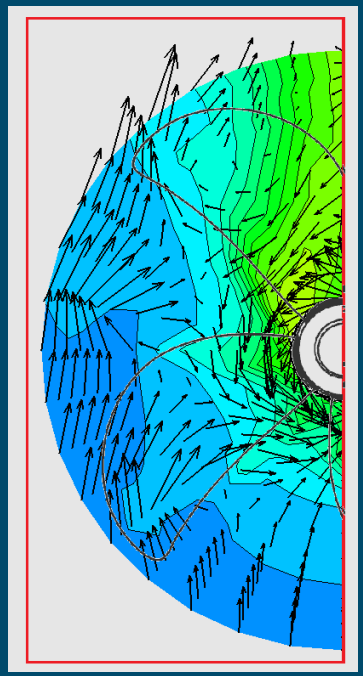
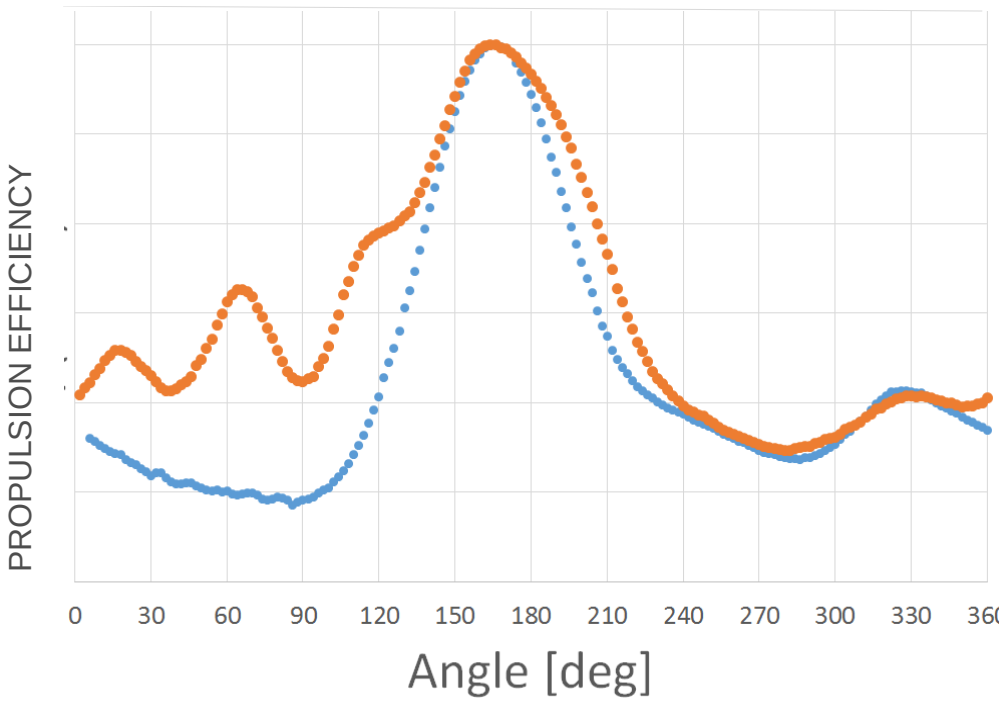
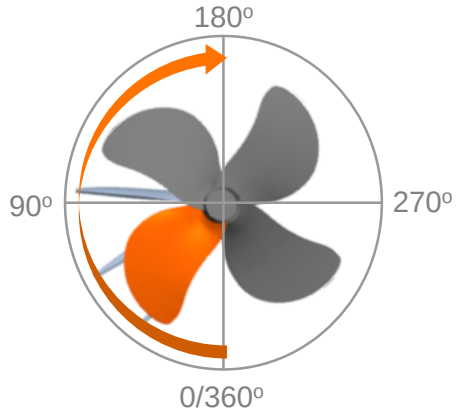
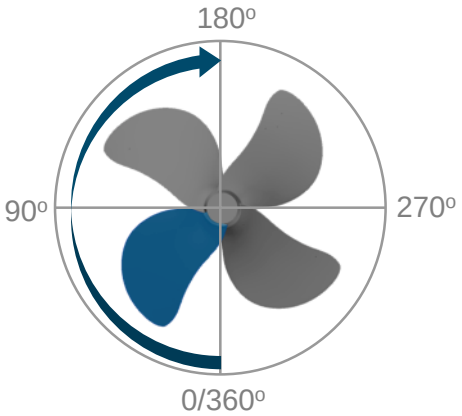


Fig. 3 Wakefield
Tangential counter flow with EnergoFlow









The propeller's blade efficiency varies during one revolution depending on the local inflow (wakefield).

The blue curve shows the variation in blade efficiency over one rotation for a 4-blade propeller.

After applying Wärtsilä EnergoFlow, efficiency increases mostly between 0˚ and 120˚, which equals the zone of the upward-moving blade.

Wärtsilä EnergoFlow is designed to withstand the most extreme ocean-going conditions

The hydrodynamic forces induced due to ship motion in waves is the determining load case for Wärtsilä EnergoFlow. These forces fluctuate over time and are dependent on wave height and the ship's dynamic response.

- Wärtsilä has performed extensive calculations and validation tests that take into account the highest possible loads and slamming due to vessel motion (design fatigue lifetime of 25 years)
- Scale tests are performed at an independent third-party research centre

Model propeller and EnergoFlow

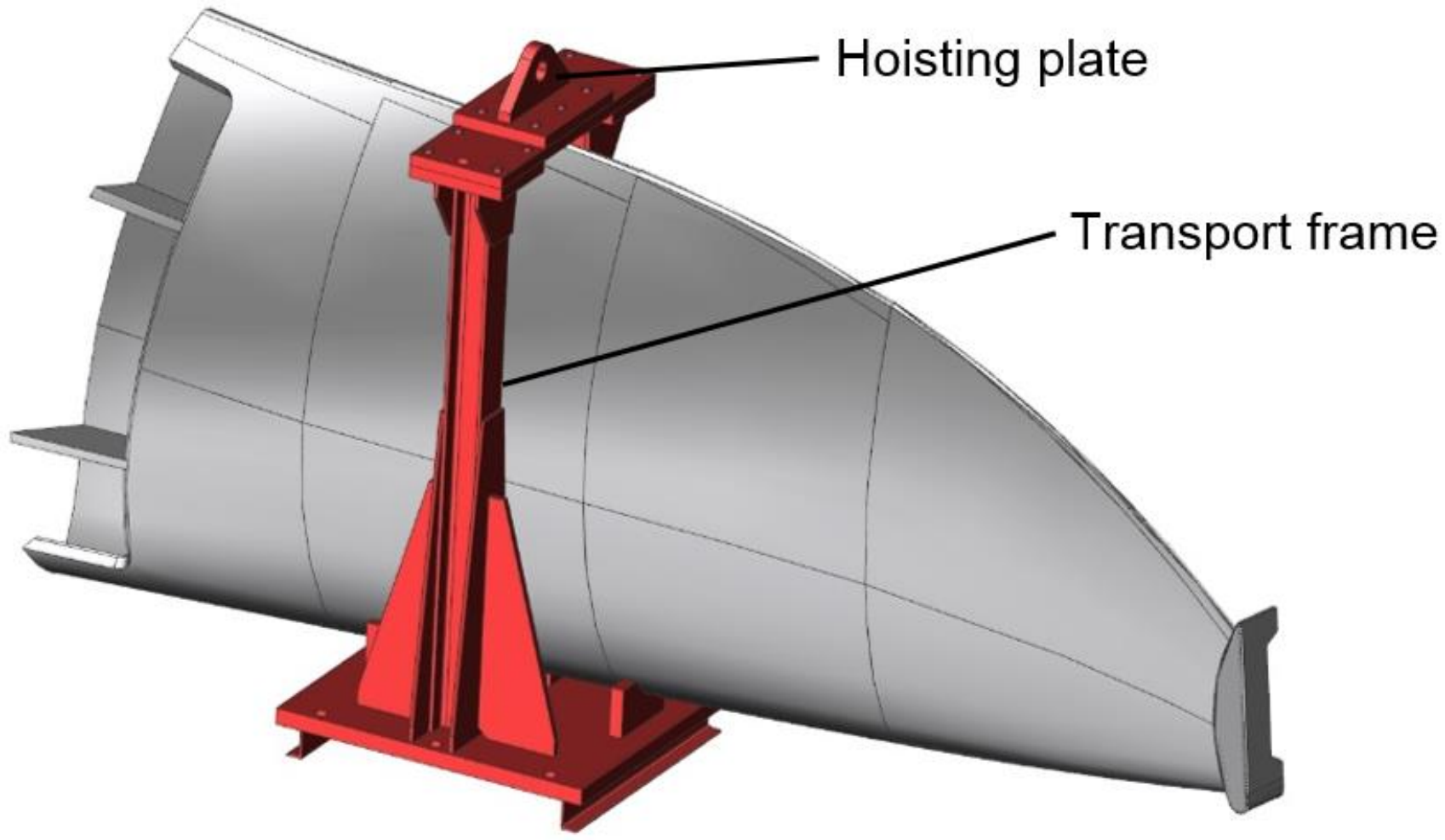
Loads on fins are measured using load sensors

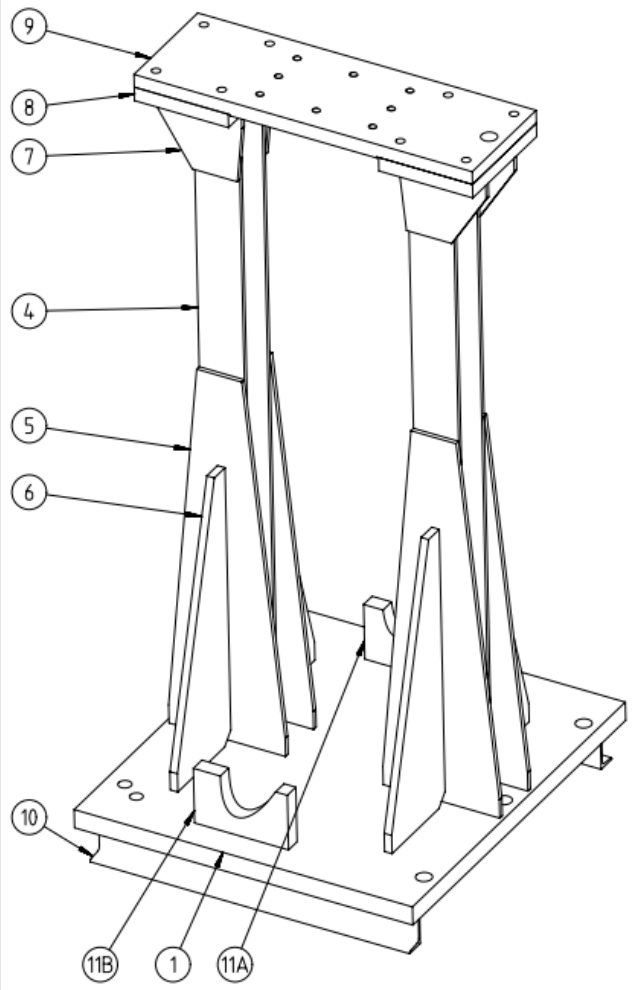
Model-scale seakeeping tests

A DURABLE SOLUTION

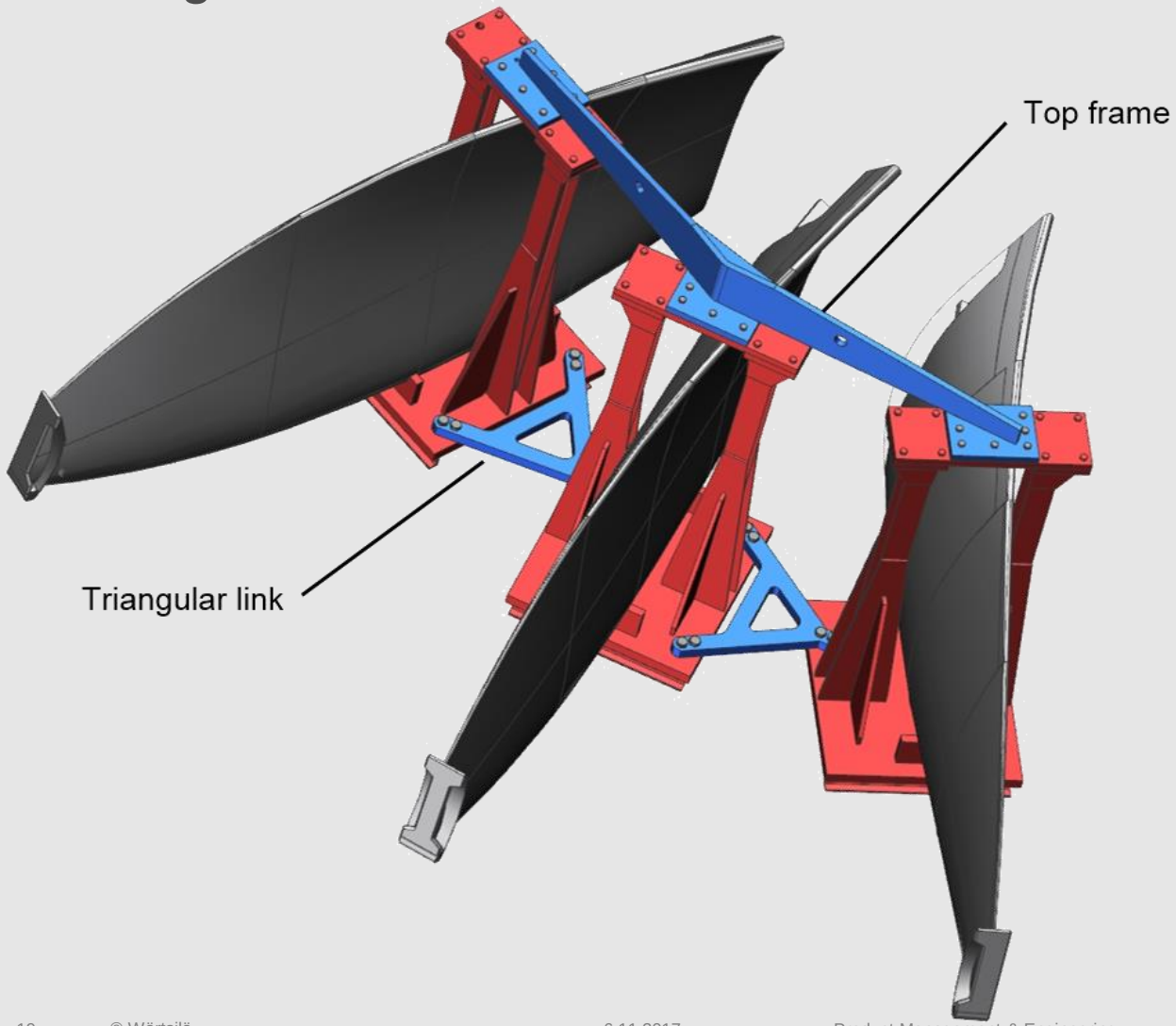
- Strength characteristics are determined by validated methodology
- Wärtsilä EnergoFlow can withstand peak loads that can occur due to vessel motion and slamming in heavy weather conditions
- The structural design is dimensioned for the required endurance with respect to fatigue
- Design fatigue lifetime is 25 years, taking into account the cumulative effect of loads due to vessel motions based on the North Atlantic wave scatter diagram
- Calculated vessel motions and resulting loads have been validated by model tests

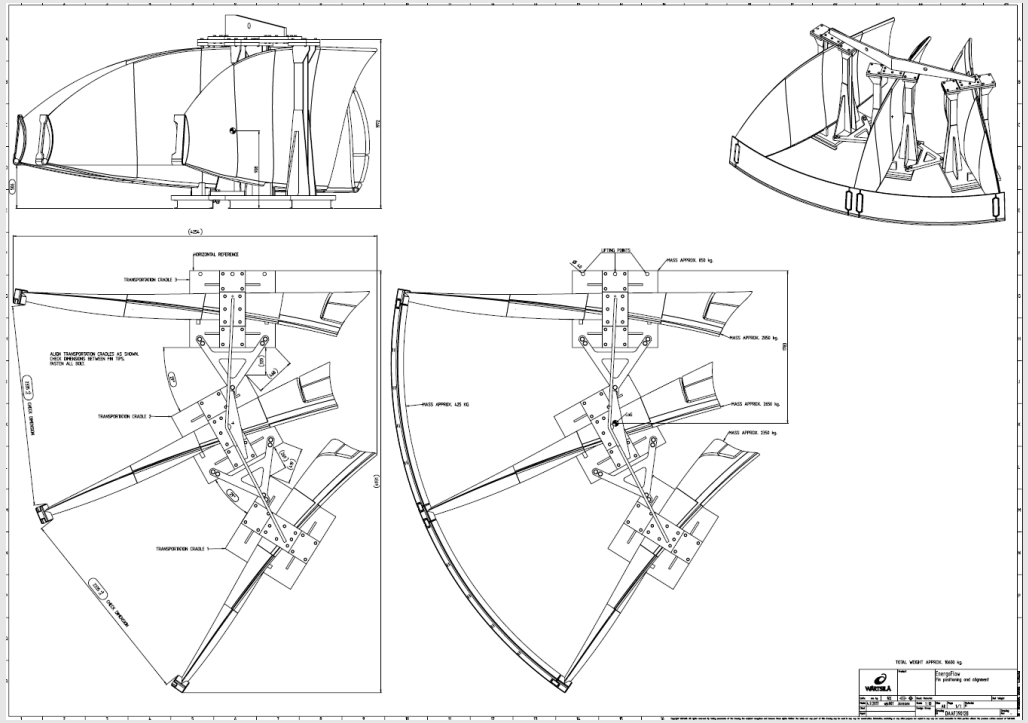
Due to the large size of the EnergoFlow components, the EnergoFlow is delivered in loose components.





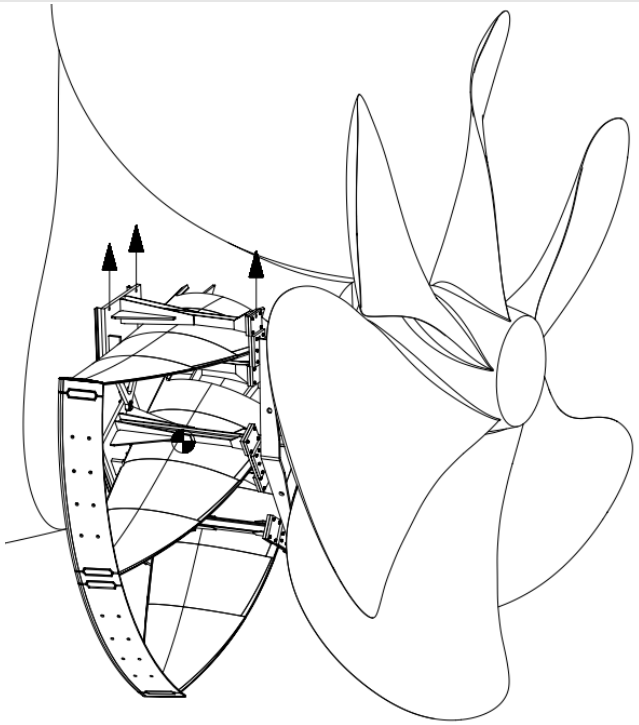
After delivery of the EnergoFlow components, the EnergoFlow is assembled on a flat surface, preferably this is done at the shipyard prior dry-docking to minimize docking time.

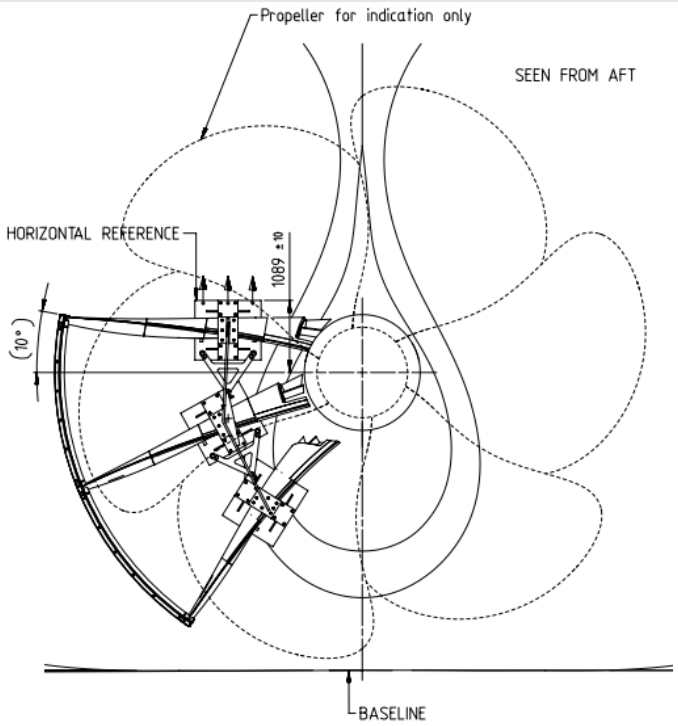


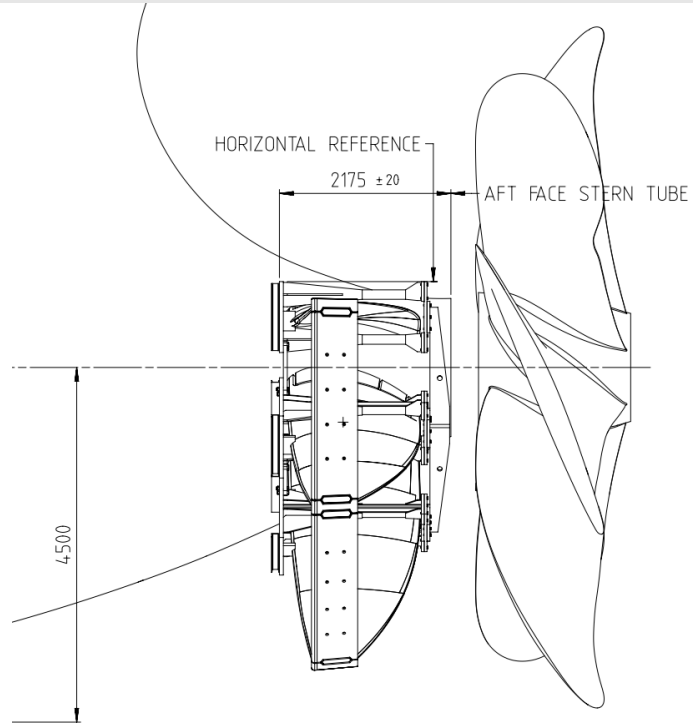


The EnergoFlow is installed and aligned as one assembly!

- Transport frames can be used also for hoisting assembly
- Transport frames include reference planes for alignment (horizontal references)
- The Stator blades are delivered oversized and are to be cut to final shape during installation
- Assembly in the yard before actual drydocking
- Estimated installation time five to seven days







Standard scope of supply includes:

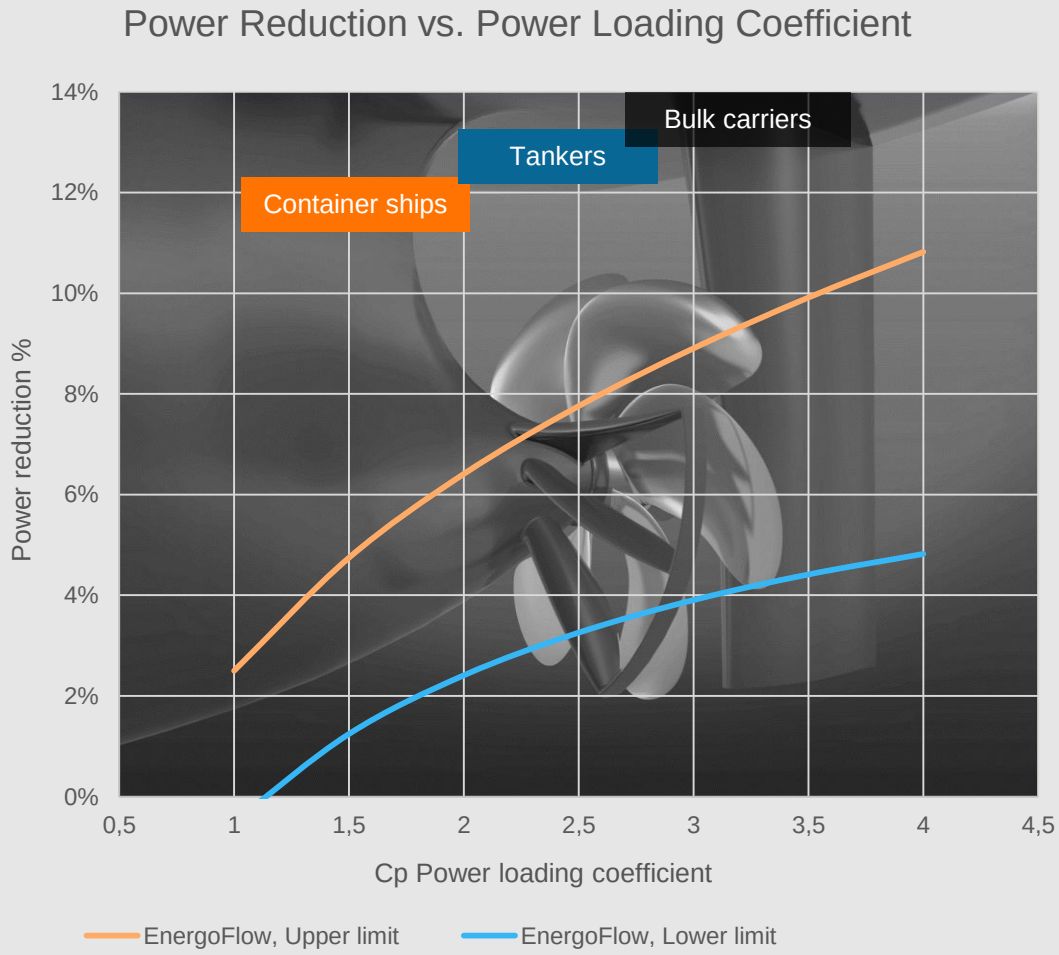
- System design, supply and class certification
- Redesign and modification of the existing propeller
- Installation drawings and instructions
- Design interface with the shipyard or ship designer
- Supervision by Wärtsilä technicians during installation
- Modification of the existing propeller if a new, optimized propeller is not included in the scope of supply

Optional scope of supply:

- New propeller with design optimized for Wärtsilä EnergoFlow Model EnergoFlow and/or model propeller for model tests

The power savings achieved by Wärtsilä EnergoFlow largely depend on the ship's block coefficient and propeller power loading

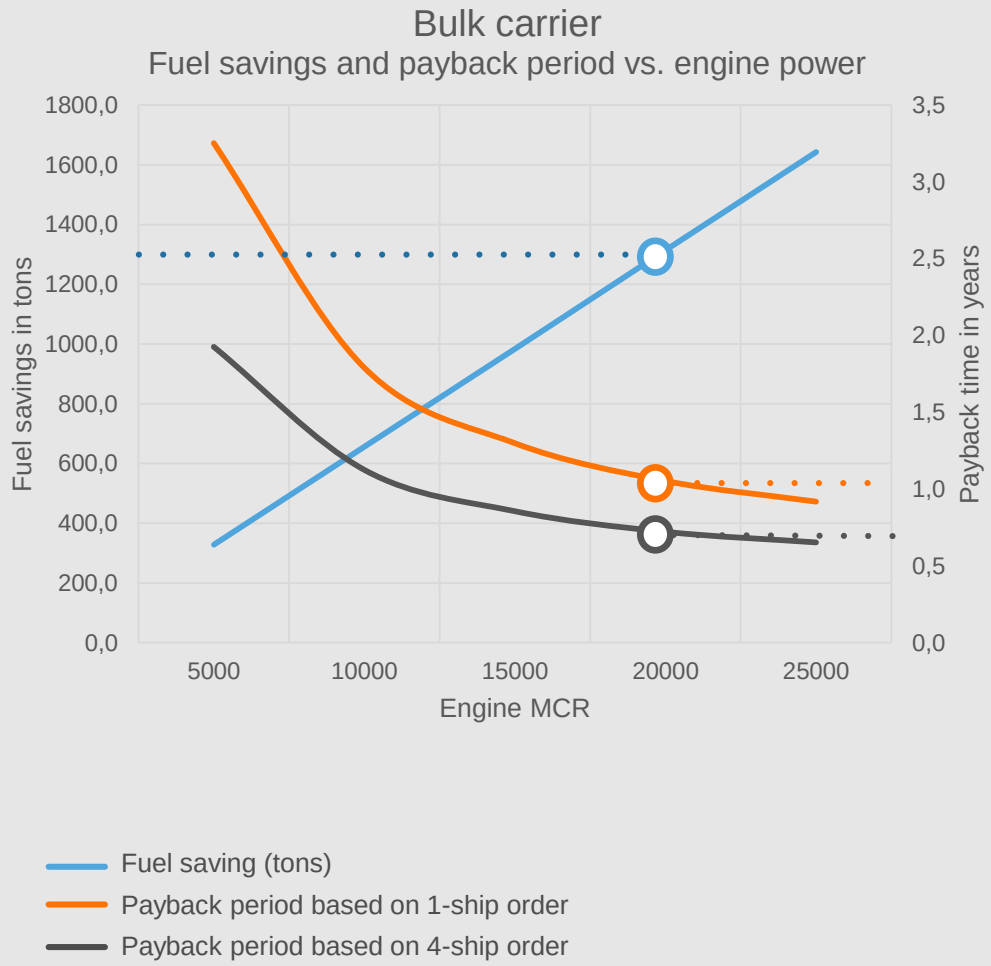
- Full-form vessels such as tankers and bulk carriers can achieve the highest fuel savings in the 10% range
- Faster vessels such as container vessels can expect fuel savings of about 4%
- Regardless of ship type, the solution has a typical payback period between 1 and 2 years



BUSINESS CASE – 250,000 DWT BULK CARRIER

The payback period is based on the April 2017 average 380 CST Bunker Index of €300/ton and includes Wärtsilä EnergoFlow installation costs but not docking costs.

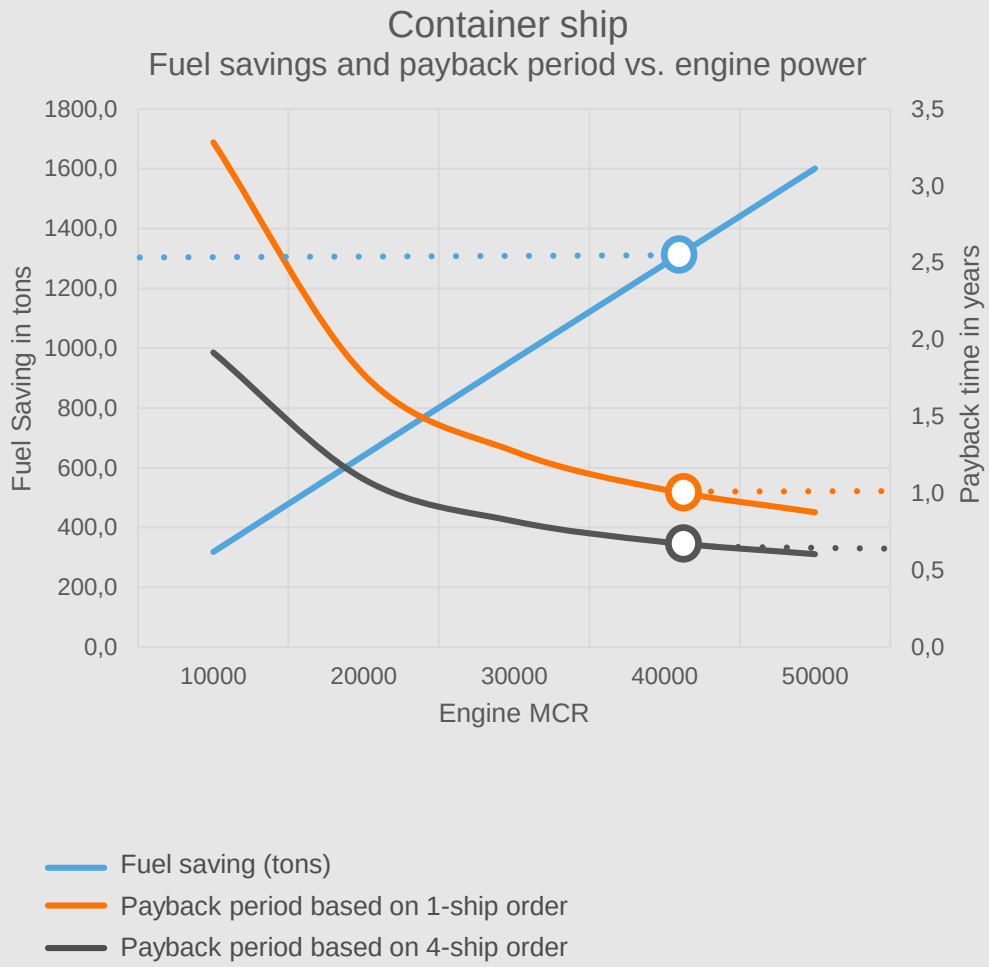
Investment based on order for	One vessel	Four vessels
Ship type and size	250,000 DWT bulk carrier	
Engine power	20,000 kW	
Annual fuel consumption	18,000 tons	
Efficiency improvement	7.3%	
Fuel savings	1,314 tons	
Fuel savings (HFO price €300/ton)	€394.20	
Return on investment (HFO price €300/ton)	1.1 years	0.7 years



BUSINESS CASE – 6,000 TEU CONTAINER SHIP

The payback period is based on the April 2017 average 380 CST Bunker Index of €300/ton and includes Wärtsilä EnergoFlow installation costs but not docking costs.

Investment based on order for	One vessel	Four vessels
Ship type and size	6,000 TEU container ship	
Engine power	40,000 kW	
Annual fuel consumption	33,700 tons	
Efficiency improvement	3.8%	
Fuel savings	1,280 tons	
Fuel savings (HFO price 315 €/ton)	€ 384.20	
Return on investment (HFO price 300 €/ton)	1.0 years	0.7 years

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