Ship Energy Performance Framework

Case Study: Wind Propulsion Technology, Estimation of Fuel Savings

Tier 3: Improvement Investigation

CASE

A major tanker operator assigned ABS to investigate the potential effect of a wind propulsion technology (WPT) installation with four Flettner rotors on the vessel's propulsive performance.

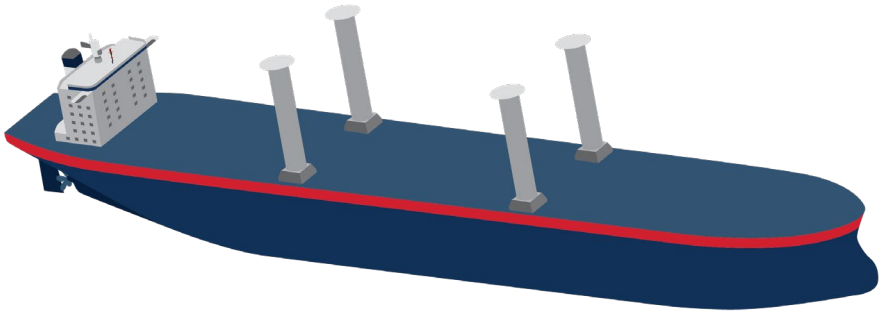

Figure 1: Arrangement of Flettner rotors.

METHODOLOGY

ABS created a computational model of the vessel's propulsive performance utilizing its design data and modeled the aerodynamic performance of each rotor using original equipment manufacturer data.

This enables the calculation of thrust and side forces due to the rotors acting on the vessel in any wind condition. ABS uses these forces to calculate the propeller thrust unloading, as well as the secondary resistance effects due to rudder action and hull leeway in any seaway and loading condition.

DELIVERABLES

ABS delivers graphs analyzing the impact of WPT installation on a vessel's consumption.

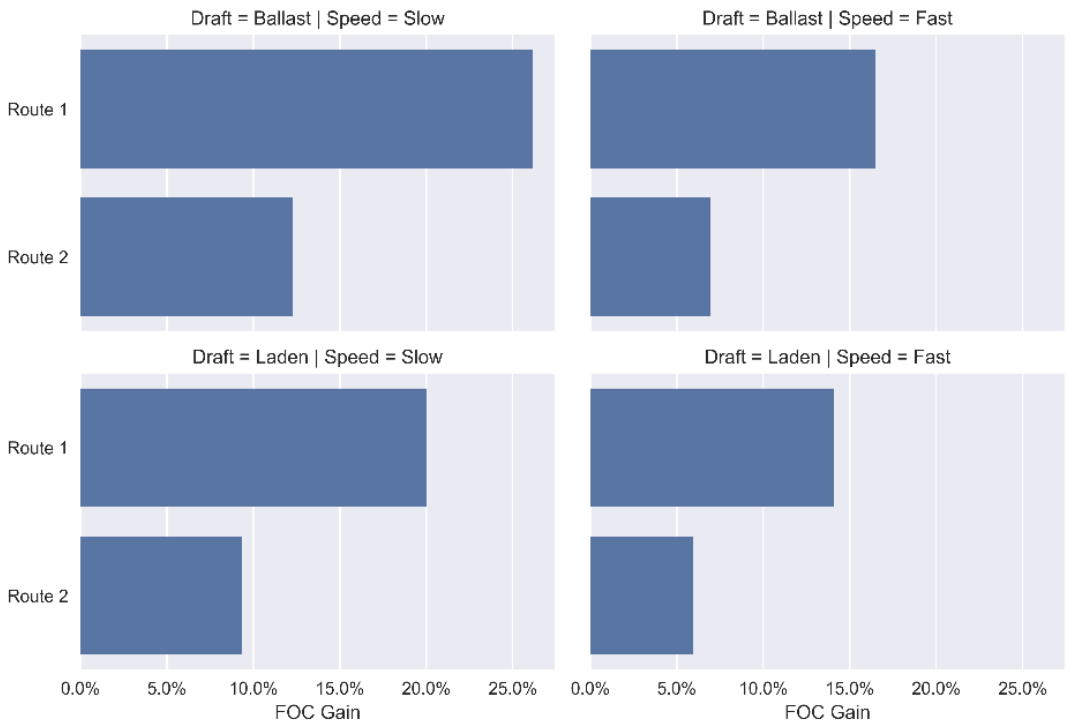

Figure 2: Analysis of calculated fuel consumption gains for two distinct routes for two speeds and two loading conditions.

As WPT impact depends directly on wind conditions, the distributions of wind speed and encounter wind angle are also provided to add context to the impact results.

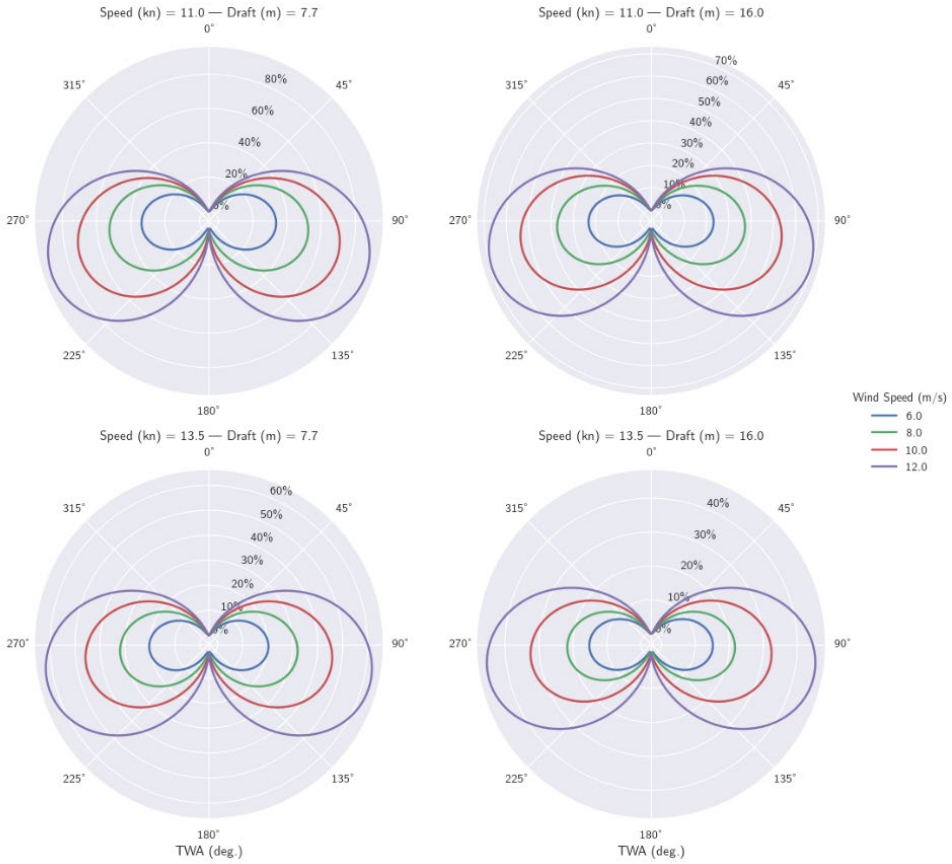

Figure 3: Polar plots of fuel consumption savings versus true wind angle for various wind speeds.

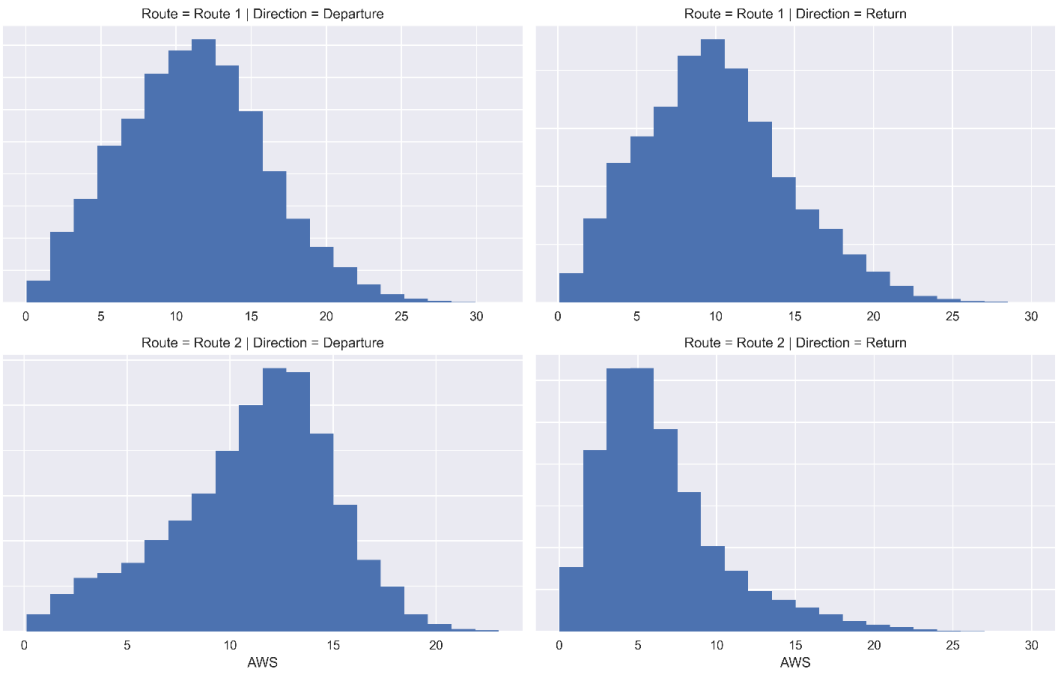

Figure 4: Histograms of apparent wind speed for each simulation.

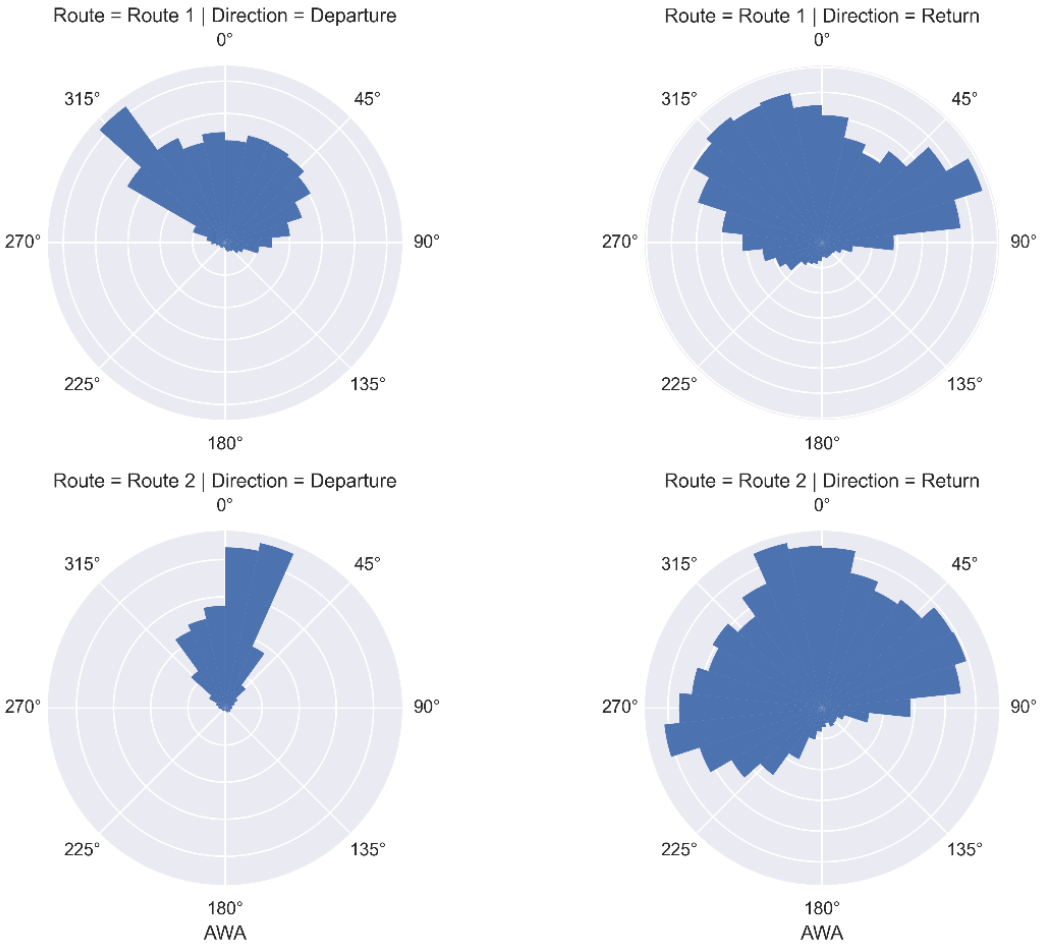

Figure 5: Polar histograms of apparent wind angle for each simulation. Intense sidewinds cause increased thrust production from WPT.

The life-cycle cost analysis of the studied investment, including fuel costs and regulatory costs, provides estimates of the payback time.

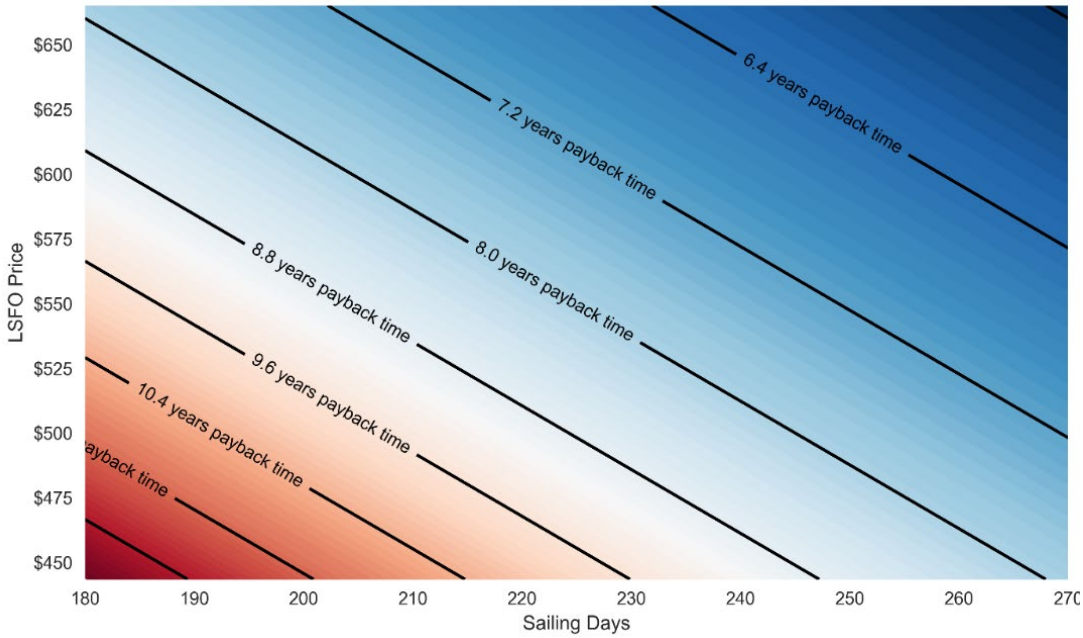

Figure 6: Sensitivity analysis of investment payback time.

CONCLUSION AND RECOMMENDATIONS

- Wind propulsion technology performance is highly dependent on weather conditions. To ensure that the results are representative, studies on typical routes should span long periods.
- Many commercial brochures present estimates of fuel consumption savings. However, the complete computational model for the vessel/WPT interaction applied to realistic simulations of the vessel's operation, based on hindcast metocean data, is state-of-the-art for such assessments.
- Through assumptions for the vessel's operating profile and costs associated with WPT installation, a technoeconomic analysis can provide insights into the expected payback time of the investment for the system procurement, retrofit works and operational expenses.
- Post-implementation evaluation, often involving analysis of high-frequency measurements during service, is essential as this can revise the projected return on investment and can become the catalyst for implementation on other vessels in the fleet.

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