

CROSSWINDS

THE FUTURE OF WIND

WINDS OF CHANGE - NEW TECH STEERING SHIPPING TO A MORE SUSTAINABLE FUTURE

Pyxis Ocean retrofitted with WindWings setting sail for its maiden voyage, August 2023. (Courtesy: © 2024 Cargill, Incorporated)

Cargo ships and cruise liners may soon be harnessing the power of wind and waves to reduce their carbon emissions — thanks to EU-funded researchers.

By TOM CASSAUWERS

In August 2023, a 5-year-old cargo ship, Pyxis Ocean, made history when it set sail from Shanghai, China, heading toward the southern Brazilian port of Paranaguá — a journey of nearly 25,000 kilometers.

What was historic about the journey was that, instead of running solely on heavily polluting bunker fuel, the Pyxis Ocean would be the first ship of its kind to supplement fuel power with wind power. It was testing out the pioneering WindWings® — 37.5-meter-high, foldable steel and fiberglass “sails” able to harness energy from the wind to propel the immense bulk carrier through the water.

BACK TO THE FUTURE

Designed by the U.K. company, BAR Technologies, built by Norway-based Manta Marine Technologies, and fitted in China to a ship chartered by international company Cargill, WindWings are the result of an ambitious international collaboration — the CHEK project — that received funding from the EU to help commercial shipping chart a course toward a lower carbon future.

“It was quite a challenge at the time,” said Suvi Karirinne, director of the Vaasa Energy Business Innovation Center (VEBIC) at the University of Vaasa, Finland, who coordinated the endeavor.

The Pyxis Ocean’s maiden journey provided the first real-world test of WindWings — and an opportunity to assess whether a return to this traditional method of propelling ships could be the way forward for moving cargo at sea.

In May 2024, DNV Maritime Advisory, an internationally recognized certification and testing authority, confirmed that, when sailing in favorable conditions, the two WindWings installed on the Pyxis Ocean reduced the energy consumption of the main engine by 32 percent per nautical mile.

The WindWings technology is expected to be widely adopted over time and is already set to be incorporated into 20 new vessels lined up for installation in 2025 and beyond.

CLEANER SHIPPING

As much as 90 percent of the world’s goods and raw materials are transported by sea — which is not as clean a means of transportation as one might think. A loaded container ship

can burn as much as 150 metric tons of heavy fuel per day, which is unsustainable from an environmental perspective.

Shipping is a major source of carbon emissions — about 2 percent of the global total, according to the International Energy Agency. In April 2018, the International Maritime Organization agreed to reduce emissions by at least 50 percent by 2050 compared with a 2008 baseline.

To help achieve this goal, CHEK experts have been working together to come up with innovative design solutions that could be integrated into existing commercial vessels. Their ultimate goal is to create zero-emission vessels by synergistically combining different options.

SYNERGISTIC INTEGRATION

The team of experts set out to integrate a range of different technologies and concepts into two vessel types: a bulk carrier and a cruise ship. Some of these designs were tested in re-



The two WindWings installed on the Pyxis Ocean reduced the energy consumption of the main engine by 32 percent per nautical mile. (Courtesy: © 2024 Cargill, Incorporated)

al-world conditions on the Pyxis Ocean and a passenger cruise ship belonging to MSC Cruises, a global cruise line company.

By harnessing the synergies between different operational, power supply, and drag reduction technologies, they have come up with a range of solutions that can be adapted for use in other vessel types such as tankers, container ships, general cargo ships, and ferries.

Proposed innovations include, among others, hydro-



WindWings being retrofitted on Pyxis Ocean at the COSCO shipyard in Shanghai, China, in August 2023. (Courtesy: © 2024 Cargill, Incorporated)

gen-powered engines, ultrasonic anti-fouling devices, and advanced route planning systems that consider the prevailing atmospheric and maritime conditions to provide the most energy-efficient route.

If applied together, the CHEK experts believe the advances they have developed and tested could reduce ships' energy use by 50 percent and their greenhouse gas emissions by 99 percent.

"There is no silver-bullet technology for maritime decarbonization," Karirinne said, who believes the progress can best be achieved through the integration of both new and already existing innovative technologies.

IMPROVING EFFICIENCY

"Shipping needs to reduce its emissions," said Anders Öster, research manager at Wärtsilä, a Finnish engineering company. "That's why we need to find solutions to make ships more efficient, and to decarbonize their propulsion."

In addition to taking part in CHEK, Öster coordinated another international research project called SeaTech, which also received funding from the EU to improve the efficiency of commercial shipping.

The SeaTech research, conducted between 2020 and late 2023, included both shipping companies and academic partners such as the University of Southampton in the U.K., the National Technical University of Athens and the University of Tromsø in Norway. It developed two key technologies that can be retrofitted to existing ships and thereby have a rapid impact on the sector's emissions.

WAVE POWER

Inspired by the movement of whales and dolphins through water, the researchers attached a dynamic underwater wing, similar to the front fins of a hammerhead shark, to the front of the 10-meter-long model ship.

The wing, which harnesses wave power to help drive the



The WindWings technology is expected to be widely adopted over time and is already set to be incorporated into 20 new vessels lined up for installation in 2025 and beyond. (Courtesy: © 2024 Cargill, Incorporated)

ship forward, was tested both in wave tanks and in the Aegean Sea. The researchers found it generates thrust, particularly in choppy seas, allowing engines to reduce their output.

“These wings take the energy from waves and thrust the ship forward,” Öster said. “They also stabilize the ship’s movements.”

In addition, the SeaTech team used sensors and software to control the combustion process in a ship’s gas-powered engine, improving its efficiency.

“Compared to diesel engines, our gas engine emitted one-third less CO₂,” Öster said.

The two innovations work particularly well together, he said, because the engine control software can respond quickly to the same conditions that determine the power output of the wings. The result is more than the sum of its parts.

“One plus one equals three when we combine these technologies,” Öster said. “By taking different technologies and combining them, we strengthen their performance.”

The researchers found that, taken together, the two technologies could reduce diesel-powered ships’ CO₂ emissions by 46 percent.

ECONOMIC ADVANTAGE

The next challenge will be to persuade the shipping industry to adopt these innovations. Karirinne believes the results will speak for themselves.

Although the shipping industry can be quite conservative, according to Karirinne, it is also very competitive. In addition, the extension of the EU’s Emissions Trading System (EU ETS) in January 2024 to cover CO₂ emissions from all large ships has provided further impetus for change.

She expects that CHEK technologies will be welcomed by shipping operators as they can significantly reduce costs thanks to reductions in fuel consumption — and thus CO₂ emissions.

“These technologies aren’t just attractive because they reduce emissions, there’s also a societal and economic need for them,” she said.

The rate of adoption will depend both on the perceived economic advantage and on how easily the respective innovations can be implemented. It may be some time before all cargo ships are fitted with giant sails, but SeaTech’s engine developments are being retrofitted to ships already.

“Shipping is considered a hard-to-decarbonize sector,” Karirinne said. “But we have shown examples of how to do it. It is possible, and there are options. We just need to use them.”

ABOUT THE AUTHOR

Tom Cassauwers is a freelance journalist from Belgium. He writes about science, technology, and politics for outlets such as Trends, BBC, Al Jazeera, and Horizon Magazine. This article was originally published in Horizon, the EU Research and Innovation Magazine. Research in this article was funded by the EU’s Horizon Programme. The views of the interviewees don’t necessarily reflect those of the European Commission.