Two 9.5 MW floating wind turbines deployed at Kincardine Offshore Wind project off coast of Aberdeen, Scotland.
Photo courtesy of Principle Power

lab to life

Taming the Tow

Author: **Christian Keszthelyi**

Before a floating offshore wind turbine can generate electricity, it must be assembled, towed to its site, and anchored. During its 20- to 25-year lifetime, it may also need to be towed back to port two or three times for major maintenance before returning offshore. Significant amounts of fuel are consumed by tug boats for each journey. For Malta, where promising offshore wind sites lie in deep water, this matters. The challenge is to make floating wind cleaner across its whole lifecycle.

Floating offshore wind turbines are used where the seabed is too deep for fixed-bottom turbines. Around Malta, potential offshore wind areas are in waters deeper than 100 metres, making fixed foundations difficult. Floating platforms solve that problem but create another. They have to be towed from an assembly port to the installation site, sometimes over long distances. To make matters worse, these platforms are large – about 100 metres wide and extending about 20 metres below the sea surface. They must remain stable in open water. That is essential once the turbine is operating, but the same shape makes the platforms harder to tow.

The University of Malta's Department of Mechanical Engineering is working on this problem through TowFOWT, a research project focused on reducing drag, and therefore the fuel consumption of tug boats, during the towing of floating offshore wind turbines.

The project is financed by Xjenza Malta and the Ministry of Science and Technology of the People's Republic of China, through the SINO-MALTA Fund 2024 Call.

The UM team includes Prof. Christopher Micallef, Prof. Tonio Sant, Dr Jean-Paul Mollicone, and researchers Martina Zammit and Nathaniel Scerri. Their aim is to design a drag-reduction fairing, a streamlined device that helps large floating structures move through water with less resistance.

In Malta's case, Zammit explains, local ports may not have the depth or facilities needed to assemble such structures. 'This means the turbines could be assembled elsewhere, such as Sicily, then towed fully built to their final site,' she says.

A turbine is not towed only once. 'It may need to go back to port for major maintenance several times during its life. Each structure could be towed about three times for maintenance. For a wind farm with 20 or 25 turbines, which is the expected size of projected large-scale wind farms, this adds up to a lot of towing,' Zammit says.

That is why drag matters. Drag is the force that resists movement through water or air. Anyone who has tried to walk through the sea has felt it. The faster you move, the more the water pushes back. For a floating wind platform, resistance comes from several sources: water pressing against the front of the structure, friction along its surfaces, waves created by the tow, and wind acting on the tower and blades.

Figure 1: Render of the UMaine VolutrnUS-S platform supporting a 15MW wind turbine

'Total drag is the accumulation of the different kinds of resistance that are present during towing,' Scerri says. 'It stops the platform from moving easily through the water.'

Floating wind platforms are not ships. They are closer to large floating columns connected together, built for stability rather than speed. A ship's hull is shaped to move efficiently through water. A turbine platform is designed more like a barge to handle offshore conditions and keep the turbine steady.

NOT BUILT TO MOVE

TowFOWT focuses on this often-overlooked part of floating wind projects. The aim is not to change the floating structure itself but to add a fairing that makes towing easier without harming stability or creating new problems. A fairing is an attachment added to a bluff body to streamline the flow around it, reducing drag and improving performance. By guiding water smoothly around the structure, it minimises flow separation and wake formation, which are major sources of resistance.

The idea comes from other industries. Trucks use fairings to reduce air resistance. Bullet trains use streamlined shapes to cut drag. Similar ideas can work at sea, but the physics is more complex because a floating wind platform must contend with water, air, and waves simultaneously.

The team began by measuring the platform's drag before adding any fairing. They use Computational Fluid Dynamics (CFD) to run computer simulations of water and air moving around the platform. This shows where resistance is highest and allows the researchers to test design ideas before building physical models.

'First, we started by quantifying the drag without any additional features,' Scerri says. 'We are performing simulations of the actual towing process, which allow us to quantify the forces and analyse the flow around the platform.'

This step is important because different types of drag need different solutions. A fairing that reduces one kind of resistance may not reduce another. The team first needs to know which type of drag has the greatest effect.

Early results are promising. Scerri says the first fairing designs have reduced drag by about 40% in simulations. These are not final results, but they show the idea has potential. The team is still refining its analysis and testing new shapes.

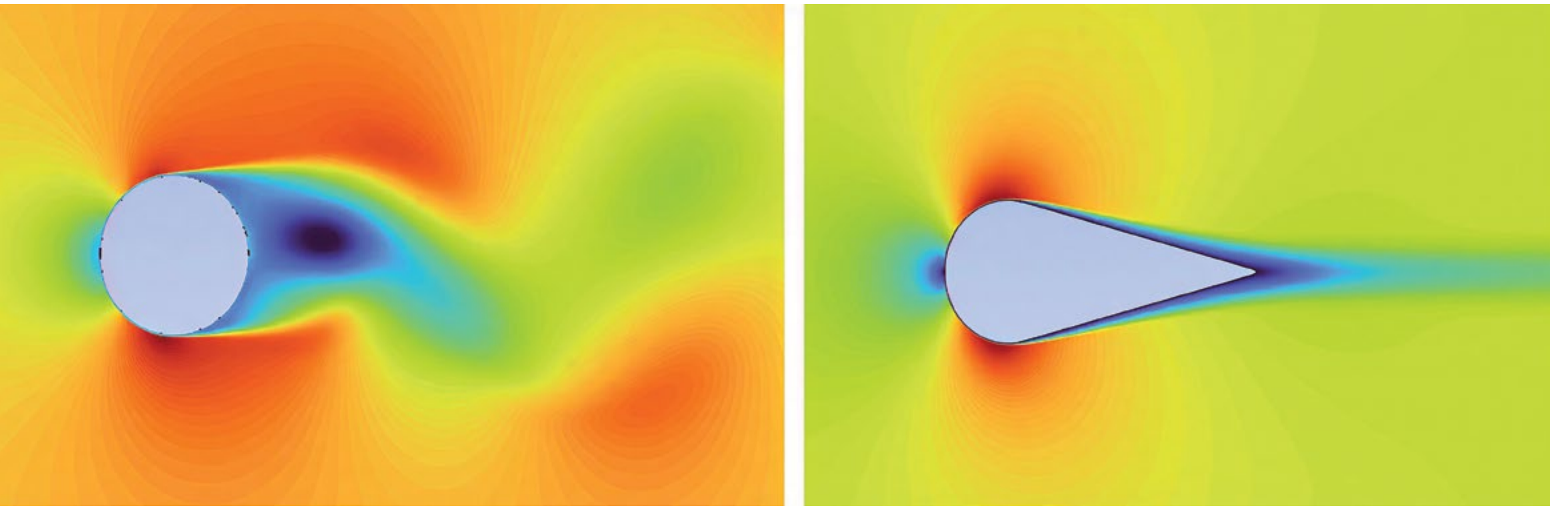

Figure 2: Flow Visualisation using a velocity contour showing the wake behind a cylindrical 2D body (Left) and an introduction of a fairing (Right).

PROOF BEFORE PROMISE

The next stage combines simulations with experiments. The Chinese partners are testing small-scale models in controlled conditions. This allows the team to compare computer results with real measurements. If the two match, the researchers can have greater confidence in the results.

The collaboration matters because towing stability is as important as drag reduction. A fairing should not make the platform harder to control at sea. The project therefore examines drag and stability together. The final design also has to make practical sense. A large fairing might cut drag, but if it costs too much, produces too much carbon during manufacturing, or is hard to attach, the benefit may be lost.

'Very complex fairings may achieve significant drag reduction, but if they require substantial carbon dioxide emissions to manufacture, this defeats the purpose of implementing them,' Scerri says. The team is therefore looking not only at hydrodynamic performance, but also cost, manufacturing, lead time, and viability.

This matters because renewable energy projects are judged across their whole lifecycle. Installation, maintenance, towing, and decommissioning all add cost and emissions. Green energy depends on every step, from cradle to grave, not only on what happens after the system starts running.

For Malta, this work is timely. Floating wind could open offshore sites that fixed turbines cannot reach. The technology is still young. Most floating wind farms are small or experimental, but future projects will use bigger turbines and more units. As turbines grow from 8–10 MW to 15 MW or more, their platforms become larger. That means more resistance and more towing work. By June 2027, the team plans to have a fairing concept backed by simulations and experiments, offering a clear design direction and useful data for future projects.

Zammit sees this as part of a wider transition. Floating wind has promise, but practical engineering will determine how clean, affordable, and scalable it becomes. 'These operations have not been optimised yet because floating offshore wind is still developing,' she says. 'That is why projects such as ours are important for the future of this technology.'

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