#03 - CARGO AIRSHIP FOR WIND TURBINE INSTALLATIONS

With the growing demand for green energy in the face of climate change, wind energy has become more important than ever. The expected size of the wind energy market is around 500 GW by 2030 in the EU alone. The onshore wind energy market is currently limited by the truck transportation of wind turbine blades on existing road infrastructure, which limits the size of the blades and emits a significant amount of greenhouse gas emissions. Providing a better way to transport wind turbine blades can reduce energy costs and increase the potential for clean energy worldwide.

Mission Objective

The cargo airship aims to satisfy the following mission need:

> *Transport wind turbine blades using a new, sustainable method, which will be cost-effective and time-effective.*

Airships have the potential to outperform trucks on this mission due to their advantage in carrying substantial payloads without the need for much infrastructure. The airship's mission is to transport a 60-tonne wind turbine blade over a minimum distance of at least 200 km. The airship will be made using mostly recycled and recyclable materials and emit no CO_2 during operation. Compared to the current truck solution, the airship should cost less and be at least 20% faster to ensure a competitive advantage over the alternative methods.

System Design

The optimal airship design was found to be a classic zeppelin type with a rigid internal structure and the lifting gas being contained in internal gas cells. To ensure that the design is as sustainable as possible, several measures were taken, such as the selection of a renewable lifting gas, propulsion and material choice. For the lifting gas and fuel, hydrogen will be used, this will be done with an emphasis on safety and sustainability. The blade will be kept in an internal payload bay during flight and lowered from the airship during loading and unloading. At the pickup and drop-off locations, the ship will be temporarily moored using cables while payload operations will be performed. The ship accommodates a payload mass of 60 tonnes for a maximum take-off mass of 225 tonnes. The envelope has a volume of 266 000 m^3, of which 223 000 m^3 is lifting gas. The hull length would be 221.2 m with a maximum diameter of 47.9 m. The typical mission starts with a vertical take-off, followed by the airship cruising towards the pick-up point. There, the wind turbine blade is loaded and safely stowed into the airship's payload bay using an internal crane. For safe loading, the airship will moor at the pick-up location. Once the blade is inside the payload bay, the cruising phase continues until arrival at the wind farm, where the blade is lowered similarly to how it was loaded. The mission is then complete, allowing the airship to deliver another blade or return to base. At the base, the airship performs a vertical landing, after which it is moored using cables. The airship is able to cruise for 14 hours at a cruise speed of 80 km/h. Over the entire trajectory, propulsion would only use 756 kg of hydrogen. This does not only offer a significant improvement in sustainability over trucks but also in convenience and speed.