

PRESS RELEASE

4 November 2024

EOLIAN: a new generation of sustainable, recyclable wind turbine blades

Strategies to build a circular economy for wind energy include extending the lifespan of wind turbines, improving their recyclability, and minimising waste. The EU-funded EOLIAN project aims to facilitate this transition by developing rotor blades with a longer service life than current designs, which are simpler to maintain and repair, and easier to recycle at the end of their service life.

The EOLIAN blade will be manufactured using composite materials based on a bio-based repairable and recyclable vitrimer matrix reinforced with basalt fibres, and a structural health monitoring system will be embedded into the blade to enable early detection and repair of damage.



Picture © Jason Bickley.

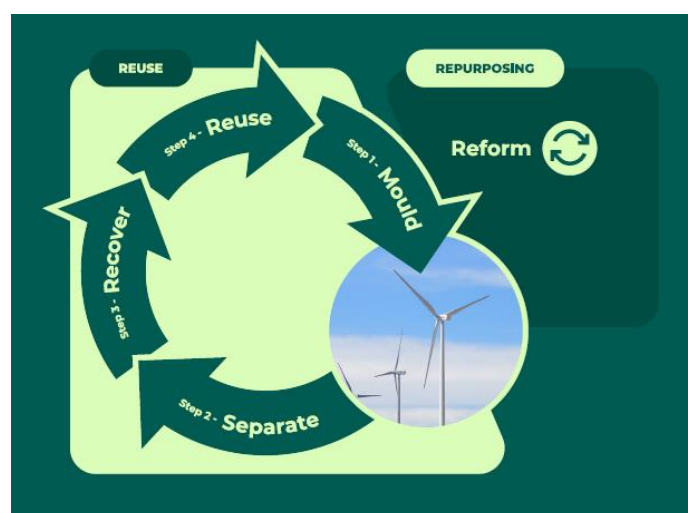
The project consortium brings together 10 organisations from five countries: Proplast (Italy), the project coordinator; AEP Polymers (Italy); Brunel University London/Brunel Composites Centre (UK); Entelea (UK); EuCIA (Belgium); IRES (Belgium); Norvento (Spain); Politecnico di Milano (Italy); Tekniker (Spain); and Zorlu Enerji (Türkiye).

New recyclable vitrimer composites

Today, around 85-90% of a wind turbine's total mass can be recycled. The blades are more challenging to recycle, mainly due to their complex design and the thermoset composites used in their manufacture. Technologies to recycle these composite materials exist but they are not yet widely available or economically competitive.

EOLIAN will explore the possibilities of using vitrimers, a new class of polymer that enables recyclable composite materials. Vitrimers will pave the way to different end-of-life opportunities for blades:

- **Reuse:** Vitrimer composites can be reprocessed after cure, which allows the reuse of parts through simple thermoforming (heating and re-shaping). A vitrimer composite blade could be reformed into a shape suited to a new application, such as a component for a wind turbine nacelle.
- **Recycling:** Chemical recycling can separate the vitrimer matrix and the reinforcing fibres. The recovered materials could be used to manufacture new composite parts for wind energy and other applications.



Vitrimer composite reuse and recycling options.

Vitrimers also possess 'self-healing' properties. When subjected to mechanical stress or temperature changes, the reversible bonds within the vitrimer can break and reform, effectively 'healing' minor damage. This means simple, in-the-field repair of a range of blade damage will be possible through localised heating of the vitrimer composite using portable handheld equipment.

EOLIAN will develop sustainable vitrimer composites incorporating >60% bio-based vitrimer. The project will also aim to replace synthetic glass fibre reinforcement with more readily recyclable basalt fibres (natural mineral fibres produced from volcanic basalt rock).

New sustainable vitrimer composites – repairable, reprocessable, and easily recyclable – will provide a step change in how wind turbine blades are maintained, reused and recycled in a circular economy.

Structural health monitoring

In addition, erosion and ice detection sensors and a heating system will be embedded into the composite blade using in-mould electronics processes. The sensors will enable rapid identification of damage so that the blade can be repaired quickly. Addressing damage early will eliminate the need for more extensive repairs later on. Activating the heater will prevent the build-up of ice before it can affect the blade's aerodynamic efficiency.

These innovations will help to extend the blade's service life, reduce unplanned downtime, maintain the turbine's performance and safety, and reduce maintenance costs.

EOLIAN will manufacture a prototype sensor-assisted vitrimer composite blade of 14 m in length to demonstrate the technologies developed by the project.

A Horizon Europe project

EOLIAN – *Bio-based, repairable and recyclable vitrimer composites and advanced sensors for highly reliable, sustainable wind blades* – commenced in June 2024 and will run until the end of November 2027. EOLIAN has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement no. 101147532.

Further information

Amanda Jacob, Communications Manager, EuCIA

Email: amanda.jacob@eucia.eu

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.