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Blade End-of-Life Treatments: State of the Art, Challenges, Barriers & Environmental Impacts

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IEA Wind Task 45 Wind Turbine Blade Recycling
Deliverable 2.2

Blade End-of-Life Treatments: State of the Art, Challenges, Barriers & Environmental Impacts

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Background to the Document

This document has been prepared in support of IEA Wind Task 45 Subtask 3.1 on "Integrated life cycle assessment with social and economic factors", Subtask 2.2 on the "Reuse and repurpose of end-of-life wind turbine blades" and Subtask 2.3 on "Recycling and recovery methods". This document provides a review of all potential blade end-of-life options, at various stages of technical development, including their associated environmental impacts and the identified challenges, barriers and opportunities.

The intended audience is wind turbine OEMs, blade manufacturers, asset owners and decommissioning contractors, as well as governments, local authorities and public agencies with responsibility for waste and the circular economy.

Table of contents

List of Figures

Blade End-of-Life Treatments: State of the art, Challenges, Barriers and Environmental Impacts

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Introduction

It is widespread knowledge that the waste from decommissioned wind turbine blades is a serious waste disposal issue. The composite materials which blades are made from are not currently recycled at scale and with many developed countries prohibiting the landfilling of wind turbine blades, there is no obvious solution to the rapidly increasing mass of composite waste being decommissioned from sites. This waste mass is set to exponentially increase, as more turbines are commissioned throughout the world, this will eventually translate to more blades being decommissioned at end-of-life. The recycling of glass fibre reinforced composites and the challenges related to the end-of-life of wind turbine blades have been studied for many years. The International Energy Agency Wind TCP Task 45 on the recycling of wind turbine blades has identified 47 European projects dedicated to solving the issues related to the end-of-life of wind turbine blades and of the recycling glass fibre reinforced polymer composites. These research projects started as early as 1997 and continue to be funded today. The document prepared by the IEA Wind Task 45 categorizes the projects into seven topics: Prevention, Reuse, Repurpose, Recycling, Recovery, Circular economy and Decision support.

A recent report by the University of Leeds for the United Kingdom Department for International Trade summarised current research and development activity in the area of end-of-life blade treatments (Velenturf, 2022), "A timed search was carried out for research and innovation projects for glass fibre reinforced composites/offshore wind turbine blades. 32 Projects were identified, of which 26 were wholly or partly focused on recycling solutions, 12 included design aspects primarily on the development of alternative composites, and 10 arguably covered reuse, repurposing and/or remanufacturing (arguable because some constituted remanufacturing post-recycling, which others would define as recycling). A further structured search was carried out in July 2021 for projects on wind and sustainability, within the repositories on Gateway to Research (holding projects funded by UK Research and Innovation) and Cordis (holding projects funded by the European Union). This was part of the yet-unpublished Wind Energy Lifecycle Sustainability project by the University of Leeds, and returned a total of 237 projects on Cordis and 105 on Gateway to Research offering another source of relevant projects on turbine blades. Of the projects on Gateway to Research, nine projects focused mainly on blades/rotors, with subjects ranging from material selection/development to design of blades and manufacturing facilities and leading edge protection. Cordis held 25 projects focused mainly on blades/rotors with subjects ranging from remote condition monitoring to composites hub design and manufacturing, composite material development, blade design optimisation, durability, manufacturing and inspection, mobile blade shredding and market research for recovered fibres.