



Report 2022

Task 45

Photo: Henri DUPUY / Getty Images, Canva.

Recycling Wind Turbine Blades

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recycling solutions at scale. The participating industries are wind turbine blade manufacturers, wind farm owners and recycling industries. Furthermore, universities and wind energy associations from several countries are involved. The objectives of the Task are to recommend best practices for recycling wind turbine blades and identify new fields of

research on this topic.

In 2022, the IEA Wind Task 45 held several events online and in person. Two general assemblies held online in May and December provided Task members and stakeholders with information about ongoing activities and allocated time for networking in breakout rooms. In addition, the IEA Wind Task 45 members met in person on two occasions. First, in Bremerhaven in September, where Fraunhofer IWES kindly hosted a working session to advance the first deliverables of Task 45, as seen in Figure 1. The second was in November at the International Conference on sustainable wind turbine blades, organised by DTU Wind at its Risø campus in Roskilde, Denmark. (See Figure 2.)

Additionally, the deliverables scheduled in IEA Wind Task 45 were re-visited in 2022. Considering the voluntary basis of the work in IEA Wind Tasks and the busy schedule of its members, the initial plan needed to be more realistic. The deliverables were combined, and their purpose and format were discussed. Nevertheless, the Task was able to publish deliverable 4.1, which reviews policies, legislation, guidelines, and initiatives

addressing the recycling of wind turbine blades.

Introduction

Research on wind turbine blade recycling has been ongoing for over a decade. However, recycling solutions are uncommon, and the few existing solutions are not yet implemented at scale. As a result, the ability to recycle wind turbine blades is only possible in some countries. The technical difficulty associated with recycling fibreglass reinforced thermoset composite, the low cost of landfill, and the lack of predictability in waste volume are some of the challenges preventing the implementation of sustainable recycling solutions. To tackle these challenges, expertise within several disciplines and a unified approach between nations are needed. Therefore, IEA Wind Task assembles key stakeholders to identify barriers and develop mitigation strategies for the implementation of large-scale recycling solutions. Namely, their main objectives are to identify new research areas within the topic of blade recycling that are not yet covered by existing projects and recommend best practices for successful recycling operations.

The expected outcomes at high TRL are best practices for an efficient recycling value chain, as well as guidelines concerning end-of-life decisions, which consider economic, environmental, and social impacts of recycling turbine blades, including legislative recommendations. At low TRL, the expected outcome is to provide a comprehensive description of the current state of wind turbine blade recycling. Additionally, the identification and prioritisation of new recycling technologies, as well as prioritisation for research into innovative materials and blade structure design for improved recyclability.

The industry participation, universities and associations involved in the Task are presented in **Table 1**.

Progress and Achievements

IEA Wind Task 45 activities revolve around three recurring themes central to the challenges of wind turbine blade recycling. These include the technical considerations of recycling (WP2), analysis of the recycling value chain (WP3) and standards and legislations framing the end-of-life of blades and the recycling activities (WP4).

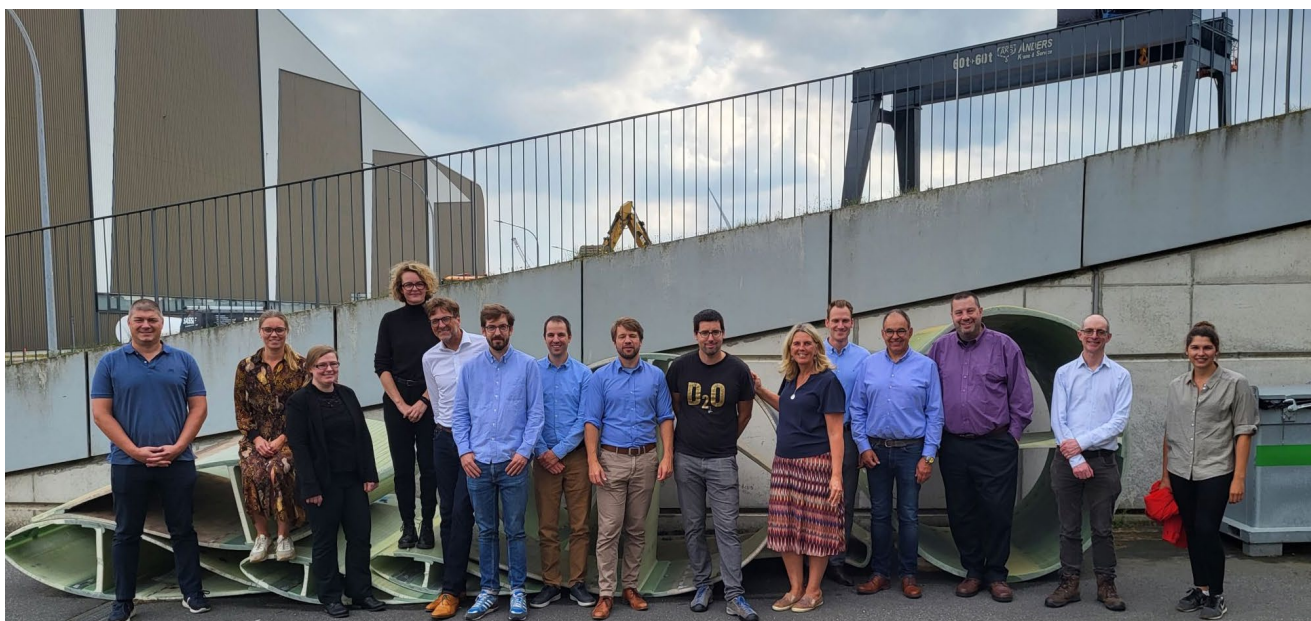


Figure 1. First in-person meeting hosted by Fraunhofer IWES in Bremerhaven.

DTU International Conference on Sustainable Wind Turbine Blades: New Materials, Recycling and Future Perspectives



Figure 2. International Conference on sustainable wind turbine blades organised in connection with the IEA Wind Task 45.

Table 1. Countries Participating in Task 45

COUNTRY/ SPONSOR	PARTICIPATING INSTITUTIONS	COUNTRY/ SPONSOR	PARTICIPATING INSTITUTIONS
1 Denmark	- Aarhus University - DTU Wind & Energy System - ErhvervsShus Nord - HJ Hansen - Port of Aalborg - Siemens Gamesa Renewable Energy - SDU - Vestas	5 Germany	-Fraunhofer IWES -Fraunhofer ICT -DNV -DLR -NEOWA -TPI Composites -VDMA -Windnovation
2 United States	- DNV - Georgia Tech - NREL	6 The Netherlands	-ECHT Community -IX Wind -TNO -TU Delft -Windesheim University
3 United Kingdom	- Cambridge University - National Composite Centre (NCC) - ORE Catapult - University of Leeds - University of Strathclyde	7 Sweden	-Chalmers University -RWE -RISE research center -Vattenfall
4 Ireland	- Munster Technological University - University College Cork (UCC) - SEI - Wind Energy Ireland	8 Norway	-NVE
		9 France	-EDF Renouvelable -Arkema -IRT Jules Vernes -Engie Laborelec
		WindEurope	

In WP2, the technical aspects of blade recycling were discussed from two different perspectives: blade materials and recycling processes. Fraunhofer IWES (DE), in collaboration with TU Delft (NL), RISE Sweden (SE) and TPI Composites (DE), prepared an overview of the existing, upcoming, and future materials used in the manufacturing of blades (Deliverable 2.1), in which the recyclability of the reviewed materials is analysed and discussed. The next step for the group is to formulate guidelines for designing recyclable wind turbines. These guidelines aim to address questions such as how to incorporate elements of design (material and structure) that could ease the repurposing or recycling process. Regarding the processes themselves, the University College of Cork, UCC (IE) took the lead in the coordination of Deliverable 2.2, which reviews the available recycling methods for existing blades as well as possible applications for recycled materials. In the future, the discussion is intended to understand how promising recycling processes can be scaled and to identify technical and economic optimisation strategies. The University College of Cork, UCC (IE) is additionally leading WP3. This WP is dedicated to the analysis of the recycling value chain and its environmental, social and economic impact. However, in 2022, this work package was paused.

DNV (US) is leading WP4, which is dedicated to defining standards, certification and legislation framing the activities related to recycling wind turbine blades. In 2022, DNV collaborated with the University of Leeds and Vattenfall to prepare an overview of existing standards and legislation. This content was published as Deliverable 4.1, "Review of existing available recycling methods for existing blades as well as the applications for recycled materials". The next step for the group is to reflect on how legislation, standardisation and certification help in the implementation of large-scale recycling solutions.

In November 2022, DTU Wind and Energy Systems organised a conference dedicated to wind turbine blades, their recyclability, and sustainability [1]. The open conference, attended by many members of the IEA Wind Task 45, successfully addressed the topic of wind turbine blade recycling before 110 total participants representing 14 different countries and a diverse range of backgrounds.

Highlight(s)

- In May and December 2022, the IEA Wind Task 45 held two general assemblies with 30 participants from 9 different countries. Despite being held remotely and a large audience, it achieved in enabling interaction between all participants.
- In September 2022, the IEA Wind Task 45 met in person for the first time at a working session dedicated to the first Deliverables of Task 45.
- In November 2022, the IEA Wind Task 45 members met again openly at the International Conference on sustainable wind turbine blades.

Outcomes and Significance

Based on a review of the current state of recycling in the wind energy industry, the outcome of the Task expects to provide recommended best practices for wind turbine blade recycling. These recommended best practices are relevant to public authorities interested in implementing recycling solutions for wind turbine blades on a regional or national scale. Furthermore, for industrial stakeholders interested in developing a recycling business for wind turbine blades, researchers developing innovative blade designs, new composite materials, or new recycling processes. Based on the analysis of the recycling value chain and its associated impacts (economic, environmental, and social), the outcome of the Task aims to provide a framework which

supports modifications and the development of new standards.

Next Steps

The participants of Task 45 will again meet twice a year for general assemblies. In 2023, the first meeting is organised to be online on the 6th of June, while the second is anticipated in December. A roadmap for identifying the next steps for the development of recycling technologies will be coordinated by VDMA for members of Task 45. An in-person meeting is under consideration for November at the National Centre for Composites in the UK. Finally, Task 45 members are keen on extending the Task for an additional three years. To pursue this extension, a proposal will be prepared and submitted for consideration.

References

[1] Website:
<https://www.conferencemanager.dk/recyc>

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