

CIRCular gLass fibre rEcycling solution for offshore WIND turbine blades

Publieke samenvatting / Public summary

Aanleiding

To achieve a climate-neutral EU in 2050, energy must be generated by renewable energy sources that fit within a circular economy. Wind turbines must become circular with a focus on a sustainable end-of-life solution for recycling of the composite blades. Landfilling, incineration and cement co-processing are not suitable recycling options compliant to the climate and environmental objectives. Currently, there is no economically feasible recycling facility for large-scale processing of composite materials. WindEurope expects throughput of discarded blade mass will grow in Europe from 60 kton/year in 2025, to around 800 kton/year in 2050. For the Dutch situation for offshore wind, it is estimated that until 2030 more than 1955 turbines with 5865 blades will be installed offshore with a total mass of 260 kton composite material. The challenge to be solved is the circular processing with a sound business case with efficient and low emission logistics and pre-processing and transparency of the available volume and composition of blade material as raw feedstock for the recycler and implementation of recycled glass fibre in blade design and regulations.

Doelstelling

The goal of CIRCLE4WIN is to develop a cost-competitive and scalable circular end-of-life solution with glass fibre reclamation by thermolysis (pyrolysis and decarbonization), into raw glass material for the production of new recycled glass fibre for use in new blades. The result is an unique

Projectinformatie / Project information

Projectnummer / Project number
MOOI124042

Subsidiebedrag / Grant amount
€ 2.060.732,00

Algemene informatie / General information

Penvoerder / Secretariat
Nederlandse Organisatie voor
Toegepast-Natuurwetenschappelijk
Onderzoek TNO

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thermo-mechanical glass fibre composite recycling and production route for large-scale application (50 to 80 kton/yr) with a dedicated supply chain in the Benelux within 5 years after project completion. To achieve this goal, the following sub-goals have been defined:

- Assessment of the impact of offshore and onshore dismantling, logistics and pre-processing processes (cutting, shredding) on costs, environmental impacts and socio-economic benefits
- Guidelines for design for circularity of new wind turbine blades to integrate use and traceability with a Digital Product Passport (DPP) of blade components and materials

Korte omschrijving

- Development of an EoL multidisciplinary decision support framework for decommissioning, pre-processing and logistics. Scenarios will be assessed on environmental impact with LCA and social economic benefits with a method developed by TNO.
- Development of a mobile facility for on site dust-free cutting and an integrated shredding and grinding facility with the thermolysis recycling facility will be established for the glass fibre thermolysis process
- Optimization of the thermolysis process carried out at TNO in terms of energy balance, material purity and process conditions for future large scale application. The reclaimed glass fibre is processed at Sibelco as raw material to produce Furnace Ready Cullet enabling the production of new glass fibre by Envalior. Which will be produced and tested in composite blade parts and recyclable thermoplastic composite products.
- Based on assessment results, the demonstrated pre-processing and thermolysis process, guidelines are established for circular design with required traceability with a DDP to ensure the validity of the EoL solution all the way to the end user.

Resultaat

To achieve the goal of the thermolysis glass fibre recycling solution, a decision support framework is established based on cost, environmental impact and socio-economic effects. To optimize the process, advice is given on blade design and Digital

Product Passport (DPP) for traceability of the recycled material to the final product. To achieve this, preprocessing and logistics solutions and EoL developments from other related research projects (EoLO HUBs, DecomBlades, etc.) are used and optimized to bring costs down to the level of new fibre. Parallel composite waste flows from oil & gas and other industries and traceability of materials with a DPP are included. The following four results are defined: 1. Multi-criteria decision support framework of the EoL route on costs, environmental (LCA) and social economic benefits 2. Demonstrator of the pre-processing route with smart blade cutting and shredding 3. General thermal and site-integration design and testing of the thermolysis process for glass fibre reclamation and fibre remelting process 4. Guidelines for circular blade design incorporating use and traceability of recycled materials (DPP)

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.

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