RECYCLEWIND 2.0:
Environmental Product Declarations (EPDs) and Data Sharing for an effective Recycling of Rotor Blades

Wind EUROPE

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Speakers

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OBJECTIVES OF THE PROJECT

Conception of a recycling network, self-learning and resilient, **for the sustainable control of the material flows of wind energy plants** using the example of rotor blades.

1
Self-learning

Independent definition of standards within the network on the basis of previously agreed principles.

2
Resilient

Robust, i.e. secure approach to high-quality recycling even when framework conditions change (circular economy).

PROJECT PARTNERS

RecycleWind

brands & values sustainability consultants

Institut für Energie und Kreislaufwirtschaft

Universität Bremen

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tpi COMPOSITES

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APPROACH

Main work packages

Identification of relevant actors

- Relevant actors in the process chains
- Tasks, influence, responsibilities, interactions of the actors
- Options for action

BPMN = Business Process Model and Notation

1

2

Inventory of recycling system

- Quantitative data of components and materials
- Decommissioning, recycling technologies
- Material qualities and quantities
- Material flow models of the process chains

Development of a central database; Sankey diagrams

APPROACH

Main work packages

Definition of indicators & terms

- Recyclability, Circularity
- High quality recycling
- Recycling rate, secondary material rate
- Recovery rate

Control in the planned recycling network

3

4

Concept of recycling network

- Designed as a quality association*
- Setting objectives
- Setting standards with regular evaluations

Self-learning and resilient

*With representatives of all members of the value chain, R&D, public authorities.

SUPPORTING TOOLKIT for a resilient recycling network

WTG inventory database

- Location
- Manufacturer
- Operator
- Turbine type
- Hub height
- Rotor diameter
- Etc.

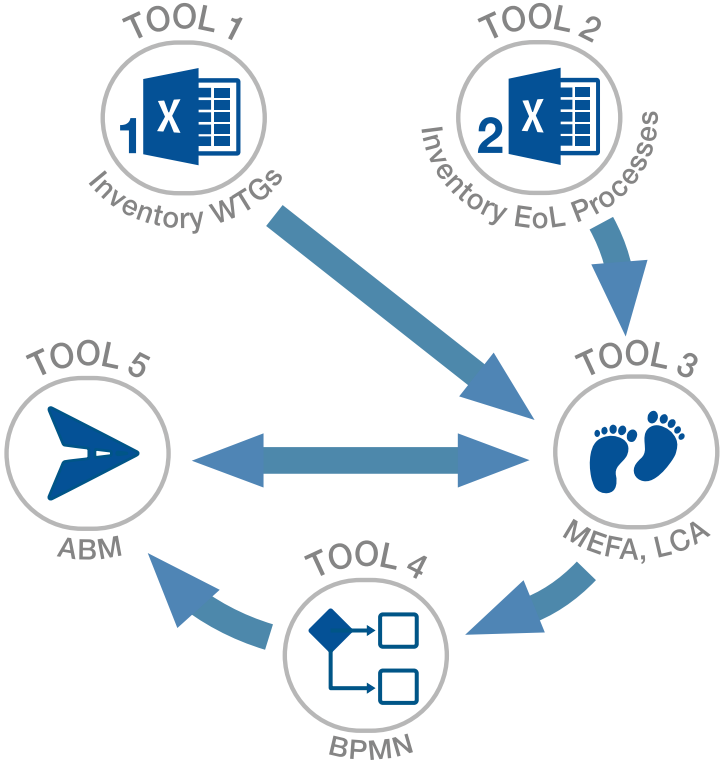
► Forecast type and quantity of materials used

Agent based modelling (ABM)

- Simulation of the annual development of EoL & Recycling routes for rotorblades based on the MEFA, relevant actors and additional external influences.

Business process modell (BPMN)

- Model of the process chain with the key actors along the entire product life cycle with tasks, influences, responsibilities, interactions of the actors and options for action.



Process database:

- Involved processes of the EoL technology routes and recycling options.
- Information on mass balances and energy consumption of the individual processes from practice.

Material & Energy Flow Analysis (MEFA), Life Cycle Assessment (LCA):

- Visualization (Overview) of EoL Routes for different szenarios and predictions
- Calculation of potential ecological impacts, for example GWP
- Benchmark of the existing technological End of Life processes

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MAIN FINDINGS

Datasharing via EPD

To enable high value recycling for long lived products data sharing is mandatory!
Environmental Product Declarations Type III (EPDs) fulfill datasharing requirements.

EPDs can be used to secure high quality recycling:

1. Documentation of mass-percentages of used materials and total blade mass
2. Construction details and/or design drawings that show for example:
    - position, width and thicknesses of all Spar Caps/Girders,
    - position (and thicknesses) of core materials (shells/webs)
    - circumferential length of different blade sections incl. SparCaps/Webs positions

MAIN FINDINGS

Datasharing via EPD

3 Presentation of the recyclability for the entire product with additional consideration of

- used "energy-intensive materials"; > 2 times the calorific value of crude oil
- used "critical raw materials" according to EU listing
- used "hazardous substances" according to EU regulation

4 With regard to the assessment of recyclability, for the climate and resource-relevant materials it is examined whether for these used substances

a dismantling instructions for separation are available

b existing recycling processes and routes exists

c and if a real, effectiv recycling or cascade use is possible

DRAFT EPD ROTOR BLADE

in cooperation with tpi COMPOSITES.

3.3 Construction and Material Composition

3.13 Disassembly
3.14 Re-Use
3.15 Recycling and Disposal

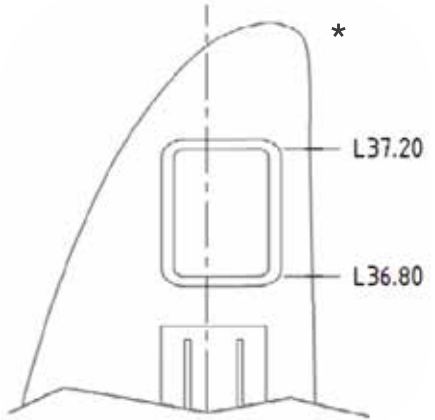
DATA SHARING VIA EPD

Example: balancing chamber

Exemplary description of conctruction details that are relevant to decommissioning and recycling. The following descriptions are refer to a GFRP-blade, length L = 37.50 m:

From L36.80 m to L37.20 m, there is a closed chamber to balance out a set of three blades. This chamber can be loaded with a mixture of epoxy resin/steel and is not marked from the outside.

Additional balancing masses can be fixed to the webs, close to the center of gravity at L12.75 m.



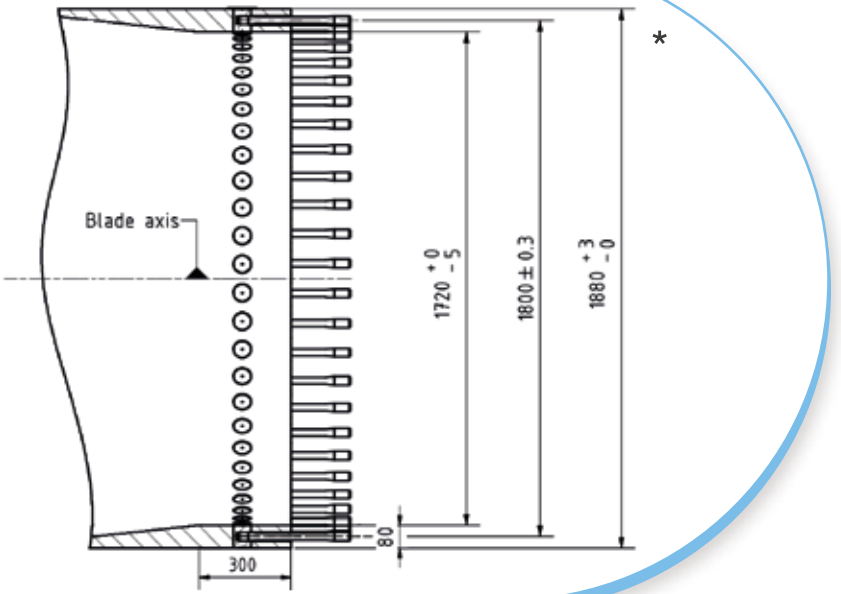
*The described blade design is intellectual property of TPI Composites Inc..

DATA SHARING VIA EPD

Example: blade connection

From L0.00 m to L0.30 m, the flange laminate has a constant thickness of 80 mm.

The blade connecting bolts forming the “IKEA”-connection can be removed by unscrewing the length bolts from the cross bolts, which might fall out of their holes, because they are not glued to the blade. From the outside (and sometimes inside), the cross bolts are covered/sealed by an aluminium/butyl tape.



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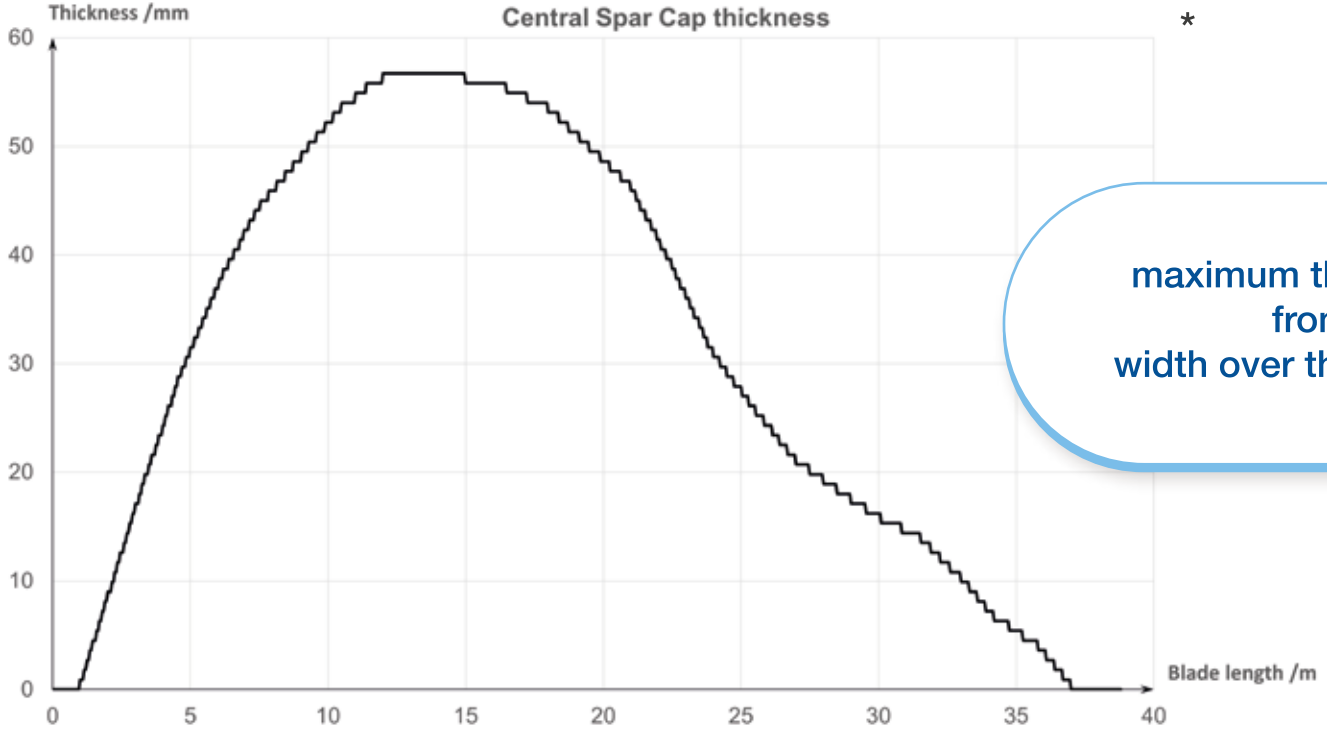
DATA SHARING VIA EPD

Example: spar cap



*

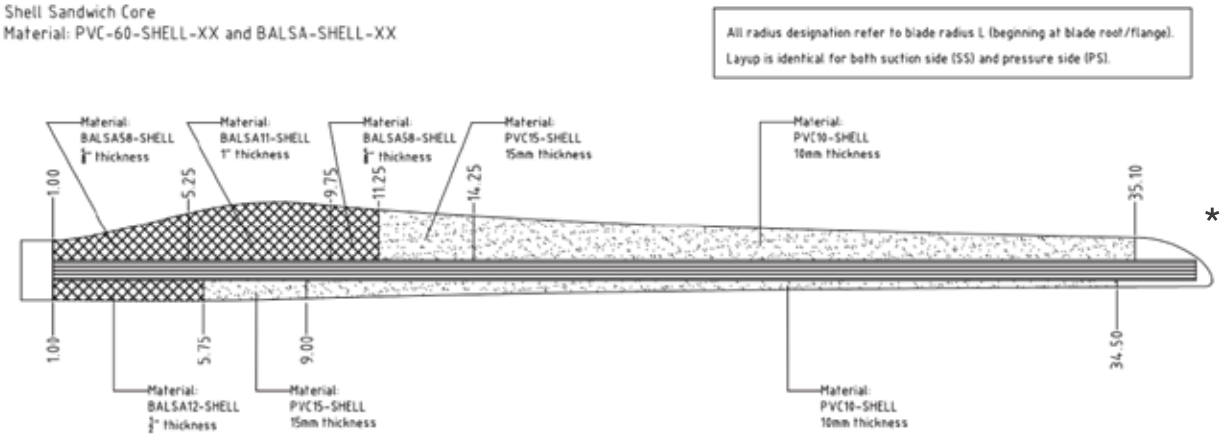
maximum thickness of t_{SC} = 57 mm
from L12.00 m to L15.00 m
width over the entire length 630 mm

*The described blade design is intellectual property of TPI Composites Inc..

DATA SHARING VIA EPD

Example: shell core

The suction- and pressure side shells are formed by GFRP-sandwich panels that consist of balsa and closed-cell structural foam with varying, position-related thicknesses:



To enable drapeability of the (biaxially) curved core panels during manufacturing, foam and balsa sheets are (uni-/bidirectional) slit or knife-cut. To secure reliable vacuum infusion processing, additional perforation and grooving can be applied in specific areas. All of these cavities will be filled with resin during infusion.

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RECOMMENDATIONS for a recycling network

- Integration into an existing Europe-wide organisation (e.g. Wind Europe).
- All stakeholder groups must be integrated into the recycling network, i.e. also the dismantling, processing and recycling companies
- Data sharing via EPD is also necessary for all main components of the WTG:
  - Tower
  - Nacelle incl. gearbox, generators
  - Hub
  - Rotor
  - Blades
  - Foundation
- Supporting toolkit of RecycleWind should be used, e.g. for the quantity forecasts for the dismantling and processing capacities to be maintained (including crane capacities, pyrolysis capacities for CFRP)

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NON-DISCLOSURE within a recycling network

- Instead of publishing company specific EPDs, the organisation/association can create representative sector EPDs to account for non-disclosure requirements.

- If sector EPDs are implemented, the manufacturers need to deliver specific data to feed a secure database owned by the organisation.