



## WOOD

**WOOD: next generation materials and processes - from fundamentals to implementations**

**Programme: COMET – Competence Centers for Excellent Technologies**

**Programme line: K1-Centres**

**COMET subproject, duration and type of project:**

**Process analysis for more efficient processes in wood composite industry, 01/2015 – 12/2018, multi-firm**

### Innovation in Renewable energy - Rotor blades from hemp-based composites

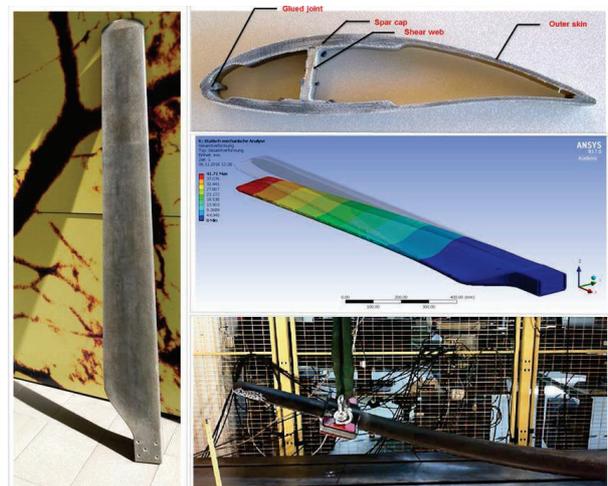
Hemp plants were utilized for constructing rotor blades for small wind turbines in order to build “green energy”-facilities consequently from a sustainable material.



#### Green Materials for Green Energy, Green2green

Firstly hemp was cultivated and harvested. Next the plant oil from hemp seeds was converted into an innovative bio-based epoxy matrix resin and hemp fibres were spun into yarns and woven into fabrics for reinforcement. Both were combined to a sustainable composite material providing properties that fulfil requirements of wind turbines. With the hemp-based material 1.75 m long rotor blades of a small wind turbine (SWT) were manufactured and full scale testing was performed according to standards of wind turbines (Fig. 4).

Today rotor blades of wind turbines are generally made from glass fiber-reinforced plastics (GFRP). After 20 to 25 years of service, the system reaches the end of life cycle and then disposal of GFRP is problematic. The project result is based on an innovative material from renewable resources, which offers a solution for this problem.



**Fig. 4: Rotor blade made of hemp (left), Cross-section of rotor blade (top right), FEM simulation of rotor blade (middle right), Full scale test of rotor blade (bottom right)**

It is closely related to the third key target “Climate Change and Energy” of the Europe 2020 strategy, namely by the development of a bio-based composite material which is able to substitute eco-unfriendly composite materials typically used for (S)WT and the establishment of a regional value-added chain. The R&D-

project "Green2Green" was funded by the Austrian Ministry of Technology (BMVIT) under the project number 848668 (Fig. 5).



Fig. 5: Scheme of R&D project Green2Green

The present bio-based material based on hemp fibre reinforcement structures and epoxidized hemp seed oil was successfully applied for structural components such as rotor blades of a SWT. In addition, the material has an enormous potential to support the new market trend towards sustainable solutions in the

broad field of modern lightweight applications. Apart from the wind energy industry, the automotive sector demands for sustainable materials that enable the industry to fulfil the strict regulations concerning end-of-life strategy. Another potential market is the market of sporting goods, because more than in other sectors customers of sporting goods like surfboards, tennis rackets etc. are aware of the nature.



### Impact and effects

In terms of technological readiness level (TRL) the project has reached a TRL between 4 and 5. Although the R&D project was officially finished in April 2017, the promising results motivated the project consortium to establish as soon as possible a fully operative SWT with 1.75 rotor blades made from the hemp-based material which will increase the TRL up to 7 (System prototype demonstration in an operational environment). Furthermore, the project consortium has already received positive feedback from relevant SWT manufacturers from Austria. Wherever GFRP materials are used in the SWT, the manufacturers want to replace them with the new bio-based material developed within the R&D project.

#### Contact and information

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#### Project partners

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| Department of Polymer Engineering at Montanuniversität Leoben, | Österreich |
| Kästle Technology GmbH,  | Österreich |
| R&D Consulting GmbH & Co KG                                    | Österreich |
| Waldland Naturstoffe GmbH                                      | Österreich |