Re-Wind Project: Submission to the Public Consultation Waste Action Plan for a Circular Economy

February 2020.

Submission Context

This submission to the Wind Energy Guidelines Consultation process is made on behalf of **Re-Wind,** a collaborative international project between researchers in the United States, the Republic of Ireland, and Northern Ireland.

This Re-Wind Project supports collaborative research between researchers in the United States, the Republic of Ireland and Northern Ireland. The project partners are University College Cork, Queens University Belfast, and Georgia Tech, USA. The objective of the proposed research is to establish a methodology to compare sustainable end-of-life (EOL) reuse strategies for composite material wind turbine blades using a Geographic Information System (GIS) platform coupled with environmental, economic and social Life-Cycle Assessment (LCA). The very rapid growth in wind energy technology in the last 15 years has led to a commensurate rapid growth in the amount of non-biodegradable, thermosetting GFRP composite materials used in wind turbine blades. The hypothesis of the research project is that feasible repurposing applications can be found that will prevent environmentally and socially unpalatable and unsustainable landfilling and incineration disposal methods. The project team has developed designs of artefacts incorporating repurposed wind turbine blades, including a detailed design of a pedestrian bridge (Fig. 1).

Fig. 1. Design for an 8 m span pedestrian/cycle bridge for greenways incorporating wind turbine blades

Composite Material Wind Turbine Blade Waste

Wind turbines have an estimated lifespan of 20 years (Beauson and Brøndsted, 2016; Elsam Engineering A/S, 2004; Jensen and Skelton, 2018; Marsh, 2017) and there is an estimated 12-15 tonnes of blade material per MW installed capacity [1] [2]. Blade waste is a complex material to recycle and currently any blades that reach end of life stage in Ireland are subject to export or landfill. Dealing with composite blade waste from decommissioned wind turbines will become a major issue in the coming years. The installed base of wind generation continues to grow in many countries. A recently released report commissioned by the Irish Wind Energy Association shows that Ireland can achieve 70% renewable energy generation by 2030 by increasing wind power capacity from 5400 MW in 2018 to 10,000 MW by 2030 [3].

The Irish Government issued a Climate Action Plan in June 2019 with a target of 11,700 MW installed wind energy by 2030 [4]. Therefore, based on the installed power in 2018 and the target installed

power for 2030, there will be approximately 64,800 tonnes of blade waste material that Ireland must dispose of by 2038 (see Fig. 2) with a further 55,200 tonnes of waste material by 2050.

Decommissioned wind turbine blades present some unique challenges when considered in a circular economy framework. The blades are highly engineered composite products with specific structural and mechanical properties. However, the major constituent materials of the blades (glass fibres, polymers such as polyester or epoxies) are of relatively low value. Conventional recycling or material recovery routes destroy the engineered value of intact blades and transform them into relatively low-value materials. For example, recovered glass fibres are regarded as inferior to virgin fibres and command lower prices as a result.

Blade **re-purposing,** where feasible, is preferable to recycling, materials/energy recovery, or landfill under current EU Directives. Re-purposing also supports the development of a Circular Economy in Ireland by keeping resources in use for as long as possible. Where re-purposing is not a viable option recycling is the most environmentally sustainable and socially acceptable solution for the blade waste.

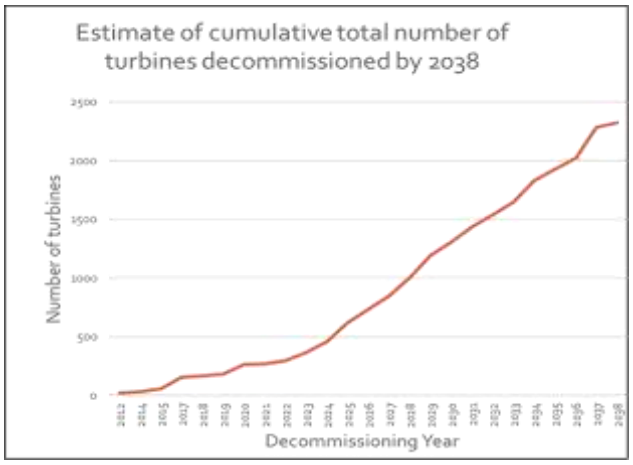

Figure 2: Estimate of cumulative total number of Wind Turbines decommissioned by 2038

Responses to the Consultation

13 . End of Waste

Objects repurposed from whole, decommissioned wind turbine blades, or parts thereof, may satisfy the requirements for 'end of waste' status, if sustainable business models are demonstrated for repurposing wind turbine blades.

Given the projected increase in the volumes of end-of-life blades, repurposing of blades may address the three objectives for reduction of Construction and Demolition Waste[1] set out in section 13.3 of the Waste Action Plan consultation document, namely (i) helping to achieve recycling targets, (ii) moving further up the waste hierarchy, and (iii) reducing pressure on disposal infrastructure, e.g. landfills.

[1] It is assumed that decommissioned wind turbine blades generally fall in to the category of construction and demolition waste.

According 'end of waste' status to products created from composite wind turbine blades would help facilitate the development and deployment of successful business models to generate social and economic value while also improving environmental quality. If repurposing solutions close to the source of the blades can be found, the social and economic benefits may accrue to local communities. The Re-Wind project has created a geodatabase of all in-service wind turbines on the island of Ireland in order to help identify local repurposing opportunities.

17. Waste Data

The Re-Wind wind turbine database allows future volumes of composite material wind turbine blade waste to be projected, based on assumed blade service lifetimes. Collection of actual data on decommissioned wind turbine blades would help to match potential repurposing uses to end-of-life blades. As blades are bulky, voluminous and relatively low-density, transportation over long distances is expensive, therefore decommissioning contractors and wind farm owners may also benefit from local repurposing initiatives through reduced disposal and transportation costs.

18. Research & Innovation

One of the most important research topics to enable the circular economy is the study of business models surrounding repurposing of complex products such as wind turbine blades. For example, experience in Denmark has shown that sustainable business models require steady flows of resources, and therefore may require stockpiling of resources.

Life-cycle analysis (LCA) is necessary in order to provide an evidence base for any new measures proposed to support the development of the circular economy. For example, LCA carried out by the Re-Wind team has compared the environmental impacts of some currently-used disposal methods of wind turbine blades, including resource recovery by co-processing blades in cement kilns and landfilling. Work is ongoing to determine the relative environmental impacts of repurposing, but it is expected that these will be significantly lower than the current disposal methods [5].

Future research should support small-scale demonstration projects which can provide examples for sustainable circular economy business models. For example, the Re-Wind project has developed a design for a pedestrian bridge (Fig. 1) incorporating two wind turbine blades as load-bearing structural elements. These bridges could be widely deployed, for example in greenways.

Further details on the Re-Wind project can be found at www.re-wind.info

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