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Published in:
Book of Abstracts, Sustain 2017

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

Wind power material stocks in a circular economy context

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Decarbonisation of electrical grids and transitioning to renewables abate climate change i.e. compared to fossil sources, wind energy technologies emit 100 times less GHGs during their life cycle. However, uncertainty related to the end of life treatment of components and the issue of safe supply of resources for the infrastructure of renewables call for attention. In a circular economy context materials stocks embodied in wind power plants are resources for the future. For some materials such as steel, aluminium and copper, recycling technologies are already available and determined by collection and recovery. For other stocks such as composites the challenge is higher given the lack of cost effective recycling technologies and of secondary markets.

Seeing these end of life (EoL) treatment options from a life cycle perspective it should be an environmental benefit to recycle. To exemplify, Figure 1 presents the current market options for the EoL treatment of wind power plant components. A Life Cycle Assessment (LCA) reveals the benefits from metal recycling are high given the assumed recovery rates and the lower energy requirements compared to primary production. Contrary, the current treatment options for the blades which involves shredding and use of the material in cement production is suboptimal since the burdens from treatment offsets the benefits from avoided production. The case of the blades is particularly interesting since the properties of the blade material are different those of the glass fibre, epoxy and wood that compose it. The material recovered after the recycling also has different properties and its potential use needs to be understood. Despite the high research focus there are as yet no economically viable recycling technologies particularly for glass fibre composite materials. Alternative mechanical, thermal and chemical treatment options leading to the production of powdered fillers and other fibrous products are suggested. An additional challenge with blade EoL management is related to the geometric particularity of the structure; blades can be more than 75 m long, covering an area of approximately 500 m^2 . On a conceptual level and beyond mere technology-fixes, manufacturers and product developers need a mindset-shift i.e. to develop technologies and products that are designed and manufactured in a way that can be recovered and reused in multiple loops.

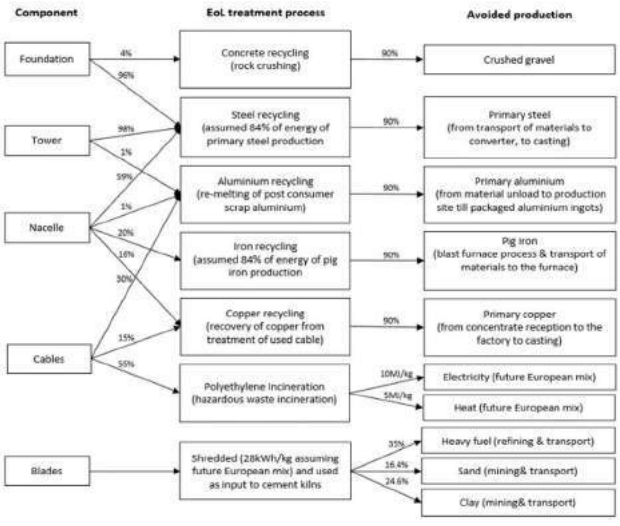

Figure 1. EOL current treatment options for wind power plant components