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This paper provides a quick-read summary of a webinar that was held in June 2024, as part of a series on circular economy in renewable energy infrastructure. To read more about the series visit our dedicated page [Circular renewables webinar series]

SESSION 5: REMANUFACTURING: THE FUTURE? – JUNE 2024

The fifth circular renewables session focused on remanufacturing, chaired by Sara Roberts from the ASD Limited with speakers Friya Tailor from WMG/University of Warwick and Carol Sheath from Renewable Parts.

Remanufacturing has been defined as: "A standardized industrial process by which cores are returned to the same-as-new, or better, condition and performance. The process is in line with specific technical specifications, including engineering, quality, and testing standards. The process yields fully warranted products".

The speakers agreed that remanufacturing can generate a number of benefits for renewables:

- Energy, material and carbon savings, lowering environmental impact:
    - Requiring less energy and fewer raw materials compared to manufacturing new products.
    - Extending the product's lifecycle, delaying the need for a new product and new manufacture. In a typical refurbished Siemens 2.3CS yaw gear, reuse of component parts results in a ~400kg CO2eq saving relative to buying a whole new gear. Similar reduced lifecycle costs for automotive manufacturers.
    - Decreasing demand for raw materials conserves finite natural resources and reduces resource security risks in the supply chain, against a background of increasing demand for sufficient volumes of critical materials to meet all ambitions for the uptake of renewables.
    - Reducing waste and landfill by reusing existing components.
- Legislation and Policies: Stricter environmental regulations and policies favour remanufacturing as a green initiative.
- Quality: Parts refurbished or remanufactured to restore as-new characteristics are tested rigorously to ensure performance and reliability, and have a warranty equivalent to new. Components subject to wear, affecting life or reliability, are replaced with new where possible.
- Availability: Speed at which renewable solutions can be made available. Stock held of high consumption parts for off-the-shelf availability, offering a significant advantage over OEM lead-times for new (defective parts to be returned for feed stock following receipt of recirculated products) plus obsolescence mitigation. This improves operational efficiency.
- Data: Introduce traceability in the second lifecycle of parts, including data collection from disassembly onwards, which enables identification of common failures, correlations with usage, and design improvements.
- Financial benefits: Reduced manufacturing costs, due to lower cost of raw materials and production and more stable costs than OEM.
- Social and economic benefit of creating green jobs in the UK and the additional social benefits those bring.

Friya Tailor explained that the rapid growth in the electric vehicle (EV) market creates a substantial demand for remanufacturing, both within the EV market and across renewables. Permanent magnets using REEs, Copper, Aluminium, Electrical Steel, for example, are used in large generators for wind turbines and in smaller EV applications.

Global demand for Neodymium is forecast to grow by 37% into 2050. There are no substitution possibilities for Neodymium permanent magnets other than elimination through use of induction motors. With the majority of the supply chain controlled by China, REEs were allocated the highest potential criticality in UK in 2021. Another material is Silicon (see Sessions 3-4 for links to solar), necessary for electrical steels, which also is highly critical. Due to the scale of wind turbines, there may be business opportunities to repurpose permanent magnets from wind into EVs.

Carol Sheath outlined that the wind industry still largely operates in a linear economy manner, in which the aftermarket can become more sustainable and procurement cultures more open to reused parts. The benefits – outlined above – could be substantial though. Since 2019, Renewable Parts diverted 125t of waste from landfill and scrap, circulated 136,000 items per year, and saved 365tCO2eq. The company has two sites in Scotland, with further sites opening in other countries. Recirculation pathways start from disassembly and component inspection, and then to either direct reuse, reuse after repair, refurbishment or remanufacture, reuse after redesign and modification for performance enhancement, repurpose and recycling. For the reuse pathways, parts are reassembled and tested, sometimes with the use of new or reverse engineered components.

Looking ahead, policies are already promoting circular economy practices that encourage remanufacturing. Moreover, there is economic potential for remanufacturing in the UK – to create our own supply chain and reduce import taxes. Technological advancements such as automation and AI will enhance the efficiency and quality of remanufacturing. Re-design can help to reduce failures and extend life, further reducing waste. But a number of challenges are to be overcome, such as the perception of the quality of remanufacture / refurbishment compared with new. The cost of comprehensive remanufacture and refurbishment solutions can be close to the cost of a new, meaning operators either buy new or cheaper repair options, the latter often feeding negative perceptions. Much of the data which would allow for a more efficient scale-up is either not collected or not available to those that need it (e.g. failure rates, bills of material, parts lists, design requirements, etc.). Unavailability of parts due to obsolescence or OEM protection, either limit ability to refurbish or drive cost beyond economical. Many minor parts continue to be scrapped at site, either because processes are not in place to consider alternatives, or because processes are in place which actively restrict material moving into a circular loop.

A note on artificial intelligence: This short paper was first drafted using artificial intelligence to summarise the recorded webinar. Prior to this publication it was then reviewed, and edited and corrected where necessary by Dr Anne Velenturf, Senior Researcher and project lead.