This paper provides a quick-read summary of a webinar that was held in February 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 3: RECYCLING VS. DURABILITY – FEBRUARY 2024

The webinar session on "Recycling vs. Durability in Circular Renewables" began with an introduction by Lorna Bennett, a senior engineer in sustainability at the Offshore Renewable Energy Catapult, who emphasized the importance of addressing the durability versus recycling debate in the context of renewable energy components. She highlighted the significant environmental impact of renewable energy components, particularly metal ones. She emphasized that recycling steel monopiles, the cylindrical structures supporting wind turbines, could significantly reduce carbon emissions, but that even greater reductions could be achieved through the use of durable, steel-reinforced concrete monopiles. This shift could also mitigate vibration damage to turbine blades and drivetrain systems. The session featured three main speakers: Professor Deborah Andrews from London South Bank University, Matt Burnell from ReSolar Ltd, and Nicola Young from BSI.

Prof Andrews introduced design for circularity, by delving into the historical evolution of product design. Over time, design approaches have become more complex, for example by using a greater number of materials and with designs that are less easy to repair; illustrated with the example of kettles, moving from early kettles to modern electric ones with increased complexity and recycling challenges. She argued that contemporary products are often designed with a linear lifecycle in mind—take, make, use, and dispose—without considering their end-of-life disposal.

She advocated for a shift towards a circular economy, where resources are conserved, and products are kept in use as long as possible. Andrews discussed the responsibility of designers in creating products that are durable, repairable, and recyclable, stressing the need for a whole-systems approach to design.

In her case study on data centers, Andrews described how a circular server was designed using modular components, standardization, and easy disassembly to extend product life and facilitate recycling. The redesigned server reduced embodied materials, overall mass, and the number of components significantly without compromising durability or recyclability.

However, she acknowledged the ongoing challenge with electronic components and printed circuit boards, which are difficult to recycle due to the complexity and economic constraints of the current recycling processes. The current recycling infrastructure, particularly for electronic components, is inadequate, underscoring the need for durable and repairable product designs.

Design criteria such as enabling product disassembly and design and manufacture can improve durability as well as recyclability, with strategies such as standardisation of parts to ease repair and avoiding single use parts. Within a circular economy, longer use of products takes priority over recycling in principle, and it certainly makes sense to use durable products while recycling infrastructure is still under development such as in the case of renewables.

The session continued with Matt Burnell, Managing Director of ReSolar Ltd and PV Cycle business manager, discussing the exponential growth of solar PV from 2014-2015 leading to ca. 15 GW installed capacity in 2024 which may further grow fivefold by 2035, driven by subsidies and future government targets. He highlighted the anticipated surge in PV waste due to this growth, stressing the need for improved recycling infrastructure and regulations to manage the influx of second-life panels from repowering projects.

Matt detailed the types of solar panels, noting that 95% are crystalline silicon designs, which dominates the market and recycling considerations. He explained various failure reasons for panels, including weather damage and installation

issues but noted that the reasons for failure are not systematically recorded. He emphasized the importance of understanding these failures to improve screening and recycling processes.

He addressed the waste hierarchy, praising the durability of PV panels but acknowledging the recycling challenges posed by their robust design. Matt outlined three main PV recycling methods—thermal, chemical, and mechanical—each with pros and cons, and the lack of a standardized best practice, which creates ambiguity in the industry.

Matt also discussed the economic challenges of PV recycling, such as the costs associated with extracting valuable materials due to the complex construction of panels. A further complexity are the current relatively low annual volumes of ca. 400 tonnes, which holds back investment. He highlighted the critical raw materials within panels and the need for policies to incentivize their extraction.

Due to policies to scale up solar, solar farms may be repowered with the used panels entering the second-hand market. However, new solar panels have become so affordable that the business case for reused panels is poor. He explained that further practical challenges exist for reuse, such as the regulatory barrier from the MCS scheme requiring new equipment for installations, which hampers the use of second-hand panels. He mentioned efforts to change this regulation and establish a reuse standard to ensure customer safety.

He shared a case study from the University of Exeter, where broken glass panels were tested and found to be highly efficient, leading to a successful reuse project in Cornwall. Burnell advocated for removing PV panels from WEEE regulations and establishing a separate extended producer responsibility framework due to the unique nature of PV panels compared to other electronic waste.

Matt concluded by emphasizing the rapid growth of the solar industry and the ongoing improvements in recycling and reuse practices, indicating a significant transformation in the next few years. He encouraged continued attention to this evolving field and welcomed further questions and engagement from the audience.

Nicola Young, Standards Development Manager at BSI, then discussed the role of standards in supporting circularity and sustainability. BSI, the British Standards Institution, operates globally with a presence in 31 countries, serving a wide range of clients from major brands to small businesses. BSI is independent and operates within the national interest, focusing on consensus-based standards developed by a diverse range of stakeholders.

Nicola explained the hierarchy of standards, starting with international standards by ISO (International Organisation for Standardisation) and IEC (International Electrotechnical Commission), followed by European standards from CEN (European Committee for Standardization) and CENELEC (European Committee for Electrotechnical Standardization), and finally national standards like those developed by BSI. She highlighted the importance of consensus and broad stakeholder engagement in the development of these standards.

Standards are agreed ways of making a product, managing a process or delivering a service, and are open consensus-based documents that are developed by a diverse range of stakeholders to specify what good looks like. There are different types of standards, positioned in between market incentives and government regulations, ranging from self-regulation to earned recognition / codes of practice and co-regulation.

Nicola emphasized the critical role of standards in supporting various government policies, including competitiveness, innovation, trade facilitation, fair trading, consumer protection, environmental protection, and public procurement. She also introduced ISO-TC 323, the international technical committee on circular economy, established in 2019 to create shorter, closed-loop materials and energy cycles that minimize pollution and waste, extend product life cycles, and enable the broad sharing of natural assets. ISO has published two circular economy standards: ISO 59004:2024 Circular economy – Vocabulary, principles and guidance for implementation and ISO 59010 Circular economy – Measuring and assessing circularity performance, which are general standards that can also apply to renewables.

In the UK, BS 8001, the world's first standard for implementing circular economy principles, was developed in 2017. It provides guidelines for organizations to transition to circular models of operation, covering six key principles: systems thinking, innovation, stewardship, collaboration, value optimization, and transparency.

For wind energy, IEC-TC88 focuses on the prevention and reuse elements of the circular economy, with an emphasis on the life extension, decommissioning, and recycling of wind turbines. Technical specifications such as IEC-TS 61400-28-2 guide through-life management and recycling of wind turbines, aiming to maximize their operational life and recyclability. There are also national standards such as the German DIN SPEC 4866 on sustainable dismantling, disassembly, recycling and recovery.

Regarding batteries, the BSI Faraday Battery Challenge, launched in 2019, aimed to advance the production, use, and recycling of batteries in the UK. It involved extensive collaboration with industry stakeholders to identify gaps and needs in battery manufacturing standards. Emerging areas of focus include performance and abuse testing to ensure durability and life extension, as well as recyclability and the safe repurposing of batteries. Standards for batteries are in preparation, such as the PAS 7060, 7061 and 7062 on vehicle design, battery cells and pack and modules, plus a roadmap for recyclability, second life and circularity.

Nicola concluded by encouraging participants to leverage standards for circularity by using them to achieve net-zero goals, contributing to the development process through public comments, and co-creating innovative solutions by engaging with BSI committees. She highlighted the significant role of SMEs as innovators in achieving energy security, sustainability, and affordability through standards development.

The final part of the webinar on "Recycling vs. Durability in Circular Renewables" included a Q&A session where various important issues were discussed. The session began with a question addressing the challenge of aligning competitors and managing product demand within a circular economy. Deborah Andrews acknowledged the complexities and highlighted the need for behavioural change and alternative business models such as leasing. She also emphasized the potential benefits of public investment in renewable projects to foster greater engagement and ownership.

Nicola Young discussed the importance of developing and implementing appropriate standards for recyclability and durability. She noted that overly stringent or outdated regulations could hinder industry best practices and innovation. She emphasized the need for timely feedback from stakeholders to ensure standards evolve alongside technological advancements. She also stressed the significance of international cooperation through bodies like ISO and IEC to address diverse environmental and contextual needs.

Matt Burnell highlighted the challenges of incorporating solar panels into the Waste Electrical and Electronic Equipment (WEEE) regulations, contrasting this with the different regulatory approaches for wind turbines and other renewables. He underscored the urgency of updating regulations to reflect current realities and ensure enforcement to maintain a level playing field in the industry. He pointed out the issue of illegal PV exports and the need for stricter enforcement to support legitimate businesses.

The session concluded with acknowledgments from the speakers and the moderator, expressing gratitude for the engaging discussions and active participation from the audience. The next session was announced to focus on recycling, promising further insightful dialogue. The speakers and attendees thanked each other, marking the end of an informative and thought-provoking hour on circular renewables.

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.