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Reinventing Textile Circularity: Scalable Water-Energy Solutions for a Climate-Resilient Industry

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ABSTRACT

The global textile and fashion industry is one of the largest consumers of water and a major contributor to industrial wastewater pollution, placing increasing pressure on already stressed water resources—particularly in manufacturing hubs across South Asia. In countries such as Pakistan, where the textile sector contributes nearly 8–9% to GDP and employs over 15 million people, unsustainable water use, untreated effluent discharge, and rising climate vulnerability are accelerating the risk of "water bankruptcy"—a condition where demand, depletion, and pollution exceed sustainable supply.

This talk presents key outcomes from the FCDO-funded SMEP programme "SAFECONOMY: Reinventing the Textile Circular Economy", led by Northumbria University in collaboration with international academic, industrial, and policy partners. The project demonstrates a transformative, lab-to-industry approach to enabling circular water systems within textile manufacturing, combining advanced treatment technologies, system integration, and real-world validation at industrial scale.

At the core of this work is the development and deployment of an innovative Molecular Distortion Technology (MDT)-based wastewater treatment system, designed to address highly complex textile effluents containing dyes, chemicals, and micro-pollutants. Pilot implementation at Sapphire Finishing Mills (Pakistan) has demonstrated >95% pollutant removal efficiency, enabling compliance with stringent discharge standards and supporting water reuse within industrial processes. Importantly, the system is engineered for reduced energy consumption and operational simplicity, making it suitable for adoption in resource-constrained environments.

Beyond technology, the project adopts a whole-systems circular economy approach, integrating water reuse, energy efficiency, and industrial symbiosis. The initiative has delivered over 15 peer-reviewed publications, multiple international conference engagements, capacity-building workshops, and direct industry training—supporting both knowledge transfer and workforce development. It has also contributed to global policy dialogue, including recognition within a UN Water stakeholder consultation framework, highlighting its relevance to Sustainable Development Goals (SDGs), particularly SDG 6 (Clean Water), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).

A key innovation of SAFECONOMY lies in its scalability and replicability. The project establishes a blueprint for transitioning textile industries from linear to circular water systems, with strong potential for deployment across Bangladesh, India, and other major textile-producing regions facing similar environmental challenges. The approach also incorporates Gender Equality and Social Inclusion (GESI) principles, ensuring that benefits extend to vulnerable communities, particularly women who represent a significant portion of the textile workforce.

Looking ahead, the project is focused on scaling up deployment, advancing commercialisation pathways, and developing sustainable financing and policy mechanisms to accelerate adoption. This includes engagement with global brands, regulators, and investors to drive systemic change across the textile value chain.

Overall, this work demonstrates how innovative engineering, interdisciplinary collaboration, and industry partnerships can deliver tangible, scalable solutions to one of the most pressing water-energy challenges of our time—paving the way toward a resilient, circular, and net-zero textile industry.