CICAT2025

How technologies can catalyze Circular Economy (CE)

CE technologies as research dilemma

Technologies have been widely acknowledged as a critical catalyst in enabling circular economy and circularity in different industries and society. However, the existing research on technology catalysts for CE is, by large, based on conceptual and review studies, leading to a lack of understanding of how diverse technologies can be implemented in different sectors for better adherence to CE principles. This poster summarizes the results of multiple case studies on CE technologies including Northern Europe-based companies from textile, construction, forest, and machinery industries as well as municipal organizations collaborating closely with private sector actors in CE-areas.

Technological catalysts for CE

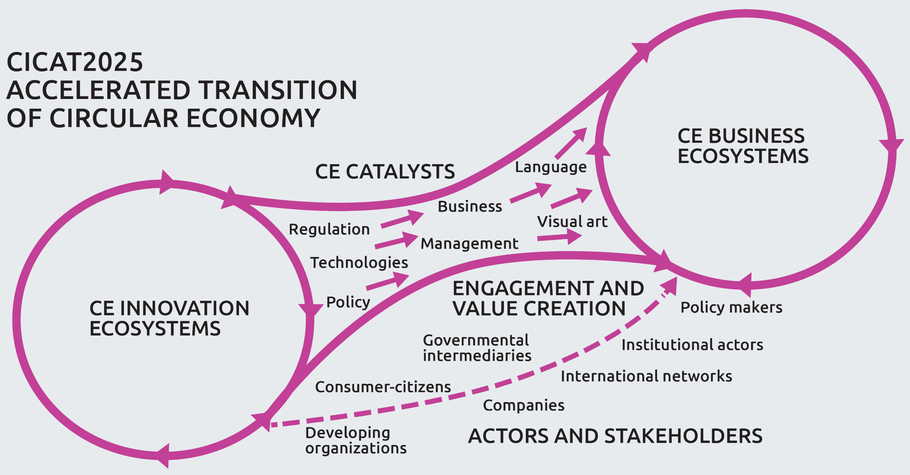
Technologies can contribute to CE by enhancing, reusing, and recycling materials as well as reducing their needed amounts. In the table below, based on our case observations, we report how different technologies can help organizations and CE areas to achieve these CE principles. The table includes both digital and processing technologies. Digital technologies include technologies for data collecting, integrating, and analysis. These technologies mainly catalyze CE with more indirect means by enhancing the organizational processes around materials and products. Processing technologies on the other hand are more directly linked to the refinement of material properties affecting directly the potential use of material.

	Technology type	Example technologies	Catalyzing effects to reduce, reuse, and recycle
Digital technologies in CE business (forestry, oil refinery, waste and water management, construction, consumer textiles)	Data collecting	RFID, IoT, Digital Twins, Material passports, Sensors	Improving material flows by optimizing supply chains and tracking products to improve efficiency in maintenance services; Locating products and their quality to enable their exploitation; Maintaining the quality of materials and facilitating their reuse; Facilitating recycling processes and the use of material for new products; Identifying products and materials, which enables material recirculation and closed loops.
	Data integration	Cloud computing, ERP systems, Digital platforms and marketplaces, 3D-printing, Robotic manufacturing	Facilitates product-service systems enabling remanufacturing. Lowers resource need by shifting from selling products to providing products as services; Facilitating circulation of existing materials; Enhancing manufacturing processes.
	Data analysis	Big data, AI, BIM	Enables efficient use of non-renewable materials; Marking cost-effective and sustainable decisions.
Processing technologies (urban nutrient recycling, circulation of consumer textiles)	Material collection, Processing, Distribution (nutrients)	Source-separating toilets, Biogas process, Dewatering, Ammonium stripping, Fertilizer spreading	Concentrating nutrients in a safe manner by reducing volumes of nutrient-rich streams and removing contaminants, while simultaneously converting carbon to enregy and stabilising waste streams; Enables local production of energy and fertilisers, while decreases the use of virgin nutrients.
	Material processing (textiles)	Mechanical recycling, Chemical recycling, Thermal recycling	Enables converting textiles back into fibres (e.g. opening non-reusable textile products into fibrous form mechanically and recycling cellulose-based fibres further chemically), reducing need for virgin fibre production.

Not only the technologies matter

While the poster focuses on individual technologies, we want to emphasize the need to bring the technologies together to form a functioning entity. For example, covering the whole value chain, from collection to safe use, requires a combination of different kinds of technologies, both digital and processing technologies. Furthermore, creating and implementing novel technological solutions requires both individuals and organizations to adopt new operational models, processes, and attitudes.

The poster is supported by CICAT2025 that explores a wide range of circular economy catalysts that have the potential to accelerate the adoption of circular economy principles in society and markets. In addition to technologies, other important catalysts include institutional, business and social factors as well as regulation.



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