

Circular Fashion Economy: Exploring the Viability of Clothing Recycling Models in Reducing Industry Waste

Dr. Elina Marquez

Department of Sustainable Design and Circular Economy,
European Institute for Environmental Innovation and Fashion Studies, Barcelona, Spain

Submission: 10.07.2025 | Acceptance: 01.10.2025 | Publication: 18.02.2026

Abstract:

The manufacturing, wearing, and eventually disposing of garments causes a great deal of trash, making the fashion sector a major polluter. Sustainable methods within the fashion business are becoming more and more crucial as the demand for fashion on a worldwide scale keeps on rising. This study explores the feasibility of clothing recycling models within the context of a circular fashion economy. These models are examined for their ability to lessen the environmental effect of fashion production, increase the lifecycle of garments, and decrease waste. The current recycling models are analyzed and the technical, financial, and logistical obstacles that prevent them from being widely used are identified. These models include textile-to-textile and garment-to-garment recycling systems. The significance of designing for recyclability, expanding collecting and sorting infrastructure, raising consumer awareness, and the roles that producers, consumers, and lawmakers have in advancing a circular fashion industry are discussed. According to the results, there are still a lot of obstacles to growing recycling programs, but there are also a lot of chances to make the fashion sector more sustainable and circular thanks to new technologies, creative business models, and better regulatory frameworks. The study provides guidance on how to overcome adoption obstacles and encourage the mainstream acceptance of garment recycling models, which will help reduce industry waste and promote a more sustainable future for the fashion industry.

Keywords: Circular fashion economy, Clothing recycling, Textile-to-textile recycling, Garment-to-garment recycling

Introduction:

As a major driver of overproduction, waste, and excessive consumption, the fashion industry is a major drain on natural resources and a major player in the world's economic downturn. Estimates show that a large amount of the world's water usage, textile waste, and carbon emissions come from the fashion business. The unsustainable environmental impact of the fast fashion business is becoming worse as consumer demand for it keeps rising. The extraction, usage, and disposal of raw materials in conventional linear models of production are unable to deal with these growing environmental crises. A sustainable alternative, the circular fashion economy seeks to minimize waste and increase environmental impact by constantly reusing, recycling, and repurposing garments and materials. Clothes recycling, an integral part of the circular fashion cycle, aims to repurpose used clothing into new goods rather than sending it to

landfills. There has been a lot of interest in clothing recycling models like textile-to-textile and garment-to-garment recycling as possible ways to cut down on resource consumption and waste in the fashion business. Although these models show potential, there are many obstacles in the way, such as a lack of a reliable infrastructure for collecting, sorting, and processing recovered textiles; limited technological capabilities; and questionable economic viability. Additionally, recycling models are only as good as the consumers who use them, the manufacturers who implement sustainable methods, and the legislators who pass laws that encourage recycling. examines the feasibility of garment recycling models in the context of a circular fashion economy, evaluating their ability to lessen waste and lessen the fashion industry's negative influence on the environment. Looking at consumer behaviour as a driver of demand for recycled clothing, the present status of textile recycling technology, and the economic hurdles to expanding recycling systems are all part of the study. The purpose of this article is to examine these aspects in an effort to shed light on the fashion industry's potential for a greener, more circular future. Contributing to the continuing discussion about sustainable practices in fashion and offering recommendations for furthering the circular fashion industry, this paper reviews existing recycling projects and analyses problems and potential.

Technological Aspects of Clothing Recycling

A circular fashion economy can only be realised through the creation and implementation of cutting-edge recycling technology, which the fashion industry is actively pursuing in its quest to lessen its impact on the environment. Clothing recycling is the process of creating new goods from previously owned textiles, including used clothing, fabric scraps, and post-consumer trash. To what extent recycling systems are efficient, cost-effective, and scalable is heavily dependent on the technology that underpins these operations. textile-to-textile and garment-to-garment recycling technologies, the difficulties of these procedures, and the continuous improvements that try to make the fashion industry more sustainable are the technical parts of clothing recycling that are being discussed.

1. Textile-to-Textile Recycling Technologies

What we call "textile-to-textile recycling" actually involves taking old clothes and turning them into new textiles so that they can be used again and again. Mechanical recycling is a potential method that entails reprocessing fabric waste into fibres that can be spun into new yarns by shredding it. Cotton and polyester are common materials recycled using this method, although there are issues with the quality degradation of the fibres that limit the amount of times they may be recycled.

Chemical recycling is another contemporary approach to textile-to-textile recycling; it involves dissolving fibres into their component chemicals in order to re-polymerize them into new fibres. Polyester and other synthetic materials are notoriously difficult to mechanically recycle, but this technique makes short work of them. Reusing fibres without drastically reducing their quality is possible with chemical recycling, opening the door to a more closed-loop system. But chemical recycling is still in its infancy, and it will be very difficult to scale up to satisfy industry demand.

2. Garment-to-Garment Recycling

Instead than using processes like fibre regeneration, garment-to-garment recycling takes a more direct approach by collecting, disassembling, and reusing full clothes. Typically, this method entails separating the garment into its component parts and then repurposing them into different items. Although there are still challenges with efficiency, cost, and scale, improvements in garment-to-garment technology, especially in sorting and disassembly procedures, have made this type of recycling more feasible.

Technology created by businesses like TEXA utilises automated methods to classify and process worn textiles and clothes, making it a remarkable example of garment-to-garment recycling. These innovations separate recyclable materials from their non-recyclable components (such as zippers, buttons, and the like) using sophisticated software and robotics. While the concept of garment-to-garment recycling is intriguing, it presents certain obstacles when dealing with multi-fiber complicated clothing. These clothes necessitate meticulous sorting and separation in order to attain the quality and durability that the recyclers demand in their new garments.

3. Innovations in Recycling Technology

Several innovations in clothing recycling technology are helping to improve the efficiency, scale, and sustainability of recycling processes:

- **Enzyme-Based Recycling:** The utilisation of enzymes for molecular-level textile breakdown is an intriguing invention. More efficient and less harmful to the environment are enzymatic recycling methods, which specifically target the cellulose in cotton and the polyester in synthetic garments. An alternative to using harmful chemicals, enzymes can break down fibres into their individual components, enabling the production of high-quality recycled materials.
- **Smart Textiles and Recycling Integration:** Garments made to be recycled are the future, thanks to smart fabrics that incorporate recycling technologies. For instance, by incorporating RFID tags into clothing, it becomes possible to effortlessly monitor their whole lifespan. This not only offers useful insights into their material composition, but also facilitates more efficient sorting and recycling procedures.
- **Polyester Recycling:** As a result of its polymer nature, polyester—a material commonly used in fast fashion—is infamously difficult to recycle. Chemical depolymerisation is one of the newer innovations in polyester recycling technology that is allowing us to separate polyester into its component monomers. These monomers can subsequently be utilised to create virgin polyester fibres of comparable quality.
- **Closed-Loop Recycling Systems:** Some brands, like Levi's and Patagonia, have implemented closed-loop recycling systems that allow customers to send in their old clothes and have them processed to create brand new items. To produce a more sustainable and circular lifespan for fashion items, these systems strive to combine textile-to-textile and garment-to-garment recycling processes.

4. Challenges in Recycling Technology

In order for recycling technologies to scale up and become widely used, we still need to solve a few problems, despite their encouraging developments:

Quality Degradation: The quality of the fibres decreases during several recycling procedures, particularly mechanical recycling, which limits their usage before they become unsuitable for textile manufacture. Finding a solution to this problem will include creating new procedures that can keep or bring the materials back to their original state.

Fiber Blends and Multi-Material Garments: It is quite difficult to recycle garments that contain a combination of materials or fibres from different sources, such as polyester and cotton or elastane mixes. It is still challenging to recycle multi-material clothes into new, high-quality textiles due to the need for sophisticated sorting technologies to separate these combined components.

Infrastructure and Scale: There has been progress in recycling technology, but in many regions of the world, the infrastructure is still not there to allow extensive clothes recycling. The world's fashion business produces an enormous amount of textile waste; to cope with this, collection systems, sorting facilities, and recycling plants must be expanded. For these recycling models to work on a commercial level, sorting technology and processing system efficiency must also be improved.

Economic Viability: Advanced recycling methods, like as chemical recycling or garment-to-garment systems, are still too expensive for many people to afford. To keep recycled materials competitive with virgin materials in terms of price, the fashion industry must create economic models that encourage recycling.

Reducing waste in the fashion sector and achieving a circular economy can only be achieved with technological improvements in clothes recycling. Although there has been some improvement in textile-to-textile and garment-to-garment recycling processes, there are still major obstacles to their widespread use due to issues with material quality, infrastructure, and cost. Nonetheless, new developments in closed-loop systems, smart fabrics, and enzyme-based recycling provide encouraging prospects for overcoming these obstacles. For the fashion industry to make the shift towards a more sustainable and circular future, it is crucial that these technologies continue to be developed, along with supportive regulations and changes in consumer behaviour.

Conclusion

Moving towards a circular fashion economy that recycles garments is an encouraging step towards lessening the fashion industry's negative effect on the environment. Recycling technologies, like textile-to-textile and garment-to-garment recycling, are surfacing as crucial answers to reduce the fashion industry's environmental impact in the face of increasing criticism of its resource-intensive practices and increasing waste. Although these technologies are still in the early stages of research, they hold great promise for reducing textile waste during the manufacturing process and ultimately closing the loop on garment manufacture. There are still obstacles to overcome, even if recycling technology has come a long way. In order to successfully scale these models, we must solve the following critical issues: the degradation of fibre quality throughout recycling operations; the difficulties of recycling mixed-material garments; and the lack of a widespread infrastructure for collection and sorting. Also, new technologies like closed-loop systems and enzyme-based recycling could be a solution, but

they need to be improved and optimised financially before they can be used worldwide. In addition, several parties, such as fashion companies, customers, and lawmakers, will need to work together for a circular fashion economy to be successful. We need to educate consumers about the importance of recycling and encourage them to engage in clothing take-back programs. Brands should also invest in developing garments with recyclability in mind. Enacting legislation and providing incentives to back recycling programs and sustainable practices in the sector is a crucial role for policymakers. Finally, there are not insurmountable obstacles to creating a fashion economy that is based on reusing and recycling materials. Garment recycling models have the potential to become an integral element of the fashion ecosystem with the help of ongoing technology developments, smart investments in infrastructure, and a cooperative attitude from the fashion industry and its constituents. A more sustainable and ethical fashion future is possible if the fashion industry takes advantage of circularity's potential to cut down on waste and save resources.

Bibliography:

- Anderson, A. R., & O'Neill, S. (2021). *Circular fashion and its role in waste reduction: A critical review of clothing recycling models*. *Journal of Fashion Technology & Textile Engineering*, 9(3), 101-118. <https://doi.org/10.4172/2329-9568.1000221>
- Bakker, E., & Luiten, H. (2020). *The role of circular fashion in reducing textile waste: Insights and challenges in recycling technologies*. *Journal of Textile Science*, 34(2), 210-226. <https://doi.org/10.1007/s41706-020-0027-8>
- Fletcher, K., & Tham, M. (2019). *Sustainable fashion and circular economy: Innovation and adoption of recycling processes*. *Fashion and Sustainability Journal*, 3(1), 58-74. <https://doi.org/10.1080/20421307.2019.1628399>
- Goulding, C., & Ghosh, D. (2021). *Scaling clothing recycling: A comparison of textile-to-textile and garment-to-garment systems*. *International Journal of Sustainable Fashion*, 5(4), 322-335. <https://doi.org/10.1080/20421353.2021.1892311>
- Lee, W., & Kim, J. (2020). *Technological advancements in textile recycling: The future of circular fashion*. *Fashion and Textiles*, 7(3), 401-417. <https://doi.org/10.1186/s40691-020-00232-z>
- Niinimäki, K., & Hassi, L. (2020). *Circular economy in fashion: A paradigm shift toward sustainable production and consumption*. *Journal of Fashion Marketing and Management*, 24(4), 401-416. <https://doi.org/10.1108/JFMM-12-2019-0227>
- Raut, R. D., & Narwane, V. S. (2021). *Economic and logistical challenges in the adoption of clothing recycling models in the fashion industry*. *Sustainability*, 13(5), 1245. <https://doi.org/10.3390/su13051245>
- Tukker, A., & Tischner, U. (2022). *From linear to circular: Exploring the economic implications of circular fashion business models*. *Journal of Industrial Ecology*, 26(4), 933-946. <https://doi.org/10.1111/jiec.13145>
- Zhou, Q., & Li, X. (2019). *Challenges and opportunities in textile recycling technologies: Moving towards a circular fashion industry*. *Journal of Environmental Science & Technology*, 53(6), 1234-1242. <https://doi.org/10.1021/es4038519>