

## Turning Textile Waste into Wealth: The Untapped Potential of Recycling

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### SUMMARY

The global fashion industry produces a staggering amount of waste every year. According to recent studies, over 92 million tons of textile waste are generated annually, much of which ends up in landfills. This growing environmental challenge calls for innovative solutions, and textile recycling is emerging as a powerful way to address it. Transforming discarded fabrics into valuable resources not only reduces waste but also conserves natural resources, cuts greenhouse gas emissions, and fosters sustainable economic growth.

### INTRODUCTION

The Growing Problem of Textile Waste is a complex issue, encompassing not only discarded clothing but also production scraps and various fabric-based materials like upholstery and home textiles. The following key statistics shed light on the severity of the problem:

- **Landfill Overflow:** A large amount of textile waste is disposed of in landfills, where it can take decades to break down, releasing harmful methane gas as it decomposes. This not only harms the environment but also accelerates climate change, highlighting the urgent need for effective textile waste management on a global scale.
- **Fast Fashion:** The growth of fast fashion has significantly increased both the production and disposal of clothing, with many items being discarded after only brief use. Since 1996, clothing purchases per person in the EU have risen by 40% due to a sharp decrease in prices, resulting in shorter lifecycles for textiles. On average, each person in the EU consumes nearly 26 kg of textile products annually, yet discards about 11 kg, with 87% of this waste ending up in landfills. This underscores the urgent need to address consumer behaviour and industrial waste in textile management.
- **Resource Depletion:** The production of textiles demands vast amounts of water, energy, and raw materials. For example, creating a single cotton T-shirt can consume up to 2,700 litres of water-equivalent to one person's drinking water needs for 2.5 years. This overconsumption of resources places significant pressure on natural supplies, particularly in areas facing water scarcity.

To address these challenges, it is essential to fundamentally change how textile waste is perceived and managed. Recycling offers a promising solution to facilitate this shift.

### Textile Recycling:

Textile recycling refers to the process of reclaiming old or discarded fabrics and clothing to produce new products or raw materials. The process can be divided into two main categories:



Textile Recycling

- **Mechanical Recycling:** In this method, involves shredding textiles into fibres, which are then spun into yarn or repurposed for insulation, padding, and other industrial uses. This method works well for natural fibres such as cotton and wool, though it can lead to lower-quality fibres because the fibres are shortened during the process.
- **Chemical Recycling:** It uses advanced technologies to decompose textiles into their fundamental chemical components, which can then be used to produce new fibres with properties akin to virgin materials. This method is especially effective for synthetic fabrics like polyester and nylon, as it helps preserve the quality of the original material.

Recycling textiles is a complicated process. The fibres are often too short to be reused, and many garments are made from a mix of materials that are challenging to separate. Each material needs a unique recycling method, and when combined, this creates difficulties. For example, recycling polyester differs from recycling cotton, and separating them in blended fabrics is almost impossible. Additionally, recycling can be costly and at times, detrimental to the environment. Mechanical recycling, which involves breaking down materials by fraying and spinning fibres, can weaken them, reducing their usability. Chemical recycling, which relies on solvents, can pose risks to both human health and the environment. These obstacles make large-scale textile recycling a challenging difficult. Both methods play a key role in supporting a circular economy by prolonging the life cycle of textiles and decreasing the reliance on virgin resources. Moreover, ongoing innovations in these processes are enhancing their efficiency and scalability, positioning textile recycling as a sustainable solution for the future.

### Benefits of Textile Recycling:

Recycling textiles has numerous environmental, economic, and social benefits. Here are some of the most significant ones:

#### 1. Environmental Impact

- **Waste Reduction:** Diverting textiles from landfills helps reduce pollution and conserve landfill space. This is especially important as landfills around the world are nearing capacity, and textile waste frequently contains dyes and chemicals that can seep into soil and water.
- **Resource Conservation:** Recycling helps lower the demand for raw materials such as cotton and synthetic fibres, which in turn conserves water, energy, and fossil fuels.<sup>3</sup> For example, recycling polyester can save up to 70% of the energy needed to produce new polyester.
- **Carbon Footprint:** Recycling reduces greenhouse gas emissions linked to textile production and waste decomposition by reusing existing materials. Research has demonstrated that recycling one ton of textiles can prevent up to 25 tons of CO<sub>2</sub> emissions.<sup>4</sup>

#### 2. Economic Opportunities

- **Job Creation:** The textile recycling sector generates employment opportunities in areas such as collection, sorting, processing, and product development. These jobs not only support local economies but also foster the growth of green industries.
- **Cost Savings:** By using recycled materials in their production processes, manufacturers can reduce costs. This lowers reliance on expensive virgin resources and helps stabilize supply chains.
- **Market Expansion:** Recycling creates new opportunities for eco-friendly products, appealing to an expanding group of environmentally conscious consumers. Companies that adopt recycling practices can improve their brand image and strengthen their competitive advantage.

#### 3. Social Benefits

- **Community Engagement:** Recycling initiatives frequently involve local communities, raising awareness and encouraging participation. Programs driven by the community can empower individuals to take responsibility for their waste and embrace sustainable practices.
- **Donation Programmes:** A significant amount of textiles are donated to charities, offering affordable clothing to those in need. This not only prolongs the life of garments but also benefits underprivileged communities.

### The Textile Recycling Process

The recycling process starts with the collection of discarded textiles. Here's an overview of the key steps involved:

- **Collection:** Textiles are collected through donation bins, retail take-back programs, and municipal waste systems. Effective collection systems are crucial to ensure textiles are diverted from landfills and sent to recycling facilities.

- **Sorting:** Collected textiles are categorized according to their material type, quality, and condition. Wearable items are typically set aside for resale or donation. Advanced sorting technologies, like optical scanners, can accurately identify materials, making the process more efficient.

- **Processing:** Non-wearable textiles are shredded, chemically treated, or processed in other ways to extract usable fibres or raw materials. For instance, cotton can be transformed into cleaning cloths, while polyester can be repurposed into new fibres for clothing or industrial applications.

- **Production:** Recovered materials are converted into new products like yarn, fabric, insulation, or even construction materials. These products are then reintroduced to the market, closing the recycling loop.

North America leads the textile recycling market, fueled by stringent regulatory frameworks, high consumer awareness, and significant investments in recycling technologies. Both the United States and Canada enforce strong environmental protection laws and introduce government policies that promote sustainable practices within the textile industry.

## Challenges in Textile Recycling

Despite its many benefits, textile recycling faces several hurdles:

### 1. Material Complexity

Many garments are crafted from blended fabrics that are challenging to separate and recycle efficiently. For instance, a shirt composed of 60% cotton and 40% polyester presents considerable difficulties for recycling technologies. Furthermore, fabrics treated with dyes, coatings, or finishes often need extra processing, which raises costs.

### 2. Lack of Infrastructure

Recycling facilities are often scarce and have limited capacity, particularly in developing regions. Without proper infrastructure, large-scale recycling is not feasible. Expanding recycling networks and investing in advanced facilities are essential to overcoming this challenge.

### 3. Consumer Awareness

Many people lack knowledge about how to recycle textiles or why it matters. Enhancing public education and encouraging participation are key to fostering change. Campaigns, school programs, and collaborations with retailers can help address this issue.

### 4. Economic Viability

Recycling textiles can be more costly than producing new materials. Technological innovations and government incentives are necessary to make recycling more affordable. Partnerships between the private sector and policymakers can be crucial in making this possible.

## Innovations and Future Potential

The future of textile recycling looks promising, thanks to emerging technologies and innovative business models:

### 1. Smart Sorting Systems

Cutting-edge sorting technologies that utilize AI and robotics can enhance both efficiency and accuracy in identifying and processing textiles. These systems can distinguish between different fibre types, colours, and even identify contaminants, minimizing manual labour and improving the quality of the output.

### 2. Chemical Recycling Advances

Innovative chemical processes are being introduced to process blended fabrics, simplifying the recycling of complex materials. For example, enzymatic treatments can selectively break down specific fibres while preserving others, leading to higher recovery rates.

### 3. Circular Fashion Initiatives

More brands are embracing circular fashion models, designing garments with recycling in mind. Some companies provide take-back programs to ensure their products are responsibly recycled. These initiatives help reduce waste and foster stronger customer loyalty.

### 4. Legislation and Incentives

Governments worldwide are introducing policies to promote textile recycling, such as Extended Producer Responsibility (EPR) schemes and tax incentives for eco-friendly practices. These measures encourage manufacturers to prioritise sustainability and invest in recycling infrastructure.

In January 2024, BASF and Inditex<sup>5</sup> announced a major advancement in promoting recyclability within the textile industry. These companies introduced loopamid, a polyamide 6<sup>6</sup> (PA6, or nylon 6) made entirely from

textile waste. BASF's innovation offers the first circular solution for nylon apparel made from 100 per cent textile waste.

Zara has created a jacket entirely from loopamid, which is now available worldwide. Following a 'design for recycling' approach, the jacket's components—such as the fabrics, filling, buttons, zippers, and hook-and-loop fasteners—are all made from loopamid.

### Businesses Contribution:

The global textile recycling market was valued at \$5.3 billion in 2023<sup>7</sup>. According to IMARC Group, leading textile recycling companies are prioritising research and development to meet the growing demand for recycled textiles, driven by environmental concerns, raw material shortages, and the rising greenhouse gas emissions associated with textile production.

The global textile recycling market is home to several key players, including Anandi Enterprises, Boer Group Recycling Solutions, American Textile Recycling, Infinited Fibre Company, I: Collect, and Patagonia.

Businesses have a pivotal role to play in advancing textile recycling and fostering a circular economy.

### Here are some impactful ways they can contribute:

- Adopt Sustainable Practices: Companies can focus on using recycled materials in their products and reduce waste in the production process. This not only lessens environmental impact but also sets a positive example for others in the industry.
- Implement Take-Back Programs: Retailers can introduce clothing take-back initiatives to motivate customers to recycle their old garments. These programs help keep textiles out of landfills and provide a consistent supply of materials for recycling.
- Work with Recycling Facilities: Collaborating with textile recycling organizations can enhance the efficiency of waste collection and processing. Companies can also contribute to research and development efforts to advance recycling technologies.
- Educate Consumers: Brands can leverage their platforms to educate consumers about the importance of recycling and offer clear guidance on how they can get involved. This helps build a sense of shared responsibility and enhances brand loyalty.
- Support Innovation: Companies can invest in or create innovative solutions to recycle complex fabrics and improve the efficiency of recycling processes. Such investments not only benefit the industry but also bolster a company's reputation as a leader in sustainability.
- Comply with Regulations: Companies should align with government policies and industry standards regarding textile recycling. Compliance reflects a commitment to environmental responsibility and can create opportunities for incentives and partnerships.

By taking these steps, businesses can lead the way in creating a sustainable future for the textile industry.

### CONCLUSION:

Textile recycling is a powerful tool for turning waste into valuable resources. By overcoming challenges and harnessing the full potential of this process, the environmental impact of the fashion industry can be significantly reduced, while also generating economic and social benefits. The future of textile waste management will rely heavily on digitisation, which can streamline the collection, sorting, and recycling processes. Digitisation is expected to play a crucial role in guiding used products towards recycling and encouraging manufacturers to gather and utilize product data. However, the digitisation of textile waste management and fibre recycling technologies are still in the research phase and have not yet been widely implemented. The journey from waste to value requires the collective efforts of individuals, corporations, and governments. Together, these stakeholders can unlock the full potential of textile recycling, paving the way for a more sustainable future.

### REFERENCES:

- <https://theroundup.org/textile-waste-statistics/>
- <https://www.eea.europa.eu/en/analysis/publications/textiles-in-europes-circular-economy>
- <https://www.wragwrap.com/recycled-polyester/>
- <https://phys.org/news/2022-09-reusing-kg-co2.html>
- <https://www.basf.com/global/en/media/news-releases/2024/01/p-24-109>
- <https://www.loopamid.com/global/en/technology>