

## Circular textile value chains

### Business case:

# Developing a local specialized recycling value chain for valorizing higher and lower quality denim cutting waste

## The challenge

Textile waste presents a significant challenge within the jeans industry, particularly in the denim production. Denim, a widely used fabric, is projected to yield approximately 4.5 billion linear meters in 2023, catering to a market demand for 3.3 billion pairs of denim jeans (Source: Statista, Denim Market Worldwide, 2023). However, this production volume also generates a substantial amount of post-industrial textile waste. In Tunisia alone, over 31,000 tons of textile waste are generated annually from the textile and garment industry, with more than 50% originating as cutting scraps from ready-made garment-making companies.<sup>1</sup>

Recycling textile waste is not always a feasible option due to the potential damage to the material during the tearing process. This often results in short fibers that are unsuitable for spinning. Moreover, the colour of fabrics has an impact on the potential recyclability application of the fibers. Denim fabrics are primarily dyed with indigo, with other colors used less frequently, which makes this material particularly suitable to recycle within the fashion industry.

The recyclability of denim waste can be categorized into three groups based on composition:

- A. 100% cotton;
- B. 95% or more cotton, usually with minimal elastane fiber content;
- C. Less than 95% cotton, containing different proportions of synthetic fibers.

Waste from categories A and B is generally considered as high-quality waste, while category C is low-quality. Recycling for Fashion-to-Fashion applications, for producing yarns, fabrics and garments, is restricted to higher-quality waste due to stringent technical specifications, with many recyclers exclusively accepting 100% cotton fiber, and also preferably single-colour scraps.

Lower-quality waste and fibers that have degraded or become too short for spinning can still be repurposed through down cycling into non-woven products, without any colour limitations. Lower-quality textile fibers find applications in insulation fiberboards for construction, furniture, automotive industries, mattresses, wadding, and filling, aligning with an industrial symbiosis circular model, which is a collaborative approach among industries where resources, waste, and by-products are exchanged to optimize efficiency, reduce waste, and improve sustainability.

## The scope of the pilot project

Beginning in 2019, the United Nations Industrial Development Organization (UNIDO), under the regional EU-funded SwitchMed Programme, demonstrated how circular economy practices can improve environmental performance and competitive advantage in Tunisia's textile value chain. As part of this initiative, UNIDO initiated in 2022 a pilot project to

demonstrate a business model for valorizing higher quality fractions of pre-consumer textile cutting waste into a closed-loop fashion cycle and the lower quality fractions to other end uses.

The pilot project involved a collaboration with DIESEL, a brand of the international OTB Group with a worldwide sales figure of €1,900 million. The project engaged two of the value chain business partners of the brand, respectively a Tunisian garment manufacturer and an integrated Tunisian company, with spinning, weaving processes that recently invested in a new shredding and tearing line to recycle denim waste. Lastly UNIDO proposed to recover also the lower-quality pre-consumer cutting waste through a third Tunisian company specialized in recycling and production of non-woven products. The objectives of the pilot project were to:

- Improve the textile waste segregation and classification procedures at the premises of the Tunisian garment manufacturer.
- Demonstrate the business case for recycling higher-quality textile waste locally through a fabric buy-back agreement, and calculate the savings in Greenhouse Gas (GHG) Emissions compared to the use of virgin cotton.
- Determine the potential for an industrial symbiosis business model that recycles lower-quality waste into non-wovens for non-fashion end-uses in a fully local value chain.

## Improving the textile waste segregation and classification procedures

A team of international experts conducted an audit to evaluate the textile waste management procedures at the production premises of the Tunisian garment manufacturer. Following the audit, a training session was conducted to educate the staff on the proper ways of segregating, storing, and classifying waste, with an emphasis on separating higher-quality fibers from lower-quality fibers. Finally, a waste management protocol was established to enhance the segregation and classification procedures.

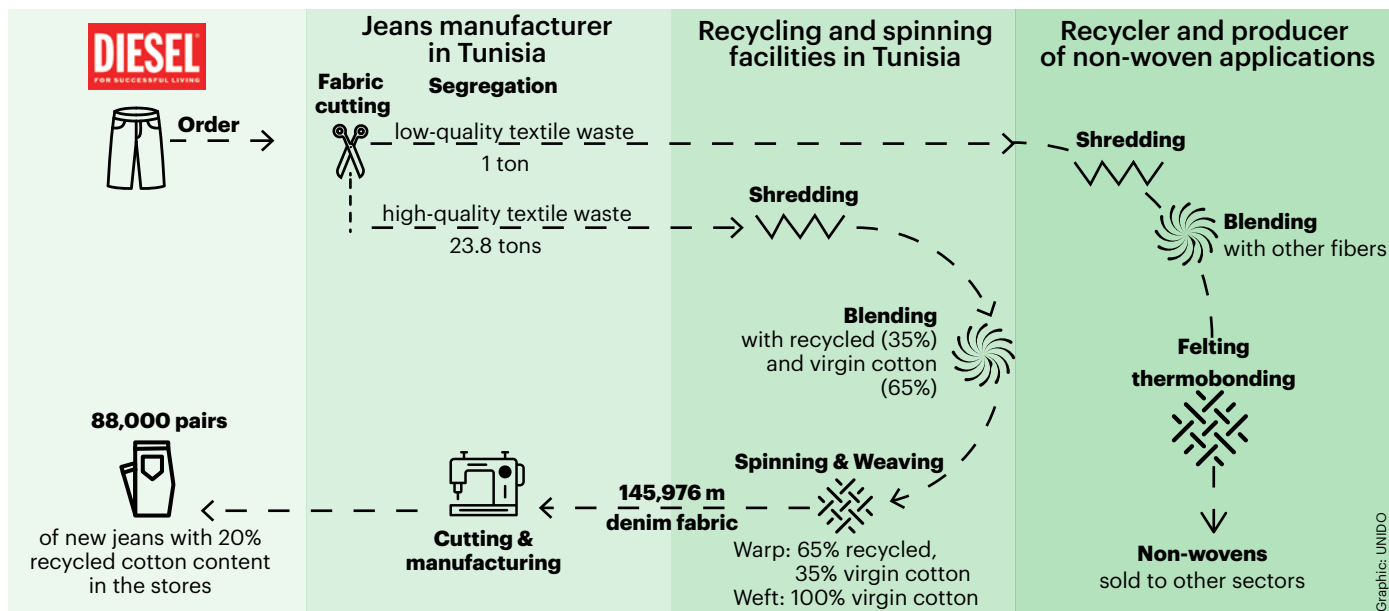
## Demonstrating the business case of higher quality textile waste recycling

International experts provided assistance to Diesel's suppliers in complying with the local legal requirements for transferring the textile waste between the two production facilities in Tunisia<sup>2</sup>. A first batch of 7.5 tons of segregated denim waste was sent for processing to the local integrated recycling, spinning and weaving facility, which reprocessed the waste into 46,000 meters of new denim fabric with at least a 20% ratio of recycled cotton. This denim fabric was used to produce 28,000 pairs of denim jeans that DIESEL launched in its stores during the 2023 Fall/Winter season.

<sup>1</sup> SwitchMed Textile waste mapping in Morocco and Tunisia, Blumine & Reverse Resources, 2020

<sup>2</sup> Following the procedure described in the guide « Comment recycler dans l'industrie textile. Guide pratique aux normes et règlements » published by UNIDO in 2022

## Pilot project in numbers



Following the successful results of this pilot, DIESEL has decided to continue with this initiative located in Tunisia on a regular basis. Until March 2024, two additional batches of respectively 7.6 and 8.7 tons of cutting waste have been recovered for recycling and repurposed back into DIESEL products. By end of 2024, the total waste collected and recycled by DIESEL in the pilot, will generate more than 88,000 pairs of new denim jeans with at least 20% recycled content, showing an increase over the last two seasons compared to the Fall/Winter 2023.

So far, the business model experimented in the pilot has managed to save up to 35.4 tons of CO<sub>2</sub>-eq. by utilizing high-quality recycled textile fibres instead of virgin materials.

For the future DIESEL has set ambitious plans to continue with a circular business model.

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Here at Diesel, we foster creative ways to reuse or recycle products and waste across our value chain and we believe that production scraps should be treated as a resource and a way to create innovation with our own product. A more responsible use of raw materials can be achieved through circular business models throughout the entire supply chain, with the essential involvement of suppliers.

Andrea Rosso  
Diesel Sustainability Ambassador

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## Testing mechanical recycling of lower quality waste

During the pilot, UNIDO has also identified a textile waste recycling company for recycling the low-quality textile waste.

International experts have supported this company to enhance its alignment to international social standards, as well as in the identification of technological upgrade solutions for the existing recycling lines including operational management and improvement of the quality of the non-woven products. An action plan was proposed and accepted by the recycler and currently the company is on track with the implementation of the improvement plan. Additionally, the company participated in a study tour to ITMA exhibition held in Milan, one of the most prominent international fairs for textile technology, and the company is now contemplating an investment for upgrading its recycling unit.

In 2023, a first test batch of 1 ton of low-quality waste was sent to the recycling company. Based on the results from this test there will be a further evaluation of recyclability into non-woven applications for 2024.



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