

# Toward an efficient and competitive circular textile industry

**National Roadmap for minimizing and valorizing  
pre-consumption textile waste**

*Tunisia*

English Edition



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Each implementing organization contributes specialized experience and tools to partner with the eight beneficiary countries on policy development, capacity building, business support services, demonstration activities and networking.

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#### Concept

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The concept of the circular economy is of essential importance for the fashion business today due to its potential to address and mitigate various environmental and sustainability challenges inherent in fashion’s conventional linear model of production and consumption. In this perspective, this document advocate for addressing a compelling case for radically improving recycling in the textile and clothing value chain to allow the industry to capture the value of the materials that get wasted during the transformation process in the supply from the raw materials to the stores.

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## Table of Contents

### CONTEXT

1. Executive summary	5
2. Introduction	9
3. Assessment of the Textile and Clothing Value Chain and pilot Project Interventions	13

### ROADMAP

4. The way ahead	23
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# A. CONTEXT



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# 1. Executive summary

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The concept of the circular economy is of essential importance for the fashion business today due to its potential to address and mitigate various environmental and sustainability challenges inherent in fashion's conventional linear model of production and consumption.

Fashion brands have started to commit to the circular economy model in recent years, adopting various strategies such as developing second-hand and resale platforms, introducing circular design practices, recycling initiatives, and commitments to use recycled materials in their collections. The impact of a brand's circular strategies is reflected all along its supply chain, where suppliers are pressured to source recycled fibre in a market that is not yet prepared to supply the requested volumes.

According to the waste mapping study implemented within the framework of the SwitchMed Project, 31,000 tons per year of pre-consumer textile waste generated by Tunisia's textile and clothing industry. This is a remarkable volume, the majority of which could be channeled into textile-to-textile recycling in the cotton supply chain. On the other hand, waste consisting blends of various fibres – synthetic,

cellulosic, natural, or pure synthetic – needs to find a different end use. For most of it, nonwoven applications will be the primary option.

This document provides a brief on the pre-consumption waste recycling value chain in the textile industry and an assessment of its state-of-the-art in Tunisia followed by a description of the implemented SwitchMed pilot projects aimed at demonstrating the business case for the valorization of pre-consumption textile waste in the country. The core content of the document is the "Way ahead" section, that presents a comprehensive Roadmap of action to support the development of a textile waste valorization value chain in the country. This Roadmap aims to stimulate and guide stakeholder discussion about key steps, objectives, and timelines for developing and implementing a strategic plan for leveraging circular business models to make the Tunisian textile industry more competitive and reduce its environmental impact. It also provides a tentative framework for coordinating actions among various stakeholders involved in industry interest representation, business activities, research and development, and policy development and implementation.

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Three Pilot projects were implemented in Tunisia, engaging the following group of companies: i) Tunisian garment making companies, such as Manifatture Tessili, WIC-MIC group and Denim Authority; ii) a vertically integrated spinner, weaver and recycler the SITEX-SWIFT group; iii) a textile waste recycler for non-woven applications; iv) three international brands sourcing denim garments in Tunisia such as Nudie jeans, OTB/ DIESEL and PVH/Kalvin Klein. In addition, several stakeholders were involved such as the Tunisian textile federation FTTH, The custom authority and the national waste agency (ANGED), besides the two ministries of industry and environment. The three pilots aimed at demonstrating the technical-economical-environmental benefits of implementing closed loop recycling of the high quality pre-consumption textile waste for the fashion market and the lower quality for non-woven applications. In total almost 70 tons of textile waste have been collected and repurposed for placing on the market more than 200,000 pair of new jeans with 20% recycled content.

The pilot projects demonstrated that waste segregation at the source, i.e. right on the textile or ready-made garments (RMG) company's "factory floor," is more efficient and increases the opportunity to generate value from waste. However, textile and RMG companies do not see segregation as part of their business, and it is considered just another additional cost, and so selling the concept of efficient waste segregation and management to these companies can be a challenge. Some form of public support or incentive could help overcome the obstacle.

Besides the fashion and textile industry, which is the core industry involved in the input phase of the recycling value chain and a key player in higher-value recycled fibres for textile-to-textile applications, other industries could also be involved:

- The furniture and bedding industry use lower-value recycled fibres to fill mattresses and other upholstered items of furniture such as sofas, chairs, etc.
- The automotive industry uses lower-value recycled textiles in rigid shapes for sound insulation.

The construction industry is a destination for thermal and acoustic insulation materials that can be produced locally using lower-value recycled textiles, making panels and sheets to be applied to walls and ceilings.

Building upon the findings about the volumes and the type of textile waste generated in Tunisia and based on the experience gained in the implementation of the three pilots, nine objectives and eleven related actions were defined and are reported in chapter 4 of this Roadmap that, if achieved, can foster the development of a circular economy approach for the Tunisian textile industry. The key axes of interventions defined within this roadmap highlight the importance of raising awareness and training of garment makers in waste segregation at source, the adoption of market based incentives to promote investments in new recycling capacity as well as digital and physical infrastructure to create a proper market place for textile waste valorization, the implementation of regulatory reforms especially for facilitating the retainment and valorization within Tunisia of the textile waste generated by the majority of the companies that are exporting, finally engaging brands sourcing in Tunisia to establish partnerships for circular initiatives in the country.







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# 2. Introduction

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## The textile and clothing and circular economy

### *The Circular Economy and the Fashion Industry*

The concept of the circular economy is of essential importance for the fashion business today due to its potential to address and mitigate various environmental and sustainability challenges inherent in fashion's conventional linear model of production and consumption.

The essential nature of the challenge for textiles is due to its position as being the second largest consumer goods sector, after food. The economic and material size of this sector means that it has a significant impact on the environment and on society.

The critical factors affecting the sustainability of the fashion industry are depletion of natural resources, release of GHGs and toxic chemical pollutants, and the enormous amount of waste generated at both the pre-consumption and post-consumption stages.

On the other hand, only too often circularity in fashion is considered in its most simplistic form, merely highlighting the "recycling route."

The concept referred to as the waste hierarchy, embraced by policymakers in many countries and regions, including the EU, has fixed this concept since the issuing of the Waste Framework Directive in the nineties. Indeed, the preferred policy for addressing the issue of waste is Prevention, by reducing the generation of waste, while the second best is Reuse, giving the products a second life before they become waste. Recycling comes third in this hierarchy, just above energy recovery through incineration and disposal, and becomes a priority when waste is

created, and materials cannot be reused without further transformation.

When recycling comes into play, several factors need to be considered, including:

- *Is the reclaimed material safe? Or might it be polluted by hazardous chemicals?*
- *Do the reclaimed materials come from the post-consumption or pre-consumption stages?*
- *Can the material be recycled, and what is the most suitable recycling technology?*
- *What is the best end-use for the recycled materials? Can recycled materials re-enter the textile and fashion businesses, or is using them in industrial symbiosis in other sectors more environmentally and technically sound?*
- *How can textile and fashion products be designed to permit better recycling?*

The answers to these questions will define the features of a circular economy business model.

Fashion brands have started to commit to the circular economy model in recent years, adopting various strategies such as developing second-hand and resale platforms, introducing circular design practices, recycling initiatives, and commitments to use recycled materials in their collections. Polyester, wool, polyamide, and cotton are the most commonly recycled fibres. The impact of a brand's circular strategies is reflected all along its supply chain, where suppliers are pressured to source recycled fibre in a market that is not yet prepared to supply the requested volumes. Recycled fibre market trends. In recent years, the recycled fibre market is

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characterized by robust expansion of demand, driven by the fashion brands' growing appetite for more sustainable materials.

According to the latest Textile Exchange Report, recycled fibre production grew by 26.5% (CAGR 4.8%) from 2017 to 2022, double the growth rate for virgin fibres (+12.7%, CAGR 2.4%).

Notwithstanding this rapid growth, the market share of recycled fibres in the global textile fibre market remains below 10% (7.9% in 2022).

However, the existing production capacity limits the supply of recycled fibre, especially for recycled materials from textile applications. Over 90% of the recycled fibre currently available is polyester from plastic bottles, and less than 1% of the global fibre market is from pre- and post-consumer recycled textiles.

The supply limitations make the available recycled fibres insufficient to meet the brands' and other end users' requests and have raised prices for rPET (recycled polyester) and recycled cotton in recent years. Creating the proper conditions for expanding the global capacity of recycling textile waste is essential to mitigate the resource and energy intensity of the fashion industry.

### *About the SwitchMed II Project*

Launched by the European Union and managed by the United Nations Industrial Development Organization (UNIDO), the SwitchMed Programme has demonstrated the potential for a green and circular economy in Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Palestine, and Tunisia since 2014. SwitchMed scales up the transition towards sustainable consumption and production practices in the Southern Mediterranean region through industry demonstrations, policy development, networking opportunities, and support for start-ups and green entrepreneurs. The project was financed by the European Commission's Directorate-General for Neighbourhood and Enlargement (DNEAR); the Italian Development Cooperation, and the Catalan Waste Agency.

Stimulating the creation of business opportunities that can reduce the inefficient use of resources and the environmental footprint of industrial activities offers a chance for the region to respond to economic, social, and environmental challenges.

Designing out waste, reducing pollution, and keeping products and materials in use for longer are all cornerstones of a circular economy.

*In recent years, the recycled fibre market is characterized by robust expansion of demand, driven by the fashion brands' growing appetite for more sustainable materials.*

These principles also outline the activities of UNIDO in developing resource-efficient and circular industries under the second phase (2019-2023) of the SwitchMed programme. This phase launched an initiative targeting the industrial textile supply chains of Egypt, Morocco, and Tunisia. Collaborating with international brands and expert organizations, UNIDO has engaged national stakeholders in developing circular value chains to valorize post-industrial and pre-consumer textile waste, aiming to guide the textile industries toward adoption of safer chemical protocols.

The SwitchMed initiative for valorization of textile waste in Tunisia aims to demonstrate the potential for recycling pre-consumer textile waste and transfer know-how to develop a local value chain for recycling textile fibers, focusing on two critical components of the circular economy business model:

- The design of new garments aimed at minimizing waste and making garments easily recyclable under the concept of eco-design.
- The valorization of existing waste, primarily generated in manufacturing, also known as post-industrial and pre-consumption waste.

The elimination of hazardous chemicals from the textile supply chain is a prerequisite for safe circular production. Through collaboration with the ZDHC Foundation, UNIDO has enhanced expertise in the safer management of chemicals within the Tunisian textile industry.

The SwitchMed textile initiatives were implemented in two phases: a first phase focusing on understanding the business environment, including a waste mapping survey during 2020, and a second phase implementing three pilot projects involving circular textile business models relevant to the Tunisian context commencing in 2022.

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## *Purpose and Scope of the Roadmap*

This document provides a brief on the pre-consumption waste recycling value chain in the textile industry and an assessment of its state-of-the-art in Tunisia followed by a description of the implemented SwitchMed pilot projects aimed at demonstrating the business case for the valorization of pre-consumption textile waste in the country. (section 3)

The core content of the document is the “Way ahead” section (section 4” that presents a comprehensive Roadmap of action to support the development of a textile waste valorization value chain in the country.

This Roadmap aims to stimulate and guide stakeholder discussion about key steps, objectives, and timelines for developing and implementing a strategic plan for leveraging circular business models to make the Tunisian textile industry more competitive and reduce its environmental impact.

It also provides a tentative framework for coordinating actions among various stakeholders involved in industry interest representation, business activities, research and development, and policy development and implementation.

An equally important role is to enhance transparency by clearly articulating the steps and processes involved in roadmap development.

The document draws from the experience and lessons learned during the implementation of the UNIDO textile circular initiative within the framework of SwitchMed 2 across the textile and apparel value chain between 2019 and 2023.

The Roadmap also incorporates international experience from other projects and policies dealing with the circularity and sustainability of textiles and is meant to complement the policy recommendations and findings from other projects concerning the circular business model for textiles that has been implemented in Tunisia in recent years.



# 3. Assessment of the Textile and Clothing Value Chain and pilot Project Interventions

## The Textile Recycling Value Chain

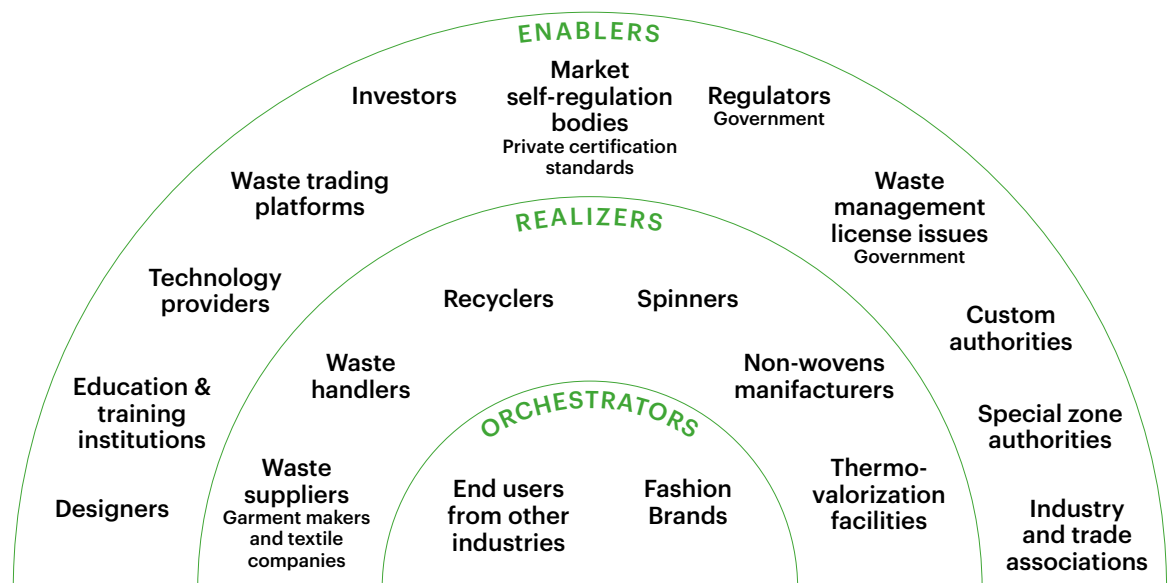
### *Textile waste valorization as an “ecosystem”*

The textile waste valorization ecosystem engages a network of interconnected participants (“stakeholders”) across industry boundaries and with different roles.

Policies aimed at valorizing textile waste and promoting circular business models in the textile and fashion supply chain are expected to address the ecosystem’s various components and

stakeholders and go beyond the strict boundaries of the textiles value chain.

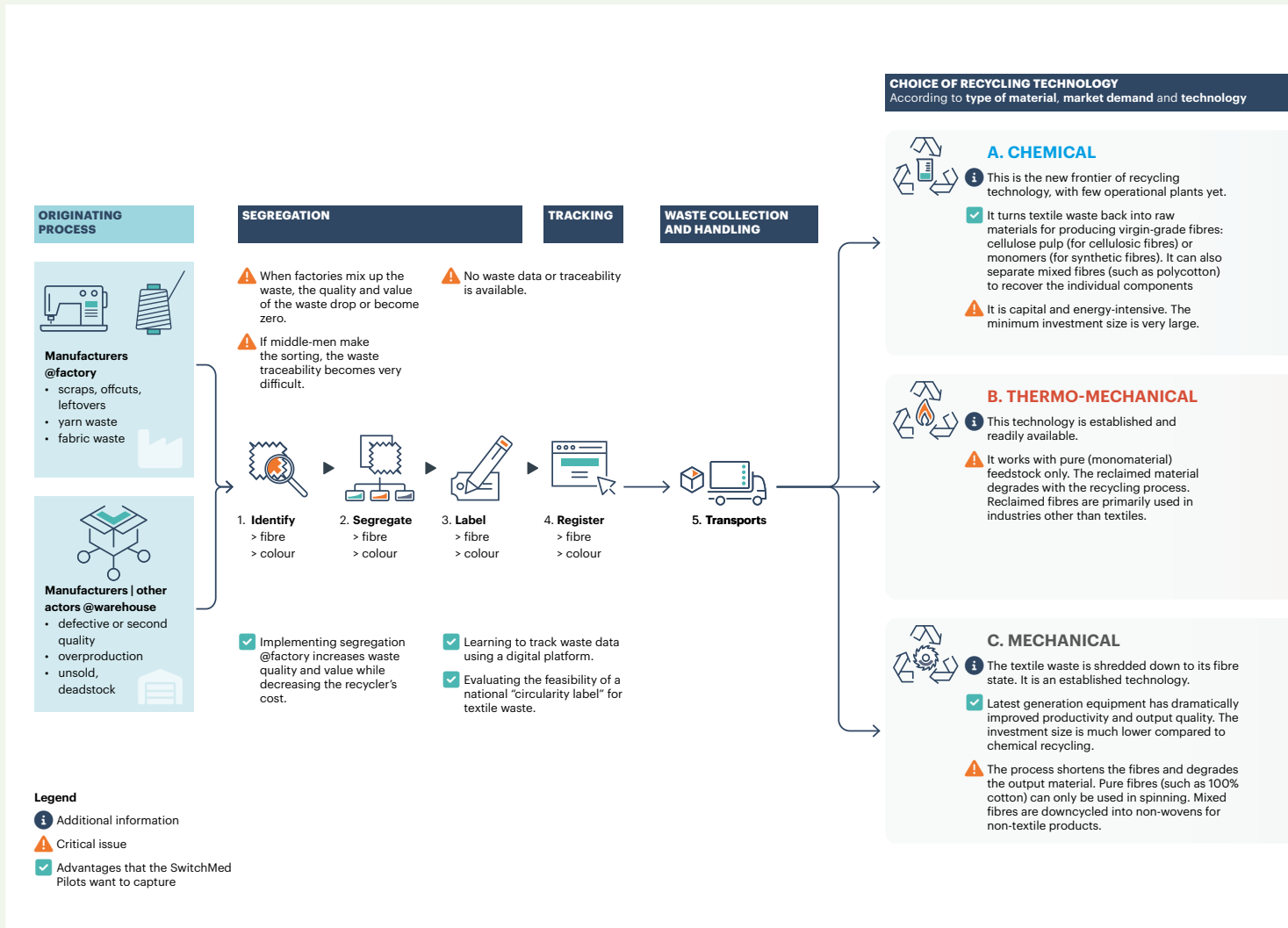
Some of these participants play the role of Orchestrators, maintaining direct contact with the final markets; they may be in the fashion business (fashion brands, fabric makers, etc.) or other end-user industries of textile fibres in different sectors (automotive, furniture, construction, etc.). These business players identify the needs and requirements of the market and match them with the Realizers’ capabilities.



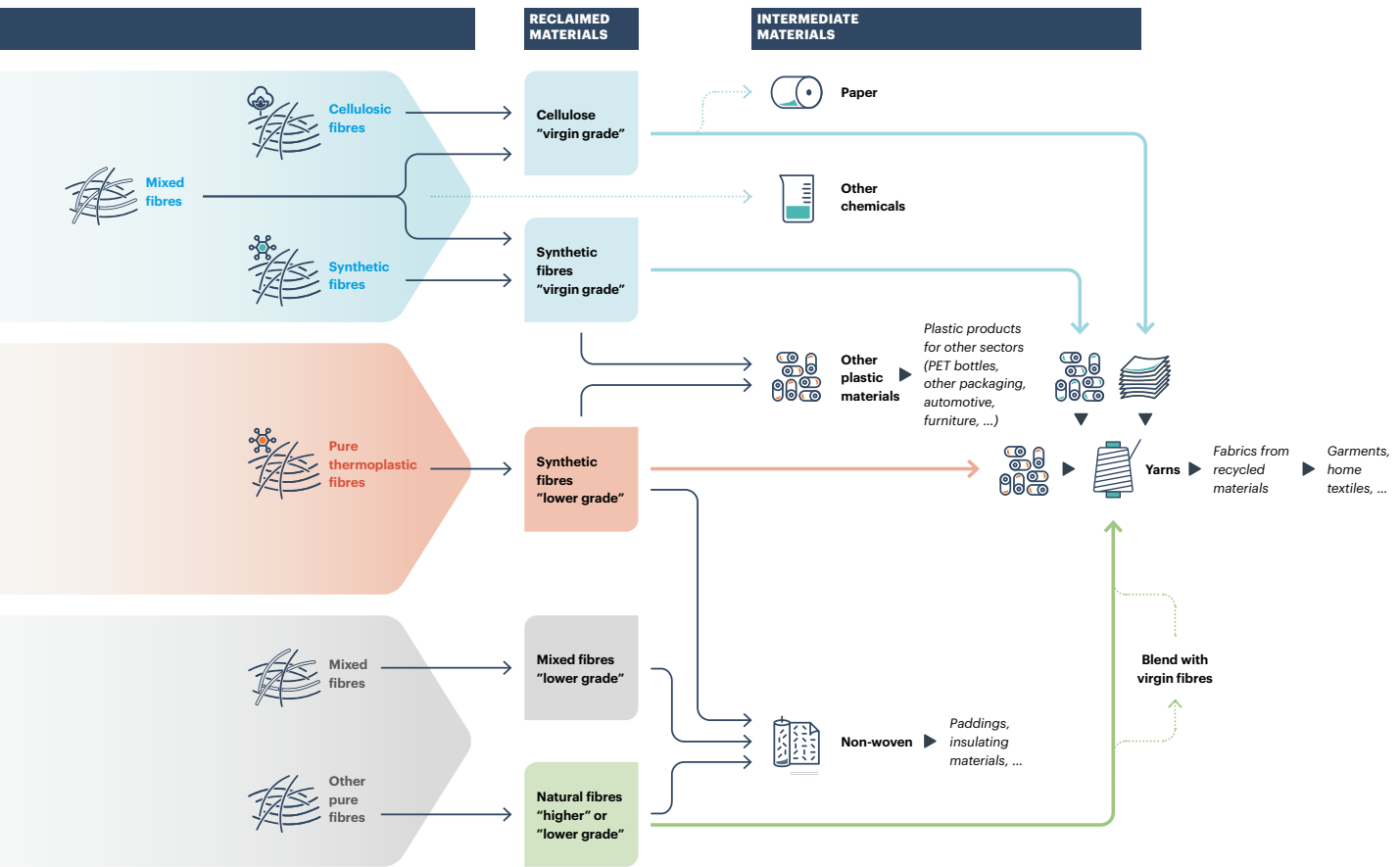
SOURCE: BLUMINE

Figure 1 – The textile waste valorization ecosystem

Figure 2 – The post-industrial textile recycling value chain



SOURCE: BLUMINE



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*Realizers* are providers of products, such as recycled fibres and yarns, and services, such as collection, transportation treatment and recycling of textile materials, in the waste valorization value chain.

*Enablers* are supporters of both *Realizers* and *Orchestrators*. They can be private organizations or government institutions, and contribute as regulators, voluntary standards maintainers,

market connectors, such as trade or traceability platforms, or technology providers. It is also interesting to note that the same player can take on several roles in the ecosystem. For example, a textile company or a brand can simultaneously act as a supplier (of textile waste) and buyer (of recycled fibres).

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## An Assessment of the Textile Recycling Value Chain in Tunisia

### Methodology

In 2021, UNIDO commissioned Blumine and Reverse Resources to conduct a waste mapping study with the support of the Fédération Tunisienne du Textile et de l'Habillement (FTTH). The study analyzed the textile waste value chain, engaging a representative group of key market players and estimating the pre-consumer textile waste flows generated by Tunisia's textile and clothing industry to be 31,000 tons per year.

The survey was instrumental in validating the most suitable circular business models adapted to the Tunisian business sector, the key players and market dynamics in waste recycling, and the specific needs and opportunities to upgrade the sector. Three pilot projects have been defined at the end of the waste mapping phase: this Roadmap builds on the lessons learned from the practical experience of working with all the actors in the textile value chain.

### Baseline Analysis

*"The quantities of waste are steadily increasing. In the absence of waste prevention and reduction measures, our modes of production and consumption take on a dimension of waste and overconsumption of resources."*<sup>1</sup>

According to the waste mapping study, pure-cotton and cotton-rich (>85% cotton) waste accounts for 56% of the 31,000 tons per year of pre-consumer textile waste generated by Tunisia's textile and clothing industry. This is a remarkable volume, the majority of which could be channeled into textile-to-textile recycling in

the cotton supply chain. On the other hand, most of the remaining 44%, consisting of blends of various fibres – synthetic, cellulosic, natural, or pure synthetic – needs to find a different end use. For most of it, nonwoven applications will be the primary option.

*"The quantities of waste are steadily increasing. In the absence of waste prevention and reduction measures, our modes of production and consumption take on a dimension of waste and overconsumption of resources."*<sup>1</sup>

Cutting scraps are the most significant part (55%) of the waste flow, and more than 85% originate in just two macro-regions, Center-East and North-East.

The concentration of waste in the two areas minimizes transportation costs and maximizes synergies through collaborations and shared facilities, keeping costs down for recycling operations in Tunisia. The mapping study also found significant economic potential for recycling high-value 100% cotton and cotton-rich pre-consumer textile waste in Tunisia.

The information collected during the SwitchMed project does not provide evidence of a structured textile value chain for higher-value (cotton and cotton-rich) or lower-value (other

<sup>1</sup> Source: Ministry of Local Affairs and the Environment; National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035



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blends and synthetics) waste. With a few remarkable exceptions in both textile-to-textile and non-woven applications (wadding, felt, insulation boards, and mattresses), the information indicates that higher-value waste is often exported as-is, without undergoing any transformation.

On the other hand, garment makers seldom or never have information about the destination of the waste they deliver to waste handlers as also their clients are not imposing any traceability requirement on them regarding the waste management practices. Lack of information and traceability pose significant obstacles to the successful implementation of circular business models.

Without adequate information on the origin, composition, and condition of these materials:

- ensuring the quality and safety of products made with recycled materials becomes challenging.

- compliance with regulations promoting sustainability and waste reduction can be impossible, leading to legal and reputational risks for businesses.
- sustainability claims regarding circularity in terms of both the use of recycled materials and responsible management of the brand's own waste can be considered greenwashing.
- the accurate assessment of products' environmental footprint with LCA or LCA-like approaches is a challenging task.

Overcoming the obstacles created by the lack of information and traceability requires collaboration between stakeholders, adopting standardized tracking systems, and appropriate digital technology to enable accurate data collection and sharing throughout the supply chain.

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## Outcomes of the Textile Waste Valorization Pilot projects

### *The pilot projects*

The pilot projects were selected in cooperation with the Tunisian Federation of the Textile and Clothing Industry (FTTH) and in partnership with international fashion brands sourcing in Tunisia. The three pilots have been designed and implemented with the objective to test and demonstrate the economic, technical and environmental benefits of two different circular business models: the closed-loop fashion-to-fashion and the industrial symbiosis for valorizing textile pre-consumption waste into other value chains (furniture, automotive, construction, etc.).

The decision to focus the valorization pilots exclusively on post-industrial waste (spinning and weaving waste, cutting scraps) and pre-consumption waste (second quality and defective garments, overproduction, deadstock) was motivated by four considerations:

- Dealing with post-industrial waste is the action with the highest short-term impact on the valorization of textile waste. Recycling post-consumption waste is much more challenging and requires the preliminary establishment of a complex worn garments collection and management supply chain.

- The volume of resources in post-industrial and pre-consumption waste is huge, and so far, untapped.
- Working with post-industrial and pre-consumption waste directly supports companies' competitiveness.
- The valorization value chain created for post-industrial and pre-consumption waste can easily be extended to post-consumption waste in the future.

### **Pilot Project A: Closed-loop local recycling of second-quality jeans into new jeans.**

This pilot project was conducted in collaboration with the Swedish brand Nudie Jeans and Tunisian companies in the yarn, fabric, and denim production sector, namely Denim Authority (Ras Jebel, Tunisia), and Swift/SITEX (Governorate of Monastir, Tunisia).

The pilot project aimed to experiment with recycling defective products accumulated at Denim Authority over a decade, which could not be resold in secondary markets and were destined for landfills. Approximately 40,000 pairs of jeans were collected and locally recycled within a recycling chain operating within a 300 km radius.

#### *Achievements*

- More than 40,000 pairs of defective jeans were recycled.
- Eighteen tons of reclaimed cotton fibers from recycling were processed into approximately 80,000 meters of fabric with 20% recycled fibers. From this fabric, over 90,000 pairs of new jeans were manufactured and made available for sale in Nudie Jeans stores.
- By utilizing the reclaimed cotton, 18 tons of virgin cotton were saved.

#### **Pilot Project B: Valorising higher quality and lower quality textile waste in specialised value chains: textile-to-textile and non-wovens applications**

This pilot project was conducted in collaboration with the Italian brand Diesel and Tunisian companies in the yarn, fabric, and denim production sector, namely Manifatture Tessili (Menzel Jemil, Tunisia), Swift/SITEX (Governorate of Monastir, Tunisia), and Sotrafib (Ksibet El Mediouni, Tunisia), a recycler and producer of non-woven fabrics.

The pilot project aimed to implement a small-scale economic model to valorize the high-quality textile cuttings in a closed-loop fashion cycle, directing lower-quality fractions towards other end-users.

#### *Achievements*

- The transportation of segregated waste from a totally exporting company (Manifatture Tessili) was tested, subjected to customs controls covering waste movement, to be directed for recycling in the domestic market.
- During the timeframe of the Pilot, for the jeans sold in the seasons Fall/Winter 2023, Spring/Summer and Fall/winter 2024.
  - a. 23.7 tons of textile waste made of pure cotton or containing over 95% cotton were collected, separated, and recycled into new fibers for spinning,
  - b. A total of 145.600 meters of fabric with 20% recycled fibers were produced.
  - c. 88,600 new pairs of jeans were produced for the collection of 2022/2023/2024 with an increase by 15% for the winter/autumn season 2024 compared to the previous one of 2023
  - d. 35.4 tons of CO<sub>2</sub>eq emissions compared to the traditional use of 100% virgin cotton were saved in all the lifecycle of the produced jeans corresponding to a reduction of 4% of CO<sub>2</sub> per pair of jeans with recycled content

- The company is planning to continue to recycle their own waste to be used within their collections in the future
- Training on textile waste management was provided at Manifatture Tessili, and a workplace safety improvement plan was developed and implemented at the recycler Sotrafib.
- Capacity-building efforts were completed to enhance machine utilization in the production of non-woven textiles at Sotrafib.

#### **Pilot Project C: valorization of textile waste within a large textile-apparel group.**

This pilot project was conducted in collaboration with WIC MIC, a Tunisian manufacturing group based in the Bizerte Governorate, serving as a supplier to European brands, and with the recycler Sotrafib located in Ksibet El Mediouni.

The involvement of a large group aimed to demonstrate opportunities for positive impact on a large scale. The Pilot triggered the interest of PVH Group and the Calvin Klein brand which ordered 40 thousand pairs of jeans made with 9 tons of waste recycled by WICMIC. The pilot demonstrated the business case of a textile waste valorization value chain within the country. A second objective was to assess opportunities for attracting investments in new recycling technologies in Tunisia, within the framework of a large, multi-located group.

#### *Achievements*

- Three companies within the group have been trained in waste management and segregation protocols.
- In 2023, 19 tons of waste were recycled, sufficient to produce 114,000 meters of denim fabric and over 85,000 pairs of jeans made with 20% recycled cotton. Nine of the 19 tons were used in the production of 40,000 pairs of jeans with 20% recycled materials for Calvin Klein's FW2024 season, and the remaining 10 tons were transformed into 60,000 meters of denim fabric for future jeans production.
- A first batch of waste from WIC MIC was sent to the recycler Sotrafib, who assessed their type and quality, verifying that the management protocol conveyed during the training was correctly applied.
- Contact has been established between the WIC MIC group and two technology suppliers to assess the possibility of two investments, one in a textile waste recycling line and the other in a system for recycling wastewater sludge in the group's washing and finishing unit (WIC)

- Following the training and capacity building received during the project, WIC MIC has also initiated a closed-loop project segregating and repurposing 19 tons of denim cutting waste back into one of its client's collection of jeans (PVH/Kalvin Klein)

The full case studies from the pilots can be found at the following link :

<https://switchmed.eu/country-hub/tunisia/>

### *Lesson Learned from the Pilots*

The implementation of the pilot projects indicate that the proposed circular business models are feasible and potentially scalable within the Tunisian context. A number of critical factors and priorities have also been identified shaping the actions of the roadmap.

Post-industrial textile waste is classified among Non-Hazardous Industrial Waste (DIND), also known as Common Industrial Waste (DIB). As such, they are assimilated with household waste. Therefore, the National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035, published by the Ministry of Local Affairs and the Environment in year 2021, serves as the reference document for the development strategies of the recycling sector, including textile waste. However, the National Strategy primarily focuses on the overarching theme of urban waste, providing less in-depth information regarding Common Industrial Waste (DIB).

The following lessons has been learned, not necessarily listed in order of importance:

- Waste handlers play a crucial role in the circular value chain: an increase in the quantity and quality of the collected waste can hardly be achieved without their involvement. The challenge is to make it profitable and convenient for informal waste handlers to transition to more formal, efficient and transparent business models.
- At this stage, fashion brands (the "donneur d'ordres") are essential in engaging the local supply chain in circular projects. Many Tunisian RMG manufacturers act as subcontractors. They have limited decision-making power and lack awareness and transparency about the destination of their waste after it is delivered to waste handlers. On the other hand, fashion brands are interested in new projects for sustainability and circular business models when they are credible, i.e. the proposing

company has the know-how and the capacity to manage such projects.

- Individual companies can hardly succeed in implementing a circular business model alone. A collaborative approach is required involving all parties – waste suppliers, waste handlers, recyclers, textile companies, and garment makers – to behave efficiently and transparently.
- Lack of cooperation and transparency can jeopardize the best efforts and dramatically increase costs.
- Waste segregation directly at source is more efficient and can produce economic advantages for all players in the recycling value chain in cascade.

### *Opportunities*

Pure cotton or cotton-rich waste accounts for 56% of the 31 Ktons of post-industrial and pre-consumption waste generated by the textile value chain in Tunisia. The collection rate in best international practices is in the 50%-55% range.

Considering the midpoint of the best practices range and assuming a medium-term 52% collection rate for Tunisia leads to a 8,4 Ktons target for higher-value cotton-rich waste segregated, collected, and recycled locally in the medium term.

### *Challenges*

The pilot projects demonstrated that waste segregation at the source, i.e. right on the textile or ready-made garments (RMG) company's "factory floor," is more efficient and increases the opportunity to generate value from waste. However, textile and RMG companies do not see segregation as part of their business, and it is considered just another additional cost, and so selling the concept of efficient waste segregation and management to these companies can be a challenge. Some form of public support or incentive could help overcome the obstacle.

The competitive landscape in the textile recycling value chain is evolving quickly. Several ambitious textile recycling projects were announced in 2023 in the broader Mediterranean region and Europe.

- In Morocco, the investment of 60 million euros by the Spanish company Recyclados in an integrated recycling and spinning facility in the Tangier region, supported by the IFC (International Finance Corporation, part of the World Bank Group).
- In Morocco, the 90 million euros

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investment by the Portuguese company Valérius Têxteis for a recycling facility in collaboration with the Moroccan company SG3H.

- In Spain, in 2023, the Spanish company Recover, specializing in recycling and spinning textiles, secured new funding for an investment aimed at increasing the production of recycled fibers and yarns to over 350,000 metric tons by 2026.
- In Europe, the first chemical recycling facilities on an industrial scale are underway, the entry of new players like Infinited Fiber in Finland and GR3N/Intecsa in Spain. Their commissioning will lead to a significant increase in demand for textile waste in the Mediterranean region to supply these facilities

The swift rise of textile recycling capacity and demand for textile waste could trigger a spike in feedstock price and speculative behaviour on the part of waste handlers and put the economic viability of investments in the recycling value chain at risk, especially if brands will not accept a premium price for recycled fibres.

On the other hand, orderly growth in the prices of textile waste and recycled fibres, reflecting the forces of supply and demand without being influenced by speculative positions or lack of transparency on the market, could serve as a valuable incentive for establishing new recycling facilities.

### *Stakeholder engagement*

Besides the fashion and textile industry, which is the core industry involved in the input phase of the recycling value chain and a key player in higher-value recycled fibres for textile-to-textile applications, other industries could also be involved:

- The furniture and bedding industry use lower-value recycled fibres to fill mattresses and other upholstered items of furniture such as sofas, chairs, etc.
- The automotive industry uses lower-value recycled textiles in rigid shapes for sound insulation.
- The construction industry is a destination for thermal and acoustic insulation materials that can be produced locally using lower-value recycled textiles, making panels and sheets to be applied to walls and ceilings.

Guidance from experts in sustainability and the circular economy is essential, given the current

state of awareness and know-how in the country.

All the pilots were developed with an international mindset, aligning with the requests and strategies of global brands. While certain features of the pilots exhibit distinct national characteristics, they can be applied across all Mediterranean regions where a significant volume of textile waste is generated through the operations of the textile supply chain.

### *High-level analysis of the textile valorization value chain opportunities for the Tunisian industry*

The implementation of the pilot projects clearly revealed the Tunisian textile industry's strengths and weaknesses as well as some clear business opportunities and potential threats to be considered in defining a strategy and an action plan for an efficient and competitive circular textile industry in Tunisia.

## Strengths

Tunisia is a recognized sourcing destination for major fashion brands. The transportation costs of textile waste are low, given that over 85% of textile waste is concentrated in two neighboring macro-regions. The geographical and logistical proximity to the European market is a valuable advantage compared to Asian suppliers.

The legal framework for waste management (Law 2001-14 and 2017-8; Decrees 2000-2339, 2005-1991, and 2017-419; Ministerial Order

dated 17.01.02 from the Ministry of Environment) is well-established. In 2021, the government issued a 'National Strategy for Integrated and Sustainable Management of Household and Similar Waste (DMA),' adopting a new approach in line with modern international waste management strategies.

Note: The DMA also includes non-hazardous industrial waste, also known as DIB (Déchets Industriels Banals) or DIND (Déchets Industriels Non Dangereux), including textile waste.

## Weaknesses

The valorization of waste streams is limited by non-existent or poor on-site sorting. Source-separated sorting is not currently part of the waste management system administered by municipalities. The lack of quantification and characterization devices for waste is a hindrance to understanding and managing waste flows, as well as promoting sorting and recycling.

No waste traceability system has been implemented, and no transparent waste trading platform is locally available.

Neither local clothing manufacturers nor their ordering customers have sufficient information on the destination of waste once delivered to collectors.

The recycling production capacity is insufficient. The spinning capacity for recycled fibers is also inadequate. Awareness of waste management laws and regulations is low. The legal framework for waste management needs modernization to promote the development of circular economic models.

## Opportunities

International brands want to manage waste responsibly and increasingly demand recycled yarns or fabrics in their collections.

Demand is growing for quality textile waste from local recyclers and brands.

The domestic market for nonwoven applications (automotive, construction, bedding) is growing.

Favorable Technological Developments in Textile Recycling Technology

## Threats

Investment in textile waste recycling capacity in competing Mediterranean countries is booming.

The race to become the favoured circular sourcing destination for international fashion brands has begun.

Waste is a resource that must be valorized domestically; large-scale chemical recycling projects are hunting for waste on a regional scale.

SOURCE: BLUMINE

**Figure 3 – SWOT Analysis**

# B. ROADMAP



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# 4. The Way Ahead

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## Goals and Objectives of the Roadmap

Building upon the specific challenges related to Non-Hazardous Industrial Waste (DIND) or Common Industrial Waste (DIB), the roadmap aims to clearly define objectives and solutions in alignment with the diagnostic elements regarding

the current situation and the overarching goals identified by the 'National Strategy for the Integrated and Sustainable Management of Household and Similar Waste' (2021).

<b>Goals and Objectives</b>	<b>Roadmaps actions</b>
Establish a clear and modern legal framework to implement efficient, competitive, and transparent circular business models	<b>1</b>
Modernize and integrate the waste collection, processing, and recycling sector to make the recycling value chain more efficient.	<b>2, 6, 8</b>
Increase recycling and recycled fiber spinning capacity, and non-woven production.	<b>6</b>
Reduce waste in textile and RMG manufacturing.	<b>5</b>
Increase waste segregation and collection rates.	<b>7</b>
Increase use of recycled fibres in the value chains textile-to-textile and nonwoven applications.	<b>3,4</b>
Upgrade education in sustainability and circularity for future technicians, engineers, product managers and designers.	<b>9</b>
Make Tunisian industry and society aware of the advantages of a proper waste management system	<b>10</b>
Publicize the achievements of Tunisia's textile and garments industry and engage international brands.	<b>11</b>

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## Actions in the Roadmap

### *Toward an efficient and competitive circular textile industry*

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#### **1 – Facilitate the recycling of cutting waste from a totally exporting companies**

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<b>Type of Action</b>	Policy reform
<b>Description</b>	<p>Most of textile waste is generated by a totally exporting companies (Law 72), which, despite existing procedures, often face difficulties, administrative burdens, and costs to transfer waste to recyclers operating in the domestic market. Simplifying administrative procedures for the sale or transfer of textile waste from Law 72 companies to recycling companies operating in the domestic market will help.</p> <p>This action aligns with Axis 2 of the National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035.</p>
<b>Objective</b>	Establishing a clear and modern legal framework to implement efficient, competitive, and transparent circular business models
<b>KPIs</b>	Increase the number of transactions of textile waste between fully exporting companies and recyclers in the domestic market.
<b>Key Stakeholders</b>	Government institutions and ministries, waste handlers, recyclers, textile and garment companies.

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#### **2 - Establish a national information network for the management and traceability of textile waste**

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<b>Type of Action</b>	Information system and capacity building
<b>Description</b>	<p>Tunisia lacks quantification and characterization about waste, including textile waste, at the national and municipal levels.</p> <p>To address these gaps, a dedicated national information system is essential, to serve all stakeholders as part of an information circulation mechanism. The platform implementation can be facilitated by financial and non-financial incentives and training programs in the areas of traceability, digitization, and transparency.</p> <p>Establishing a mandatory digital platform will encourage the informal sector integration, promote traceability and a deeper understanding of the market; and enhance rigorous planning of policies.</p> <p>This action aligns with Axis 1 of the National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035</p>
<b>Objective</b>	Modernize and integrate the waste collection handling and recycling sector to make the recycling value chain more efficient.
<b>KPIs</b>	The creation of the digital platform, the number of participating companies, the tons of registered and traced waste, and the publication of an annual report on textile waste.
<b>Key Stakeholders</b>	Government institutions, specialized agencies and task forces, MSMEs, and workers in the informal sector.

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### 3 – Support the implementation of the National Sustainable Public Procurement Action Plan (PANAPD) for public procurement of textile and apparel products.

<b>Type of Action</b>	Policy reform
<b>Description</b>	<p>Within the framework of the National Sustainable Public Procurement Action Plan (PANAPD), it is important to develop initiatives dedicated to textile, including technical sheets for sustainable products and product selection criteria, such as fiber type, recycled content, chemical restrictions, sustainability, extension of lifespan, and eco-design. In the short term, sustainable procurement practices, particularly for clothing, can be experimented with in pilot projects with national or local administrations." Establishing criteria for Sustainable Public Procurement will encourage domestic demand for recycled fibers.</p> <p>This action aligns with Axis 2 of the National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035</p>
<b>Objective</b>	Increase the use of recycled fibres in the textile-to-textile and nonwoven applications value chains.
<b>KPIs</b>	Share of 'green purchases' in public procurement of textiles and clothing.
<b>Key Stakeholders</b>	Government bodies and administration.

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### 4 – Support the demand for recycled fibers for non-woven textile products.

<b>Type of Action</b>	Policy reform
<b>Description</b>	<p>Thermal insulation in buildings has emerged as a promising market opportunity, offering economic and environmental benefits as it significantly influences the heating/cooling energy consumption of buildings. Several recent studies have also explored the possibility of using recycled post-industrial textile waste, including wool, fabric scraps, recycled cotton, and synthetic fibers, as thermal insulation.</p> <p>Promote the adoption of non-woven products from recycled textile to improve energy efficiency in buildings or preserve crops and soil health in agriculture. Agricultural non-wovens are a new generation of environmentally friendly materials. Due to its ecological characteristics, non-toxic and non-irritating nature, recyclability, reusability, and affordable price, it is widely used.</p> <p>This action aligns with Axis 2 of the National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035</p>
<b>Objective</b>	Increase the use of recycled fibres in the textile-to-textile and nonwoven applications value chains.
<b>KPIs</b>	<p>Number of new buildings equipped with thermal insulation based on textile recycling-derived products.</p> <p>Meters of non-woven textile products used in agriculture</p>
<b>Key Stakeholders</b>	Government agencies and administrations, construction companies, architects, real estate developers, non-woven textile manufacturers, agricultural businesses, and agricultural equipment suppliers.

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## 5 – Incentivize investment in waste reduction technology

<b>Type of Action</b>	Market-based incentives for investments
<b>Description</b>	<p>Encourage the adoption of waste reduction technologies with incentive measures such as subsidies, low-interest loans, guarantee systems, or accelerated depreciation.</p> <p>Modern digital and automated systems, such as modeling software and automated cutting machines, will significantly reduce waste volumes and save resources for clothing manufacturers. Green and resource-efficient investments can be accelerated or prioritized within existing investment incentive programs.</p> <p>This action aligns with Axis 2 of the National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035.</p>
<b>Objective</b>	Reduce waste in textile and RMG manufacturing.
<b>KPIs</b>	Total value of investments leveraged.
<b>Key Stakeholders</b>	Government institutions and ministries, specialized government agencies and task forces, recyclers, textile and garment companies.

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## 6 – Incentivize investment in recycling equipment

<b>Type of Action</b>	Market-based incentives for investments
<b>Description</b>	<p>Investments in mechanical recycling equipment are quickly amortized; however, the investment size is often high for SMEs. Green and resource-efficient investments can be accelerated or prioritized within existing investment incentive programs.</p> <p>Incentivize investments in recycling equipment with subsidies, low-interest loans, guarantee systems, or accelerated depreciation, which can be a decisive factor.</p> <p>This action aligns with Axis 2 of the National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035.</p>
<b>Objective</b>	Expand recycling capacity and modernize equipment to increase productivity, quality and profitability.
<b>KPIs</b>	Total value of investments leveraged.
<b>Key Stakeholders</b>	Government institutions and ministries, specialized government agencies and task forces, recyclers, textile and garment companies.

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## **7 – Training in proper and efficient waste segregation and management procedures for garment-makers**

<b>Type of Action</b>	Training and awareness-raising
<b>Description</b>	<p>Waste sorting at the source has proven to be a fundamental prerequisite for reducing waste management costs and increasing the value of waste delivered to recyclers. However, clothing manufacturers may be reluctant to engage in audit and training sessions perceived as an additional cost.</p> <p>Promote audits on waste management procedures in textile and garment companies.</p> <p>Promote practical 'on-site' training for textile and garment companies on proper waste sorting and management procedures, followed by sessions to verify the implementation of quality waste management procedures. A national certificate or quality label for waste management could also be established for companies that have successfully completed the audit, training, and verification stages.</p> <p>This action aligns with Axis 2 of the National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035</p>
<b>Objective</b>	Increase textile waste segregation and collection rates.
<b>KPIs</b>	Number of companies trained.
<b>Key Stakeholders</b>	Government institutions and ministries, specialized government agencies and task forces; national certification bodies; textile business associations, textile schools and technical research institutes; textile companies and garment makers.

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## 8 – Incentivize investment in waste management infrastructure

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<b>Type of Action</b>	Market-based incentives for investment
<b>Description</b>	<p>Incentivize investments in physical or digital infrastructure for the valorization of textile waste. The circular textile value chain goes beyond waste sorting and shredding. It also involves significant physical infrastructure, such as storage and logistics hubs, as well as digital infrastructure, including monitoring and traceability systems and platforms, including marketplaces dedicated to the trade and exchange of waste.</p> <p>This action aligns with Axis 2 of the National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035</p>
<b>Objective</b>	Modernize and integrate the waste collection, processing, and recycling sector to make the recycling value chain more efficient.
<b>KPIs</b>	The total value of investment leveraged, volumes of waste traded on digital infrastructure.
<b>Key Stakeholders</b>	Government institutions and ministries, specialized government agencies and task forces, waste handlers, recyclers, textile and garment companies, software houses, and digital platforms.

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## 9 – Introducing circular business models and design for circularity in the higher education curricula

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<b>Type of Action</b>	Training and awareness-raising
<b>Description</b>	<p>The principles and practices of sustainability and circularity regarding textile and fashion processes and materials must be integrated into higher education course syllabi for textile engineering and management and Technical Vocational Education and Training (TVET). This includes the development of higher education courses focused on sustainability and circularity for aspiring fashion designers.</p> <p>This action is in line with Axis 1 of the National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035</p>
<b>Objective</b>	Upgrade education in sustainability and circularity for future technicians, engineers, product managers, and designers.
<b>KPIs</b>	Number of courses taught, number of students attending.
<b>Key Stakeholders</b>	Ministry of Education, Universities, Fashion and Design schools.

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## 10 – Awareness-raising actions aimed at the Tunisian textile industry and society

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<b>Type of Action</b>	Training and awareness-raising
<b>Description</b>	<p>Promote workshops on eco-design practices, proper waste management, and valorization opportunities.</p> <p>Organize communication campaigns involving local businesses, international brands, and technology suppliers.</p> <p>Conduct targeted educational campaigns for citizens and the general public to inform, educate, and inspire individuals about the benefits of recycled textiles compared to virgin fibers, encouraging them to prefer sustainable clothing over disposable garments.</p> <p>Launch social media campaigns targeting consumers born between 1981 and 1996 (Generation Y) and younger generations, involving ambassadors from international brands focusing on sustainability, and local businesses committed to sustainability and the circular economy.</p> <p>This action aligns with Axis 5 of the National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035.</p>
<b>Objective</b>	Make Moroccan industry and society aware of the advantages and business opportunities associated with textile waste management and recycling.
<b>KPIs</b>	Number of events, number of companies participating in the events.
<b>Key Stakeholders</b>	Textile and Clothing Federation (AMITH), Ministry of Industry, Ministry of Environment, civil society actors (NGOs), consumers' associations, and citizens.

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## 11 – Engagement of international brands in circular economy projects

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<b>Type of Action</b>	Communication outreach for new partnerships
<b>Description</b>	<p>Launch a communication plan targeting international brands sourcing from Tunisia to showcase the achievements and efforts of the Tunisian textile industry in sustainability and circular textiles, aiming to establish new partnerships.</p> <p>Brands play a crucial role in engaging the local supply chain in circular projects. A significant portion of the Tunisian apparel sector operates through subcontractors with limited decision-making independence. Conversely, brands are eager to assess new projects to advance circular business models.</p> <p>This action aligns with Axis 5 of the National Strategy for the Integrated and Sustainable Management of Household and Similar Waste 2020-2035.</p>
<b>Objective</b>	Showcase the Tunisian textile and garments industry's achievements and engage international brands.
<b>KPIs</b>	Number of brands engaged; new partnerships/programs launched.
<b>Key Stakeholders</b>	Ministry of Industry, business textile associations (AMITH), international organizations (e.g. UNIDO), brands, donors.

## Implementation Timeline

The roadmap schedule is organized into phases based on the level of importance within the intervention framework. Almost all measures, except one, are short-term priority interventions for the period 2024-2027. Meanwhile, four

of these measures, aiming to generate the necessary impact to transform the recycling value chain into a modern and efficient one, should continue during the period 2027-2030.

	Priority 2024-2027	Advanced 2027-2030
1) Facilitate the recycling of cutting waste from fully exporting companies	✓	
2) Establish a national information network for the management and traceability of textile waste	✓	✓
3) Support the implementation of the National Sustainable Public Procurement Action Plan (PANAPD) for public procurement of textile and apparel products	✓	✓
4) Support the demand for recycled fibers for non-woven textile products	✓	✓
5) Incentivize investment in waste reduction technology		✓
6) Incentivize investment in recycling equipment	✓	✓
7) Training in proper and efficient waste segregation and management procedures for garment-makers	✓	
8) Incentivize investment in waste management infrastructure	✓	✓
9) Introducing circular business models and design for circularity in the higher education curricula	✓	
10) Awareness-raising actions aimed at the Tunisian textile industry and society	✓	
11) Engagement of international brands in circular economy projects	✓	



