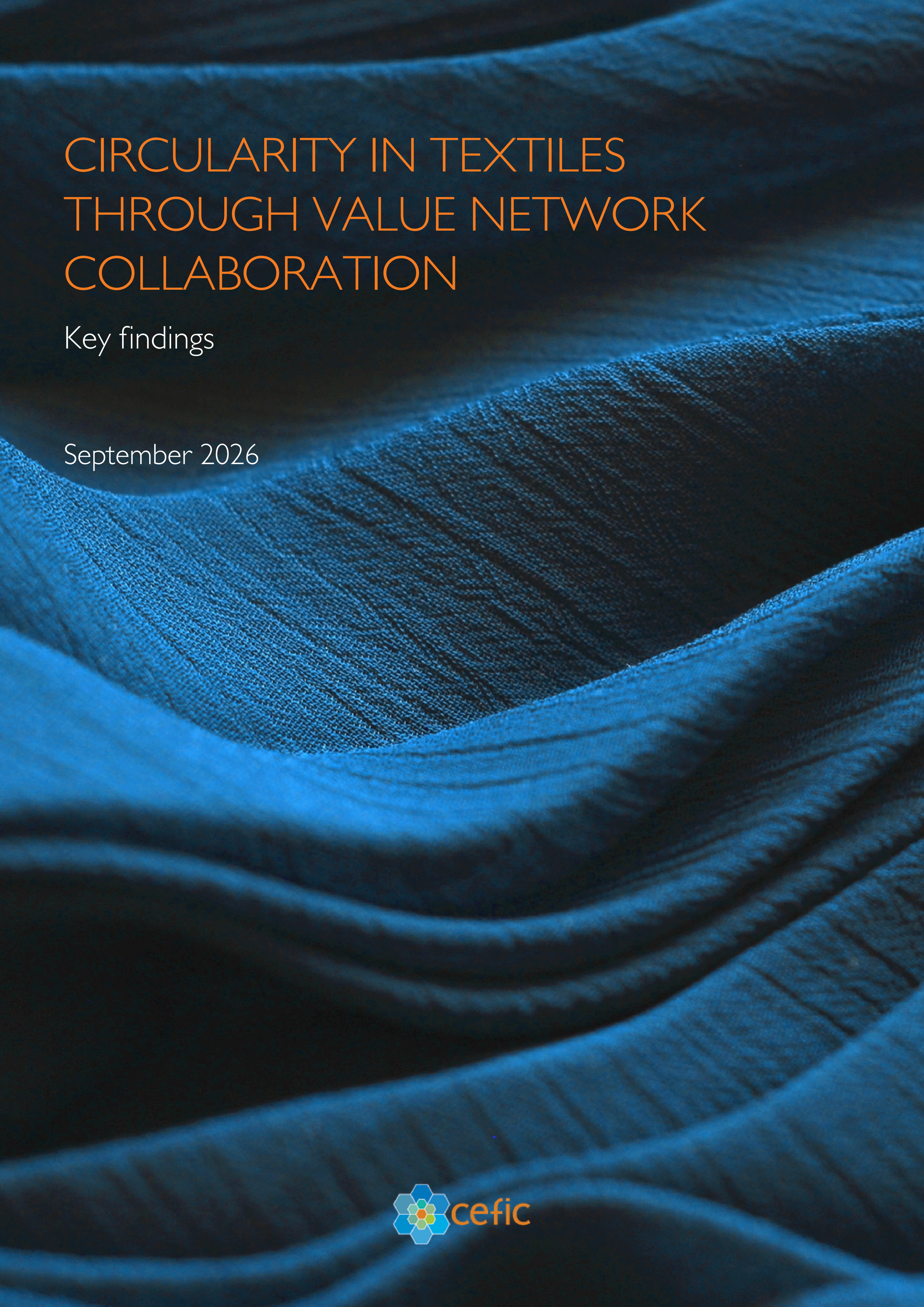
CIRCULARITY IN TEXTILES THROUGH VALUE NETWORK COLLABORATION

Key findings

September 2026



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Abstract summary

This report reflects the outcomes of three cross-industry workshops, "Value Network Collaboration: Circularity in Textiles", organised by Cefic, which brought together experts and representatives from the textile value chain.

It explores how the textile sector can become more circular, focusing on recycling and bio-based technologies, product design, and business models. It highlights the need for scaling collection, sorting, and recycling infrastructure, alongside harmonised standards, clearer regulatory frameworks, and improved data availability through tools such as a Digital Product Passport.

Key barriers include fragmented requirements, lack of transparency, limited infrastructure, and economic challenges related to the higher cost of recycled and bio-based manmade fibres compared with virgin materials.

Case studies are included to illustrate how different approaches and technologies are being applied in practice across the textile value chain.

A central focus of this publication is the importance of designing textiles for durability, recyclability, and reduced environmental impact, while managing trade-offs between performance, material complexity, and recyclability. The report discusses technical challenges linked to additives, impurities, fibre composition, and recyclability constraints, as well as the need for eco-design and eco-modulation under regulatory frameworks such as the Ecodesign for Sustainable Products Regulation (ESPR) and Extended Producer Responsibility (EPR) schemes.

Finally, alternative business models are presented such as leasing, repair, reuse, and take-back schemes as mechanisms to extend product lifetimes and support circularity. Overall, the report shows that progress depends on better design, enabling policy, more investment, and closer cooperation across the textile value chain.

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1. Introduction

Multiple players from the textile value network came together to discuss how to scale circularity in textiles in Europe in three hybrid workshops organised on 25 November and 10 December 2025, and 28 January 2026, in Brussels. The objective was to identify the challenges and opportunities in scaling circularity and how to realise these opportunities. This report presents key findings and case-studies, highlighting ways to scale recycling, increase bio-based fibres, increase durability, and incentivise alternative circular business models.

1.1 Circular value network collaboration

A circular economy is only attainable when entire value chains increasingly work together in circular value networks. Circularity can be much further optimised by looking beyond specific value chains and thus focusing on the optimised use of the value of resources, materials and products within value networks between multiple sectors. Both open and closed loop recycling will be needed to transition to a fully-fledged circular economy. Circular value networks require a collaborative approach to value creation, where the interests of multiple actors in volved in different value chains are aligned to keep resources in the loop.

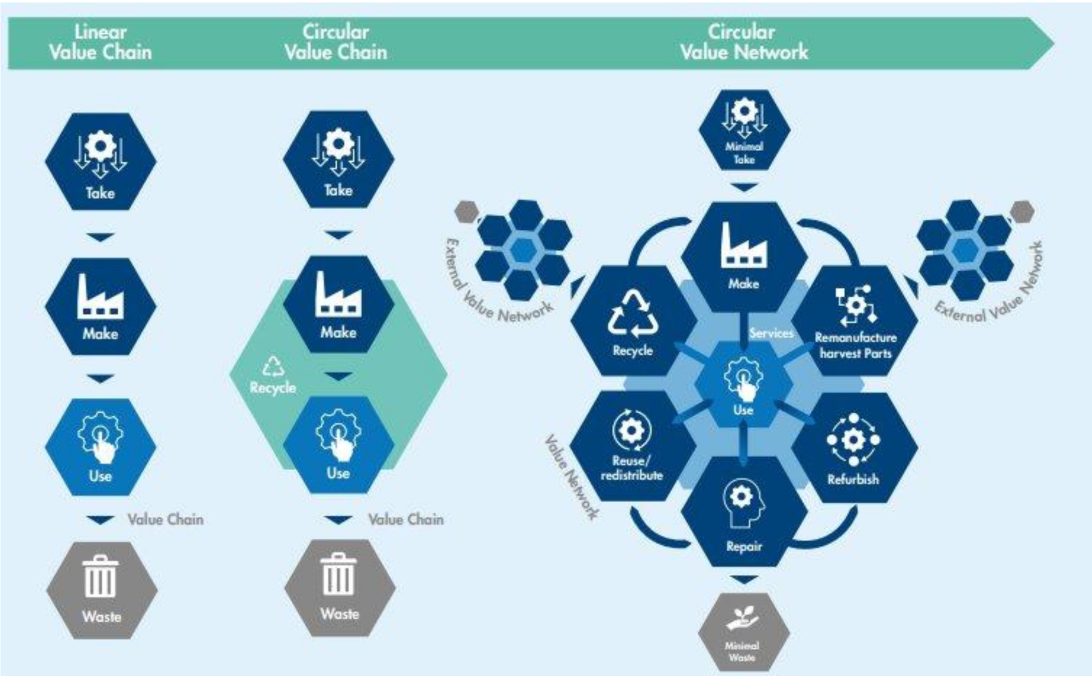

Figure 1: Illustration of a linear value chain and circular value networks; Source: [Cefic-UNITY study – Accelerating the circular transformation (2025).]

Cefic has developed a set of [Key principles for value network collaboration enhancing circularity] (Figure 2). These principles were applied in this value chain collaboration project focusing on circular textiles. In the workshops organised in this collaboration, the 10-R strategies (Figure 3) were utilised to identify challenges and opportunities to advance circularity in textiles.

Figure 2: Key guiding principles for value network collaboration for circularity; Source: [Cefic](#) (2025).

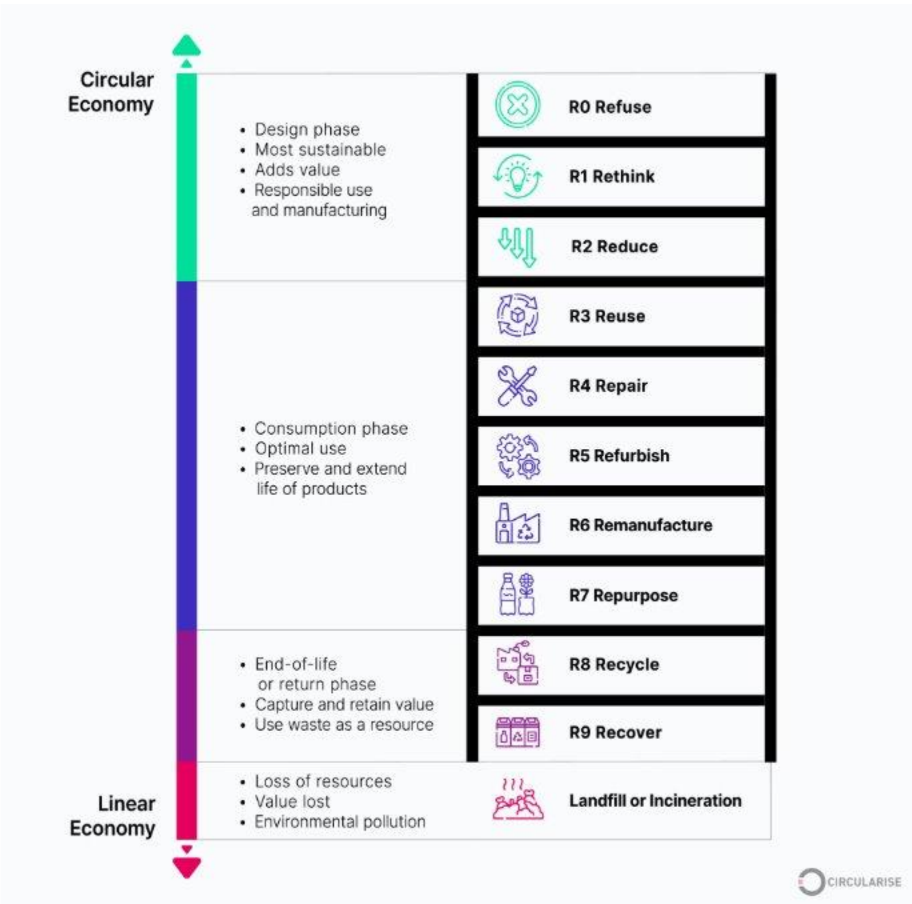

Figure 3: The different stages in which R strategies can be implemented; Source: [Circularise](#) (2023).

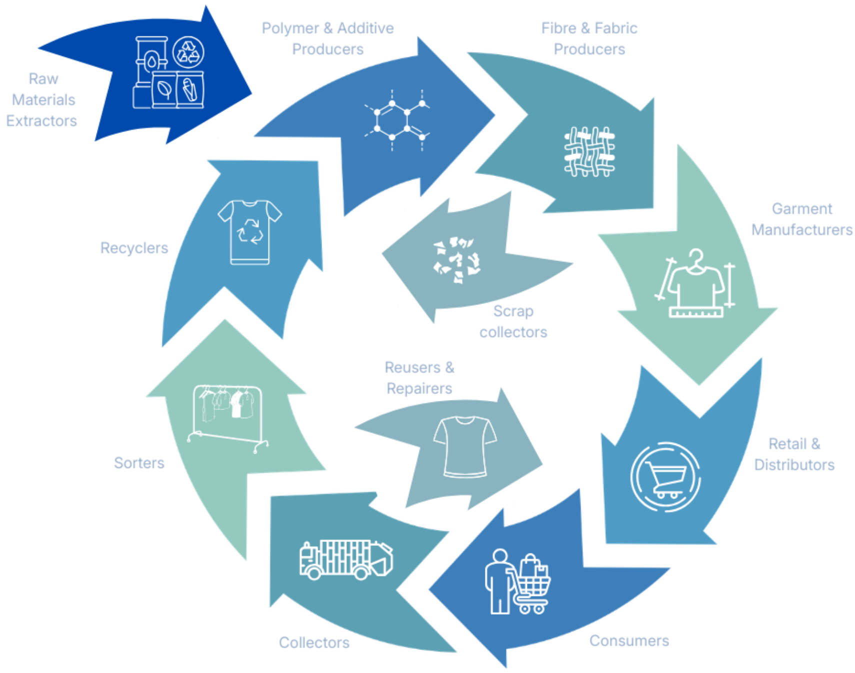

Figure 4: The circular textile value network; Source: Cefic (2026).

Over 80 stakeholders throughout the European textile value network (Figure 4) have participated in the workshops of which the key summaries are listed in this document.

- Raw material extractors: Axens, BP, ExxonMobil, Orlenunipetrol CZ, UPM, The Woolmark company;
- Polymer and additive producers: Arkema, BASF, Bostik, BYK-Chemie GmBH, Dow, DuPont, Eastman, Evonik, Federchimica, GAMMACOLOR S.R.L., Huntsman, Indorama, Ingevity Corporation, Lenzing Aktiengesellschaft, Polytechnyl, SCHP CZ, TEBO, Teijin, Thrace Plastics, 3M;
- Fibre and Fabric producers: Clariant, CIRFS, Oerlikon Barmag, RDD textiles, Utexbel;
- Garment manufacturers: Asics, Austrian Textile-Clothing-Shoe and Leather Industry Associations, CLUTEX, Confederation of the German Textile and Fashion Industry, Confindustria Moda, EUCTL - European Chemistry for Textiles and Leather, Euratex, Fanatics, Federation of the German Textile and Garment Industry, FESI, Finnish Textile & Fashion, IFTH, Inditex, Institut Français de Textile & d'Habillement, IVC Home, Lululemon, Nudie Jeans, Policy Hub - Circularity for Apparel & Footwear, RDD textiles, UK Fashion and Textile association, Vaude, VF Corporation, WL Gore;
- Retail & distributors: ALDI
- (Scrap) Collectors and sorters: Boer Group, Eko-kom, Mohu Co, ReHubs, RISE, Veolia, Wolkat.
- Recyclers: Accelerating circularity, Boer Group, Coleo, Eko-kom, EURIC, Mohu Co, Recyc'Elit, Recycling Europe, RE&UP Recycling Technologies, ReHubs, Resortecs, RISE, Valerius 360, Veolia, Valmet, Wolkat.
- Reusers & Repairers: Nudie Jeans, Vaude, VF Corporation, WL Gore

Organisations representing consumers were approached for the project, but were not able to participate in the workshops.

1.2 Current status of textile waste in Europe

In 2020, Europeans generated around 6.95 million tonnes of textile waste annually, with cotton and polyester making up the largest portions by volume. Over the past 5–10 years, textile waste has been on the rise due to increased consumption (doubling of clothing sales from 2010 to 2015) and decreased utilisation rates[1]. Synthetic fibres, such as polyester and polyamide (nylon), now account for roughly two-thirds of fibre production by weight, while natural fibres, mainly cotton, make up the remaining one-third (Figure 5). In 2015, an estimated 73% of global textiles ended up being incinerated or landfilled (Figure 6).

In the EU in 2022, 16 kg of textile waste was generated per person per year of which 29% of textiles were collected separately for reuse and recycling, while 71% ended up in mixed household waste that is either incinerated or landfilled (Figure 7). 74% of the separately collected textile waste was recycled, and 26% was landfilled or incinerated (Figure 8).

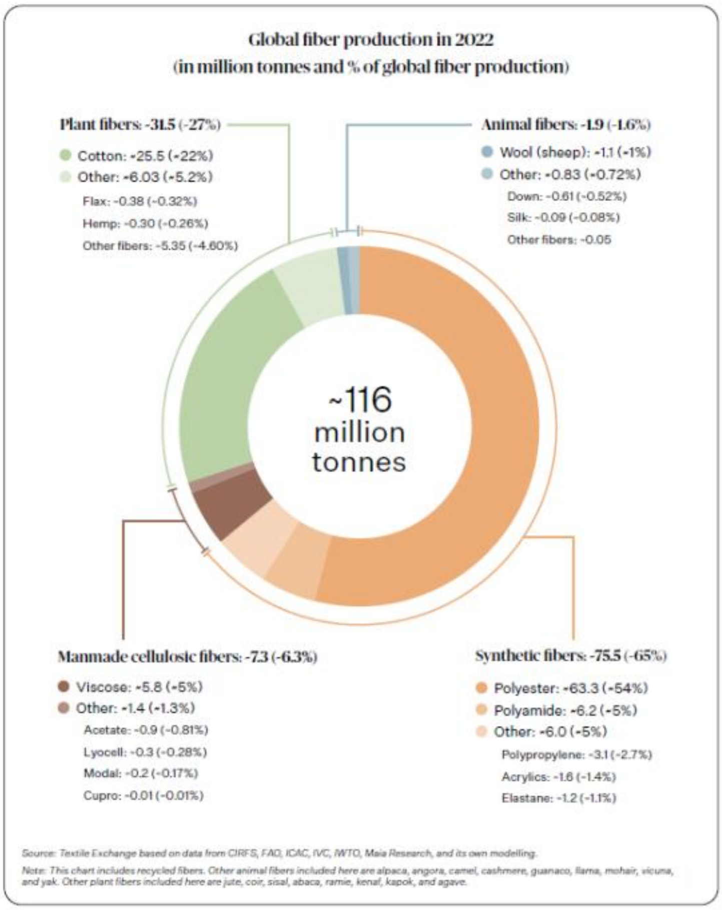

Figure 5: Global fibre production in 2022 – Total fibre and raw materials production volumes, independent of whether they are used for apparel, home textiles, footwear, or any other applications; Source: Textile Exchange report 2023.

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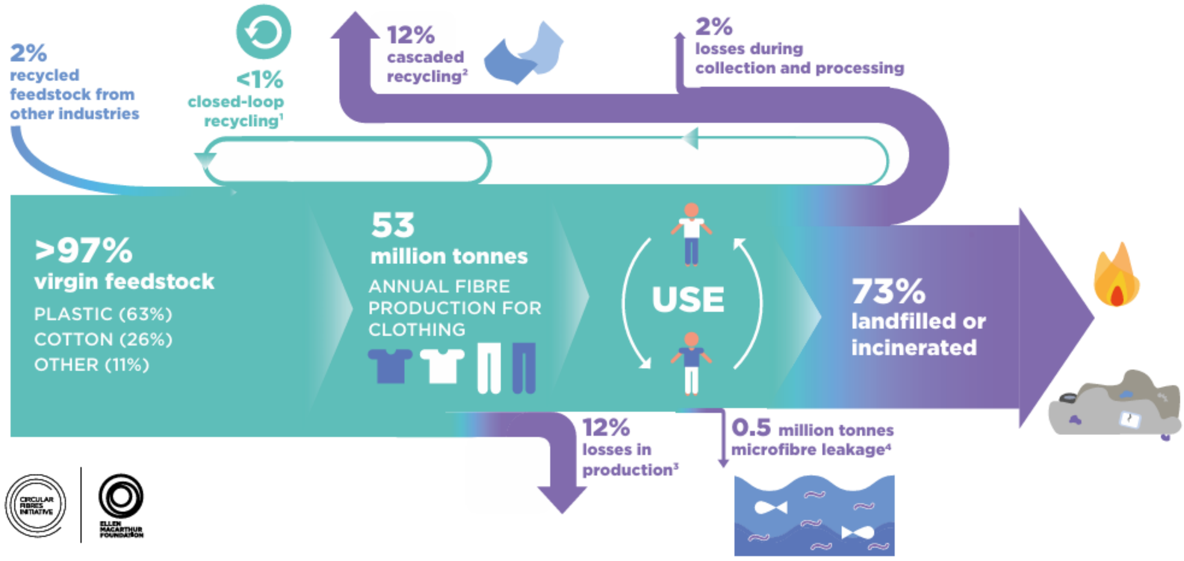
[1] = Euromonitor International Apparel & Footwear 2016 Edition (volume sales trends 2005–2015); World Bank, World development indicators – GD (2017).



1 Recycling of clothing into the same or similar quality applications
2 Recycling of clothing into other, lower-value applications such as insulation material, wiping cloths, or mattress stuffing
3 Includes factory offcuts and overstock liquidation
4 Plastic microfibres shed through the washing of all textiles released into the ocean

Source: Circular Fibres Initiative analysis – for details see Appendix B

Figure 6: Global material flows for clothing in 2015; Source: Circular Fibres Initiative analysis (2017).

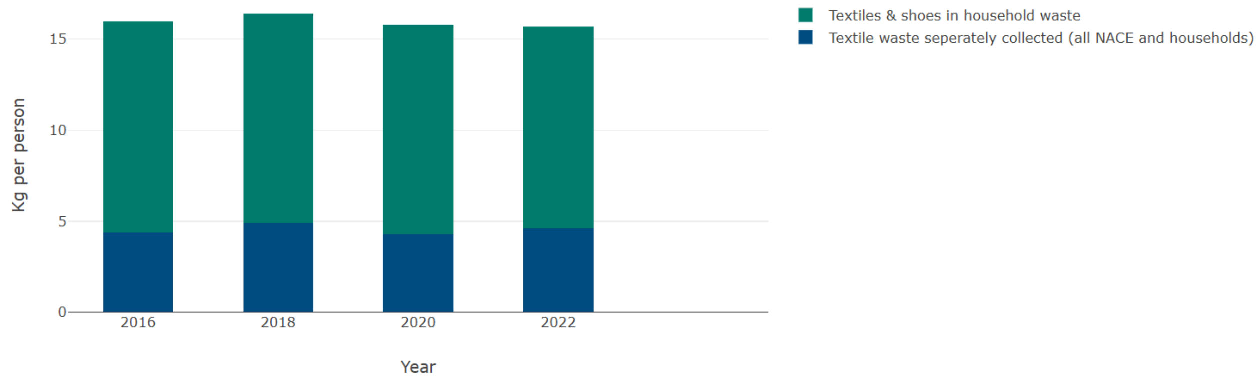


Figure 7: Textile waste generation in the EU per person per year; Source: EEA (2025).

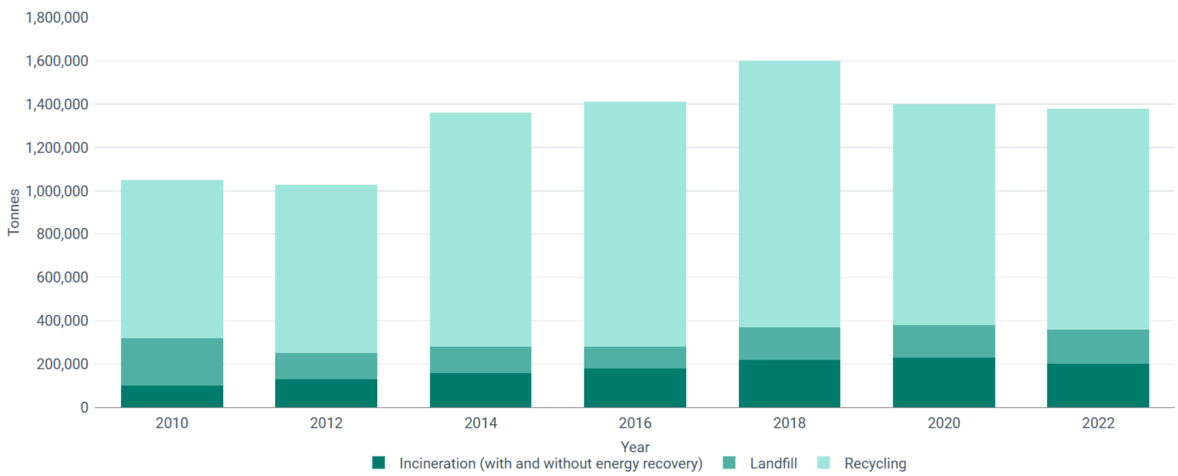


Figure 8: Treatment of separately collected textile waste in the EU; Source: EEA (2025).

2.Scaling recycling

Key message by ReHubs – In 2020, fibre-to-fibre recycling accounted only for 1% of the 7 million tons of textile waste produced in the EU-27 and Switzerland. By increasing the collection rate, advancing and automating sorting of fibres, and further develop pre-processing and recycling technologies to decrease costs and improve the output quality, fibre-to-fibre recycling could reach 18-26% of gross textile waste in 2030 (Figure 9). An estimated €6–7 billion of investments would be needed by 2030 to achieve these rates.

ReHubs' mission is to drive a circular and profitable textile-to-textile recycling industry through investments in European infrastructure and collaborations globally. Their mission is to recycle 2.5 million tons of European textiles waste by 2032 through scaled infrastructure, technology, policy, partnership, promotion, and investments. They aim to break the supply and demand deadlock by driving progress on building market conditions for reliable supply and demand certainty.

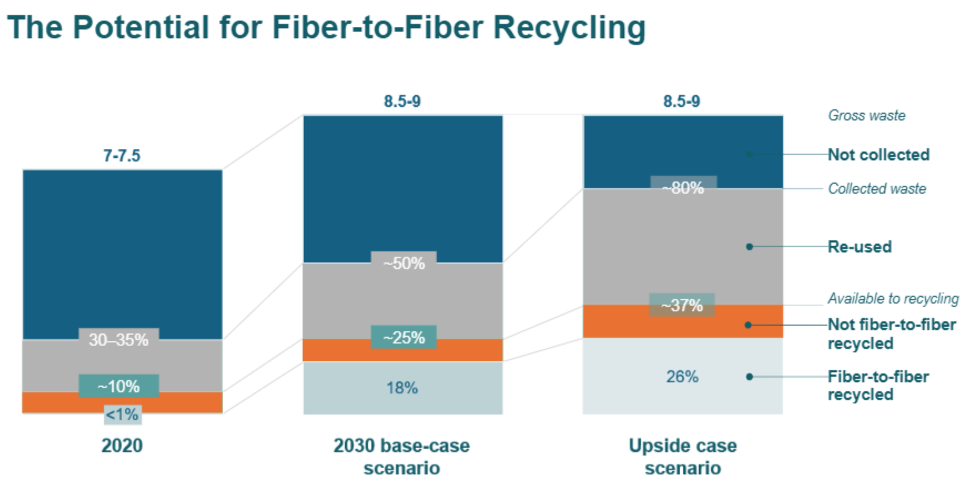


Figure 9: Scaling textile recycling in Europe – turning waste into value; Source: McKinsey & Company (2022).

2.1 Main findings

Creating the conditions to scale textile recycling

1. Demand certainty and aligned incentives

To create certainty in demand for recycled fibres, recycled content targets in product legislation are key like the example of Packaging and Packaging waste Regulation (PPWR). An extension of circular carbon content requirements in end markets to selected additional product categories for textiles and additional carbon sources (next to recycling including biomass and CCU), e.g. via the Ecodesign for Sustainable Products Regulation (ESPR), following a thorough impact assessment, and where enabling conditions, such as appropriate feedstock available, mass balancing methods and end of waste definitions, are in place.

In parallel, Green Public Procurement criteria could also increase demand for recycled fibres. Secured offtake agreements play an important role in uptake of textile waste as feedstock. Clear targets are therefore essential to de-risk investments and scale recycling infrastructure. Incentives must raise industry ambition and align investment, policy, and demand to create an economic environment that supports circular business models. Circular products must become not only environmentally beneficial, but also economically viable. Another incentive that could be introduced to circular and low-carbon fibres are VAT reductions for these products.

The recycled content targets should be developed assuring technology neutrality to optimise complementary recycling technologies and to allow for future innovation and most cost-technology effective recycling options. Therefore, the inclusion of mass balance credit method with fuel use exemption for chemical recycling is important.

2. Scaling collection, sorting and infrastructure

Increasing circularity requires a significant scale-up of separate collection and sorting for reuse and recycling. Transitioning an ecosystem that currently produces around 100 million tonnes of textiles annually and globally presents major challenges in both scale and timing. Textile fibre lifecycles can span up to 100 years, making rapid systemic change inherently difficult. Developing meaningful consumption of recycled fibres and a functioning secondary raw materials market is likely to take decades, not years.

Apart from textile waste in EU going to incineration and landfilling, export of textile waste[2] is another factor that limit the supply of secondary materials for textile recycling. In addition, majority of the easiest-to-recycle apparel (post-industrial) is located outside of the EU, and importing textile waste for recycling faces legislative barriers. Pre-consumer waste is often available in batches and not very often as recurring opportunities, and its management should adhere to the waste hierarchy.

3. Level playing field and imports

At the same time, increasing volumes of low-priced textile imports are entering the European market. Without appropriate measures to ensure a level-playing field, these products risk outcompeting European companies investing in circular business models. Creating a level playing field is therefore critical by establishing workable equivalency clauses that require imported materials to meet equivalent sustainability standards and production.

There is a need for better and more harmonised enforcement of EU rules for imported goods. Non-compliant products that end up in the EU due to lack of or weak controls reduce the competitiveness of EU businesses, who invested millions into compliance with the EU laws, including to be sustainable and circular (as can be illustrated bankruptcy of Renew cell in February 2024). To achieve a functioning secondary materials market and clean circular streams, the EU must ensure that non-compliant and un-safe imports do not contaminate EU streams.

4. Investment stalemate and lack of clarity

Many recyclers are postponing investments while awaiting legislation, harmonised schemes, and clarity on national sorting and recycling capacities. The current lack of transparency and regulatory certainty prevents final investment decisions. To break this stalemate, policy, demand signals, and investment frameworks must be aligned to enable viable business cases for textile recycling infrastructure.

Design as a cornerstone of circularity

5. Design for disassembly and recycling

Design plays a critical role in increasing circularity. Design for disassembly and recyclability is essential to enable high-quality recycling and reduce processing costs. Recycled content targets in textiles are a key lever to increase demand and incentivise further development of recycling

[2] = EEA, EU Export of use textiles

technologies, enabling higher technology readiness levels (TRLs) and larger-scale investments. Currently, outlets for recycled fibres remain limited, constraining scale-up. Incentives for recyclability should be technology neutral as technologies are constantly improving and incentives should not discriminate between one technology or material over the other and allow room for future innovation.

6. Eco-design and eco-modulation via EPR

Currently, many recycling technologies have specific feedstock specifications, which challenges acceptance of some fibre blends and additives. Designing for circularity is needed to ensure appropriate end-of-life solutions. Eco-design should support recyclability by facilitating the use of materials and substances that are compatible with recycling processes. Elements and impurities that hinder recycling should be considered at the design stage, while taking into account the function, performance and durability of the textile product. Eco-modulation of Extended Producer Responsibility (EPR) fees is an important tool to improve recyclability, recycled and bio-based content, and durability in manmade fibre textile products. Stakeholders are also exploring whether additional eco-modulation incentives could be provided for recycled content derived from European post-consumer waste recycled in Europe, and the potential implications of such measures for investment and the economics of textile recycling.

This would support domestic recycling investments, retain value in Europe, and reduce dependency on other regions. Without such measures, recycling of textile waste remains economically unviable, as virgin materials continue to be significantly cheaper than recycled alternatives.

Substances of concern and regulatory coherence

7. Understanding and harmonisation of chemical requirements

Understanding from recyclers' and textile manufacturers' experience in operations whether any and which substances or materials might hinder recycling is important. Requirements for substances of concern in virgin and recycled textiles either produced in Europe or imported should be fully harmonised where relevant with existing regulatory frameworks (REACH, CLP, POP, etc.). Multiple regulations with differing thresholds would increase testing requirements, raise costs, and risk undermining the business case for recycling. Harmonised concentration limits would also reduce fragmentation, as brand owners currently apply diverging requirements. Legacy substances will remain present in textile waste for some time, and legislation should therefore include pragmatic transitional periods. At present, analysis and identification methods for textile waste are insufficient and not harmonised, making it difficult for recyclers to assess incoming feedstock quality.

Traceability, data, and Digital Product Passport

8. Data availability and traceability challenges

To enable effective recycling, a practical, interoperable and reliable Digital Product Passport (DPP) is required to trace fibres and substances of concern throughout the value chain. Recyclers should have access to relevant information on materials, additives, dyes, coatings and other substances used in each product component from the manufacturers that might impact recycling. Data assurance is critical, particularly for imported products. Physical verification of recycled content remains challenging, and while tracer technologies (e.g. fibre markers) are emerging, they are not universally applicable and require robust methodological validation. Even with DPP implementation, a long transition period will persist during which many textile products lack composition data. Unknown additives can contaminate entire recycling batches, leading to variable output quality. Trade-offs between durability-enhancing additives and recyclability remain a structural challenge.

Sorting, impurities, and technical barriers

9. Sorting technologies and limitations

Sorting for reuse, recycling and other valorisation routes remains largely manual and underdeveloped. While automated sorting technologies are emerging, they cannot yet reliably distinguish all fibre types. Further support for innovation and scale-up of sorting technologies is essential. DPP data could support sorting, provided QR codes remain intact and reliable. Alternative identification technologies, such as Radio Frequency Identification (RFID), may offer potential, but their cost-benefit balance as well as their additional electronic waste burden requires further assessment. Materials produced in smaller volumes are particularly difficult to separate using conventional sorting systems.

10. Impurities and fibre-specific considerations

Some impurities and colouration might challenge recycling processes. Decisions on impurity removal and decolourisation involve trade-offs between performance, quality, durability, yield and cost, and a lack of harmonised standards increases uncertainty. Recycling natural fibres might pose additional challenges, including dust formation and moisture-related degradation during storage and processing. Exchange between recycling operators and textile garment designers should be fostered to facilitate recycling of textile.

2.2 Case studies and initiatives

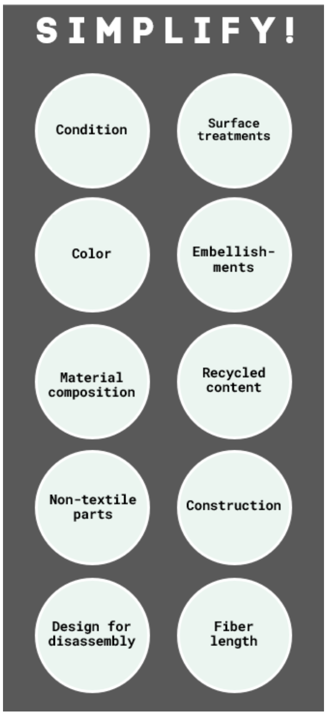


Figure 10: Simplify to design for recyclability; Source: ri.se.

Design considerations: RISE Institute – designing for recycling aims to simplify the design of textile products for several design elements mentioned in Figure 10. Pre-processing and recycling of fibres comes with significant losses that could be avoided through smart design at the inception of the textile product. Research is being conducted to improve design and depolymerisation technologies for polyester based materials.

Case study: Boer Group has sorting capacity of over 110,000 tons of discarded textile waste per year for preparation for reuse (vintage and wholesale), recycling (capacity of 12,000 tons/year into over 25 types of articles) and for energy recovery. With FFIBR from Frankenhuis, they started automated sorting for recycling that removes contaminations (metals, plastics, labels), sorts on colour and composition and mechanically recycle and spin these into new fibres.

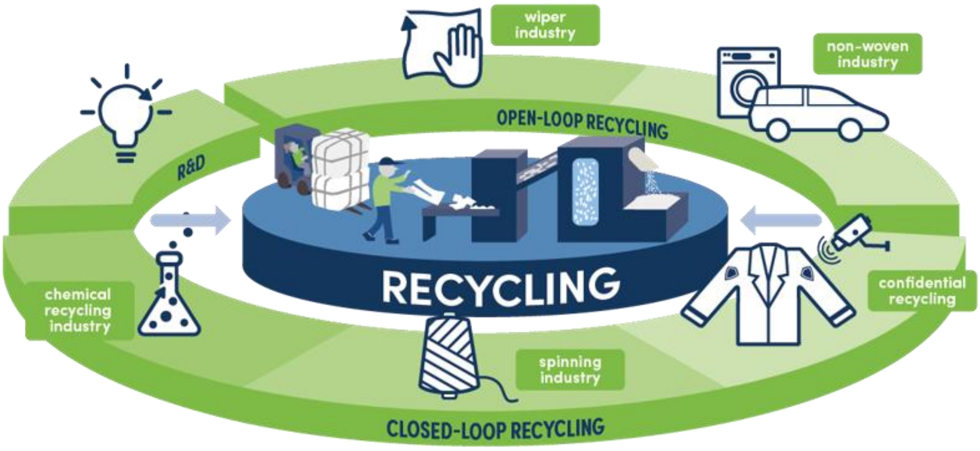


Figure 11: Textile recycling options; Source: Boer Group.

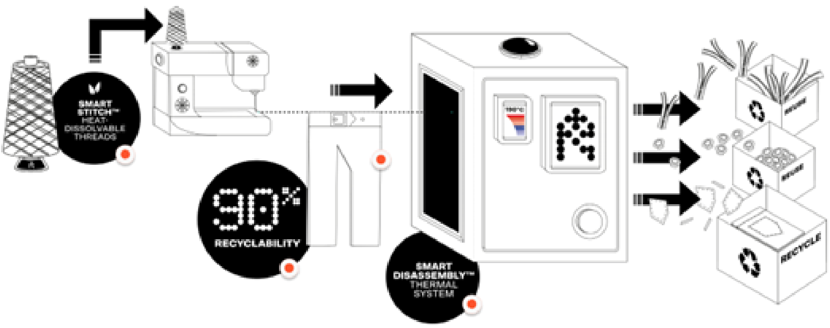


Figure 12: Smart Stitch technology; Source: resortecs.

Case study: Resortecs provides an active disassembly solution for products designed to last while allowing them to come apart when needed. They produce a smart thread that decomposes under thermal pre-treatment, enabling the disassembled parts to be easily sorted. Multiple brand owners are already using the thread in their products.

Case study: BASF recycles post-consumer and post-industrial textile waste into a 100% recycled polyamide 6 called Loopamid. The technology tolerates other synthetic fibres in lower concentrations like PET, PA6.6, spandex (<20%), non-synthetics like cotton (< 5%), coatings and dyes. It yields virgin-like colourless polyamide 6 that is certified by the Global Recycled standard (GRS) and has reduced CO2 emissions per kilogram of product compared to primary raw materials. The company operates a 500 metric tons/year facility in China.

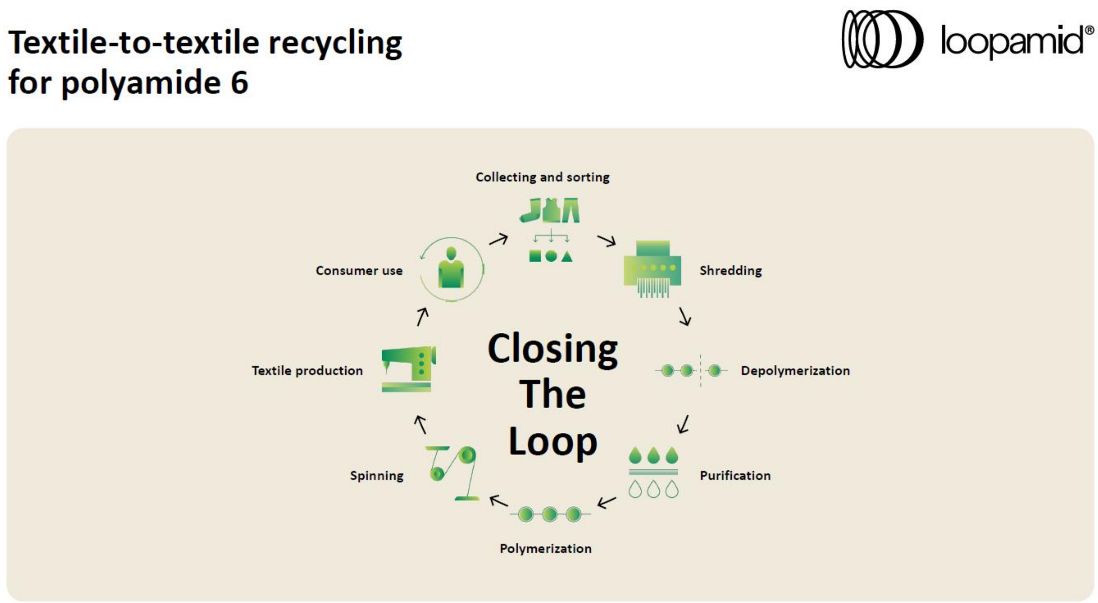


Figure 13: Textile-to-textile recycling for polyamide 6; Source: BASF.

Case study: Recyc'Elit developed an advanced polymer fibre separation via a solvolysis chemical recycling process selective to polyester for multi-fibre polyester textiles. The process is selective to polyester, so co-materials like elastane, polyamide, cotton will remain intact and can be valorised. Complex polyester based textiles waste is converted via monomers (dimethyl terephthalate (DMT) and mono ethylene glycol (MEG)) to rPET pellets at mild temperatures (below 100°C) and atmospheric pressure, with a short reaction time of about 1 hour. The first pre-industrial demonstrator (TRL7-8 & 10-30 tons/year) was built in 2025 and the industrial scale and further scale-up is planned for 2028-2030.

Figure 14: Recyc'Elit ' s textile to textile recycling technology; Source: Recyc ' Elit.

Case study: Valerius 360 – Mechanically recycles cotton waste into recycled cotton and paper via mechanical recycling. Impurities in the cotton (even 1-2% elastane or other synthetic fibres) are problematic. Dark colours and certain additives like coatings, pigment prints, PU layers, and resin finished reduce quality and create contamination for recycling. Accessories and non-textile components like zippers, buttons, labels, polyester sewing threads, elastic waistbands, prints and coating need to be removed before recycling, otherwise increasing cost and downtime in mechanical recycling plants. Other contamination in post-consumer waste may include oils, dirt, stains, sweat or odour residues, microplastics, household chemical residues and non-fabric components (e.g. coins, tissues etc.).

Case study: Valmet supplies key technologies for textile-to-pulp recycling plants, building on its pulp and paper expertise. Valmet supports the scale-up of cellulosic and mixed-fibre recycling processes. Practical examples include the delivery of major equipment for Circulose's textile recycling plant in Sundsvall, Sweden, which converts discarded cellulosic textiles into dissolving pulp and projects such as TexirC and PESCO UP. Its main value lies in transferring industrial pulp and paper know-how to textile waste recycling, where mechanical and chemical pretreatments, decolorization, cleaning, separation, and industrial scale-up are critical.

3. Increased biomass-derived content

Biomass-derived renewable materials are one of the solutions to support Europe's industrial growth and reach climate goals. The chemical sector provides not only substances and bio-based fibres in the form of coatings, additives and dyes, and the manufacturing of semi-synthetic fibres like viscose and lyocell, but also the manufacture of bio-attributed and bio-based synthetic fibres from sugar, starch, lignin, plant oils and protein to produce polylactic acid, biomass-derived polyesters, polyamides and others.

3.1 Main findings

Lead Markets to strengthen strategic autonomy

- Create lead markets for biomass-derived materials with clear demand-side measures such as targets for biomass-derived synthetic fibres with sustainability safeguards, which accelerate adoption and give investors certainty. Ideally, these targets should be separate from recycled content targets so they are complementary and not competing. Products with lower environmental impacts might provide additional bonus points in product legislation and eco-modulation (e.g. of Value Added Tax or Extended Producer Responsibility).
- Diversifying sourcing of both locally and imported bio-based feedstock with the below sustainability criteria could increase strategic autonomy and create new market opportunities. It can secure long-term industrial resilience.

Sustainability assurance and traceability

- Ensure sustainable feedstock availability with reliable, responsibly sourced feedstock. Sustainability criteria are key to ensuring the utilisation of sustainability sourced feedstock but must be pragmatic and enabling. EU regulations need to ensure biomass availability while avoiding excessive restrictions that could hinder industrial scale-up. Participants suggested exploring existing credible voluntary schemes (e.g. PEDFC, ISCC Plus and FSC) to leverage suitable schemes, ensure sustainability, and simplify overcompliance burdens. Alignment with RED III sustainability criteria articles 29 (2-7) is important, including for imported feedstock.
- Inclusion and recognition of mass balance methods suitable for biomass use in EU legislation is important to support business models for products that are not produced in a segregated manner. Mass balance enables accurate tracking and verification of relevant characteristics, such as the use of bio-based feedstocks, throughout the value chain. The use of mass balance facilitates the co-feeding of feedstocks with different characteristics (e.g., bio-based and fossil) within existing manufacturing facilities, thus leveraging existing production assets with a typically lower CAPEX and shorter implementation timelines compared to segregated facilities.

Adress cost gaps and infrastructure needs

- Bio-based feedstock and smaller scale of production might come at higher costs than virgin feedstocks based synthetic fibres[3]. In particular, new infrastructure may be required to store, transport, and convert these feedstocks. Furthermore, due to the variety of sources that can be used (e.g., waste, feedstocks with seasonal variability, …)

[3] = Future markets insights, Biosynthetic materials pricing analysis: why the "green premium" is so stubborn.

the continuity of their composition might vary, requiring a more flexible processing. This could be addressed by:

- incentivising the use of bio-based feedstock in man-made and synthetic fibres, as well as textile products made in Europe via additional scoring or bonus points in eco-modulation, resulting in lower EPR fees.
- Considering the role of EU origin feedstocks and products made in the EU in the context of providing additional bonus points in product legislation and eco-modulation.
- Providing funding opportunities for promising technologies and infrastructure rollout.

Process efficiency and environmental performance

- While the use of biomass as a feedstock can deliver environmental advantages, its processing still requires energy. Therefore, taking into account energy & material efficiency of technological processes and opting for low-carbon energy sources need to be taken into account to lower environmental impacts.

Biomass-derived versus biodegradability and compostability

Not all biomass-derived fibres are biodegradable or compostable. The biodegradability and compostability of fibres might also be impacted by the addition of dyes, coatings, and other additives. Harmonised definitions and standards for biodegradability will provide clarity on the conditions under which textile products are biodegradable and compostable and will enable this to be communicated clearly and transparently to consumers. Biodegradable fibres may contribute to reducing microfibres release and accumulation in the environment, yet proper infrastructure need to be available (i.e., compost) to ensure biodegradation or the microfibres need to be biodegradable in natural environments like water and soil (i.e., agricultural biodegradable plastics in soil).

3.2 Case studies and initiatives

Case study: Thread by thread - How UPM renews the textile value chain

UPM refines hardwood as a feedstock via biorefining into bio glycol and bio-mono ethylene glycol. They also convert softwood via pulp mills into tall oil, renewable naphtha and terephthalic acid into bio-based polyester (Figure 15). This commercially produced polyester is 100% renewable, sourced from managed forests in the EU and certified under ISCC Plus, FSC and PEFC standards. The carbon impact for 1 tonne of their bio-based polyester compared to mechanically recycled, advanced recycled and fossil based polyester is shown in figure 16. As demand for circular polyester is expected to increase, this is an opportunity for circular solutions to meet part of that demand (Figure 17).

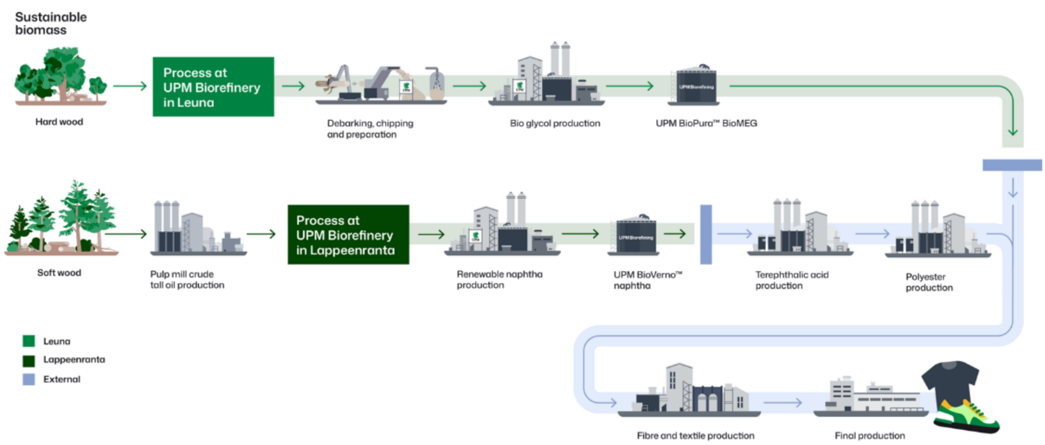


Figure 15: Production of 100% renewable virgin-quality polyester from sustainable biomass; Source: UPM.

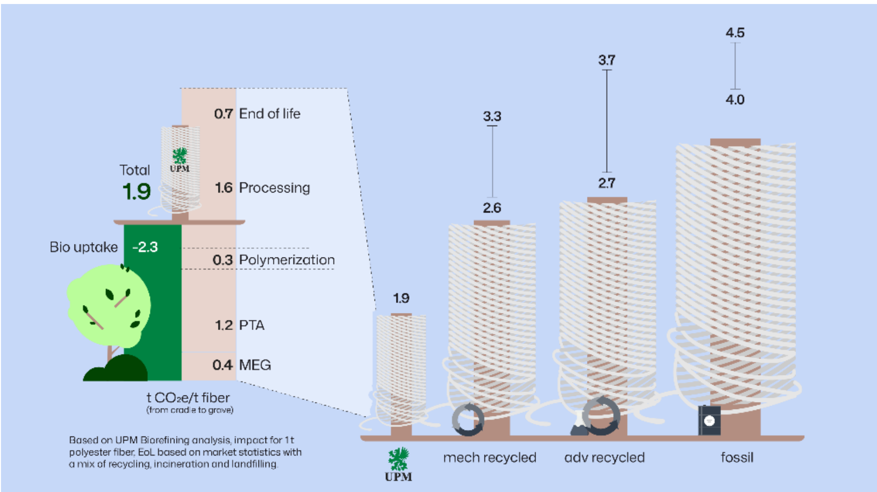


Figure 16: Production of 100% renewable virgin-quality polyester from sustainable biomass; Source: UPM.

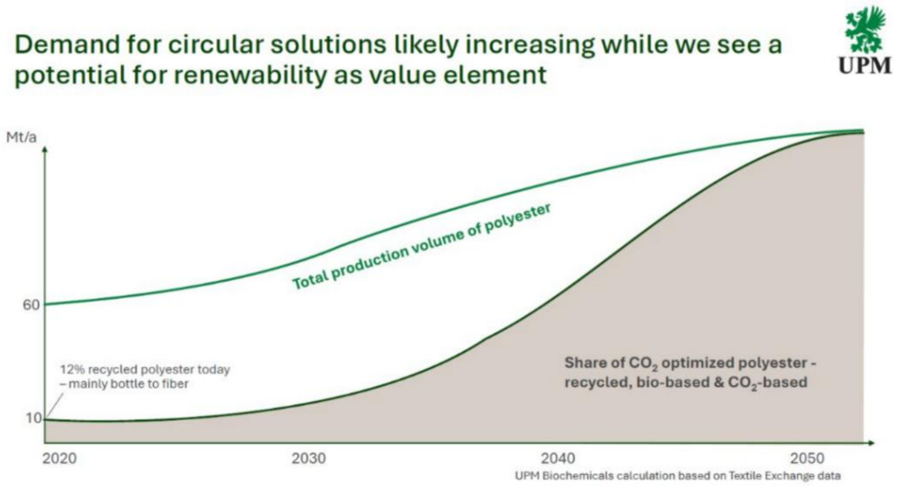


Figure 17: Production of 100% renewable virgin-quality polyester from sustainable biomass; Source: UPM.

Case study: Eastman produces its Naia Renew cellulosic acetate fibre from 60% sustainably sourced wood pulp and 40% acetyl sourced from a portfolio of recycled waste material via their carbon renewal technology. The fibre is certified biodegradable and of the same quality without compromise. It has a reduced carbon footprint of 35% and is a solution for hard-to-recycle waste materials. They also produce Naia Renew ES, which contains 60% recycled content of which one-third is made from GRS certified recycled cellulose from agricultural waste or non-forest-derived cellulose. They have also partnered with brand owners like Patagonia and Debrand to recycle apparel waste using Eastman's carbon renewal technology in the US and Canada.

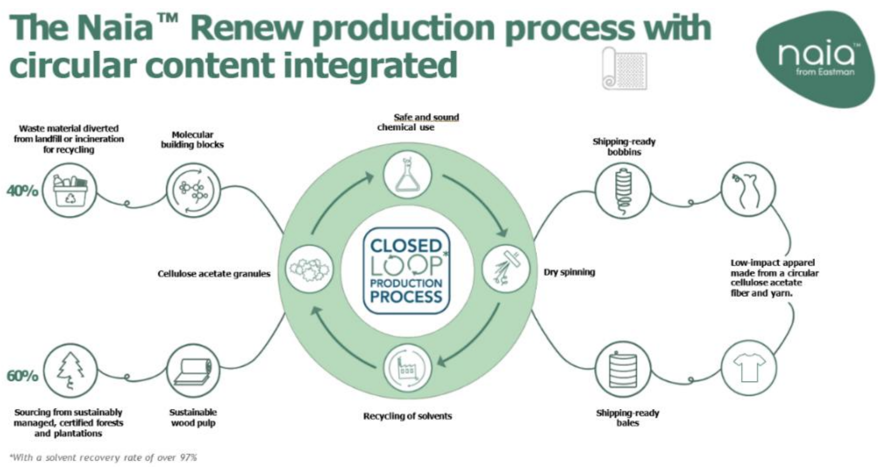


Figure 18: Naia™ Renew production process with circular content; Source: Eastman

Case study: DuPont is incorporating bio-circular feedstock from waste and residues of biological origin, such as used cooking oils or agricultural by-products, into its Tyvek® 500 Xperts BioCircleTM protective solutions. These raw materials do not compete with food production as they do not require additional land use. The company has adopted International Sustainability and Carbon Certification (ISCC) procedures, with ISCC Plus certification, to reduce its environmental impacts without compromising on safety and protection for their products. Using an independent cradle-to-gate LCA that includes biogenic carbon, supported by additional internal modelling, a climate change impact reduction of at least 58% can be achieved.

Figure 19: Enabling a more sustainable supply chain; Source: DuPont.

4. Incentivising Durability

4.1 Main findings

Designing for Durability under ESPR

Integrating durability requirements into the Ecodesign for Sustainable Products Regulation (ESPR) could be a powerful lever to ensure that only products designed for longevity are placed on the EU market. Given the wide diversity in intended use, performance, and material composition of apparel textiles, durability criteria might be differentiated by product category. A sweater has fundamentally different use and performance criteria compared with an outdoor hiking jacket. Possible durability aspects such as performance criteria relevant to specific product categories, like robustness after washing, water repellence, UV resistance, and colour fastness could be explored.

Need for harmonised standards & enforceability

There is a clear need to identify or develop harmonised standards to measure functionality and performance across the industry. This would help align the wide range of methods and criteria currently used by brand owners and provide a common basis for assessing durability.

Durability requirements must remain scalable and enforceable across all apparel produced in Europe, as well as for large volumes of imported textiles. Harmonisation of substance-of-concern thresholds, test methods, and sustainability criteria across brand owners is essential, as fragmented requirements disproportionately burden smaller companies.

Managing performance and recyclability trade-offs in product design

Durability requirements inevitably involve trade-offs with comfort, performance, recyclability, and recycled content. Many textile products must meet specific performance demands, making it essential that durability criteria remain proportionate and product-specific.

Measures to reduce micro-fragmentation, such as adding fibre-binding additives, could negatively affect recyclability. However, reducing the release of non- or hard to degradable microfibres is increasingly important, as these are now ubiquitous in aquatic, terrestrial, human, and animal environments, with still-uncertain health impacts. Designing textiles with fibres that lead to less microfragmentation is therefore a key prevention strategy. In parallel, additional innovation to decrease micro fragmentation during all product life cycle stages is necessary, such as decreasing airborne releases during production processes, decreasing releases during washing in the use phase and end-of-life management and removing micro fragmented fibres from wastewater. Well-designed additives can also help prevent microfragmentation while maintaining the recyclability of textiles.

4.2 Case studies and initiatives

Case Study: RISE Research Institutes of Sweden are carrying out their BioSusTex project where they look at bio-based materials for textiles, including designing textiles for durability while keeping in mind sustainability impacts like degradability in the environment and recyclability. Carbon and environmental footprint should be quantified by Life Cycle assessment methodologies to ensure a balance and trade-offs between durability, biodegradability, recyclability, and the environmental impacts of apparel products.

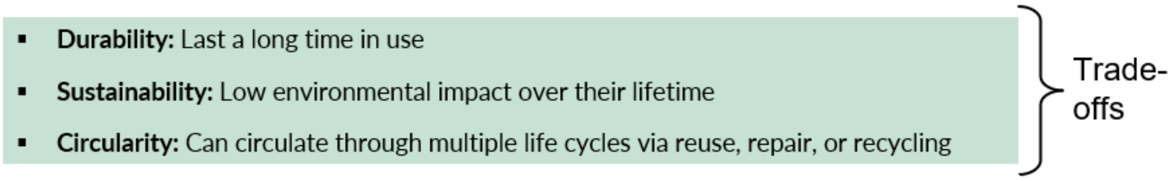


Figure 20: What is sustainable durability for circularity in textiles? Source: RISE institute.

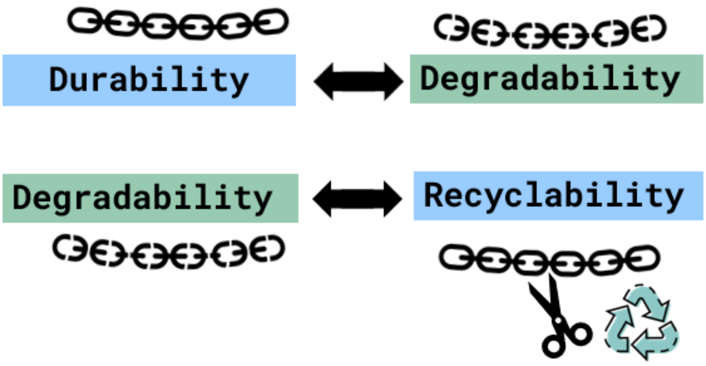


Figure 21: Trade-offs in volved in achieving sustainable durability; Source: RISE Institute.

Case study: Arkema produces bio-based Polyamide 11 polymer from castor oil. The fibres made from PA11 have the following properties compared to PA6, PA66 and polyester: light, cool touch, abrasion resistant, retention of burst strength, low water absorption, high drying fastness, better heat transfer time and rate and comfortable fabric for sportswear. Polyamide 11 is derived from the castor bean, a renewable crop that does not compete with food and is grown mainly in marginal soils. It is a drought-resistant crop that takes advantage of the natural monsoon rain phenomenon in India. Polyamide 11 is also a recyclable material.

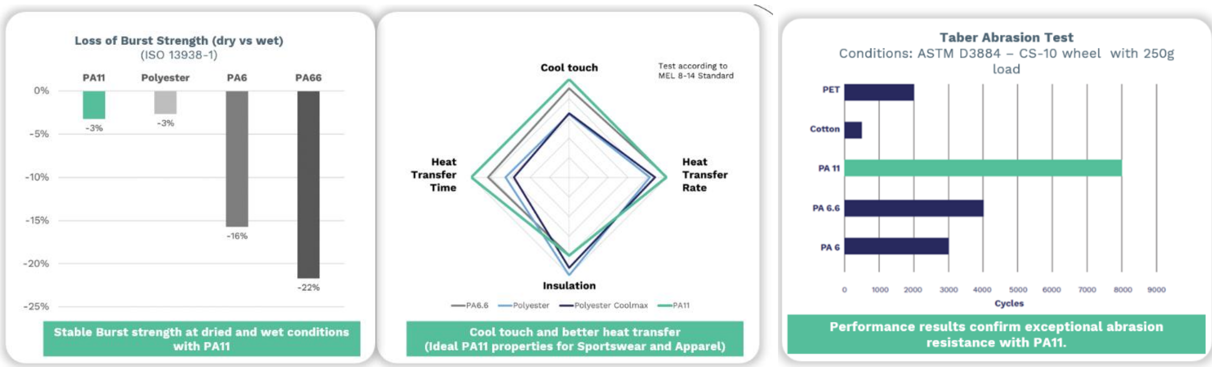


Figure 22: Technical properties tests of fibres from Arkema's Polyamide 11 compared to other fibres; Source: Arkema.

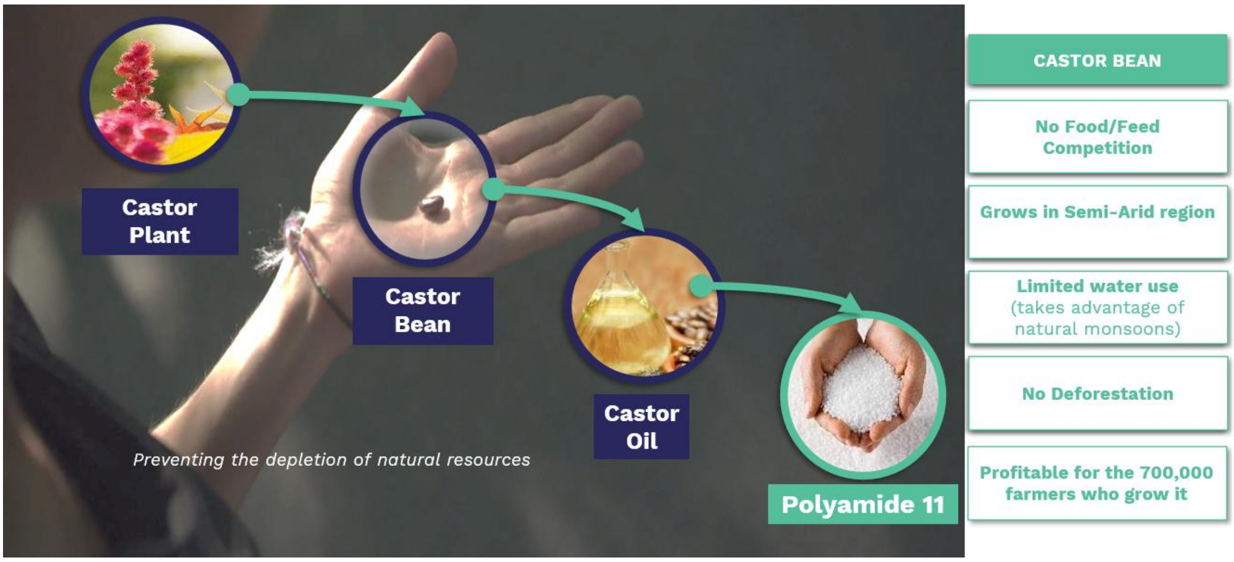


Figure 23: Arkema's bio-based Polyamide 11 value chain: from castor beans to advanced polymers; Source: Arkema.

Case study: Bostik innovates for adhesives in the form of pellets, powders, webs, and films that are made from the same polymers as fibres in textile products. This is one example of design for mono-material products, that facilitates end-of-life separation, repairability and recyclability. The more performant an adhesive needs to be, the more difficult it is to keep it as a mono-material, recyclable and disassemblable. They manufacture hot-melt adhesives that melt at high temperatures, enabling end-of-life separation & repairability.

Figure 24: Bostik's hot melt application to facilitate recycling; Source: Bostik.

Case study: W. L. Gore & Associates - How to define and measure durability for outdoor jackets? Outdoor wear should meet requirements for intended use: UV exposure, temperature, rain resistant, breathable, abrasion resistance, physical and chemical resistance, colour fastness etc. Currently, there are no common methods to measure durability of clothing. A collaborative project has been initiated to test waterproof and breathable jackets on ageing and when they start failing due to aging by wear in air and wind tunnels. It is led by an independent scientific research partner, the Sports Tech Research Centre at Mid Sweden University, together with 45 project partners including many outdoor apparel brands. The research found that jacket construction, along with the quality of materials used for laminates and seams, were the most frequent reasons for failure. It also indicated that a lack of garment maintenance can contribute to accelerated failure. These findings highlight the critical role of materials and care in an outdoor jacket's overall lifespan.

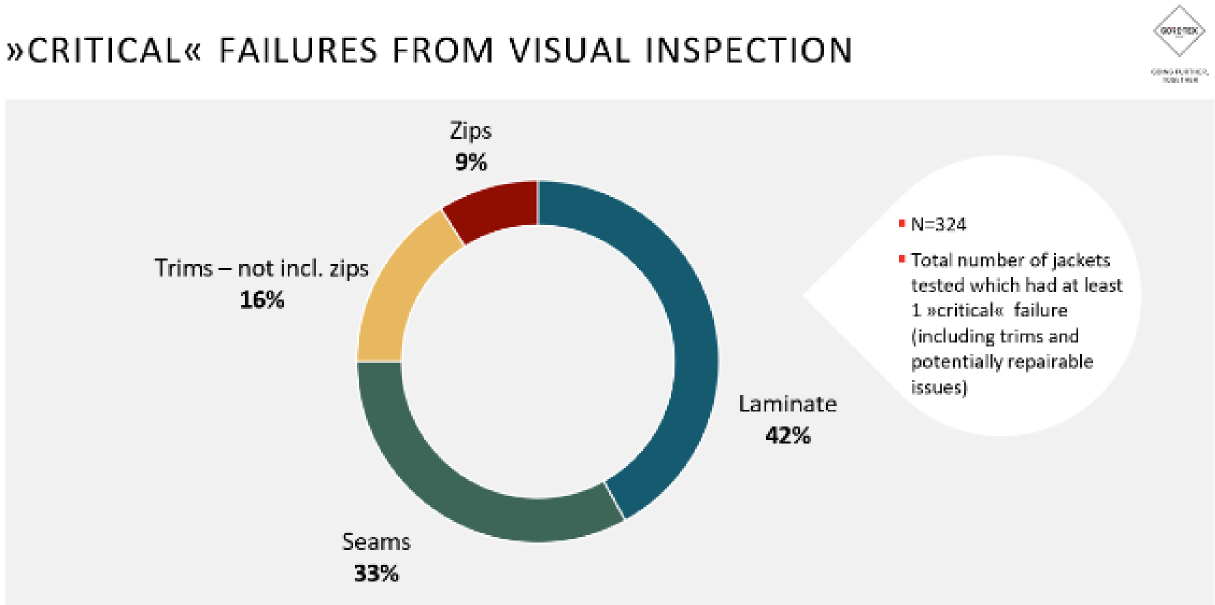


Figure 25 and 26: The [Durability Project](#) - Lab testing and visual inspection of critical failures in waterproof and breathable jackets; Source: Mid Sweden University.

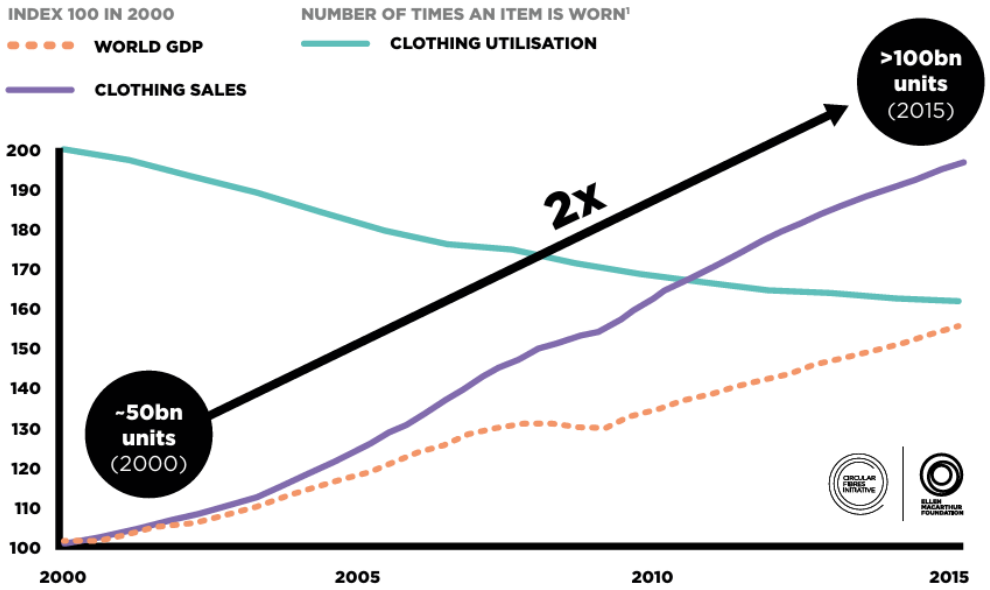
5. Alternative Circular Business models

5.1 From Owner to User

Transitioning towards a more circular textile value network also entails refusing, rethinking, and reducing the use of resources and existing business models. Alternative business models that move away from purely volume-based sales will become increasingly important, where businesses not only sell ownership of products, but (partially) provide apparel products as a service to consume fewer virgin resources and reduce waste.

Ownership of a product exists on a spectrum. At one end, the consumer fully owns the product; at the other, the product is leased as part of a service-based model—for example, “dressing the consumer for a certain period of time.” In this model, the item remains the property of the brand owner or manufacturer, and value creation is driven by the provision of a service rather than by product ownership.

Figure 27: Product-Service System (PSS) framework by Tukker; Source: Cefic-UNITY study – Accelerating the circular transformation (2025).



1 Average number of times a garment is worn before it ceases to be used

Figure 28: Growth of clothing sales and decline in clothing utilisation since 2000; Source: [Ellen MacArthur Foundation](), A new textiles economy: Redesigning fashion's future (2017).

5.2 Leasing of textile fibres

How could the chemical sector explore leasing textile materials as a business model? Could polyester or polyamide remain the property of the chemical manufacturer, while brand owners receive a fee for the value they add, and customers pay to use the textile product? The material could then be easily returned to the manufacturer for remanufacturing or recycling. A comparison was made with the return of reusable and recyclable glass bottles in Germany, where consumers bring bottles back and receive a deposit. Apparel textile is, however, more complex than glass bottles due to the diversity of materials, variety of designs, shapes, colours, and finishing of parts and layers. There are many different types of polyester and polyamides, so differentiation among these groups is still necessary. Also, an initial investment would be necessary to establish the infrastructure needed to enable this vision.

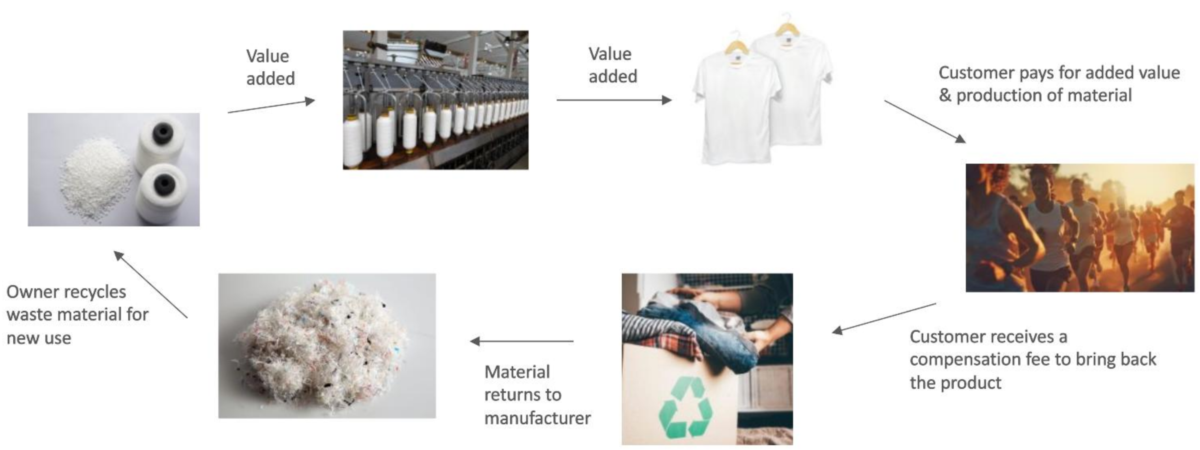


Figure 29: Textile leasing as a service; Source: Cefic.

Business models based on leaving of textile materials could be enabled by several factors. Design for durability and recyclability is key to enabling easy dismantling and recycling of the different parts. Collaboration and partnerships between fibre manufacturers and brand owners, repairers, collectors, and recyclers are also important to establish the value network necessary to realise these types of business models.

Extended producer responsibility schemes for textiles could be an incentive to enhance these business models, where the consumer would receive a fee when returning the material to the manufacturer for recycling. Introducing eco-modulation following the waste hierarchy would also incentivise for eco-design, making products easier to repair and recycle, and helping to cover the difference in the green premium. Including minimal recycled content targets would also support the development of business models for companies to invest in recycling. In order to recycle textile waste, regulation should allow the transport of these streams to sorting and recycling facilities.

In addition, this would need a behavioural shift, as currently, customers can attach emotional value to owning certain pieces of garments, while in this case, they would not own the piece of clothing but lease it instead. Several brand owners like Nudie Jeans, and On have already introduced leasing business models for some of their products.

5.3 Case studies and initiatives

Case study: VF Corporation has a family of brands like The North Face, Timberland, Vans, and Icebreaker. They currently provide repair services, guides, and DIY tutorials for some of their brands for common repairs of zipper replacements, holes and tears in insulated jackets, and open seams.

Case study: The outdoor brand VAUDE is working on increasing its design for durability, recycled (recycled mono-material PET) and renewable content, recyclability, and decreasing the presence of regulated substances well below REACH limits. VAUDE has offered rental, second-hand, refurbishment, and repair business models. With the trade-in program (buy-back from customers) the next step is planned for the end of 2026, to scale the second-hand business and make it sustainable and profitable at the same time.

Figure 30: Product Life Cycle Vaude Germany; Source: Vaude.

Case study: Nudie Jeans has a repair, take-back, and reuse business models for its denim wear. They offer free repairs for life. When turning an old pair of jeans, consumers receive 20% discount on new jeans. They upcycle their old jeans into carpets, but also mechanically recycle their Nudie Jeans into new recycled Nudie Jeans and blankets in a fibre-to-fibre loop with 20% recycled content.

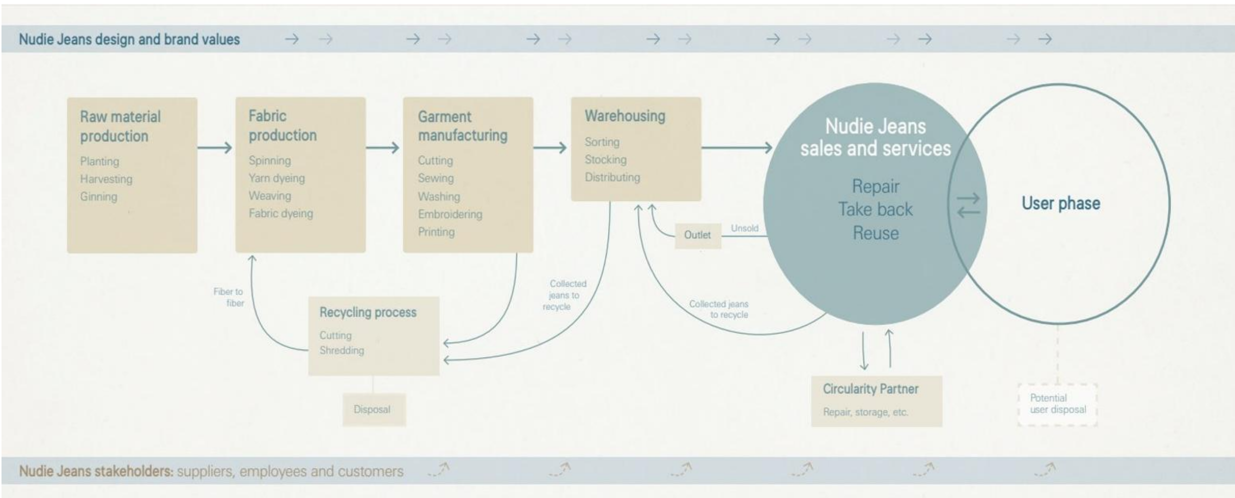


Figure 31: Circular value network Nudie Jeans; Source: Nudie jeans co.

Case study: On offers leasing of castor oil-based running shoes with a monthly subscription fee. After six months, the shoes can be returned, swapped, or the subscription can be kept. Worn-out shoes can be returned for recycling.

Figure 32: Subscription to lease partially bio-based running shoes, instead purchasing them; Source: On.

6. Author and Acknowledgements

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