We Can Cut Petrochemicals Use Today: Textiles

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Authors and Acknowledgments

Authors

Sasha Bylsma
T.J. Conway
Tania Evans
Joseph Fallurin
Meghan Peltier
Jikai Wang

Authors listed alphabetically. All authors from RMI unless otherwise noted.

Contacts

Sasha Bylsma, sbylsma@rmi.org
Joseph Fallurin, jfallurin@rmi.org
T.J. Conway, tconway@rmi.org

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About RMI

RMI is an independent nonprofit, founded in 1982 as Rocky Mountain Institute, that transforms global energy systems through market-driven solutions to align with a 1.5°C future and secure a clean, prosperous, zero-carbon future for all. We work in the world's most critical geographies and engage businesses, policymakers, communities, and nongovernmental organizations to identify and scale energy system interventions that will cut greenhouse gas emissions at least 50 percent by 2030. RMI has offices in Basalt and Boulder, Colorado; New York City; Oakland, California; Washington, D.C.; and Beijing.

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Executive Summary

- After packaging, textiles are the most common end use for major commodity plastics, accounting for nearly one of every four tons. Textiles also drive significant demand for non-plastic petrochemicals including detergents, solvents, elastomers, and fertilizers. Because carpets are covered in our previous **brief on buildings**, this report focuses on textiles used in clothing.

- Most clothing contains plastics. About two tons of plastic fibers are used for every ton of natural fibers. Apparel makes up the largest share of textiles and drives over 55% of demand for polyethylene terephthalate (PET) (resin code #1) plastic to make polyester fabrics.

- Plastic fiber production is closely linked to gasoline and polystyrene (resin code #6) plastic production. Although some inputs can shift among all three of these uses, demand for one maintains a minimum supply chain capacity for the others to process byproducts. This production link creates an effective floor on gasoline production and thus oil demand.

- Clothing use per person varies widely in amounts accumulated, time used, and articles wasted. Globally, the average time from clothing article purchase to disposal has **dropped by over one-third** since 2000, and the rate of clothing purchases outpaced population and GDP growth. Consumers are buying more clothes and using them for a shorter time than ever before.

- Decision makers should prioritize:
  - **Quantity of years textiles are used** over quantity sold
  - **Repairing core clothing** when possible and otherwise replacing items with long-lasting secondhand items
  - **Increasing use of specialty garments** by sharing between wearers across the shortest practical distances, ideally using electric transport
  - **High-quality designs for clothing articles** that lower reuse and recycling barriers
  - **Sustainably sourced** natural fibers and specific recycled content when new garments are required

- Key actors can incentivize these actions by:
  - **Scaling models** that minimize new materials and life-cycle emissions
  - **Accelerating transparency platforms** with independent certifications and standards that empower clothing buyers to make the lowest-impact decisions
  - **Unlocking finance flexibility** for sustainable circular business models
  - **Raising corporate disclosure requirements** to address transparency bottlenecks
  - **Shifting tax burdens** away from reuse transactions and toward new synthetic clothing

Analysis of Existing System

Textiles are a group of materials created from fiber strands through processes like weaving, knitting, and tufting. Although textiles are predominantly recognized as fabrics and clothing garments, the term also includes a wide variety of other fiber-based products, from furniture upholstery to rope to medical masks. The history of textiles follows that of human history, predating industrialization by thousands of years as evidenced by **weaving looms** in several ancient civilizations. In the mid-18th century, mechanical and technological advancements in cotton fiber processing and fabric weaving devices led textiles to become the first sector to mass produce. The next important shifts in textile history, taking place over the past 60 years, were the commercialization of synthetic fibers and the **movement of manufacturing** largely to the Global South.

Pairing subsidized fossil feedstocks with **low-wage labor markets** has enabled inexpensive mass production of textiles to meet growing consumer demand. Mass production of textiles, both synthetic and bio-based, has also posed significant external costs, including **2%–7% of global greenhouse gas emissions** and **20% of industrial wastewater pollution** annually. This insight brief focuses on the clothing and apparel segment as the main driver of textile market growth and the leading contributor to the social and environmental impacts of current textile production.

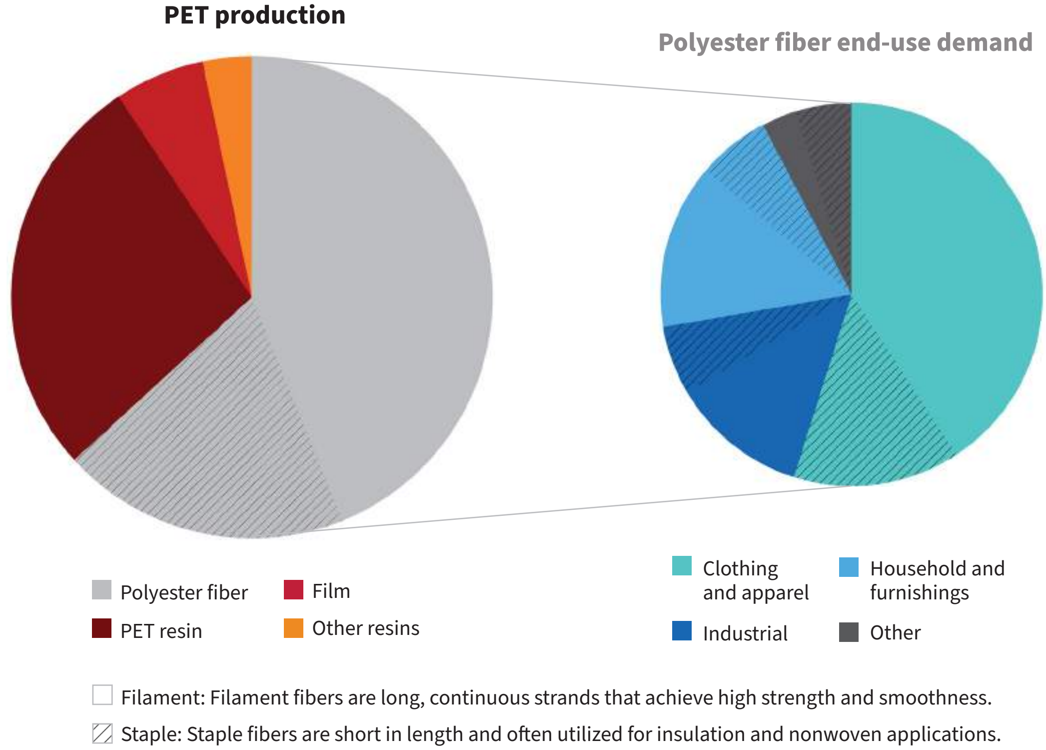
> **Reducing demand for synthetic, plastic-based textiles is an important element of the effort to cut oil product demand.**

Petrochemicals in Textiles

Plastic fibers are the primary component of petrochemical demand in the textile sector, and growth in this market **outpaced all other plastic end use applications** in recent decades. Reducing demand for synthetic, plastic-based textiles is an important element of the effort to cut oil product demand. Among the various materials and associated impacts of the textile industry today, one fiber material is ahead of the field: polyester. Polyester, the fibrous form of the polymer polyethylene terephthalate (PET, resin code #1), constitutes **nearly 84% of global synthetic fiber production** — larger demand by a wide margin than other petrochemical-derived fibers in this category such as nylon, elastane, and acrylics. Over the past two decades, polyester production grew **over five times faster than cotton** and effectively doubled global fiber output. Today, virgin fossil fuel–based polyester makes up over half of the total fiber market by weight.

As shown in Exhibit 1 (next page), polyester fiber production is double that of PET resin for packaging, and over half of polyester fiber demand is consumed as clothing and apparel.

Exhibit 1 **Clothing demand is a key driver of PET plastic production**



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The production of polyester, like other commodity plastic sectors such as packaging, relies on the extraction of nonrenewable resources and emissions-intensive manufacturing, and creates long-lived waste legacies. In the production segment, polyester requires two main, traditionally fossil fuel–based inputs — monoethylene glycol (MEG) and purified terephthalic acid (PTA) — and incurs the use of **several harmful chemical and metallurgical additives**. These PET building blocks are sourced from different points in the oil and gas value chain, and both require energy-intensive processes with toxic byproducts to synthesize: PTA relies on processing naphtha from crude oil refineries, and MEG requires ethylene steam cracking, both of which create benzene byproducts. The use and disposal of polyester also pose risks of water contamination and ecological damage through the **release of microplastics** from garment washing and deterioration.

Petrochemical use in the clothing industry isn't limited to polyester, however, or even to synthetic fibers. Cotton production may use petrochemicals in the form of fertilizers and pesticides during growing, and synthetic dyes during fiber and fabric processing. Beyond the embodied carbon and chemical footprint of clothing textiles, the hallmark consequence comes in the post-use stage, where an estimated **73% of clothes disposed of end up landfilled or incinerated**. Further, the **export of textile waste** to developing countries presents environmental justice concerns.

Consumer Preferences and Behavior

Unlike in the packaging and building sectors, consumers wield a high degree of bargaining power in buying clothing and apparel products. As a result, a wide array of personal preferences — such as style, comfort, and identity — join the more common differentiating factors of consumer goods like quality, durability, and price in the purchase decision-making process.

Fashion trends are a particularly significant driver of the clothing industry's social and environmental impacts. Fast fashion has been the predominant trend in the apparel market since the 1990s, characterized by an accelerated time line of production to sale, a high number of trend cycles and product catalog switching, a decrease in garment build quality, low prices, and intensive branding and marketing to sell the latest on-trend style. The rise of fast fashion has created high-paced consumption and waste cycles, turning once durably constructed products to disposable, with **one garbage truck of clothing textile landfilled or incinerated every second**.

Trends create their own counter-movements, and in the clothing industry the principles of slow fashion are emerging on the heels of fast fashion. Sustainability-conscious shopping looks different across generations, geographies, and personalities. Generation Z consumers are especially influenced by environmental and social concerns. **Nine in ten** of these consumers believe that companies have a responsibility to address environmental and social issues. Furthermore, they gravitate toward brands backing shared values like workers' rights, climate action, and executive equity.

As consumers pay more attention to social and environmental criteria, they may define "sustainable" in different ways. Researchers from Institut Français de la Mode **traced consumers' understanding of sustainable fashion** and found that a company's commitment to environmental protection and use of sustainable materials stood out as two critical factors. A **McKinsey survey** shows that 60% of consumers would prefer sustainable fashion with less climate impact. Two-thirds of respondents said the use of sustainable materials is a vital factor for a purchase.

There is a considerable gap between consumers' attitudes and their actions when it comes to sustainable fashion. WWF and Bain point out that **differences emerge between what consumers say and what they do** when faced with decisions like whether to avoid fast fashion, buy secondhand pieces, and purchase clothes with sustainability certifications. The discrepancy between attitude and behavior is especially pronounced when the consumer is required to gather and verify information before making a purchase. For example, consumers' attitudes and actual behaviors are much more consistent with regard to reducing purchases than to buying natural-fiber clothes. Zalando, a leading European online platform for fashion and lifestyle, found that **although 60% of survey respondents appreciate transparency, only 20% proactively search for the sustainability profiles** and take them into account during the purchasing process.

In addition, the lack of sustainable options can thwart consumers' efforts, especially when no sustainable product lines are offered by their preferred brands. Even when sustainable options are offered, limited or obscure information on the label could further hamper consumers from making the deal. The so-called **attitude-behavior gap varies among consumers**. Newer generations, who show strong preference for sustainability, consistently take more action than those in older generations and consumers who prioritize affordability in clothing over green characteristics. Three potential pathways to narrow the gap include:

- Building a transparent and standard information-sharing pattern with customers
- Lowering barriers to sustainable fashion products via more accessible purchase channels
- Tailoring strategies to specifically target the purchasing habits of different consumer personas

It may be difficult to motivate consumers to purchase sustainable fashion with green attributes alone. However, when sustainability is combined with other benefits such as quality, durability, and style, consumers' purchasing decisions can change. As **durability and quality are closely tied to sustainability**, the attitude-behavior gap can be mitigated by focusing on higher-quality clothes instead of on "sustainability."

Paying for durability and quality is often more acceptable and targetable because consumers can see, touch, and experience it; in contrast, sustainability benefits can seem conceptual and intangible. The mantra **"buy less and buy luxury"** proposes that high-end apparel considerably reduces life-cycle emissions and reduces consumption of low-cost, less durable clothing. When these purchases are viewed as long-term investments, they also have more potential for repair, reuse, and resale. However, since fast-fashion garments offer a cost advantage, leveling the playing field to make sustainable options more affordable remains paramount. Shifting marketing budgets and consumer incentives from quantity-based discounts to **use-based and source-based rewards** can profitably align retailers better with their customers' true sustainable demands.

Weighing Alternatives to Virgin Plastic

The search for alternatives to virgin fossil fuel–based polyester inevitably encounters trade-offs when taking a life-cycle perspective inclusive of raw material sourcing and disposal. Compared with synthetic fibers, natural fibers use fewer total petrochemicals per ton but use more land, water, and farm-specific petrochemicals, with cotton alone using about **4% of fertilizer** and **3% of arable land** globally. In a meta-analysis review of life-cycle assessment (LCA) literature on the emissions intensity and energy usage of different fiber types, **cotton on average outperformed polyester** in key supply chain segments like raw material extraction, yarn spinning, fabric manufacturing, and the use phase. Fortunately, increasing cotton production through crop location optimization can also increase food production as shown in **an analysis of US farmlands**.

> **In a meta-analysis review of life-cycle analysis literature on the emissions intensity and energy usage of different fiber types, cotton on average outperformed polyester in key supply chain segments like raw material extraction, yarn spinning, fabric manufacturing, and the use phase.**

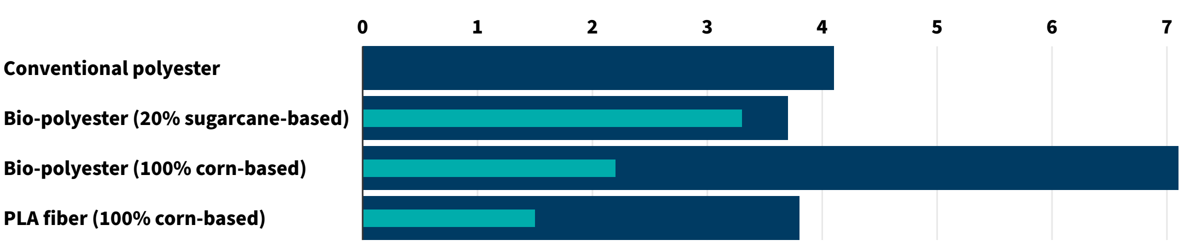
The use of bio-based feedstocks introduces another variable to the environmental impacts of fibers. Crops such as corn and sugarcane can be fermented and distilled to produce bioethanol, which can serve as a drop-in feedstock for production of plastics like polyester. Integrating bio-based content into feedstocks retains the infrastructural efficiencies of using existing technology while achieving emissions reductions, but the magnitude of these reductions **can vary based on accounting methodologies**.

As Exhibit 2 illustrates, bio-based polyesters with various renewable feedstock slates and production routes can achieve a lower emissions intensity than conventional, fossil-based polyester. If the biogenic carbon that the crops sequester in their growth is accounted for as carbon removal, this tips the scales further and can drastically change outcomes. These additional emissions savings hinge on assumptions about a product's end-of-life treatment as well as the presence of a robust carbon accounting ecosystem.

Exhibit 2 **Carbon accounting affects climate impact of bio-based polyester alternatives**

kg CO_2e/kg fiber

Production processes only | Net including biogenic carbon uptake

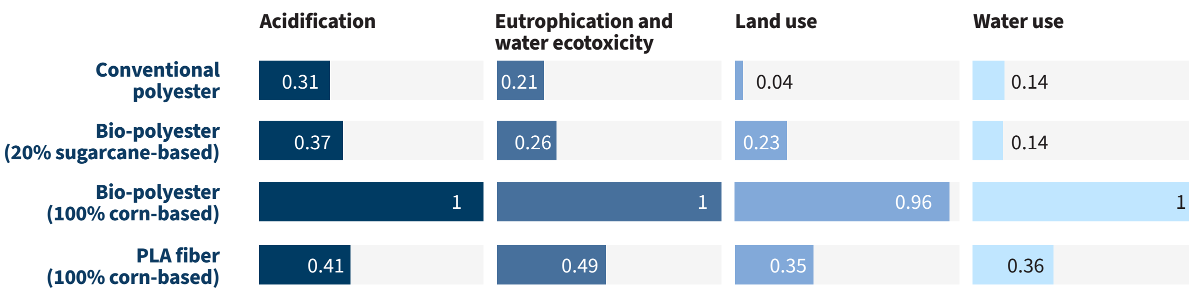


RMI Graphic. Source: Ivanovic et al., **https://doi.org/10.3390/app11072993**

Considering a wider array of environmental impacts beyond CO_2 equivalent further complicates analysis of bio-polyester's potential. In Exhibit 3, select impact categories of the same modeled fibers are normalized into indices of low to high relative impact. The results confirm that in scenarios using bio-based feedstock, the environmental impacts — aside from greenhouse gas emissions — generally increase. These impacts, which vary widely depending on original feedstock and production method, in some cases approach, but often exceed, those of conventional polyester.

Exhibit 3 Environmental impacts can increase with more bio-based inputs

Each value represents a 0–1 low to high environmental impact score relative to nine polyester alternatives.



RMI Graphic. Source: Ivanovic et al., https://doi.org/10.3390/app11072993

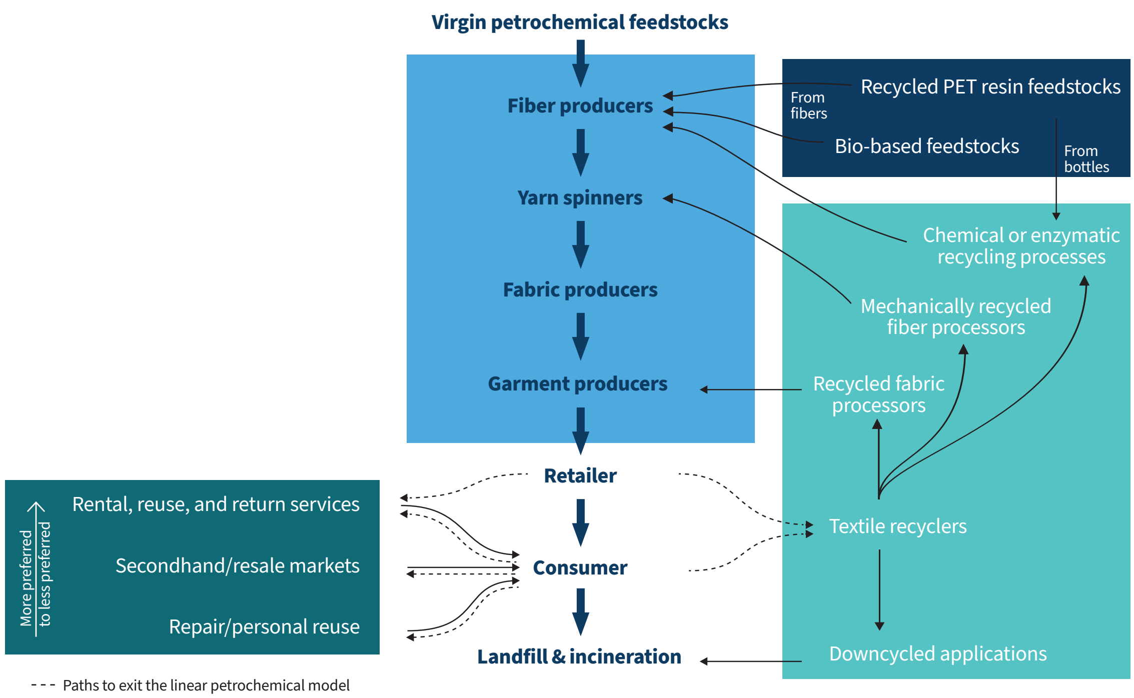
To facilitate sustainable sourcing of textile fibers while avoiding the uncertain environmental impact and limiting factors of a complete switch between fiber types, the textile industry has adopted the concept of "preferred" materials. Coined by **Textile Exchange, preferred materials** are those resulting in improved environmental and/or social sustainability outcomes and impacts compared with conventional production. This distinction lays out criteria that a preferred material must meet, such as the use of chain-of-custody models for data integrity and transparency throughout the supply chain, industry standards and LCA studies to confirm performance, and product design that aims for both reclaimed material inputs and circular-waste outputs.

For cotton, some **sustainability standards** require and monitor regenerative agriculture practices such as cover crops, rotational grazing, and no synthetic inputs. Emerging standards programs that focus on utilization of agricultural waste residues also have potential to reduce the environmental impact of **bio-based feedstocks** for textiles by avoiding additional land use and preventing waste. Other standards produce preferred textiles by using recycled materials, such as the Global Recycled Standard (GRS) and the Recycled Claim Standard (RCS). **Under these certifications**, the emissions intensity of recycled cotton is 80% below the conventional baseline, and certified mechanically recycled polyester demonstrates a 76% emissions reduction from virgin polyester.

Textile Circularity

Although alternatives to petrochemical fiber can result in greenhouse gas emissions reductions, the discourse around sustainable fashion is largely focused on the detrimental impacts of fast fashion and increased textile waste. To address this issue, there has been a focus in the fashion industry on driving toward a circular economy through reuse and recycling methods. These solutions may sound simple, but a large array of methods is available for textiles with varying stakeholder responsibility, market popularity, and sustainability benefits (see Exhibit 4).

Exhibit 4 Mapping opportunities to advance decarbonized circularity in textiles



Design for circularity

- Design textiles for circularity through durable mono-material or recyclable blend garments.
- Discontinue the use of hazardous dyes and additives.
- Increase use of clear labeling for end-of-life management.

Reuse markets

- Adopt repair and refurbishment best practices to extend textile lifetimes.
- Increase supply and demand for secondhand garments through incentives that encourage reuse.
- Focus rental services to markets with low usage rates per owner while minimizing transportation distances and emissions.

Alternative feedstocks

- Increase transparency of sustainable natural fiber production through producer uptake of certifications and standards.
- Ensure waste PET resin feedstocks are below minimum mechanical recycling quality limits to avoid downcycling.
- Actualize 100% post-consumer recycled content commitments with clear labeling of recyclate origin.

Recycling models

- Provide takeback programs that create single stream recycled feedstocks and offer transparency into end-of-life for garments.
- Increase sortation capabilities by investing in advanced sorting equipment and workforce education.
- Reuse fabric scrap waste from manufacturing and pre-consumer overstock by repurposing material into new garments.
- Encourage innovation in fiber-to-fiber recycling technologies that minimize chemical and water usage and production greenhouse gas (GHG) emissions.
- If material is downcycled, preferentially downcycle to long-lived applications such as shoddy or insulation over short-lived applications like rags.

RMI Graphic.

Reuse Models

In the textile industry, the greatest environmental benefit can be gained by reducing consumption and extending the useful lifetime of garments. Some brands offer repair services that allow consumers to bring in damaged textile products. Using a garment for longer results in the lowest greenhouse gas impact by not introducing additional transport, cleaning, or production emissions. Although this method of personal reuse has the most environmental benefit, consumers often want change in their wardrobes. Additional reuse models can fill that need while reducing environmental impact compared with virgin production.

An LCA for clothing demonstrated that resale models result in lower climate impacts than base virgin production as long as secondhand purchases displace consumption of virgin materials. In the same study, rental models, which extend the lifetime of a garment by increasing the number of users, showed an increase in climate impact due to increased delivery and washing. Understanding that resale and rental models must replace virgin consumption and limit delivery-related emissions to result in overall environmental benefits is critical to making a tangible impact. To this end, a focus on place- and market-based applications of these models can result in the greatest environmental benefits.

“Traditional donation and thrift centers, local clothing swaps, and consignment shops like Buffalo Exchange and Plato’s Closet that take clothes and resell them in the same region, capture the largest environmental benefit by minimizing transportation emissions.”

The resale market is the largest segment of the fashion circular economy and has been growing quickly, representing a $211 billion market. Secondhand clothing is projected to account for 10% of the global apparel market in 2024. This market is made up of a mix of traditional donation and thrift centers, clothing swaps, brick-and-mortar consignment shops, online resellers, and brand resellers. Traditional donation and thrift centers, local clothing swaps, and consignment shops like Buffalo Exchange and Plato’s Closet that take clothes and resell them in the same region, capture the largest environmental benefit by minimizing transportation emissions.

As demand for secondhand clothes has increased, so have innovations in online resale shops including online peer-to-peer resellers and online consignment shops. Resale markets have proven to be a viable business model, and major brands have started to invest in their own lines like Patagonia’s Worn Wear, partnering with companies providing resale as a service to capture sustainability-minded consumers. These models extend the lifetime of existing textiles and provide environmental benefit compared with virgin production of these materials, even with additional transportation emissions for online delivery.

The fashion rental market is the second-largest segment of the industry’s circular economy. Rental or fashion subscription services attempt to increase the useful wears of textiles by raising the number of users per garment. Rental models can result in higher greenhouse gas impacts compared with virgin textile consumption due to higher transportation and wash emissions associated with each rental, return, and cleaning. To minimize these environmental detriments, rental-based textile models can be applied intelligently to targeted markets and, where possible, work to reduce transport and cleaning emissions through renewable electric systems. **Formal or special occasion wear** is a natural fit for this model, with items that owners typically dry clean between uses and wear only a few times. To produce tangible environmental benefits, the rental of a textile must replace production of a new garment for several owners, a model that is already popular for some special occasion wear such as tuxedo rentals.

Recycling Textiles

Textile recycling constitutes the smallest share of the fashion circular economy. Most clothing in the United States is discarded to landfill or incineration, with **about 15% of remaining textiles** diverted to thrift donation centers or other collections. Some places like New York City have programs **in place** to increase awareness and accessibility of these collection centers in hopes of increasing this number. After reaching donation centers, about 80% of the material is sent to additional sorters/graders/brokers, and from there 50% of the material is downcycled into other materials with less than 1% of material recycled back into fiber.

Fiber-to-fiber recycling is the only closed-loop method of recycling for textiles and remains a very small share of the textiles market. Compared with recycling rates of **about 29% in the United States for PET bottles**, textile recycling rates are low due to the inherent difficulties of the process. Textiles are often made of fiber blends that are difficult to identify during sortation, and clothing often contains a mix of dyes and embellishments that further prevent single-material segregation. Given these complexities, the textile recycling landscape has a variety of recycling processes with varying environmental impacts, ease of application, and technological readiness.

The most straightforward way to simplify complex and manual sortation for textiles is to recycle textiles that come from a homogenous stream. More than 15% of textile fiber is wasted during garment production — in the form of defects, fabric scraps, and other loss. An estimated additional 20%–30% of textiles are wasted as retail overstock. Recycling this pre-consumer material, either at the production facility or wholesaler or through a fiber recycling facility, can cut down on textile waste and provide a relatively homogenous stream for the recycling process.

In addition to waste collection and recycling, textile producers can increase their use of "mono-material" garments and recyclable fibers, and reduce embellishments like sequins that hinder recycling to create a more easily recycled garment. Additionally, garment producers can engage in takeback programs that allow consumers to send used garments back to the producer at their end of life to be recycled and include clear labeling of fiber blends in garments to ease sortation at collection facilities.

Once material has been identified and sorted, textiles can be mechanically recycled through shredding fabric and respinning the fibers into new yarn. This process is only viable for mono-materials and polycotton blends, and results in shorter fiber length than virgin fiber production, typically limiting recycled fiber content in garments. This process is the least energy intensive but results in limited fiber-to-fiber applications due to the reduced properties of the fiber.

> **More than 15% of textile fiber is wasted during garment production — in the form of defects, fabric scraps, and other loss. An estimated additional 20%–30% of textiles are wasted as retail overstock.**

To address the technical limits with hopes of creating a closed-loop process for fiber-to-fiber recycling, innovation in solvent-based chemical recycling for textiles is ongoing. These processes often have higher environmental impact than mechanical recycling due to more process heat and the use of large volumes of chemicals or solvents. Both mechanical and chemical recycling for textiles is expensive due to technical difficulty and cumbersome feedstock sortation. As a result, these materials are often downcycled instead — that is, textile fibers from clothing are used to produce non-clothing goods such as industrial rags, stuffing, insulation, and carpets. Most recycled textiles — 99% — are downcycled versus recycled to new garments in fiber-to-fiber processes.

Recycled Textiles Content

Despite low textile-to-textile recycling rates, many major brands and retailers have announced ambitious targets for recycled content in products. Some of these targets and progress toward them are being reported by Textile Exchange, which requires signatories to commit to 45%–100% recycled polyester content in their products by 2025. To reach these goals, fashion retailers and brands use polyester recycled largely from PET bottles. As textiles are downcycled into insulation or rags, rPET (recycled polyethylene terephthalate) from recycled bottles can be downcycled into fiber for use in fabric. Closed-loop recycling of PET bottles, bottle-to-bottle, requires higher grade material for food contact, allowing lower grade rPET to enter the recycled fiber market.

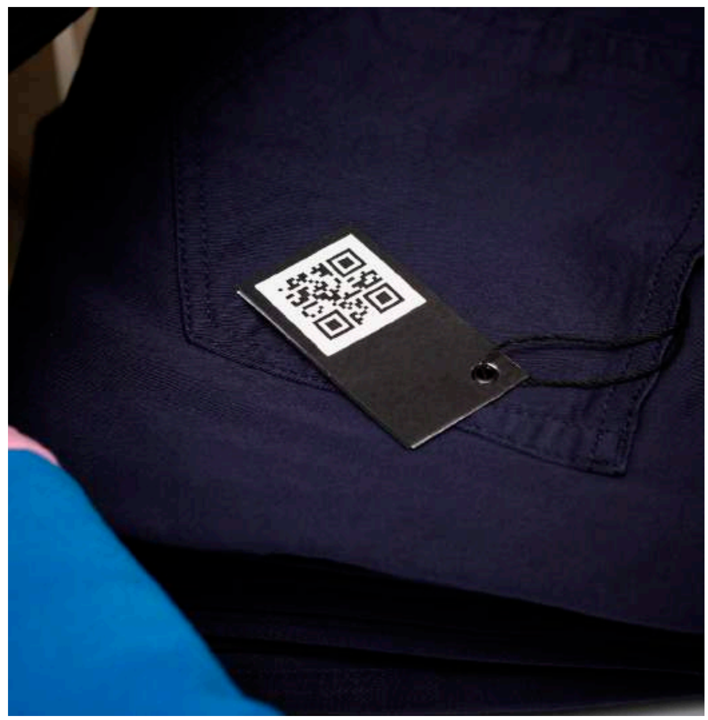
Although this makes certain grades of rPET attractive for use in textiles, companies selling packaged consumer goods have also signed on to ambitious recycled content targets with the **Ellen MacArthur Foundation**. To hit targets in both industries, **14 million tons** of new rPET supply would be necessary, requiring massive improvements in PET collection and recycling.

Much like the other circular economy models, using recycled polyester from bottles in textile production results in substantial environmental benefit as long as it offsets virgin polyester production. However, the ***First Annual Report*** from Textile Exchange demonstrated that more than half of the participating companies reported an increased overall polyester usage which would offset benefits from incorporating recycled PET into products. Similarly, using rPET in clothing provides an environmental benefit for lower quality rPET material only. Taking higher grade rPET out of closed-loop bottle-to-bottle recycling streams and downcycling the material into fiber to meet fashion brand targets would result in lower environmental benefits than the base case bottle-to-bottle recycling scenario. To address this issue, it is critical that textile retailers and producers be transparent about the source of recycled content in clothing to ensure maximum sustainability benefits from recycling.

Demand Reduction Levers

It is increasingly evident that solutions to curb the impact of clothing and its associated petrochemical use face many barriers and bottlenecks — from consumer attitudes and land use change to gaps in recycled material supply. Overcoming key obstacles will require concerted effort not just from the immediate supply chain players but from supporting stakeholders as well. These stakeholders, including traceability innovators, investors, and local policymakers, play a vital role in helping the textile industry's transition.

Product Transparency



Emerging digital capabilities are bolstering the fashion industry's transition to sustainability by improving authentication, offering transparency, building consumer trust and retention, and scaling circular models. These can include consumer-facing initiatives, such as Stylyze's **digital labels that inform recycling best practice**, and EON's **cloud-based product passports** that provide customers with transparent and comparable sustainability information. They also include solutions that are deployable to retailers' behind-the-scenes business intelligence, such as Vaayu's **carbon accounting software** for tracking and calculating emissions down to granular data at the product level.

In addition to providing greater transparency for customers and other stakeholders, digitalization can empower a sustainable apparel industry by improving inventory management and operational efficiency. Digital technologies can help monitor supply and demand balances and provide a more accurate stock forecast. This minimizes the need for forced clearance sales that exacerbate overconsumption and long-distance replenishment that drives up emissions. By decreasing unnecessary stock, **pre-consumer waste can be reduced** from the retailers' value chain or redirected to fabric recyclers. Meanwhile, a transparent and robust digital inventory platform can boost collaboration between apparel retailers and multiple vendors, leaving **more flexibility in regional sourcing and more potential to achieve nearshore manufacturing**, contributing to a more sustainable supply chain.

Consumer coalitions and consultancy experts in verification services play an essential role in building the third-party certification of green attributes and the recycling standards for the apparel industry. Verified products are usually tagged with a QR code or RFID that consumers can scan to access the relevant certificates and information. **Bluesign** constructed a comprehensive methodology to verify textile product profiles with a focus on sustainable chemicals, and designed product segment–based guidelines to specify the highest environmental standards for different apparel. **OEKO-TEX offers eight different textile sustainability standards** with concentrations on materials, environmental and social responsibility, life-cycle emissions, and health security. ECOCRET promotes its **Global Recycled Standard labels**, which certify textile products containing at least 20% recycled materials and meet other criteria.

Despite widespread implementation, some certificates have drawn criticism due to lack of data transparency and questionable methodology. The controversy around the Higg Material Sustainability Index (MSI) and the subsequent **pause of its use** as a consumer-facing label by many European regulators is a valuable case study. A variety of Higg indices were introduced by the Sustainable Apparel Coalition for standardized measurement of value chain sustainability, and more than 21,000 organizations adopted these measures. However, an article by the *New York Times* reporting that **Higg MSI favors synthetic materials (nylon, polyester) over natural fibers** triggered a crisis of trust with consumers. Experts found that Higg indices skewed toward petrochemical-based fibers because the methodology offers a non-life-cycle analysis of climate impact and **relies on studies sponsored by fossil fuel–based fabric producers**. Furthermore, some core data is accessible only to companies, creating more greenwashing risk.

Hence, there is a growing call for these third-party certification providers to improve independence and transparency, refine their frameworks, and communicate their data and results to consumers in a more accessible way.

Finance

To achieve a systematic transition to sustainability by 2030, the textile industry needs **at least $20 billion annually** to deploy technology and transform its business model to meet consumers' preferences and regulatory compliance. Innovation in raw materials will require the largest portion of this investment at 25%, followed by end-of-life disposal technology and infrastructure for the circular economy, which makes up 20%.

Given that investing in these hard-tech fields requires a high technical threshold and usually a long-term investment cycle, impact funds or thematic funds with a focus on sustainable apparel stand out. The Good Fashion Fund (GFF) is the first investment fund solely concentrated on sustainable fashion technology implementation. **GFF provides $1 million to $2.5 million long-term loans** to help textile and apparel manufacturers adopt green technologies with a geographical focus in Bangladesh, India, and Vietnam. GFF uses an impact measurement framework based on the best market standards and collaborates closely with local partners to measure, monitor, and verify the impact throughout the investment cycle.

Alante Capital and **Style With Substance Ventures** are boutique venture capital firms focusing on innovative technologies for apparel production and retail. They mainly make equity investments across clean tech and supply chain software to support a more sustainable apparel industry. A diversified portfolio along the whole value chain of sustainable fashion dilutes the risks and creates a supportive and collaborative ecosystem for potential synergies between those early-stage companies.

Impact investors have been gradually transferring their strategy from best-in-class to pursuits for positive impacts. For instance, **Triodos Investment Management** used to include Inditex (Zara's parent company) and H&M in its portfolio, with an acknowledgment that they went beyond the environmental, social, and governance (ESG) compliance monitoring and manufactured and managed a sustainable supply chain. However, Triodos has turned to investing in brands leading in durable materials usage, reuse, repair, and recycling, along with incubators that support startups pioneering sustainable materials to encourage circular economy growth and sustainable innovation.

Another trend in sustainable fashion investing emerged in the bond market. Increasing adoption and further integration of an ESG lens from investors have put massive pressure on the fashion industry to pledge sustainability targets. Green bonds, sustainability bonds, and sustainability-linked bonds (SLBs) add considerable financial incentives to apparel companies' ESG commitment, requiring them to take continuous action and be transparent with investors. For example, VF Corporation, the owner of Timberland and Vans, just **announced a closing of its second €500 million green bond** this year, with which it promised to finance three criteria: green materials, sustainable operations and supply chain, and natural carbon sinks.

However, people tend to **doubt the fashion industry's commitment to green investments due to greenwashing concerns**. A Bloomberg analysis found that most fashion SLBs are tied to weak, irrelevant, or even already-achieved climate targets. This has given rise to **investors' desire for more measurable, comparable, and aggressive key performance indicators for green bonds**, such as demanding a limit on production volume and a higher ratio of bio-based alternative material usage.

Policy

Policies that encourage corporations to disclose their activities and environmental impact can lead to better emissions tracking and waste management and allow consumers to make more informed purchases. One approach to this is to minimize greenwashing through stricter regulation of advertising. Part of the **EU Strategy for Sustainable and Circular Textiles** is the enforcement of its **Green Claims Directive**, which provides criteria on environmental labels and requires claims to be checked by accredited third parties. In addition to ensuring the accuracy of overall environmental claims, requiring textiles to have labels that **disclose the weight percentages** of constituent fibers helps differentiate the environmental impact of individual garments. Transparent and accurate labels bridge the consumer demand for environmentally friendly textiles and actualized emissions reductions.

Beyond the labels on consumer-facing products, policies can push for disclosure further up the supply chain. The **New York Fashion and Sustainability Act** requires retailers and manufacturers to maintain an emissions inventory, establish reduction targets, and report them annually, in addition to requiring disclosure of water and chemical use. Another aspect of the **EU Strategy for Sustainable and Circular Textiles** is the requirement for companies to publicly disclose the number of products that they discard, destroy, reuse, and recycle. This measure was further strengthened by the accelerated timeline for a ban on destruction of unsold clothing as part of the **Ecodesign regulation**. EU member states agreed to work toward disclosure on discarded products and their end-of-life treatment with measures banning the destruction of unsold textiles.

Tax incentives can be used to support circularity measures, which would ultimately drive down demand for new synthetic textiles. One example is **Maryland's sales and use tax exemption** for secondhand apparel under $20. This strategy could be extended in the opposite direction by placing higher taxes on new clothing with high synthetic-fiber content. Monetary incentives for consumers can also include rebates on circular behaviors. An example of this approach is in place in **France, which offers a credit** to consumers who mend their clothing. Extended producer responsibility legislation, which places the responsibility for waste management on producers, could also be used to encourage circularity. The shifted responsibility may incentivize producers to recycle or repurpose items that otherwise would have been landfilled or incinerated.

Demand Reduction Series Concluding Remarks

Reducing demand for new clothes ultimately means understanding the existing textile landscape and acknowledging that each garment is a useful asset, as we did for **buildings** and **packaging** systems. Using this knowledge to identify new approaches to textiles, building finishes, and packaging can reduce wasteful material dependencies while redirecting unsustainable investments toward building a cleaner future. Systemic and structural changes, in addition to technological advancements, are needed at every step of the supply chain to create extended and sustainably circular product life cycles. Front-loading these demand reductions would eliminate the need for new conventional petrochemical infrastructure this decade, reducing the risk of stranded facilities with unfavorable economics, dire climate consequences, and harmful local community impacts.

Sasha Bylsma, T.J. Conway, Tania Evans, Joseph Fallurin, Meghan Peltier, and Jikai Wang, *We Can Cut Petrochemicals Use Today: Textiles*, RMI, 2023, **https://rmi.org/insight/we-can-cut-petrochemicals-use-today-textiles/**.

RMI Innovation Center
22830 Two Rivers Road
Basalt, CO 81621

www.rmi.org