Textile Exchange

Preferred Fiber & Materials Market Report

October 2022

Foreword

Materials Matter. The production, use, and disposal of fibers and materials have significant impacts on people and planet.

Textile Exchange's vision is not only to reduce these negative impacts but to harness the potential benefits that more sustainable global fiber and material production can have on people and the environment.

Textile Exchange is a global non-profit that creates leaders in the preferred fiber and materials industry. Our Climate+ strategy aims to help the global textile industry achieve a 45% reduction in the emissions that come from producing fibers and raw materials by 2030 while also addressing soil health, biodiversity, and water.

Our Preferred Fiber and Materials Market Report is a comprehensive annual publication which provides unique data and insights and helps the industry to measure progress towards its goals. The report covers the market for the key fibers and materials, including the conventional ones and those referred to as "preferred".

We want to note that **our definition of "preferred" is evolving**. Textile Exchange historically defined a preferred fiber or material as "one which results in improved environmental and/or social sustainability outcomes and impacts compared to conventional production."

But as the window to protect the 1.5°C pathway narrows, we've got to keep raising the bar. So, Textile Exchange is revisiting the definition to identify key indicators across climate, nature, animals, people, and governance that not only focus on reducing negative impacts but drive forward measurable beneficial outcomes too.

In September 2022, Textile Exchange proposed the following updated definition: "A raw fiber or material that delivers ongoing beneficial outcomes and impacts for climate, nature, and people through a holistic approach to transforming raw fiber and material production systems." The development of detailed assessment criteria is scheduled for 2023. The definition will continue to evolve in line with the best available climate science and modeling.

While the updated definition may be aspirational today, the direction of travel for materials to be considered "preferred" should be in-line with its underlying principles. Textile Exchange acknowledges that there are a variety of different approaches and that the continuum of options evolves over time. The report provides examples of programs, initiatives, and products working towards these goals.

Key takeaways from the report

The report shows that it's unlikely for the textile industry's fiber and materials market to stay within 1.5°C pathway without reducing growth, a major acceleration of transition to preferred fiber and materials, and innovation.

The industry must:

1. Rethink growth—the elephant in the room.

Global fiber production reached an all-time high again in 2021 after a slight decline due to COVID-19 the previous year. Given this growth of the overall fiber and materials market and its impacts, it's increasingly important to rethink growth and decouple value creation from resource use.

2. Speed up the shift from conventional—particularly fossil-based—to preferred fiber and materials.

More than half of global growing fiber production is fossil-based. A transition to preferred sources is a must.

3. Innovate and collaborate.

Use the solutions that already exist—but also innovate and collaborate in order to accelerate progress and take the bold actions needed to scale new emerging materials and regenerative agriculture.

4. The best way to predict the future is to create it.

The forecast data shared in the report is one of multiple scenarios. While these scenarios may help the industry think about potential future pathways and impacts, the future can—and must be—influenced. We need to be part of the solution to create a planet that is habitable well into the future.

5. Everybody needs to be a leader.

Significant acceleration in terms of climate action is needed in order to stay within the 1.5° pathway. Everybody needs to be—and can be—part of the solution.

Contents

Introduction

Executive summary

The Global Fiber Market

Global fiber production increased again to a record 113 million tonnes in 2021, after a slight decline due to COVID-19 in 2020. In the last 20 years, global fiber production has almost doubled from 58 million tonnes in 2000 to 113 million tonnes in 2021 and is expected to grow to 149 million tonnes in 2030 if business as usual continues. **Without rethinking untethered growth, the industry will not stay within the 1.5° pathway.**

The share of recycled fibers slightly increased from 8.4% in 2020 to 8.9% in 2021—mainly due to an increase in bottle-based polyester fiber. **Still, less than 1% of the global fiber market was from pre- and post-consumer recycled textiles in 2021.**

While the industry has made commitments towards the 1.5° pathway, the virgin fossil-based synthetic fiber volumes continue to increase. The production of fossil-based synthetics raised from 60 million tonnes in 2020 to 63 million tonnes in 2021.

 Cotton

The market share of "preferred" cotton—defined by a list of recognized programs—decreased from 27% of the total cotton production in 2019/20 to 24% in 2020/21 after years of growth. The reasons consist of a variety of factors, including weather variations, changes in the Better Cotton program, market conditions and socio-political challenges. In order to still meet a 50% market share of preferred cotton by 2025—the goal of Textile Exchange's 2025 Sustainable Cotton Challenge—a significant acceleration in the transition towards preferred programs is necessary. Also, continuous improvement in terms of the impacts of all cotton grown is needed.

 Polyester

The production volume of polyester fibers increased from 57 million tonnes in 2020 to 61 million tonnes in 2021.

With a market share of 54% of the global total fiber production in 2021, polyester continues to be the most widely produced fiber. **The market share of recycled polyester fibers slightly increased from 14.7% in 2020 to 14.8% in 2021.** Due to low prices of fossil-based polyester, the recycled polyester market has been growing slowly in the past years. The 2025 Recycled Polyester Challenge was launched in 2021 by Textile Exchange and the UN Fashion Industry Charter for Climate Action to accelerate the recycled polyester market. Between its launch in April and December 2021, over 132 brands and suppliers (including subsidiaries) have signed on to the Challenge and committed to jointly increasing the share of recycled polyester to 45% by 2025. Systems for textile-to-textile recycling are in development but most recycled polyester is still made from plastic bottles. The interest in, and use of, ocean or ocean-bound plastic, is also increasing.

The market share of biobased polyester fiber remained very low at around 0.03% of the polyester fiber market. Key reasons are prices, availability, and questions around the sustainability of currently available biobased polyester.

 Polyamide (Nylon)

Polyamide had a market share of 5% of the global fiber market in 2021. **Due to technical challenges and low prices for fossil-based polyamide, the market share of recycled polyamide is only 1.94% of all polyamide fiber.** As the second-most used synthetic fiber, polyamide offers significant impact potential by transitioning to recycled and biobased polyamide. Most recycled polyamide is made from pre-consumer waste; some are from discarded fishing nets and carpets. Increasing the use of post-consumer textiles is needed.

The market share of biobased polyamide fibers in 2021 remained low at around 0.4% of the global polyamide fiber market. Similar to the reasons for the low uptake of biobased polyester, price, availability, and also questions around the sustainability of biobased polyamide counteracted the increase of the market.

 Manmade Cellulosics

Production of manmade cellulosic fibers (MMCFs) including viscose, lyocell, modal, acetate, and cupro increased from 6.5 million tonnes in 2020 to 7.2 million tonnes in 2021. The market share of FSC- and/or PEFC-certified MMCFs increased from around 55-60% in 2020 to around 60-65% of all MMCFs in 2021. **In March 2022, FSC and PEFC announced their decision to suspend Russian and Belarus wood certification. This equals a ban of around 18% of all FSC- and/or PEFC-certified forest.**

The market share of “recycled MMCFs” increased to an estimated 0.5%. A lot of research and development is ongoing, so the recycled MMCF volumes are expected to increase significantly in the following years. With new standards such as bluesign® and ZDHC introduced at the pulp and fiber level, action is also likely to accelerate on these supply chain levels.

Executive summary

 Wool

Global wool fiber production was relatively unchanged at around 1 million tonnes in 2021. Conventional wool accounts for the vast majority of the wool market but the market for non-mulesed and preferred wool programs is increasing. The market share of wool produced according to the Responsible Wool Standard (RWS), ZQ, and SustainaWOOL GOLD and GREEN reached around 3% in 2021. **The RWS market share alone increased from 1.23% in 2020 to 2.62% in 2021 on a global average. In the key apparel wool producing countries, tthe market shares were as high as 30% in South Africa, 17% in Uruguay, and 15% in Argentina.** Transitioning to wool programs with both animal welfare and responsible land use criteria in place offers the potential to create positive impacts on animal welfare, land use, and biodiversity. **Recycled wool had a market share of around 6% of the global total wool market.**

Mohair

Global mohair fiber production in 2021 was around 4,320 tonnes of greasy fiber. **The Responsible Mohair Standard (RMS), covering both animal welfare and responsible land use criteria, was launched in March 2020. Its market share reached 20% in 2020, its first year of existence, and increased to 35% of all mohair produced worldwide in 2021.** The RMS market share increased to 67% of the total mohair production in South Africa and 42% of the total mohair production in Australia in 2021.

Alpaca

Global alpaca fiber production was around 6,000 tonnes in 2021. **In April 2021, Textile Exchange launched its Responsible Alpaca Standard (RAS) with animal welfare and responsible land use criteria.** The first groups in Peru have been certified to RAS, but the certified alpaca fiber is already committed to specific supply chains. It will take time to build the volume of certified fiber in order to make it available on the open market.

Cashmere

Global cashmere production was around 26,344 tonnes of greasy fibers in 2021. **The market share of the cashmere programs—AVFS, Good Cashmere Standard®, Responsible Nomads, SFA Cashmere Standard, and WCS combined—significantly increased from 6.6% of all cashmere produced worldwide in 2020 to 17.4% in 2021.**

 Down

Global down production volume was estimated at around 0.57 million tonnes in 2021. **Awareness of animal welfare issues has led to successful growth in the use of standards such as the Responsible Down Standard (RDS) with a market share of 3.2% and Downpass with a market share of around 1.2% of the total down market.** While influencing change at the farm level is challenging, the use of preferred down standards helps to reduce the risks along the supply chain.

Other fibers

Other fibers—from hemp to elastane—are starting to gain the industry's attention. The report highlights innovations from Pineapple Leaf Fibers (PALF) to CO_2-based fibers.

The Global Non-Fibrous Materials Market

 Leather

Leather—measured in terms of fresh hides of cattle, sheep, goat, and buffalo, had a global production volume of around 12.5 million tonnes in 2021. Until recently, leather processing risks (tanning, chemical use) have been the main focus, but there is a growing interest in animal welfare, deforestation, land use change (and associated biodiversity loss), and climate change issues. Textile Exchange has developed the Leather Impact Accelerator (LIA), which includes Impact Incentives, a tool that allows brands to directly support farmers that are addressing deforestation and conversion, as well as animal welfare at all cattle farming levels. **The first Leather Impact Incentives were traded between brands and Brazilian farmers in 2021.**

Rubber

The global natural rubber production was around 15 million tonnes in 2021. Natural rubber had an approximate market share of 49% of the global total 31 million tonnes rubber market in 2021. Synthetic rubber accounted with 16 million tonnes for 51% of the global rubber market in 2021. **In 2021, FSC- and PEFC-certified rubber reached a market share of 2.7%.**

The number of certified sites increased sharply

The number of sites certified to Textile Exchange's portfolio of standards significantly increased from 29,699 in 2020 to 48,868 in 2021. This includes sites certified to the Global Recycled Standard (GRS), Organic Content Standard (OCS), Recycled Claim Standard (RCS), Content Claim Standard (CCS), Responsible Down Standard (RDS), and Responsible Wool Standard (RWS).

Background and the big picture

At Textile Exchange, our goal is to help the industry achieve a 45% reduction in the GHG emissions that come from producing fibers and raw materials by 2030. This is known as Tier 4 of the supply chain.

This goal underpins our Climate+ strategy[1]. We're calling it Climate+ because it goes beyond accounting for greenhouse gas emissions. Instead, it is an interconnected approach that swaps siloed solutions for interdependent impact areas like soil health, water, and biodiversity.

Our strategy is underpinned by three major areas of impact and opportunity:

First, we're accelerating the adoption of organic, regenerative, recycled, or other more responsible alternatives to conventional fibers. We want to make these materials the accessible default by providing global certifications and standards as well as industry-wide benchmarking for brands to measure and manage their sourcing strategies.

Next, we need innovation and out-of-the-box thinking. New business models, circular systems, and even innovative materials. This means collecting better data and facilitating information sharing around how we can scale existing solutions, like regenerative agriculture and textile-to-textile recycling. We do this through our industry reports and data-driven tools, while bringing leaders together via our round tables, conference, and other platforms. Innovation and out of the box thinking is also needed in terms of how we measure, understand and communicate impact with a clear need to develop methodologies that are able to capture the full range of ecosystem impacts to allow us to both track progress against global goals but also to facilitate credible product level impact claims. At Textile Exchange we call this approach LCA+ and it is a key priority area of work for us.

Most importantly, we've got to rethink growth. Slowing down, making less, and producing with purpose.

Our vision is a new system that works in sync with nature, respecting planetary boundaries while protecting the people that sustain it. To get there, we're keeping our focus holistic and interconnected as we guide our global community in this collective climate strategy.

Getting to 45% in Tier 4: Apparel, home textiles and footwear

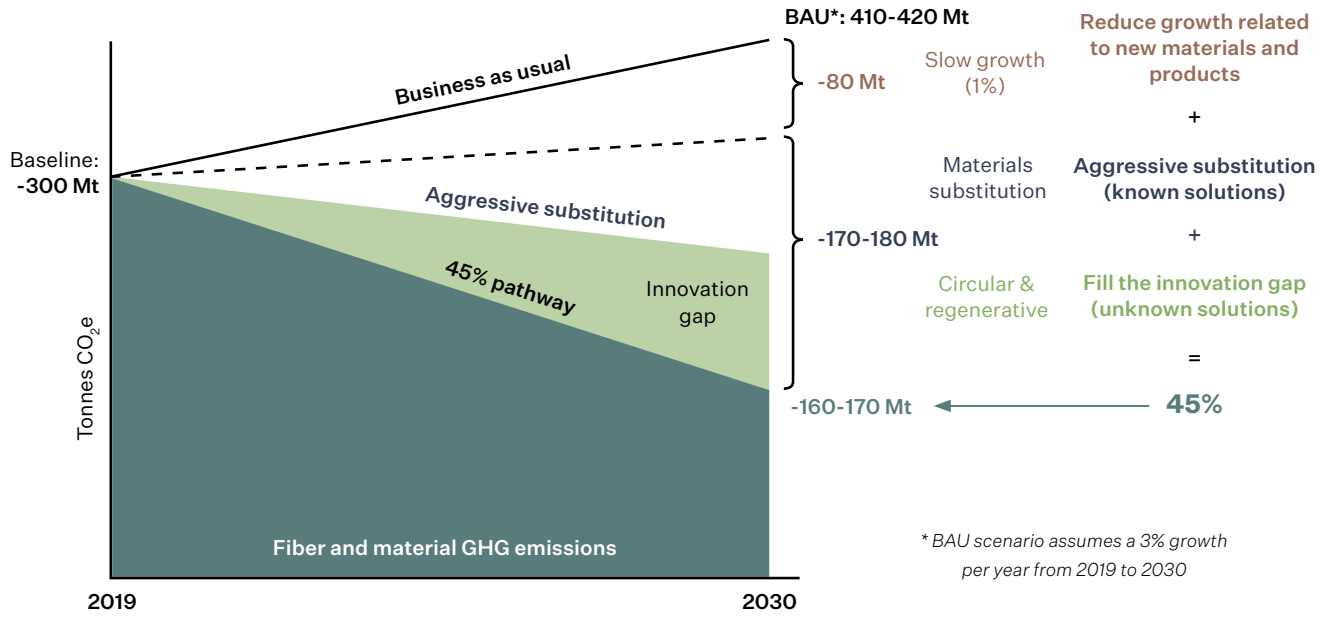


Figure 1: Modeling of interventions needed in the apparel and footwear raw materials extraction phase in order to achieve 45% GHG impact reduction by 2030, as measured against a 2019 baseline.

1 Textile Exchange, "About Climate+." https://textileexchange.org/about-us/climate/

The Global Fiber Market

The global fiber market trends

Global fiber production[1] increased again to a record 113 million tonnes in 2021, after a slight decline due to COVID-19 in 2020. In the last 20 years, the global fiber production has almost doubled from 58 million tonnes in 2000 to 113 million tonnes in 2021 and is expected to grow to 149 million tonnes in 2030 if business as usual continues.

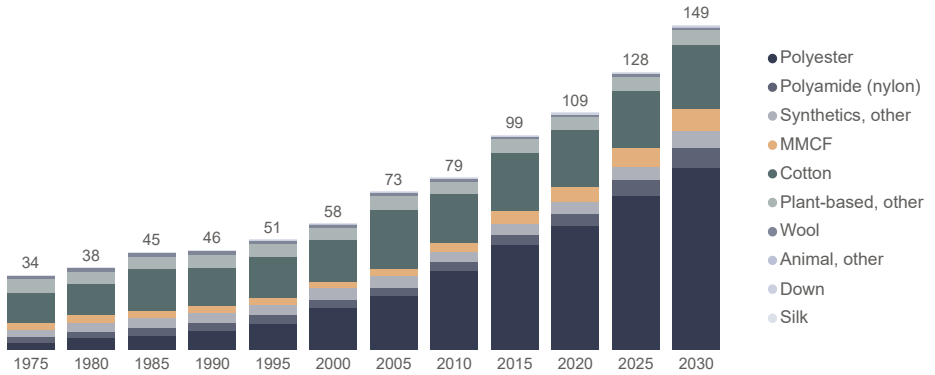
The global fiber production per person increased from 8.4 kilograms per person in 1975 to 14.3 kilograms per person in 2021[2].

The growth in fiber production has significant impacts on people and the planet. Awareness of the urgent need for more responsible use of resources and decoupling growth from resource consumption is growing; however, change is not yet happening at the scale and speed required.

Without rethinking growth, the industry will not stay within the 1.5° pathway.

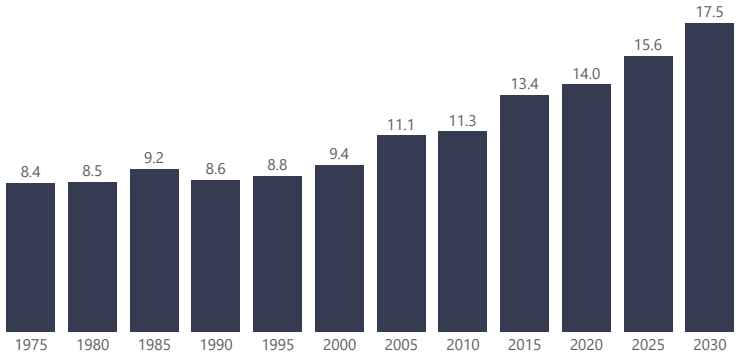
Textile Exchange's GHG emissions scenario model on the Climate+ page in this report shows the importance of rethinking growth, transitioning to preferred fibers, and innovation in order to limit global warming to 1.5° Celsius compared to pre-industrial levels.

Global fiber production (million tonnes)[1]



Source: Textile Exchange based on data from ICAC, FAO, IWTO, Mohair South Africa, inserco, CIRFS, IVC, Maia Research, and its own modelling

Global fiber production (kilograms per person)[2]



Source: Textile Exchange based on UN data and global data compilations

1 Textile Exchange compilation based on data from ICAC, FAO, IWTO, Mohair South Africa, inserco, CIRFS, IVC, Maia Research, and its own modelling. Volumes of certain minority fibers such as PTT, carbon, aramid, PLA, PBS, and PEF are not included. Textile Exchange allocates the ICAC year which ends in a calendar year to the respective calendar year (e.g. 2020/21 cotton production volumes to the 2021 calendar year). MMCFs and synthetic fibers volumes include staple fiber and filament. Please note that the percent market shares may differ from other sources because our overview includes other plant fibers, other wool, down and silk—all fibers which are often not included in other global statistics—and due to different ICAC cotton year allocations. In general, all global figures are estimates.

2 Textile Exchange based on "UN Population Division, 2020. World Population Prospects 2019. Link." and volume data as specified in footnote (1).

The global fiber market 2021

Synthetic fibers have dominated the fiber market since the mid-1990s, when they overtook cotton volumes. With around 72 million tonnes of synthetic fibers, this fiber category made up approximately 64% of the global fiber production in 2021. Read more here.

Polyester alone had a market share of around 54% of total global fiber production. Approximately 60.5 million tonnes of polyester were produced in 2021. Read more here.

Polyamide—the second most used synthetic fiber—accounted for 5.9 million tonnes and approximately 5% of the global fiber market in 2021. Read more here.

The other synthetics—polypropylene, acrylics, and elastane—had a market share of 5.2%, with a combined production volume of 5.8 million tonnes in 2021. Read more here.

Plant fibers, including cotton, jute, hemp, flax, and others, had a combined market share of around 28% of the global fiber market in 2021.

Cotton is the second most important fiber in terms of volume. With about 24.7 million tonnes, it had a market share of approximately 22% of global fiber production in 2021. Read more here.

Other plant-based fibers, including jute, flax, hemp, and others, had a market share of about 6%. Read more here.

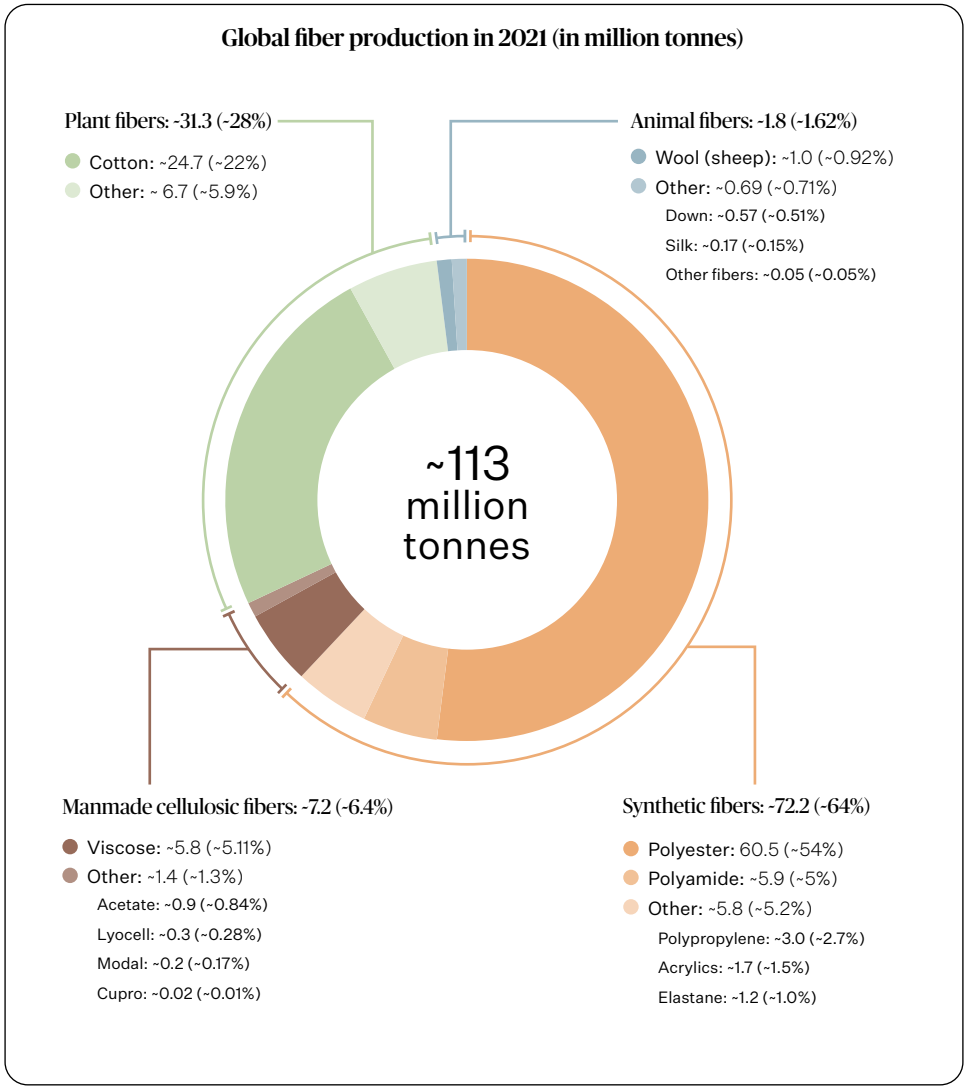
M**anmade cellulosics fibers (MMCFs)**, with a global production volume of around 7.2 million tonnes, had a market share of around 6.4% in 2021. Read more here.

Animal fibers had a market share of 1.6% in 2021. Read more here.

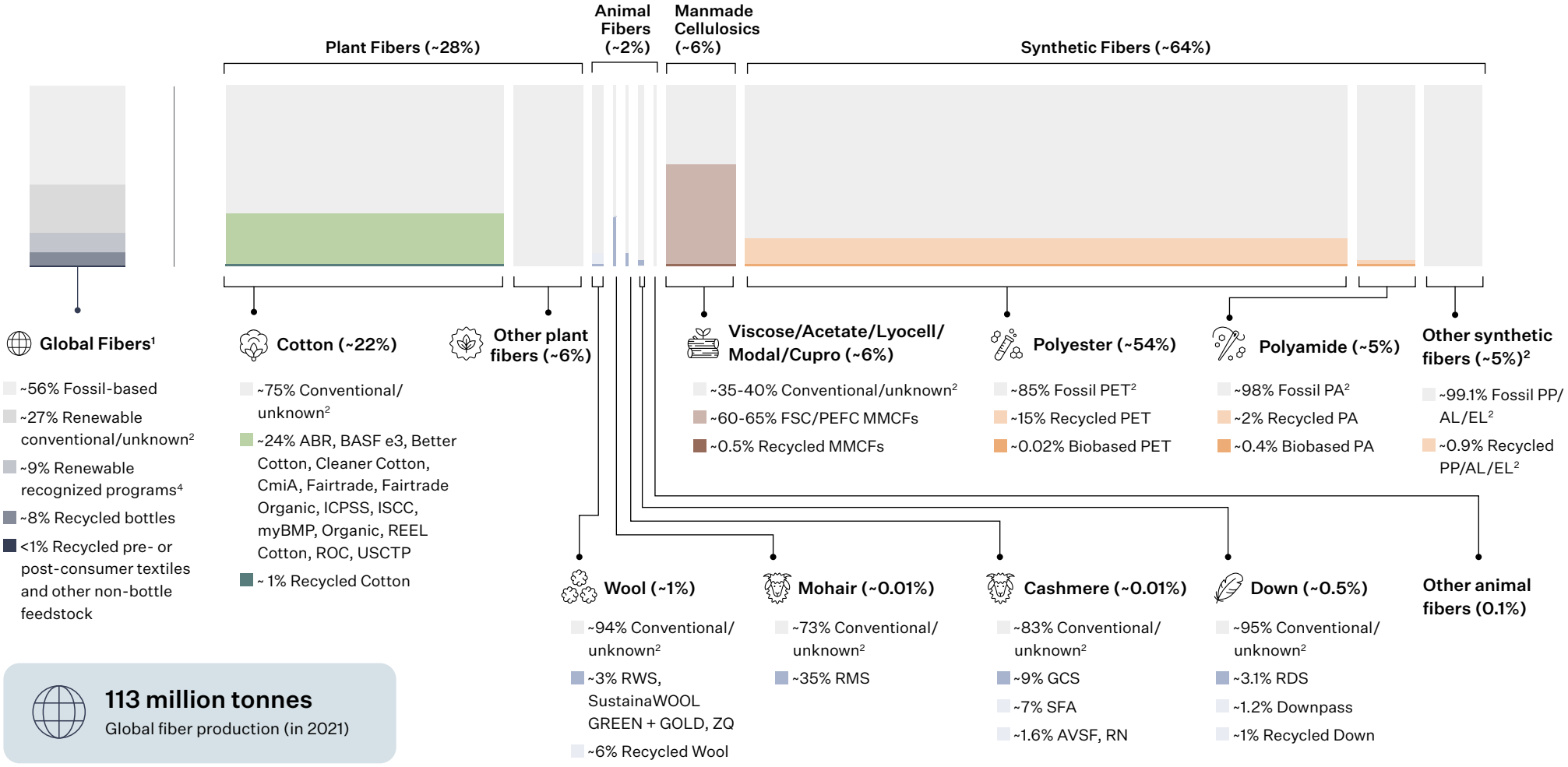
Wool had a market share of around 1 %, with a global production volume of around 1 million tonnes. Read more here.

Down and feathers had a market share of around 0.5% of the global fiber market. Read more here.

Silk had a market share of around 0.2%. Read more here.



The global fiber market 2021: Program overview



1 This graph aims to inform the industry about the global total production volumes and the shares covered by different programs. Our definition of "Preferred" is currently being updated, and the assessment of the programs along a continuum of different levels of preferred is work-in-progress. For more information see also our methodology chapter.

2 Conventional and unknown. This includes volumes of preferred or potentially preferred but unassessed programs for which data are not accessible or available.

3 Other synthetic fibers include polypropylene (PP), acrylics (AC), and elastane (EL).

4 Renewable recognized programs include here all the recognized programs listed in this chart apart from the recycled fibers.

Global recycled fiber market

Increasing the uptake of recycled fibers is a key strategy, with vast potential to reduce GHG emissions to mitigate climate change, prevent biodiversity loss, halt negative impacts on soil health, and reduce water consumption.

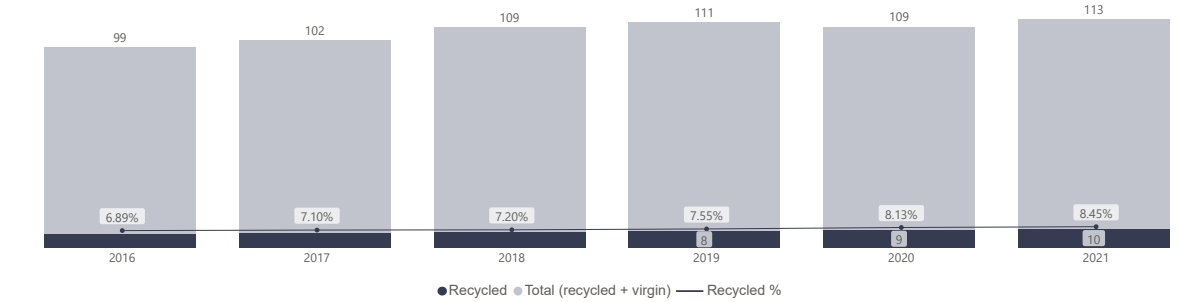
In 2021, the overall uptake of recycled fibers compared to the total fiber production was just around 8.5%—with 7.9% recycled polyester from plastic bottles and only around 0.6% of all fibers included all other recycled fibers. **Overall, less than 1% of the global fiber market was from pre- and post-consumer recycled textiles in 2021.**

The market share of recycled fibers increased from 8.1% in 2020 to 8.5% in 2021, and the percentage of virgin fibers decreased from 91.9% in 2020 to 91.5% in 2021. **In absolute numbers, though, the virgin fiber production volume increased from 100 million tonnes in 2020 to 103 million tonnes in 2021.** This includes an increase of virgin fossil-based fibers from 59.7 million tonnes in 2020 to 63.1 million tonnes in 2021. This means in 2021 around 3.4 million tonnes per year more fossil-based fibers were produced than in 2020. To limit global warming to 1.5° Celsius, an absolute reduction of GHG emissions by 45% by 2030 compared to the 2019 baseline is required.

Polyester had the highest recycled fiber percentage, with around 15% in 2021. Around 99% of the recycled polyester was PET bottle-based. It is estimated that the market share for recycled elastane was around 3%, for recycled polyamide around 2%, and for recycled polypropylene around 0.2% in 2021.

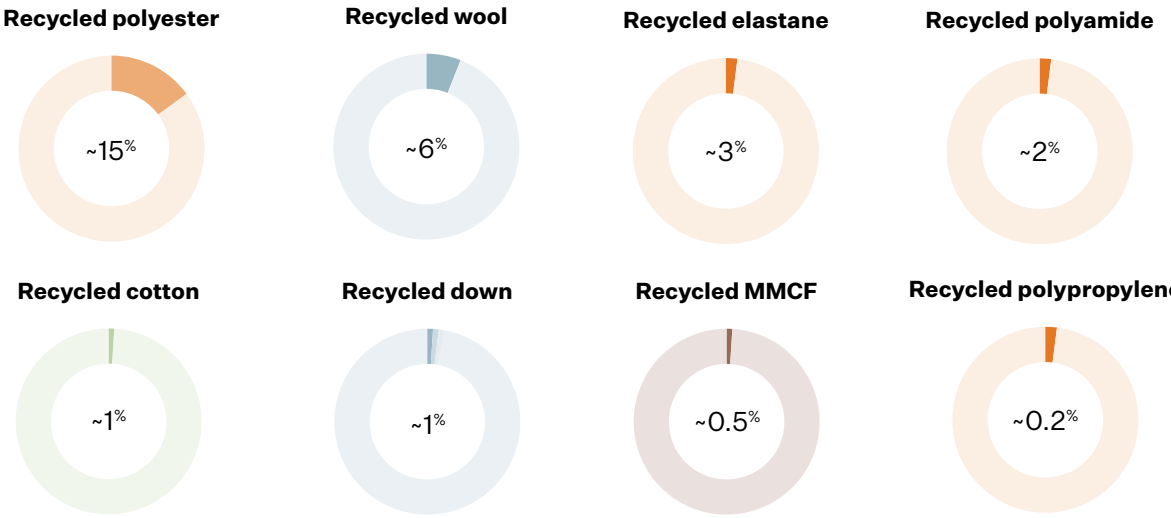
The market shares for recycled cotton and recycled down are estimated at roughly 1% of the total cotton and down production volume in 2021.

Global fiber production (million tonnes) and % recycled



Source: Textile Exchange based on Maia Research and global data compilation

Market share of recycled fibers by type in 2021



Source: Textile Exchange based on Maia Research and global data compilation

Plant Fibers & Materials

Cotton

Virgin cotton
Global cotton production

The market share of cotton covered by the recognized programs,[1] also referred to as "preferred cotton", decreased from 27% of the total cotton production in 2019/20 to 24% in 2020/21 after years of growth.[1,2]

This equals a decrease in global production volume of cotton produced according to these programs from 7.2 million tonnes in 2019/20 to 6 million tonnes in 2020/21.[2] There are a number of factors causing this reduction, including weather variations, changes in the Better Cotton program, market conditions, and socio-political challenges.

The cotton programs included here align with all virgin cotton options recognized by the 2025 Sustainable Cotton Challenge (see more on page "Commitments to Preferred Cotton").

The cotton programs exist within a continuum and significantly vary in terms of requirements, their approaches to assurance, as well as degrees of traceability throughout the supply chain.

All Better Cotton, including its equivalents ABR, CmiA, ICPSS, and myBMP, made up around 19% of all cotton in 2020/21 and thus, the majority of the 24% of preferred cotton in 2020/21. The Better Cotton without equivalents accounted for around 8%, ABR for around 8%, CmiA for around 3%, and MyBMP for below 1 % of all cotton in 2020/21. With a market share of 19% of all cotton, Better Cotton did not achieve its target to increase its market share including equivalents to 30% of the global cotton production by 2020.

All other cotton programs together, including BASF e3, Fairtrade, ICPSS, ISCC, organic[3], REEL cotton, and the USCTP, had a combined market share of around 5 % of all cotton in 2020/21.

1 The recognized programs for virgin cotton include BASF e3, Better Cotton, Cleaner Cotton (discontinued in March 2020), Cotton made in Africa (CmiA), Fairtrade, Fairtrade organic, in-conversion cotton ("transitional" in US), Israel Cotton Production Standard System (ICPSS), International Sustainability and Carbon Certification (ISCC), myBMP, organic, REEL Cotton, Regenerative Organic Certified (ROC), Responsible Brazilian Cotton (ABR), and the U.S. Cotton Trust Protocol (USCTP). The figures presented here are specific for virgin cotton and do not include recycled cotton. Please see the chapter Recycled Cotton for more information on recycled cotton. In-conversion cotton is not included in the global trend data due to lack of data for most years, but an estimate for 2020/21 is reported in the program-specific section.

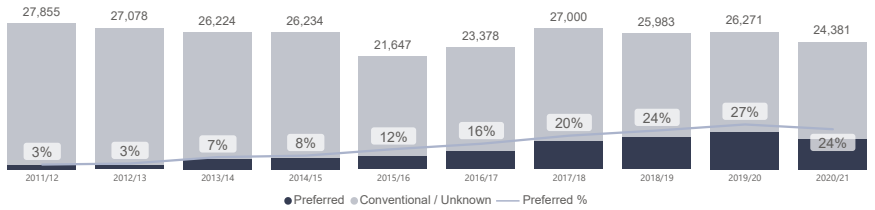
2 Textile Exchange based on "ICAC, 2022. World Cotton Statistics May 2022" for the total virgin cotton production volumes and the cotton programs received by email. Overlaps of programs excluded.

3 This includes organic cotton certified to Regenerative Organic Certification (ROC), and supplier-specific programs such as bioRe.

4 The Better Cotton, including equivalents, as reported by BCI. It slightly differs from the aggregate of the data provided by the individual programs because minor parts of their volumes are not accounted as Better Cotton equivalent and due to somewhat differing data collection and reporting methodology.

5 Better Cotton, 2013. Better Cotton sets 2020 growth target. Link.

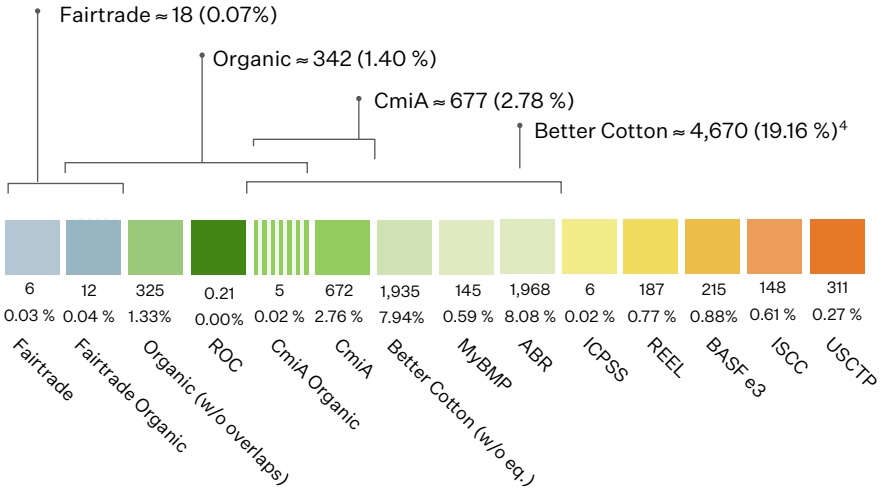
Global cotton fiber production (thousand tonnes and %)



Source: Textile Exchange based on ICAC and cotton programs.
Note: This chart only includes virgin cotton and not recycled cotton.

Global cotton fiber production by program in 2020–21 [1,2]

Total cotton: 24.4 million tonnes
Covered by the programs below: 5.9 million tonnes (=24%)



in thousand tonnes and % of total cotton

Virgin cotton

A closer look at the cotton programs

The BASF e3 cotton production increased from 160,754 tonnes in 2019/20 to 214,861 tonnes in 2020/21, equaling 6.75% of all US and 0.88% of all cotton produced worldwide in 2020/21.

Better Cotton production, including equivalents, decreased from around 6.2 million tonnes in 2019/20 to 4.7 million tonnes in 2020/21. Reasons were a variety of factors, including weather variations, changes in the Better Cotton programme, market conditions and socio-political challenges. Better Cotton (without equivalents) made up around 41% of all Better Cotton produced in 2020/21. The remaining 59% of Better Cotton was produced according to the Better Cotton equivalents ABR, Cotton made in Africa, ICPSS, and myBMP. Better Cotton, including equivalents, represented around 19% of all cotton production in 2020/21.[2] In 2022, Better Cotton production in Pakistan was severely hit by the floods. BCI fears that 70% of the Better Cotton production in Pakistan, a major production region, could have been destroyed due to the floods. Read more here.

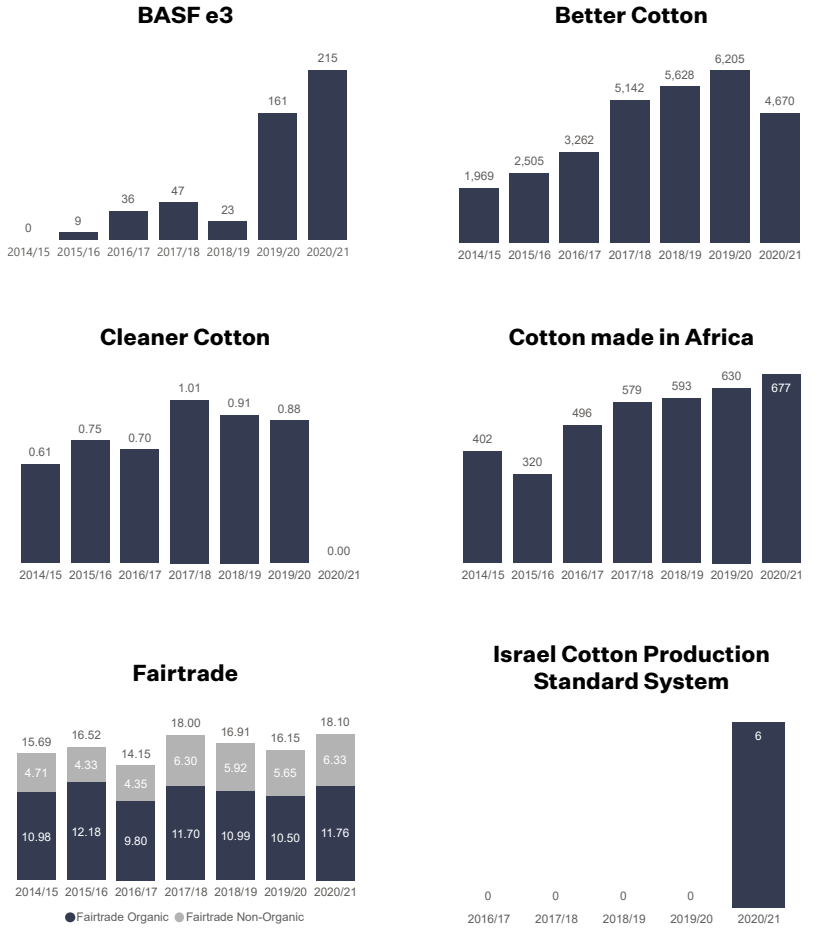
Cleaner Cotton production was discontinued in March 2020, when the funding for the regular farm program ended.

Cotton made in Africa (CmiA) production increased from 629,789 tonnes in 2019/20 to 677,479 tonnes in 2020/21. This equaled 2.8 % of all cotton produced in 2020/21 and around 38% of all cotton production in Africa in 2020/21. Almost all (91%) of the CmiA produced in 2020/21 was also accounted for as Better Cotton equivalent. With 4,993 tonnes, around 60% of the CmiA cotton produced in Tanzania was also certified organic.

Fairtrade cotton production increased from 16,150 tonnes in 2019/20 to 18,097 tonnes in 2020/21, equaling 0.07% of all cotton produced in 2020/21. Fairtrade organic cotton production, i.e. the production of cotton that is certified to both, Fairtrade and an organic standard, was around 11,763 tonnes in 2020/21. Approximately 65% of all Fairtrade cotton in 2020/21 was also certified to an organic standard.

The Israel Cotton Production Standard System (ICPSS)—Israel Cotton Production and Marketing Board (ICB)'s new standard (developed in 2018)—was recognized as equivalent to the Better Cotton Standard System (BCSS) in 2020 and is thus included for the first time in 2020/21. 5,708 tonnes of ICPSS cotton were produced in 2020/21, equaling 0.02% of all cotton produced in 2020/21.

Global cotton production by program (thousand tonnes)



The data is based on information from the standard owners, which we have received through email correspondence or from their websites.
The production volumes reported here include the total volume produced per standard including equivalents and overlaps with other standards.

Virgin cotton

A closer look at the cotton programs

International Sustainability and Carbon Certification (ISCC) cotton production increased from 132,626 tonnes in 2019/20 to 148,158 tonnes in 2020/2021. This amount equaled 0.61 % of the global cotton production and 46 % of the cotton production in Greece in 2020/21.[2] All ISCC-certified cotton in 2020/21 was produced in Greece.

myBMP cotton production increased from 31,411 tonnes in 2019/20—which was a huge drop compared to previous years due to a severe drought in Australia—to 144,528 tonnes in 2020/21, equaling 0.60% of all cotton produced worldwide in 2020/21. myBMP is also accounted as Better Cotton equivalent.

Organic cotton production increased from 249,153 tonnes in 2019/20 to 342,265 tonnes in 2020/21. Organic cotton equaled a market share of 1.4% of all cotton produced in 2020/21. The organic cotton production volume includes all IFOAM Family of Standards recognized organic cotton which also includes CmiA organic, Fairtrade organic, ROC, and supplier-specific programs such as bioRe®. For more information on organic cotton please see our Organic Cotton Market Report 2022.

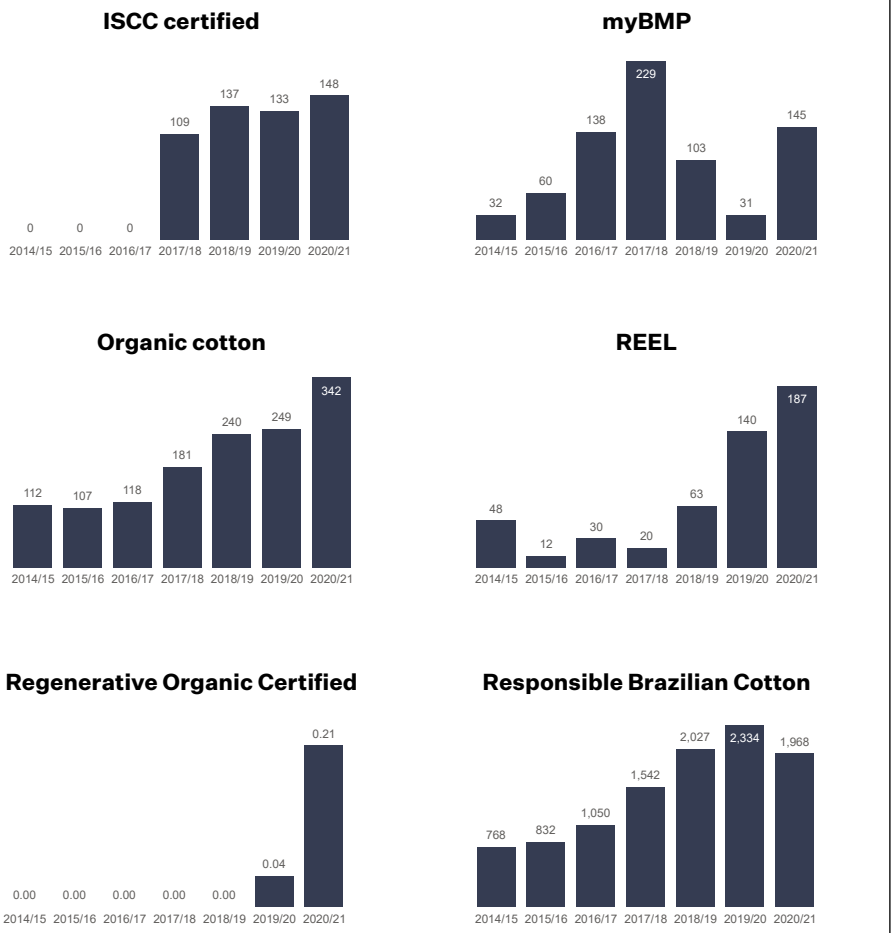
REEL cotton production increased from 140,067 tonnes in 2019/20 to 186,589 tonnes in 2020/21. This amount equaled 0.77% of all cotton produced worldwide in 2020/21.

Regenerative Organic Certified™ (ROC) cotton production increased from 40 tonnes in 2019/20 to 208 tonnes in 2020/21. This was less than 0.01% of all cotton produced worldwide in 2020/21. Since then, ROC further expanded its coverage in India and included cotton from Ecuador for the first time.

Responsible Brazilian Cotton—ABRAPA's Algodão Brasileiro Responsável (ABR)—production decreased from 2.3 million tonnes in 2019/20 to around 2.0 million tonnes in 2020/21. This decline was caused by several factors including unfavourable market conditions with low cotton prices (in combination with attractive corn and soy prices), uncertainly about the COVID-19 recovery as well as a non-favorable weather forecast for the beginning of the season. This volume equaled a market share of 8% of all cotton grown in 2020/21.

In-conversion cotton ("transitional" in the US) is the cotton-in-conversion to organic. 293,204 ha of land were in-conversion in 2020/21. For more details, please have a look at the Organic Cotton Market Report 2022. Branded in-conversion cotton is still rare. One example is the Pre Organic Cotton (POC) program initiated by Itochu and kurkku.

Global cotton production by program (thousand tonnes)



1 ISCC cotton volumes are collected by calendar year, not ICAC harvest year. The data from the 2021 calendar year have been allocated to the 2020/21 ICAC harvest year, the 2020 calendar year data to the 2019/20 ICAC harvest year.

Virgin cotton

A closer look at the cotton programs

U.S. Cotton Trust Protocol® cotton increased from 215,683 tonnes in 2019/20 to 310,568 tonnes in 2020/21. This equaled around 10% of all cotton produced in the US and 1.72% of all cotton produced worldwide in 2020/21. The environmental performance of U.S. Cotton Trust Protocol cotton is measured and analyzed at the field-level using Field to Market's Fieldprint Platform and verified with Control Union Certifications.

New and discontinued cotton programs

Cleaner Cotton was discontinued in March 2020, when the funding for the regular farm program ended.

The QAI Transitional program was discontinued in 2020. when NSF made the decision to discontinue textile certification.

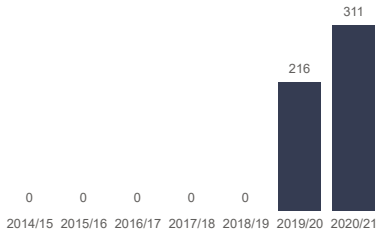
Field to Market continues to be used as a tool but the decision was made to discontinue measuring Field to Market separately. Most of the cotton using Field to Market's Fieldprint Platform to measure and analyze environmental performance on the field is also enrolled in the USCTP, as Field to Market enrolment is a condition of the USCTP. The cotton that is part of Field to Market but not part of the USCTP is not otherwise certified or verified.

The ICPSS cotton standard was recognized as equivalent to the Better Cotton Standard System (BCSS) in 2020 and is thus included for the first time in 2020/21.

Upcoming cotton program changes

In January 2022, the Aid by Trade Foundation (AbTF)—the non-profit responsible for CmiA—and Better Cotton announced that the sale of CmiA as Better Cotton will be discontinued at the end of 2022. Both organizations will continue to collaborate but focus on concrete projects that create lasting benefits.

Global cotton production by program (thousand tonnes)



Tip: How to find out more about the different cotton programs.

To learn more about the specific programs, what they cover, and how they differ, check out the CottonUp Guide.

Key Milestones

1996	*IFOAM* set first international organic standard
1996	*Sustainable Cotton Project (SCP) / Cleaner Cotton* founded
1997	*MyBMP* founded
2004	*Fairtrade* standard for seed cotton established
2005	*BCI* founded
2005	*Cotton made in Africa (CmiA)* founded
2009	*ABRAPA*'s sustainability program started
2010	*CottonConnect*'s *REEL* cotton program started
2010	*ISCC* started
2013	*Field to Market* launched
2013	*Bayer CropScience's e3* cotton program (now BASF e3) launched
2018	*Regenerative Organic Certified (ROC)* launched
2019	*U.S. Cotton Trust Protocol* started

Virgin cotton

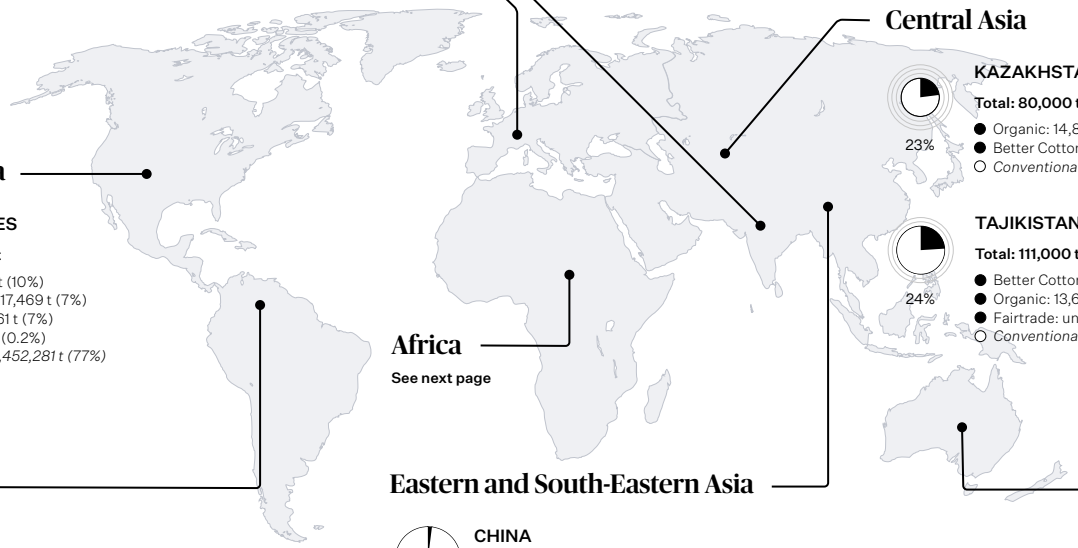
Cotton production by program globally in 2020/21

Legend:[1]

- Total cotton >1 million t
- Total cotton >300,000 t
- Total cotton >100,000 t
- Total cotton < 100,000 t
- ● Cotton programs (%)
- ○ *Conventional cotton (%)*

This chart lists only countries where cotton is produced according to one of the listed cotton programs.

Big cotton producing countries (>100,000t) with no cotton covered by the programs are: Mexico, Turkmenistan, Argentina, Myanmar, Sudan.



Southern Europe

GREECE — 47%
Total: 321,000 t
- ● ISCC: 148,158 t (46%)
- ● Organic: 1,827 t (0.6%)
- ○ *Conventional: 171,015 t (53%)*

SPAIN — 0.04%
Total: 64,000 t
- ● Organic: 26 t (0.04%)
- ○ *Conventional: 63,974 t (99.96%)*

Southern Asia

BANGLADESH — 3%
Total: 35,000 t
- ● REEL: 999 t (3%)
- ○ *Conventional: 34,001 t (97%)*

INDIA — 17%
Total: 6,307,000 t
- ● Better Cotton: 829,508 t (13%)
- ● Organic: 130,849 t* (2%) *incl. ROC
- ● Fairtrade: 15,097 t (0.24%)[4]
- ● REEL: 105,349 t (2%)
- ○ *Conventional: 5,236,010 t (83%)*

PAKISTAN — 83%
Total: 890,000 t
- ● Better Cotton: 682,000 t (77%)
- ● REEL: 52,891 t (6%)
- ● Organic: 1,925 t (0.22%)
- ● Fairtrade: undisclosed[2]
- ○ *Conventional: 153,184 t (17%)*

Central Asia

KAZAKHSTAN — 23%
Total: 80,000 t
- ● Organic: 14,893 t (19%)
- ● Better Cotton: 3,527 t (4%)
- ○ *Conventional: 61,580 t (77%)*

KYRGYZSTAN — 258%[5]
Total: 12,000 t
- ● Organic: 30,945 t (258%)
- ● Fairtrade: undisclosed[2]
- ○ *Conventional: none*

TAJIKISTAN — 24%
Total: 111,000 t
- ● Better Cotton: 13,539 t (12%)
- ● Organic: 13,648 t (12%)
- ● Fairtrade: undisclosed
- ○ *Conventional: 83,813 t* [2]

UZBEKISTAN — 0.05%
Total: 1,028,000 t
- ● Organic: 465 t (0.05%)
- ○ *Conventional: 1,027,535 t (99.95%)*

Northern America

UNITED STATES — 23%
Total: 3,201,000 t
- ● SCTP: 310,568 t (10%)
- ● Better Cotton: 217,469 t (7%)
- ● BASF e3: 214,861 t (7%)
- ● Organic: 5,821 t (0.2%)
- ○ *Conventional: 2,452,281 t (77%)*

Africa

See next page

Latin America and the Caribbean

BRAZIL — 79%
Total: 2,494,000 t
- ● ABR: 1,968,467 t
- ● Organic: 70 t
- ○ *Conventional: 525,463 t*

PERU — 4%
Total: 19,000 t
- ● Organic: 694 t (4%)
- ○ *Conventional: 18,306 t (96%)*

Eastern and South-Eastern Asia

CHINA — 2%
Total: 5,910,000 t
- ● Better Cotton: 92,430 t (1.6%)
- ● Organic: 33,687 t (0.6%)
- ● REEL: 27,350 t (0.5%)
- ○ *Conventional: 5,756,533 t (97%)*

Australia and New Zealand

AUSTRALIA — 25%
Total: 562,000 t
- ● MyBMP: 141,438 t (25%)
- ○ *Conventional: 420,562 t (75%)*

1 Cotton program-specific data were collected from the programs. Total cotton production data are from ICAC. Conventional cotton volumes were calculated by Textile Exchange. Better Cotton refers here to Better Cotton (excl. equivalents). Better Cotton equivalents are listed separately. Volumes in metric tonnes (t).

2 Fairtrade data are not disclosed on a per-country level due to confidentiality reasons. The volume for all programs in this country does not include Fairtrade cotton and is thus actually slightly higher.

3 Cotton volume covered by the programs as share (%) of the country's total global cotton production volume.

4 The total Fairtrade cotton production in India was 15,097 tonnes in 2020/21, including around 9,813 tonnes of Fairtrade organic.

5 The percentage of a country's cotton that is covered by the cotton programs is derived from the difference between Textile Exchange's reported cotton programs production for that country and the overall cotton production of that country reported by ICAC. In some countries, there is a discrepancy between the two. Both ICAC and Textile Exchange rely on secondary data. We are trying our best to understand more about this discrepancy. You can learn more about Textile Exchange's data collection methodology here, and about the sources of ICAC's cotton statistics here.

Virgin cotton

Cotton production by program in Africa in 2020/21

Legend:[1]

Total cotton >1 million t

Total cotton >300,000 t

Total cotton >100,000 t

Total cotton < 100,000 t

● Cotton programs (%)

○ *Conventional cotton (%)*

This chart lists only countries where cotton is produced according to one of the listed cotton programs.

Big cotton producing countries (>100,000t) with no cotton covered by the programs are: Mexico, Turkmenistan, Argentina, Myanmar, Sudan.

Sub-Saharan Africa

BENIN
5%
Total: 317,000 t
- ● CmiA: 14,780 t (4.7%)
- ● Organic: 1,893 t (0.6%)
- ○ *Conventional: 300,327 t (95%)*

BURKINA FASO
101%[4]
Total: 195,000 t
- ● CmiA: 196,300 t
- ● Organic: 647 t
- ● Fairtrade: undisclosed[2]
- ○ *Conventional: none*

CAMEROON
104%[4]
Total: 140,000 t
- ● CmiA: 146,157 t (104%)
- ○ *Conventional: none*

CHAD
67%
Total: 75,000 t
- ● CmiA: 50,533 t (67%)
- ○ *Conventional: 24,467 t (33%)*

COTE D'IVOIRE
110%[4]
Total: 215,000 t
- ● CmiA: 237,400 t (110%)
- ○ *Conventional: none*

ETHIOPIA
0.1%
Total: 61,000 t
- ● Organic: 60 t (0.1%)
- ○ *Conventional: 60,940 t (99.9%)*

MALI
13%
Total: 62,000 t
- ● Better Cotton: 8,000 t (12.9%)
- ● Organic: 63 t (0.1%)
- ○ *Conventional: 53,937 t (87%)*

MOZAMBIQUE
100%
Total: 22,000 t
- ● CmiA: 12,088 t (55%)
- ● Better Cotton: 9,898 t (45%)
- ○ *Conventional: 14 t (0.06%)*

NIGERIA
2%
Total: 90,000 t
- ● CmiA: 1,598 t (2%)
- ○ *Conventional: 88,402 t (98%)*

SENEGAL
n/a
Total: 8,000 t
- ● Fairtrade: undisclosed
- ○ *Conventional: na*

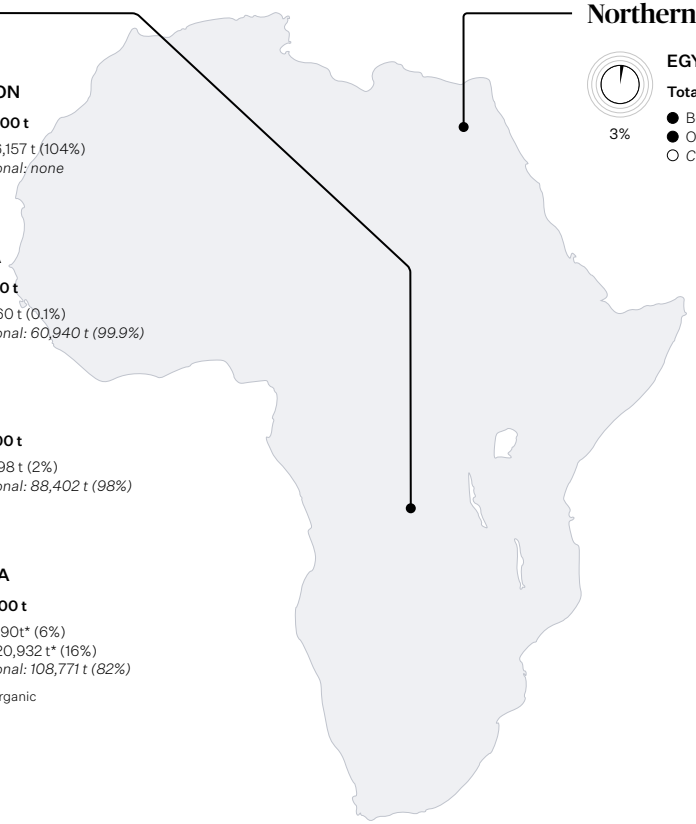
SOUTH AFRICA
63%
Total: 16,000 t
- ● Better Cotton: 10,001 t (63%)
- ○ *Conventional: 5,999 t (37%)*

TANZANIA
18%
Total: 133,000 t
- ● CmiA: 8,290t* (6%)
- ● Organic: 20,932 t* (16%)
- ○ *Conventional: 108,771 t (82%)*

* incl. CmiA Organic

UGANDA
10%
Total: 43,000 t
- ● Organic: 2,551 t (6%)
- ● CmiA: 1,950 t (4.5%)
- ● Fairtrade: undisclosed[2]
- ○ *Conventional: 38,499 t (90%)*

ZAMBIA
32%
Total: 26,000 t
- ● CmiA: 8,383 t (32%)
- ○ *Conventional: 17,617 t (68%)*



Northern Africa

EGYPT
3%
Total: 58,000 t
- ● Better Cotton:1,221 t (2%)
- ● Organic: 437 t (1%)
- ○ *Conventional: 56,342 t (97%)*

1 Cotton program-specific data were collected from the programs. Total cotton production data are from ICAC. Conventional cotton volumes were calculated by Textile Exchange. Better Cotton refers here to Better Cotton (excl. equivalents). Better Cotton equivalents are listed separately. Volumes in metric tonnes (t).

2 Fairtrade data are not disclosed on a per-country level due to confidentiality reasons. The volume for all programs in this country does not include Fairtrade cotton and is thus actually slightly higher.

3 Cotton volume covered by the programs as share (%) of the country's total global cotton production volume.

4 The percentage of a country's cotton that is covered by the cotton programs is derived from the difference between Textile Exchange's reported cotton programs production for that country and the overall cotton production of that country reported by ICAC. In some countries, there is a discrepancy between the two. Both ICAC and Textile Exchange rely on secondary data. We are trying our best to understand more about this discrepancy. You can learn more about Textile Exchange's data collection methodology here, and about the sources of ICAC's cotton statistics here.

Virgin cotton

Accelerating the transition to preferred cotton

Accelerating the transition to preferred cotton needs the commitment, action, and collaboration of multiple stakeholders.

Call to action

Join the Organic Cotton Round Table: The Global Organic Cotton Round Table and the Regional Organic Cotton Round Tables bring together stakeholders to accelerate the transition to organic cotton.

Sign the 2025 Sustainable Cotton Challenge: Signatories commit to using 100% preferred cotton by 2025. The progress is tracked through the Corporate Fiber and Materials Benchmark program.

Joint initiatives

The Sustainable Cotton Aligned Impacts Measurement and Reporting Commitment signatories have worked together, convened by Cotton 2040 and The Delta Project, to agree on a meaningful, credible and practically feasible set of shared core impact indicators and metrics. In 2021, the Better Cotton Initiative, Fairtrade, The Organic Cotton Accelerator, and Textile Exchange as well as the CottonConnect and the U.S. Cotton Trust Protocol piloted the impact and output indicators. Cotton 2040 is convened by Forum for the Future with funding from Laudes Foundation and The Delta Project is delivered by The Better Cotton Initiative with funding from the ISEAL Innovations Fund.

The guidance document Screening of genetically modified organisms (GMOs) in cotton and textiles (ISO IWA 32_2019), developed in 2019, is the result of a collaboration of GOTS, OCA and Textile Exchange with technical support from Wageningen Food Safety Research. The number of laboratories who have passed the proficiency test to conduct the GMO testing accordingly increased from 14 in 2020 to 21 in 2021.

Key organizations

Cotton 2040, founded in 2016 and led by Forum for the Future, is a platform that aims to accelerate progress and maximize the impact of existing sustainable cotton initiatives, bringing together leading international brands and retailers, sustainable cotton standards, and other stakeholders across the value chain. In 2021, Cotton 2040 and Acclimatise published the new report "Physical Climate Risk for Global Cotton Production" as well as a "Cotton 2040 Climate Risk Explorer". The analysis shows that 50% of cotton-growing regions face high or very high exposure to climate risk. Earlier, Cotton 2040 launched CottonUpGuide.org that provides practical information and resources to either start sourcing sustainable cotton or increase volumes.

CottonConnect, founded in 2009, is an enterprise with a clear mission to transform the cotton industry for good. To further investigate the benefit and opportunities for regenerative agriculture in cotton farming, for the 2020/2021 growing season, CottonConnect started a Regenerative Agriculture and Carbon Sequestration Pilot Project with 100 organic farmers in Madhya Pradesh, India.

GIZ, a service provider in the field of international cooperation, initiated the project "Sustainability and Value Added in the Cotton Economy in Uzbekistan" with the aim to increase the area of cotton grown in accordance with internationally recognized sustainability standards in Uzbekistan to 30,000 hectares by 2023, amongst other goals.

Organic Cotton Accelerator (OCA), founded in 2016, is a multi-stakeholder initiative focused on creating a prosperous organic cotton sector which benefits everyone from farmer to consumer. The number of farmers in the OCA network increased from around 20,000 in 2020/21 to around 80,000 in 2021/2022 according to their latest Farm Programme Impact Report launched in March 2022. In 2021, OCA also began preparing the expansion of their program to Pakistan.

Soil Health Institute (SHI), a US-based non-profit organization, launched the U.S. Regenerative Cotton Fund in 2021 with the aim to sequester atmospheric carbon into soil carbon. SHI also initiated the "Healthy Soils for Sustainable Cotton" project to help US cotton farmers increase their soil health.

Textile Exchange, founded as Organic Exchange in 2002, is a global non-profit that works closely with its members to drive industry transformation in preferred fibers, integrity and standards, and responsible supply networks. Flagship projects related to cotton include the Organic Cotton Market Report, the Global and Regional Organic Cotton Round Tables, the Sustainable Cotton Round Table, and the 2025 Sustainable Cotton Challenge commitment (progress measured through the Corporate Fiber and Materials Benchmark program).

West Africa Organic and Fairtrade Coalition was launched at the International Cotton and Textile Conference (SICOT) in Koudougou, Burkina Faso in September 2018.

For more information see also the pages on preferred cotton commitments, programs that include standards and certification, and the Textile Exchange's Organic Cotton Market Report 2022.

Recycled cotton
Market overview

Recycled cotton had an estimated market share of approximately 1% of the total cotton production in 2021 but is expected to grow significantly in the coming years[1]. While approximately 25 million tonnes of virgin cotton were produced in 2021 (ICAC harvest year 2020/21)[2], the production volume of recycled cotton is roughly estimated at around 272 thousand tonnes[3].

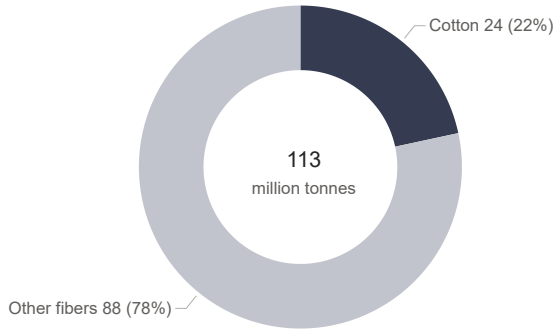
An analysis by the Circular Fashion Partnership revealed the significant value in utilizing textile waste more efficiently, focusing on Bangladesh. Its research has found that Bangladesh alone produced approximately 250 thousand tonnes of 100% pure pre-consumer cotton waste in their Ready-Made Garments (RMG) and fabrics mills in 2019. The study estimates that factories in Bangladesh could sell this 100% pre-consumer cotton waste to the recycling market for up to 100 million USD. The Circular Fashion Partnership is a cross-sectorial project led by Global Fashion Agenda, with partners Reverse Resources, the Bangladesh Garment Manufacturers and Exporters Association (BGMEA) and is supported by P4G, that aims to achieve a long-term, scalable transition to a circular fashion system[4].

Please note that the data presented here refer to mechanically recycled cotton. Chemically recycled cotton is covered in the chapter on manmade cellulosics since the result is a "manmade cellulosic," not a "cotton."

Key standards

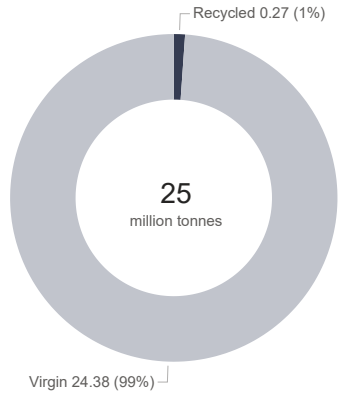
Textile Exchange's Global Recycled Standard (GRS) and its **Recycled Claim Standard (RCS)** are key third-party standards used for recycled cotton. Read more on the page on Sustainability Standards.

Global fiber market in 2021



Source: Textile Exchange based on ICAC and further sources

Global cotton market in 2021



Source: Textile Exchange based on ICAC and Maia Research

1 Calculated by Textile Exchange based on sources in (2) & (3) below.

2 ICAC, 2022. World Cotton Statistics May 2022. Note: For the virgin cotton production volume in 2021, the ICAC harvest year data from the 2020/21 season are applied.

3 Maia Research, 2022. Global Recycled Cotton Market 2022 (customized report).

4 Circular Fashion Partnership, 15 June 2021—Press release. Link.

Recycled cotton

A closer look at recycled cotton

Textile Exchange Member Action

Circular System's Texloop™ converts pre-consumer and post-consumer materials into high-value materials through a purely mechanical and hydrothermal process. An example of a Texloop material is a fabric consisting of 50% RCOT™ recycled cotton and 50% organic cotton. Texloop™ "Lightest-Touch" processing preserves original fiber quality for the next generation of recycled materials. Read more in the Supplier Mapping.

Geetanjali Woolens is a 40-year-old company that has been recycling post-consumer used clothing for as many years. It is Global Recycled Standard (GRS)-certified. Read more in the Supplier Mapping.

Giotex is a US-based company offering recycled cotton yarns and fabrics from pre-consumer feedstock. The company is certified to the Global Recycled Standard (GRS) and Recycled Claim Standard (RCS). Read more in the Supplier Mapping.

Recover offers GRS-certified recycled cotton fiber. In 2021, Recover forged a strategic partnership with Story3 Capital and announced its plan to increase its annual production capacity to 350,000 tonnes of recycled cotton fiber by 2026. Read more in the Supplier Mapping.

Säntis launched RCO100 in 2016. RCO100 products are made from 100% pre-consumer and/or post-consumer recycled cotton yarns without blending and RCS- or GRS-certified. Read more in the Supplier Mapping.

Taishoboseki, based in Japan, offers recycled pre-consumer cotton waste yarn under the brand name Raffy. Read more in the Supplier Mapping.

Takihyo, a Japanese company, launched Takihyo's Circular System in 2019. It includes two projects: a partnership with The New Denim Project (TNDP) that mechanically recycles pre/post-consumer cotton materials into upcycled denim and cotton in Guatemala and the No Waste project that mechanically recycles pre/post-consumer natural fiber-based materials in Thailand. Read more in the Supplier Mapping.

The Movement, a start-up from The Netherlands, offers 100% traceable recycled cotton yarns made in Europe.

Usha Yarns offers RCS- and GRS-certified yarns made with 60% pre-consumer recycled cotton and 40% post-consumer recycled polyester. Read more in the Supplier Mapping.

WeTurn offers GRS-certified recycled cotton yarn produced in collaboration with a network of partner companies. Read more in the Supplier Mapping.

Tip:

Visit the Textile Exchange database for a list of RCS- and/or GRS-certified suppliers.

Photo: Usha Yarns

Commitments to preferred cotton
Examples

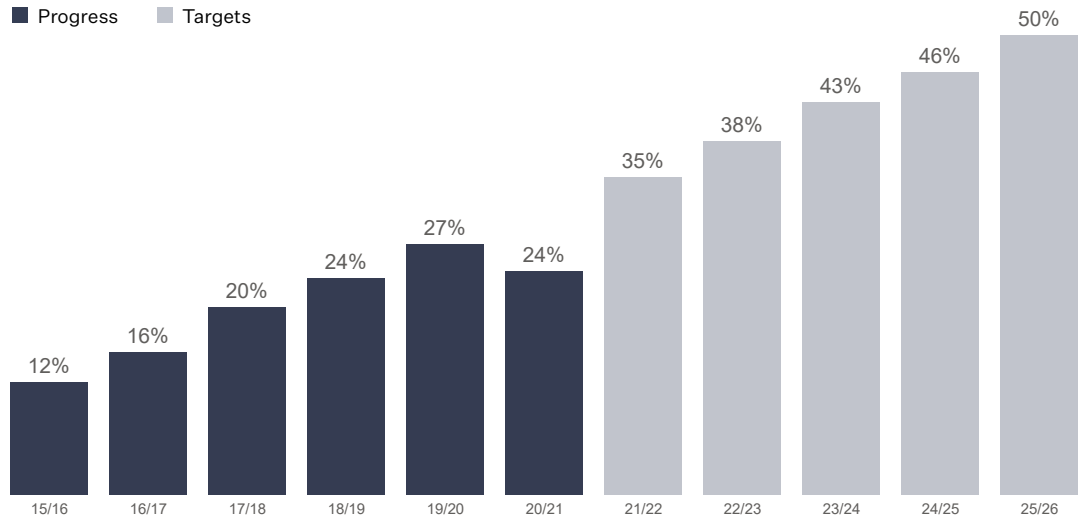
Overall industry goal

The vision of Textile Exchange's 2025 Sustainable Cotton Challenge is that **more than 50% of the world's cotton in 2025 is converted to more sustainable growing methods**, defined as grown according to a list of recognized programs[1]. In the last five years, the market share of preferred cotton increased from 13% in 2015/16 to 24% in 2020/21. However, compared to the 27% market share in 2019/20, this is a decrease. Reasons include weather variations, changes in the Better Cotton programme, market conditions and socio-political challenges. The industry thus must significantly accelerate its uptake of preferred cotton in order to meet Challenge's goal. The aim is also to drive continuous improvement across the programs. A focus will be the dissemination of best practices for soils and implementing regenerative practices that put carbon back into the soil to mitigate and reduce the climate crisis.

Company commitments

162 companies (including subsidiaries) signed up to the 2025 Sustainable Cotton Challenge between its launch in May 2017 and December 2021. By signing the pledge, the companies committed to sourcing 100% of their cotton from one or more of the recognized programs by 2025. For more information, have a look at the latest 2025 Sustainable Cotton Challenge Report.

Progress towards the 2025 Sustainable Cotton Challenge Target



Source: Textile Exchange based on ICAC, cotton programs, and 2025 Sustainable Cotton Challenge targets

Call to action:

- Sign the 2025 Sustainable Cotton Challenge
- Join the Organic Cotton Round Table and the Sustainable Cotton Round Table

1 Recognized programs include ABR, BASF e3, Better Cotton, Cleaner Cotton (discontinued in 2020), Cotton made in Africa (CmiA), Fairtrade, Fairtrade Organic, In-Conversion Cotton (Transitional in the US), ISCC, myBMP, Organic, Recycled cotton (that is certified to an independently verifiable standard such as the Global Recycled Standard or the Recycled Claim Standard), REEL Cotton, Regenerative Cotton, and the U.S. Cotton Trust Protocol.

Plant Fibers & Materials

Other Plant-based Fibers

Other plant-based fibers

Flax, hemp, and beyond

Other plant-based fibers include a diversity of fibers such as jute, coir, flax, hemp, sisal, abaca, kapok, ramie, agave fibers, and henequen. It is estimated that more than 8 million households are involved in the production of these natural plant-based fibers.[1]

With a global production volume of around 6.7 million tonnes, the market share of these other plant-based fibers was approximately 6% of the total global fiber production volume in 2021.[2]

Jute had the largest market share of all other plant-based fibers with around 50%.[1] Similar to hemp, flax, and ramie, they are bast-fibers. Jute is used to make twine, ropes, matting, and packaging materials, as well as home textiles such as curtains and carpets.

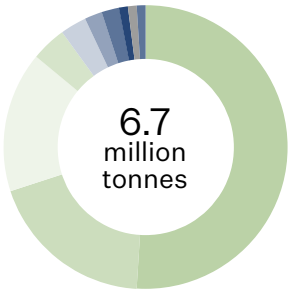
Coir had the second largest market share of other plant-based fibers at approximately 20%.[3] Coir is the fiber extracted from the husks of coconuts. It is used to produce home textiles such as floor mats, doormats, brushes, and mattresses.

The global **flax** fiber and tow production in 2021 is estimated at around 1 million tonnes.[3] Processed flax, also called linen, is used for a variety of products including home textiles and apparel.

Hemp fiber and tow had an estimated global production volume of around 0.25 million tonnes in 2021.[3] The bast-fiber hemp is used in various industries including home textiles and apparel.

Further plant-based fibers include sisal, abaca, kapok, ramie, agave, and henequen.

Other plant-based fibers[1]

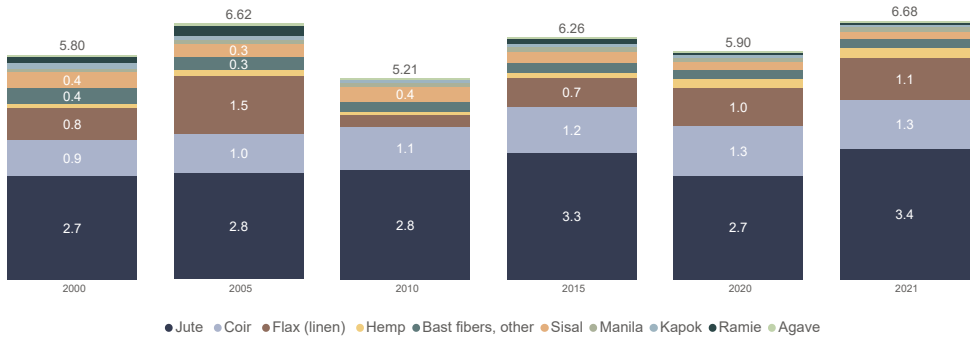


Jute · Coir · Flax fiber and tow · Hemp · Sisal
Abaca · Kapok · Ramie · Agave · Other bast fibers

8+ million households

are estimated to be involved in the production of natural plant-based fibers such as jute, coir, flax and hemp.[1]

Other plant-based fiber production (million tonnes)



Source: Textile Exchange based on FAOSTAT

Note: 2021 numbers are estimated by Textile Exchange

1 DNFI, 2017. Press release "Natural fibers production reaches 30 million tonnes" published on 29 July 2017. Link.

2 Textile Exchange based on FAOSTAT and total global production volumes compiled by Textile Exchange (see Global Fiber Market).

3 Textile Exchange based on FAOSTAT. 2021 figures were not available at report launch so were estimated similar to the 2020 figures. Please note that the data quality of these other plant-based fibers is limited. Data adjustments are regularly made also for historical data and data gaps exist for some countries.

Other plant-based fibers

Hemp

Hemp fiber and tow had an estimated global production volume of around 254,692 tonnes in 2021[1]. The market share of hemp is thus around 0.2% of the total fiber market in 2021. Hemp for fibers has mainly been grown in China, but there are also emerging initiatives in other countries, including Europe and the US. The US Farm Bill, signed into law in December 2018, makes the growing of hemp in the US much easier as cannabis with less than 0.3% THC is now considered an agricultural crop rather than a controlled substance. Some advocates in the US, however, are pushing to increase that amount to 1%. The bast-fiber hemp is used in various industries, including home textiles and apparel.

Research is underway into hemp and jute as feedstock for manmade cellulosics (see the Manmade Cellulosics Chapter) and also non-fiber materials (see Emerging Non-Fiber Materials chapter).

Textile Exchange Member Action

AltMat is developing fibers made from residues of food and medicinal crops. First commercialized Alt fibers were created from the stalks of oilseed hemp. Read more in the Supplier Mapping.

Bear Fiber is developing a novel alkaline hemp cottonization process and manufacturing platform to produce cotton-like hemp fiber that can be easily spun with and complement cotton. Read more in the Supplier Mapping.

Circular Systems launched The Agraloop Bio-refinery 1.5 pilot facility in Belgium in January 2020, using food crop residues as feedstock and powered by 100% renewable energy. Oil-seed hemp is one of the feedstocks that can be utilized for these fibers. The first Agraloop BioFibre™ products hit the market in 2020 with French oilseed hemp used as feedstock. Read more in the Supplier Mapping.

Ecovus is planning to develop large scale industrial hemp processing facilities in strategic locations across the US.

element6 Dynamics aims to have over 1 million acres of industrial hemp will sequester vast amounts of carbon and feed 60 processing facilities that transform the crop into essential value-added hemp-derived materials for major paper/pulp, plastics, and animal feed manufacturers.

Hemp Black is working on a patented technology platforms to stabilize this carbon sequestered in hemp plants permanently, and deliver innovative solutions to a multitude of industries.

Hemp Fortex is a leading supplier of hemp textiles. This vertically integrated company uses hemp grown in China and manufactures yarn, knitted, and woven fabrics made from hemp.

Panda Biotech aims to process 130,000 tonnes of Texas-grown industrial hemp per year into high-quality, textile grade fiber and premium cellulose.

Tung Ga offers REECO, RCS/GRS-certified recycled hemp fiber. Read more in the Supplier Mapping.

Winona's Hemp & Heritage Farm is working to find ways to process their hemp for textile applications.

Photo: University of Kentucky

1 FAOSTAT, 2022. Database. Link. Note: 2021 figures estimated similar to the 2020 figures by Textile Exchange as 2021 figures were not yet available at the launch of this report. Please note that the FAO data for hemp were recently updated and also backward adjusted. Data gaps for some countries still exist and overall the data quality is limited.

Other plant-based fibers

Flax

The global flax fiber and tow production in 2021 is estimated at around 1 million tonnes[1]. The market share of flax is thus less than 1% of the global fiber market. Processed flax, also called linen, is used for various products including home textiles and apparel.

Around 80–85% of the flax used for fibers is grown in Europe. France is the largest producer of flax fibers. European flax is cultivated in a broad coastal band stretching from northern France through Belgium and the Netherlands. Other key flax fiber-producing countries are Belarus, Russia, Ukraine, and China.[2]

Standards

A small percentage of flax is certified organic. According to estimates of the European Confederation of Linen and Hemp (CELC), around 0.5% of the flax grown in Europe is certified organic.[2]

European Flax® is CELC's traceability standard for flax fiber grown in France, Belgium, and the Netherlands and includes sustainable production provisions while prohibiting the use of GMOs and requiring third-party verification. MASTERS OF LINEN® is their registered mark indicating linen 100% made in Europe, from field to fabric.

Cotton Connect's REEL Linen Code is a code of conduct to support the more sustainable production of linen. The Code requires farmers and processors to adopt more sustainable practices when producing the flax fibers which are spun into linen yarn. Building on the REEL Cotton Code, Cotton Connect developed the REEL Linen Code in partnership with Kingdom, one of the largest linen yarn manufacturers in the world. The NGO claims that adherence to the Code has increased both yields and farm profits while reducing environmental impacts.

Textile Exchange Member Action

Circular Systems' Agraloop Bio-refinery is currently developing BioFibre™; fibers made entirely from food crop residues. Oil-seed flax is one of the feedstocks that can be utilized for their fibers. Read more in the Supplier Mapping.

Tung Ga offers REECO, RCS/GRS-certified recycled flax fiber. Read more in the Supplier Mapping.

Photo: Johan Neven

1 FAOSTAT, 2022. Database. Link. Note: 2021 figures estimated similar to the 2020 figures by Textile Exchange as 2021 figures were not yet available at the launch of this report.

2 European Confederation of Linen and Hemp (CELC). Email correspondence.

Other plant-based fibers

Nettle, kapok, and others

There is an emerging interest in using plant-based specialty fibers such as nettle, lotus, kapok, and others. The use of agricultural residues is also gaining much attraction.

Additional plant-based fibers used in the textile industry include nettle, kapok, lotus, and others. The use of crop residues, such as rice straw, pineapple leaves, banana tree trunks, and sugar cane bark, is another emerging field. Please note that the companies listed below do not chemically dissolve the plants into pulp, nor do they depolymerize them. If the same plants are dissolved into pulp, they are listed in the chapter on Manmade Cellulosic Fibers. If depolymerization is used to process them, they are listed as biosynthetics.

Textile Exchange Member Action

AltMat is developing fibers made from residues of food and medicinal crops. The technology is applicable for various kinds of biomass including stalks and leaves of fruit crops like banana and pineapple, wild or medicinal crops like nettle, and industrial crops such as cotton. A combination of mechanical, chemical, and microbial sciences is used to transform the low-value materials into soft and strong fibers. Read more in the Supplier Mapping.

Circular Systems' Agraloop Bio-refinery is currently developing BioFibre™, fibers made entirely from food crop residues. The Agraloop™ can utilize a range of feedstocks—apart from oil-seed hemp and oil-seed flax—for example, rice straw as well, as pineapple leaves, banana tree trunks, and sugar cane bark can be used. Read more in the Supplier Mapping.

Himalayan Wild Fibers extracts textile fiber from a nettle plant that grows wild in the mountain forests of the Himalayas. Read more in the Supplier Mapping.

NextEvo offers textile-grade ready-to-spin Pineapple Leaf Fibers (PALF). The pineapple leaves are the by-product of the pineapple fruit industry and collected from the major agricultural food processing companies and farmer cooperatives in Southeast Asia. Read more in the Supplier Mapping.

Spinnova is a Finnish company using a proprietary, innovative mechanical approach to produce textile fiber from micro-fibrillated cellulose (MFC). In 2020, Spinnova and the world's largest wood pulp producer Suzano launched the construction of their first commercial-scale SPINNOVA® fiber production facility, called Woodspin, in Finland. The facility, producing SPINNOVA® fiber, is the first step towards the ambition of scaling production volume to 1 million tonnes of annual capacity by 2031. Construction is well underway in Jyväskylä, and the fiber is expected to be available at the end of 2022. Read more in the Supplier Mapping.

Other

FLOCUS™ produces yarn blends and filling made with kapok. Read more in the Supplier Mapping.

Photo: Linda de Volder

Plant Fibers & Materials

Rubber

Rubber

The global natural rubber production was around 15 million tonnes in 2021[1]. Natural rubber had a market share of around 49% of the global total 31 million tonnes rubber market in 2021. Synthetic rubber accounted with 15.7 million tonnes for around 51% of the global rubber market in 2021[2]. The market share of natural rubber increased from around 40% of the total rubber market in 2010 to around 50% in 2020, and slightly decreased again in 2021.[1,2]

The largest natural rubber producing countries in 2021 were Thailand (32%), Indonesia (23%), and Vietnam (8%)—in percentage compared to the global total rubber production.[1] It is estimated that around 85% of the natural rubber is produced by smallholders, involving around 10 million farmers[3].

The market share of rubber forest certified to FSC and PEFC was around 2.6% in 2021.[1,4,5]

FSC-certified rubber forest had around 0.25 million hectares[4] compared to a total of 12.8 million hectares of rubber forest[1] and thus a market share of around 2% in 2021.

PEFC-certified rubber forest had with around 0.1 million hectares a market share of around 0.8% of the total rubber forest in 2021. The first PEFC-certified rubber has been available since 2021[5].

1 FAOSTAT, 2022. Database. Link. 2021 data not yet available at launch and thus estimated to be similar to 2020.

2 Statista, 2021. Synthetic rubber global production 2000-2020. Link. IRSG, 2022—IRS Group release latest industry outlook. Link.

3 FSC, 2019. Responsible Sourcing of Natural Rubber. Link.

4 FSC, 2022. Email correspondence.

5 PEFC, 2022. Email correspondence.

6 Textile Exchange member list as of 18 June 2022.

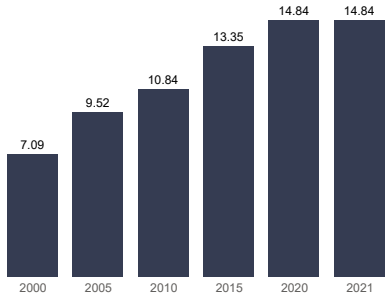
FSC and PEFC are founding members—and together with several other organizations—members of the **Global Platform for Sustainable Natural Rubber (GPSNR)**.

Textile Exchange Member Action

From the 15 companies that signed the FSC call to commit to sourcing deforestation-free, environmentally-conscious and socially responsible rubber, 11 companies are Textile Exchange members: Allbirds, Avocado, Clarks, H&M, Ikea, Inditex, Patagonia, The North Face, Timberland, Vans, and the VF Corporation.[6] The Textile Exchange members Allbirds, Clarks, and Patagonia are already using FSC-certified rubber.[4]

In 2021, the VF Corporation including Timberland, Vans and The North Face, announced its new partnership with Terra Genesis International in Thailand to build the fashion industry's "first regenerative rubber supply system".[7]

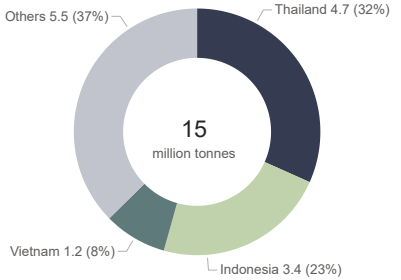
Global natural rubber production (in million tonnes)



Source: Textile Exchange based on FAO
Note: 2021 numbers are estimated by Textile Exchange

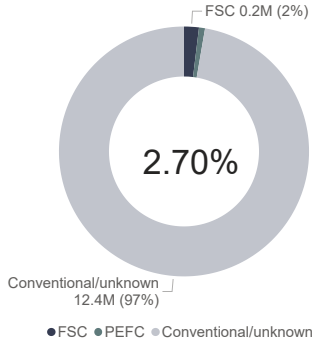
7 Timberland, 2021. Press Release. Link.

Global natural rubber production by country in 2021



Source: Textile Exchange based on FAO
Note: 2021 numbers are estimated by Textile Exchange

Global rubber forest area by program in 2021



Source: Textile Exchange based on FSC, PEFC and FAO
Note: 2021 numbers are estimated by Textile Exchange

Animal Fibers & Materials

Down & Feathers

Virgin down

Production facts and figures

The global down and feather production volume increased to around 565,103 tonnes[1] in 2021, after a slight decline due to COVID-19 in 2020. The Responsible Down Standard (RDS) had a market share of 3.2%, while Downpass had a market share of 1.2% in 2021.

The global down and feather market is highly fragmented, with many small and medium producers. Around 85–90% of the down comes from ducks; the remaining down comes mainly from geese.[1]

China is the largest producer of down, responsible for around 60% of all ducks worldwide.[2]

Concerns about the treatment of animals have led to the development of animal welfare standards for down. Key standards include the Responsible Down Standard (RDS) and Downpass[3]. These standards ensure that there is:

- no live-plucking
- no force-feeding
- broader animal welfare (depending on standard)

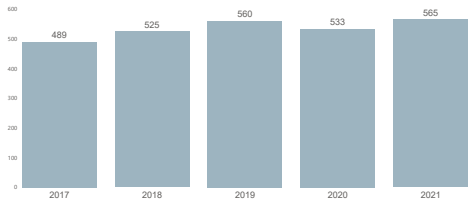
Multi-tier cage farming, increasingly used in China for ducks, is also prohibited in RDS as the animal welfare outcomes described by RDS cannot be delivered by these systems. China is the largest producer of RDS certified down and this trend may have an impact on the availability of RDS-certified down in the future.

RDS-certified down production volume increased from 16,022 tonnes in 2020 to 17,876 tonnes in 2021, equaling 3.2% of total down production in 2021. The number of RDS-certified farms was 8,107[4] in 2021, while the number of certified processing sites was 1,339. The RDS was launched in 2014.

The global Downpass-certified down production volume increased from 5,780 tonnes in 2020 to 6,958 tonnes in 2021. This is equivalent to an estimated 1.2% of the total down production volume in 2021. The number of Downpass-certified farms increased from 7,942 in 2020 to 9,256 in 2021. The number of certified processing sites increased from 479 in 2020 to 577 in 2021.

With 54% of all Downpass-certified farms located in Ukraine in 2021, the future supply may be negatively impacted due to the war. The RDS supply may also be negatively impacted due to this but its vast majority (93%) was produced in China and only minor volumes (101 tonnes) in Ukraine in 2021.

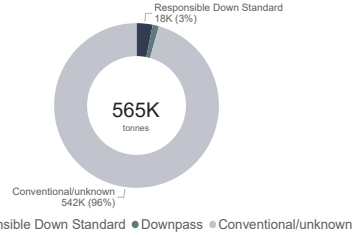
Global down production (thousand tonnes)



Source: Textile Exchange based on Maia Research

Note: This chart covers only virgin down and not recycled down

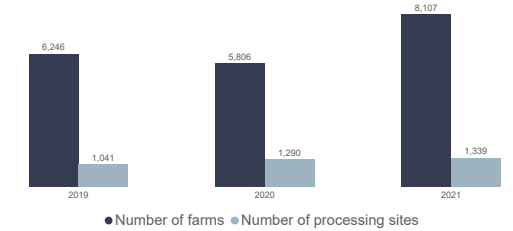
Preferred down market share in 2021



Source: Textile Exchange based on Maia Reports 2021 and standard owners

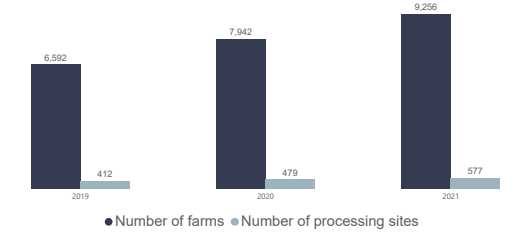
Note: This chart covers only virgin down and not recycled down

Number of Responsible Down Standard (RDS) sites



Source: Textile Exchange

Number of Downpass sites



Source: Textile Exchange based on Downpass

1 Maia Research, 2022. Global Down and Feather Market Report 2022. Customized report.

2 FAOSTAT, 2022. Database. Link. Note: 2021 figures estimated similar to the 2020 figures by Textile Exchange as 2021 figures were not yet available at the launch of this report.

3 The Global Traceable Down Standard (TDS) was withdrawn in 2020 and is thus no longer covered in this report.

4 This includes a total of 7 farm areas (more than 8,342,003 small farms).

Virgin down

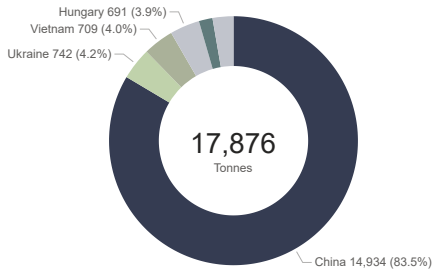
Directory: Where to find preferred down across the globe

Around 24,834 tonnes[1] of preferred down were produced on 17,363 farms[1] in 15 countries in 2021. Major production regions for preferred down are China and Eastern Europe, including Poland and Ukraine. The war in Ukraine may negatively impact supply in future years.

Tip: How to find suppliers of preferred down.

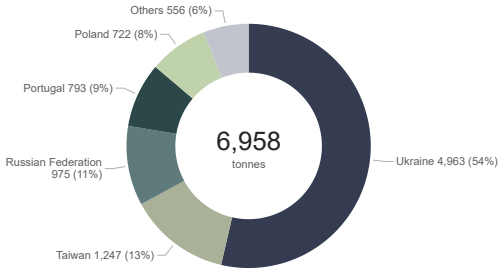
Check out the Textile Exchange database for Responsible Down Standard (RDS) certified down suppliers or contact Downpass for a list of Downpass certified suppliers.

Responsible Down Standard (RDS) certified down by country 2021



Source: Textile Exchange

Downpass certified down by country 2021



Source: Textile Exchange based on Downpass

Western Europe

IRELAND
Downpass: n.a.

FRANCE
RDS: 4 tonnes
Downpass: n.a.

NETHERLANDS
Downpass: n.a.

GERMANY
RDS: 48 tonnes
Downpass: n.a.

PORTUGAL
Downpass: n.a.

Eastern Europe

BULGARIA
RDS: 21 tonnes

HUNGRARY
RDS: 691 tonnes
Downpass: n.a.

POLAND
RDS: 317 tonnes
Downpass: n.a.

RUSSIA
RDS: 207 tonnes
Downpass: n.a.

UKRAINE
RDS: 742 tonnes
Downpass: n.a.

North America

UNITED STATES
RDS: 204 tonnes

East and South-East Asia

CHINA
RDS: 14,934 tonnes
Downpass: n.a.

TAIWAN
Downpass: n.a.

VIETNAM
RDS: 709 tonnes

Australasia

AUSTRALIA
Downpass: n.a.

1 This assumes that no down and farms were double-certified to RDS and Downpass. Information on double-certification was not available at report launch.

2 Based on 14.5% loss from birds to down and on 60:40 duck:goose ratio.

3 Downpass production volumes were only available at global level but not at country level. The percentages indicated here are based on the number of farms by country. As the number of farms do not necessarily correlate with the production volumes, the percentages in volumes may differ from the percentages listed here.

Recycled down
Production facts and figures

Recycled down had an estimated market share of around 1% of the global down production volume in 2021. While virgin global down production was around 565 thousand tonnes in 2021, the production volume of recycled down is roughly estimated at around 5,580 tonnes. The market for recycled down is growing[1].

Key standards

Key standards used for recycled down include the Recycled Claim Standard (RCS) and the Global Recycled Standard (GRS). Further information on these standards is provided in the chapter on Sustainability Standards.

Tip: How to find suppliers of recycled down.

Check out the Textile Exchange database for a list of RCS- and/or GRS-certified suppliers.

Key suppliers for third-party certified down

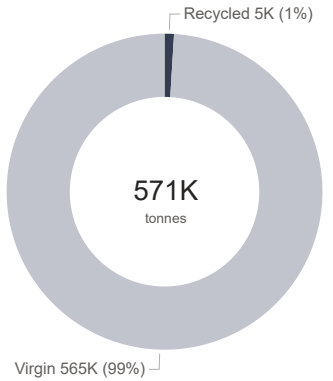
Major suppliers for GRS-certified recycled down are:

- Allied with its GRS-certified TITANIUM: RENU™. Read more in the Supplier Mapping.
- Downlite, a US-based company, with its GRS-certified Re/charged down, launched in 2017.
- Navarpluma, a Spanish GRS-certified company, with its Recycled NEOKDUN® originating from the recycling of bedding/apparel finished products that have reached the end of their product life cycle.
- Rohdex with its recycled down certified to the GRS.

Textile Exchange Member Action

Re:Down is a company specialized in the down recycling made from post-consumer products. Re:Down produce a garden fertilizer from feathers that do not make the grade. Read more in the Supplier Mapping.

Recycled down market share in 2021



Source: Textile Exchange based on Maia Research

1 Maia Research, 2022. Global Down and Feather Market Report 2022 (customized report).

Commitments to preferred down
Examples

The number of apparel, outdoor and home textile companies that have publicly committed to preferred down is increasing every year.

Examples of public commitments by Textile Exchange members

All down used by **Arc'teryx** is certified to the RDS. Read more here.

Aritzia uses only down that's certified to the RDS. Read more here.

BESTSELLER only uses virgin down sourced according to the RDS. Read more here.

Since fall 2016, all the down and feathers in **C&A**'s products are RDS-certified. Read more here.

Columbia has committed to 100% RDS-certified down and feathers throughout its global line (excluding its Japanese subsidiary). Read more here.

Eileen Fisher is committed to 100% RDS-certified down and feathers. Read more here.

Esprit ensures that 100% of their down and feathers are sourced according to the RDS, or RCS/GRS certified recycled down. Read more here.

All down sourced by **GANT** is compliant to the RDS. Read more here.

Gucci's sustainability principles state that the supplier and its sub-supplier ensure that feathers or downs are RDS-certified or that they adopt, maintain, and verify a sourcing policy that ensures there has been no live-plucking and they don't derive from animals that have undergone force-feeding during the reproductive phase of their lives. Read more here.

H&M only accepts down from farms that have been RDS-certified and recycled down since 2015. Read more here.

100% of the down in **Kathmandu** products is certified under the RDS. Read more here.

All down sourced by **Marks & Spencer** must be certified by RDS or the IDFL Down Standard (IDS) or RCS/GRS-certified recycled down. Read more here.

Norrona only uses down that is RDS-certified or recycled. Read more here.

All **Patagonia**'s virgin down is certified to the RDS. Read more here.

prAna is committed to only sourcing RDS-certified down. Read more here.

PVH Corp requires all down and feathers to adhere to the RDS. Read more here.

100% of the down sourced by **Ralph Lauren** is RDS-certified or recycled down by 2023. Read more here.

100% of down insulation used by **REI** has been RDS-certified since 2015. Read more here.

The North Face started using RDS-certified down in Fall 2015 and since Fall 2016 they have only purchased RDS-certified down. Read more here.

Varner is committed to 100% RDS down. Read more here.

All virgin down purchased by **VF Corporation** in 2017 and 2018 was certified to the RDS. 2018 was the first year that VF purchased recycled down, which was all certified to the GRS. Read more here.

Since 2017, 100% of the down sourced by **Volcom** is RDS-certified. Read more here.

Other examples

All down used in **Deckers**-branded products is certified in accordance with the RDS. Read more here.

Starting with its fall/winter collection 2016, **Hugo Boss AG** exclusively uses down that is produced without live-plucking or forced feeding and has documented origins. Read more here.

From fall 2017, **Tommy Hilfiger** confirmed that all their down products are certified to the RDS. Read more here.

Since 2018, all down used by **Helly Hansen** is RDS-certified. Read more here.

Make a Standards Commitment

Whether you have already made a commitment to one or more of Textile Exchange's Standards, or you want to share a new one, you may use this form to register details of your commitment(s).

Wool & Other Animal Fibers

Virgin animal fibers: Sheep wool

Production facts and figures

With an annual production volume of approximately one million tonnes of clean wool fiber, sheep wool is the most used animal-based fiber[1]. This equals a greasy wool production of around 1,950,240 tonnes in 2021.

While the global wool production has been declining over the years, the market share of wool programs is increasing. As such, the wool market is trending in the right direction and is setting a lead for other fiber and materials to follow.

The market share of wool produced according to the Responsible Wool Standard (RWS), ZQ + ZQRX, and SustainaWOOL GOLD and GREEN combined was 58,434 tonnes (=3%) of the total greasy wool production in 2021.

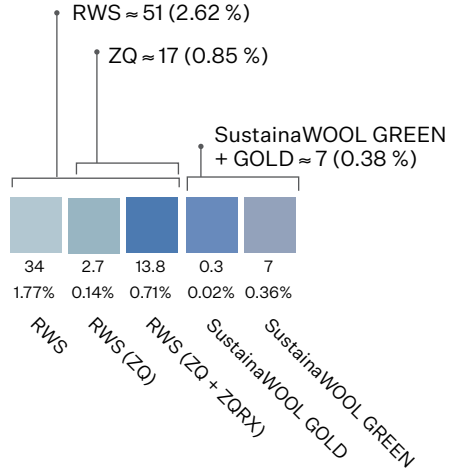
The RWS (including equivalents) accounted for approximately 87% of this 3% market share, equaling 2.6% of the global greasy wool market. ZQ (including equivalents) accounted for 0.9% of the global greasy wool production, and SustainaWOOL GREEN and GOLD together accounted for 0.4% of the greasy wool market. Due to the double-certification of around 0.9% of the global greasy wool production, around 3% (and not 4%) of the global greasy wool production was certified according to these programs.

The increasing number of wool programs significantly vary in terms of requirements; their approach to assurance ranging from self-declaration to third-party audits as well as degrees of traceability and oversight through the supply chain. Some are active in only certain regions or markets and others focus in on particular impact areas.

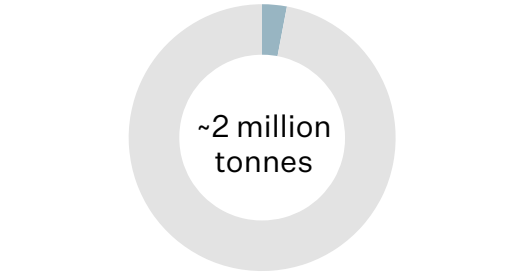
The programs listed here have assurance and traceability models and were able to share volume data in time for this report launch. The RWS was developed with the aim of providing a holistic global benchmark and definition for responsible wool production. Textile Exchange measures the progress of the most ambitious wool programs that are able to share volume data.

2021 data for the production volume of organic, Land to Market, and other programs were not available for the launch of this report.

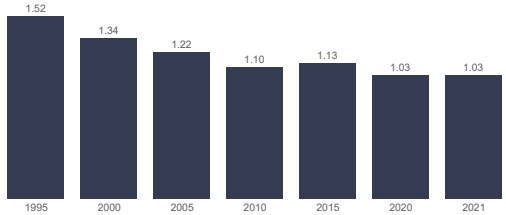
Global wool production by program (in '000 tonnes and % of total greasy wool)



Global wool programs' greasy wool market share in 2021



Global wool fiber production (million tonnes)



Source: Textile Exchange based on IWTO

Note: This chart covers virgin clean wool and not recycled wool

1 IWTO, 2022. Market Information. Edition 17. Link.

2 This includes the volumes of wool programs for which data were unavailable or inaccessible at the launch of the report.

Virgin animal fibers: Sheep wool

Production facts and figures

Responsible Wool Standard (RWS)-certified wool production increased from 24,195 tonnes (1.23%) of all global greasy virgin wool in 2020 to 51,078 tonnes (2.62%) in 2021—on global average. In the key apparel wool producing countries, RWS-certified wool has reached market shares as high as 30% of all wool in South Africa, 17% in Uruguay, and 15% in Argentina. In 2021, RWS wool was produced in India and the Falk Islands for the first time.

To date, the majority of RWS-certified wool is merino wool. With the release of the Communal Farmer Group Certification model, access to certification has broadened to cover farmers with no or limited land tenure, including nomadic and semi-nomadic farmers. In 2021, RWS-certified wool was produced in communities with such production systems in India for the first time.

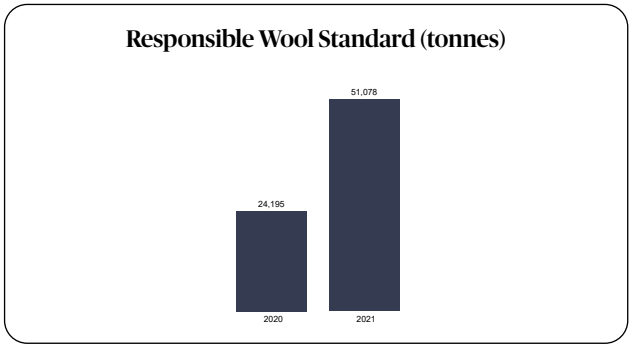
RWS has also seen a strong adoption through the supply chain with a concentration in key apparel wool processing countries such as Italy and China. With the release of RWS 2.0 the supply chain certification for RWS, Responsible Mohair Standard (RMS), and Responsible Alpaca Standard (RAS) were combined into one scope of Responsible Animal Fibers (RAF).

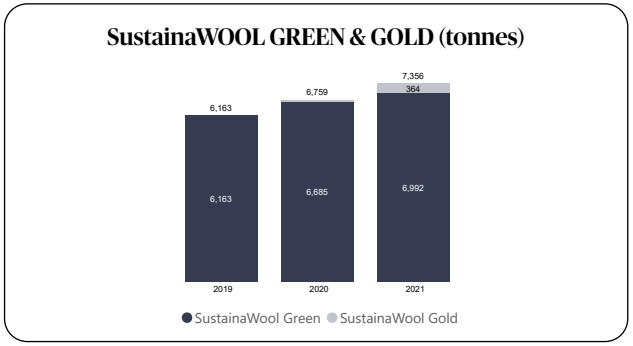
The aim of RWS (and RMS, and RAS) is to ensure that the potential for high animal welfare for animals raised in extensive grazing and free ranging farming systems is realized. This is possible through audited standards covering all aspects of the animals' lives to ensure best practice from the farmers and to deliver high level welfare. At the close of 2021, more than 10 million sheep were under RWS certification.[1] In addition to animal welfare, the RWS addresses land management and with the launch of the RWS 2.0 in March 2020 new biodiversity requirements and a new module addressing social welfare on farms were introduced. At the close of 2021, there was over 23 million hectares under RWS certification.[1]

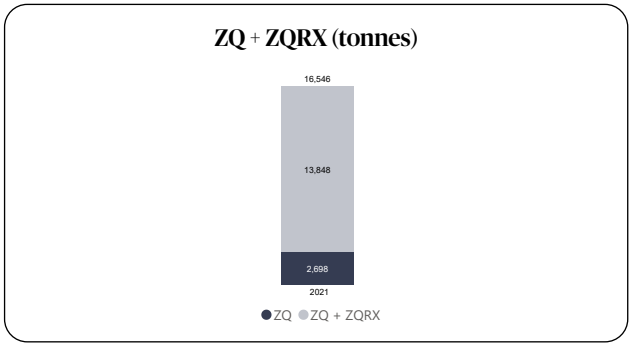
SustainaWOOL GREEN production volumes increased fro 6,685 tonnes in 2020 to 6,992 tonnes in 2021. SustainaWOOL GOLD production volumes increased from 74 tonnes in 2020 to 364 tonnes in 2021. SustainaWOOL is produced in Australia.

ZQ wool (New Zealand Merino) reached 0.85 % (16,546 tonnes) in 2021. All ZQ wool in 2021 was also RWS-certified in 2021. ZQ wool is produced in New Zealand and Australia. Additional outcome measurement according to ZQRX was carried out for around 84% of all ZQ wool produced in 2021.

Data for the production volume of **organic, Land to Market, and other programs** were not available at the launch of this report. More information on the market share of non-mulesed wool can be found in the chapter on The Non-Mulesed Wool Market.







Virgin animal fibers: Sheep wool

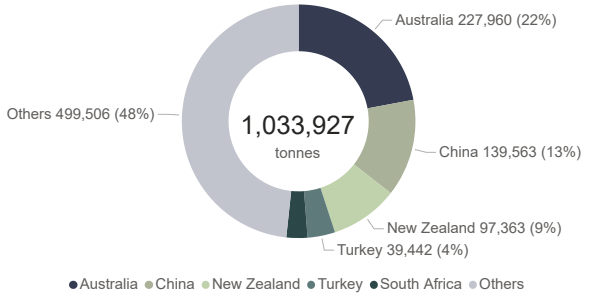
Wool production by country

In the key apparel wool-producing countries, RWS-certified wool has reached market shares as high as 30% of all wool in South Africa, 17% in Uruguay, and 15% in Argentina. In 2021, RWS wool was also produced in India and the Falkland Islands for the first time.

Tip: How to find suppliers of preferred wool

Check out the Textile Exchange database for certified suppliers of RWS, OCS and recycled wool, the Responsible Wool Standard Brand Sourcing Guide for support related to the RWS and the GOTS database for GOTS certified wool suppliers.[2] Or contact SustainaWOOL or ZQ for a list of certified suppliers.

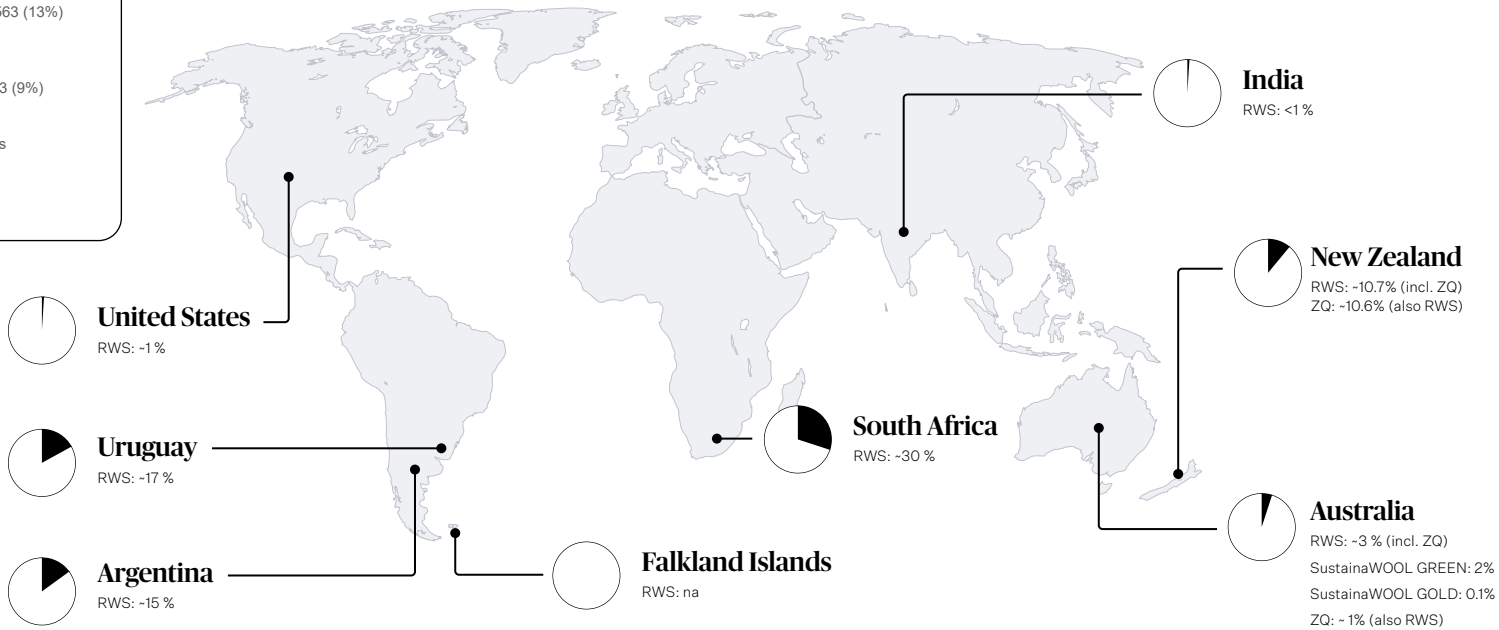
Global wool production by country in 2021



Source: Textile Exchange based on IWTO

Note: This chart covers virgin clean wool and not recycled wool

Market share of wool programs by country [2]



1 IWTO, 2022. Market Information. Edition 17. Link

2 Only including RWS, ZQ + ZQRX, and SustainaWool Green+Gold as data were unavailable for Land to Market, organic, and other programs at report launch. Market share given in percentages compared to overall wool production based on ITWO data as mentioned in (1). Only wool producing countries with production according to these standards highlighted in dark blue.

Virgin animal fibers: Sheep wool

The Non-Mulesed Wool Market

Mulesing, i.e., the removal of wool-bearing strips of skin from between the hind legs of sheep (the "breech" area) in an effort to avoid problems of fly strike, remains a key issue related to wool production.

With the ban of mulesing in New Zealand in 2018, the only country where mulesing is still practiced is Australia. As Australia has a market share of around 22% of the global clean wool market[1], the risk of sourcing wool produced with mulesing practices remains high if no traceability system is in place to ensure that the wool is mulesing-free.

In this context, it's important to note that different forms of mulesing exist: the removal of skin via cutting with shears and by the application of liquid nitrogen (sheep freeze branding or "steining") and the use of rubber rings—more commonly used for tail docking or castration to remove loose skin from the breech area. Four Paws and Human Society International published a position statement opposing freeze mulesing (steining) in September 2019 because of the severe pain this inflicts on sheep. Both organizations are against any form of breech mutilation or modification.

The number of "Brands against mulesing" listed by Four Paws increased from 203 in June 2021 to 305 in July 2022[3].

While definitions of mulesing usually include any form of breech mutilation or modification, including steining, the mulesing definition of the Australian Wool Exchange (AWEX) used to only include the removal of skin from the breech and/or tail of a sheep using mulesing shears[2]. **This means that wool sold as non-mulesed as per the AWEX definition could still be produced using freeze mulesing (steining).** However, AWEX has published the latest version of its National Wool Declaration (NWD V9.3) in March 2022, following extensive stakeholder consultations. **The new version, which came into force in July 2022, includes a new separate labeling category for "steining", i.e. sheep treated with liquid nitrogen (LN).**

Responsible Wool Standard (RWS), ZQ, and SustainaWOOL GREEN and GOLD certifications ensure that wool is from non-mulesed sheep. If organic wool is certified to the Organic Content Standard (OCS), it also has to be non-mulesed or from a farm with ceasing-mulesed status based on the latest revised version (OCS 3.0), launched in April 2020. Additionally, the Global Organic Textile Standard (GOTS) 6.0, launched in March 2020, added mulesed wool to their list of prohibited fibers.

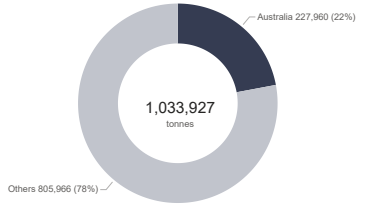
Australian National Wool Declaration (NWD) Definitions[2]

M = Mulesed = "some/all sheep in this mob have been mulesed".
AA = Analgesic/Anaesthetic = "All sheep in this mob were mulesed and treated with a pre- and /or post-Analgesic &/or Anaesthetic product(s) registered by APVMA for use on sheep".
ND = Not Declared
CM = Ceased Mulesing = "No lambs born on this property in the last 12 months have been mulesed. No mulesed (or mulesed with AA) ewes or wethers have been purchased."
NM = Non Mulesed = "No sheep in this mob has been mulesed".
Mulesing = "The removal of skin from the breech and/or tail of a sheep using mulesing shears."

Source: Australian Animal Welfare Standards and Guidelines for Sheep.

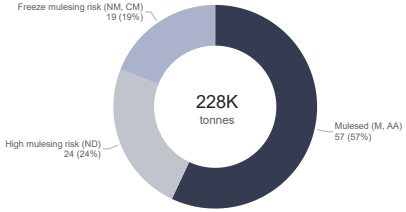
It is important to note that the definition of "mulesing" of the Australian National Wool Declaration does not include freeze mulesing (steining).

Market share of Australian wool in 2021



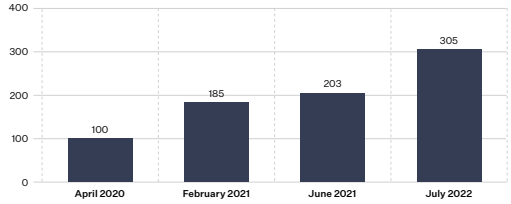
Source: Textile Exchange based on IWTO

Mulesing status of wool in Australia 2021



Source: Textile Exchange based on Awex

Number of brands against mulesing



Source: Four Paws

1 IWTO, 2022. Market Information. Edition 17. Link.

2 AWEX website "Mulesing Status"—accessed on September 15, 2022. Link.

3 Four Paws website "Timeline to End Mulesing" and "Brands Against Mulesing"—accessed on July 7th, 2022. Link and Link.

4 AWEX, 2022. "NWD Wool Market". Link.

Virgin animal fibers: Sheep wool

Land, biodiversity, regenerative practices, carbon sequestration

The majority of fiber-producing animals are kept in extensive, free-ranging, pasture-based systems. The management of land is therefore a key consideration.

Grazing management for fiber-producing animals can degrade soil but using regenerative methods can not only arrest degradation, but also improve soil health. The vegetation coverage, diversity of species in the sward, timing of grazing, stocking rates and use of manures and other inputs can all be monitored and managed to deliver a positive outcome. Regenerative livestock management not only has the potential to deliver better soil health and better quality and quantity of vegetation for grazing (and thus better animal welfare), but it also has the potential to mitigate greenhouse gas emissions from grazing livestock through carbon sequestration and therefore reduce the carbon footprint of animal fibers.

Transitioning to regenerative practices is going to require collaboration and financial support. This need for funding has been recognized by governments and the private sector as the examples below show.

The **Australian Government** has introduced a $34 million Agriculture Stewardship Package focusing on biodiversity. Part of the Agriculture Biodiversity Stewardship Pilot Program will be to make grants available to incentivize the adoption of improved biodiversity practices on farms.

In 2021, the global luxury group Kering, working with Conservation International, launched the "Regenerative Fund for Nature" to transform 1 million hectares of farms and landscapes producing raw materials in fashion supply chains to regenerative agriculture over the next five years. This fund intends to provide grants to farmers, NGOs and key stakeholders who are on the frontlines of developing and scaling agricultural change on the ground.

In addition to funding initiatives, there are many groups already working with farmers to deliver regenerative solutions. As well as working with a network of RWS-certified sheep wool producers in Argentina, Chile and Uruguay, Ovis 21 has trained over 700 people in holistic, regenerative land management. The earlier work of Ovis 21 led to the development of the Savory Institute's Ecological Outcome Verification (EOV), an empirical soil and landscape assessment methodology. EOV underpins the Land to Market program that offers a range of products from foodstuffs to leather and fiber. Ovis 21 has over 400,000 hectares of land with the EOV seal and is able to market regenerative wool.

Fibershed, a California-based organization, develops regional fiber systems to build soil and protect the health of the biosphere. Fibershed is the initiator of the Climate-Beneficial™ wool program, which is grounded in an effort to scale the implementation of carbon farming to create carbon sinks.

Photo: Bronwyn Botha

Virgin animal fibers: Sheep wool

Supplier update

Preferred wool is based on the commitment and support of leading suppliers.

Textile Exchange Member Action

BKB, a wool broker operating in South Africa and Lesotho, and the leading producer of RWS-certified wool globally.

Chargeurs Wool is an internationally operating company that supplies RWS merino wool.

Fox and Lillie, one of the largest buyers and exporters of Australian wool, operating a rapidly expanding RWS farm group.

Lanas Trinidad, jointly owned by Chargeurs and the Otegui family and main producer and exporter of combed wool tops in Uruguay, operating an RWS farm group that is rapidly growing.

The Schneider Group is adopting the RWS in their Authentico program and all Authentico top-making facilities and several Authentico farms are now RWS-certified.

Shaniko Wool Company was established to continue the work of their family ranch **(Imperial Stock Ranch)** and others like them, in supporting the use of wool. At the request of a leading outdoor recreation brand, Shaniko has been involved with the RWS since 2015. They were a pilot audit site in 2015, and the following year, they were the first ranch in the world to receive RWS certification. Working with additional ranches and scaling the effort, Shaniko Wool Company is an approved US Group supplier of RWS wool. In 2020, Shaniko launched its Shaniko Wool Carbon initiative. Read more about Shaniko's action from direct market connections to measuring ecosystem impacts in this interview.

Other key suppliers of RWS-certified wool include:

- Fuhrmann, part of the Schneider Group and based in Argentina, managing 11 farms and combing 9 million kg of wool per year, including organic and RWS-certified wool.
- Ovis 21, a network of more than 160 producers and professionals working with over one million sheep in Argentina, Chile, and Uruguay who seek to change the paradigm of farming from extractive to regenerative.

Tip: How to find suppliers of preferred wool

Check out the Textile Exchange database for certified suppliers of RWS-certified suppliers.

Photo: Shaniko Wool

Virgin animal fibers: Mohair

Production facts and figures

Mohair is the hair of the angora goat (not to be confused with the angora rabbit which produces angora wool). In 2021, around 4,590 tonnes of raw mohair fiber were produced globally. Approximately half of the global mohair (2,330 tonnes) was produced in South Africa. The remaining mohair was produced in Lesotho (750 tonnes), Turkey (470 tonnes), Argentina (360 tonnes), United States (250 tonnes), New Zealand (20 tonnes), Australia (80 tonnes), and other countries (330 tonnes)[1].

The South African mohair industry has been governed by its own Sustainable Mohair Production Guidelines since 2009. These industry guidelines have been developed and regularly revised by the South African Mohair Growers Association. They provided background information on the principles, criteria, and indicators supported by self-assessment checklists.

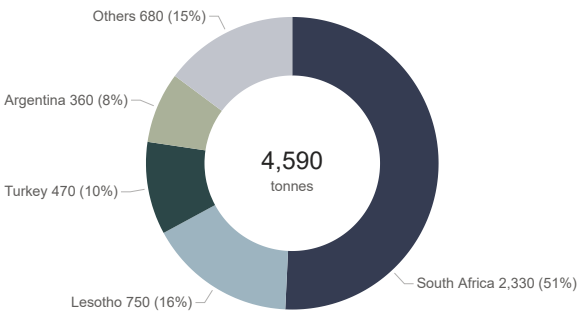
The Responsible Mohair Standard (RMS) is the evolution of the increasing importance and demand for an independent, third-party audited, international standard.

In response to requests from stakeholders, Textile Exchange launched the RMS in 2020. It is based on the existing Responsible Wool Standard, which was released in 2016. The latest version, RMS 1.2, was released in 2021.

The market share of the RMS reached an impressive 20% in 2020, its first year of existence, and increased to 35% of all mohair produced worldwide in 2021.

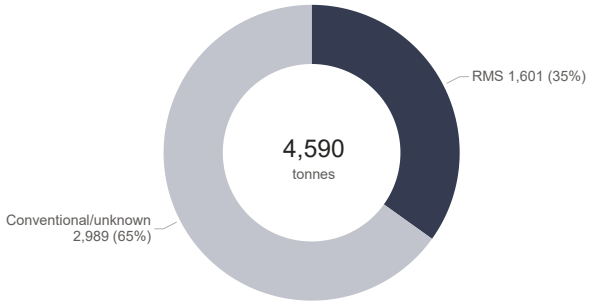
RMS fibers were produced in South Africa—and for the first time also in Australia—in 2021. The RMS market share increased to 67% of the total mohair production in South Africa and 42% of the total mohair production in Australia in 2021.

Global greasy mohair fiber production by country in 2021



Source: Mohair South Africa

Global market share of Responsible Mohair Standard (RMS) in 2021



Source: Textile Exchange based on IWTO and own data
Note: This chart includes greasy mohair data

1 Mohair South Africa—received by email in July 2022

Virgin animal fibers: Mohair

Supplier insights

Textile Exchange Member Action

BKB, a wool and mohair broker operating in South Africa and Lesotho is a leading global supplier of RMS mohair.

Mohair South Africa is the organization that represents the South African mohair industry. It has been actively involved in the development of the new Responsible Mohair Standard (RMS) and is supporting the industry in its implementation.

Margarete Steiff GmbH, the 120-year-old teddy bear company, partnered with Katharine Hamnett, London-based fashion designer, to produce Bio-Fur. The new material is made from mohair fiber trapped in a cotton backing fabric. The mohair is sourced from farms in South Africa.

Cape Mohair & Wool (OVK), part of the OVK group of companies, and the mohair handling and marketing leader in South Africa and worldwide. OVK is also a leading supplier of RMS mohair.

The Stucken Group in South Africa is a vertically integrated niche-focused processor and trader of South African Wool and Mohair and key supplier of RMS mohair.

Tip: How to find suppliers of preferred mohair

Check out the Textile Exchange database for RMS-certified suppliers.

Other key suppliers of RMS-certified mohair

- The House of Fibre is a leading mohair and wool broker and supporter and supplier of the RMS.
- South African Mohair Industries Limited (SAMIL) is a leading trader of mohair from South Africa and a key supplier of RMS mohair.

The Mohair Empowerment Trust is another key organization for supporting the implementation of the RMS.

Photo: Bronwyn Botha

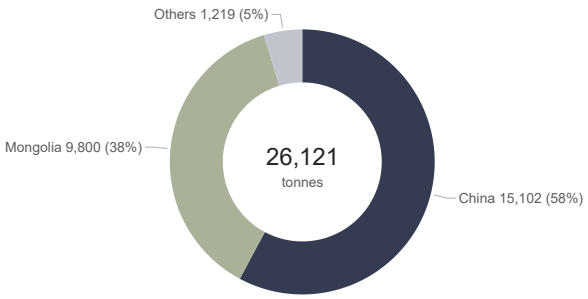
Virgin animal fibers: Cashmere

Production facts and figures

Cashmere is the hair of the cashmere goat. Around 26,121 tonnes of greasy cashmere fiber were produced globally in 2021[1]. Around 58% of the cashmere was produced in China, 38% in Mongolia, and the remaining 5% in other countries[2].

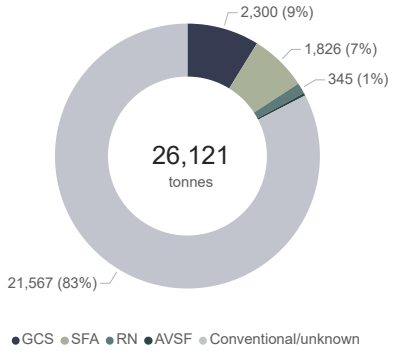
The global market share of cashmere produced according to Agronomeset Vétérinaires Sans Frontiers (AVSF), THE GOOD CASHMERE STANDARD® (GCS), Responsible Nomads (RN), Sustainable Fiber Alliance (SFA), Wildlife Conservation Society (WCS) increased from 1,748 tonnes (=6.6%) in 2020 to 4,554 tonnes (=17.4%) in 2021[3].

Global cashmere production by country in 2021



Source: Textile Exchange based on IWTO, NBS China, and Mongolian Statistical Information Service

Global cashmere production by program in 2021



Source: Textile Exchange based on programs

1 IWTO, 2022. Market Information. Edition 17. The Schneider Group, 2019. Annual Cashmere Market Report 2018. Link.

2 Textile Exchange compilation based on data provided by the program(s): AVSF, GCS, RN, SFA, WCS. 2019 figure for SFA estimated as no data available.

3 The Green Gold and Animal Health Project of the Swiss Agency for Development and Cooperation (SDC) and Mongolian National Federation of Pasture User Groups of Herders (MNFPUG) have partnered in the development and implementation of program.

Virgin animal fibers: Cashmere

Production facts and figures

Agronomeset Vétérinaires Sans Frontiers (AVSF) greasy cashmere fiber production increased from 60 tonnes in 2020 to 83 tonnes in 2021. The AVSF project, operating in Mongolia, involved 11 cooperatives including 977 herder families and covered 1.9 million hectares of land with 252,006 goats in 2021.

THE GOOD CASHMERE STANDARD® (GCS) by the Aid by Trade Foundation (AbTF), developed in 2019, covered 2,800 tonnes of greasy cashmere fiber produced by 9,000 herder families and more than 4 million goats in China in 2021.

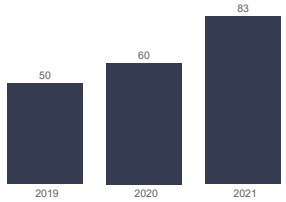
The Responsible Nomads (RN) program, previously referred to as Green Gold and Animal Health program, covered 22,400 herder families organized in 56 cooperatives on 4 million hectares of land in 13 provinces in Mongolia in 2021. The greasy cashmere production volume increased from 180 tonnes in 2020 to 345 tonnes in 2021.

The Sustainable Fiber Alliance (SFA) with its SFA Cashmere Standard covered 16,058 herder families organized in 74 producer groups producing 345 tonnes of greasy cashmere fiber from around 3.6 million goats in 2021, independently assessed as compliant with the standard.

The Wildlife Conservation Society (WCS) program has gone through a substantial review and changes. Moving forward, WCS will be working to deliver the science and monitoring implementation required for verification of sustainable practices and will transition away from community engagement and engagement directly in cashmere sale processes. From 2021 onwards, the progress will no longer be measured in production volumes.

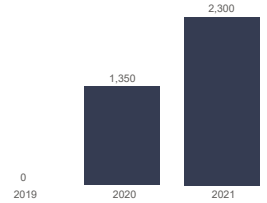
Cashmere production by program (in tonnes)

AVSF Cashmere Standard



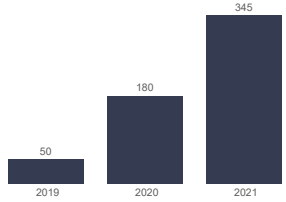
Source: Textile Exchange based on AVSF

Good Cashmere Standard®



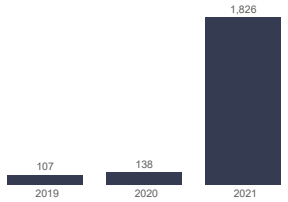
Source: Textile Exchange based on GCS

Responsible Nomads



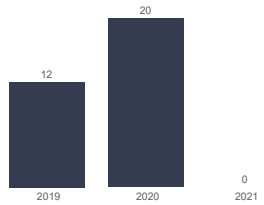
Source: Textile Exchange based on SFA

SFA Cashmere Standard



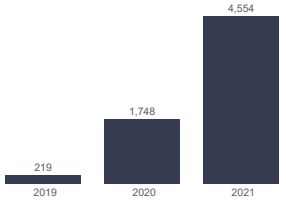
Source: Textile Exchange based on SFA

WCS Cashmere



Source: Textile Exchange based on WCS

Total



Source: Textile Exchange based on program

Virgin animal fibers: Cashmere

Overview

In response to interest and queries from brands, Textile Exchange established the Responsible Cashmere Round Table (RCRT) in March 2019. The aim was to better understand the issues and opportunities surrounding global cashmere production, as well as to have a collective voice in the development of any market-based solutions. Since 2020, the RCRT is part of the new Animal Fibers Round Table (AFRT) which covers all animal fibers. Many important topics for animal welfare and land management cut across different animal species and fibers, so a single Round Table gives all stakeholders access to relevant information, as well as the chance to collaborate and exchange knowledge.

Over two dozen global brands have signed a statement of support for the establishment of the **Mongolia Sustainable Cashmere Platform (MSCP)**, a national-level umbrella mechanism with collaborative leadership and facilitated by the **United Nations Development Program (UNDP)**.

The Platform has four key objectives in its two-year Collection Action Plan:

1. To formulate and implement a collective action plan that addresses the root causes limiting the sustainability of cashmere in Mongolia.
2. To influence and harmonize government policy that ensures a strong and coherent legal and institutional framework for sustainable cashmere in Mongolia.
3. To establish partnerships and coordinated investments and actions that accelerate current efforts.
4. To position Mongolia as a global leader for sustainable cashmere.

Textile Exchange is leading the Market Sector Advisory (MSA) group, which brings together several cashmere buyers that will provide valuable input and guidance into the work of the MSCP.

Photo: SFA

Virgin animal fibers: Alpaca

Production facts and figures

Alpaca fiber is the hair that has been gathered from alpacas. Alpaca, a South American camelid, is native to Peru. Historically, alpaca fiber was reserved for royalty due to its fine micron range. Today, the majority of alpaca still live in the highlands or Peru at an average of 11,000 to 16,000 feet (3,500 to 5,000 meters). About 4 million alpacas live in Peru, with the other small percentage residing in other countries such as Bolivia, Australia, UK, and the US. The vast majority of alpaca are classified under the Huacayo breed (95%), while the remaining are classified as Suri (5%). Huacayo fleece is the main variation used in textile and knitwear production. The current supply chain is centralized in Peru, where around 90% of the processing is condensed through two main suppliers who have vertically integrated processing operations. There are a number of smaller producer groups that operate independently. More than 90% of all fiber produced in Peru comes from smallholder farmers. These farmers have on average 45 animals. This fiber is currently collected and sold by middlemen and then processed by the two large processors[1].

The global alpaca production volume was around 6,244 tonnes in 2021[2].

Key standards

The Responsible Alpaca Standard (RAS)—a voluntary global standard that aims to address the welfare of alpacas, the land that they graze on and social welfare at the farm level—was launched in April 2021.

The first groups in Peru have been certified to RAS, but the certified alpaca fiber is already committed to specific supply chains. It will take time to build the volume of certified fiber such that it is available on the open market.

Alpaca farming has a high animal welfare potential due to a husbandry system based on extensive grazing and free-ranging with animals adapted to their environment. The RAS was developed to ensure that this high welfare potential is realized and to provide a mechanism to verify that alpaca fiber comes from responsible sources. The standard addresses farm-level animal welfare practices as well as land management and social welfare at the farm. Through production, chain of custody certification ensures that the fiber from certified farms is properly identified and tracked. The RAS will join the Responsible Animal Fiber (RAF) framework along with the Responsible Wool and Mohair Standards. Visit the RAS website here.

Photo: Anna Heaton

1 Minagri, 2019. Potencial productivo y comercial de la alpaca. Link.

2 IWTO, 2022. Market Information. Edition 17. Link.

Virgin animal fibers: Other

Production facts and figures

Additional animal fibers—apart from sheep, cashmere, mohair and alpaca—includes angora rabbit, camel, guanaco, llama, vicuna, and yak hair.

Angora wool is the hair of angora rabbits (not to be confused mohair which is the hair of the angora goat). 90% of Angora is produced in China. Europe, Chile and the US also produce smaller quantities. Several major brands and retailers have banned Angora due to animal welfare concerns.

Camel hair comes from camels. Major suppliers of camel hair are Mongolia, Tibet, Afghanistan, Iran, Russia, China, New Zealand and Australia.

Guanaco, llama and vicuna are camelids mainly found in South America. Their hair is used as fiber. While llamas are raised domestically, guanacos and vicunas are two wild camelids, which are relatives to the llama and alpacas, and live in the high alpine areas of the South American Andes. They are usually caught from the wild to be shorn, thus their extremely fine wool is very expensive.

Yak fiber is the hair of yaks which are mainly found in the Himalayas and some areas of Mongolia and Central Asia. Yak hair has been used in the Himalayan region for over a thousand years and more recently has been introduced as premium fiber in the international fashion industry.

Examples of initiatives

The Mongolian National Chamber of Commerce and Industry announced in a press release the development of a cluster to manufacture products from yak and camel wool as part of the European Union funded project Trade Related Assistance for Mongolia (EU TRAM).

As part of a poverty alleviation project Orient Hongda have also been working on sustainable yak farming encompassing environmental management, animal welfare, and social factors.

Textile Exchange Member Action

Shokay is a social enterprise in China that works with farmers on the Tibetan plateau to promote yak wool.

Textile Exchange has initiated research into yak farming practices and how yak could fit into the Textile Exchange animal welfare framework.

Photo: Santosh Yonjan

Recycled wool
Production facts and figures

Recycled wool has a long tradition. With an estimated production volume of around 70 thousand tonnes[1], the market share of recycled wool is estimated at around 6% of the total wool market[2].

The Italian district of Prato is a major producer of recycled wool, where approximately 22,000 tonnes of wool are recycled every year[3]. Other major production centers for wool recycling are Panipat, India and China.

Recycled standards

The key standards for recycled wool are the **Recycled Claim Standard (RCS)**, **Global Recycled Standard (GRS)**, and **Cardato Recycled** for recycled wool from Prato in Italy.

Please see the page on Sustainability Standards for more information.

Textile Exchange Member Action

Datini Fibres offers GRS-certified post-consumer recycled wool fibers under the brand name OON by Datini. Read more in the Supplier Mapping.

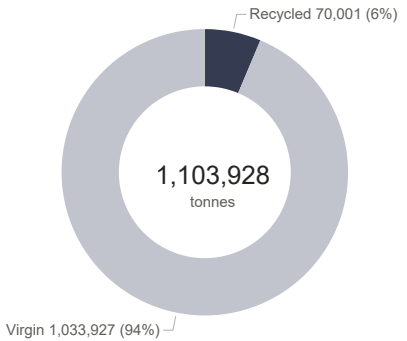
Geetanjali Woollens is a 40-year-old company that has been recycling post-consumer clothing for as many years. It's Global Recycled Standard (GRS) certified. Geetanjali Woollens offers—amongst other recycled fibers—recycled sheep wool and recycled cashmere. Read more in the Supplier Mapping.

WeTurn offers GRS-certified recycled wool yarn produced in collaboration with a network of partner companies. Read more in the Supplier Mapping.

Tip: How to find suppliers of recycled wool.

Check out the Textile Exchange database for a list of RCS- and GRS-certified suppliers. The Cardato Recycled website provides a list of certified recycled wool suppliers from Prato.

Global recycled wool market share 2021



Source: Textile Exchange based on IWTO and Maia Research

1 Maia Research, 2022. Global Recycled Wool Market Report 2021. Customized report.

2 IWTO, 2022. Market Information. Edition 16. Link.

3 Cardato, 2015. Website. Link.

Commitments to preferred wool
Examples

An increasing number of brands and retailers are committed to preferred wool, such as RWS, organic, or recycled wool.

Examples of public commitments by Textile Exchange members

Allbirds has committed to sourcing 100% regenerative wool by 2025. Read more here.

Arc'teryx is working to transition its wool supply to the RWS. Read more here.

Armedangels uses organic raw wool which is RWS-certified. Read more here.

BESTSELLER has committed to sourcing 100% RWS by 2025. Read more here.

DK Company has committed to sourcing 100% of its wool in line with industry best practise, for example, RWS. Read more here.

Eileen Fisher has published the objective that all suppliers will source wool that meets the RWS. Read more here.

Esprit has made the commitment that 50% of their wool will be certified according to the RWS by 2022. Read more here.

H&M is committed to using 100% RWS-certified, recycled or regenerative wool in their products by the end of 2025. Read more here.

IKEA committed to transforming all wool to 100% RWS by 2025. Read more here.

Kathmandu has committed to sourcing 100% RWS wool by 2025. Read more here.

Kmart Australia has the target that 100% of wool used in their own Kmart-branded (Anko) clothing and bedding will be either: farms certified under the RWS or equivalent standard; or farms that are fully traceable and verified as non-mulesed; or from recycled wool materials by July 2023.

Lindex has committed to 100% either RWS-certified, recycled or derived from responsible agricultural practices by 2025. Read more here.

Marks & Spencer have committed to use 50% recycled, RWS-certified or organic wool by 2025. Read more here.

Norrona uses only third-party verified and traceable or RWS-certified wool and plans to have 100% of its wool RWS-certified or reprocessed. Read more here.

Patagonia is committed to 100% RWS as a baseline requirement. All the wool in their products is RWS-certified, from farm to finished product. Read more here.

Ralph Lauren committed in 2019 that 100% of its wool will be RWS-certified or recycled by 2025. Ralph Lauren is also committed to 100% Sustainable Fiber Alliance-certified cashmere in 2025. Read more here.

Target said that by July 2023, 100% of wool used in its own Target-branded clothing and bedding will be either from farms certified under the RWS or equivalent standard, from farms fully traceable and verified as non-mulesed, or from recycled wool materials.

Further brands that have made public commitments to the RWS are William-Sonoma, Inc., Eddie Bauer, REI, Tchibo, Varner, Coyuchi, Mountain Equipment Company, Kathmandu, and KnowledgeCotton Apparel. Among companies that have expressed support of the standard and are working toward implementation are LL Bean, Indigenous Designs, and prAna.

Other examples

Deckers Outdoor has set a target to use 100% recycled or RWS-certified wool by 2022. Read more here.

Make a Standards Commitment

Whether you have already made a commitment to one or more of Textile Exchange's Standards, or you want to share a new one, you may use this form to register details of your commitment(s).

Animal Fibers & Materials

Silk

Silk
A global overview

Another important animal-based fiber is silk. Even though the market share is small, it's estimated that around 300,000 households are involved in the production of raw silk[1].

In 2021, around 79% of all silk was produced in China. The second-largest producer was India, with a market share of 17%. This means that China and India together produced around 96% of all silk worldwide in 2021[2].

Around 173,162 tonnes of raw silk were produced in 2021.[2] Silk production volumes more than doubled from 1990 to 2019 but saw a decrease over the last five years.[2]

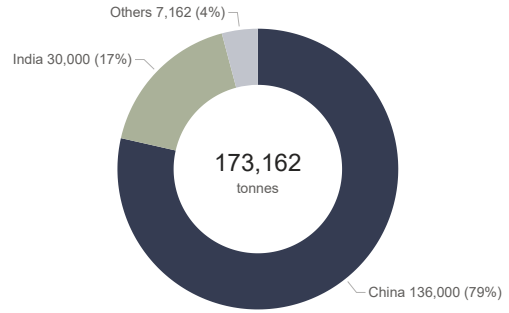
Silk programs include organic standards such as the Indian National Programme for Organic Production (NPOP), the Organic Content Standard (OCS), and the Global Organic Textile Standard (GOTS). Certified Wildlife Friendly® and the World Fair Trade Organization (WFTO) are other options. For recycled silk, the Global Recycled Standard (GRS) and the Recycled Claim Standard (RCS) can be used.

Textile Exchange Member Action

Takihyo, a Japanese company, has started an Eri Silk project that provides additional income to support cassava farmers in Thailand. The cassava plants are cultivated for their roots, an important source of food, and the leaves of the plants are used to feed the silkworms. The fecal byproduct is used as fertilizer for cultivating the cassava plants, and the pupa can be sold as food, for cosmetics, or medicine once the silk is harvested.

Waschbär GmbH supports and owns 50% of **Sichuan OTEX Textiles**, producing around 30 tonnes of organic silk filament in China a year.

Silk production in 2021



Source: Textile Exchange based on FAOSTAT
Note: 2021 numbers estimated by Textile Exchange

1 DNFI, 2020. Website. Link.
2 FAOSTAT

Animal Fibers & Materials

Leather

Virgin leather
A global overview

Global leather production—measured in weight of fresh hides—was more than 12.5 million tonnes in 2021[1]. The hides and skins of over 1.4 billion animals were used for leather production in 2021.[1]

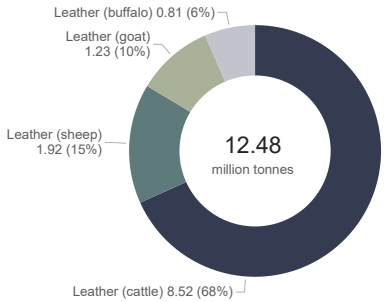
Cattle hides were the most-used type of hides with 8.5 million tonnes in 2021, accounting for around two thirds of the leather production. China was the largest producer of cattle hides accounting for 16% of the global cattle hides production in 2021, followed by the US with 13%, Brazil with 12%, and Argentina with 6%.

Sheep hides were the second most used type of hides with a production of around 1.9 million tonnes in 2021. Largest producers were China with 32%, Australia with 8%, and New Zealand with 4% of the global sheep hides production.

Goat hides were the third most-used type of hides and had a production volume of 1.2 million tonnes in 2021. Largest producers were China with 37%, Pakistan with 10%, and India with 8% of the global goat hides production.

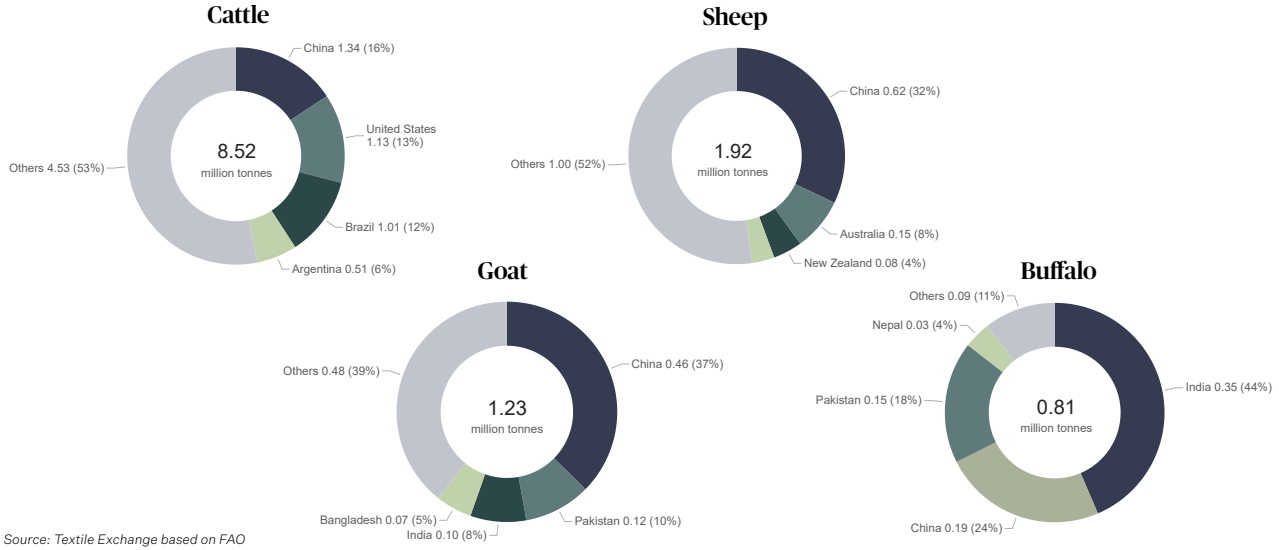
Buffalo hides accounted for around 0.8 million tonnes in 2021. The largest producers were India with 44%, China with 24%, and Pakistan with 18% of the global buffalo hides production volume.[1]

Global leather production: Fresh hides by type in 2021



Source: Textile Exchange based on FAO
Note: 2021 numbers estimated by Textile Exchange

Fresh hides by country in 2021



Source: Textile Exchange based on FAO
Note: 2021 numbers estimated by Textile Exchange

1 FAOSTAT. Accessed June 2022. Link. Including fresh cattle hides, buffalo hides, goat skins, and sheep skins. Other types of hides and skins not included. 2020 data used as estimate for 2021 as 2021 data were not yet available at report launch.

2 FAOSTAT. Accessed June 2022. Link.

Virgin Leather
A global overview

Concerns about animal welfare and environmental impacts of livestock and leather production have led to increasing awareness and demand for more sustainable leather.

The Responsible Leather Round Table

In 2017, Textile Exchange began an initiative to focus on leather in response to demand from brands. Textile Exchange has pulled together over 400 stakeholders from all parts of the industry, including brands, farmers, and suppliers, as well as NGOs, international organizations, and special interest groups. In 2018, the Responsible Leather Round Table (RLRT) was launched, a platform where everyone can participate, share information and contribute to a collective action towards tackling the industry's impacts on climate, environment, people and animals. Since then, the RLRT has been an active space where stakeholders can connect through webinars and the Round Table summits to develop a shared understanding of the leather industry, along with the challenges and opportunities. This has led to the development of the Leather Impact Accelerator (LIA).

The Leather Impact Accelerator

The Leather Impact Accelerator (LIA) is a program developed by Textile Exchange to address all the major sustainability challenges throughout the bovine leather supply chain; from farm to finished leather. In its first version, LIA focuses on deforestation/conversion- free (DCF) and animal welfare at farm level, environmental and social risks at leather processing. LIA is not a standard but a set of six tools that identifies and leverages existing solutions along the supply chain. Textile Exchange works with stakeholders to evaluate standards and programs for inclusion in LIA, so brands have confidence knowing they are delivering impact and making clear and credible claims. LIA was launched in January 2021 and was piloted over the year; the first Impact Partnership Incentives were sold from Produzindo Certo in Brazil to H&M, Ralph Lauren and Capri Holdings. For more information about the Impact Incentives please see chapter on Impact Incentives. For more information about LIA, visit https://textileexchange.org/leatherimpactaccelerator.

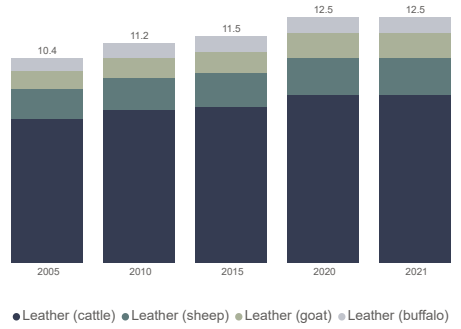
Spotlight on deforestation

Globally, the conversion of forests to cattle pasture resulted in an estimated 45.1 million hectares of deforestation between 2001 and 2015. Forest area replaced by cattle accounts for 36% of all agriculture-linked tree cover loss worldwide.[1]

Call to action

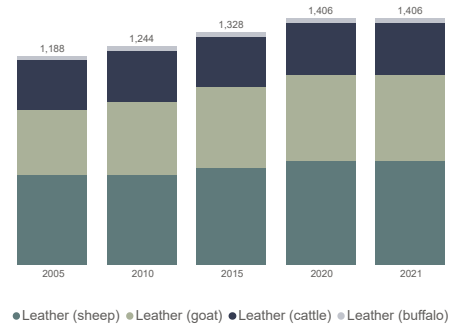
Join the Responsible Leather Round Table and explore the use of Impact Incentives to provide direct financial support to farmers that meet Leather Impact Accelerator (LIA) deforestation/conversion-free (DCF) and/or Animal Welfare requirements.

Global hides production (in million tonnes)



Source: Textile Exchange based on FAO
Note: 2021 numbers estimated by Textile Exchange

Global leather production (in million hides)



Source: Textile Exchange based on FAO
Note: 2021 numbers estimated by Textile Exchange

1 WRI website. Accessed in July 2022. Link.

Virgin leather
Standards and certification systems

The adoption of standards and certification systems helps the industry to ensure compliance with sets of criteria and acknowledge good industry practice.

The different standards and certification systems significantly vary in terms of their requirements, their approach to assurance—ranging from self-declaration to third-party audits—as well as degrees of traceability and oversight through the supply chain. Some are active in only certain regions or markets and others focus in on particular impact areas.

For leather, most standards cover the processing. The use of standards on the animal production level is not yet very common but increasingly seen as important.

The Leather Working Group (LWG) for manufacturing facilities

The Leather Working Group (LWG), formed in 2005, is a multi-stakeholder group with over 1,800 members that offers a suite of auditing tools to assess the environmental performance of leather manufacturing facilities and certifies those that meet its standards. In 2021, approximately 4.7 billion square feet of wet blue leather and around 7.4 billion square feet of finished leather were produced in the 989 leather production facilities audited by LWG. The market share of LWG leather increased from around 22% of the global total finished leather production in 2020 to 29% in 2021[1].

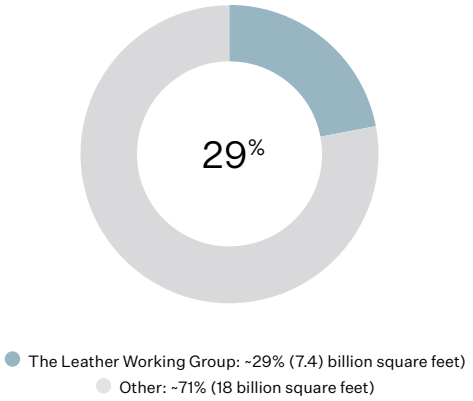
STeP by OEKO-TEX® certification for tanneries

First tanneries were STeP by OEKO-TEX®-certified in 2022.

Responsible Wool Standard (RWS) for sheep skin and leather

The release of RWS 2.0 in March 2020 introduced a new optional slaughter module. Where this module is applied and the chain of custody is maintained, claims about the RWS origin of sheep skin and leather can be made.

Global market share of the Leather Working Group (LWG) (% of global finished leather in 2021)[1]



1 LWG, 2022. Email correspondence. Global leather production estimated based on FAO and further sources. 2020 is referring to the 2020/21 LWG year and 2021 to the 2021/22 LWG year.

Recycled leather
Overview

Around 800 thousand tonnes of leather waste is produced annually[1]. Recycled leather—leather cut post use and then re-purposed—and bonded recycled leather fiber materials, play a role in diverting materials from the waste stream.

Bonded recycled leather fiber materials are mainly made from pre-consumer production scraps, consisting of recycled leather fibers and binders, or recycled leather fibers attached to the surface of a synthetic material.

The European Outdoor Group (EOG) published a Recycled Leather report in 2019 that aims to support industry professionals to better understand recycled leather as alternative to virgin leather.

Textile Exchange Member Action

Nike Flyleather is an engineered material made by binding at least 50% reclaimed leather fibers together, combined with synthetic materials, using a water-powered process.

Spinnova and KT Trading—the leather partner to global shoe brand ECCO—announced their new partnership to produce **Respin**, a fiber made from leather waste. The pilot scale production has been completed at the end of 2021.

Other suppliers

RenTec.one is using leather waste for the creation of non-woven and woven fabrics. Read more in the Supplier Mapping.

Sustainable Composites has developed a material made with waste leather converted into RCS-certified leather fiber-based sheets or rolls which contain between 60% and 80% recycled material content. Read more in the Supplier Mapping.

Photo: Sustainable Composite, enspire leather®

1 UNIDO 2000—Wastes generated in the leather products industry.

Commitments to preferred leather
Examples

A growing number of companies are committed to using preferred leather, defined as leather with more sustainable properties at farming level (deforestation-free, animal welfare considerations) and processed more responsibly (better environmental and social management in production facilities, the use of more sustainable processing technologies).

Commitments to biodiversity, animal welfare and deforestation-free leather

75 fashion brands have signed a pledge called the G7 FashionPact by March 2022[1]. The commitment is built on three pillars: climate, biodiversity, and oceans. All signing brands should develop strategies connected to each pillar. The biodiversity pillar includes animal welfare as one of the aspects to consider in their strategy.

Companies are starting to make efforts to **eliminate deforestation** from their supply chains, and are working with global references, such as the Accountability Framework. Commitments related to the **UNFCCC, Fashion Pact, New York Declaration on Forests, Amsterdam Declaration Partnership, and the Consumer Goods Forum Zero Net Deforestation Commitment** are further examples. Eliminating deforestation and improving grazing practices can also be important measures to contribute to the Sustainable Development Goals (SDGs).

As the number of **commitments to the SDGs** is increasing, a collaboration between the leather and beef industry is expected to accelerate the progress made.

Investor groups, environmental groups and consumers already focus on how the beef industry can help meet the SDGs, particularly SDG 15 "Life on Land" and SDG 13 "Climate Action," through eliminating deforestation and following improved grazing practices. Leather is linked to the same impacts; cross-sectoral learning and collaboration with the beef industry is the best option to accelerate changes required to meet the SDGs. The Leather Impact Accelerator (LIA) tool, which is being developed by **Textile Exchange, supports the industry to drive progress towards the SDGs goals through the leather value chain.**

Several large corporations have strong **animal welfare policies** that cover all their animal-derived fibers and materials. To ensure that these policies are indeed implemented in the supply chains, good knowledge of the actors in the company's supply chain and robust management systems are required.

Textile Exchange's LIA tool was launched in 2021 and piloted over the year. The program supports the industry to drive progress towards the SDGs with a focus on deforestation and animal welfare at the farm level of the leather value chain.

Commitments to more responsible leather processing

Several companies also started to set targets for more responsible leather processing. Several companies have, for example, set a target to source 100% of their leather from Leather Working Group (LWG) certified suppliers.

Examples of public commitments by Textile Exchange members

Adidas, Bestseller, Burberry, Chanel, Everybody & Everyone, FashionCube, Gant, H&M, Inditex, Kering, Gap, Nike, Nordstrom, Puma, PVH, Selfridges, Stella McCartney and others have signed the G7 FashionPact commitment as of April 2021.

H&M, Timberland, Vans, and VF Corporation are committed to deforestation-free leather and put a temporary ban on leather from Brazil in 2019. This ban is in response to the fires in the Amazon area which are also linked to the cattle production.

ASOS is committed to only sourcing leather from tanneries that have a LWG audit. Read more here.

Ralph Lauren committed to sourcing from 100% LWG-certified leather suppliers by 2025. Read more here.

Ted Baker has set the target that 100% of their leather is to come from LWG- or equivalent-certified tanneries by 2025. Read more here.

VF Corporation has committed to 100% of its footwear leather to be from LWG-audited tanneries. Read more here.

1 The Fashion Pact, 2022— website. Link.

Manmade Cellulosic Fibers

Virgin manmade cellulosic fibers

Production facts and figures

With an annual production volume of around 7.2 million tonnes, manmade cellulosics fibers (MMCFs) had a market share of about 6% of the total fiber production volume[1].

With 7.2 million tonnes in 2021, the MMCF production volume slightly exceeded the pre-COVID-19 production volume of 7.1 million tonnes in 2019, after a decline to 6.5 million tonnes in 2020.[1]

The global MMCF production volume has more than doubled from around 3 million tonnes in 1990 to approximately 7.2 million tonnes in 2021, and is expected to further grow in the coming years.[1]

MMCFs include viscose, acetate, lyocell, modal, and cupro.

Viscose is the most important MMCF, with a market share of around 80% of all MMCFs and a production volume of around 5.8 million tonnes in 2021.[1]

Acetate has a market share of around 13% of all MMCFs with a production of approximately 0.9 million tonnes in 2021,[1] but it is mainly used for non-textile applications.[2]

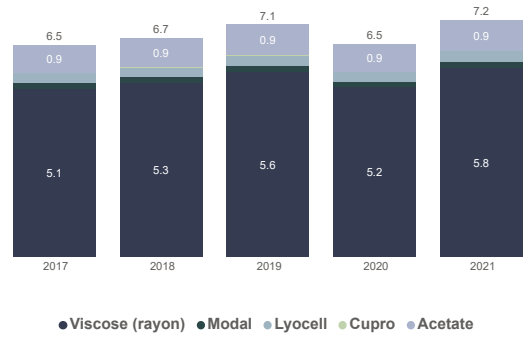
Lyocell was the third most used MMCF type after viscose and acetate in 2021. It had a market share of around 4% of all MMCFs in 2021 with a production volume of around 0.3 million tonnes.[1]

Modal had a market share of around 3% of the total MMCF market in 2021 with a production of around 0.2 million tonnes.[1]

Cupro had a market share of around 0.2% of the total MMCF market. There was only one supplier of cupro producing around 0.02 million tonnes in 2021.

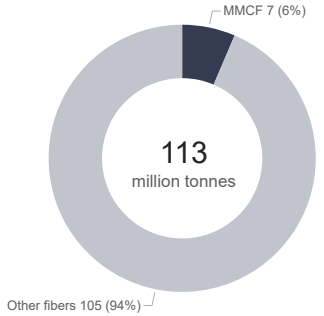
Manmade cellulosic fibers are currently primarily produced from wood. Less than 1% is currently made from recycled or other alternative feedstock.

Global MMCF production (million tonnes)



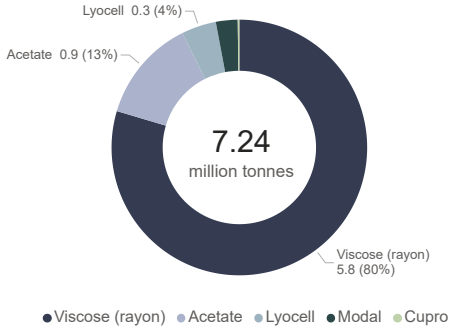
Source: Textile Exchange based on Maia Research

Global market share of MMCFs in 2021



Source: Textile Exchange based on Maia Research and global data compilation

Global MMCF production by type in 2021



Source: Textile Exchange based on Maia Research and other additional sources

1 Maia Research, 2022. Global Manmade Cellulosic Fiber Market Report 2022 (customized report).

2 More information on the applications by fiber is available in the Report Scope: Beyond Apparel section of this report.

Virgin manmade cellulosic fibers

Standards for feedstock

The market share of FSC- and/or PEFC-certified MMCFs increased from around 55-60% in 2020 to around 60-65% of all MMCFs in 2021[1].

FSC, founded in 1993, is an international member-led organization that sets standards for responsible forest management and chain of custody. The first FSC-certified fabrics were produced by the fiber producer ENKA and the fabric manufacturer Ghezzi S.p.a in 2017. First textile products with consumer-facing FSC labels hit the market in 2020. In the beginning of 2021, 8 companies had FSC-labelled garments in the market. Read more in the Supplier Mapping.

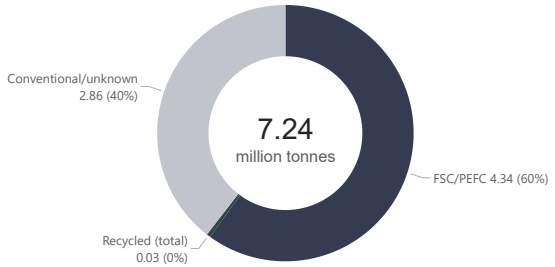
PEFC, founded in 1999, is a global alliance of national forest certification systems and the largest forest certification system worldwide. Since the launch of the world's first PEFC-certified fabrics in 2018, the number of certified textile companies is increasing. Read more in the Supplier Mapping.

Overall, the share of the global forest area certified to FSC and/or PEFC has increased from around 1% of all forests in 2000 to around 11% in 2021.[2,3] With a market share of 11.38% in 2021, this is a slight increase compared to the market share of 11.18% in 2020. In total, around 8% of the certified forest was certified according to PEFC and its equivalents in 2021, with almost half of this being SFI-certified. Approximately 6% of all forests were FSC-certified. Due to the double certification of around 3% of all forests, 11 (and not 14) % of all forests were certified to FSC and/or PEFC.[4]

In March 2022, PEFC and FSC announced the ban of certified wood from Russia and Belarus. Because of the association of the forest sector in Russia and Belarus with armed invasion, no FSC-certified material or controlled wood from these countries will be permitted to be traded.[5] PEFC announced that all timber originating from Russia and Belarus is "conflict timber" and therefore can't be used in PEFC-certified products.[6]

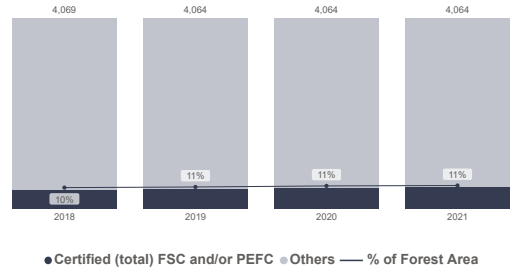
First MMCFs have also been certified according to Textile Exchange's Organic Content Standard (OCS). The OCS is an international, voluntary standard that sets requirements for third-party certification of certified organic input and chain of custody.

Global MMCF production by feedstock in 2021



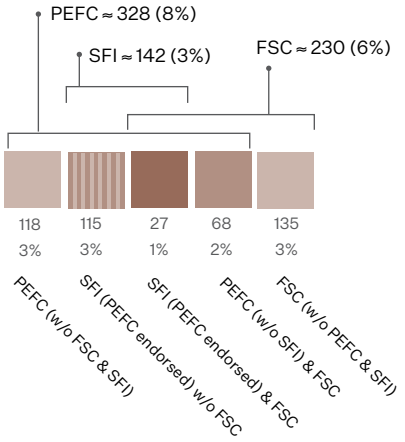
Source: Textile Exchange based on Maia Research and supplier information screening

Forest programs (ha and % of total forest area)



Source: Textile Exchange based on FAO, FSC, PEFC, and SFI

Forest programs in 2021 (ha and % of total forest area)



1 Textile Exchange estimates based on publicly available information and its own supplier mapping.

2 Data received from FSC, PEFC, and SFI per email.

3 FAOSTAT, 2022. Database. Link. 2021 figures not yet available at report launch and thus 2020 figures used as proxy.

4 Based on FSC and PEFC press releases March 2022, and email correspondence with FSC, PEFC and SFI.

5 FSC, 2022. No FSC material from Russia and Belarus until the invasion ends. Link.

6 PEFC, 2021. Timber from Russia and Belarus considered "conflict timber". Link.

7 Maia Research, 2021. Global Recycled Manmade Cellulosic Fibers Market Report 2021. Customized report.

Virgin manmade cellulosic fibers

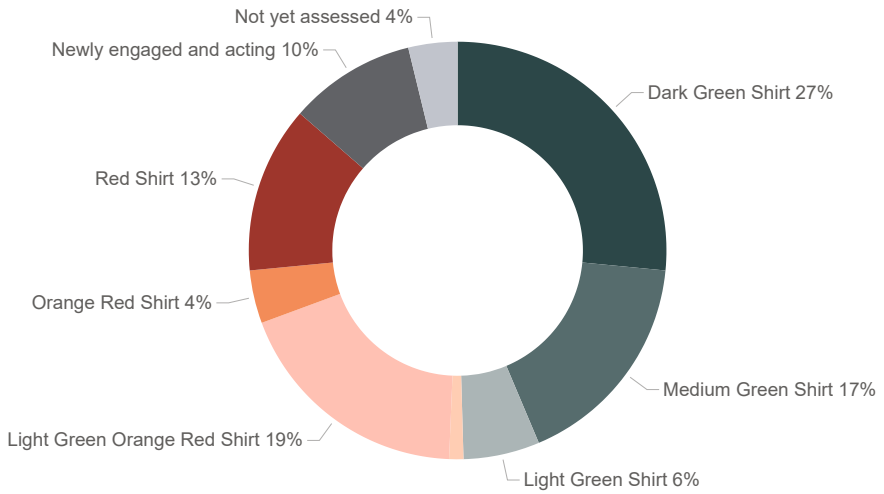
Standards for feedstock

The CanopyStyle Audits have become the leading assessment of MMCF suppliers on their raw material sourcing practices since the launch of the CanopyStyle initiative in 2013 and the first audits in 2017. In 2021, 53% of the global MMCF supply has been awarded by "green shirts" in the 2021 Hot Button Report and Ranking. These producers have been audited and assessed as being at low risk, or have taken substantive action to eliminate known risks of sourcing MMCFs from ancient and endangered forests. The market share of MMCF producers committed to the CanopyStyle initiative through public sourcing policies increased from around 35% of the global production in 2015 to 90% in 2021. A summary of results is published in the annual Hot Button Report.[1]

Tip: How to find suppliers of MMCFs with FSC and/or PEFC feedstock—and CanopyStyle audited fiber producers

Check out the FSC database or PEFC database and the CanopyStyle Hot Button Report. A list of textile-related FSC and PEFC suppliers is also included the Supplier Mapping.

Global market share of MMCF production capacity with CanopyStyle Greens Shirts in 2021



Source: Textile Exchange based on Canopy

1 Canopy, 2022. CanopyStyle Hot Button Report 2021. Link.

Virgin manmade cellulosic fibers

Standards for pulp and fiber

Pulp and fiber

Bluesign has developed specific criteria for fiber production that were added as Annex "Fiber Manufacturing" to its "bluesign® CRITERIA for production sites" in March 2020. The criteria for fiber manufacturing are applicable for the manufacturing of synthetic fibers, for example, polyester and polyamide, as well as MMCF. For MMCFs, this includes criteria for feedstock, pulp, and fiber production. One MMCF supplier has already become a bluesign® SYSTEM PARTNER and produces bluesign® APPROVED fibers.

ZDHC has expanded the scope of its work to cover fiber production to account for the environmental impact of fibers. In April 2020, the ZDHC Man-Made Cellulosic Fibres (MMCF) Guidelines 1.0 were launched, together with the ZDHC MMCF Responsible Fibre Production Guidelines 1.0, the ZDHC MMCF Interim Wastewater Guideline 1.0, and the ZDHC MMCF Interim Air Emissions Guidelines 1.0. The initial focus of the guidelines is viscose and modal. The guidelines give suppliers producing MMCF unified criteria for measuring output indicators like wastewater, sludge, air emissions, and other process-related parameters. They also offer an aligned approach for the recovery of Sulphur compounds, part of the inputs, as well as by-products generated during the production process. Fiber producers are expected to engage on a continuous improvement roadmap defined by three levels of foundational, progressive and aspirational. Dissolving pulp production process will be considered at a later stage.

Further standards that can be used for the pulp and/or fiber level include Cradle to Cradle Material Health Certificate Standard, STeP by OEKO-TEX®, and the EU Eco Label. Another option is the production in compliance with the EU BREFs (BAT Reference Documents).

For standards related to "recycled" MMCFs made see the chapter on Recycled Manmade Cellulosics.

Textile Exchange Member Action

By July 2022, **Asahi Kasei Bemberg, Asia Pacific Rayon, Birla Cellulose, Century Rayon (Aditya Birla Grasim), Eastman, Lenzing, Sateri,** and **TreeToTextile** were ZDHC Contributors.

Tip: How to find MMCF suppliers meeting pulp and fiber level standards.

Check out the Bluesign® System Partner List, the ZDHC Roadmap to Zero Database, or explore the websites of the other standards mentioned above.

Photo: Birla Cellulose

Virgin manmade cellulosic fibers

Supplier updates

Textile Exchange Member Action

Birla Cellulose worked on several sustainability initiatives in the past years. In 2021, Birla Cellulose received a "dark green shirt" again in the Canopy assessment. Birla Cellulose claims that it maps 100% of its forest sources on the traceability platform Greentrack™. Read more about Birla's actions from building a circular business model to reducing water consumption in this interview.

Eastman launched Naia™, a di-acetate fiber made from wood pulp from sustainably managed plantations and produced in a near closed-loop chemical process in 2017, available as filament and since 2020 also as staple fiber. In 2020, Eastman introduced Naia™ Renew, which combines 60% renewable wood pulp with 40% acetic acid sourced from a variety of recycled waste material[1].

GP Cellulose GmbH operates four wood-pulp mills in the US. Over a decade ago, GP began mapping endangered forests within its key wood fiber supply regions. Once they mapped an endangered forest, they committed not to buy wood fiber from these areas.

Lenzing received a "dark green" shirt in the CanopyStyle 2021 Hot Button Report. In 2022, Lenzing announced that it will switch to green electricity at its Chinese site as well. Read more on Lenzing's actions from installing solar panels to circularly in this interview.

The joint demo plant of Itochu and Metsä Group with a nominal capacity of about 500 tonnes per annum and with the aim to demonstrate a new technology for converting paper-grade pulp into textile fibers, is in operation since late 2020. The textile fiber product name, Kuura, was launched in early 2021.

Sateri, part of the Royal Golden Eagle (RGE) Group, together with Asia Pacific Rayon (APR), is the world's largest producer of viscose. In 2020, it began producing lyocell as well. Its parent company, the Royal Golden Eagle (RGE) has announced plans to invest $200 million USD over the next ten years into cellulosic textile fiber research and development including alternative feedstock.

Sappi is a leading global provider of wood fiber products and solutions such as dissolving wood pulp. In 2022, the Science Based Targets initiative (SBTi) has approved Sappi's target to reduce carbon emissions 41.5% per ton of product by 2030, as well as the commitment that 44% of the suppliers by spend have science-based targets by 2026.

TreeToTextile, owned by H&M Group, Inter IKEA Group, Stora Enso, and LSCS Invest, is a company developing a new innovative chemical process—using forest raw material and regenerating the cellulose into a textile fiber by spinning the dissolving pulp. Stora Enso will host TreeToTextiles's demonstration plant, a EUR 35 million investment.

Photo: PEFC

1 Naia™ Renew recycled content is achieved by an allocation of recycled waste material using an ISCC-certified mass balance process.

Virgin manmade cellulosic fibers

Supporting the transition

Several initiatives are supporting the transition to preferred MMCFs. Collaboration and information are essential for successful uptake of preferred MMCFs.

Call to action

Join the Textile Exchange Manmade Cellulosics Round Table. The aim of the MMCF Round Table is to bring the industry together, share knowledge and learning, and drive action. As of 2022, more than 50% of the global MMCF supply has published the "Manmade Cellulosic Transparency Questionnaire", developed by the MMCF Round Table driven by industry demand. The suppliers include APR, Birla Cellulose, Sateri, Tangshan Sayou, Yibin Grace. Other suppliers like Lenzing and Eastman have completed it and can provide the information upon request.

Further initiatives

Canopy works with the forest industry's biggest customers and their suppliers to develop business solutions that address deforestation and protect forests. Read more about their CanopyStyle Audits and Hot Button Report, and the CanopyStyle Commitments and Next Generation Vision.

Challenge the Fabric (CTF), including the CTF Award, is initiated by EKMAN & Co. and the Swedish Fashion Council, in partnership with Altri, Arauco, Sanyou Group, and Södra, with the aim to speed up the market for more sustainable MMCFs. In 2022, a CTF symposium was hosted in Paris.

Changing Markets Foundation in collaboration with Earthworm (formerly The Forest Trust) launched a roadmap towards responsible viscose and modal fiber manufacturing in 2018. In 2020, Changing Markets published its report "Dirty Fashion: Crunch time. Where does the industry stand on stamping out dirty viscose?".

The Collaboration for Sustainable Development of Viscose (CV), established in 2018, is a public governance organization set up by viscose enterprises, upstream and downstream companies in the industry chain and associations in China. CV is supported by the Social Responsibility Office of the China Textile Industry Federation. As of September 2022, CV has a total of 12 members (two industry associations and 10 MMCF producers) and 163 downstream enterprises as members of the industrial chain. In 2021, CV published its Sustainability Report 2020 which reviews its Three-year Action Plan on Green Development (2018-2020) as well as progress in governance and continuous improvement in 2020. It also includes the new CV Roadmap 2025 and the 2030/2050 sustainability vision.

Earthworm (formerly The Forest Trust) has worked in value chains of key raw materials linked to forests such as wood and pulp since 1999. Over the years, Earthworm helped more than 60 companies to set up No Deforestation, Peat, and Exploitation (NDPE) policies and put them into practice. With businesses and civil society, Earthworm innovated the High Carbon Stock (HCS) Approach—paving the way for a concrete definition of deforestation. In 2020, Earthworm launched the Forest Conservation Fund. Companies can support the protection of an equivalent area to their tropical forest footprint by channeling funding of $40 per hectare—less than 2% of their cost of goods—to conservationists on the ground.

Forum for the Future, in collaboration with Textile Exchange, launched the "MMCF 2030 Vision - A Vision for building resilience and accelerating regeneration" report in 2020.

The German Partnership for Sustainable Textiles initiated a working group for manmade fibers and released the Joint Letter Viscose in April 2019, a call for commitment to sustainable MMCF production.

GRETE, a consortium of the seven partners, coordinated by VTT and funded under the European Union's Horizon 2020 from 2019 to 2023, aims to improve the existing MMCF value chain by developing new technologies using standard paper grade pulps, implementing novel green technologies based on ionic liquid (IL) chemicals and recovery process for cellulose dissolution with novel post-modification process.

The Science Based Targets initiative (SBTi) released the Forest, Land and Agriculture (FLAG) Science Based Target Setting Guidance, the world's first standard method for companies in land-intensive sectors including the wood fiber industry to set science-based targets that include land-based emission reductions and removals. Read more here.

WWF, in partnership with H&M and FORESTS.AI have developed the WoodAI App. The app can quickly identify wood species with the help of a smartphone and macro lense. This can help companies to verify that the wood they source is indeed from a certain species approved by the company. The WoodAI App is currently pilot-tested by H&M.

“Recycled” manmade cellulosic fibers

Supplier updates

The market share of “recycled” MMCFs is estimated at around 0.5% of all MMCFs in 2021[1]. But a lot of research and development is ongoing, so it is expected to increase significantly in the next years.

Canopy estimates that recycling just 25% (5 million tonnes) of global pre- and post-consumer cotton textile waste, plus 25% (1.6 million tonnes) of MMCF textile waste, could replace all wood fiber currently used to manufacture dissolving pulp[2].

Many of the “recycled” MMCFs are still in development. The first commercially available MMCFs partially or wholly made from recycled materials use mainly cotton linter or pre-consumer cotton textile residues as feedstock.

For MMCFs made from recycled materials, the Recycled Claim Standard (RCS), Global Recycled Standard (GRS) and SCS Recycled Content Certification can be used. The first recycled MMCF suppliers have been RCS-certified.

Launched in September 2020, The Fashion for Good initiated Full Circle Textiles Project: Scaling Innovations in Cellulosic Recycling—a first-of-its-kind consortium project. Over an 18-month period, project partners will collaborate with innovators, Evrnu, Infinited Fiber Company, Phoenxt, Renewcell and Circ (formerly Tyton BioSciences), to validate the potential of their technologies in this still nascent market. The recycled content produced by four of these innovators will be converted at Birla Cellulose’s state of the art pilot plants to produce high quality cellulosic fibers.

Launched in 2020, the New Cotton Project is a three-year multi-stakeholder project. Textile waste will be collected and sorted and then chemically recycled into a new MMCF that looks and feels like cotton—a “new cotton”—using Infinited Fiber Company’s textile fiber regeneration technology.

MMCFs made from recycled textiles

Aalto University’s Ioncell is a technology-in-development that turns used textiles, pulp, or even old newspapers into new textile fibers using a novel solvent called ionic liquid. The commercial production start is planned for 2025. Read more in the Supplier Mapping.

Asia Pacific Rayon (APR) is pilot testing the production of viscose made from recycled pre-and post-consumer textiles. A production facility with a capacity of 12,000 tonnes is planned to convert cotton and cotton-rich textile waste and viscose textile into feedstock for viscose. Read more in the Supplier Mapping.

Asahi Kasei’s Bemberg™ is a cupro fiber made in Japan from 100% cotton linter, a pre-consumer residue of the cotton processing, and certified under the Recycled Claim Standard (RCS). The annual production capacity is around 17 thousand tonnes. Read more in the Supplier Mapping.

Birla’s Liva Reviva is a new viscose fiber made with up to 20% pre-consumer cottonplus a small amount of post-consumer waste (up to 5%), certified under the Recycled Claim Standard (RCS). The pre-consumer waste will be increased up to 30% shortly. Read more in the Supplier Mapping.

BlockTexx—see chapter on Fiber Blend Recycling.

Circ (earlier called Tyton Biosciences)—see chapter on “Fiber Blend Recycling”.

Circular Systems has developed the Texloop technology which can mechanically recycle TENCEL™ lyocell. Read more in the Supplier Mapping.

Evrnu is a US-based startup working on the commercialization of NuCycl™, an MMCF made from discarded clothing and textile waste. Read more in the Supplier Mapping.

GP Cellulose GmbH’s Cotton Linter Fiber Pulp is an SCS Recycled Content Standard certified pulp made from cotton linters used for acetate. The production is powered by 80% renewable energy. Read more in the Supplier Mapping.

The Hong Kong Research Institute of Textiles and Apparel (HKRITA)—see chapter on Fiber Blend Recycling.

Infinited Fiber Company’s Infinna™ is a cellulose carbamate fiber currently created out of 100% post-consumer textile waste. A 30,000 tonnes flagship factory in Finland is expected to be operation in 2024. Read more in the chapter on Fiber Blend Recycling and the Supplier Mapping.

Photo: Södra

1 Textile Exchange based on Maia Research, 2022. Global Recycled Manmade Cellulosic Fiber Market Report 2022 + Global Manmade Cellulosic Fiber Market Report 2022.

2 Canopy, 2020. SURVIVAL. A Plan for Saving Forests and Climate A Pulp Thriller. Next Generation Report.

“Recycled” manmade cellulosic fibers

Supplier updates

Jilin Chemical Fibre’s Ecojilin is a commercially available RCS-certified viscose filament yarn made from pre-consumer cotton linters feedstock. Read more in the Supplier Mapping.

Jilin Chemical Fibre’s White Mountain is a commercially available viscose filament yarn made from uncertified pre-consumer cotton linters feedstock. Read more in the Supplier Mapping.

Lenzing’s TENCEL™ Lyocell with REFIBRA™ technology is the first lyocell fiber made with reclaimed materials offered on a commercial scale. Refibra™ was launched in spring 2017. While it was initially made with 20% pre-consumer cotton residues, the percentage increased to 30% in 2019. A special lot production including 5% post-consumer waste and 25% pre-consumer waste started and will become the standard product in the near future. Lenzing’s and Södra’s joint goal is to process 25 thousand tonnes of textile waste per year by 2025. Read more in the Supplier Mapping.

Phoenxt—see the chapter on Fiber Blend Recycling.

Mistra Future Fashion's Blend Re:Wind—see chapter on Fiber Blend Recycling.

Newstartex offers a commercially available RCS-certified MMC filament made with cotton linter.

Renewcell’s Circulose®, launched in 2019, is a branded dissolving pulp made from 100% cellulosic textile waste such as cotton and viscose, reusing the process chemicals. Fiber producing partner companies can use it to make viscose, lyocell, modal, acetate, or other types of MMCFs. The Kristinehamn demo plant in Sweden produces 7,000 tonnes of Renewcell pulp per year. In 2022, Renewcell started running its new 100% textile-to-textile recycling plant with a production capacity of 60,000 tonnes per year in Sundsvall, Sweden. Due to high demand, Renewcell announced its plan to increase its capacity to 120,000 tonnes per year by 2023/24 and to 360,000 tonnes by 2030. Fiber producing partners of Renewcell includeTanghan Sanyou, Sateri, Yibin Hiest Fiber, and Birla Cellulose. Read more in the Supplier Mapping.

RISE - The Regenerator—see the chapter on Fiber Blend Recycling.

The Royal Golden Eagle (RGE) Group invested in Infinited Fiber in 2019 and conducts in-house research on alternative cellulosic feedstock, such as recycled cotton and agricultural waste. Read more in the Supplier Mapping in the submission of Asia Pacific Rayon, part of RGE.

Sateri’s Finex® is a RCS-certified viscose staple fiber made with post-consumer cotton textiles. It is the result of a collaboration with the pulp suppliers Södra and Renewcell. The production of first commercial lines with below 5% recycled content were announced in March 2020 and the recycled content share is now up to 20% by mid-2021. Sateri aims to offer viscose products with 50% recycled content by 2023 and 100% by 2030. Sateri's intention is to have 20% of its overall feedstock contain alternative or recycled materials by 2025. Read more in the Supplier Mapping.

SaxCell has developed a pulp made from post-consumer cotton textiles. SaxCell aims to create the first industrial scale production unit in 2022. Additionally, the first apparel test collection produced in collaboration with partners is scheduled for 2022. Read more in the Supplier Mapping.

Södra’s OneMore® is RCS-certified dissolving pulp, currently produced with 20% post-consumer cotton. The project started in autumn 2019 with 20 tonnes of post-consumer cotton added to their wood-derived pulp in their mill in Mörrum, Sweden resulting in 3% recycled content. In 2020, Södra increased this share to 20% and became RCS-certified. Södra`s and Lenzing's joint target is to recycle 25,000 tonnes in 2025 to create products with 50% recycled content. To achieve this, Södra needs to make continuous improvements and investments. Södra is also exploring a decoloring solution, possibilities to extract products from the polyester from poly-cotton blends, and the use of used MMCF textiles. See chapter on Fiber Blend Recycling.

Tangshan Sanyou announced in June 2019 that it succeeded in producing viscose staple fiber ReVisco™ made from 50% post-consumer recycled cotton textiles supplied by Renewcell.

Worn Again Technologies’—see chapter on Fiber Blend Recycling.

Xinxiang Chemical Fibre offers RCS-certified MMCFs made with cotton linter.

Yibin Hiest Fiber announced the successful industrial-scale production of viscose filament yarn made with 100% Circulose® pulp in 2022.

“Recycled” manmade cellulosic fibers

Supplier updates

MMCFs made from non-textile residues

Infinited Fiber Company’s Infinna™ is a cellulose carbamate fiber currently created out of 100% post-consumer textile waste, and it can also be created from other cellulose-based waste streams like used cardboard, paper or agricultural residues like wheat or rice straw. Read more in the Supplier Mapping.

Inspidere’s Mestic® is a method in development to retrieve and convert cellulose from dairy cow manure into regenerated cellulose fibers. The startup is based in the Netherlands.

The Hurd Co engineers man-made cellulosic fiber pulp from 100% agricultural waste. Agrilose is used to make lyocell or viscose.

Nanollose is an Australian biotechnology company that has developed a MMCF, using microbes that convert biomass waste products from the beer, wine and liquid industries into microbial cellulose. In 2018, Nanollose launched its first microbial cellulose-based fabrics and is in the process to scale production.

Orange Fiber, an Italian startup, has developed a process to extract cellulose from the by-products of the citrus industry to produce fabrics. The latest collection was produced in an acetate process; viscose and lyocell trials are ongoing. Orange Fiber aims to expand the production capacity to 60 tonnes per year in 2022 and is fundraising to scale up the production further. Read more in the Supplier Mapping.

MMCFs with non-cellulosic recycled building block

In 2020, Eastman introduced Naia™ Renew, a cellulosic acetate fiber that combines 60% renewable wood pulp with 40% acetic acid sourced from a variety of recycled waste material[1]. The recycled waste materials such as recycled polyester are broken down to molecular building blocks and these building blocks are used as a feedstock for acetic acid through Eastman's new Carbon Renewal Technology. Read more in the Supplier Mapping.

Photo: Orange Fiber

1 Naia™ Renew recycled content is achieved by an allocation of recycled waste material using an ISCC-certified mass balance process.

Commitments to preferred manmade cellulosic fibers
Examples

The number of brands and retailers committed to preferred manmade cellulosics is increasing. To drive industry change, several companies are making joint commitments through industry initiatives.

CanopyStyle Next Generation Vision

In 2020, Canopy published its CanopyStyle Next Generation Vision that at least 50% of all MMCFs will be made from Next Generation feedstocks in 2030. At its launch, this vision was backed by 26 of CanopyStyle brands and suppliers[1].

The objective of the vision is to displace ancient and endangered forest pulp from supply chains, i.e., 3.3 million tonnes estimated to be from ancient and endangered forest by:

- Regenerating 50,000 tonnes of wood pulp with virgin wood from new well-managed plantations and forests.
- Extending the life of, at minimum, 10% (650,000+ tonnes) of clothing containing viscose.
- Replacing 2.6 million tonnes of wood pulp with pulp derived from alternative fibers.

By 2020, MMCF producers declared to be investing a combined sum of 233 million USD in Next Generation research and development, and an intent to procure 274,000 tonnes of Next Generation fiber solutions[2].

CanopyStyle commitments to eliminate the sourcing of ancient and endangered forests

The number of brands and retailers committed to eliminate ancient and endangered forests from their fabrics increased from 60 in fall 2015 to 455 in 2021[3].

Examples of commitments by Textile Exchange members

The CanopyStyle Next Generation Vision is, for example, backed by the members **Aritzia, Bestseller, C&A, Esprit, GAP, Gina Tricot, G-Star Raw, H&M, Inditex, Kathmandu, Lindex, Mara Hoffmann, M&S, New Look, Next, Patagonia, Reformation, Ted Baker, Tesco, Woolworth and Stella McCartney.**

Commitments to the Changing Markets Roadmap have been made, for example, by the members **ASOS, C&A, Esprit, H&M, Inditex, Levi's, M&S, New Look, Next, Reformation, and Tesco.**

Make a Standards Commitment

Whether you have already made a commitment to one or more of Textile Exchange's Standards, or you want to share a new one, you may use this form to register details of your commitment(s).

1 CanopyStyle press release (February 20, 2020). Announcing the CanopyStyle Next Generation Vision for Viscose and the CanopyStyle Next Generation Vision for Viscose.

2 Canopy, 2020. 2020 Hot Button Report. Link.

3 Canopy, 2021. Highlights: CanopyStyle by the Numbers. Link.

Synthetic Fibers

Polyester

Recycled polyester
Production facts and figures

Polyester is the most widely used fiber worldwide. With an annual production of around 61 million tonnes[1] polyester had a market share of approximately 54% of the global fiber production in 2021.

Global polyester fiber production increased from 57 million tonnes in 2020 to 61 million tonnes in 2021 after a slight decline due to COVID-19 in 2020.

Global recycled polyester (rPET) fiber production volume increased from 8.4 million tonnes in 2020 to around 9 million tonnes in 2021[2]. This equals a slight increase in the market share of recycled PET fiber from around 14.7% of the global PET production in 2020 to around 14.8% in 2021[3].

Recycled polyester is mainly made from PET plastic bottles with an estimated share of 99% of all recycled polyester[4]. Recycled polyester can also be made from other post-consumer plastics such as ocean waste, discarded polyester textiles, or from pre-consumer processing residues such as fabric scraps.

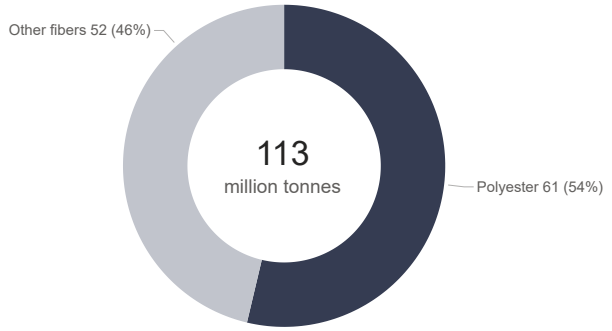
With an increasing demand for post-consumer bottles by the bottle industry, but also packaging more broadly and further industries, competition for post-consumer bottles is increasing. Textile-to-textile recycling is an important strategy to ensure future feedstock supply for the rPET textile industry. The development and scaling of these technologies will be key in transitioning uptake from conventional fossil-based polyester to rPET.

Standards

The main standards used for recycled polyester include the **Global Recycled Standard (GRS)**, the **Recycled Claim Standard (RCS)** and the **SCS Recycled Content Standard**. For further information, see the chapter on Sustainability Standards.

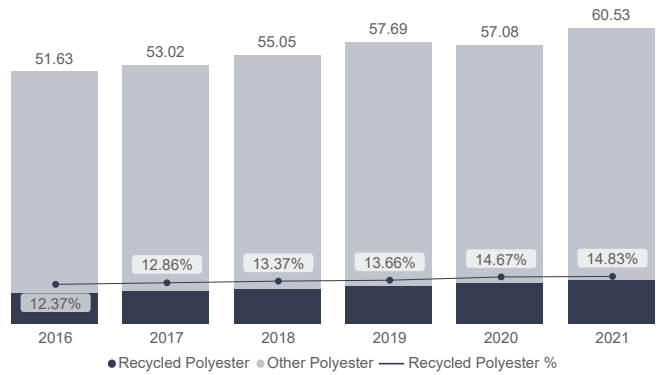
Further standards and certifications for rPET include the **World Fair Trade Organization (WFTO) standard** and the **Ocean Bound Plastic (OBP) Certification**.

Global fiber production in 2021



Source: Textile Exchange based on Maia Research and global data compilation

Global polyester production (million tonnes)



Source: Textile Exchange based on Maia Research

1 Maia Research, 2022. Global Polyester Fiber Market Report 2022. Customized report.

2 Maia Research, 2022. Global Recycled Polyester Fiber Market Report 2022. Customized report.

3 Textile Exchange, 2022. Based on sources listed in footnote (1) and (2).

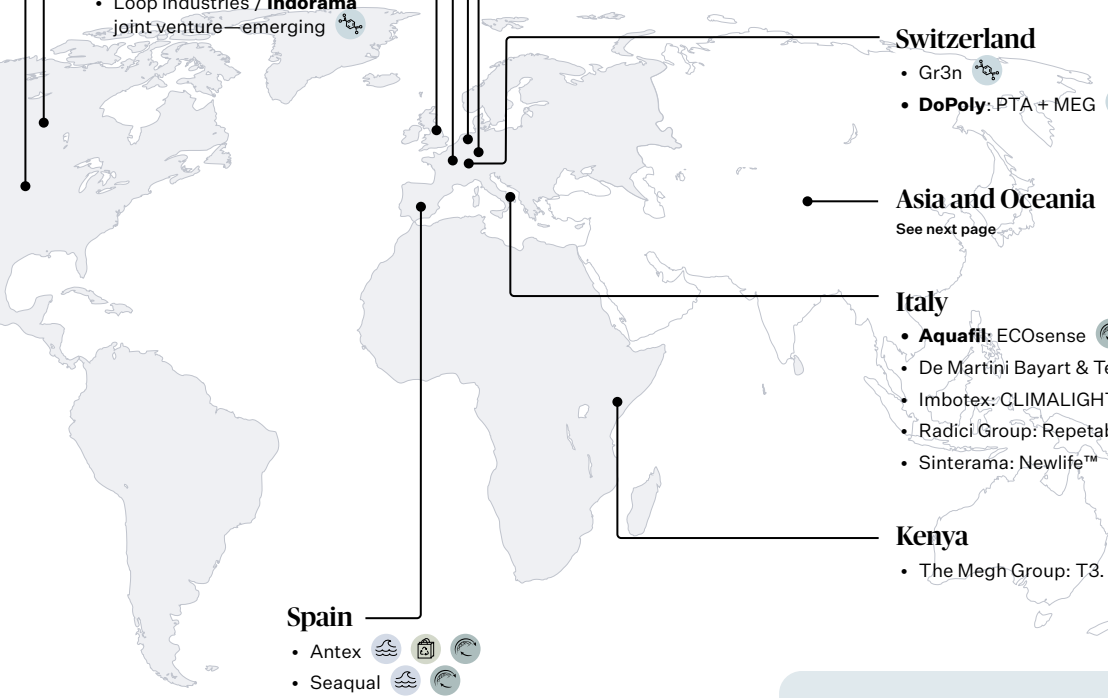
4 Textile Exchange estimate based on (2) and bottom-up estimate of non-bottle rPET fiber production based on supplier mapping, publicly available information, and market modeling.

Recycled polyester

Directory: Key suppliers and innovators

This map locates key suppliers and innovators of recycled polyester based on their headquarters.

All use mechanical recycling of plastic bottles except where indicated otherwise.



France
- CARBIOS

UK
- **Worn Again**: polymer recycling

United States
- Ambercycle
- BIONIC®
- **Circular Systems**: Texloop rPET-1
- **Lycra Company** (Invista): LYCRA® T400® + COOLMAX® bottle + COOLMAX® textiles + THERMOLITE® EcoMade
- Martex Fiber
- Poole Company: EcoSure®
- Premiere
- First Mile by Thread: Ground to Good™
- **Unifi:** REPREVE®

Canada
- Loop Industries / **Indorama** joint venture—emerging

Spain
- Antex
- Seaqual

Netherlands
- **CuRe Technology** (formerly Cumapol)
- Ioniqa
- **The Movement**: Polylana

Germany
- Advansa: Adva® + Suprelle®
- Trevira: SINFINECO®

Switzerland
- Gr3n
- **DoPoly**: PTA + MEG

Asia and Oceania
See next page

Italy
- **Aquafil**: ECOsense
- De Martini Bayart & Textifibra SpA 40%
- Imbotex: CLIMALIGHT
- Radici Group: Repetable® 49% RE
- Sinterama: Newlife™

Kenya
- The Megh Group: T3. Trash. Thread. Textile

Innovation beyond mechanical recycling of plastic bottles

- Chemical recycling
- Biological recycling
- Ocean waste incl. ocean bound
- Post-consumer textiles
- Pre-consumer textiles
- GRS-certified
- % renewable energy (>40% reported)

Tip: How to find suppliers of recycled polyester.

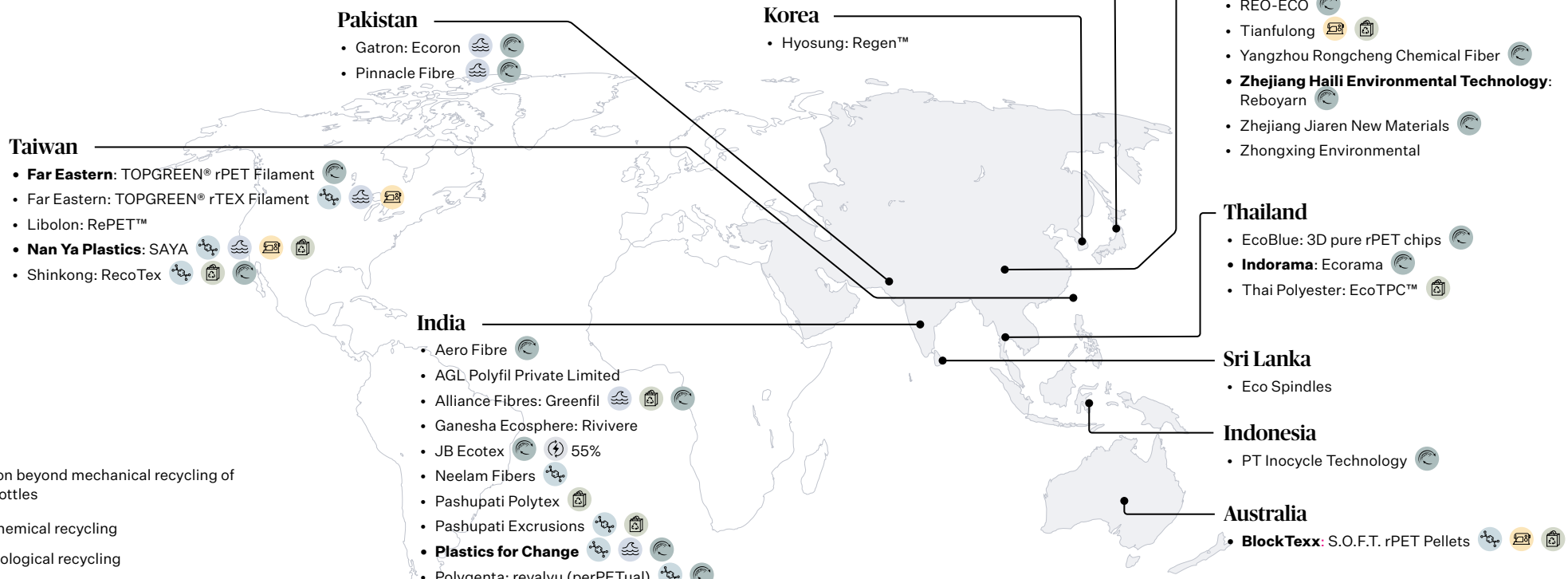
Check out the Textile Exchange database for a list of RCS- and GRS-certified suppliers. More details also in the supplier mapping.

Recycled polyester

Directory: Key suppliers and innovators

This map locates key suppliers and innovators of recycled polyester based on their headquarters.

All use mechanical recycling of plastic bottles except where indicated otherwise.



Japan

- **Itochu**: RENU™ 60%
- Jeplan
- Teijin: ECOPET™ + Eco Circle™
- Toray: ECOUSE™

China

- Cixi Xingke 90%
- Elite Color Environmental
- Fujian Baichuan Resources
- Fujian Mr Fiber Joint
- Guangdong Qiusheng Resources
- Jiangnan Chemical Fiber
- Longfu Recycling
- Nan Ya Plastics: ECOGREEN® -plus
- Ningbo Qiusheng Resources
- REO-ECO
- Tianfulong
- Yangzhou Rongcheng Chemical Fiber
- **Zhejiang Haili Environmental Technology**: Reboyarn
- Zhejiang Jiaren New Materials
- Zhongxing Environmental

Pakistan

- Gatron: Ecoron
- Pinnacle Fibre

Korea

- Hyosung: Regen™

Taiwan

- **Far Eastern**: TOPGREEN® rPET Filament
- Far Eastern: TOPGREEN® rTEX Filament
- Libolon: RePET™
- **Nan Ya Plastics**: SAYA
- Shinkong: RecoTex

Thailand

- EcoBlue: 3D pure rPET chips
- **Indorama**: Ecorama
- Thai Polyester: EcoTPC™

India

- Aero Fibre
- AGL Polyfil Private Limited
- Alliance Fibres: Greenfil
- Ganesha Ecosphere: Rivivere
- JB Ecotex 55%
- Neelam Fibers
- Pashupati Polytex
- Pashupati Excrusions
- **Plastics for Change**
- Polygenta: revalyu (perPETual)
- Reliance: R|Elan™ GreenGold
- **Sulochana**: ECOESPIN (Polycycle) 100%
- Sutlej Textiles
- Sybil Industries: SyGreen

Sri Lanka

- Eco Spindles

Indonesia

- PT Inocycle Technology

Australia

- **BlockTexx**: S.O.F.T. rPET Pellets

Innovation beyond mechanical recycling of plastic bottles

- Chemical recycling
- Biological recycling
- Ocean waste incl. ocean bound
- Post-consumer textiles
- Pre-consumer textiles
- GRS-certified
- % renewable energy (>40% reported)

Tip: How to find suppliers of recycled polyester.

Check out the Textile Exchange database for a list of RCS- and GRS-certified suppliers. More details also in the supplier mapping.

Recycled polyester
Chemical and biological recycling

Most polyester is currently mechanically recycled from PET bottles[1]. The market share of chemically or biologically recycled polyester is still very low (<1%). Key challenges related to chemical and biological recycling are costs, technological challenges, feedstock suitability and availability, as well as energy use. With new operations starting the commercial production of chemically recycled polyester, and further companies in the research and development phase, the market share of chemically recycled polyester is expected to grow in the coming years.

Commercially available on the market

FENC's TOPGREEN® is a commercially offered GRS-certified chemically recycled PET. Read more in the Supplier Mapping.

In 2018 INVISTA launched **LYCRA® T400® EcoMade** fiber. More than 65% of the overall fiber content comes from a combination of recycled plastics (PET bottles) and renewable plant-based resources (corn). The LYCRA® T400® Ecomade recycled content is chemically recycled. Read more in the Supplier Mapping.

Ioniqa has developed a chemical recycling process for rPET. In July 2019, they took the first production plant of 10 kilotons in the Netherlands in operation.

Itochu's RENU is a GRS-certified chemically recycled PET made from pre- and post-consumer textiles. Read more in the Supplier Mapping.

Jeplan's new Kitakyushu Hibikinada Plant for chemical recycling of polyester in Japan started commercial operation in January 2019. Jeplan's **BRING Material™** is a GRS-certified chemically recycling PET made from post- and pre-consumer textiles. The production capacity increased to 400 tonnes per year in 2020. In 2020, JEPLAN, Axens, and IFPEN announced their partnership to demonstrate and commercialize an an optimized, glyolysis based PET depolymerization process for all types of waste PET called "Rewind™. Read more in the Supplier Mapping.

Nan Ya Plastics SAYA is a GRS-certified commercially offered chemically recycled PET, also made from pre- and post-consumer textiles. Read more in the Supplier Mapping.

Polygenta's perPETual is a commercially offered chemically recycled PET, made with recycled plastic bottles and pre-consumer textiles. Read more in the Supplier Mapping.

Teijin's ECOPET™ (formerly Eco Circle™) is a commercially offered chemically recycled PET.

In development:

Ambercycle is a US-based startup developing an enzymatic process for polyester recycling.

CARBIOS is piloting an enzymatic process to depolymerize PET into its monomers. **In 2020, Carbios produced the first clear plastic bottles from enzymatically recycled textile waste.** Its first industrial unit with an annual production capacity of 40,000 tonnes of recycled PET is expected to generate first revenues in 2025. Read more in the Supplier Mapping.

CuRe Technology (formerly Cumapol), DSM-Niaga, Morssinkhof, DuFor and NHL Stenden are collaborating on the new CuRe Technology, a new low energy chemical polyester recycling process for any type of colored polyester. The pilot plant is located in The Netherlands and started operation at the end of 2019.

Garbo S.r.l. has developed an innovative "chemical recycling" process, called **ChemPET**, which is able to treat most of the PET-based waste that is currently not recoverable.

Gr3n invented a new chemical process using microwave radiation to accelerate the depolymerization of PET into monomers.

Indorama/Loop Industries joint venture has developed a patented chemical recycling process to depolymerize all kinds of polyesters with zero energy use. The chemical recycling produces recycled polyester DMT and MEG.

NextChem has completed the construction of the first demonstration plant in Italy for the chemical recycling of PET and polyester from textiles, as part of the European Union's DEMETO project in 2022. NextChem is the developer and co-licensor of the depolymerization technology, owned by the Swiss start-up gr3n, as well as designer and constructor of the plant. Various types of materials, including polyester-based textile fibers, will be tested in the plant, which is capable of recycling almost 100% of the incoming material, amounting to 1,000 tonnes per year.

In 2021, Fashion for Good launched the Full Circle Textiles Project which focuses on scaling polyester chemical recycling for true fiber-to-fiber polyester recycling. Participating innovators include CuRe Technology, Garbo, gr3n and PerPETual who will test path-breaking solutions that will be assessed and validated by participating brand and supply chain partners.

1 Estimated at 99% of all recycled polyester.

Recycled polyester
Ocean-bound and ocean plastic

More than 8 million tonnes of plastic end up in the oceans every year[1]. An increasing number of initiatives are working on the collection of ocean-bound[2] or ocean plastic as feedstock for recycled polyester. While the priority must be to avoid single-use plastic in the first place, such initiatives can help to reduce the plastics in our ocean as long as ocean-bound and ocean plastic exists.

Ocean-bound plastic standards

In 2020, Control Union and Zero Plastic Oceans launched the Ocean Bound Plastic (OBP) Certification. The OBP Certification Program is designed to encourage the removal of ocean-bound plastic from the environment by adding value in effectively collecting and treating it before it reaches oceans.

Textile Exchange Member Action

Plastics For Change is expanding to coastal communities across Asia. This initiative is about creating better livelihoods for the urban poor while keeping plastic out of the ocean. In 2021, Plastics For Change has become one of the first companies in the world to be certified by the OBP certification. Read more in the Supplier Mapping.

SAYA Coastal is a specialized recycling program that targets the clean-up and renewal of discarded plastic bottles in coastal regions that would otherwise migrate out to sea.

Unifi's REPREVE® Our Ocean uses ocean-bound plastics certified by an independent third party organization. The bottles are collected within 50 kilometers of coastlines in countries or areas that lack formal waste or recycling systems. Read more in the Supplier Mapping.

Further ocean plastic initiatives

Circulate Capital is an investment management firm dedicated to financing innovation, companies, and infrastructure that prevent the flow of plastic waste into the world's ocean while advancing the circular economy. Circulate Capital established the world's first investment fund dedicated to preventing ocean plastic: Circulate Capital Ocean Fund (CCOF).

First Mile, an initiative of Thread International and WORK, formalizes waste collection networks in low-income communities and bridges the gap for global brands to purchase from these responsible supply chains, while diverting plastic waste from our oceans and landfills. Read more in the Supplier Mapping.

NextWave Plastics is a consortium of multinational technology and consumer brands gathering in the spirit of collaboration and transparency to rapidly decrease the volume of plastic litter entering the ocean by developing the first global network of ocean-bound plastic supply chains.

OceanCycle is a social enterprise reimagining the circular economy through sourcing, certifying and reusing materials to prevent ocean plastic pollution.

Ocean Material is working with leading ocean recycling specialists to replace virgin plastic with ocean plastic waste.

PlasticBank is a social enterprise committed to stopping ocean plastic while providing opportunities for brands to have environmental and social impact. **Social Plastic®** is ethically recovered material that transfers its value to communities in need. Read more in the Supplier Mapping.

Seaqual is an initiative in Spain to clean oceans from marine litter. Licensed Seaqual members can produce, buy or sell products containing Upcycled Marine Plastic. Seaqual yarn is an 100% recycled material with full traceability ("DNA tracer inside"). Read more in the Supplier Mapping.

Tide Ocean SA is currently being audited for the Global Recycle Standard (GRS), the Recycled Claim Standard (RCS) and the Ocean Bound Plastic Certification (OBP).

Further suppliers of recycled polyester made with ocean-bound or ocean plastic are listed on the recycled polyester supplier map.

Photo: Seaqual

1 IUCN, 2021. Website. Link.

2 Ocean-bound plastic is generally defined as Abandoned Plastic Waste located within the range of 50km from shore. Source: Ocean Bound Plastic (OBP) Certification, 2021. Website. Link.

Recycled polyester
Fairness for waste pickers

While social conditions in the factories are, at least, on the radar of most companies, the livelihoods of the waste picking communities are often not yet sufficiently considered. With first initiatives explicitly addressing the social impact on the polyester feedstock collection level, it is expected that social topics related to waste collection will receive increasing attention in the next years.

Fairness for waste pickers

First Mile are recycled polyester bottles that can be traced back to the collection networks responsible for picking up the post-consumer bottles. They are used for the **Thread Ground to Good™**. The raw materials are sourced from Haiti, Honduras, and Taiwan. Read more in the Supplier Mapping.

The Megh Group - T3. Trash. Thread. Textile. is a new project in development in Kenya. T3 is currently constructing a mechanical PET bottle recycling plant in Kenya with an initial capacity of 25 tonnes per day. A key goal is to turn waste into a resource that generates income and improved conditions for families living in poverty.

PlasticBank is a social enterprise committed to stopping ocean plastic while providing opportunities for brands to have environmental and social impact. **Social Plastic®** is ethically recovered material that transfers its value to communities in need. As a user of Social Plastic® one will have a direct and traceable impact on helping to stop ocean plastic and improve lives.

Plastics For Change is the first and, currently, the only rPET supplier certified by the World Fair Trade Organization. Plastics For Change has developed a franchise model to fortify recycling businesses that pay waste-pickers decent incomes, train them, and make investments. Read more in the Supplier Mapping.

Photo: Plastics for Change

Biobased polyester
An emerging material

The market share of biobased polyester is estimated at around 0.02% of the total polyester production[1]. Biobased polyester has the potential to reduce GHG emissions, but materials have to be sourced and managed responsibly to realize this potential. Further development of feedstocks is needed to provide the industry with innovative solutions to drive uptake of biobased polyesters.

Many biosynthetic materials that exist on the market today are partially biobased; it's important that the industry continues to invest and develop 100% biobased solutions.

While many sustainability standards for biobased feedstocks exist, the scale and adoption of these standards for biosynthetics is still limited. Key standards for biomass certification are the **Roundtable for Sustainable Biomaterials (RSB), ISCC Plus**, and **Bonsucro**.

Fibers and yarns

OceanSafe naNea fibers are 25-30% biobased PET staple fibers. They are Cradle to Cradle Certified® Gold. Read more in the Supplier Mapping.

Far Eastern's TopGreen® Bio PET Filament is a PET filament made with 30% biobased feedstock from sugarcane. Read more in the Supplier Mapping.

LYCRA® T400® EcoMade fiber is PET fiber with more than 65% of the overall fiber content from a combination of chemically recycled plastics (PET bottles) and renewable plant-based resources (corn). Read more in the Supplier Mapping.

Radici's Biofeel® -PET is a 30% biobased polyester filament yarn produced from bio-PET resins made with plant-based bio-MEG. Read more in the Supplier Mapping.

In 2012, Teijin started the production of its **ECO CIRCLE™ Plantfiber**, a partially biobased PET resin made from 30% bio-based EG derived from sugarcane and the rest from petroleum-based dimethyl terephthalate (DMT) or terephthalic acid (PTA).

Toray's Ecodear® PET is a 30% plant-based polyester fiber derived from sugarcane. Toray launched ecodear® as an integrated brand for biomass-based polymer materials and products in 2013.

Chemicals

Avantium inaugurated its bio-MEG demonstration plant in the Netherlands in 2019.

Anellotech is a US-based company producing BioBTX, a biobased paraxylene.

Braskem and Haldor Topsoe announced a partnership in 2017 to validate the MOSAIK™ sugar-to-biochemicals solution for the production of bio-MEG in a demonstration plant. The demo plant started operation in 2019.

Gevo has developed fully renewable carbon-based para-xylene, a key ingredient to convert petro-based polyester for fibers and bottles to 100% renewable content. It opened a plant making biobased paraxylene in Texas in 2013. Gevo and Toray signed a bio-paraxylene offtake agreement for the world's first pilot-scale fully renewable, bio-based polyethylene terephthalate (PET) production in 2012.

In 2014, Gevo, Inc. has announced that it is selling para-xylene (PX) derived from its renewable isobutanol to Toray, a leading producer of fibers, plastics, films, and chemicals. PX is a primary raw material for the manufacture of bio-polyester (PET).

Global BioChem is a Chinese producer of bio-MEG.

India Glycols has been producing bio-MEG using ethylene derived from bio-ethanol since 1989.

Indorama offers a bio-PET resin made with 30% plant-based bio-MEG.

Iwatani develops eco-friendly resin using 30% plant-based raw materials. Iwatani announced the procurement of Bio-MEG from India-based India Glycols Limited, and consignment of Thailand-based Indorama Ventures in 2012.

PEFerence announced the establishment of a biorefinery flagship plant producing FDCA (furan dicarboxylic acid), a bio-based building block to produce high value products including biobased polyester.

Virent develops its BioFormPX® paraxylene made from sugars. In 2016, Virent and FENC announced the first 100% bio-polyester shirt made with Virent's BioFormPX® paraxylene. Virent completed a year-long run of a demonstration plant in 2017/18 which demonstrates the technology to convert plant sugars to bio-paraxylene, a critical raw material for biobased polyester fiber. Read more in the Supplier Mapping.

1 Estimate based on nova-Institute, 2021. Bio-based Building Blocks and Polymers – Global Capacities, Production and Trends 2020 – 2025. Link and Maia Research, 2022. Global Polyester Fiber Market.

Commitments to preferred polyester

Accelerating the transition

Commitments to Recycled Polyester

In April 2021, Textile Exchange and the United Nations Framework Convention on Climate Change's Fashion Industry Charter for Climate Action (UNFCCC) launched a joint initiative to spur a shift in the market towards the uptake of recycled polyester and its associated reduction in greenhouse gases.

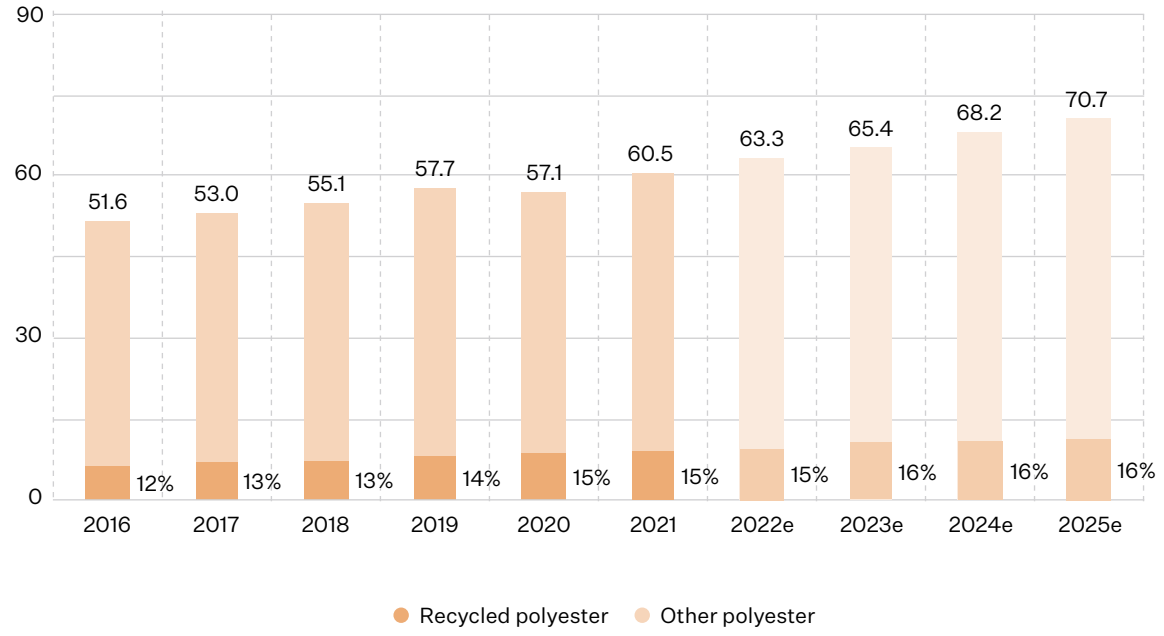
The 2025 Recycled Polyester Challenge serves as an important catalyst for change in the apparel industry. It is challenging the industry to commit to bringing the overall percentage of recycled polyester up from 14% to 45% by 2025. It encourages brands to commit to the most ambitious uptake target possible of 80-100% recycled polyester.

132 companies (including subsidiaries) signed up to the 2025 Recycled Polyester Challenge between its launch in April 2021 and December 2021. This includes 109 (83%) brands and retailers and 23 (17%) suppliers and manufacturers. All participants have committed to targets ranging from having 45% to 100% recycled polyester by 2025.

Commitments to Biobased Polyester

The interest in alternatives to fossil-based synthetics including biosynthetics is increasing. Public commitments to biobased polyester are still very rare though.

Global polyester fiber market growth trend without acceleration of decoupling from virgin fossil feedstock (total polyester fiber in million tonnes and % of recycled)



Call to action

Sign the 2025 Recycled Polyester Challenge

Call to action

Join the Recycled Polyester Round Table

Call to action

Join the Biosynthetics Round Table

Synthetic Fibers

Polyamide

Recycled polyamide
Production facts and figures

Global total polyamide (nylon) fiber production increased again from 5.4 million tonnes in 2020 to 5.9 million tonnes in 2021, after a slight decline due to COVID-19 in 2020[1]. With this, polyamide fibers accounted for about 5% of the global fiber production market in 2021[2].

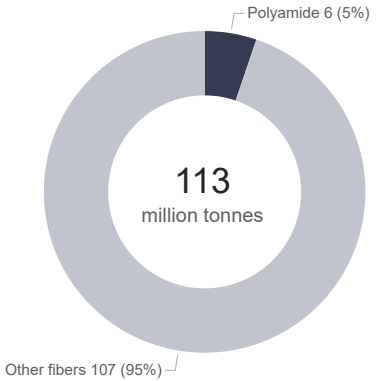
The recycled polyamide fiber market is growing but at a rather slow rate. Around 0.1 million tonnes of recycled polyamide were produced globally in 2021. Due to technical challenges, limitations related to feedstock quality and availability, and low prices for fossil-based polyamide, the market share of recycled polyamide is still very low, accounting for 1.9% of all polyamide fiber production.[3]

Recycled polyamide can be produced from pre- or post-consumer waste. Pre-consumer waste may be processing scraps, fabric cut-offs or hard polyamide waste. Post-consumer polyamide is made from materials such as discarded fishing nets, carpets, or other used textiles. The recycling process can be mechanical or chemical.

The main standards used for recycled polyamide include the Global Recycled Standard (GRS) and the Recycled Claim Standard (RCS). For further information, see the chapter on Sustainability Standards.

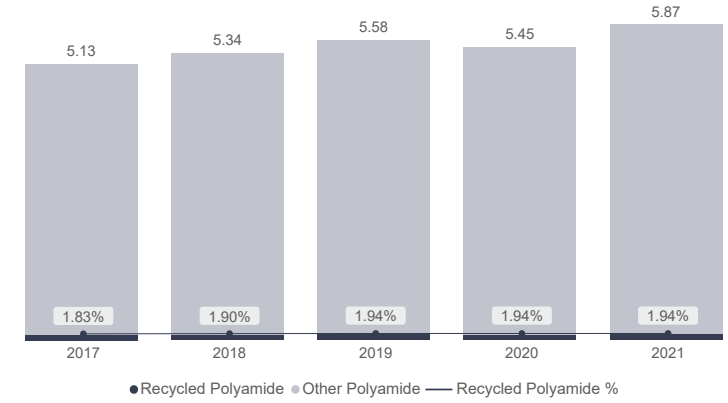
The recycling of polyamide helps to decrease dependency on fossil based raw materials and to reduce the waste material. Aquafil estimates that 70,000 barrels of oil are saved per 10,000 tonnes of regenerated caprolactam[3].

Global market share of polyamide in 2021



Source: Textile Exchange based on Maia Research and global data compilations

Global polyamide production (million tonnes)



Source: Textile Exchange based on Maia Research

1 Maia Research, 2022. Global Polyamide Fiber Market Report 2021. Customized report.

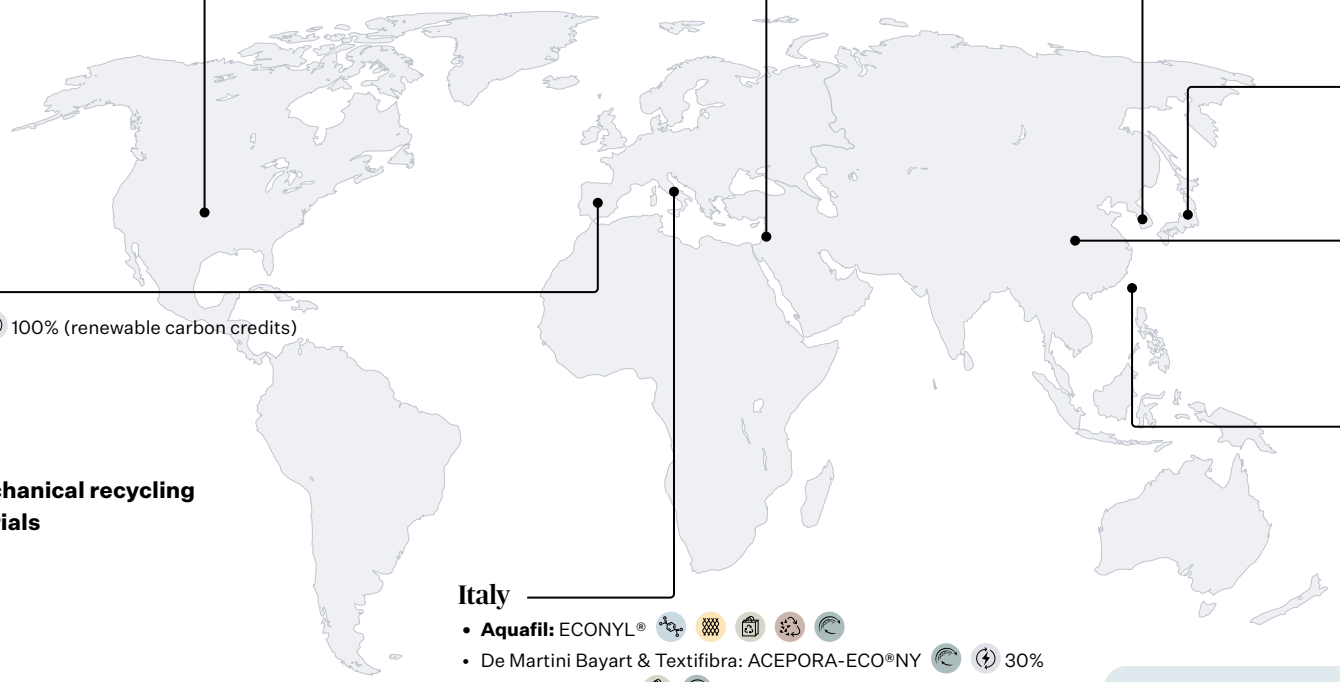
2 Textile Exchange estimate based on various sources (see the chapter on the Global Fiber Market).

3 Aquafil, 2022. Website. Link.

Recycled polyamide

Directory: Key suppliers and innovators

This map locates key suppliers and innovators producing recycled polyamide by headquarters.
All polyamide is mechanically recycled from pre-consumer waste unless otherwise indicated.



United States

- Ascent
- Premiere: EcoInnovationFiber™
- **Unifi:** REPREVE®

Israel

- Nilit: Ecocare

South Korea

- Hyosung: Mipan Regen™
- Taekwang: Acepora-Eco®

Japan

- Toray: CYCLEAD™

China

- Guangdong Xinhui Meida Nylon
- Highsun Holding Group
- Zhejiang Taihua New Materials

Spain

- Nurel: Reco Nylon® 100% (renewable carbon credits)
- Nylstar: Meryl® Recycled

Taiwan

- Chain Yarn: Chainlon Greenlon® Recycled
- Far Eastern: FEFC® eco
- Formosa: Sunylon

Italy

- **Aquafil:** ECONYL®
- De Martini Bayart & Textifibra: ACEPORA-ECO®NY 30%
- Fulgar: Q-NOVA®
- Radici: Renycle ® 42%

Innovation beyond mechanical recycling of pre-consumer materials

- Chemical recycling
- Fishing nets
- Post-consumer textiles
- Other feedstock
- GRS-certified
- % renewable energy (>40% reported)

Tip: How to find suppliers of recycled polyamide.

Check out the Textile Exchange database for a list of RCS- and GRS-certified suppliers. Find more details also in the Supplier Mapping.

Textile Exchange members are highlighted in **bold** (as of September 2022).

Biobased polyamide

Introduction and supplier innovation landscape

The global production volume for biobased polyamide fiber is around 0.02 million tonnes.[1] It is estimated that the share of biobased polyamide fibers is around 0.4% of the polyamide fiber market.[1]

Fibers and yarns

Cathay's TERRYL® is a biobased polyamide line offering PA56, PA510, PA512, PA514 and co-polymers chips and filament with 31 to 100% renewable shares.

Chainlon's biobased polyamide 6.6 yarn is made with **Evonik's VESTAMID® Terra HS®** and contains 62% biobased content made from castor oil.

Fulgar's EVO® is a 100% biobased polyamide yarn made from castor oil.

RadiciGroup's Biofeel® PA is a 64 to 100% biobased polyamide filament yarn derived from castor oil and agricultural waste. Read more in the Supplier Mapping.

RadiciGroup's Dorix® 6.10 is 64% biobased polyamide staple fiber made from castor. Read more in the Supplier Mapping.

RadiciGroup's Radilon® 6.10 is a 64% biobased polyamide yarn.

Toray's ECODEAR® PA 6.10 is a biobased polyamide filament derived from the castor bean.

Unitika, partner of Arkema, offers Castlon®, a 100% biobased polyamide filament derived from castor seed oil.

Chemicals and resins

Anellotech announced the production of sample quantities of bio-based benzene in 2019.

Arkema's Rilsan® is a 100% bio-based polyamide 11 resin derived from castor seeds oil. With its partners, Arkema is driving the sustainable production of castor seeds in India through the Pragati Initiative since 2016. Read more in the Supplier Mapping.

BASF Ultramid® Biomass Balance Polyamide is a mass-balance based polyamide.

DSM's EcoPaXX® is a 70% biobased polyamide (PA410) resin derived from the castor bean plant.

Evonik and BioAmber have a long-term agreement for the development and manufacturing of catalysts for making BDO (1,4- butanediol), THF (tetrahydrofuran), and GBL (gamma-butyrolactone) from biobased succinic acid.

Evonik's VESTAMID® is the name for a group of polyamides based on renewable raw materials: The monomers are obtained partly or entirely from castor oil.

Scientists at Sweden's Lund University have found a way to convert cotton into sugar, which in turn can be made into elastane or polyamide.

Genomatica announced the world's first ton of 100% biobased caprolactam (CPL) in 2020 which is converted into polyamide 6. Genomatica collaborates with Aquafil. The development is part of the "Project EFFECTIVE." Read more in the Supplier Mapping.

PEFerence announced the establishment of a biorefinery flagship plant producing FDCA (furan dicarboxylic acid), a bio-based building block to produce high value products including biobased polyamide and polyester.

RadiciGroup's Radipol® DC is a 64% biobased polyamide 6.10 resin. Read more in the Supplier Mapping.

RadiciGroup's Radipol® PX resin is a 100% biobased polyamide 5.10 resin based on castor. Read more in the Supplier Mapping.

Virent's BioFormBZ®Benzene is a biobased benzene that can be used to produce polyamide. Read more in the Supplier Mapping.

Photo: Arkema

1 Estimate based on nova-Institute, 2021. Bio-based Building Blocks and Polymers. Global Capacities, Production and Trends 2020-2025. Link and Maia Research, 2022. Global Polyamide Fiber Market 2021. Customized report.

Commitments to preferred polyamide
Examples

Brands and retailers are starting to make public commitments to replace virgin polyamide with recycled polyamide.

Examples of public commitments to recycled polyamide by Textile Exchange members

Everlane is committed to using only recycled nylon by 2021. Read more here.

H&M is committed to using only 100% recycled or other sustainably sourced materials including recycled nylon. Read more here.

Moose Knuckles is committed to eliminate virgin nylon from its garments by the end of 2025. Read more here.

Norrona has the goal to use as much recycled or responsibly produced plant based polyamide in its products as possible. Read more here.

Patagonia's goal is to stop using virgin fossil-based nylon by 2025. Read more here.

StellaMcCartney is working towards switching all nylon to ECONYL® regenerated nylon. Read more here.

VF Corporation has committed to increasing uptake of recycled nylon to 50% by 2025. Read more here.

Volcom is committed to increase their share of recycled nylon to 20% by 2020. Read more here.

Other commitments

Arkema, producer of the 100% bio-based polyamide 11 resin Rilsan® derived from castor seeds oil, is working with partners to drive the sustainable production of castor seeds in India through the Pragati Initiative since 2016. Read more here.

Make a Standards Commitment

Whether you have already made a commitment to one or more of Textile Exchange's Standards, or you want to share a new one, you may use this form to register details of your commitment(s).

Photo: Arkema

Synthetic Fibers

Other Synthetic Fibers

Other synthetics
Production facts and figures

The other synthetics category, which includes polypropylene, acrylics, and elastane had a combined production volume of 5.8 million tonnes and a market share of around 5% of the global fiber market in 2021.

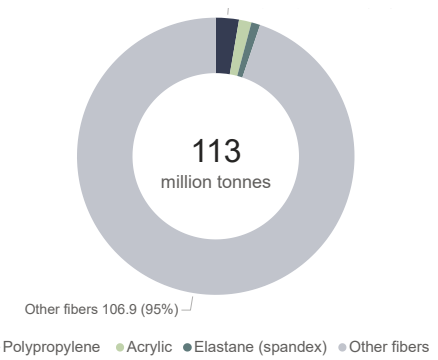
Polypropylene had a market share of 2.7% of the global fiber market in 2021. The polypropylene fiber production volume slightly increased again from 2.9 million tonnes in 2020 to 3.0 million tonnes in 2021, after a slight decline due to COVID-19 in 2020. It is estimated that just about 0.2% of all polypropylene fibers are recycled.

Acrylic fibers had with a production volume of around 1.7 million tonnes a market share of 1.5% of the global fiber market in 2021. Global acrylics fiber production volumes have been declining over the years[1]. The market share of recycled acrylics is estimated at around 0.3% of the total acrylic fiber production in 2021.

Global elastane fiber production just crossed the 1 million tonnes per annum in 2020 and increased to 1.2 million tonnes in 2021, accounting for a market share of around 1% of the global fiber market in 2021. The global elastane fiber production volume growth trend continued in 2021. The share of recycled elastane was an estimated 2.6% of the global elastane fiber production volume in 2021.

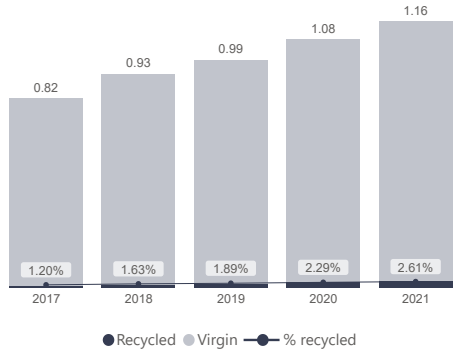
The production volumes of further other synthetics such as polytrimethylene terephthalate (PTT), polylactic acid (PLA), and similar are very low and currently not included in the report.

Global market share of other synthetics 2021



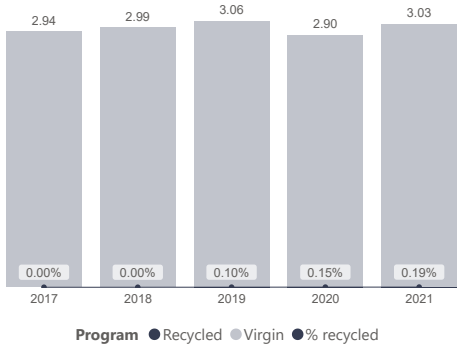
Source: Textile Exchange based on Maia Research and global data compilation

Elastane fiber production (million tonnes)



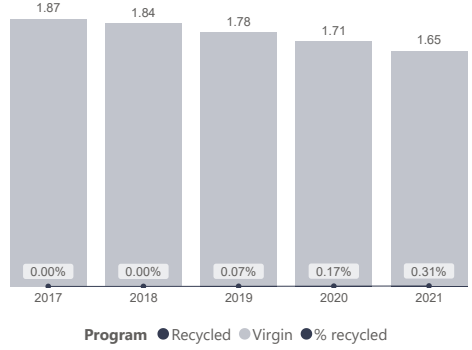
Source: Textile Exchange based on Maia Research

Polypropylene fiber production (million tonnes)



Source: Textile Exchange based on Maia Research

Acrylic fiber production (million tonnes)



Source: Textile Exchange based on Maia Research

1 Maia Research, 2022. Global Other Synthetics Fiber Market Report 2022. Customized report.

Other recycled or biobased synthetics

Recycled and biobased elastane, acrylic, and polypropylene

There are several examples of recycled or biobased synthetics other than polyester and polyamide, such as recycled elastane, acrylic or polypropylene.

Recycled elastane

Asahi Kasei's Roica™ EF launched its first GRS-certified recycled elastane, a polyurethane filament made from pre-consumer materials, in 2016. Read more in the Supplier Mapping.

Hyosung's creora regen elastane, a GRS-certified, 100% recycled elastane, was launched in 2019.

LYCRA® EcoMade fiber is The LYCRA Company's first branded elastane made with recycled content, introduced in 2019. The fiber contains 20% pre-consumer content, diverting waste, and keeping materials in use. Read more in the Supplier Mapping.

Sheico Group's Sheiflex® is a recycled elastane which received its GRS certification in 2017.

Spanflex™ recycled elastane is GRS-certified.

Biobased elastane

The Lycra Company launched the **LYCRA® 162 R** fiber, an elastane fiber with 70% biobased content derived from corn, in 2014. Read more in the Supplier Mapping.

The Helm AG in collaboration with Cargill launched **QIRA**, a biobased 1,4 Butanediol (BDO) with around 95% corn-based feedstock, in 2021. The production capacity at the start in 2024 will be 66,000 tonnes per annum. Biobased BDO is a chemical that can be used for a variety of applications including biobased elastane. Read more in the Supplier Mapping.

Scientists at Sweden's Lund University have found a way to convert cotton into sugar, which in turn can be made into elastane or polyamide.

Recycled acrylic

Aksa started the commercial scale production of Acrycycle® recycled acrylic fiber made with 100% pre-consumer material in 2019. Read more in the Supplier Mapping.

Hebei Acrylic Fibre offers a 70% recycled acrylic fiber branded as RCA. It is made from pre-consumer acrylic textiles and RCS-certified. Read more in the Supplier Mapping.

Thai Acrylic Fibre Co. Ltd. (TAF), part of Aditya Birla Group, has launched a recycled acrylic fibre branded as "Regel™", which is made by with 50% pre-consumer recycled acrylic textiles and is GRS-certified. Read more in the Supplier Mapping.

Recycled polypropylene

Radici's Respunsible® is a recycled polypropylene spunbond from pre-consumer materials. Read more in the Supplier Mapping.

Photo: USGS

Other recycled or biobased synthetics

Supplier innovation landscape

Biobased PLA

Advansa offers ADVA® made from PLA staple fibers. Read more in the Supplier Mapping.

In 2021, Total Corbion PLA, a 50/50 joint venture between Total and Corbion, confirms that it has kicked off the front-end engineering design stage for its new 100,000 tonnes per annum PLA plant in France.

Far Eastern offers biobased PLA made with NatureWorks Ingeo™, which is made from corn.

Natureworks has developed its Ingeo™ branded PLA to manufacture plastics and fibers. Ingeo™ is currently derived from corn, cassava, sugar cane or beets. In 2019, NatureWorks announced its commitment that 100% of its agricultural feedstock used for Ingeo will be ISCC Plus certified by 2020. The Natureworks R&D team is also working on a new technology to skip plants entirely.

NOOSA® is a 100% biobased PLA, which is made from corn and sugarcane. Read more in the Supplier Mapping.

Palmetto Synthetics offers biobased PLA staple fiber made with NatureWorks Ingeo®, which is derived from corn.

Radici's Biofeel® - PLA (formerly Cornleaf) is a 100% biobased filament yarn based on Ingeo™ PLA biopolymer, which is made from corn. Read more in the Supplier Mapping.

Toray also offers a 100% biobased PLA filament.

Trevira, an Indorama Ventures company, offers biobased PLA fibers and filaments made with Nature Works LLC Ingeo™ which is made from grain (corn).

Biobased PTT

Covation Biomaterial's (fomerly DuPont's) **Sorona®**, commercially available since 2000 and celebrating its 20th anniversary in 2020, is a partially biobased PTT polyester polymer with 37% biobased content by weight made from corn sugar. As of 2021, Covation Biomaterials has many fiber production partners across the globe and over 150 mill partners. Read more in the Supplier Mapping.

Ecopel's KOBA® is a bio-based material with 37% biobased content based on Sorona® fiber from Covation Biomaterials (formerly DuPont). Read more in the Supplier Mapping.

Far Eastern offers biobased PTT.

Toray`s Ecodear® PTT is a 30% plant-based PTT.

Teijin Frontier's SOLOTEX® ECO-Hybrid fiber was launched in 2020. The high-stretch fiber combines biobased PTT and chemically recycled PET.

Biobased PHA

In 2021, Fashion for Good launched The Renewable Carbon Textiles Project, a consortium project to accelerate the development of PHA fibers from different feedstocks together with the innovators Bio Craft Innovation, Full Cycle Bioplastics and Newlight.

Biobased polyurethane

Covation Biomaterials (formerly DuPont) Susterra® PDO is 100% corn-based building block, called propanediol, for a variety of polyurethane applications. Read more in the Supplier Mapping.

The Helm AG in collaboration with Cargill launched QIRA, a biobased 1,4 Butanediol (BDO) with around 95% corn-based feedstock, in 2021. The production capacity at the start in 2024 will be 66,000 tonnes per annum. Biobased BDO is a chemical that can be used for a variety of applications including biobased polyurethane. Read more in the Supplier Mapping.

Biobased PBS

Kintra Fibers is developing a polybutylene succinate (PBS), which is a linear aliphatic polyester, currently with 50% biobased content derived from corn. Read more in the Supplier Mapping.

Photo: Kintra

Other Manmade Fibers & Materials

Recycled fibers from blended textiles

Chemical and mechanical recycling of blended materials

Many textiles produced today are fiber blends. Recycling of fiber blends is particularly challenging due to the mix of materials, such as cotton and polyester. Blending of fibers such as elastane with other fibers cause significant challenges when it comes to recycling post-consumer textiles. Thanks to a few innovative startups, there is the prospect that high-value fiber blend recycling will be possible soon.

Chemical recycling

Ambercycle has developed a technology to separate post-consumer polyester-cotton blends on a molecular level and turn it into high-quality polyester pellets and products sold under the brand cycora™.

BlockTexx owns proprietary technology that separates polyester and cotton materials such as clothes, sheets and towels of any color or condition back into their high-value raw materials of PET and cellulose for reuse as new products for all industries. Read more in the Supplier Mapping.

Circ (earlier called Tyton Biosciences) is developing a proprietary polycotton blend recycling process utilizing hydrothermal technology to separate polyester fiber from cotton at any ratio, yielding polyester monomers and dissolving pulp. Circ aims to recycle 10 billion garments by 2030. Read more in the Supplier Mapping.

The Hong Kong Research Institute of Textiles and Apparel (HKRITA)—in collaboration with the H&M Foundation and Novetex—has developed a hydrothermal method using heat, water, and green chemicals for recycling post-consumer cotton and polyester blends. A new pre-industrial size facility called Novetex Upcycling Factory scaling this technology was opened in September 2018.

Infinited Fiber Company, a spin-off of the VTT Technical Research Center of Finland, has developed a technology that is also able to digest mixed post-consumer cellulose-based textile waste. Cellulose-based fibers are separated from other fibers like polyester and elastane, and the cellulose fibers are then chemically dissolved through a Cellulose Carbamate (CCA) technology. The technology can also turn cotton, viscose and other cellulose based residues into new MMCF. The technology can be applied in any existing dissolving pulp and MMCF plant. Investors include the H&M Group, Virala, Fortum and the RGE Group. The material is sold under the brand Infinna™, a cellulose carbamate fiber currently created out of 100% post-consumer textile waste. A 30,000 tonnes flagship factory in Finland is expected to be operation in 2024. Read more in the Supplier Mapping.

Photo: Infinited Fiber

Recycled fibers from blended textiles

Chemical recycling of blended materials

Mistra Future Fashion's Blend Re:Wind is a Swedish process for the recycling of poly-cotton blended textiles. Cotton is turned into new high-quality viscose filaments and polyester into two pure new monomers.

Phoenxt is a textile-to-textile chemical recycling technology that aims to convert textile waste back to raw material, including blended materials made of polyester, cotton, and cellulosic fibers. Read more in the Supplier Mapping.

RISE - The Regenerator is working on a technology to recirculating fashion by separating cotton and polyester blends, turning them into new textile fiber.

Södra announced its new solution called OnceMore® to separate cotton and polyester from polycotton blends in October 2019. The project started in autumn 2019 with 20 tonnes of post-consumer cotton added to their wood-derived pulp in their mill in Mörrum, Sweden resulting in 3% recycled content. In 2020, Södra increased this share to 20% and became RCS-certified. Södra's target is to recycle 25,000 tonnes in 2025 to create products with 50% recycled content. To achieve this, Södra needs to make continuous improvements and investments. Södra is also exploring a decoloring solution, possibilities to extract products from the polyester, and the use of post-consumer MMCF textiles. Read more in the Supplier Mapping.

Worn Again Technologies' patented process can separate, decontaminate, and extract polyester polymers and cellulose (from cotton) from non-reusable textiles, as well as plastic bottles and packaging, to go back into new products as part of a repeatable process. The construction of Worn Again Technologies' first demonstration plant with a capacity of 1,000 tonnes per year is scheduled to start end of 2022 in Winterthur, Switzerland. Read more in the Supplier Mapping.

Photo: Circ

Recycled fibers from blended textiles

Mechanical recycling of blended textiles

Mechanical recycling

Circular Systems' Texloop, a purely mechanical and hydrothermal process, can also recycle blends, which in turn act as raw material inputs to next-generation fabrics. More in the supplier mapping.

Kishco Group mechanically recycles various input materials, including polyester/cotton blends.

Martex Fiber has been innovating in the field of textile recycling since its founding in 1970 as a textile waste trading company. The company also mechanically recycles polyester/cotton blends.

Novetex opened its Novetex Upcycling Factory in Hong Kong in September 2018 for mechanical fiber-to-fiber recycling. The technology was developed in collaboration with HKRITA and H&M Foundation and can recycle post-consumer fiber blends.

Photo: MPCA

Manmade protein fibers
Overview

Biobased manmade protein fibers are another example of material innovations. Please note that not all biobased fibers are, by definition, sustainable or preferred. Further research is required in order to assess their sustainability profiles holistically.

Biobased manmade protein fibers

AMSilk Biosteel® is a biobased protein fiber produced in a continuous spinning process.

Bolt Threads' Microsilk is a biobased manmade "spidersilk" primarily made of sugar, water, salts and yeast.

Kraig Biokraft is a protein fiber made by genetically engineered silkworms and composed entirely of protein produced naturally by the silkworm.

Spiber's Brewed Protein™ is a 100% protein-based material, created from sugars derived from either sugarcane, corn, or saccherification of cellulose. After more than 12 years of research and development, Spiber is now focusing on the transition to mass production. Spiber's first commercial Brewed Protein™ production plant, launched in Thailand in 2022, has a maximum annual capacity of up to several hundred tonnes. Bonsucro-certified sugar will be used as the primary feedstock for commercial production in Thailand. Read more in the Supplier Mapping.

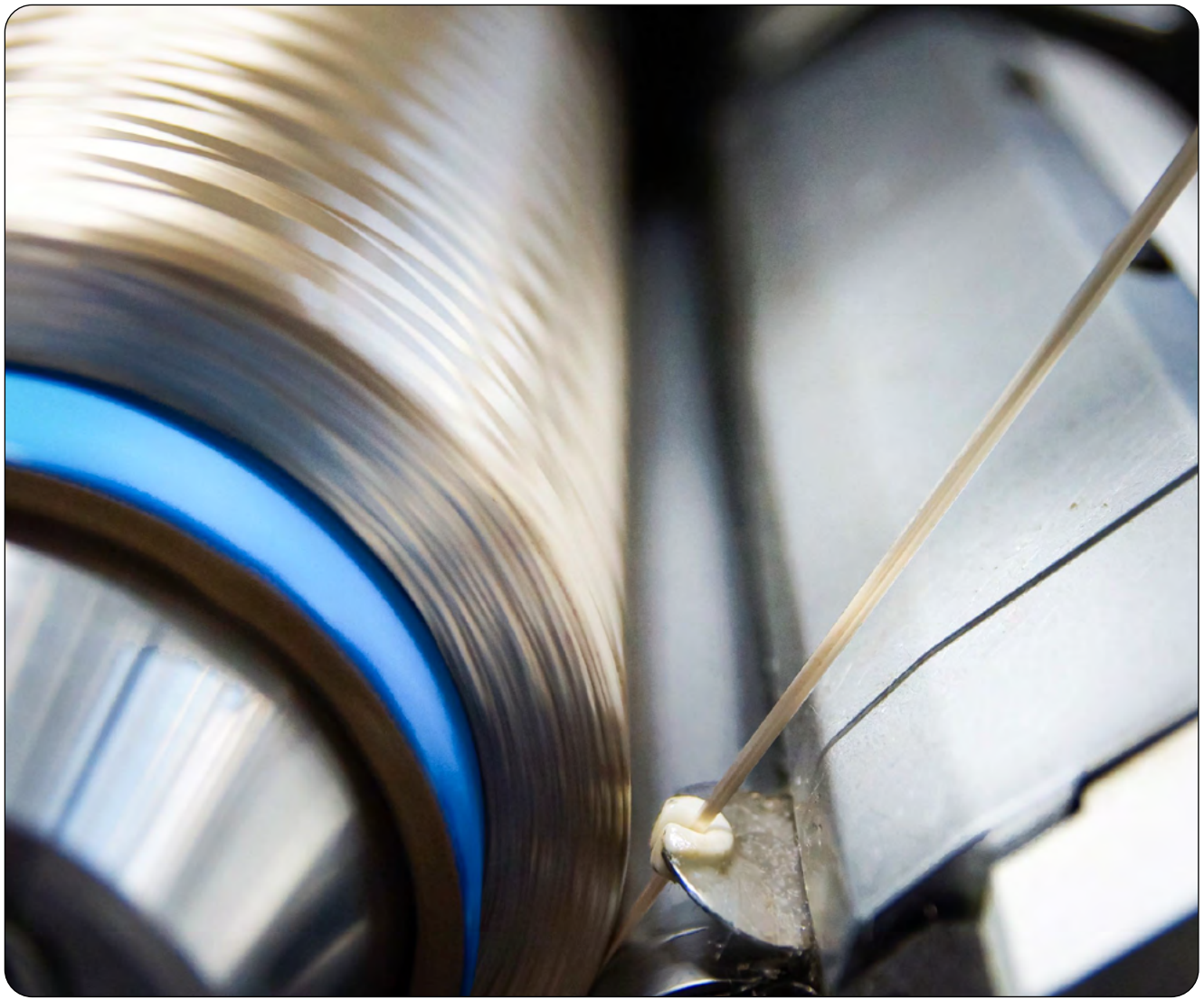


Photo: Spiber Inc.

CO_2-based fibers
Overview

Addressing climate change is one of the most urgent action areas for the textile industry. A few companies are exploring innovative approaches to directly capture carbon dioxide (CO_2) from the air and use its carbon as feedstock for textiles. This can be processed into pre-cursor chemicals which are used in the production of synthetic fibers such as polyester. Direct Carbon Capture and Utilization (CCU) is a new technology in development. Its energy use is currently very high but if technological challenges are overcome and if it is powered by renewable energy it has great potential as alternative to virgin fossil feedstock.

Examples

Covestro and its partners, foremost the Institute of Textile Technology at RWTH Aachen University and various textile manufacturers, announced in July 2019 that they have succeeded in making elastic textile fibers based on CO_2 and in doing so, partly replacing crude oil as a raw material.

Fairbrics is a Global Change Award winner developing a technology to convert greenhouse gas into polyester. In 2021, Fairbrics produced the first proof-of-concept garment partially made of CO_2 converted into polyester with the help of H&M group's Circular Innovation Lab (CIL). The pilot project is planned for 2023 and the first commercialization in 2025. Read more in the Supplier Mapping.

LanzaTech is developing a carbon recycling technology. In 2021, Lanzatech together with lululemon announced the production of the world's first partially CO_2-based polyester yarn and fabric. Later in 2021, Lanzatech together with Far Eastern New Century (FENC) and Inditex's Zara announced their first partially CO_2-based capsule collection. Steel mill emissions were captured and converted into ethanol to produce 20% CO_2-based polyester.

Mango Materials is developing a process to produce PHA biopolymers from waste biogas (methane) via a microbial process.

NatureWorks is currently using plants to capture and sequester CO_2 into long-chain sugar molecules, and its PLA called ingeo. Their R&D team is assessing new technology to skip plants and use microorganisms to convert greenhouse gases into lactic acid directly.

NewLight is working on a technology to turn greenhouse gases into aircarbon™, a PHB that can be melted and forged into fibers and solid parts.

RUBI, Global Change Award winner 2022, is developing a technology to produce viscose made of carbon emissions captured from the air.

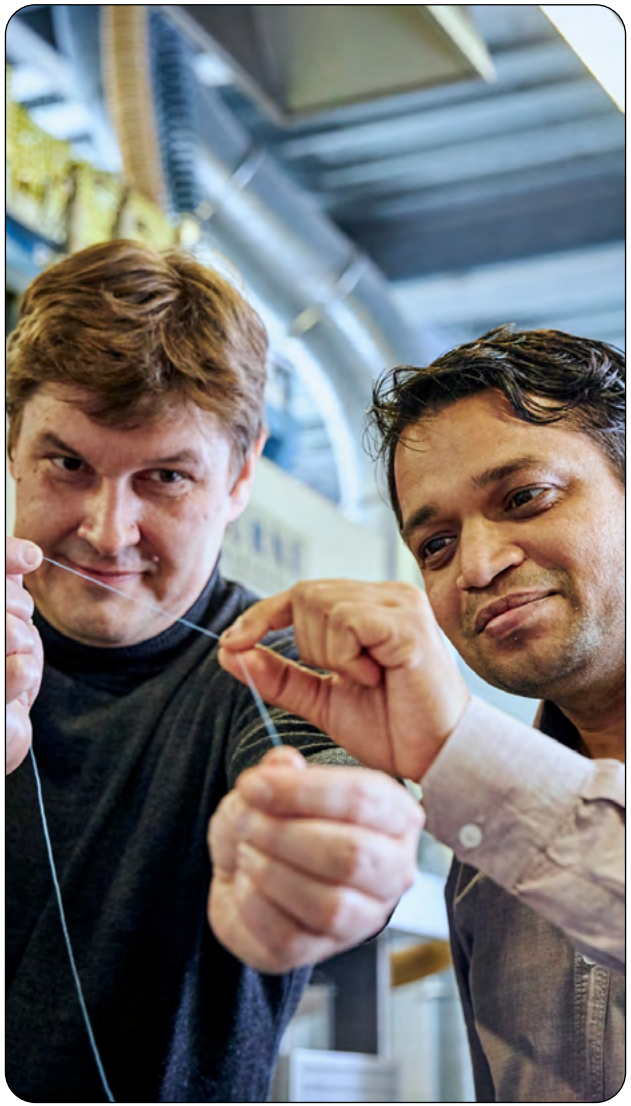


Photo: Covestro

1 Covestro July 2, 2019 Press Release "Dress with CO2". More information here.

Manmade non-fiber materials

An overview

While leather is a by-product of the meat and dairy industry, some brands prefer emerging manmade non-fiber materials.

While most manmade non-fiber materials are fossil-based synthetics, a rapidly growing number of partially (and rarely fully) recycled and biobased manmade non-fiber materials is being developed. Many are still in development as it is not easy to achieve some of the quality attributed of natural leather, such as its durability.

While partially or ideally fully substituting fossil-based with biobased or recycled content is a start, continuous improvements and a holistic approach including material health and circularity are important.

Mycelium-based materials

Bolt Threads—Mylo™ is developed from mycelium cells. First consumer products made with Mylo™ were revealed in 2021. Read more in the Supplier Mapping.

Forager™ by Ecovative are 100% biobased materials made from mycelium.

MuSkin is a 100% biobased material derived from the Phellinus Ellipsoideus, a parasitic fungus that grows in the wild and attacks the trees in the subtropical forests.

MYCL is currently developing Mylea™, a mycelium-based non-fiber material.

MycoFutures North Atlantic is developing a mycelium-based materials.

Mylea™ is a mycelium-based material developed by Mycl.

MYLIUM is a mycelium-based material. Other natural ingredients are added to the mycelium to strongly bind it together. The material can be finished with a coating to finetune its properties.

Reishi™ from MycoWorks is a material grown rapidly from mycelium and agricultural byproducts.

Sporatex™ from Spora Biotech is a mycelium-based material.

100% bio-based materials containing rubber or gum

Bambuflex© is a 100% biobased material derived from bamboo.

Malai Biocomposite is a biobased material based on bacterial cellulose and a blend of natural fibers. It is grown in coconut water, a leftover from the coconut industry in South India, through fermentation of a bacterial culture. This jelly is harvested and enriched with natural fibers, gums and resins to create a more durable and flexible material. Read more in the Supplier Mapping.

Natural Fiber Welding's Mirum™ is a 100% plant-based material. Ingredients used include cotton and hemp fiber, coconut coir, cork, natural rubber, and similar. Unlike most other non-fiber materials, the final Mirum™ materials are not coated in polyurethane or PVC. The cork and rubber part is FSC-certified. Read more in the Supplier Mapping.

Photo: Natural Fiber Welding

Manmade non-fiber materials

An overview

Partially bio-based materials blended with polyurethane or other synthetics

Desserto from Adriano di Marti is a partially biobased material, launched in 2019. The resin is made with 40% cactus fiber, protein, pigments and 60% polyurethane. Backings are made with different fiber blends. More in the supplier mapping.

Piñatex® is a non-fiber material made of up to 95% of renewable resources including 72% Pineapple Leaf Fibers (PALF), 18% biobased PLA, 5% biobased PU, and 5% fossil-based PU. More in the supplier mapping.

Ultraleather® Volar Bio is a a blended multi-layer non-fiber material with 29% biobased content, composed of a polycarbonate and biobased surface made from corn and a backing consisting of 65% polyester and 35% rayon. More in the supplier mapping.

Vegea uses grape marc, the seeds and the stalks of the wine grape bunch, which are left over after winemaking, combined with polyurethane (PUD), resulting in a 70% biobased and 30% fossil-based manmade non-fiber material.

Bioengineered materials

Modern Meadow's Zoa™ is a bioengineered material based on the protein collagen produced through fermentation from yeast in a lab with the support of biotechnology. Modern Meadow is currently collaborating with selected brands to launch their first products in 2019.

Provenance is a bioengineered material based on collagen as building blocks.

Vitrolabs is a biotechnology company based in California using stem cell-based technologies to develop a manmade non-fiber material. More in the supplier mapping.

Further manmade non-fiber materials

Several further manmade non-fiber material types such as coated textiles and cork-based materials exist.

Photo : Ananas Anam Piñatex®

Sustainability Standards & Traceability

Sustainability standards

Standards that can be used for multiple fiber types

The importance of sustainability standards and chain-of-custody systems is increasing.

While the previous chapters in this report provide an overview of the most important fiber-specific standards such as cotton, wool, and down standards, this section includes standards that can be used for multiple fiber types.

As leading standards for organic textiles, the Organic Content Standard (OCS) and Global Organic Textile Standard (GOTS) both further expanded their market.

Organic Content Standard (OCS)

The Organic Content Standard (OCS) is an international, voluntary standard that sets requirements for third-party certification of certified organic input and chain of custody. The goal of the OCS is to increase organic agriculture production.

Textile Exchange launched the **OCS** 3.1 in July 2020. Updates include updated manuals, more robust traceability between farm and first processor, GMO testing requirements, and non-mulesing for organic wool. More information here.

The number of OCS-certified sites increased from 8,680 in 2020 to 11,885 in 2021.

Global Organic Textile Standard (GOTS)

GOTS is the worldwide leading textile processing standard for organic fibers, including ecological and social criteria, backed up by independent certification of the entire textile supply chain.

The GOTS version 6.0 was released in March 2020. The revised version includes updates related to GMO testing, living wages, and environmental criteria, among others. The release of the GOTS version 7.0 is scheduled for March 2023. Read more information here.

The number of GOTS-certified sites increased from 10,388 in 2020 to 12,340 in 2021, covering more than 4 million workers.

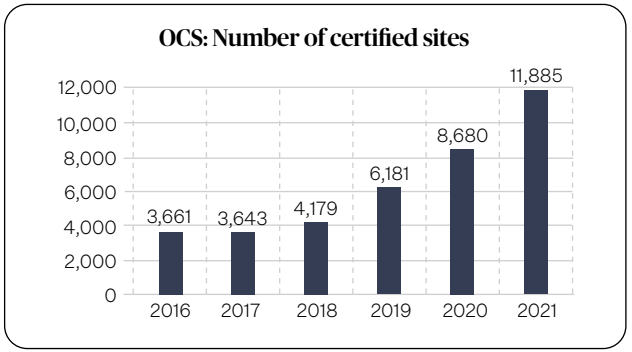
Content Claim Standard (CCS)

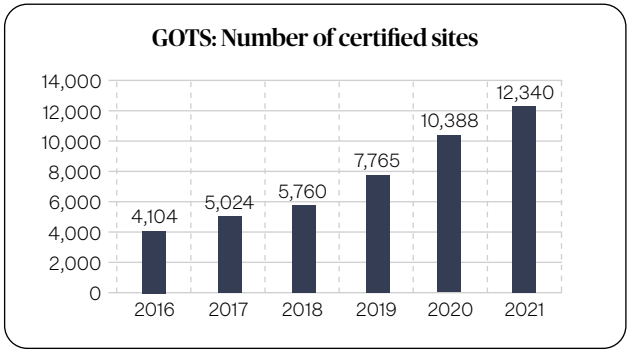
The Content Claim Standard (CCS) is the foundation of all Textile Exchange standards. It's a chain of custody standard that provides companies with a tool to verify that one or more specific input materials are in a final product.

The CCS 3.1 was released in June 2022 and includes an updated certification eligibility section. More information here.

Its use as a foundational standard for the other Textile Exchange Standards (GRS, OCS, RCS, RDS, RWS) increased significantly from 29,639 sites in 2020 to 48,755 sites in 2021.

The number of CCS-certified sites—with the CCS used as a standalone standard beyond the Textile Exchange's portfolio of standards—increased from 60 in 2020 to 113 in 2021.





Sustainability standards

Standards that can be used for multiple fiber types

The two leading standards for textiles made with recycled materials—the Recycled Claim Standard (RCS) and the Global Recycled Standard (GRS)—are growing particularly fast.

Recycled Claim Standard (RCS)

The Recycled Claim Standard (RCS) is an international, voluntary standard that sets requirements for third-party certification of recycled input and chain of custody. The goal of the standard is to increase the use of recycled materials.

The RCS 2.0 has been in effect since July 2018. A key update was the introduction of the Reclaimed Materials Supplier Agreement, a document that provides more visibility into the suppliers of reclaimed materials. In April 2021, Textile Exchange began another revision of the RCS. The revision process of the RCS will be rolled into the development of the unified standard. Read more here.

The number of RCS certified sites increased from 4,383 in 2020 to 8,004 in 2021.

Global Recycled Standard (GRS)

The GRS—going beyond the RCS—includes additional criteria for social and environmental processing requirements and chemical restrictions.

The GRS 4.0 was released in parallel to the updated RCS version and has been in effect since July 2018. A key change was the adoption of ZDHC's Manufacturing Restricted Substance List v1.1 (MRSL) that replaced GRS's previous Prohibited Substance List.

In April 2021, Textile Exchange began another revision of the GRS. The revision process of the GRS will be rolled into the development of the unified standard. Read more here.

The number of GRS certified sites increased significantly from 14,367 in 2020 to 25,763 in 2021.

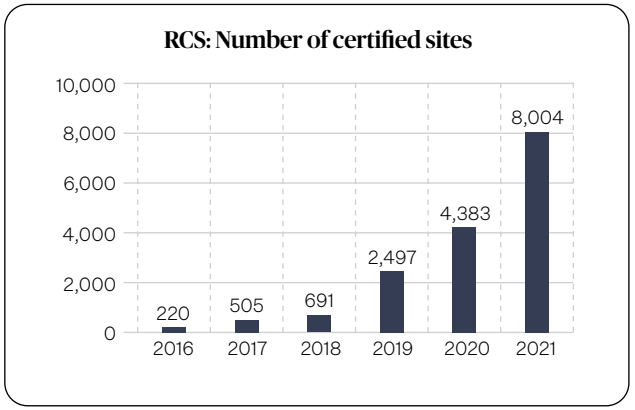
Towards a unified standard

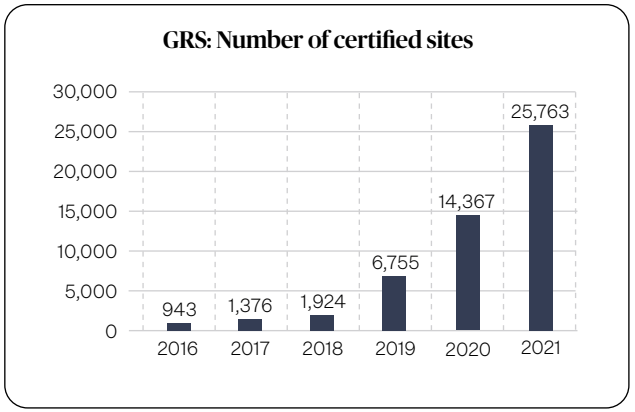
In July 2021, Textile Exchange began a comprehensive revision of its standards framework with the intent to embed its Climate+ strategy into a more unified standard system across its eight standards. "Unified standard" is being used as a placeholder to refer to the development of the new standard system. A concurrent process is underway to establish a name for our future standard(s). Textile Exchange is anticipating publication of the new standard system in Quarter 4 of 2023 (subject to change). To learn more about the unified standard progress, read more here.

Cradle to Cradle (C2C)

Cradle to Cradle Certified® is a globally recognized measure of safer, more sustainable products made for the circular economy.

The Cradle to Cradle Certified® Standard Version 4.0, released in March 2021, features new and enhanced requirements in all performance categories, including: new frameworks for Product Circularity and Social Fairness that define global best practices. More rigorous requirements in Clean Air & Climate Protection that promote urgent action to address climate change. Expanded requirements in Water & Soil Stewardship to ensure clean water and healthy soils are available to people and all other organisms. Improved alignment of Material Health requirements with leading chemical regulations and other standards, including a new Restricted Substances List.





Traceability and transparency

Brands and retailers are increasingly being held accountable for what happens throughout the value chain. The ability to map the materials value chain is not only critical for due diligence but core to tracking progress towards Textile Exchange Climate+ strategic direction and the Sustainable Development Goals. While the majority of the top 100 apparel brands have sustainable material targets in place, according to a 2019 UNECE study, only about 34% of companies track and trace their value chains, of which half have visibility only up to their immediate suppliers.

Textile Exchange Trackit is our response to this call to action—a formative program for improved integrity, traceability, and efficiency of sustainable material provenance.

The role of sustainability standards in traceability

Standards provide the industry with a way to verify sustainability claims of a product. In general, there are three levels of verification:

- Site level
- Transaction level
- Physical material level

Credible traceability requires the interplay of verification at site, transaction, and physical material levels. What is traced, how it is traced, and the assurance levels very much depend on the chain of custody and requirements of the standard.

Introducing Textile Exchange Trackit

Textile Exchange standards cover third-party certification at site and transaction level. As different certification bodies operate in different regions, traceability is disaggregated across certification bodies which makes value chain mapping a challenge. The Textile Exchange Trackit program is being developed to address these challenges and support the traceability needs for Textile Exchange standards. The Trackit program offers two traceability paths:

- Digital Trackit "dTrackit" forms the traceability baseline for the existing certification process of all Textile Exchange standards. Traceability in dTrackit is achieved by centralizing and connecting scope and transaction certification data stored by certification bodies.
- Electronic Trackit "eTrackit" is an alternative for companies wanting more granular traceability using innovative technologies. It takes the traceability of Textile Exchange standards one step further by tracking the volume of certified material of each product (rather than the entire transaction) entirely online via tokens (think eBanking). Traceability is achieved by tracking these tokens at an article level in a central platform which certification bodies access for verification and approval. Physical material verification may be integrated and reconciled with data along the chain for additional assurance

The MVP (Minimum Viable Product) development of dTrackit was completed in November 2021. Since then, Textile Exchange has been improving the system and ingesting, cleaning, and harmonizing data from its 30 approved certification bodies. Phase 1 of dTrackit is on course for release in January 2023 with the following features.

- **Find a certified company**: An up-to-date search engine for certified companies and its materials, processes and products.
- **Transaction authentication**: A capability to authenticate transaction certificates.
- **dTrackit brand portal**: A portal for certified brands to centrally access scope certificate, transaction certificate and traceability data.

In October 2021, Textile Exchange and TextileGenesis™ announced the RCS and GRS pilot of Textile Exchange's Electronic Trackit "eTrackit" program. The pilot was completed in July 2022 and improvements from the pilot feedback is now underway. Subject to final approval, eTrackit is planned for release in first half of 2023.

Traceability and transparency

The Textile Tracer Assessment

Fashion for Good, together with Textile Exchange, jointly released "The Textile Tracer Assessment", a detailed analysis for benchmarking physical tracer technologies relevant in the textile industry in July 2021. Read more here.

Textile Exchange Member Action

Applied DNA Science is a B2B technology providing innovative molecular business solutions under the CertainT Platform to enable brands and manufacturers to Tag-Test-Track their raw materials all the way to finished product. Applied DNA Science offer solutions for cotton, down & feather, leather, synthetic fibers, and many other materials.

AWARE™ by The Movement is a traceability technology that can be used for all kinds of materials that are verified by unique tracer particles and validated by secure blockchain. AWARE™ blockchain is powered by Circularise.

Haelixa is a DNA-based technology creating a unique and traceable fingerprint for different materials.

The Organic Cotton Accelerator (OCA) initiated the Textile Traceability Task Force (TTTF) to harmonize efforts and co-develop a traceability framework. One project of this task force was the TTTF landscape analysis that researched 40 companies, 49 technologies and 26 pilots and initiatives—including technologies such as blockchain, microbiome, isotope, DNA markers, and fluorescent tracers.

Oritain offers an isotope technology to trace products back to their true origin.

The Waste2Wear® blockchain system provides indisputable evidence that Waste2Wear® Fabrics are really made of plastic waste. The blockchain records the journey of the plastic waste bottles, step-by-step, to become a finished textile product and allows customers to track each step in the value chain of the fabrics that they ordered.

Photo: FSO

Impact Incentives
Making impact happen

Textile Exchange has led the development of Impact Incentives, Impact Partnerships and is a founding member of the Impact Alliance.

Impact Incentives are a market mechanism for brands to deliver their expectations back to the start of the supply chain and provide financial rewards to encourage improved practices.

The way they work is quite simple: farms that have been verified to meet a set of sustainability requirements will be able to sell Impact Incentives proportional to their production of raw material. Brands can purchase Impact Incentives to reward farmers for improved practices and help build the supply of preferred materials.

The farms selling the Incentives may or may not be in the supply chain of the brands. While this means that brands can't make any content claims on their products, they can bypass the cost and complexity of long or opaque supply chains to deliver impact quickly and efficiently. Brands can still make claims about their support for improved practices and tell credible stories based on the data collected from the farms.

The Impact Partnership is an option to help brands work with on-the-ground Partner Programs to support farmers to meet the Impact Incentives requirements within three years.

The Partner Programs support the farmers through training, infrastructure investments, verification and data collection, while providing stories, data, and credibility back to the brands. This model allows brands to share the risk and cost of improving practices to meet a standard that is normally carried by farmers alone.

In 2021, the Impact Incentives were piloted for leather. In 2022, the piloting will continue for leather and Textile Exchange is extending the model to cotton and cashmere.

For more information, visit www.impactincentives.org and textileexchange.org/impact-incentives.

> Impact Incentives are a powerful tool to address the complexity of supply chains and connect brands with farmers to share the risks and costs of improved practices. They provide a fast and efficient means to build up a more sustainable supply and drive the speed and scale of impact that is needed to address the world's challenges.

– **Anne Gillespie**, Director of impact Acceleration, Textile Exchange

Photo: Produzindo Certo

Textile Exchange programs

Corporate Fiber & Materials Benchmark

Textile Exchange's Corporate Fiber & Materials Benchmark (CFMB) program enables participating companies to measure, manage, and integrate a preferred fiber and materials strategy into their business. By participating in the corporate benchmark, companies demonstrate a commitment to transparency and continuous improvement around their materials sourcing strategy.

Textile Exchange's ambition is to be the driving force for urgent climate action on textile fiber and materials. By benchmarking the industry and providing actionable tools for improvement, we are pushing a race to the top. Read more here.

Preferred Fiber and Materis Matrix

Textile Exchange created the Preferred Fiber and Material (PFM) Matrix to help everyone from brands to suppliers and consumers to compare the impacts of different fibers, materials, certifications, and initiatives according to the material type. Its categories include cotton, synthetics, flax (baste fibers), manmade cellulosic fibers (MMCFs), and wool (animal fibers).

The PFM Matrix exists to enable more responsible sourcing decisions backed by guidance from a trusted, centralized data source. It builds upon—instead of being limited to—Life Cycle Assessment (LCA) data, using program documentation, quantitative and qualitative research studies, and data quality considerations. In this way, it enables brands to consider a more holistic set of impacts. Read more here.

Global Fiber Impact Explorer

The Global Fibre Impact Explorer (GFIE) tool is a web-based environmental data platform enabling companies to assess the risk associated with their raw materials sourcing regions. The platform brings together hundreds of relevant national and regional data sets into an algorithm that provides risk assessment and recommendations for addressing key hotspots.

The first version of the GFIE was gifted to Textile Exchange in 2021 by Google and development of the tool is ongoing. Read more here.

Round Tables

Textile Exchange's round tables are designed to enable entities all along the textile supply chain, from farmers to brands, to work collectively towards its Climate+ goals by sharing learning opportunities, tools, relevant data, reports, and more. They brings together stakeholders from across the industry through online meetings, webinars, and at the annual Textile Exchange Conference.

The organization's mission is to mobilize action by establishing a shared understanding of core material sustainability issues, creating alignment on goals and actions, boosting commitment from brands, and measuring progress. Read more here.

Photo: Gallant International

Supplier Mapping

Supplier mapping

Textile Exchange annually invites suppliers to submit information for the Preferred Fiber and Materials Market Report. A summary of the submissions is included here in our public report.

The full supplier mapping benefits Textile Exchange Supporter and Partner level members and includes 131 snapshots of innovative fibers and materials across various material categories shared by 108 suppliers with us between 2019 and 2021. The most recent submission year is indicated in brackets after each product name.

The supplier mapping includes the information submitted by the suppliers and has not been verified by Textile Exchange. The submission is voluntary and the supplier mapping is limited to those submissions. The 2021 supplier mapping focuses on the fiber categories listed on the next pages.

Photo: NextEvo

Supplier mapping

Synthetics

Recycled Polyester (download)

- ADVANSA: Suprelle® + ADVA® (2022)
- Aero Fibre (2021)
- AGL: Polyfil (2019)
- Alliance Fibres: Greenfil (2022)
- **BlockTexx**: S.O.F.T. rPET Pellets (2021)
- Carbios (2021)
- Cixi Xingke (2019)
- De Martini Bayart & Textifibra Spa: non-branded (2021)
- **DePoly** (2022)
- EcoBlue: 3D-Pure rPET chips (2022)
- **Far Eastern:** FENC® TOPGREEN® (2022)
- First Mile (2019)
- Gatron: Ecoron (2022)
- **IMBOTEX**: CLIMALIGHT (2021)
- **Itochu:** Renu™ (2022)
- JB Ecotex: non-branded (2022)
- Jeplan: Bring Material™ (2020)
- **Nan-Ya Plastics**: Saya (2020)
- Neelam Fibers (2020)
- Pashupati (2020)
- Pinnacle (2022)
- **Plastics for Change** (2022)
- Polygenta: perPETual (2021)
- Radici: Repetable® (2021)
- Reliance: RElan™ Green Gold (2020)
- **REO-ECO** (2022)
- SEAQUAL: SEAQUAL® (2022)
- Shinkong: RecoTex (2022)
- **Sulochana:** ECOESPIN, formerly Polycycle (2022)
- Thai Polyester: EcoTPC™ (2020)
- **The LYCRA Company**: LYCRA® T400® EcoMade (2021)
- **The LYCRA Company**: THERMOLITE® EcoMade (2021)
- **The LYCRA Company**: COOLMAX® EcoMade (2021)
- **The Movement:** Polylana® (2021)
- **Unifi:** REPREVE® (2020)
- **Worn Again Technologies** (2021)
- **Zhejiang Haili:** Reboyarn (2020)

Recycled Polyamide (download)

- **Aquafil S.p.A.**: ECONYL® (2022)
- De Martini Bayart & Textifibra Spa: Non-branded (2019, 2021)
- Far Eastern: FEFC® eco (2022)
- Fulgar-Q-Nova (2022)
- Nilit (2019)
- Nurel: Reco Nylon (2022)
- Radici: Renycle® (2022)
- Taekwang Industrial: Acepora-Eco® (2021)

Other Recycled Synthetics (download)

- **Aksa:** Acrycycl® recycled acrylic (2020)
- **Asahi Kasei Corporation**: ROICA™ EF (2021)
- Hebei Acrylic Fibre: RCA (2022)
- Radici: Respunsible® (2021)
- **Thai Acrylic**: Regel (2022)
- **The LYCRA Company:** EcoMade recycled elastane (2020)

Biosynthetics (download)

- ADVANSA: ADVA® PLA (2021)
- Arkema: Rilsan® polyamide 11 (2021)
- **Covation Biomaterials** (formerly DuPont): Sorona® PTT (2021)
- **Covation Biomaterials** (formerly DuPont): Susterra® PDO (2021)
- Ecopel: KOBA® (2020)
- **Far Eastern**: FENC® TOPGREEN® (2019)
- Genomatica: Biobased Nylon 6 (2020)
- HELM AG: QIRA (2021)
- **Kintra Fibers**: Biobased PBS (2021)
- **NOOSA**: NOOSA® (2022)
- **OceanSafe AG**: naNea (2022)
- Radici: Biofeel® PET (2021)
- Radici: Biofeel® PA (2021)
- Radici: Biofeel® PLA (2021)
- Radici: dorix® 6.10 (2021)
- Radici: Radipol® DC (2021)
- Radici: Radipol® PX (2021)
- **The LYCRA Company**: Lycra® 162 R (2020)
- **Virent**: BioForm Paraxylene + Benzene (2019)

= Textile Exchange Members

Supplier mapping

Natural Fibers (plant- and animal-based)

Recycled Natural Fibers (download)

- Allied Feather and Down: RENU (2022)
- **Circular Systems**: Orbital™ (2019)
- **Circular Systems**: Texloop™ (2019)
- **Datini Fibres**: Recycled wool (2022)
- **Geetanjali Woollens** (2020)
- **Giotex**: Rcot (2020)
- **Recover Textile Systems**: Recover™ (2022)
- **Re:Down**: Re:Down (2022)
- **Säntis**: RCO100 (2022)
- **Takihyo**: NO WASTE Project (2021)
- **Taishoboseki Industries**: Raffy (2021)
- **Usha Yarns** (2022)
- **Weturn** (2022)

Virgin Natural Fibers (download)

- **AltMat**: Alt (2021)
- **Bear Fiber** (2021)
- **Circular Systems**: Agraloop™ (2019)
- Flocus™ (2022)
- **Himalayan Wild Fibers**: Himalaya™ (2022)
- **Nextevo™** Pineapple Leaf Fibers (2022)
- **Spinnova** (2022)
- **Tung Ga Group**: REECO (2022)

Manmade cellulosics

Recycled Manmade Cellulosics (download)*

- **Aalto University**: Ioncell® (2020)
- **Asahi Kasei**: Bemberg™ (2022)
- **Asia Pacific Rayon** (2022)
- **Birla Cellulose**: Liva Reviva (2022)
- **Eastman**: Naia™ Renew (2022)
- **Evrnu**: NuCycl™ (2020)
- **GP Cellulose**: Cotton Linter Pulp (2022)
- **Infinited Fiber Company**: Infinna™ (2021)
- Jilin Chemical Fibre: ECOJILIN (2022)
- Jilin Chemical Fibre: White Mountain (2022)
- **Lenzing**: TENCEL™ Lyocell with Refibra™ technology (2021)
- **Orange Fiber** (2021)
- **Renewcell**: Circulose® (2022)
- **Sateri**: FINEX™ (2022)
- SaXcell (2021)
- **Södra**: OnceMore® (2021)

Virgin Manmade Cellulosics (download)

- Includes lists of FSC- and PEFC-certified suppliers and a link to The CanopyStyle Hot Button Report.
- Algiknit (alternative virgin feedstock) (2020)
- Metsä: Kuura (2022)

Other

Fiber Blend Recycling (download)

- **BlockTexx**: S.O.F.T. (2022)
- **Circ** ex. Tyton Biosciences (2021)
- **Circular Systems**: Orbital™ (2019)
- **Circular Systems**: Texloop™ (2019)
- **Recover Textile Systems**: Recover™ (2022)
- **Infinited Fiber** (2020)
- PHOENXT (2021)
- **Södra**: OnceMore® (2022)
- **Worn Again Technologies** (2021)

Manmade Non-fiber Materials (download)

- **Adriano Di Marti**: Desserto (2020)
- **Ananas Anam**: Piñatex (2022)
- **Bolt Threads**: Mylo™ (2022)
- China Green Plastic: Blue RenTec (2020)
- Ecopel: KOBA® (2020)
- Malai (2022)
- **Natural Fiber Welding**: MIRUM™ (2021)
- Sustainable Composites: enspire leather® (2020)
- Ultrafabrics: Ultraleather® | Volar Bio (2021)
- VitroLabs: Calf Leather (2020)

Manmade Protein Fibers (download)

- **Spiber**: Brewed Protein™ (2021)

CO_2-based Fibers (download)

- Fairbrics (2022)

= Textile Exchange Members

Methodology & Disclaimer

Methodology

Scope of the report: Global total and "preferred" fiber and materials market

The Preferred Fiber and Materials Market Report covers the market for the key fibers and materials, including the conventional ones and examples of "preferred" options. Textile Exchange historically defined a preferred fiber or material as "one which results in improved environmental and/or social sustainability outcomes and impacts compared to conventional production."

But as the window to protect the 1.5°C pathway narrows, we've got to keep raising the bar. So, Textile Exchange is revisiting the definition to identify key indicators across climate, nature, animals, people, and governance that not only focus on reducing negative impacts but drive forward measurable beneficial outcomes ones too.

In September 2022, Textile Exchange proposed the following updated definition: "A raw fiber or material that delivers ongoing beneficial outcomes and impacts for climate, nature, and people through a holistic approach to transforming raw fiber and material production systems." The development of detailed assessment criteria is scheduled for 2023. While the updated definition may be aspirational today, the direction of travel for materials to be considered "preferred" should be in-line with its underlying principles. The definition will continue to evolve in line with the best available climate science and modeling.

Textile Exchange acknowledges that there are a variety of different approaches and that the continuum evolves over time. The report provides examples of programs, initiatives, and products working towards these goals.

Textile Exchange has not assessed the degree of sustainability of each individual program, initiative, or product mentioned in this report. It rather aims to provide an overview of potential solutions. The Preferred Fiber and Materials Matrix will assess a select group of programs.

Key information shared in the report

The Preferred Fiber and Materials Market Report contains 1) global production volumes of various fibers and materials, 2) standard specific data such as the number of certified sites or production volumes per standard, and 3) a variety of news, updates, stories, and quotes.

Textile Exchange has collected, analyzed, and compiled all this information in all good conscience and cross-checked the data and information wherever possible. A guarantee for all the information is not given. This report is intended for general guidance and information purposes only. It is not the report's intention to be used or considered as advice or recommendation in any direction.

1. Global production volumes*

The compilation of global market data is challenging. The collection of primary data from the suppliers is beyond what is possible within the scope of this report, so we rely on secondary data from industry associations, international organizations, governmental organizations, standard setters, and research institutes. We are trying our best to provide an accurate and reliable picture of the market, but data gaps and inconsistencies are very common for global market data and modelling has to be applied for some data. Specific data sources are directly mentioned on the pages.

a) Data quality checks and triangulation

Textile Exchange tried to identify the most reliable sources for each fiber category and conducted triangulations with at least 2 to 3 sources wherever possible. In general, all global market data are rounded estimates.

b) Production volume scope

The production data in this report cover the total amount of fibers produced. The report does not differentiate between different usages and is thus not specific to the apparel industry. The fibers may be used for apparel, home textiles, technical textiles, or any other application.

Minority fibers such as PLA, PTT, protein fibers are not included.

c) Definition of fiber and materials

Fiber includes staple fiber and filament. All numbers reported on manmade cellulosics and synthetics include staple fiber and filament production volumes. Materials include fibers and non-fibrous materials such as leather and rubber.

d) Allocation of years

Textile Exchange reports data based on calendar year. Some data sources collect data on a seasonal basis. The cotton production volumes are collected in ICAC harvest years starting from August 1 and ending on July 31, and could thus be allocated to the calendar years in different ways. This report allocates the ICAC year which ends in a calendar year to the respective calendar year (e.g. 2020/21 cotton production volumes to the 2021 calendar year). ITWO applies the same approach for wool production data

Methodology

in several countries (e.g. 2020/21 wool production volumes are allocated to the 2021 calendar year).

e) Modelling

To close data gaps, modeling as well as assumptions and inference have been used (e.g. applying country average yields instead of program-specific yields).

f) Fiber specific methodology

Organic cotton data: For a detailed description of the methodology behind the organic cotton production volumes, please see our Organic Cotton Market Report.

Recycled cotton, wool, down: As ICAC's cotton data, IWTO's wool data, and Maia Research's down data refer to virgin production volumes, the recycled cotton, wool, and down production volumes were added on top. The total cotton, wool, and down production volumes is thus higher than the volumes reported by ICAC, IWTO, and Maia Research.

Recycled manmade fibers: The total synthetic fiber production volumes reported by Maia Research, CIRFS, IVC, in contrast, include the recycled share. Recycled manmade cellulosic fibers are also assumed to be included in the total manmade cellulosic fiber production as reported by Maia Research, CIRFS, and IVC.

2. Program specific data

The program specific data such as the number of certified sites per standard or production volumes are based on information collected from the programs and initiatives. In selected cases, the estimates are based on publicly available information (e.g. FSC/PEFC-certified MMCFs).

3. News and narratives

The news, updates, stories, quotes and narratives presented in the report are either based on information directly received from the companies and organizations or from their press releases or websites.

Methodological changes, data revision, and comparison to previous years

Textile Exchange continuously improves its data collection and analysis. Some data reported in previous years has been revised or updated since the actual data has become available for initial estimates, or the methodology has been improved. A simple comparison between previously reported numbers and data reported in this year does not show the actual change over time but is caused by these reasons. The latest data for the reporting period and previous years is always published in the latest report.

Key revisions from the 2021 to 2022 report

The following methodological changes were applied in the 2022 version:

- Abrapa was replaced with ABR for all years.
- Cleaner Cotton program was discontinued in March 2020 and thus excluded from 2020/21 onwards.
- CmiA total cotton data for 2013/14 and 2014/15 were updated.
- Field to Market continues to be used as a tool but the decision was made to discontinue measuring Field to Market separatly. The overwhelming majority of cotton using Field to Market's Fieldprint Platform to measure and analyze environmental performance on the field is also enrolled in the USCTP, as Field to Market enrollment is a condition of the USCTP. The cotton that is part of Field to Market but not part of the USCTP is not otherwise certified or verified.
- ICPSS was included for the first time as a new BCI equivalent program.
- QAI International was discontinued in 2021 and thus excluded.
- ROC production volumes for 2018/19 and 2019/20 were updated.
- Updated ICAC cotton statistics were applied, including revision of the data of a couple of previous years.
- Updated FAO statistics for other plant-based fibers, rubber, and leather were applied.
- Updated figures for the production volume of synthetics (including recycled polyester), MMCFs, and down were applied.
- The latest figures for the number of certified sites per standard were applied, including updates for previous years.

This means that the following data reported in the 2022 report slightly differ compared to previous versions:

- global fiber production volumes.
- preferred cotton production volumes.
- global plant-based fiber production volumes.
- global synthetics (incl. recycled polyester), MMCFs, and down production volumes.
- number of certified sites for several standards.

Report scope: Beyond apparel

Fiber and materials are used for a broad range of applications. This report covers the overall fiber and materials production independent of their usages. The fibers and materials may be used for apparel, home textiles, technical textiles, or any other application.

Textile Exchange has conducted a desk research and stakeholder consultation to estimate the percentages of the global fiber and materials volumes by application. While solid figures do not exist on a global level, the graphic on the right side is meant to visualize the rough average percentage estimates by application for the different fibers and materials. The main purpose of the graph is to show that the percentages used for apparel vary by fiber and material and that only parts of all fibers and materials produced and covered in this report are used by the apparel and home textile industry.

Please note that the percentages keep changing over time and that huge regional differences exist as well.

Cotton is mainly used for apparel accounting for around 60-70% of the total cotton fiber production. Around 20-30% of all cotton is used for home textiles, and about 10% for other products.

Wool is also mainly used for apparel accounting for around 60-70% of the total sheep wool. Approximately 30-40% of all sheep wool is used for home textiles and the remaining part for other applications.

Other animal fibers such as cashmere, mohair, alpaca, and silk are predominantly used for apparel.

Around 60-80% of **down and feathers** are used for home textiles such as bedding and pillows. A smaller percentage is used for apparel.

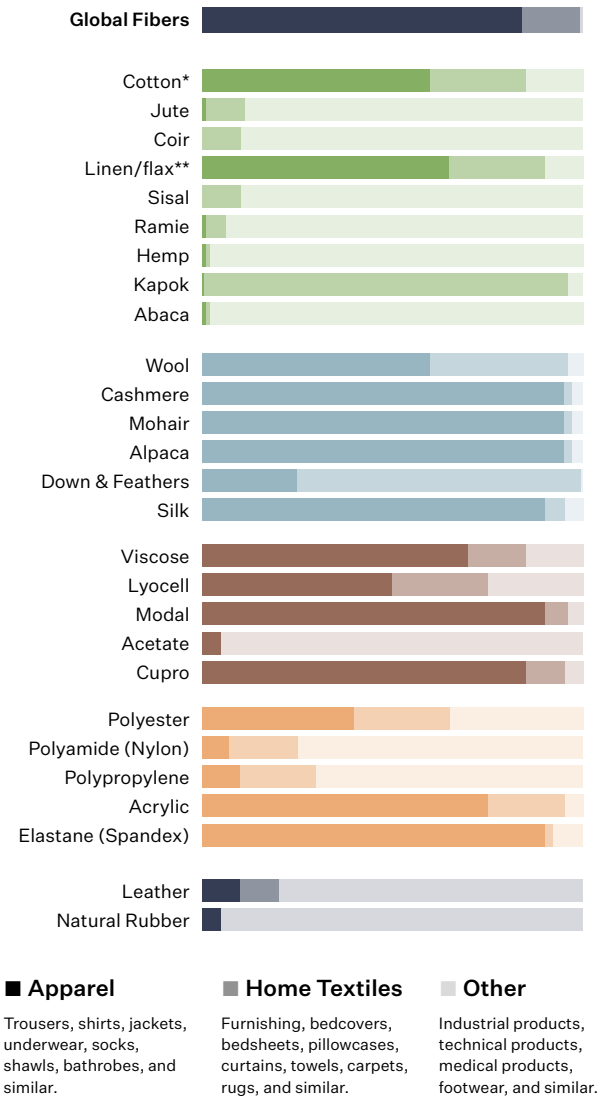
Around 30-60% of **polyester** fibers are used for apparel, 20-35% are used for home textiles, and the remaining part for various other applications.

Polyamide fibers are used in various applications. The percentage estimates range widely from less than 10% to more than 50% of the global polyamide fiber production being used for apparel. A significant share of polyamide fibers is used for home textiles such as carpets as well as technical and industrial applications.

Manmade cellulosics such as viscose, lyocell, modal, and cupro are mainly used for apparel with around 50-80% of their production. An exception is acetate fibers, used primarily for cigarette filters, and only a small percentage (about 5%) is used for apparel.

Leather is mainly used for footwear with around 40-50% of its production. Around 5-10% are used for apparel, 10-15% for home textiles, and the remaining part for other applications such as leather goods (bags), the automotive industry or other products.

Natural rubber is mainly used for tires with around 65-70% of its production. Only a small percentage is used for apparel.



Acknowledgements

Acknowledgements

We would like to extend our sincere gratitude to all that have contributed data and expertise for their continued and valuable cooperation, as well as to those who provided stories and photos, which help to bring the report to life, particularly:

- Aalto University
- ABRAPA
- Accelerating Circularity
- Aditya Birla
- Adriano di Marti
- Advansa
- Aero Fiber
- AGL Polyfil
- Agronomes et Vétérinaires sans frontières
- Aksa
- Algiknit
- AltMat
- Applied DNA Sciences
- Arkema
- Asahi Kasei
- Asia Pacific Rayon
- AVSF
- BASF e3
- Better Cotton
- Bear Fiber
- Birla Cellulose
- BlockTexx
- Bolt Threads
- Carbios
- Circ
- Chargeurs Luxury Materials
- China Green Plastic
- Circular Systems
- CIRFS
- Cixi Xingke
- Cleaner Cotton
- CmiA
- Cotton Connect
- Covation Biomaterials
- CWF
- DBT Fibre
- DNFI
- Downpass
- Eastman
- EcoBlue
- Ecopel
- European Confederation of Linen and Hemp
- Evrnu
- Fabrikology
- FAO
- FARM
- Fashion For Good
- Fashion Positive
- Fairtrade International
- Far Eastern
- FibL
- Field to Market
- First Mile
- Flocus
- FSC
- Fuhrmann
- Fulgar
- Gatron
- GCS
- Geentanjali Woollens
- Genomatica
- Giotex
- GOTS
- GP Cellulose
- Green Gold
- HELM
- Hilaturas Ferre
- Himalayan Wild Fibers
- ICAC
- IMBOTEX
- Infinited Fiber Company
- Interplume
- inserco
- ISCC
- Itochu
- IVC
- IWTO
- JB Ecotex
- Jeplan
- Jilin Chemical Fiber
- Kintra Fibers
- Leather Working Group
- Leit & Held
- Lenzing
- Lycra
- Maia Research
- Mohair South Africa
- myBMP
- Nan Ya Plastics
- Natural Fiber Welding
- Neelam Fibers
- New Zealand Merino Company
- Nilit
- Nova Institute
- Nurel
- NSF
- Orange Fiber
- Pashupati
- PHOENXT
- Pinnacle
- PEFC
- Plastics for Change
- Polygenta
- Radici Group
- Recover
- Re:down
- REEL
- ROC
- Reliance Industries
- Renewcell
- RN
- Sappi
- Sateri
- Säntis
- SFA
- SFI
- Shaniko Wool Company
- Shinkong
- Spiber
- Spinnova
- Sulochana Cotton Spinning Mills
- Sustainable Composites
- Sustainable Down Source
- Sustainable Fibre Alliance
- SaXcell
- Södra
- Taekwang Industrial
- Taishoboeski Industries
- Takihyo
- Thai Polyester
- Transitional Cotton
- The Movement
- Thread
- Ultrafabrics
- USCTP
- UNFCCC
- Unifi
- Vitrolabs
- Virent
- WCS
- Wildlife Friendly Enterprise Network
- Worn Again
- Xingke
- ZDHC
- Zheijang Haili Environmental Technology

Acknowledgements

Core team

- Sophia Opperskalski
- Amy Franz
- Andrea Patanè
- SuetYin Siew
- Evonne Tan

With support from:

- Lisa Barsley
- Hanna Denes
- Rui Fontoura
- Anne Gillespie
- Amish Gosai
- Anna Heaton
- Nicholas Johnson
- Nicole Lambert
- Sandra Marquardt
- Siobhan Momberg
- Megan Stoneburner

References and feedback

A significantly growing number of organizations and publications are referring to our Preferred Fiber and Materials Market Report. We want to start tracking the references to our report and hear your feedback. Please share your feedback and inform us about references to our report.

Photo: SFI