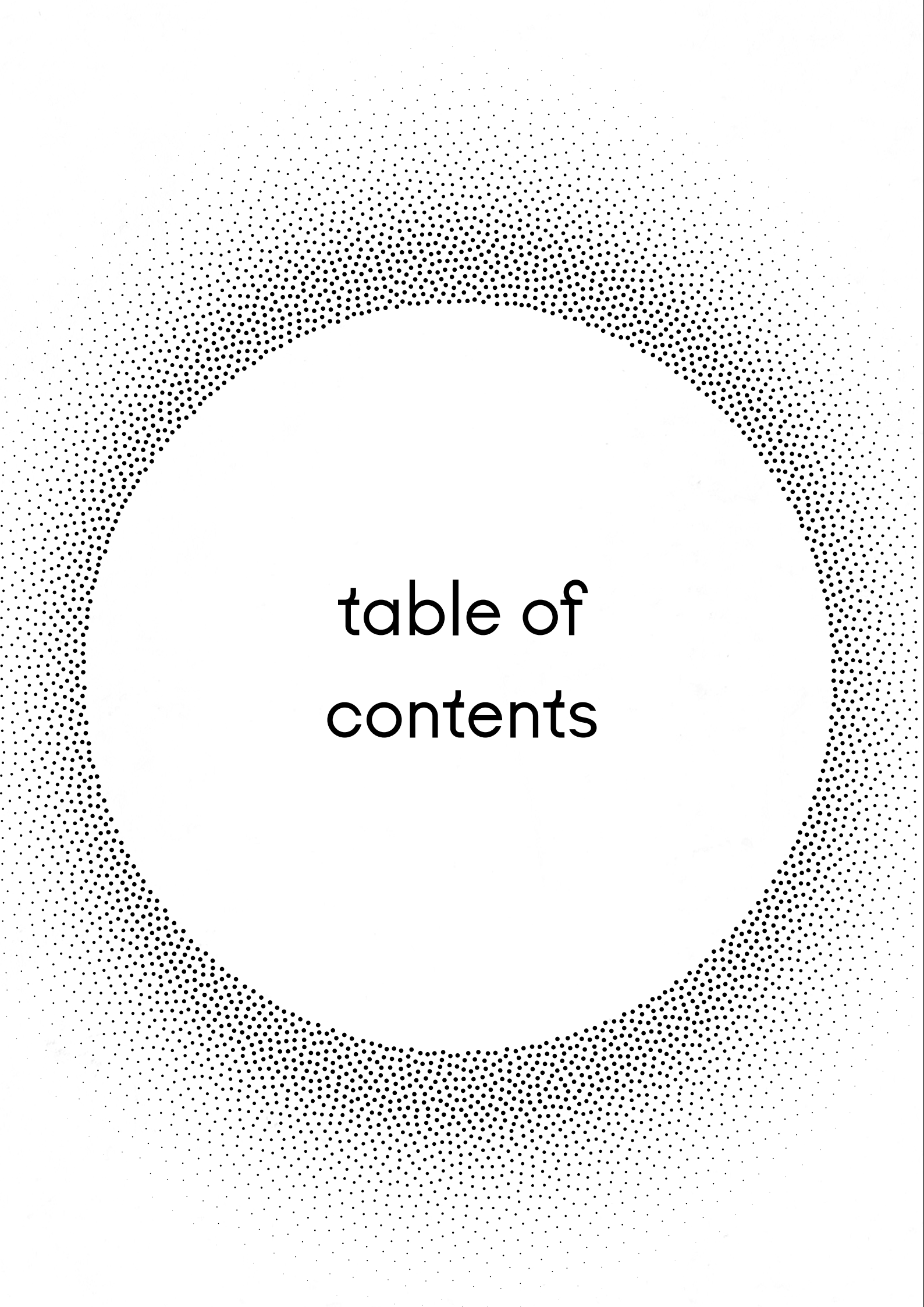


# SUPPLY CHAIN<sup>\*</sup> 101

by **SIMPLY  
SUZETTE**



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# introduction

# hello! and welcome to fashion supply chain

## 101

If you've engaged with our Denim Supply Chain 101, you're already acquainted with the journey a pair of jeans undertakes, detailing each phase it traverses before reaching store shelves, and its post-retail life.

This initiative expands upon DSC101, targeting a broader spectrum of fashion items. We initiate with the foundational principles of sustainability, pivotal throughout this guide, then progress through the supply chain stages—beginning at the source. We elaborate on a wide range of materials, and how these are transformed into fabrics, garments, sold products, and waste.

Our objective is to demystify supply chain mechanics, emphasizing the best practices at every production phase. We believe that if there was more knowledge on fashion supply chains, consumers, designers, and all those who come across fashion in their lives would have the tools to make more sustainable choices.

**Feel free to skip directly to the part that interests you the most, and let us know if this was useful for your work, studies, or curiosity.**

The fashion industry has found a way to use pretty much all materials and processes available, and it comes up with constant innovation, so it is pretty much impossible to cover it all. We know that our page is non-exhaustive, but if you would like to suggest some additions, we are always updating it, and happy to learn what's new.

We start by introducing some practices that are relevant across the entire supply chain and then dive into the specific steps that garments go through.



practices

# practice 1:

## social impact

people  
in supply chains

good practice

social  
procurement

An estimated 60 million workers power the global garment industry, generating its billions in profit. The majority work inhumane hours and multiple jobs to make ends meet. Roughly [80%](#) of these workers are women.

Since the Rana Plaza disaster in 2013 when more than 1000 people died in an accident in Bangladesh, because of the very poor working conditions, the world has started paying more attention to fashion workers' rights. Terrifying stories in supply chains, however, have not ended there, and you can read an overview in our article on the [Dark Side of Fashion](#).

Many of the processes in the making of garments can be dangerous to people's health because of big machinery and chemicals, which is why it is very important to protect them.

In the current set-up of the fashion industry, brands have extremely big supply chains, which makes it nearly impossible to know exactly what is going on in every factory. Systems of audits and certifications have been set up to ensure that factory employees receive a fair wage and work in a safe and healthy environment.

Another major issue beyond health and safety is around wages. The difference between a living wage and a minimum wage is that the former allows a worker's

family to have enough to pay for varied and nutritious food, afford water, housing that meets certain standards, education including that to achieve a better position, health care, transportation, clothing and some discretionary earnings, including savings for unexpected events, such as the death of a family member (..or a pandemic).

There is a lot more than just receiving a living wage. Unions allow workers to ask for what they need, this could be insurance, support for their children's education, better facilities in the factories, social security, and transport. There are companies that don't allow their employees to start a union and ask for rights, which shows that they do not value the well-being of their employees.

The concept of Diversity and Inclusion is also very important, and it looks at including in the workforce those who are discriminated against. Companies that hire thousands of people should ensure that they welcome women, people with disabilities, people from ethnic minorities and LGBTQ+.

Sustainability goes further than just within the factory. A company that hires a large proportion of a community should support it through CSR projects that can also benefit the company itself in the longer term.

people  
in supply chains

good practice

social  
procurement

### company policies

Companies should reduce the number of suppliers they work with, and ensure that they have long lasting relationships that allow both parties to invest in social impact.

Codes of conduct are written by brands and suppliers to ensure that their suppliers meet certain standards. There is a wide range of other policies that can be used to set standards, such as:

- + Occupational Health & Safety
- + Recruitment
- + Diversity & Inclusion
- + Anti Discrimination
- + Family Rights
- + Environmental & Biodiversity Protection
- + Animal Statement

### laws and government projects

Governments should take on the task to ensure that the supply chains of items produced and imported are human and respectful. There are many systems that can be put in place, that are slowly being implemented.

An example is the Fashioning Accountability and Building Real Institutional Change (FABRIC) Act (S.4213) was re-introduced in the US Senate by Senator Kirsten Gillibrand (D-NY) on September 13th, 2023. It is a federal bill that proposes both new workplace protections and major incentives to accelerate domestic apparel manufacturing that would cement the US as the global leader in responsible apparel production.

### ngo guidelines

There are wonderful NGOs and organisations out there that provide guidelines and standards, and campaigns that can be used as a reference by companies. Examples include Fashion Revolution, the Clean Clothes Campaign, Fair Trade, the Global Fashion Agenda, the Ellen Macarthur Foundation, and the list could go on for a lot longer.

An example of a guideline is that of the Fair Wear Foundation, which has developed [a set of recommendations](#) for brands to reduce sexual harassment in the garment industry, which include:

- + Set up accountability mechanisms to ensure adherence to legislation that addresses sexual harassment.
  - Leverage influence to make reduction of violence and sexual harassment a priority.
  - Ensure a safe reporting environment for sexual harassment complaints.
  - Ensure functional Internal Committees are operating at supplier factories.
- + Support targeted efforts to raise awareness of the Act and ensure its implementation to reduce sexual harassment.
  - Train factory management and supervisors to prevent and address violence in the workplace.
  - Ensure workers are aware of, and can enact, their rights in relation to sexual harassment.

people  
in supply chains

good practice

social  
procurement

*The concept of social procurement can be applied to the entire supply chain of fashion, which is why we have added it as the first step.*

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**Social procurement** is the act of buying from a social enterprise, and there is a wide range of ways in which it can be implemented in the world of Fashion. All offices can apply it for their indirect spend, as we have explained [here](#), but it can also be part of the supply chain, as we have analysed in detail [here](#).

**Social enterprises** are businesses that put the interests of people and the planet ahead of shareholder gain, and are driven by a social and/or environmental mission. Social enterprises commit to reinvesting most profits into achieving their objectives. This is a fundamental difference between social enterprises and traditional businesses, which are accountable to shareholders and as such are primarily driven by these interests.

It is entirely possible to source from social enterprises, therefore having a positive impact on people through purchasing, either business-to-business (B2B) or business-to-consumer (B2C). Rekut is an example of a social enterprise in the fashion industry, which we wrote in detail about [here](#).

Through social procurement, any company in the fashion supply chain can achieve positive social and climate impacts directly as part of daily business operations, rather than separately through charity or compliance programs. All it takes is to choose social businesses as suppliers for materials, services, and even office supplies.

# practice 2:

## traceability & transparency

what & why

best practices

This is a good place to stop and talk about these two hot topics that many often find confusing.

Many companies have a limited view of the network of business partners within their supply chain and do not get the full story behind their products. Getting this information and being able to know all the steps that a garment has gone through is called Traceability.

Most know their immediate suppliers, which are the factories that do the cutting, sewing and final quality control, but information about their suppliers, subcontractors, or component suppliers is easily lost. Therefore, all of the farmers, fabric mills, accessory suppliers, miners of the metals, oil refineries that produce plastic-based materials, etc., are lost too. Basically, all that will be explained from now is out of reach for most brands, and without this knowledge, it is extremely difficult for them to make a real impact through their environmental and social policies.

Traceability is the concept of looking at the supply chain and being able to accurately map all suppliers from the raw material extraction stage to its end use. It requires the collaboration of all industry partners, the deployment of common approaches and reliable technical solutions that are fit for different environments. The practice of subcontracting, which we have analyzed in depth with Kim Wan Der Weerd, certainly plays a key role in traceability.

Read more about it [here!](#)

Transparency means explaining clearly to consumers what impact the production of their garments have, which can range from disclosing production locations, CO2 values, certifications, progress towards targets, issues with accidents and human rights, etc. This allows consumers to make informed purchasing decisions, and help research entities and NGOs establish where the industry is at.

*Both transparency and traceability are now a priority for the garment industry to manage supply chains more effectively, however transparency and traceability individually are not enough.*

Even with transparency and traceability initiatives in place, there are many *manufacturers that rely on subcontracting to help them fulfil orders due to lack of technical machinery / specialised machinery or overcapacity. You can learn more about subcontracting [here](#). This information must be used to generate real change.*

what & why

best practice

We have physical tracers and blockchain traceability, and we have some companies who are combining the two. Physical marking allows for information on the supply chain to be written in the garment, and it can be done through chemical/physical marking. Blockchain traceability requires inputting information into the blockchain, which might sound a little riskier already (ie. who's to say someone isn't entering the wrong information!?).

Several of these solutions apply QR codes to clothing labels so that customers can learn about the provenance of their garments. These include the Lyfcycle (mobile app and web traceability platform), or brand initiatives, such as by Residus. They can include information on fibres, certifications, processes, location of production, and visibility on several aspects of the supply chain. QR codes are also useful tools for informing consumers of best practices in garment aftercare and end-of-life.

### Examples of traceability solutions are

+ **Oritain** works across the fashion, food and pharmaceutical industries, and it has managed to map out the majority of the world's cotton. Its mission is to help companies verify their sourcing claims with an 'origin fingerprint'. Unlike any other traceability program, Oritain doesn't need to add or rely on any tracers, which allows you to test a product at any stage of the manufacturing process without any change to production! Click [here](#) to view the conversation between Ani, Cone Denim and Oritain, and to read how the science used was originally used for murder investigations and is admissible in the court of law.

+ **FIBRETRACE**<sup>®</sup> embeds luminescent pigments on the fibre, right at the raw source or spinning mill. The pigment bonds and is indestructible throughout the entire textile processing cycle. The pigments can be read and tracked at every stage of the supply chain through the use of a handheld FIBRETRACE<sup>®</sup> hardware device which scans and reads the brand's individual signature created in the luminescent pigment. Each audit is recorded on the blockchain, and currently the technology is applicable today to cotton, responsible viscose and recycled polyester.

+ **EON**, another major company focusing on traceability using QR codes, was founded in 2015 with the mission to power industry's transition to a circular system of commerce. EON established the CircularID<sup>™</sup> Initiative in 2018, to develop a protocol that would unlock the communication and connectivity for this network. Through the initiative, EON led the development of the Circular Product Data Protocol - the global language for connected products. Today, EON works with global brands and retail's across the fashion industry to provide Digital ID technology and implementation.

+ **The TextileGenesis**<sup>™</sup> platform is an outcome of intensive "grass-root" discussions with the entire apparel supply chain; its technology combines blockchain with GS1 (a global traceability standard) for the apparel industry. Its platform allows digitization and traceability of any textile asset such as fibre, yarn, fabric, or garment through fibrecoins<sup>™</sup> (blockchain based digital-tokens, likened to fingerprints). fibrecoins stay intact no matter how many times the material is reused or recycled, and the information is stored using blockchain, which can't be altered or tampered with.

+ **Haeliexia** is another company combining physical tracers with blockchain technology. The markers are applied to the raw material or to semi-finished products at any production step, which creates a unique identity. At any point, the product can be submitted to a quick test to unravel its history and ultimately verify its integrity. The non-destructive test can be done with both the finished and the intermediate product.

+ **AppliedDNA Sciences'** CertainT<sup>®</sup> platform tags, tests and tracks raw materials such as cotton and lyocell through each stage of production. Materials are tagged with a unique molecular tag and products can later be tested using a portable device at the yarn, greige or finished product level.

+ **Tailorlux** is a solution provider for material integrity and detection, offering a total concept that gives your product an individual fingerprint. Uniquely, the tracer is permanent even when it's recycled and is currently working with Tejidos Royo to mark cotton seeds so they can be tracked from planting to beyond end of life.



We now go into the specifics of every step in the fashion supply chain:



supply chain

# step 1:

The range of materials used in fashion is extremely wide, and classified in a range of ways. Because we will be following the chronological steps in the supply chain, we are splitting this first section into two categories based on where it all begins:

our favourites of course :)

<b>Natural Materials</b> that come from fields or forests		<b>Synthetic Materials</b> that come from petrol extraction facilities	
Natural Fibres	Cotton		Petrol is used to make all types of synthetic materials, which include
	Hemp		
	Linen		
	Flax		
	Jute		
	Kapok		
Animal Derived	Fibres	Wool	
		Silk	
		Cashmere	
		Mohair	
	Leather		
Man Made Cellulosics Fibres	Tencel		
	Viscose		
	Rayon		
	Lyocell		
	Modal		
	Fibres made with recycled or upcycled cellulose-rich waste		
Next-gen Materials	A whole new area of materials that tend to use organic waste or lab grown materials, many of which are next-gen leather alternatives.		
	Polyester		
	Nylon		
	Elastane/Spandex		
	Lycra		
	Plastic Buttons		
	Zippers		
	Beads		

the grey area is exactly that, materials that blur the lines between natural and synthetic materials

# raw materials

Other materials such as *metals* or *wood* can be used for trims or specific decorative additions.

natural materials

man-made cellulosic fibres

synthetic materials

## Farming & Fibre Cultivation



The best thing about all natural fibres is that they can be farmed through **Regenerative and Organic Farming Techniques**, which means that they become **Climate Positive fibres** that restore soil health.

There are many methods for building resilient soils and we have our dedicated farmers to thank for that. Regenerative farming includes incorporating animals for grazing and natural fertilisers, building bio-diverse fields by planting trees, cover crops to conserve soil, rotating crops, inter-cropping, boosting soil fertility with fungal compost, and methods for no-till cotton, but it is important to remember that approaches to increasing soil health requires very context specific methods!

Supporting farmers through intermediaries like BCI or CMiA that understand the local contexts of the regions farmers are working in is the key to ensuring we are not pushing a top down approach to sustainability, but understanding generational and indigenous methods that have long prioritised a symbiotic relationship with nature.

By prioritising soil health, growing fibres can literally reverse the negative impacts of traditional fibre cultivation and help to protect biodiversity :)

## Certifications for Natural Fibers

+ RCS and GRS: *Recycled*

+ CLIMATE BENEFICIAL

+ REGEN ORGANIC (ROC): *Regenerative*

+ OCS and GOTS: *Organic*

+ *Fairtrade*



Let's dive into some of the most common (and our favourite) natural fibres used in fashion.

natural  
materials

man-made  
cellulosic fibres

synthetic  
materials

## Cotton

is a crop that requires specific conditions such as a long frost-free period, ample heat and sunshine, and fertile sandy soil. And since it's not a food crop, there are fewer regulations on the chemicals used during farming. But, there are many cotton projects out there that are prioritising soil health, as well as the communities and individual farmers who lead them.

It is pretty clear that the environmental sustainability of cotton production is directly linked to the amount of water and chemicals used in the farming process. But here are some numbers for you.

There is a range of data on cotton usage of pesticides: it covers 2.4-3% of the world's cultivated land, and it accounts for 4.41% of the global pesticide use on crops at 122,481 tonnes in 2020 (ICACs Cotton Data Book 2022). Regardless of the exact value, we can agree that the use of chemicals is high.

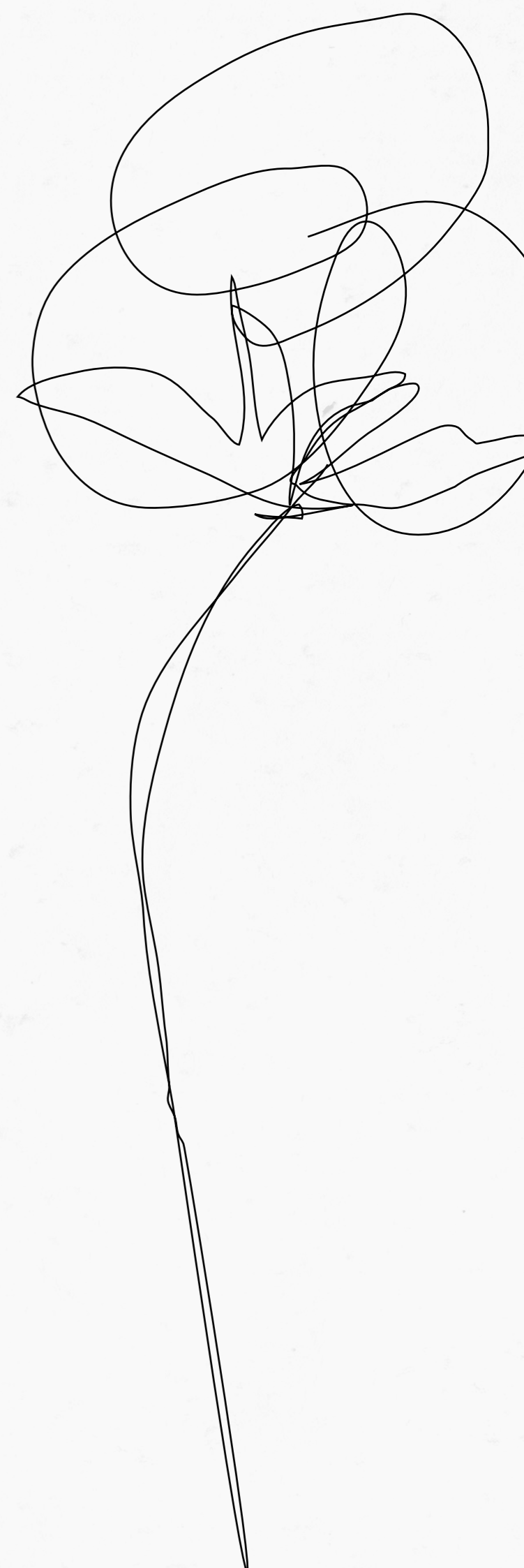
Cotton has become very industrialised and is known to be grown in monocultures (an area where only a single type of crop is produced) with heavy pesticide use. However, according to IDH around 99% of the world's cotton farmers across 70 countries are smallholder farmers, who produce 75% of the 25 million metric tons ([Transformers Foundation 2023 Cotton Report](#)) of global cotton production annually. Smallholders are farmers, mostly living in developing countries, that do not own large areas of land (often less than 2 hectares), rely on crop production for their livelihoods, and are very dependent on yields.

However, it's important to note that with proper management, cotton production does not have to be detrimental to the environment or the communities that grow it! There are many beautiful stories of farmers who choose to grow cotton in ways that respect the environment and provide a livelihood for their families. Learn more about these stories from the ground on [Cotton Diaries](#).

Apparel made of cotton has been the fibre of choice for hundreds of years due to its versatility, breathability, and durability. But, things changed in 1958 with the invention of Spandex, a stretchy version of polyester, allowing garments to expand and retract back to their original shape. The issue with all materials similar to spandex (lycra and elastane to name two) is that they are made of a synthetic polymer called polyurethane. Like all plastic-based materials, it is not renewable, as it comes from fossil fuels, and has a high environmental impact in terms of raw material extraction and chemicals used in processing. Learn more about the extraction process in our Fossil Fashion article [here](#).

Now most cotton items are mixed with other fibres for performance and aesthetic attributes.

With issues such as cotton's heavy pesticide use, soil degradation, and the negative impact of synthetic fibres on the environment, it can be confusing to know which fibres to choose. One solution is to opt for reclaimed materials, which are made from waste or by-products of other processes. Another option is to choose recycled fibres that are free of microplastics and fibres sourced from renewable sources or regenerative farming methods. Additionally, look for fibres that have the potential to be recycled or composted, this way you can ensure that they will not become waste after you are done using them.



natural  
materials

man-made  
cellulosic fibres

synthetic  
materials

+ **Regenerative Organic Certified™** is a newer certification that ensures that farms and products meet the highest standards in the world for soil health, animal welfare, and farmworker fairness.

+ **Good Earth Cotton** is climate positive cotton, meaning growing the cotton actually removes carbon from the air, and it is also 100% traceable with fibretrace technology. To learn more click [here](#).

+ **Organic Cotton** is grown with NO PESTICIDES and non-GMO seeds. But, currently, only 1% of the world's cotton that is grown is organic cotton and with the influx of organic cotton products out there... something doesn't add up! Be sure to aim for traceable supply chains to know what's going into your products. For an in-depth look at organic cotton click [here](#).

+ **Recycled Cotton** is an amazing way to use the enormous amounts of textile waste as a resource! We would love to see a world where it's possible to have 100% recycled and recyclable apparel in a closed loop system. When using recycled material, you can avoid all the sourcing and processing steps required to make virgin material from scratch, so the impact is drastically reduced as you can imagine! But, of course it depends on the waste product you start with, whether you have to wash it and dye it again, and what processing steps are required. When recycled mechanically, it has a lower processing impact and requires less specific technology than chemically recycled cotton, but this reduces the length of the fibre, which is a measure for its strength. So, it is currently only possible to include a percentage of recycled cotton in a new fabric.

*But! Never forget about **balance** :) The positive human impact farming fibres can bring should not be underestimated. More on that over at [Cotton Diaries](#).*

+ **BCI Cotton** stands for BETTER COTTON INITIATIVE. This program gives smaller farms guidelines on how to grow and harvest their crops in an environmentally friendly way through:

Using just the right amount of fertilizers

Using just the right amount of water for irrigation

Managing the planting such that water does not pool around the roots.

Controlling the use of pesticides.

+ **FAIRTRADE** cotton means that all farmers are guaranteed a living wage for what they grow and sell. Fair Trade also helps them to reduce their impact on the environment by reducing the use of chemicals and adapting to climate change patterns.

*Want to focus on the social impact of cotton? There are incredible farmer cooperatives and initiatives out there!*

**Seed2Shirt** is a vertically-integrated apparel manufacturer that works from the ground up — literally — for a transparent, diverse, and ethical supply chain created specifically to bring value back to the African diaspora communities they source from, via their Farmer Enrichment Program. This Program began with organic cotton farmers of Burkina Faso, who, in their transition to organic agriculture, were facing issues of soil nutrient depletion, less abundant yields, and less profit. Today, Seed2Shirt works with 8,400 organic cotton farmers (58% of which are women!) in 5-year partnership models, and with Black-owned production companies throughout the US — ensuring consideration of people and land throughout the *\*entire\** process.



natural materials

man-made cellulosic fibres

synthetic materials

**Hemp** is a wonderful natural textile fibre extracted from the homonymous herbaceous plant of the cannabis sativa species, a plant that blooms in areas with temperate climates. Hemp is known for its ability to capture carbon from the air and can also decontaminate polluted soils.

Textile hemp has been used in dozens of different sectors since the first civilizations that appeared in Asia, the Middle East and China. Hemp was used to make paper, ropes, cloths and sacks, automotive components, and of course clothing and home textiles.

The collection of fibres extracted from the hemp plant is considered to have a very high yield compared to other natural fibres (with the same hectares of cultivated land). It does not require pesticides, herbicides and fertilizers during its cultivation: it attracts few parasites; has a very high density per square meter; and reaches heights of up to 7 meters in a few months.

It can be blended with other fibres such as cotton, silk, and a variety of other natural fibres and materials to have a durable and strong 100% organic fabric. Some brands also like to use it as 100% content, whether in knits or woven materials. We hope that one day hemp can become the substitute to polyester to give strength to apparel and textiles, and allow us to increase the amount of recycled cotton our garments can contain. To explore how hemp is cottonized to make it less coarse, click [here](#).



natural  
materials

man-made  
cellulosic fibres

synthetic  
materials

**Linen** is a natural fibre extracted from the stem of the flax plant, a plant which grows without the need for fertilisers or pesticides. Flax fibres are known as bast fibres, indicating they are taken from the stems of plants and not their flowers, but a valuable use is available for 100% of the plant. Its processing is also extremely sustainable because it's entirely mechanical.

The finest linen must be macerated in slow-moving natural water sources, such as streams and rivers. Famous linen derives from maceration in Belgium, in the Lys river, where flax collected in France, Holland, and often also in South America, is sent. The Irish climate is also favourable for the processing of linen. Flax is grown most intensively in Russia and China, but we love the idea that the supply chain for linen could be entirely localised! There is an [association](#) dedicated to it.

Once woven, linen fibres are stronger, cooler against the skin and shinier than other textile fibres, but they wrinkle easily, often creating folds and marks on clothes. To avoid this effect, it is often mixed with other natural fibres like cotton.

The use of linen by man dates back to the year 8000 BC! Linen fabrics are therefore among the oldest in the world. Today, after 8 thousand years, many textile products are made of linen: aprons, bags, towels, napkins, bed linen, tablecloths, curtains, chair covers and clothing for men and women.

Linen gives an amazing feeling of freshness because it allows a greater flow of air on the body, being very breathable and hygroscopic. We immediately dream of fresh summer linen dresses and shirts.



natural  
materials

man-made  
cellulosic fibres

synthetic  
materials

**Kapok** is a natural textile fibre extracted from the gigantic *Ceiba pentandra* plant which grows in Indonesia and other tropical countries, and can reach up to 60 - 70 meters in height. It is considered a natural wonder, and the Maya have always respected the kapok as they believed that the souls of the dead, climbing this plant, would reach heaven.

Kapoks do not bloom every year, but when the tree does bloom, however, it is prolific, producing up to 4,000 fruits measuring up to 15cm. These pods open on the tree, exposing the pale kapok fibres to the wind for dispersal. The fibres, in which over 200 seeds are loosely embedded, are sometimes referred to as silk cotton and are lightweight, and lustrous. The seeds are separated from the fibre and may be processed to obtain oil for making soap, and the residue is used as fertiliser and cattle feed. Being a tree, it naturally uses a fraction of water compared to other seasonal fibres and requires no pesticides. Kapok fibre is also 100% biodegradable and 100% recyclable.

Kapok has been traditionally used as stuffing for pillows, mattresses, and upholstery, as insulation material, and as a substitute for absorbent cotton in surgery. **FLOCUS™** has developed a wider range of kapok products, including yarns and fabrics.





natural  
materials

man-made  
cellulosic fibres

synthetic  
materials

## silk

Demand for silk, a shiny, light, and beautiful material, played a key role in history, as it established the trade route through Asia, the Middle East, and Europe known as the Silk Road. For a long time, silk-making method was kept secret by the Chinese empire, to maintain power over its value, however by 550 CE two monks smuggled silkworm eggs in their walking canes, upon the orders of the Roman Emperor Justinian.

Silk is spun from the long threads which make up the inner cocoon of a silkworm. The fibres are in fact saliva, produced by the worm to insulate itself until it is time to transform. After being pulled from cocoons, raw silk threads are reeled together for commercial use. China remains the largest silk producer in the world, followed by India, Uzbekistan, Brazil, and Japan.

The sustainability of silk can vary based on how it's processed, and by how sericulture facilities are fuelled. Silk is also an inefficient material to produce, with 187kg of mulberry leaves required to be grown as feed for silkworms in order to make just 1kg of silk. So many leaves and so much land for them to grow on means that the mulberry leaf farm practices tied to silk matter a lot to the overall material impact. Boiling water and steam are used for production, which requires vast amounts of energy, therefore the source of this energy makes a big difference in the sustainability of the final product.

Naturally, after spinning their cocoon for days, the insects would then break out the top of their cocoons after their transformation is complete, but this breaks the kilometre or so of silk filament they produce. So, in the silk industry, silkworms are either steamed or boiled alive inside their cocoons. To make just one kilogram of silk, as many as 5,500 individual silkworms are killed. Exploring the ethics of using silkworms for fashion is complex. While a growing body of evidence suggests that insects have complex cognitive capacities, research in the space is still developing.



natural materials

man-made cellulosic fibres

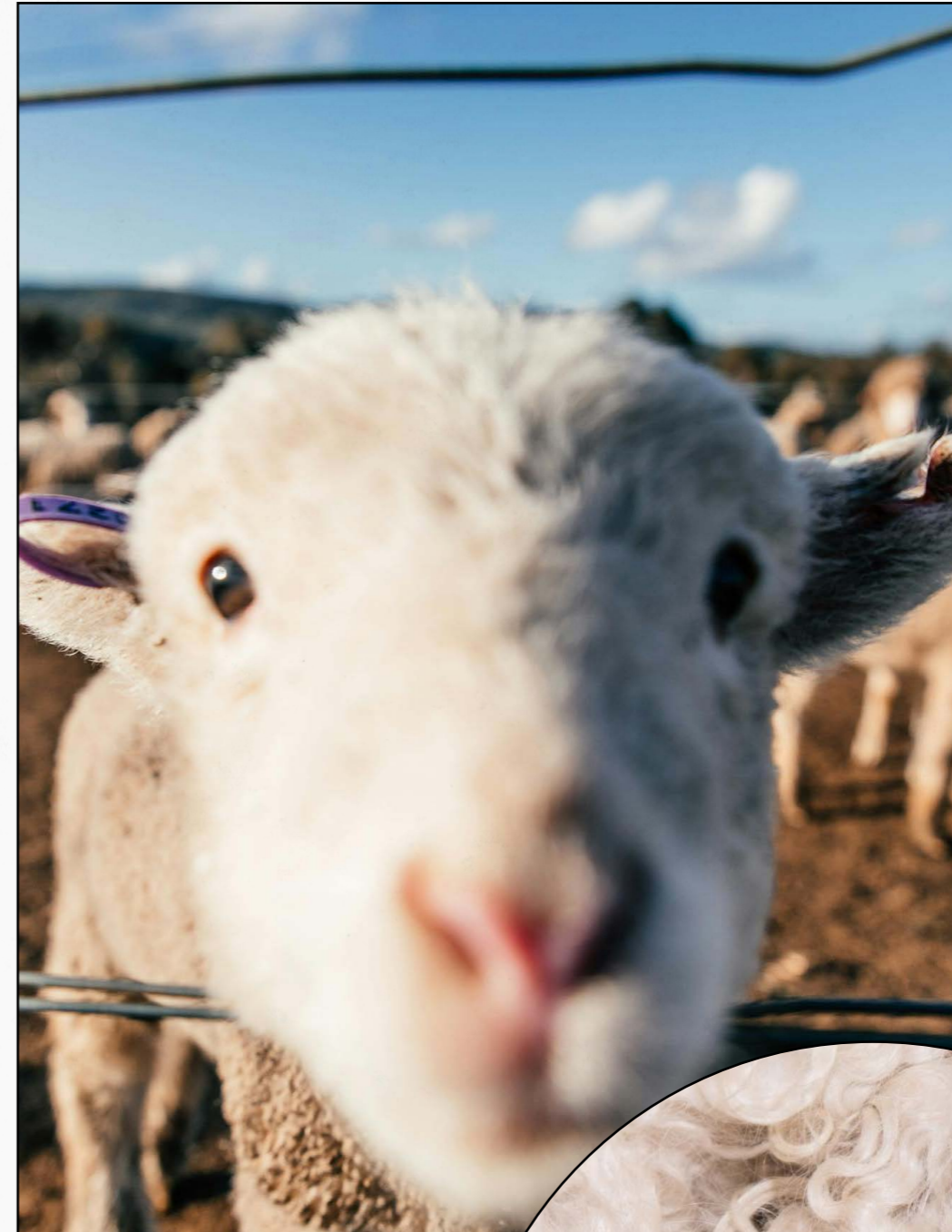
synthetic materials

Sheep **wool** is the most common animal fibre used in the fashion and textile industry. Other types of wool include mohair and angora.

Wool is natural, breathable, and resilient, and has good insulation and thermo-regulating properties, which means that it reacts to changes in body temperature to keep the wearer warmer when it is cold and cooler when it is warm. We love that it's being introduced into sports clothing, substituting synthetics! Wool is also odour- and wrinkle-resistant, which means that woollen clothing doesn't need to be washed as often as other fibre types do, saving water and energy (and time!).

The key issues with sourcing wool are animal welfare and environmental impact. Sheep are also subject to mulesing—the removal or destruction of wool-bearing skin. This makes sheep vulnerable to painful and sometimes fatal diseases. Being ruminants, sheep also produce the potent greenhouse gas methane as part of their digestive process.

Regenerative mulesing-free wool is the best one out there. We like to imagine happy sheep that have plenty of space, support surrounding ecosystems, and are treated ethically.



natural  
materials

man-made  
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synthetic  
materials

**Leather** comes from a sustainable, naturally renewable, raw material – tanned hides and skins of animals. Believed to be the first fabric crafted with human hands, leather has evolved significantly over the millennia. Although leather has lost some popularity in recent decades due to animal rights concerns, it remains a widely used textile product due to its durability, water resistance, insulative properties, and softness.

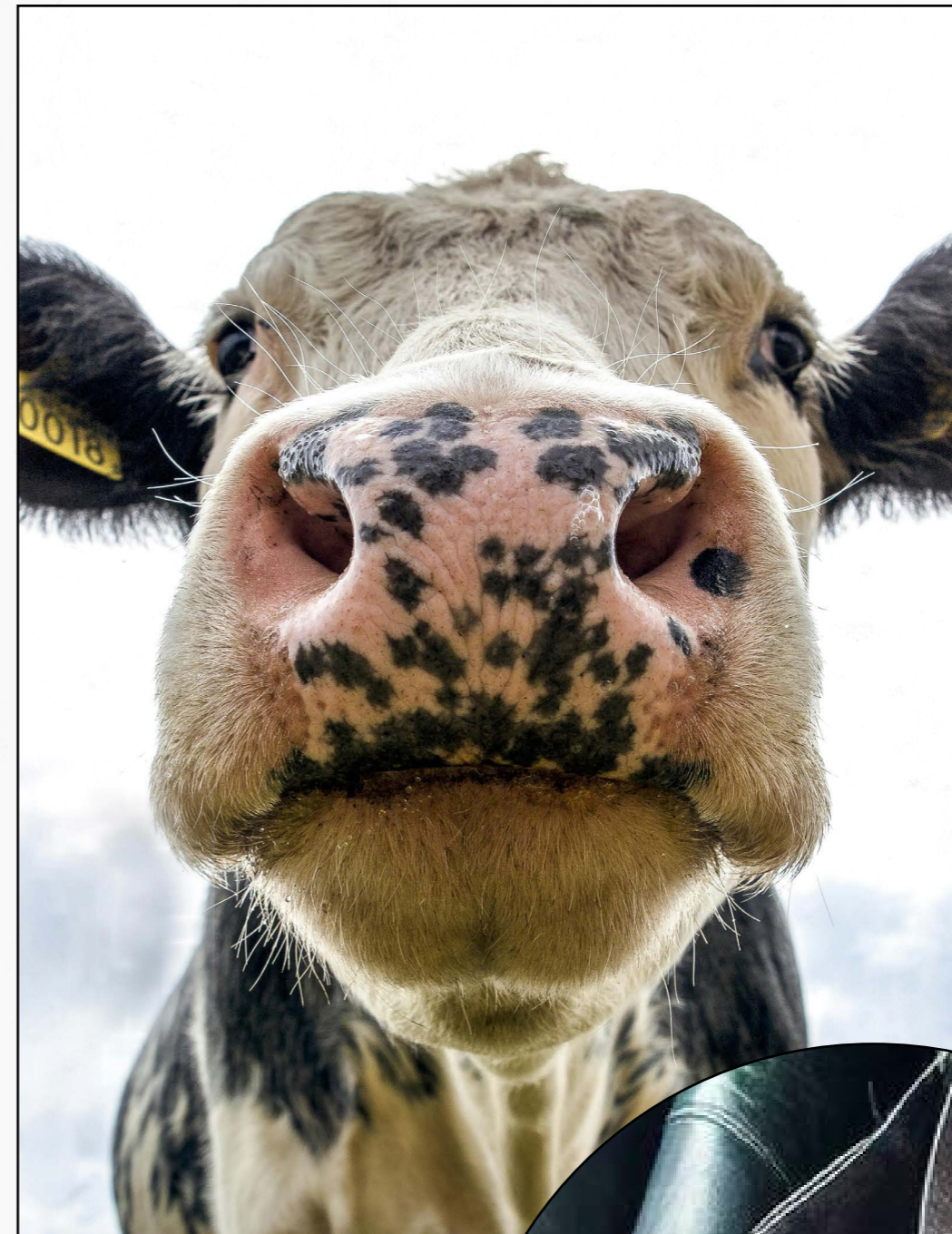
The difference between 'sustainable' and 'unsustainable' leather lies in how the leather is processed, and the sources of chemistry, water, and energy used.

It all starts from animal hides, coming mostly from cows, calves, sheep and lambs, however, exotic animals are still used. A major difference at this stage is whether the hide is a by-product of the meat industry, and how much it contributes to the financial value of the farmed animal, therefore supporting its farming.

After being cleaned of all flesh, the hide is stretched and subjected to a dehydrating process to avoid decomposition. Leather manufacturers then soak hides in a mixture of lime and water to loosen and remove hair and other undesired tissue and bathe them. The next process is tanning, which is where a huge variation in the chemical options exists. Tannins are natural astringent compounds that prevent the disintegration of collagen in animal hides, and turn flimsy skin into a strong product.

The word "tanning" comes from tannin (tannic acid), a type of chemical found in the roots, bark, seeds, and a variety of other parts of many different plant species. These days, however, most leather manufacturers use mineral tanning instead of vegetable tanning, which involves a specific type of chromium called chromium III sulfate.

Once the tanning process is complete, hides are thoroughly dried, and they are dyed using one of a number of different dyeing methods. Next, leather manufacturers apply oils or greases to the surface of the hides to make the resulting leather softer and more water-resistant.



natural materials

man-made cellulosic fibres

synthetic materials

# A next-gen leather alternative

marks a significant leap in material science, blending innovation with nature to produce a product that replicates the look and feel of traditional leather without its ethical concerns. These modern materials are derived from diverse sources, such as plant-based components, recycled elements, and advanced lab-grown technologies, providing enhanced durability, adaptability, and a reduced impact on the planet.

Cork, pineapple and mycelium, are examples of plant-based leathers available today, however, one big differentiator is the presence of polyurethane (a type of plastic). This comes with all the negative aspects of plastic production, but it also means that it can crack and peel, being a lot less durable than real leather.

Let's dive into the different types of leather alternatives being created for the market:



Plastic free	MIRUM® by Natural Fibre Welding	<ul style="list-style-type: none"> <li>MIRUM® is a new, 100% plastic-free plant-based material. At the end of its life, it can be recycled into new MIRUM® or ground up and safely returned to the earth, making it a naturally circular and climate-friendly option.</li> </ul>
	Treekind™ by Biophilica	<ul style="list-style-type: none"> <li>An alternative to leather that is devoid of plastics, PU (polyurethane), and rubber, and is crafted using lignocellulosic feedstocks sourced from urban parks and gardens, as well as from agricultural byproducts that are not fit for consumption.</li> <li>It has successfully undergone the home composting ISO 14855 test, as well as various chemical analyses and all relevant ISO standards tests applicable to leather products.</li> <li>Completely free from plastic and recyclable, Treekind is estimated to use less than 1% of the water cow skin leather production does.</li> </ul>
	Cork Leather	<ul style="list-style-type: none"> <li>An alternative to leather made from the bark of cork oak trees.</li> <li>It is celebrated for its durability and natural waterproof qualities</li> </ul>
Mycelium Leather	Mycelium Leather (coming soon)	<ul style="list-style-type: none"> <li>Mycelium leather, also known as mycelium, is made from the root network of mushrooms. This is a renewable material that requires little light and water and can feed off agricultural waste.</li> <li>Mycelium leather is strong, durable, and flexible with a similar texture to traditional leather, however, it is not widely available and is not at the scale of other alternatives on the market.</li> <li>Hyphalite is the only mycelium based leather currently available for orders and production.</li> <li>Mycelium alternatives have shown a lot of promise in the labs but scaling has been extremely challenging.</li> <li>An example is <a href="#">Really Clever</a>, a material made from algae and mushrooms, which is plastic-free and biodegradable.</li> </ul>
Plastic-Natural combination	Pineapple Leather	<ul style="list-style-type: none"> <li>Crafted from part pineapple leaf fibre, which is an agricultural waste product. It requires little water, as pineapples are a drought-resistant crop. Repurposing the leaves not only reduces waste, but it also provides additional income to the farmers.</li> <li>Piñatex is an example that is durable and flexible, with a similar texture to traditional leather.</li> </ul>
	Apple Leather	<ul style="list-style-type: none"> <li>Apple leather is made from part apple waste, including the peel, core and any scraps. This repurposes waste and can be an additional income stream for farmers. Both growing and processing the apples and apple waste requires little water compared to traditional leather.</li> <li>Apple leather is a strong, durable, and renewable material, with a similar texture to traditional leather.</li> <li>Companies supplying apple leather include:               <ul style="list-style-type: none"> <li>Mabel</li> <li>Beyond Leather</li> </ul> </li> </ul>
	Cactus Leather	<ul style="list-style-type: none"> <li>Cactus leather is produced by intertwining fibers from cacti with PU, resulting in a robust and long-lasting fabric. It looks similar to conventional leather but has a more organic appearance. Unlike traditional leather, which requires a large amount of water to produce, cacti thrive on minimal water, which has been a strong reason for its popularity (other than its non animal origins, of course)</li> </ul>
PU leathers	Microfibre Leather	<ul style="list-style-type: none"> <li>A smooth, synthetic material which can replicate the look and feel of animal skin products.</li> <li>It's supple, durable and versatile, making it a more sustainable alternative to leather and suede.</li> <li>PU = polyurethane = plastic</li> </ul>

natural  
materials

man-made  
cellulosic fibres

synthetic  
materials

*Man-made cellulose or cellulosic fibres are fibres structured from cellulose, a starch-like carbohydrate that is found in plants and serves as a structural component of plant cell walls. They are created by dissolving natural materials such as cellulose or wood pulp, which are then processed by extrusion and precipitation.*

They are created by chemically dissolving cellulose in specific solvents and then regenerating it by precipitating in an aqueous medium, think a honey-like substance. Man-made or regenerated cellulosic fibres include rayon, lyocell, modal, viscose, cupro, acetate and Tencel. These can vary widely in their physical and chemical properties, and environmental impact, based on the processing method used, the quantities of chemicals, and the water requirement of the specific process.

→ **Rayon** was the first man-made fibre used in the textile industry and in the early days of its development had the name “artificial silk.” Its processing caused major environmental issues, and had destructive effects on factory employees’ health.

→ **Tencel fibre** is the latest development and is a soft and absorbent fibre that is known for its environmental sustainability, due to its closed-loop process, and resistance to wrinkles.

→ **Viscose** is the most important man made cellulosic, having a market share of roughly 80% of all MMCFs and a production volume of around [5.8 million tonnes](#) in 2021.

The farming method used to grow the plant that the cellulose is extracted from is extremely important, and in the case of cellulose coming from wood pulp or bamboo, there is a range of responsible forest management solutions to ensure that no deforestation takes place, which comes with major environmental and social consequences. Due to concerns over deforestation, illegal logging, and irresponsible plantation management, any company using man-made cellulose should make supply chain transparency a priority. Sustainable forest standards include the Forest Stewardship Council (FSC) and the Programme for Endorsement of Forest Certification (PEFC), while the Canopy Style Audit also offers third-party audits to assess producers’ risk of sourcing from endangered forests.

Next-gen cellulosic fibres are focusing on the extraction of cellulose from various types of agricultural waste, and pre- and post-consumer textiles, which makes them extremely sustainable, examples include Orange Fibre, Infinna and Circulose.

natural materials

man-made cellulosic fibres

synthetic materials

+ **REFIBRA™** is a revolutionary fibre made from cellulose rich waste (aka post consumer textiles) and Lenzing's renowned Tencel fibre. It combines the best of two worlds to create one of the most ecological wood-based fabrics on the planet. In short, REFIBRA is the product of recycling cotton waste fabrics into virgin textile.

+ **Recycled Cellulosic fibres** are able to turn used cotton and viscose into new biodegradable pulp, from which new fibres are extruded, and can continue to be recycled over and over, creating a truly circular economy. A range of examples are successfully scaling chemically recycled cotton, a wildly exciting development for circulating textile waste! [CIRCULOSE®](#) by Re:Newcell, it is made by taking cotton waste and purifying it with a water-based chemical process to removes dyes and other contaminants. [Evernu's Nucycl®](#), is a fibre regenerated from cotton textile waste, that provides a real alternative to high impact raw materials like cotton and polyester. Infinited Fibre's InFINNA is made from cellulose-rich waste like discarded textiles, used cardboard or even rice straw, and it works on its own, and also blends with fibres like cotton and viscose.

Note that recycled cellulosic fibres are different from certified sustainable cellulosic fibres, which take cellulose from forests that are managed in a way that allows them to grow at the same rate at which they are cut. Examples of such certifications are [Canopy](#) and [FSC](#).

best practices

+ **Agraloop™** refines natural fibres derived from agricultural crops into textile-grade fibre called [Agraloop™ BioFibre™](#). A new Natural fibre mindfully sourced for circularity. With specialised wet processing technique, cellulose fibre from stems and leaves are purified into soft fibre bundles ready to spin into yarns The Agraloop processes left-overs from various food and medicine crops including, oilseed hemp/flax, CBD hemp, banana, and pineapple.

+ **Biomimicry** has been of very high interest to us, so much so, that we wrote a whole article on it [here!](#)

+ **Tencel** is a cellulosic fibre coming from tree bark. It is a "greener" fibre than cotton or many other common textile fibres as It is grown in a sustainable manner - no pesticides are required to grow the trees, and most of the time they are rain fed. Trees are grown and processed at a rate that allows them to recover, and are FSC certified. An organic solvent is used to dissolve the wood chips into a solution. The chemical used to dissolve these chips is very expensive so it is recycled after the process is complete. However, the best source for manmade cellulose like Tencel are from waste sources like textile waste or agricultural waste.

+ **CO2 based fibres** are the future. Utilising enzymes selected from across the biosphere and stabilised in an industrial reactor, [Rubi Labs](#) catalyses the synthesis of cellulose from CO2 through a cell-free system. This method not only allows for 100% conversion of CO2 to cellulose, avoiding the wasteful by-products and energy requirements of cell-based biomanufacturing but also provides improved efficiency through enhanced pathway flux.

natural materials

man-made cellulosic fibres

synthetic materials

You might have guessed it by now, but we really don't support the fact that clothing is made of plastics. From issues with its extraction, its release of microplastics during use, and its incompatibility with a circular economy, so many aspects of it are just wrong.

*Most of the clothing we make today is made of petroleum (aka oil), a non-renewable resource. The petrochemicals industry has complicated social and political implications that are relevant to all industries that use petroleum-derived products.*

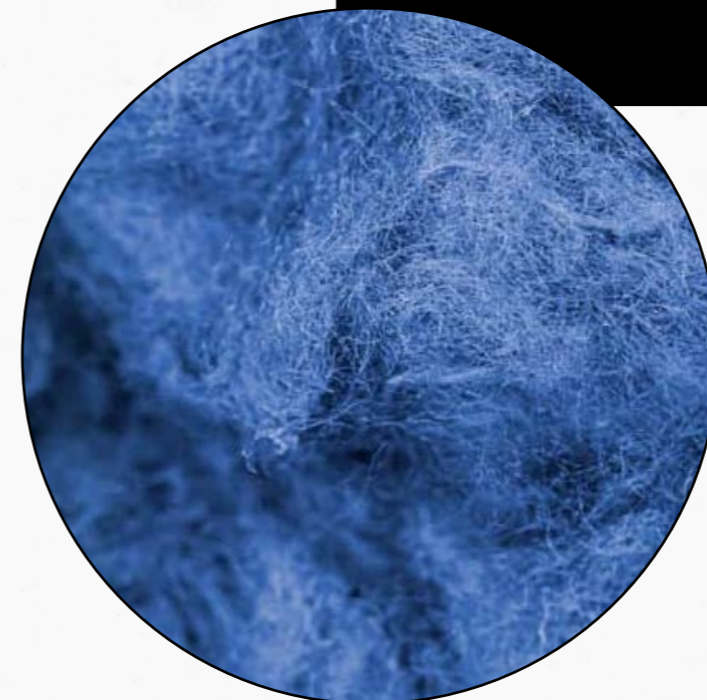
According to the Changing Markets Foundation, today over two-thirds (69%) of textiles are made from plastic, and this is expected to grow to 73% by 2030. This is because oil-based fabrics such as polyester are cheap, smooth, strong and durable, but also because there are specific financial interests that have brought us here, which we will dig into later.

## Polyester, a synthetic fibre derived

from petroleum, is the most widely used fibre in the clothing industry today with estimates reaching up to two thirds of all fashion. Its emergence as a fashion staple can be attributed to its durability, resistance to shrinking and stretching, and its quick-drying capabilities. Developed in the early 20th century, polyester's popularity soared in the 1970s when the textile industry began to favor it for its ability to mimic natural fibres at a lower cost and for its performance characteristics.

The process of making polyester involves the polymerization of ethylene glycol with terephthalic acid, producing a fibre that is essentially plastic. This material can then be spun into threads and yarns, used to weave or knit into fabrics. If you want to get into the details, we've outlined the exact extraction process [here](#).

Efforts to improve the sustainability of polyester focus on recycling existing polyester materials and developing bio-based alternatives. However, we warn against recycled polyester as it still fuels our desire for plastic based materials and does not solve the microplastics issue, which are discussed in detail [here](#). Advances in technology are also exploring the creation of polyester from bio-based sources, aiming to reduce dependency on oil and lower greenhouse gas emissions. Despite these efforts, polyester at the end of the day is plastic and it makes no sense that the same process used for fossil fuels is used for clothing.



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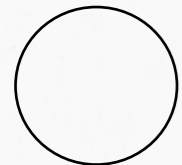
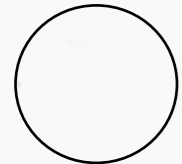
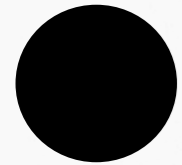
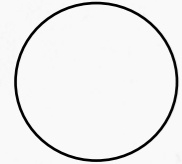
# Nylon

was a groundbreaking synthetic fibre

and made its debut in the 1930s as the first true synthetic textile fibre, revolutionising the fashion and textile industries. Celebrated for its exceptional strength, elasticity, and resistance to abrasion and mildew, nylon quickly became a cornerstone material for a vast array of products, ranging from hosiery and swimwear to parachutes and toothbrush bristles. Its invention marked a new era in textiles, offering a durable, versatile, and cost-effective alternative to natural fibres.

The creation of nylon involves the polymerization of caprolactam, resulting in a material that boasts high tensile strength and flexibility. This process yields a fibre capable of being woven or knitted into fabrics that are lightweight, yet strong, with a silky smooth texture. Nylon's ability to dry quickly and retain its shape even after repeated wear and washing has cemented its place in our wardrobes and homes.

Like other synthetics, nylon is petroleum-based, its production relying heavily on non-renewable resources and emitting significant levels of greenhouse gases. Additionally, nylon is not biodegradable, contributing to the persistent problem of plastic pollution in our ecosystems. The durability that makes nylon so valuable also means it can take decades to decompose, posing challenges for waste management and recycling efforts.



# Spandex

also known as **elastane** or by the

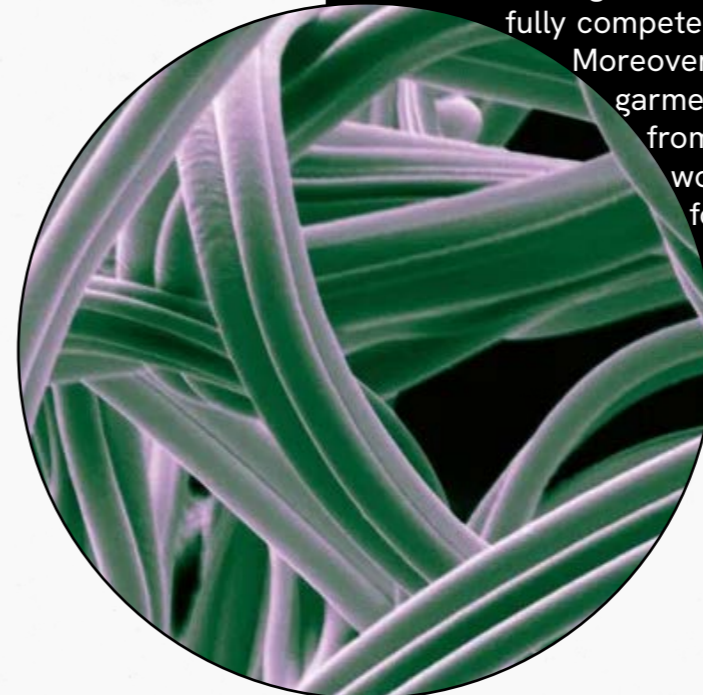
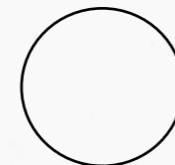
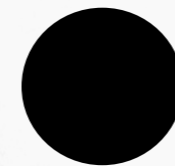
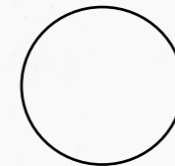
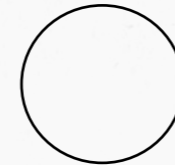
brand name **Lycra**, is a synthetic fibre known for its exceptional elasticity. It is a lightweight, soft, and smooth material that can stretch up to five times its original length, making it a crucial component in a wide range of clothing for its ability to enhance comfort and fit. First developed in the 1950s as an alternative to rubber in garments, spandex quickly became indispensable in the fashion industry, particularly in activewear, swimwear, and underwear.

From an environmental standpoint, spandex presents challenges similar to those of other synthetic fibres. Being petroleum-based, its production is resource-intensive and contributes to the consumption of non-renewable resources. Additionally, spandex is not biodegradable, leading to concerns about its long-term impact on the environment, particularly as it contributes to the growing issue of textile waste in landfills.

Natural rubber offers an intriguing alternative to elastane (spandex) in various applications due to its unique properties and environmental benefits. Derived from the sap of the rubber tree (*Hevea brasiliensis*), natural rubber possesses elasticity, resilience, and durability that can be harnessed in the textile industry, particularly in the production of elastic components of clothing.

Natural rubber boasts notable advantages for the planet and our well-being, but it's not a perfect match just yet. Its elasticity and strength are commendable, yet sometimes they can't fully compete with the stretch and resilience of elastane.

Moreover, transforming rubber trees into chic garments involves navigating complex challenges, from avoiding deforestation to ensuring fair working conditions. However, innovators and forward-thinkers are tirelessly enhancing natural rubber's performance and refining its production process, so keep an eye out for the nature-based solutions!





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## Alternatives to Synthetics

Synthetics should simply be replaced by natural fibres, which is extremely easy in most cases. For stretchy materials, it is more complicated, however solutions are being developed.

+ **COREVA™** is an innovative technology developed and patented by Candiani Denim that uses a plant-based yarn obtained from natural rubber to replace synthetic, petrol-based yarns. Made from organic cotton wrapped around a natural rubber core, the result is a yarn that is completely plastic-free and biodegradable. By replacing conventional synthetic and petrol-based elastomers with a new, custom-engineered component, Candiani has created an innovative stretch denim fabric – without compromising the elasticity, physical qualities, and durability of jeans.

+ **Mechanical Stretch.** One natural stretch solution we have seen from Naveena Denim is creating high-stretch fabrics made from 100% cotton. How have they done this? The Mecha-Stretch concept is a mechanical stretch concept designed for 100% cotton woven fabrics. It truly has an elastic behaviour thanks to a specialised weaving technique. This kind of weaving technique can be found in all fashion garments.

## Recycled Synthetic Materials

Synthetics should simply be replaced by natural fibres, which is extremely easy in The environmental and social impacts of synthetic materials have long been a concern, but with growing awareness of the harms associated with their extraction and processing, recycled versions are now emerging as the fashion industry's celebrated sustainable alternatives.

From PET bottles transformed into polyester fabric to reclaimed nylon fishnets morphing into swimwear, there is hardly a single high street fashion brand who isn't shouting about recycled synthetics.

Certifications include:



*Recycled synthetic materials are like the fashion industry's nod to a "less guilt" approach, trying to clean up the mess left by their non-recyclable siblings.*

While recycling lets synthetic materials take a second chance at life, it's kind of like slapping a band-aid on a much larger problem. We're still in bed with the plastic, complete with its tricky microplastics that make a break for with every wash, turning our oceans and aquatic friends into unwilling participants in this not-so-glamorous saga.

Sure, converting waste into wearable items does cut down on some energy and resource use, but let's face it, we're essentially still sitting at the table with the petrochemical industry. So, while recycled synthetics are making an attempt at a "less bad" approach, perhaps it's time to get rid of them altogether.

## step 2:

Fabric production and material processing is a step in the life cycle of a garment that consumes a significant amount of energy. In this stage, the raw material described above is turned into a fabric. For fibres, this means turning it into a yarn, and then either weaving or knitting it. A lot of fibres can also be non-woven, or in the case of leathers, this step is completely different.

According to Life Cycle Assessment experts [Ecochain](#), almost 10% of the impact of the apparel industry occurs by producing the fabric, which is made in fabric mills. These are extremely large factories with gigantic machinery that often run for 24 hours, which is why the sustainability of spinning and weaving is very connected to the type of energy that is used and where the factory is located.

## material processing

Renewable energy sources are the best option for large fabric mills that require a lot of energy.

Hydro and wind power can produce large amounts of energy, however they require large scale installation (and initial investment), which should be made available to mills by energy companies or government help.

Manufacturers have started installing solar panels on their roofs that fit very well in the countries that produce a lot of the world's textiles: India, Egypt, Pakistan, Turkey. The issue with solar is that it often requires more space than just the roof of a mill.

You can find a great comparison of different energy sources [here](#), and our article on [Solutions for Fossil Free Energy in Fashion](#).



# Fabric Production

from

# Fibres

Yarns

Weaving & Knitting

Dyeing

## Spinning Natural fibres

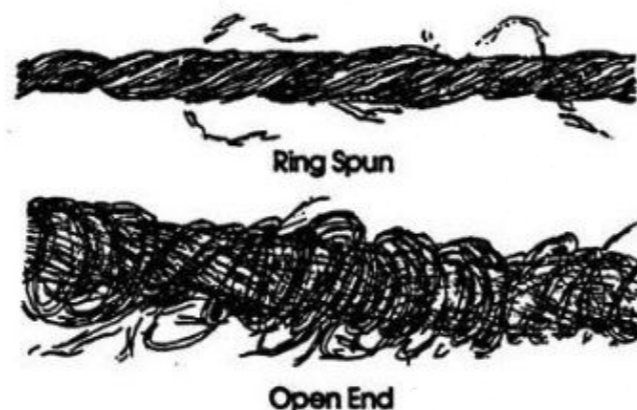
Remember natural fibres? These include cotton, hemp, linen, flax, and kapok. The same process is used for wool.

Natural fibres undergo a thorough cleaning to remove any impurities such as sticks, seeds, and leaves. This involves separating the fibre from its source, a process that varies across different types of fibres. Once purified, the fibres are spun into yarns. These yarns are then woven into fabrics, at which point additional fibres like Tencel, Refibra, or bio-based stretch materials may be incorporated.

A lot of material can get lost during this stage, but most mills have vacuum-like machines that will suck up all the lost fibres during the process and recycle them back into their feedstock. fibre is like gold, it cannot be wasted!

### Ring Spun vs. Open End Spinning:

- + Ring-spun yarn is made by twisting the cotton strands to make a very fine, strong, soft rope of cotton fibres. Ring-spun yarn is more durable than open end yarn and generally more expensive.
- + Open-end spinning, on the other hand, is a system of spinning where the yarn is twisted by rotating at the hap or break in the flow (the fibres wrap around the yarn vs spinning one long piece of yarn).



## Extruding synthetic fibres

Unlike their natural counterparts, synthetic fibres begin as chemical solutions derived primarily from petrochemicals. This process, known as extrusion, transforms these solutions into the countless synthetic fibres that populate our wardrobes and homes.

The creation of synthetic fibres is a fascinating journey from raw material to textiles. Unlike their natural counterparts, synthetic fibres begin as chemical solutions derived primarily from petrochemicals. This process, known as extrusion, transforms these solutions into the countless synthetic fibres that populate our wardrobes and homes.

- + **Melting or Dissolving:** The first step in extruding synthetic fibres involves melting or dissolving the polymer. For example, nylon and polyester are melted, whereas acrylics might be dissolved in a solvent to create a thick solution.
- + **Spinning:** Once in liquid form, the polymer solution is forced through a spinneret—think of a honey-like substance going through a showerhead with multiple tiny holes. As the solution extrudes through these holes, it forms long, continuous filaments.
- + **Cooling and Solidifying:** The emerging filaments are then cooled, either by air or water, causing them to solidify into fine threads.
- + **Drawing:** To enhance their strength and elasticity, the solidified fibres are stretched, or “drawn,” which aligns the polymer molecules within the fibres. This process can increase the fibre’s strength significantly.
- + **Texturing:** Synthetic fibres are often texturized to give them certain characteristics, such as the soft hand of natural fibres or specific performance qualities. Texturing can create fibres that mimic the feel of cotton, wool, or silk.

# Fabric Production

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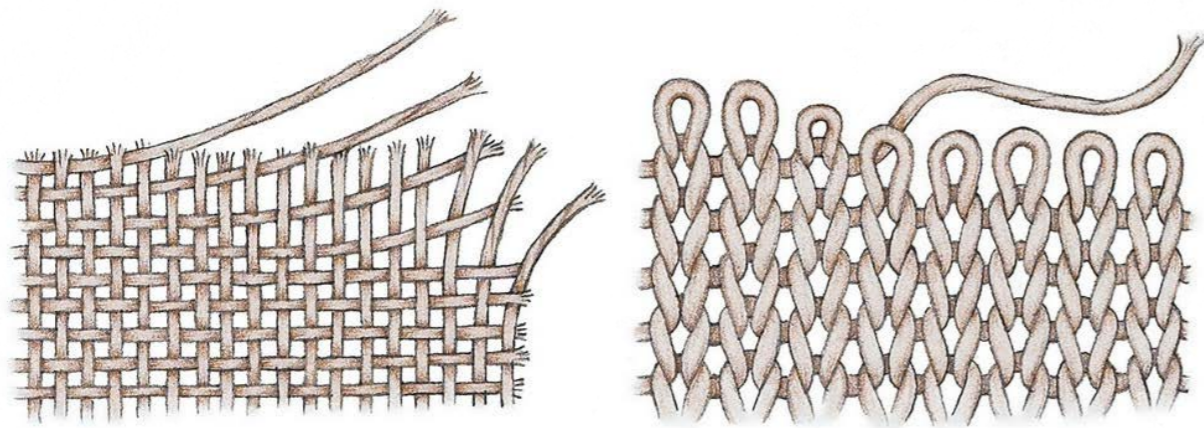
Yarns

Weaving & Knitting

Dyeing

To most fashion enthusiasts, the difference between a woven and a knit fabric is very clear. But this is not an exclusive club: we want to include everyone!

*So, what's a woven VS knit?*



A **woven** fabric is generally produced on a loom and made with many threads that will be placed at two specific angles. The two angles will then define your warp and weft directions.

A **knit** fabric is made up of a single yarn, looped continuously to produce a braided look.

To set our yarn up for weaving, we need to coat it to ease the friction that occurs during weaving known as a sizing formula. Then we take our dyed yarns for our warp and weft and watch the magic happen!

## Best Practice

Vertically integrated facilities will generally blend their pre-consumer and post-industrial waste into their products at this stage too and like we learned in the raw materials stage, we want to continue to increase the amount of recycled fibres in our clothes :) But let's keep them microplastic free.

3D weaving is a new technology that is not yet widely available to the market but is being developed by a range of companies. It is like a basket-making machine but for clothes. It has the potential to eliminate the wasted fabric scraps generated during the cut-and-sew process, and produce only what is used, custom fit to specific orders and body shapes, by combining it with 3D scans, like unspun is doing.

3D knitting is an older manufacturing technique (than 3D weaving) that creates garments and textiles directly from digital designs, producing three-dimensional, seamless items in a single piece. That means it reduces waste by precisely knitting the exact amount of fabric needed for each part of a garment, eliminating the cutting and sewing steps typical of traditional garment manufacturing.

Look for energy efficient facilities that are creative with their resources such as using natural lighting for your factory or using renewable energy.

# Fabric Production

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Yarns

Weaving & Knitting

Dyeing

## What & How

There are plenty of ways in which colours are applied to materials in fashion, which include cone dyeing, garment dyeing, hank dyeing, knitted fabric dyeing, stock dyeing, wool tops dyeing, warp dyeing, woven fabric dyeing, wet processing, fibre dyeing, yarn dyeing, etc. The most common categories, however, are yarn-dyeing or piece-dyeing.

Yarn-dyeing means that the yarns are colored before weaving. They can be stored as raw yarn and dyed when required according to the dictates of fashion. Piece-dyeing means that cloth is woven as what is known as 'grey' goods and is then dyed according to fashion need.

Direct dyeing requires only one immersion in color and has no fixing process. It is mainly used for dyeing cellulosic fibres, such as cotton and linen. It is one of the easiest processes to dye fabrics because the dyes used do not require a fixing agent to fix the dyes to the fabric.

In 2011, the organization GreenPeace launched a process of accountability through [GreenPeace's Detox Campaign](#), a campaign designed to raise awareness of brands on their environmental impact, ask them for transparency along the supply chain and make consumers aware of the dangers of fast fashion, which led to the establishment of [ZDHC \(Zero Discharge of Hazardous Chemicals\)](#), a program dedicated to promoting a more responsible use of chemicals.

*Dyeing can have major environmental impacts because of the amounts of chemicals, water, and energy used.*

Once in the waterways, dyes can accumulate to the point where light can no longer penetrate the water's surface. Large quantities of water are used which can become dangerous, especially when disposed of, as they come into contact with a series of chemical substances. This accumulation can kill aquatic plants and animals and pollute essential drinking water sources for surrounding communities.



Denim is a whole other ball game. If you want to learn more about denim's dyeing and supply chain in-depth, read our Denim 101 resource [here](#).

# Fabric Production

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Yarns

Weaving & Knitting

Dyeing

## Best Practice

Our favourite dyes of course are **natural or vegetable dyes**. Solutions to water pollution problems have been sought for years by rediscovering natural dyes, recycling certain substances or investing in new technologies like bioengineering colourants or microorganisms like produce colour themselves.

Another innovative company we have spotted is [Spira](#) who is creating dyes from spirulina microalgae! They create carbon negative materials, due to spirulina's natural ability to sequester carbon, from genetically engineered algae grown by a global network of farming partners to produce ingredients for food, cosmetic and textile companies. Algae is definitely a nature-based solution for the future of textiles, so keep your eye out for all its uses.

[Stony Creek Colors](#), however, has been making strides in producing natural indigo for denim mills, specifically with their 100% BioPreferred indigo product. A 100% BioPreferred™ score, certified by the United States Department of Agriculture (USDA), indicates that after being subject to radiocarbon dating, the product is proven not to contain any synthetic adulterants. The natural dye used in the project has the same performance capabilities of synthetic indigo but is derived from *Indigofera suffruticosa* plants, grown in partnership with US-farmers in Tennessee and Florida and cultivated through Stony Creek Colors' in-house seed genetics and agronomy program and proprietary extraction processes.

*There is something in between natural indigo and synthetic indigo that might solve our problems both in the manufacture of the dye and in the dyeing process! That is bio-based synthetic indigo (therefore not coming from the indigofera plant, but made in factories from other natural sources).*

San Francisco biotech firm [Huue](#) believes that the answer to synthetic indigo is Genetically Engineered Bacteria to mirror the way the Japanese indigo plant, *Polygonum Tinctorium*, makes and holds its color. **Tinctorium** uses *E. coli* to produce indican, the chemical precursor to indigo, in large bioreactors. The microbial fermentation process can save 100 tonnes of petroleum and 10 tonnes of toxic chemicals per tonne of product. [Pili](#)'s process differs a little using microbes working at room temperature to create color!

Research is constantly being done on new options for dyeing, such as working on the [natural color of the cotton](#), a lesson from the past, and on [printing](#), a potentially disruptive technology that could help us avoid waste.

**Digital printing** can be beneficial because it reduces the amount of water, chemicals and energy required to create a multitude of different looks using one fabric. The brand [Our Legacy](#) is selling digitally printed jeans that are inspired by vintage designs, photographed and digitally manipulated, then printed on new pairs!

Some manufacturing facilities have on-site water recycling facilities, so water for dyeing yarns can be reused over and over again. This process saves vast amounts of water with no change to production output, while helping us avoid depleting our resources!

Hot Tip: When choosing factories, be sure to check out their Effluent Treatment Plant! More advice on this from Salli Deighton [here](#).

# step 3:

## cut & sew

### 1.1 Sampling

Sampling is a process of making a product prototype prior to starting bulk production, and is a key part of the design and pre-production process, as it provides an essential opportunity to analyse what works before putting the design into production. Before deciding on the final shade, fabric, and fit, factories can make dozens of samples for one item that then goes into production. \$6 to 8 billion is spent on sampling in the fashion industry every year. These samples often are not sold, and their environmental impact should not be overlooked.

### 1.2 Best Practice

**3D sampling** allows brands to create a virtual fit model of their product, and has become an innovative tool to minimise the harmful effects of the sampling stage. Companies like Clo 3D, Taas, Optitex and Marvelous Designer provide digital sampling services, and it is impressive to see how they can recreate different fabrics, patterns, and lighting on the digital clothes.

### 3 Sewing

Sewing factories employ hundreds of thousands of people, all using variations of simple sewing machines. This is why the sustainability of this step is mostly social: material is transformed mechanically only.

### 2.1 Cutting

Automated cutting allows for a machine with an automated moving blade to cut rolls into parts of garments, for better worker safety, since the traditional cutting method required for employees to handle cutters manually. Furthermore, the cut pieces are repeated perfectly to reduce waste.

Cutting waste is one of the least talked of issues in fashion: tiny pieces of fabric are either incinerated or thrown to landfill. You can read more about the upcycling of fabric waste in '[End of Life](#)'.

There is also a big problem of minimum order quantities that is not well known. Fabric is considered a high volume low price product, therefore manufacturers who have to run extremely big machines and use vast amounts of chemicals in their production set a minimum order quantity. Garment manufacturers however receive an order from brands, who do not take responsibility over the order quantity from the mill, so they end up with unused fabric that they have to store or dispose of.

### 2.2 Best Practice

**CAD design** is a program used for placing patterns and connecting with cutters. Experts would use their knowledge to reduce the fabric waste by maximizing the fabric used with clever pattern placements.

Cutting waste highly depends on the design, size range, and fabric details, and the percentage of cutting waste can vary from 0 up to 20%. Although being used more widely in Fashion classes than in practice in industrial settings, Zero Waste Pattern Cutting means that the pattern pieces fit together so that no fabric is wasted during the cutting phase. This also allows to reduce the amounts of cuts that are required.

**Intellocut** is a fabric planning optimization software designed to help apparel and textile businesses save fabric in roll form in order to boost topline. It distributes patterns along the rolls to maximise fabric utilisation and reduce offcuts. Think of this as a puzzle solved by software!

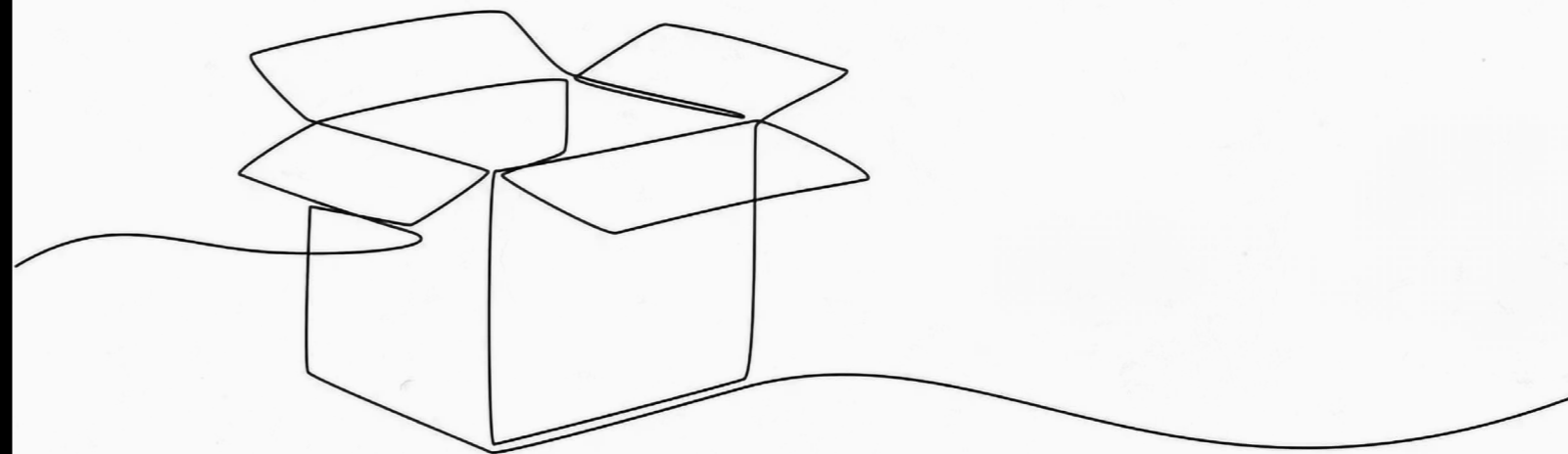


step 4:

Tags, Label, Hangers, Hang Tags, Polybags,  
Cartons, all contribute to the waste that  
comes from this industry.

*So much plastic is still used for packaging.*

packaging & shipping



what & how

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## Packaging

Polybags are the ubiquitous packaging of the fashion industry – something that unites brands small and large, from sportswear to luxury, to fast fashion retailers. This is the clear plastic bag which covers every garment from manufacturing to retail stores or consumer homes. Hundreds of billions of polybags are estimated to be produced for the fashion industry every year. Brands should consider not only the materials used but consider the wider system used with the packaging – for example, how will it be collected and recovered at all points where waste is generated?

Bioplastics are also a new hot topic. Bioplastics are plastic materials produced from renewable biomass sources, such as vegetable fats and oils, corn starch, straw, woodchips, sawdust, recycled food waste, etc. They can be great if they are also biodegradable, meaning that they can be composted. However if there is no system for composting, the effort is useless, the packaging could end up together with normal plastics and be an issue for the recycling process. It can be confusing to understand that some plastics can be biobased but not compostable, therefore we suggest that you check out a useful [diagram made by Ecoage in their article](#) explaining this group of materials.

Recycling could be increased thanks to government subsidies, legislation, oil price rise, design for recyclability (narrower range of polymers, no coloured plastics), advances in recycling technology and in sorting (optical recognition etc.). Collaboration and cooperation comes back as being the key to achieve a circular economy.

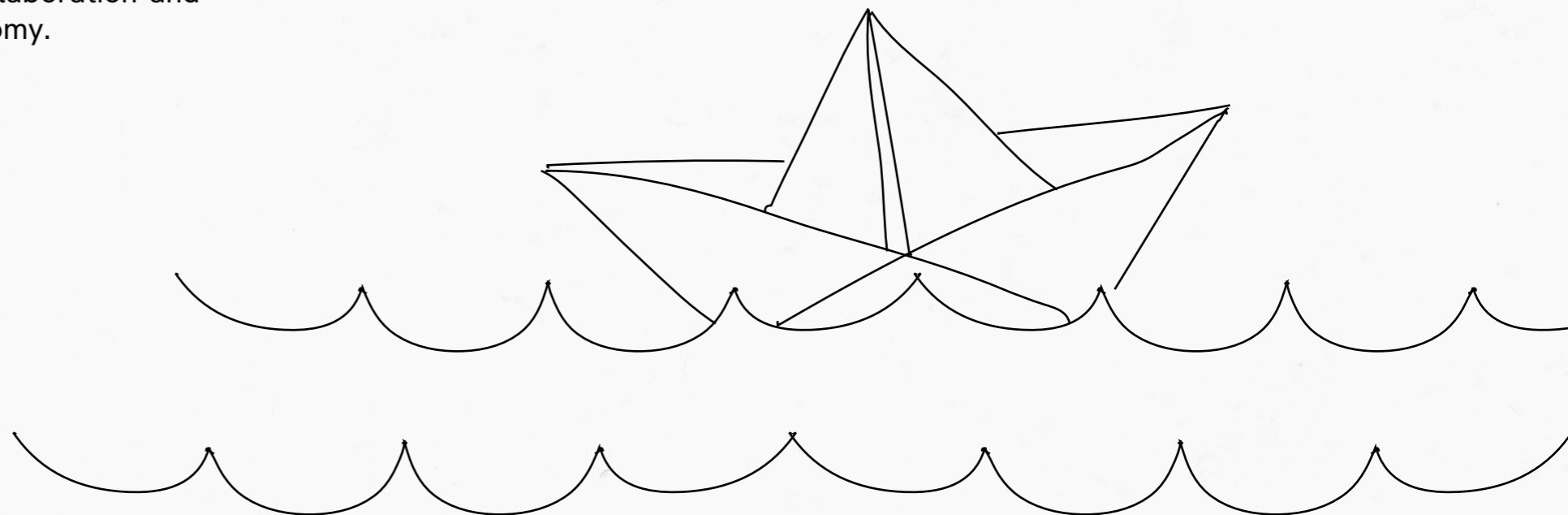
## Shipping

Your pair of jeans might have travelled more than most people in the world. Cotton could be grown in India, then spun, woven and dyed in Italy, turned into a garment in Vietnam and sold in a shop in the US.

It is very rare for one country to have a fully integrated production of garments, so how do we reduce the transportation's carbon impact?

One thing is undebatable: flights should not be used for clothes. They do not expire like fresh goods, and should not use the transport method with the highest carbon emissions. The issue comes from this system of having new collections coming out too fast, and a split up supply chain, which means that there could be delays at the end, and a pressure to get clothes into shops on time.

What other methods are available? Cargo ships have an exponentially bigger volume than trucks, but they also can transport a lot more volume, which means that the usage of diesel for a cargo ship is divided in between many more items. Shipping the same goods to the Netherlands can have a bigger carbon impact by truck from France than shipping them by ocean freight from South America.



what & how

best practice

## Packaging

Best practice for packaging is to ask: is this really needed? There are so many tags, boxes and bags that the consumer will never use. Brands should encourage consumers to put their new purchase directly in their bag, without adding unnecessary weight to it.

Ideally, brands would have strong, isolating, and moisture proof reusable containers that fit the requirements across their supply chains, share with suppliers, and use over and over again. If the logistics of sales require for something to become ownership of the consumer, then it should be compostable, and made from renewable sources.

FSC is a certification that we have already mentioned in the description of Tencel, and the same thing that is certified in the growing of trees (at a rate that allows them to recover) is valid for all paper based materials for packaging. Look for brands that use 100% FSC certified paper and carton for their tags, boxes and bags.

Recycling is also a delicate topic, it does come third in the rule “reduce, reuse, recycle”. However, it can be a good solution for certain types of packaging, but if there is a system of recycling but the polybag is not recyclable then it becomes useless. Most countries have started requiring recycling information to be written on the packaging, so try to look for recyclable materials. [Here](#) you can find recycling symbols explained.

Seaman paper has launched a line of transparent paper bags designed to replace single-use plastic poly bags. Try to look for them!

[Mushroom® Packaging](#) is a great example of a low impact packaging, it is made with hemp hurds and mycelium (which you know how much we love). It is a high-performing packaging solution, cost-competitive, thermally insulating, and water-resistant. It can be composted in a natural environment (differently than most bioplastics) in 45 days. It is also certified 100% Biobased and Cradle to Cradle Gold.

Look for compostable bioplastics and make sure you dispose of them in the correct bin!

## Shipping

Get informed on your favourite brand’s yearly impact report and check if they explain what transportation methods they use. Ocean freight is preferred when possible. If they launch new collections every two weeks and offer express shipping there is a chance they use air transport.

Offsetting is very debated in the sustainability world. By definition a carbon offset is a reduction in emissions of carbon dioxide or other greenhouse gases made in order to compensate for emissions made elsewhere. This reduction can be in the form of planting trees, investing in renewable energy, avoiding deforestation etc. The way it is calculated is by analysing what emissions would occur in the absence of a project. The issue is that there are projects that sell carbon credits for trees or land that would not have been destroyed anyways, or for renewable energy that was going to be invested in anyways.

Do you want to calculate your own emissions and offset them? The project Ecosphere Plus which combines carbon offsetting with the improvement of livelihood in endangered areas, and has a carbon calculator for deliveries, flights, businesses etc.

*Of course it would be best to reduce emissions completely, but when it is not possible it is better to offset emissions than to not do anything about it.*

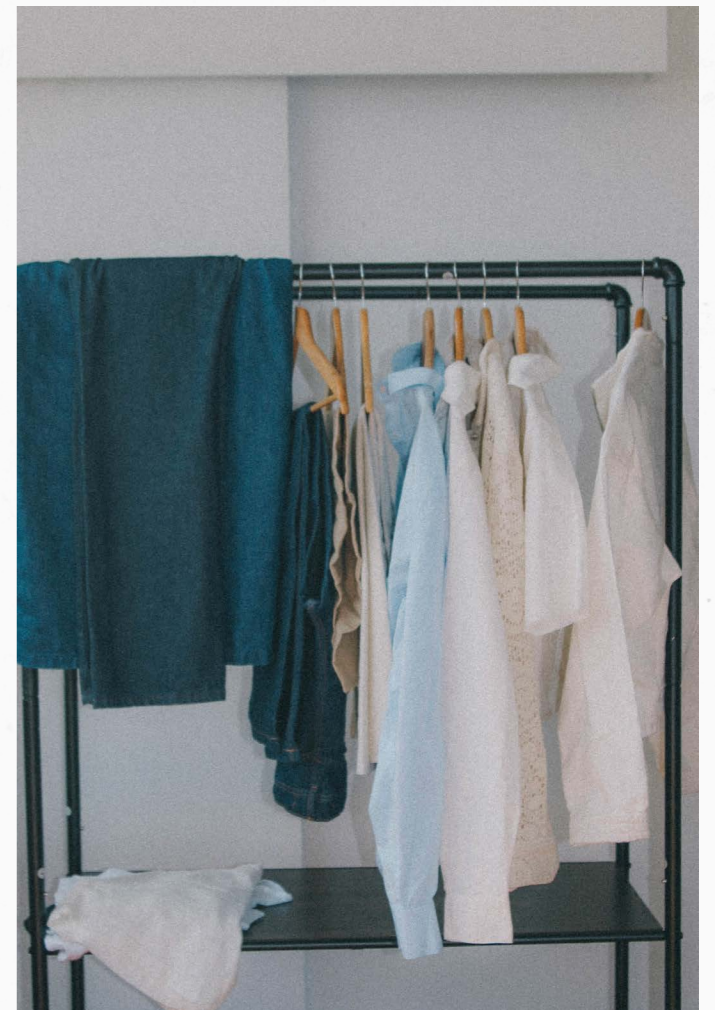
Your brand can use a carbon neutral shipping method. There are plenty of options, including from UPS.

# step 5:

There is no doubt that fashion is one of the most wasteful industries and denim was always under attack for being one of the worst offenders. We know a significant amount of greenhouse gas emissions are linked to the manufacturing of garments and unfortunately, garments are being worn 40% less than the previous generation. This leads us to the real problem - overproduction/overconsumption.

We produce way more than we need, so much so that some of what is produced (estimated at 30%) is never actually worn, and goes straight to the landfill. Some brands will partner with different organisations to donate their unsold goods, but if an estimated 150 BILLION garments are produced a year, 30% (45 billion garments) is WAY too high a number, so we need to be buying less, choosing well, and making it last, while the industry continues to minimise waste and maximise resources.

Read more on “Waste Solutions for the Denim Industry” written by Simply Suzette [here!](#)



use & care

garment  
care

what  
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better

On top of the issues that come with garments not being used at all, the Use/Care phase plays a very significant role in the life cycle impact of clothes, and has even been estimated to be the stage with the highest impact together with raw material extraction. Laundry alone accounts for approximately 30% of the carbon footprint of clothing. During this phase, large amounts of water, energy and chemicals are used in washing, tumble drying and ironing, and there is the issue of microplastics shed into the environment. It also is the longest phase of the garment, as these actions can be repeated hundreds of times, further degrading the garment and turning it into waste. It really is a critical stage, where our habits can make a big difference. Additionally, impact varies for different products and depends upon factors such as consumer behaviour, geographical zone in which the product is used, and even the weather conditions in that zone.

Let's look at each one of these issues in detail...

Washing, drying and ironing jeans at home requires large amounts of water, energy (mechanical and thermal), and chemicals.

Additionally, all this stress reduces the lifespan of clothes, as fibres degrade or shrink, colours fade, and clothes end up not being usable anymore.

The impact of your wash highly depends on the energy mix of your supplier (whether your electricity was made from impactful sources such as coal, or through renewable energy, like hydro), and the temperature that your tap water starts from, which is why we mentioned the geographical area. According to the UK Energy Saving Trust, choosing to wash at 30 degrees rather than at higher temperatures uses around 40% less energy, and reduces the degradation of clothes. According to WRAP, extending the average life of clothes by just three months of active use per item would lead to a 5 to 10% reduction in each of the carbon, water and waste footprints.

*Many of you have probably read terrifying headlines detailing the amount of plastics that we eat on average every year due to microplastics having entered the food chain, and being found in water, vegetables, milk, etc. Remember us mentioning microplastics earlier? What is the difference?*

*Microplastics are plastic pieces less than five millimeters in length (mostly formed when plastic waste material that has been discarded in nature breaks down), and microfibres are a subcategory of microplastics that are fibrous in shape (mostly formed in the washing of textiles that contain plastics, such as polyester and nylon). According to researchers at the International Union for Conservation of Nature (IUCN), plastic particles washed off from products such as synthetic clothes & textiles contribute to 35% of primary microplastics polluting our oceans. That is a LOT!*

How does this happen? During each wash, the fibres undergo a large amount of stress due to the force of the water, the temperature, and the chemicals that are applied through soaps, softeners etc. This causes tiny pieces to break, so small they're not visible to the human eye, and end up in the water.

garment  
care

what  
to look out for

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*There is no need to panic, and yes you should still continue washing your clothes, however there are several things that you can do:*

- + Firstly, washing garments less often is the most effective way to reduce the environmental impact. By washing your jeans every 10x instead of every 2x, you can drastically reduce energy use, climate change impact, and water intake!
- + Spot-clean your clothes - often a small stain means that we wash 3kg of fabric - this seems unnecessary right? Just use a damp cloth. It also means you can rewear your jeans much faster than having to wait for when you find the time to do a full wash.
- + Make sure you check the fabric care label to make sure that you're washing your clothes on the right setting, to ensure that they will not get damaged through the washing cycle. Keep in mind that the number for the temperature is the maximum temperature that the garment can withstand - and not the advised temperature for the wash.
- + Try to purchase eco-friendly fibres, such as 100% cotton jeans, that will not release any microfibres when washed.

- + Reduce washing temperature. Higher temperatures encourage the loss of dye and fade black and bright clothes by opening up the fibres. Unless your jeans are truly filthy, cleaning denim at a cooler temperature (30 degrees C or lower), and as little as possible, will help them last longer and look better. Does your older family member believe that you only really clean your clothes with very hot water? You can explain to them that detergents (such as Ariel and Persil) have evolved significantly in the last decades, and for clothes not including baby clothing, towels and bedding, they can effectively kill bacteria and remove stains.
- + Always wash at full load.
- + Only use a small amount of detergent on a delicate cycle. Find a list of good detergents [here!](#)
- + Protect the most visible part of your favourite pieces.
- + For knits, hand wash over machine wash when needed and lay flat to dry.
- + Wool barely needs to be washed, especially because wool jumpers rarely touch our skins, so they don't absorb sweat. If they do absorb an unpleasant smell, they just need to be hung out and the material will naturally lose it! If you do have to wash them, and can't just spot clean a stain, make sure you hand wash, or wash cold with a delicate spinning setting, and hang dry. This way you won't create pilling, and your jumper could last forever.

- + Leather is a tricky one to wash, but the great news is that it barely gets stained, it's naturally moisture resistant, so as soon as it gets stained, try cleaning it out with a bit of water.
- + For all clothes try to avoid drying and ironing as much as possible. Generating heat requires vast amounts of energy. Hanging your clothes can be a pleasant and mindful activity, which can also reduce your electricity bill. Give clothes a shake and smooth them out before you hang them up, so that they don't dry and set with creases.
- + Consider using a filtering bag or ball that traps microfibres during washing.

garment  
care

what  
to look out for

how to buy  
better

Good news! 100% organic natural fibre jeans, t-shirts, and shirts are produced by many brands. Look out for them, and remember that there is a lot more than just the fabric to inform yourself on, so give the tag a proper read.

GINETEX, the International Association for Textile Care Labelling, has developed an internationally applicable logo for sustainable care. Consumers are given information to help them reduce the environmental impact of caring for textile. Look out for Clever Care on your labels. Apparel companies such as G-Star Raw and Stella Mc Cartney are adopting the clevercare.info logo on their care labels.

Want to reduce microfibres getting in our precious water? The Guppyfriend laundry bag, which is also supported by Patagonia, and the Cora Ball, which does not require you to put your clothes in a bag during washing, are the two best known options to reduce microfibres in your wash. Another option is Gulp, a device that traps fibres by connecting between the outflow pipe and the drain. Lint LUV-R and Planet Care are filters that can be retrofitted to machines, although these filters are less effective than the named options. Find the listed products [here](#).

Self cleaning surfaces? Seriously? Well - don't get too excited yet - there is not a garment available yet that can be bought and used for a lifetime without ever seeing a wash. But, of course nature being amazing, it has developed self-cleaning surfaces, that are a class of materials with the inherent ability to remove any debris or bacteria from their surfaces in a variety of ways. The self-cleaning functionality of these surfaces are commonly inspired by natural phenomena observed in lotus leaves, gecko feet, and water striders to name a few. Research is being done into ways to use this in garments, so stay tuned, because we might hear some surprises soon.

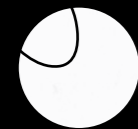
## *Certifications to Look For*

- + Fairtrade
- + B Corp
- + EcoCert
- + Cradle 2 Cradle
- + Fairwear
- + FSC
- + Climate Beneficial
- + Good On You

garment  
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what  
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## PURCHASING QUESTIONS

Before you buy, we challenge you to ask yourself the four questions:

- + Do I really need this?
- + What is it made out of and where was it made?
- + Is there a repair service?
- + What will I do when I am done with it? Upcycle, restyle, or resale?

At Simply Suzette we we spend our time looking for solutions, which naturally led us to adding more questions and searching for more answers:

- + Is it designed for durability? (see the End of Life section)
- + Is this something that I can style in different ways and wear often?
- + Have I looked for a vintage/second-hand alternative?
- + Does it have a clear care label, including tips to wash it in a sustainable way?
- + Am I prepared to keep loving this item even if it slightly changes in colour or feel?
- + If it ever gets damaged in the future, could it look cool with repair stitches, patches, or embroidery? (we are thinking of our favourite upcycling brands)

If you are already on your degrowth journey, trying to consume less, we challenge you to try the Rule of 5 by Tiffanie Darke!

Bonus Tip: If you're shopping online, look for digital sizing solutions like body scans to get your perfect fit and avoid the GHG emissions of shipping & returns!

## BE CURIOUS

In a world where big companies can cover their actions with more publicity stunts, it is important to ask questions and dig deeper. Knowledge is power! The more you know about a company, the more you can make educated purchases.

buy less, choose well, make it last

## DO SOMETHING

We can change our mindsets and ask the questions, but doing something about it is the hardest part. Sustainability is a journey that looks very different for everyone. It can start with taking your old clothes to a donation center, or saving up to buy a good quality pair of jeans that will last you years instead of your \$20.00 pair that barely lasted one season. For Ani, owner and founder of Simply Suzette, it started with buying her first pair of sustainable jeans and grew from there.



## step 6:

*Not to be dramatic, but the total quantity of fashion waste is estimated to reach 148 million tons in [2030](#).*

end of life

Sadly the majority of clothing waste is incinerated or ends up in landfills in the Global South. The latter is not a good solution: natural fibres take hundreds of years to decompose and release greenhouse gases into the atmosphere, and synthetic materials are not designed to decompose at all and may release toxic substances. We clearly need better solutions for the end of the life of garments. Some of these solutions might be available with new technologies and AI. If you are interested in how AI can be used to reduce waste and improve manufacturing, read more about it [here!](#)

best practices

what can you  
do about it

## Durability And Circularity

What if there was no need to end the life of a garment at all?

The concept of durability looks at eliminating waste by making items that last much longer, which can be achieved by using resistant materials, not applying processes that destroy the fibres, and reducing the amount of times a garment has to be washed.

Durability is often measured as the number of times a garment can resist a certain type of test, that measure values such as abrasion, tensile and te strength, burst strength, stretch and recovery, perspiration tests, croaking, colour resistance to lights and washes, and staining. Garments that don't look the same after a few washes are definitely not durable!

What if I get bored of a style, or my clothing item doesn't fit me anymore? Depop, ThredUp, Vinted, Ebay, second hand stores, and many more models are great solutions to allow people to exchange clothes. These systems need strong garments that can be shipped around the world, exchanged, worn, washed, and resold, which ties back to the concept of durability.

### Design for Circularity

Circularity is a concept which completely eliminates the concept of waste, both in terms of materials and value. Basically the end of life of a garment becomes the beginning of something else.

We have a huge respect for designers who are doing all they can to design the best garments they possibly can because as we've heard before, 80% of the impact of a garment comes from the design stage! But, not all designers have the knowledge to produce circular apparel and textiles.

## How are circular apparel items actually different?

+ All should have metal trims should be removed entirely or reduced to a minimum - as they are hard for recyclers to remove and are usually cut off and subsequently landfilled or incinerated (Lil tip: look to historic pocket designs and their use of clever bartacks)

+ All must have recyclable materials which can be kept in use once a product and its components can no longer be reused or repaired.

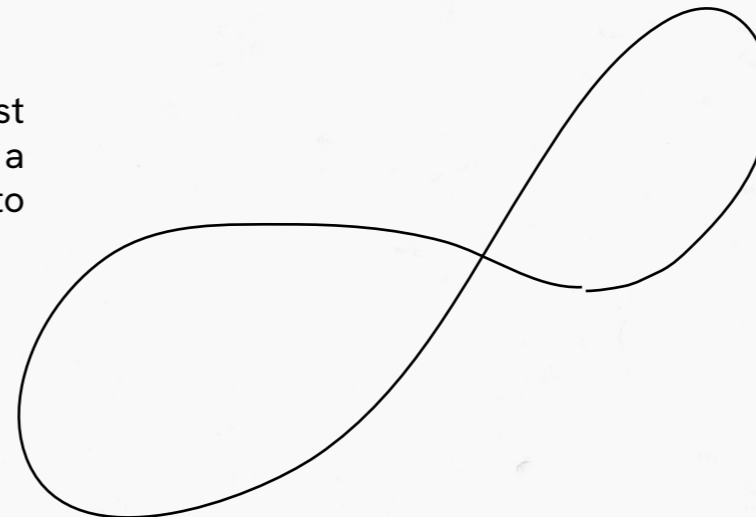
+ Alternatively, materials can be compostable, but should never only have incineration or landfilling as their only option

+ All must be identifiable and traceable

+ No hazardous chemicals should be used in the manufacture of the jeans as they can cause allergic reactions and respiratory diseases etc. in the garment workers and consumers

+ Take back schemes must be in place for consumers to return their items, that are then either resold or upcycled by the brand. The brand must also have the proper reverse logistics in place to send pieces that cannot be resold or upcycled to garment recyclers.

A good certification to look for is **C2C (Cradle2Cradle)**.



When designing for longevity, durability, and reparability, the aim is to extend the use of a garment. On the other hand, when designing for disassembly, recyclability, or compostability, the aim is to ensure that products and materials return to the system and can be regenerated through a biological or technical cycle. But, in order to cycle products successfully, we need to know EVERYthing that went into making it. Traceable supply chains and materials make this much easier to do so.

best practices

what can you  
do about it

## RECYCLING INTO NEW YARN AND FABRIC

The best solution is to keep clothing being used as clothing. Ideally forever. Brands like Atelier and Repair or Bengabelknits have taken fashionable repairs to the next level, however sometimes there is no hope for your clothes to be used any further, as they could be too torn or stained. That is when recycling comes into place. It conserves natural resources and reduces the need for landfill space. So, what are the options?

+ Mechanical recycling of cotton means that fibres are extracted and spun again, without using any water. The issue is that the length of the fibres becomes much shorter, therefore of lower quality and strength, so they have to be combined either with virgin cotton or with polyester. For wool, mechanical recycling is the most suitable solution, and an extremely high quality can be maintained, using little energy and water. [Rifo](#) is an example of an Italian startup specialising into this.

+ Chemical recycling of cotton is the newest area of research, examples of companies doing this are [Renewcell](#) and [Infinited Fibre](#). Pulp is extracted using chemical processes, and this material is used to make new textiles such as Viscose. The limitation here is that the chemical process only works on fabrics that have minimum 98% cotton content.

+ Cellulose based fabrics can be turned into new cellulose if they aren't mixed with plastic-based yarns, in the same way that cellulose is extracted initially from renewable natural resources or waste

+ Plastic based fibres are nearly impossible to recycle into new yarns, because the quality of the plastic is reduced too much through the processing. There are a few startups looking into this, but the scale is extremely small, and it's still too cheap to produce virgin plastic. [Circ](#) recycles discarded clothing to produce the basis of petroleum- and plant-based fabrics. Circ's virgin-equivalent, market-grade dissolving pulp and petroleum monomers can be sold at the same cost as virgin materials to manufacturers who make fibres.

## RECYCLING INTO NON-FABRIC

Surely there must be a solution to the problem of fabric waste. Is there no other industry that would be happy to collaborate? The construction industry is always looking for large volumes of cheap materials right? Downcycling is a concept which describes how a material loses its value through a recycling process, and is repurposed as a lower quality item. This is often the case for textile waste reused in construction, mostly as an insulating material to fill walls. Textile waste is also used to fill mattresses and make rugs, however they are considered low quality items.

Leathers have the benefit that they are extremely durable, however they can also get damaged and need to be discarded. Vegetable tanned leathers can be composted under specific environments, and other types can be shredded similarly as for textiles.

(Slightly off topic) Have you ever heard of Precious Plastics? It is a wonderful initiative which is present in lots of countries around the world, based on open source information on how to recycle plastic through shredding, heating, pressing or moulding. What if the same was done for fabric waste?

What if we used fabric waste instead of other materials that have a high impact? Check out two amazing projects that turn fabric waste into tiles and furniture:

- + [Fab-Brick](#)
- + [Stelapop](#)
- + [PLANQ](#)
- + [Nazena](#)

best practices

what can you  
do about it

Let's ditch our take - make - waste model and move towards a circular one where we design out waste and pollution, keep products and materials in use for as long as possible, and support a world that could produce less because items are circulated longer. For the fashion industry, this means rethinking and redesigning clothing so that old clothes can be used to make new, textiles are made with safe and renewable materials, and garments are worn more.

*Think about this: If it ends with you, how can it be circular?*

