

Fast fashion is ruining the planet – here’s how to make it sustainable

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By Graham Lawton

The fashion industry, which has become one of the most damaging to the planet, is having a moment of reckoning. But which changes make a difference, and which ones just come out in the wash?

A FRIEND of mine runs a vintage clothes shop in north London. Every few weeks, she visits a vast warehouse on the edge of the city to rummage through piles of discarded clothing. Most of it is worthless, but if you know what you are looking for, there are diamonds in the rough.

The warehouse has a long history. It was once a clearing house for the low-quality wool scraps called shoddy that were used to make cheap clothing for the masses in Victorian Britain. A century on, little has changed. Nowadays, it is full of modern-day shoddy: low-quality cotton, polyester, viscose and nylon, all in the form of cheap clothing made for the masses around the world. Except that this stuff is going to landfill and incinerators, not being reused.



Which fashion choices are truly sustainable?

The items are the products of an industry that, in the past 30 years, has become one of the most successful and also most destructive on the planet. Known as fast fashion, it has filled our wardrobes with cheap and cheerful clothes. But after three decades of remorseless growth, the model is butting up against fundamental environmental limits and there is widespread agreement – even from within the industry – that it is time to hit the brakes.

“The fashion industry represents a key environmental threat,” says Kirsi Niinimäki at Aalto University in Espoo, Finland. “Ultimately, the long-term stability of the fashion industry relies on the total abandonment of the fast-fashion model.”

Like fast food, fast fashion is all about instant gratification on the cheap. The term came into widespread use in 1989 after *The New York Times* reported that a new Zara outlet could have a novel item of clothing in store just 15 days after it was a twinkle in a designer’s eye. In those days, fashion houses typically created two new collections a year. Now, the fastest can rack up two a month.

This business model feeds off impulse purchases of low-priced, low-quality clothes, driven by endless novelty, says Niinimäki. Over recent decades, this pattern of consumption has become the norm for most people in the West and is spreading around the world, says Patrizia Gazzola at the University of Insubria in Varese, Italy.

Its temptations have lured consumers into buying more clothes than they need or even want, while simultaneously wearing them less and discarding them sooner. It isn’t hard to find shocking statistics about this. Fashion bible *Vogue* reports that of 100 billion items produced yearly, three in five will be discarded within the year. According to a recent paper by Niinimäki, the average US consumer buys 66 items of clothing each year – one every 5.5 days – and discards them at roughly the same rate. Other research by the Stockholm Resilience Centre in Sweden says most clothes are disposed of within three years.

This isn’t just a Western trend; according to fashion technologist Shanthi Radhakrishnan at Kumaraguru College of Technology in Coimbatore, India, the number of times a garment is worn has fallen by a third globally in the past 15 years.



Designer label Ganni offers a facility to resell preloved items like these calf leather loafers

From a business perspective, this model has been “hugely successful”, says Niinimäki. But from an environmental one, it is an abject failure. Last year, the Stockholm Resilience Centre, which developed the concept of planetary boundaries for vital life-support systems on Earth, published a study warning that the fashion industry is now so damaging that it has become a threat to the habitability of the planet.

Fast fashion has vastly inflated the industry’s size and output. Between 1975 and 2018, global per-capita textile production rose from 6 kilograms

to 13 kilograms a year, with most of the increase in the form of polyester for clothing. According to the UN Alliance for Sustainable Fashion, global clothing production doubled between 2000 and 2014. The world currently buys 62 million tonnes of apparel per year – some 100 billion items of clothing.

Even the fastest of fashionistas can’t keep up. By some estimates, about a third of clothes imported into the European Union are never sold and end up growing old and frumpy in warehouses, or are simply dumped. “Right now, garment workers, as well as being underpaid and overexploited, are also producing an inefficient and downright bonkers amount of clothing,” says Orsola De Castro, co-founder of the activist group Fashion Revolution.

The fashion industry has been slow to embrace sustainability, says Andreza de Aguiar Hugo at the Federal University of Itajubá in Brazil. “For the most part, the fashion industry still operates using a linear model of extracting, producing and disposing of resources,” she says. However, the industry knows it can’t continue like this, especially as consumers wise up to the environmental cost of their shopping habits. “We are keenly aware of the current climate, environmentally [speaking],” says Jaki Love, director of innovation and sustainability at UKFT (the UK Fashion and Textile Association). “The linear, take-make-dispose model is unsustainable. A circular model is the only way forward.”

Unsurprisingly, this juggernaut of production and consumption has a huge environmental footprint. Establishing just how big, however, is difficult. Fashion is routinely described as the world’s second most polluting industry, although the source of this “fact” is invariably a media report making the same unsubstantiated claim. Even the UN Alliance for Sustainable Fashion repeats it, but with the caveat that this is “widely believed”.

When science-based sustainable fashion website Ecocult – <https://ecocult.com/about/> – tried to establish where the statistic originated, it discovered a tangle of different numbers from various non-peer-reviewed sources. The problem is that fashion intersects with so many other polluting industries, including fossil fuels, petrochemicals, manufacturing, agriculture, logistics, retail and construction, that teasing out its individual environmental footprint is difficult.

The most authoritative number Ecocult found comes from a report by the World Economic Forum (WEF) and Boston Consulting Group on how the dirtiest industries can clean up their supply chains. It concludes that fashion is responsible for 5 per cent of global greenhouse gas emissions, making it



Only a tiny proportion of discarded clothes are ever recycled. Piles of old clothes and shoes around charity clothes collection bins, London England

the third most climate-damaging industry on Earth, after food (25 per cent) and construction (10 per cent) and ahead of cars, electronics and the freight industry.

Fashion's environmental destructiveness extends beyond greenhouse gases (see "The journey of your jeans", below). According to de Aguiar Hugo, it consumes about 100 million tonnes of non-renewable resources every year, including oil to make synthetic fibres and dyes, and chemicals to colour and finish the fabrics. It also swallows 93 trillion litres of water a year.

OUT OF FASHION

At the other end of the fashion pipeline, effluent gushes out. Textile waste is the main problem, with more than 90 million tonnes of worn out, unwanted or unsold clothes being discarded every year. On top of that, more than a tenth of the fabric sent to garment factories ends up as off-cuts. Globally, less than 20 per cent of this waste is recycled; the rest ends up in landfill, incinerators or the environment. The Stockholm Resilience Centre says that 85 per cent of litter on beaches is textile waste. "Every second, the equivalent of a garbage truck of textiles is burned or landfilled," says Tatiana Valovaya, director-general of the United Nations Office in Geneva, Switzerland.

That isn't the end of it. About 20 per cent of the world's industrial waste water is created by treating and dyeing textiles, and textile production also dumps 190,000 tonnes of microplastic pollution into the ocean each year, which is about a third of the total. Yet more microplastics are generated by laundering and drying clothing, and when discarded items degrade. According to the UN, a total of half a million tonnes of textile-derived microplastics find their way into the seas every year.

Caring for clothes also consumes vast quantities of water, energy and detergents. A report by the European Commission's Joint Research Centre found that this "consumer use" phase of the clothing life cycle is the most environmentally damaging of all, especially if clothes are tumble-dried and ironed (See "Tips for a greener wardrobe", below).

All told, "the fashion industry is responsible for one of the most glaring environmental failures of our current economic system", says Valovaya.

And it is forecast to carry on failing. According to Elisa Tonda, head of the Consumption and Production Unit at the UN Environment Programme (UNEP), the greenhouse gas emissions from the industry are expected to rise by almost 50 per cent by 2030. Global fibre production is expected to rise at about the same rate, exceeding 150 million tonnes by 2030. Unchecked, the fashion industry alone will produce a quarter of the carbon dioxide we can afford to emit by 2050 if we are to have a chance of staying below 2°C of warming. Definitely not cool.

"The industry is realising that a transformation is needed," says fashion specialist Sebastian Boger at Boston Consulting Group in Munich, Germany. But as yet, he says, its pledges and actions fall short of what is needed.



What is required, says Niinimäki, is nothing less than a complete makeover, from raw material production through to consumer behaviour, to destroy the fast-fashion model and shrink the industry. That, however, won't come

easy to an industry and its eager customers that she says are mutually hooked on ever-increasing production and consumption.

Just tackling the greenhouse gas part of the problem will require an enormous effort. According to the WEF report, even if manufacturers do everything in their power – upgrade to energy efficient machinery and transport, install renewable sources of heat, use greener dyeing and other processing technologies and choose recycled fibres and textiles – that will only eliminate about 50 per cent of emissions.

The other half of the industry's emissions remain in the gift of somebody else. The biggest win – a more than 40 per cent reduction – would be for the producing countries to phase out fossil fuels for generating electricity, although this ignores the fact that many garment factories in Asia aren't hooked up to the national grid, but use their own coal-powered generators, says Boger. A further 10 per cent can be squeezed out by growing cotton more sustainably.

That pessimistic analysis, however, rests on two assumptions: first, that the industry will continue to weave away at its current rates, and second, that technology will essentially stand still. Neither is necessarily true.

Recycling technology in particular has much room for improvement. The WEF calculates that recycling will shave only a measly 2 per cent off emissions, but this reflects the fact that current methods are pretty threadbare.

At present, there are two basic recycling processes for textiles: mechanical and chemical. Mechanical is applied mainly to natural fibres such as cotton and wool, which are shredded and carded, or combed, to recreate fibres that are spun into new yarns. The problem is that the process degrades the fibres significantly. "With mechanical recycling technologies, you are weakening the properties of the fibre – you're shortening the fibre, which means that you are getting worse quality," says Petri Alava, CEO of textile recycling firm the Infinited Fiber Company in Finland. Recycled cotton must contain up to 50 per cent virgin cotton to make it viable, he says (See "The worst materials", below).

Then there is chemical recycling, which takes polymers, breaks them down into their constituent monomers and rebuilds them. This is doable for cotton, viscose and polyester, but the technologies are in their infancy and need to be improved, says Niinimäki. Recycled polyester is an increasingly common material and is often trumpeted as "sustainable" by retailers, but the vast majority is recycled from plastic bottles made of PET, a type of polyester, rather than clothing, says Niinimäki. "It's not made from polyester garments because there are some technical problems existing for recycling that type of polyester."

Mixed fibres such as cotton-polyester blends present a major challenge. Elastane is also a stretch. "Elastane is a very nice material because it gives the flexibility to clothing, but it is very nasty for recycling," says Alavi.

RECYCLING INCENTIVES

Even before new recycling techniques can be brought to bear on textile waste, there are mountains to climb. Some retailers have started collecting old clothes, rewarding customers with vouchers or other incentives to recycle old garments (and ultimately to buy new ones). But clothing waste arrives at recycling centres as a jumble that has to be sorted by hand – although automated systems are in development. Trims, such as zips, buttons and patches, must be removed and often can't be recycled. No wonder that only 1 per cent of the world's textile waste is turned back into clothing.

The process needs to change, says Niinimäki, and that is starting to happen. Infinited Fiber is one of the companies leading the charge. Using a process developed at VTT Technical Research Centre of Finland, it takes cellulose-rich waste such as cotton and cardboard, cleans it up, breaks it down into its molecular units and re-polymerises it into a new fibre called Infinna. This is a synthetic fibre similar to viscose, but without the need for virgin wood pulp and harsh chemical processes. The

cycle can be repeated endlessly, each time generating new fibres, so there is none of the decline of quality seen with mechanical recycling, says Alava. The technology can also be retrofitted into existing viscose factories and the chemicals recycled to cut waste to a bare minimum.

Infinite Fiber is in the pilot stage, but is planning a large factory with an annual capacity of 30,000 tonnes, due to open in 2024. It envisages piles of discarded rags arriving on pallets, being sorted and processed and leaving as bundles of pristine white yarn for use by its customers, which already include big clothing brands H&M and Patagonia.

Several other companies are working on similar technologies, including Renewcell of Sweden, which makes a cellulosic fibre called Circulose. “There’s a lot happening, but Infinite Fiber is the most advanced, they are really close to commercialising this technology,” says Niinimäki.

Another company trying to break the linear model is Teemill, based in the UK. It makes garments from pure cotton and natural dyes using 100 per cent renewable energy. It holds a stock of basic garments, but only dyes and finishes them once somebody has ordered, which eliminates much of the waste of fast fashion. Crucially, every item of clothing has a label with a QR code, which can be scanned at the end of its life to get instructions on how to return the item to Teemill for recycling, in return for a discount on the next order. Eventually, Teemill hopes that there will be enough discarded cotton coming in to meet the demand for new clothes. “The material stays in use and doesn’t enter landfill. It just flows round in a circle – out to the customer, back to the business, out again to the customer,” says Teemill founder Mart Drake-Knight. “We see the customers as custodians of the material.” Teemill, which gets 5 out of 5 on the ethical and green fashion rating website Good On You, also makes its software and manufacturing facilities available for free so budding designers can start their own brands and together build a new circular clothing economy. “We could wait for all of the big brands to change,” says Drake-Knight. “Or co-create an alternative future where they get replaced.”

The goal of all these companies is to “close the loop” – that is, to create a circular economy in textiles where today’s waste products are the feedstocks for tomorrow’s clothing and so on in an endless cycle. As well as stemming the industry’s waste stream, this would go a long way to reducing the pressures of generating virgin materials such as cotton, wood pulp, polyester and wool.

We aren’t there yet, though, says Niinimäki, and there may be some loopholes that cannot be closed. Some mixed fibres may prove impossible to recycle and may have to be phased out, possibly including the cotton-polyester blends that make up a significant proportion of fast fashion items. At present, the cotton can be extracted and recycled but the polyester remains stubbornly disposable. “It might be that we have to redesign our guidelines about what kind of fibres we can use in the textile for fashion so that they are easier to recycle at the end of their life,” says Niinimäki.

Polyester may have to be sacrificed altogether, although that would be a shame, she says. “It’s a good fibre, especially in sport clothes because of its functionality. It’s not easy to substitute.” Ditto elastane, although there are emerging alternatives. And some virgin materials will still have to be produced to fulfil demand, she says.

In the EU at least, there isn’t much time to solve these problems. The bloc has set itself a target of 2025 for all textile waste to be collected for reuse rather than landfilled or incinerated, and for an



Colourful, yes, but dyes add to fashion’s environmental impact

effective recycling system to be in place. That is sending clear signals to the industry that it is time to switch to a circular model, says Niinimäki, but their level of preparedness is debatable.

“Companies are quite aware that there will be a change, but they are a little bit lost, they don’t know how to do that change.”

And closing the textile loop only solves part of the problem. As the WEF report makes clear, the textile and garment manufacturing industry in Asia is where most of the industry’s environmental impacts come from. That could be mitigated by cleaner and more energy efficient processes and decarbonisation of the host countries’ energy supplies, but a more immediate lever is to be found closer to home: us. “Consumers must be ready to pay higher prices,” says Niinimäki.

There are signs that people are becoming more aware of the negative environmental and social impacts of fast fashion and are looking for alternatives. “Consumers are saying that the supply chain should be much more transparent so that we actually know exactly where these garments are made in what kind of conditions,” says Niinimäki. “This seems to be more and more important as background information for the purchase decision.”

Getting that information, however, isn’t straightforward. Clothing labels are fairly uninformative beyond saying where and of what the garment was made, and how to care for it. Where the textile came from and what to do with it at the end of its life don’t feature. But that probably doesn’t hide very much. If it was cheap and bought in a high-street store, then chances are it is fast fashion.

Retailers are also responsive to consumer trends and increasingly offer options that sound environmentally friendly, such as lifetime guarantees, repair services and buyback schemes for unwanted items. But greenwashing is rife in this area, warns Niinimäki, especially among the big players who have the most to lose from abandoning the status quo. Even so, they also know that business-as-usual is running out of road. “The industry knows that Earth’s capacity to produce raw materials and assimilate polluting emissions can become a constraint on its growth,” says Tiina Häyhä at the Stockholm Resilience Centre.

SLOW FASHION

The only real way to break the cycle is for consumers to deliberately slow down. According to a recent report by the Ellen MacArthur Foundation, the single most effective way to make a difference is to increase the average number of times clothes are worn. “Lifetime is really critical here,” says Niinimäki. That means not just buying fewer garments and wearing them more, but also opting for better-quality and more expensive ones, hanging on to them for longer and planning for their afterlife. Buying second-hand, repairing old clothes and embracing new models of ownership such as leasing can also help. Such a shift in consumer demand will eventually feed back to the garment industry and help to break the fast fashion model, says Niinimäki.

Whether punters will accept such radical change has yet to be properly tested. There can be no denying that fast fashion is fun, entertaining and a source of emotional fulfilment for many of us. Asking people to swap it for hair shirts is bound to fail.

But by definition, fashion is about innovation, novelty and trendsetting, and right now there is plenty of that. “I see optimistic signs,” says Niinimäki. “Textile recycling, renting and leasing, repair services, quality guarantees, collecting back old garments and reselling them, redesigning new garments out of old ones – all these give a positive vibe that it is possible to make the fashion business more sustainable. Of course, there’s a lot of work to do, but I’m optimistic.”

THE JOURNEY OF YOUR JEANS

To understand where the environmental impacts of clothing come from, consider the cradle-to-grave life of a pair of jeans.

The starting point is a cotton field somewhere in Asia, probably India or China. A cotton crop takes about 160 days to grow, sluiced with water and chemicals, after which the fibre is harvested and separated from the rest of the plant. The raw cotton is sent to a factory to be washed, bleached, dyed and spun into yarn. At this point, small amounts of the synthetic fibre elastane – also called spandex or Lycra – may be added, which adds a pleasing stretchiness, but can rebound when it comes to disposal, as it makes the fabric very hard to recycle. The yarn then moves on to a textile factory to be woven into denim, from where it goes to yet another factory to be cut and sewn. Buttons, zips, linings, labels and patches – usually manufactured elsewhere – are added here.



[Do you know where your jeans have travelled?](#)

Most of these production processes are labour and resource-intensive and happen in places where wages and environmental standards are low, often south and South-East Asia. According to Kirsi Niinimäki at Aalto University in Espoo, Finland, it isn't unusual for each step of the manufacturing process to occur in a different country.

Once finished, the jeans embark on the second phase of their life cycle. They are shipped in large quantities to distribution centres in North America and western Europe, where consumer demand tends to be highest. Clothes usually travel by boat, but air freight is increasingly common, says Niinimäki, as the fast fashion cycle accelerates. This distribution phase also generates waste in the form of packaging, tags and hangers.

From the distribution centres, the jeans are dispatched to physical or online retailers and some of them are bought by consumers, worn, washed a few times (see graphic, below), then ditched. Some go straight into the bin; others are put in recycling banks.

Regardless of where and how consumers dispose of them, discarded clothes generally end up in one of two places: landfill or incinerators. Some are shipped to developing countries, mostly in Africa, to be patched up and resold or dumped all over again. Only about 20 per cent are recycled in the country where they were worn, largely for one-time “downcycled” applications such as cleaning cloths and insulation materials, which also eventually end up in landfill or incinerators. Just 1 per cent of the textiles from discarded clothing are re-spun into new fibres for clothes.

Every step of this long and convoluted journey – a garment and its components can travel the equivalent of several times around the world before being put on sale – has environmental impacts, guzzling energy, water, oil and synthetic chemicals, and disgorging all kinds of waste.

According to a report by environmental research group Mistra, the production, consumption and disposal of a single pair of jeans manufactured in Asia and bought in Sweden emits the equivalent of 11.5 kilograms of carbon dioxide – about the same as driving a car 60 kilometres. And that doesn't take into account the impact of laundering, which can be the main contributor to the carbon footprint of clothing. According to the United Nations Alliance for Sustainable Fashion, the process also consumes around 7500 litres of water, the amount an average person drinks in seven years.

THE WORST MATERIALS

Cotton accounts for about 25 per cent of global fibre production, and is widely regarded as the most environmentally damaging raw material for making clothes, largely due to the cotton plant's thirst for water and use of fertilisers and pesticides. But the alternatives are scarcely better. Polyester, which overtook cotton production in the 1990s and now accounts for about half of global fibre production, is made from petroleum and is non-biodegradable. It is hard to recycle and releases microplastics when laundered. By weight of fabric, its energy consumption and carbon footprint are greater than that of cotton. Synthetic polyamides such as nylon are even worse.

Half-synthetic textiles such as rayon and viscose – which are made from wood pulp and other plant material in chemical factories – are theoretically better because they can be produced from renewable resources. Yet manufacturers are often criticised for using unsustainable wood and manufacturing processes that rely on non-recyclable polluting chemicals. What's more, even though the cellulosic fibres created are biodegradable, they emit methane in landfill. The overall environmental footprint of these synthetic cellulosic fibres is only slightly smaller than polyester's.

Fully natural fibres aren't a good alternative. Wool has a huge carbon footprint because it comes from sheep and other methane-belching ruminants. Silk, which requires large amounts of energy to grow and maintain mulberry trees in which silk worms thrive, is the worst of the lot.