

While most of the Western world's unwanted garments are passed on or sold in emerging countries, new solutions are furthering the quest to upcycle those that cannot be reworn.

Closed-loop clothing recycling: a many-faceted challenge

As individuals, we each generate some 28 kilos of garment and textile waste every year. Those are the figures for the UK in 2009, according to data compiled by WRAP (Waste & Resources Action programme), an industry-wide programme to assess and reduce waste in the UK and which has headed the Sustainable Clothing Action Plan (SCAP) since 2011.

In the US, the Environmental Protection Agency (EPA) estimates that consumers on average throw away 37 kilos of used clothing and home linens every year, of which 85% end up in landfill. Only 14.4% of clothing and footwear, and 17.8% of towels, sheets and pillowcases were recovered in 2012. Of these, the Secondary Materials and Recycled Textiles Association (SMART) believes that 95% could have been reused or recycled.

Add to these the (very roughly) estimated 20 million tonnes of textile waste generated yearly in China, as reported by Redress, a Hong-Kong based charity. All combined, they result in an extremely large mixed bag of unwanted stuff.

While research and development into garment recycling processes is under way, business and consumer attitudes are also slowly changing, thanks in part to collection schemes set up by high street retailers such as Marks & Spencer, H&M and Uniqlo. In the UK, SCAP signatories, which are said to represent 40% of the UK clothing market based on retail sales value, have pledged to use "lower-impact fibres", extend the active life of the clothes they sell, and increase re-use and recycling.

In France, the state has taken measures by implementing what is called an Extended Producer Responsibility (or EPR) with a law that came into effect in late 2008. Manufacturers of

Extended producer responsibility applied to clothing, home linens and shoes in France has led to the creation of an industry-managed organisation, Eco-TLC, in charge of finding new ways of collecting, sorting and recycling these categories of products at their end of life.

Eco-TLC

clothing, home linens and footwear (TLCs in French) are now held responsible for providing or managing the recycling of their products at the end of their usage. To achieve this, Eco-TLC, an industry-managed non-profit private company, was set up to investigate and invest in clothing and footwear recycling processes. It is funded by an eco-contribution paid on each kilogramme of product put on the market, corresponding roughly to a half cent per item or €20 per tonne, says Alain Claudot, Eco-TLC general manager. The organisation claims to represent 93% of the French industry, with some 5,000 members, and to have levied €13 million in 2013. Since 2012, member companies that use recycled raw materials are awarded a 50% rebate on the eco-contribution for any product that contains a minimum of 15% post-consumer recycled fibres.

Despite the industry-wide framework, Mr Claudot says that the French are not the biggest recyclers of clothing, linens and footwear. In 2012, of the 9.6 kg of unwanted items thrown away or put in kerbside bins per inhabitant, he says only 2.4 kg or 25% were collected for reuse or recycling, compared to 50% in the UK and Germany.

The Vallée du Recyclage (Recycling Valley) is one several collective research programmes set up to find ways to turn used textile consumer goods into a resource. Officially launched in June 2013, the programme covers both Belgium and the north of France, to maximise its potential, and its long-term goal is to create a closed-loop textile recycling system. "There are many different processes involved and the supply chain is very fragmented," says Jeanne Meillier, the project's manager. For the moment the organisation is focusing on identifying the "missing links" in a process that she sees as having at least five stages: collecting, dismantling (which applies to upholstery and cars more than to clothing), sorting, turning waste into a new raw materials, and finding applications and end-markets for them. Logistics is another piece of the puzzle. "The French post office seems willing to contribute as it can fill the vehicles that travel with empty loads," she says.

Like other garment recycling processes in gestation, so called "pure" materials are seen as having the most potential. "Pure" in this case refers to clothing made in 100% cotton, 100% polypropylene (as disposable clothes often are) or 100% polycotton, such as workwear. "Workwear is fairly homogenous and the supply chain is often shorter than for high street fashion," says Ms Meillier.

Progress in closed-loop recycling

Many view workwear as a field in which to test recycling processes before applying them to consumer garments. A consortium funded by the UK government, set up to investigate the issue, is currently testing a yarn technology known as wear2. "Our idea originally was to find a way to remove embroidered logos from workwear in order to reuse the blank clothing from which the institution or company's name has been removed, be it the police or a corporation," says Andrew Hewitt, a textile engineer and grant manager at NIRI, a technical textile laboratory spun off of Leeds University. "As removing the embroidery often damaged the garment, we first looked to place the embroidered logos on pockets, and ended up developing a sewing thread that loses its tensile strength when subjected to microwaves," he says. The patent is jointly held by NIRI and microwave specialist C-Tech. "The bicomponent thread has a moderately conductive core that is 'fried' when heated. The operation also weakens the surrounding thread but does not damage the fabric," says Mr Hewitt. In addition, he says the microwave equipment uses one-third of the power of domestic microwave ovens. Workwear, high street and fashion brands are currently testing the thread.

There remain a number of challenges before wear2 becomes widespread, a major hurdle being the fashion industry's extended supply chain. "The company that sews the clothing is not the one that will benefit from its recycling,



A few items in the adidas performance range by Stella McCartney are designed to reduce waste on the factory floor and are labelled "Low Waste".

Stella McCartney/Adidas

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and will therefore not be able to recoup the higher cost of the sewing thread," notes Mr Hewitt. At the end of the chain, it is necessary to identify the presence of the thread in a discarded garment in order to have it sent to a microwave-equipped facility. This implies tracing the product, an additional cost. "It would be great if wear2 were widely adopted rather than exclusive to a particular brand," says Mr Hewitt.

In Japan, Teijin's Eco-Circle process, one of the few closed-loop recycling systems in operation, was developed in 2002. The chemical process depolymerises 100% polyester clothing and Teijin says 160 clothing brands have become partners. Patagonia, one of the project's instigators, launched the Common Threads recycling scheme for its 100% polyester Capilene underwear in 2005, and the bins placed in the brand's stores have since collected 56.6 tonnes of clothing of all types.

Renewcell in Sweden is working on dissolving cellulose-based clothing made in cotton, viscose, Modal or lyocell, to produce a recycled pulp that can be spun into new lyocell fibres. A pilot plant has been set up and a first item of clothing made from the recycled pulp was presented in late June (*see WSA, April/May 2014*).

Worn Again, a company that initially specialised in upcycling used garments, has since moved on to the grander project of developing a closed-loop recycling technology that chemically separates and 'recaptures' polyester and cellulose. "Our intention is to turn them back into equivalent virgin resources at the same quality and price," says Worn Again founder and director, Cyndi Rhoades. The 'recapturing' of polyester into PE chips is said to be near finalisation, while the cellulose process is further behind, she says. The process is being developed with UK-based The Welding Institute, but Ms Rhoades was unable to go into any detail before the programme's official launch this October.

Collecting and reusing

The age-old tradition of donating used clothing to charities that will find new users for a significant proportion of these is widely regarded as the most cost- and environmentally- effective way to reduce the impact of end-of-life textiles. Extending a product's lifetime has the largest effect on reducing waste footprints according to data compiled by WRAP (9% on post-consumer waste and on consumption of new clothing) and on cost (again by 9% on both post-consumer and reduced consumption of new clothing).

I:CO, a Swiss company founded in 2009, has made it its mission to collect, recycle and upcycle discarded clothing and shoes. The company works with 46 retailers, including H&M, Puma, The North Face, Levi Strauss & Co, Forever21 and Skunkfunk. US retailer American Eagle Outfitters recently expanded its partnership with I:CO to its 800 branches located in the US and Canada. Some 3,000 collection points are now in place in Europe and North America, and I:CO plans to have 135,000 bins installed by 2017 by signing up retailers in Asia, Australia and even Africa. The collected items are sorted by German company Soex and, of these, 52% are reworn, 9% reused as cloth, 33% down-cycled into fibres or padding materials and the remaining 6% found to be unusable.



Wear2 is a bicomponent thread with a moderately conductive core that loses its tensile strength when subjected to microwave radiation to facilitate the recycling of clothing; it was co-developed by NIRI (Leeds University) and C-Tech in the UK.

Wear2

In addition to collecting used clothing, I:CO also promotes upcycling. "To reach our goal of bringing and keeping products in a closed loop, all actors involved in the product cycle have to cooperate – producers as well as retailers. To make this happen, we try to support closed-loop solutions on different levels. Every two years, with the I:CO Award we distinguish exceptional, experimental and innovative scientific research that aims to keep textiles and footwear in a perpetual cycle of use," says a company spokesperson.

I:CO is currently working on seven upcycling projects, and says 36 further projects are in the planning stage. A first closed-loop project was conducted with H&M. The fast-fashion retailer presented a series of jeans made with up to 30% recycled cotton collected by I:CO. As Marks & Spencer has done in the past, H&M goes to great lengths to broadcast its eco-conscious measures, stating that it collected 3,047 tonnes of used garments in 2013.

At The North Face, 27 stores now have I:CO bins, receiving more than 2,000 kilos of clothing in the first half of 2014, according to the brand's US sustainability manager James Rogers.

For Alain Claudot, the charity-based industry for collecting and sorting used clothes is thriving. "The cost of collecting and sorting is low, and the

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quality, despite what some may say, is high. In France, 60% of collected clothing, home linens and shoes are suitable for resale in thrift or charity stores," he says.

Regarding the implementation of closed-loop recycling, the general manager of Eco-TLC identifies three key challenges: "we need to step up research in recycling technologies that will enable old garments to become new fibres. The value of recycled garments is also an issue. As it stands now, to make a recycled garment of value, recycled content can only account for 15% to 30% of the total at best." The third is consumer demand: "Clothing with recycled content has to become desirable and trendy," he says.

Waste not design

Another option is to make garments that are easy to sort, recycle or upcycle. I:CO, Eco-TLC and Lenzing are taking measures and a few brands have risen to the challenge. These efforts however tend to focus on specific product ranges or items.

In 2013, Dockers, a Levi Strauss & Co. brand, introduced Wellthread, a line designed to be easy to recycle. The products are made in long staple cotton yarns, which are said to have higher recycling value; sewing thread and pockets are made in 100% cotton, and sundries are made in compressed cotton or metal that can be extracted by magnets, the company says. In addition, the clothing is garment-dyed to order, to reduce excess inventory.

Well-known for her sustainable outlook, Stella McCartney has introduced a few items in the adidas performance ranges she designs that are intended to reduce waste on the factory floor. The so-called Low Waste products introduced in the spring-summer 2014 collection are the result of new attention to pattern-making and cutting to ensure that 95% of the fabric used creates the final product, with the remaining 5% recycled or repurposed, so that no surplus material goes to waste, the company says.

Durability first and foremost?

Outerwear brands continue to emphasise durability over recyclability. "We've always been dedicated to building products that last, backed by a lifetime warranty, allowing people to depend on our products and minimise the need to buy more," says Mr Rogers at The North Face.

A similar tune is heard at Patagonia, specifically regarding its Gore-Tex lined jackets: "One of the chief environmental benefits of Gore-Tex fabrics is their longevity. Durability enables a long and useful lifetime of the finished product, resulting in substantial savings of raw materials and energy that would otherwise be required to manufacture multiple units of shorter-lived products," the company says on its website.

Whether designed for easier recycling or longer lasting use, a garment's end of life generally remains low on brands' priorities today. Many believe that the strongest drivers of change would be true cost reporting and the implementation of producer responsibility measures on a broader level. At consumer level, it is believed that the economic crisis has had a positive effect on buying and using behaviours, as we slowly and possibly collectively begin to think about what happens to our clothing when we no longer want or need them. While extending a product's use and reuse remains a positive recourse or option, the new closed-loop solutions under way will also enable waste to become a valued resource.



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