

CIRCLE Textiles

CLOSING THE LOOP FOR WORKWEAR



INTRODUCTION: PROJECT, CONTEXT AND KEY RESULTS

MAKING THE CASE FOR CLOSED LOOP WORKWEAR



In 2016, Circle Economy partnered with Salvation Army ReShare and [Recover](#) to recycle used workwear of the Dutch military into new textile products. The aim of this strategic collaboration is to show the market that used workwear can be transformed into new, beautiful, high quality products while at the same time achieving significant environmental savings. In this project, Circle Economy, Recover and ReShare have successfully brought to the market humanitarian aid blankets produced from used workwear materials.

ReShare had been faced with the challenge of finding a sustainable and safe solution for approximately 600 tonnes of old military workwear donated to them by the Dutch Ministry of Defence. Historically, these uniforms were destroyed (incinerated) because there were significant safety issues associated with these materials being used again. However, some years ago, the Dutch Ministry of Defence saw that these used textiles could also be used again as raw materials for new products and that their Ministry could play a leading role in developing the market for high value recycling. From that moment, ReShare had a mission to explore and research commercially feasible options for high value recycling of these materials.

For this project, several tons of old Dutch navy and army uniforms were successfully transformed into new yarns that were used to produce humanitarian aid blankets. The Life Cycle Assessment on the yarns made with 80% recycled military uniforms shows a reduction in water consumption by 87%, decreased energy use by 42% and a reduction in CO2 emissions by 33%, when comparing with a non recycled yarn.



"Ultimately, old uniforms, workwear and other used textiles should not go to waste but should be put back into the loop via high value (textile-to-textile) practises. We are happy that we can contribute positively to the circular movement in the textile sector through this partnership."

- Michel Rosenquist, Manager relations at Salvation Army ReShare

INCREASED POTENTIAL FOR HIGH VALUE RECYCLING



High Value or textile-to textile recycling enables textile 'waste' fabrics or garments to be redirected back into the textiles loop as recycled raw materials. Currently, textile 'waste' streams throughout the supply chain remain a largely untapped resource due to the lack of established technologies, processes and business models to redirect these fibres back into the loop. This is however quickly changing due to the growing interest of the textile industry in circular economy and the technological advancement that can enable a circular textiles industry.

- In the US and EU, approximately 85% and 75% of used textiles ends up in landfill/incineration respectively. This adds up to a post consumer textile 'waste' stream of ± 14 million tonnes/yr. If these textiles would be collected, $\pm 55\%$ could be reworn; $\pm 20\%$ could be downcycled, and $\pm 20\%$ would be suitable for textile-to-textile recycling.
- In the Netherlands, 30 Kt of workwear and uniforms are annually thrown away by companies and governmental organisations. The majority of these resources is confidentially destroyed via incineration to protect brand reputation and to avoid garments such as used police uniforms falling into the wrong hands.

Leveraging these untapped 'waste' resources to create new textiles on a large scale would enable us to drastically cut down our need for virgin textile resources, reducing significantly the impacts associated with fibre production and textile waste.

Mechanical recycling methods are already playing a crucial role in paving the road to circular, offering 'textile to textile' solutions that proximate virgin quality and that are ready for further scaling. Furthermore, game changing chemical technologies are on the horizon and are expected to provide the scale that is needed to generate a tipping point in closing the loop for textiles.

WHAT IF...?

It is estimated that **30 Kt** of workwear and uniforms, discarded annually in the Netherlands, are suitable for fibre recycling. If all these untapped resources were to replace virgin textile materials, the environmental impact reduction would amount to approximately:



Energy:
62500
households
for a year



Water:
104 million
showers



CO2:
56000
international
flights per person

PROBLEM:
ENVIRONMENTAL IMPACTS OF
TEXTILE PRODUCTION AND
WASTE

TEXTILES AS THE SECOND MOST POLLUTING INDUSTRY IN THE WORLD

At a rapid pace, the textile industry has become one of the most polluting industries in the world. Consumption has risen through the roof and we are spending more money on clothes than ever before. To enable us in our growing consumption habits, global textile fibre production has risen to ± 90 million tonnes per year (± 80 billion garments per year). This level of production is economically unstable and ecologically unsustainable.

Upstream, the production of textile fibre is extremely water, land, energy and chemical intensive and reliant on finite resources. Downstream, increasing environmental impacts can be seen due to the growing volumes of post-industrial, pre-consumer and post-consumer textile waste. We are using resources and producing waste too fast for the planet to keep up. According to the report 'Sustainable Textiles for Apparel: Fact, Fiction and Future Prospects', a doubling in the number of consumers and an 84% hike in demand for textile fibres over the next 20 years will stretch resources to breaking point.



IMPACTS OF COTTON & POLYESTER FIBRE PRODUCTION

Most workwear is made from a blend of cotton and polyester because in this way the breathability and softness of the cotton, can be combined with polyester properties like colour stability and resistance to abrasion and repeated washings, which are all desired qualities for workwear.

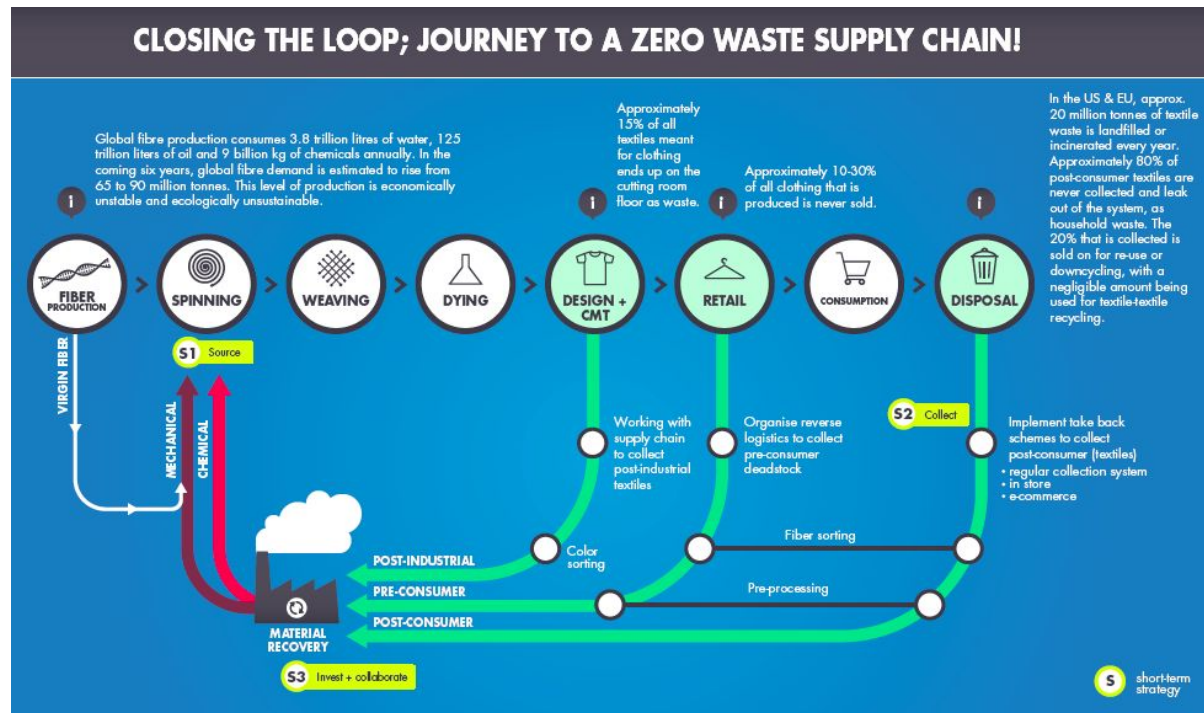
Cotton, with an annual production of about 25 million tonnes, is the second biggest textile fibre, after polyester. Current cotton production methods are widely recognized as environmentally unsustainable; cotton production consumes 10% of world's pesticides, 25% of world's insecticides, despite only taking up 2.4% of total arable land and is the 3rd biggest contributor to pesticide-illness in farmworkers. Additionally, this process is highly water intensive, with a single cotton t-shirt uses up to 700 gallons of water to make.

With cotton production facing stagnant growth, man-made fibres are already dominating the raw material supply of the textiles industry. Made from fossil fuels, polyester is the biggest textiles fibre in production volume, estimated to account for 70 % of total fibre production by 2030, according to PCI Fibres. Polyester synthesis is an energy intensive process that is linked to significant amounts of greenhouse gas emissions.



IMPACTS OF TEXTILE WASTE

Downstream the impact of the booming textiles industry, combined with fast fashion models of production and consumption can be seen in the growing volume of post-consumer textile waste, for which there are now limited end-of-life solutions. **In the EU and US alone, 20 million tonnes of textiles end up in landfill or incineration every year.** In addition to this post-consumer waste, **10-15% of textiles is left as cutting waste on the factory floor** (post-industrial textile waste), and it is estimated that **up to 33% of garments that are produced, are never sold and in many cases destroyed** to avoid flooding the market (pre-consumer textile waste).



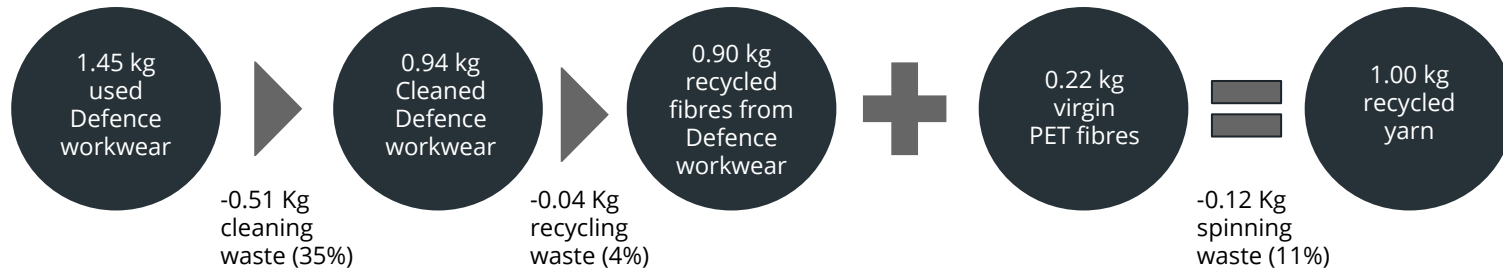
A roadmap for creating a zero waste supply chain: closing the loop for post industrial, pre consumer and post consumer textiles.

RESULTS: BUSINESS CASE AND ENVIRONMENTAL ANALYSIS

THE HIGH VALUE RECYCLING APPROACH

In this High Value Recycling pilot with ReShare, used workwear from the Dutch Defence of 50:50 cotton/polyester average composition are mixed with virgin PET (polyester) fibre and are mechanically recycled into new yarn to make blankets for humanitarian aid. The process can be described as follows:

1. Used uniforms donated by the Dutch Defence are sent to their partner Biga Groep that sorts them on colour and type (navy, army). Used uniforms are cut (mutilated) to eliminate the risk of Dutch military uniforms getting worn again by unauthorized individuals.
2. The mutilated uniforms are baled and sent to Recover near Alicante, Spain. There, the uniforms are stripped from non recyclable pieces such as zippers and buttons by a partner of Recover in a process called “cleaning”. The waste materials from this process ($\pm 35\%$ of the total volume) are processed according to Spanish environmental regulation.
3. The cleaned defence material is then cut and pulled into cotton fibre. Recycled fibres are blended with virgin polyester fibres, carded, and spun into a 3/1 Nm yarn with 80% recycled fibres and 20% virgin polyester (10-15 % waste in recycling and spinning process).
4. The recycled workwear yarns are woven into blankets for humanitarian aid by a partner of Recover in Spain.



THE RECOVER YARNS

Recover delivered 80 % recycled yarn for the production of aid blankets for ReShare. The Recover yarn includes the composition in the figures below, consisting of 80 % recycled workwear and 20 % virgin PET (polyester). A Life Cycle Assessment was performed by Circle Economy to analyse the environmental savings associated with the production of aid blankets made from recycled versus non recycled yarns.



Recycled material

80 % of recycled used military garments containing on average 50 % cotton, 50 % PET.



Virgin material

20 % virgin PET fibres are mixed with the recycled fibres.

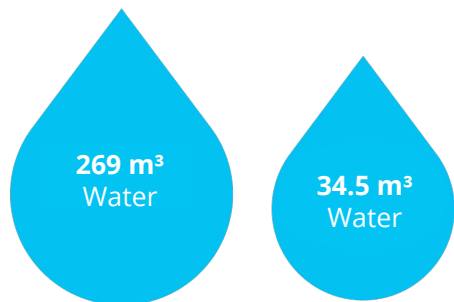


Final Yarn Composition

Recycled yarn with a final composition of 40 % recycled cotton, 40 % recycled PET and 20 % virgin PET, is used in the weft of the blanket.

ENVIRONMENTAL IMPACTS of recycled vs virgin yarn

Circle Economy compared the environmental impact of producing one tonne of 3/1 Nm yarns containing 80% recycled uniforms, with the production of an equivalent yarn made exclusively with virgin materials. The LCA shows that water consumption, energy use and greenhouse gas emissions are can be significantly reduced by using recycled instead of virgin yarns.



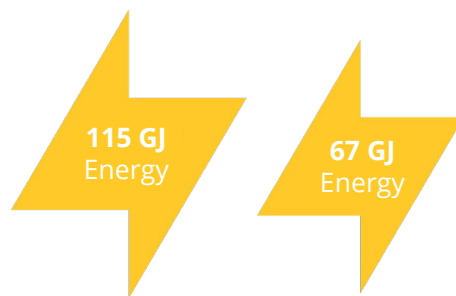
Virgin

Recycled

**Water consumption
reduced by 87 %**

Avoidance of virgin cotton fibre production. Recycling cotton contained in the used uniforms requires minimal amounts of water, which leads to the overall decrease.

Recover's process avoids dyeing, which is a water intensive process.



Virgin

Recycled

**Energy consumption
reduced by 42 %**

Avoiding part of polyester fibre production, an energy intensive process, reduces the energy consumption.

Avoidance of dyeing further reduces energy demand.



Virgin

Recycled

**Reduction in greenhouse gas
emissions by 33 %**

Recycled cotton contained in uniforms avoids greenhouse gas emissions from cultivation as well as fertiliser and pesticide inputs.

Recover's recycled polyester contained in used uniforms avoids carbon intensive production of virgin polyester fibre.

APPENDIX

Data Collection and Assumptions

DISCLAIMER

This case study was written by the Circle Textiles team (Helene Smits, Gwen Cunningham and Theodoros Spathas) of Circle Economy. Preliminary LCA results were used from Mr. Spathas' thesis titled "Life Cycle Assessment on Textile to Textile Recycling Technologies", supervised by prof. Greg Peters from Chalmers Technical University (Sweden) and assistant prof. Valentina Prado from Leiden University (the Netherlands). Sensitivity analysis is to be performed to check the robustness of the results. Full assessment will be released with the completion of the thesis.

Data for mechanical textile fibre recycling and yarn spinning were collected from Spanish upcycled yarn producer Recover (Hifesa Ferre).

Data for the sorting of uniforms textiles were collected from a Dutch company.

The software and main database used for the thesis was GABI EDUCATION under free licence from ThinkStep.

Data from dyeing of woven fabric were used from the "Life Cycle Assessment of Cotton Fiber & Fabric Full Report" by Cotton Incorporated and PE International. (2012)

Recycled PET data were collected from "Final report Life Cycle Inventory of 100 % postconsumer HDPE and PET recycled resin from postconsumer containers and packaging" by Franklin Associates, a division of Ergprairie Village, Kansas (2010)