



Ministry of Foreign Affairs

Feasibility Study Textile Recycling

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Feasibility Study Textile Recycling

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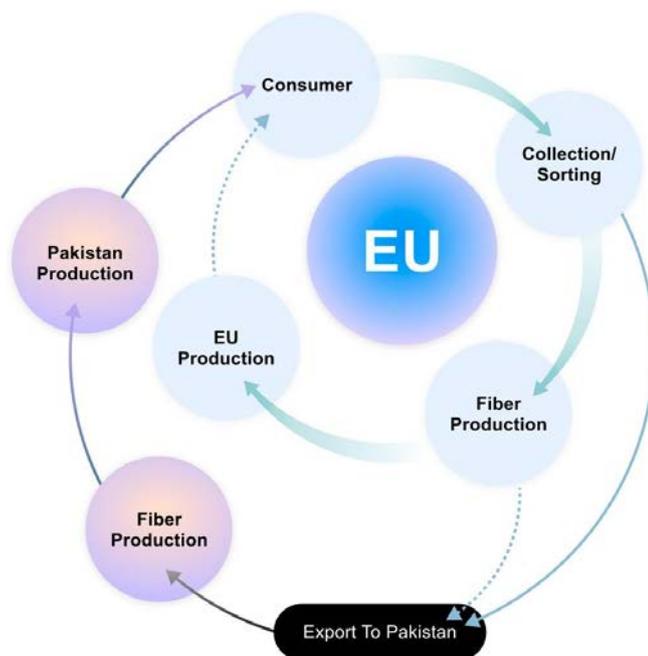
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Background

Climate change is a stark reality, staring humanity into the face. This challenge needs to be addressed with a realistic and effective approach. Circular economy is one of the prime approaches that can reduce negative impact on the environment. Recycling is the key to circularity. Under the EU Circular Economy Action Plan, member states will increasingly collect used textiles. Many states are working towards a circular economy. The Netherlands itself has pledged to become circular by 2050. Regulations regarding recycling are expected to become stricter in the coming years. The textile industry will play a significant role in this development. This means that an increasing amount of textile waste is available in Europe. While there are some recyclers in Europe, they are not the only option.

Pakistan being a signatory to the Paris Agreement has committed itself to reduce GHG emissions by up to 30% by 2030¹. Agriculture, industry and waste management are some of the prime sectors, along with energy and transport that contribute to GHG emissions. Textiles is the biggest sector in Pakistan, and the backbone of the national economy. From cotton production to fibers, yarn and clothing, the sector has the potential to become a key player in sustainable fashion and environmentally friendly practices. Use of recycled fibers in the textile industry needs to be encouraged as it addresses multiple components of circular economy and contributes to sustainable consumption.

From a mere commercial perspective, this is also a win-win situation; as most studies in the recent past have shown an increasing trend towards preference for greener products in the consumer markets. Not only this, but the percentage of consumers who are willing to pay for greener products has been on the rise². The advent of green consumerism has forced leading textile retail organizations to develop more sustainable products in order to stay relevant.



¹ Pakistan INDC report submitted to UNFCCC.

<https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Pakistan%20First/Pak-INDC.pdf>

² <https://econlife.com/2019/04/paying-for-green-products/>

Pakistan has the potential to become a key partner to the EU as textile recycling and manufacturing market. After consumers have finished using their product, it could be collected and sorted within the EU. Once it is sorted, it can be shredded into fibre in Pakistan, where it can also be used for manufacturing new products for import into the EU. With already existing tools for transparency and low shipping cost, this arrangement is a realistic and practical contribution to a circular EU.

Recycled Cotton in Pakistan

In Pakistan, the Better Cotton Initiative (BCI) has been engaged in sustainable cotton production since 2010. In the year 2018-2019, BCI farmers in the country produced 906,000 tonnes of Better Cotton which made Pakistan the second largest producer of Better Cotton, after Brazil³. During 2020-21 crop season BCI implementing partners trained more than 500,000 cotton farmers on sustainable cotton production and it is expected that close to 1 million MT of Better Cotton (more sustainable cotton) fibre will be produced by Pakistani farmers during 2020-21 crop season. Better Cotton farming has demonstrated considerably lower pesticide, fertilizer and water use than conventional cotton and better net profit for farmers. World key retailers and brands e.g., IKEA, LEVIS⁴, H&M, Zara, Decathlon, Nike, Adidas, Tesco, Target, Mango Woolworth etc. are currently sourcing Better Cotton from Pakistan⁵.

Cotton is also recovered for recycling, both from post-industrial waste (PIW) as well as from the post-consumer waste (PCW).

The post-consumer waste previously used to end up in landfills. Of late, it has been collected and recycled. However, this category has certain limitations.

- Length of cotton fibre decreases because of shredding which is part of the recycling process.
- Strength decreases, hence, 100% cannot be used. Recycled recovery ratio is up to a maximum of 40-50%.
- Since cotton is dyed during first production, there are colour limitations in the waste, which needs to be sorted according to the respective colours. In general, whites and denims are easier to recycle, while the rest have to be matched.
- Some waste cannot be recycled/reprocessed and are used for paddings/gol takkia.

Feasibility Study Textile Recycling

On behalf of the Dutch government, a case study to test the feasibility of realising a circular supply chain between a Dutch company and a Pakistani manufacturer, with particular focus on recycled coloured linen, has been conducted. While large companies are able to develop individual solutions using a variety of approaches, small and medium sized enterprises often lack the means and network to realise circularity. The study aimed to provide solutions that are easily implementable by European SME with recycling and manufacturers in Pakistan.

³ BCI: <https://preview.shorthand.com/uesMKrMyIAsDuxM3#group-Pakistan-5W2WY4IPbD>

⁴ <https://www.levistrauss.com/how-we-do-business/source/making-strides-through-the-better-cotton-initiative/>

⁵ WWF: http://assets.wwf.org.uk/downloads/better_cotton_report.pdf?_ga=1.135909169.1223884999.146

In order to support the economic stability of Pakistan, the textile sector is a focus area of private sector development activities of the Dutch embassy. As such, the embassy has set up a project to increase the capacity and sustainability of the Pakistani textile sector, including through the Textile Recycling Feasibility Study.

Pakistan has the potential to become a key partner in circularity for the EU. The country has a young, future-oriented population with a business mindset that is easy to work with. There are ample space and funds in the country for local investments in factories. As China's exporting dominance declines, Pakistan is a suitable country to relocate part of the manufacturing to. When it comes to textiles, Pakistan also has the advantage of growing cotton locally, which reduces travel distances in the supply chain, and a well-developed PET bottle collection system that is useful for recycled polyester fibre.

Partners

While large companies are able to develop individual solutions using a variety of approaches, small and medium sized enterprises often lack the means and network to improve circularity. The study aimed to provide solutions that are easily implementable by European SME with certified manufacturers in Pakistan.

Dibella

As a medium-sized, Dutch-German company, Dibella was a suitable partner for the study. Dibella is connected to industrial laundries that provide access to post-consumer waste (PCW) from various traceable sources.



Dibella Certifications:
GOTS, OCS, EU Ecolabel,
Fairtrade, Oeko-Tex 100,
Made in Green, Grüner
Knopf

Dibella is a wholesaler for home textiles and institutional textiles, headquartered in Aalten, Netherlands. The company provides long-life, high performance institutional textile products for contract business, e.g., for hotels, restaurants, and hospitals in Europe. Products include bed linen, table cloths, towels, etc. All Dibella products meet high quality standards, as they need to withstand the demanding requirements of institutional use (e.g., durability, colour stability/whiteness, consistency etc.)

Dibella sources their products from transparent supply chains and certified suppliers. Dibella textiles are certified by various labels, including GOTS, Organic Cotton Standard (OCS), EU Ecolabel, Fairtrade, Oeko-Tex 100, Made in Green, and more.

Dibella produces contract textiles for institutional businesses in Europe. The products are mainly white, 100% cotton, but also coloured and blends. They only work with supplier who at least are SteP-certified and able to provide transparency over the supply chain. Dibella rents these products out to institutional businesses or sells them to industrial laundries who rent them out. Through Dibella's network of industrial laundries, there is also access to a variety of non-Dibella products with transparent supply chains and origins.

On average, the products go through one hundred washing cycles, after which they are returned to Dibella. While Dibella is looking for sustainable use for this waste, recycling options in Europe are limited. This shows that there is a demand for textile recycling solutions for SME like Dibella, which is why they were selected as partner in this study that would provide the material.

Lamme Textielbeheer

Lamme Textielbeheer (Lamme Textile Management) is a Dutch service provider for the textile industry. Founded in 1834, Lamme has grown from a small bleaching field into a leading solution provider for airlines, hotels, restaurant, hospitality and catering, healthcare and public sectors. Lamme is Certex certified and places particular emphasis on sustainable processes. As an industrial laundry, Lamme is a partner of Dibella who manages and washes Dibella products during their use phase. After that, Lamme returns the products to Dibella, including the white napkins that would become part of the denim jeans.



Crescent Bahuman

The next step was to find a factory that could meet Dibella’s demand for a recycling solution in Pakistan. Dibella’s cotton products had to be turned into a commercially successful textile product. Due to previous testing, a short staple length of the recycled fibre was expected. Denim is suitable for recycled cotton as it can integrate coarse yarns more easily. Considering denim as a suitable end product for Dibella’s products, Crescent Bahuman Limited (CBL) came into the spotlight as one of Pakistan’s first and largest vertically integrated denim facilities. Furthermore, CBL has a shredding unit on site, allowing for quality control and traceability.



Crescent Bahuman
Certifications:
 SA8000, WRAP, ISO
 14001, GOTS, Organic 100
 Content Standard, GRS

CBL is a large size denim manufacturer with vertically integrated facilities ca. two hours outside of Lahore. The company’s commitment to sustainability can be traced back to its establishment in 1995, when it became the first vertically intergraded denim facility in Pakistan. The factory is surrounded by 500,000 trees planted to offset the factory’s impact on the environment. The CBL campus was built in a previously remote and rural area that has become a small textile town in itself, with schools, housing facilities for workers, medical installations, shops and integrated manufacturing area.

CBL has established itself as a company aware of its responsibility as one of the market leaders of sustainable denim in Pakistan. This includes fulfilling challenging certifications, the establishment and implementation of sustainable and advanced solutions within their machine park as well as awareness and improvement in terms of energy and water consumption. In 2015, Crescent Bahuman introduced Environmental Impact Measuring⁶ for the purpose of quantifying sustainability parameters such as water consumption, energy consumption, chemicals used and workers’ health. Next to their commitment towards sustainable manufacturing, CBL is active in community engagement.

CBL’s company culture fosters growth and development of all employees. CBL recognises its workers as their most valuable resource and encourages policies that enhance their skills and continuously develop their capacities.

⁶ Software by Jeanologia. More information:

https://login.jeanologia.com/v1/authorize?response_type=token&client_id=5dcc22aaf44cde05e54edd35&redirect_uri=https://eim.jeanologia.com&state=434b1e46844960151b32

CBL was a fitting partner to recycle Dibella’s products as denim is suitable for recycling 100% white cotton products. Furthermore, CBL has a shredding unit on site, allowing for a high level of quality control and traceability.

Crescent Textile Mills

On the other hand, the feasibility of creating product-to-same-product recycling was tested. As Dibella is mainly active in home textiles, a manufacturer of home textiles was selected as another partner in the study, Crescent Textile Mills (Crestex). Crestex is also suitable to test and implement polyester recycling.



Crescent Textile Mills

Certifications:

SA8000, ETI, ISO 9001, ISO 14001, SEDEX, GOTS, Organic Blended Content Standard, Organic 100 Content Standard, EU Eco Label, Sustainable Cotton Project

Crestex is a state of the art vertically integrated textile manufacturing company of yarn, greige/processed fabrics, home textile, and institutional garments of supreme quality. Crestex is located in Faisalabad and is therefore part of the largest textile cluster in Pakistan, often referred to as the “Manchester of Pakistan”. Faisalabad, and by inclusion Crestex, contributes a significant share towards Pakistan’s overall export economy but plays a major role on the local market as well.

From its establishment in 1950, Crescent Textile Mills has been working on becoming a leading manufacturer for yarns and home textiles in Pakistan. Today, Crestex is globally known for quality textiles, sustainability, and reliability.

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Crestex has a long-standing history in innovation. Development of new products and product ranges go hand in hand with ongoing and dedicated R&D activities preparing the company for ongoing change and maintaining its relevance to the market. Throughout the years, Crestex has been a part of the change happening within the market.

Crestex has a strong commitment towards sustainability. This is reflected in their long-lasting participation in various GIZ projects, their local contributions towards community development as well as their dedication towards Research and Development for more sustainable solutions. These activities have made Crestex one of the leading authorities on the development and utilisation of recycled materials, which they provide to various companies within Pakistan.

Crestex does not possess a shredder on site and instead works with outside providers. While this poses a challenge in terms of controlling and tracing the supply chain, for example to ensure the recycled material only includes BCI cotton. To achieve the highest level of transparency, Crestex works only with their own cut waste or cut waste from other trusted partner factories. The cut waste can be shredded and used in bed linen for retail purposes. Crestex is also a suitable partner to test and implement polyester recycling.

Project implementation

With Dibella and CBL, a circular textile value chain was put into practice. The project realises a practical supply chain for recycling institutional products. Dibella sourced high quality institutional products made from cotton and polyester from vertically integrated suppliers, e.g., Lucky Textile Mills. Dibella is able to provide products with transparent and certified supply chains. After their use had come to

an end, the products were separated by material and colour and returned to Dibella. From this, Dibella collected 300 kg of white 100% cotton napkins and shipped them to CBL in Pakistan.

Recycling process of coloured textiles

In order to recycle coloured textiles, they are sorted by colour (e.g., blue, green, brown) and used to produce similar coloured items, e.g., making blue towels out of blue workwear. The mono-coloured items are shredded together, spun into yarn and dyed to achieve an even colour.

This method has two main advantages: Firstly, quality is preserved compared to mixing colours which results in a grey melange. Secondly, compared to white or virgin fibre, less chemicals and dye is needed as the yarn is not bleached nor dyed excessively. The main challenge is in the collection and sorting infrastructure and limited availability of coloured items in the EU. In order to build a sustainable supply chain, a minimum threshold of material that have the same origin and colour needs to be in stock each month to be able to produce without interruptions. The exact amount of that threshold needs to be evaluated case-to-case. Within the scope of this study, coloured textile recycling was tested at Crescent Textile Mills with post-industrial waste.

Activities at Crestex

Crestex worked with coloured home textile waste from their own production. The material was readily available and allowed for an efficient testing process. As Crestex does not have in-house shredding processes, shredding took place at an external facility. The fabric scraps were cut into small pieces until the fibre was exposed (see images below).



Material is cut into smaller pieces



Shredding process

Final fibre bale



Comparison of usual fabric quality (left) and recycled fibre (right)

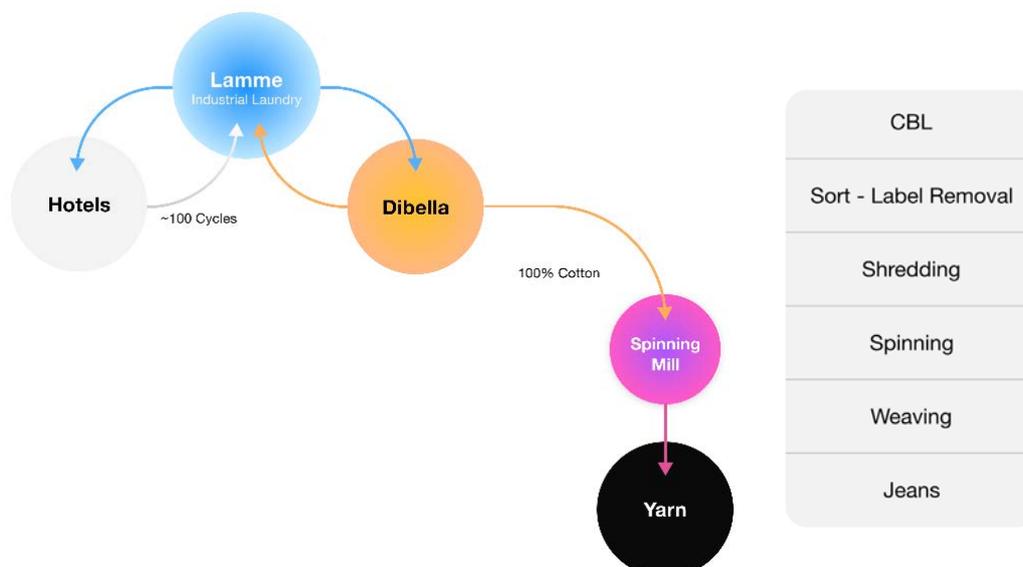
The quality of the recycled material of this test run was not sufficient for reintegration into Crestex’s home textile production. The fibre which was extracted was not suitable for conversion into home textiles, as it was too coarse. Most running fabric at Crestex uses a mid to fine yarn count. The fibre extracted also had heavy conversion wastage from fabric to fibre. Further testing will be conducted in the future with Crestex to enhance quality parameters. Working closely with the shredding partner will allow optimisation of the shredding process and likely improve quality.

Within earlier projects, similar test runs were conducted. Based on this experience as well as exchange with other relevant parties in the industry, it is realistic to expect integration of 5-10% recycled material. Crestex is also able to integrate recycled polyester from PET bottles from Pakistan. Possible products include duvet cover sets with 52% recycled Polyester/48% BCI cotton and GRS certification.

Activities at Crescent Bahūmán

Waste products from laundries were collected by Dibella and pre-sorted by material and colour in the Netherland. The material was sent to Pakistan and arrived at CBL after an initial miscommunication regarding customs. The material received by CBL totalled 268 kg. After sorting out coloured items and removing tags, the remaining material was 161 kg that was white, 100% cotton napkins.

As CBL is vertically integrated, all processes from sorting and label removal, shredding, spinning, weaving, and finishing were performed within the same company and premises.



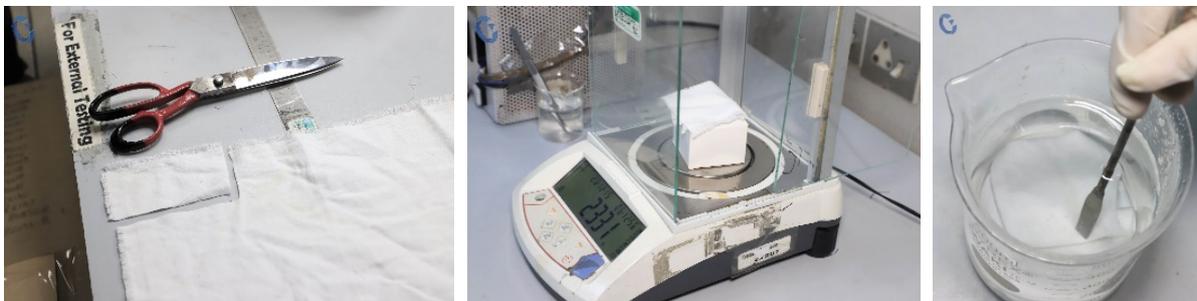
Initial yarn analysis showed that the original products provided by Dibella are made of 30/d, 100% cotton, double count warp, and 30/d, 100% cotton, double count fill. After the tags were removed, the fabric's composition was analysed, which showed that it was indeed 100% cotton.



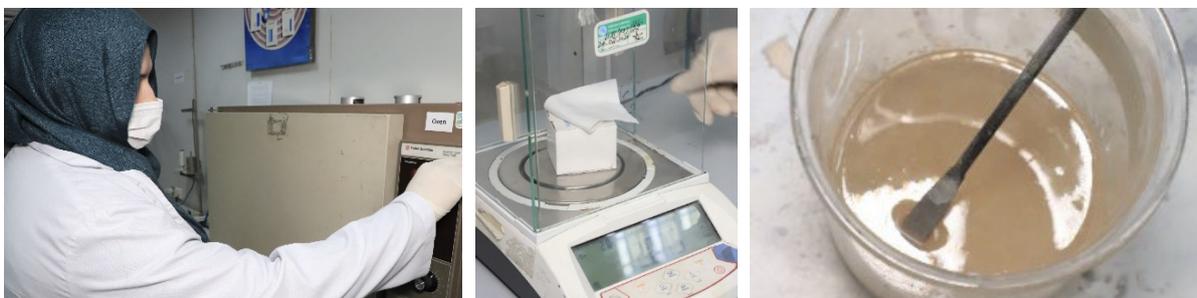
Arrival at CBL and sorting



Tag removal



Cut sample of table napkin; Weighing of the sample; Rinsing in water



Sample dried in oven; Sample weighed again; 100% cotton because sample dissolved in sulphuric acid completely

1 – Shredding

The material was shredded using CBL's on-site shredder. This resulted in four bales of recycled cotton fibre with a total weight of 161 kg. Besides that, 34 kg of shredding waste remained, 27.6kg of which was waste that cannot be processed due to excess twist that cannot be opened by the shredder. 6.6kg were short fibres that cannot be processed, and 0.4kg were items that were sorted out due to colour or for being a different kind of product (not white cotton napkins).

While shredding the material provided by Dibella at CBL, 34 kg of fibre waste was created. While this cannot be integrated into yarn, it is far from useless. It is white, 100% cotton, traceable, high quality pure cellulose. While it may not be suitable in textiles, it can still be used in other industries. By working together with local and international partner, a solution for this material can be found so that nothing goes to waste.



Shredding machine cut down 2-inch pieces of fabric into ½ inch pieces; Output of shredding machine; Fibre opening machine converts ½ inch to fibres.



Bale press compresses PCW cotton fibres to bales

2 – Yarn Development

It became evident that the fibre had a relatively short staple length of 10-15 mm. This is due to the high quality and density of the original napkins, which requires a higher degree of shredding.

Initial yarn trials were performed with 5%, 15% and 30% of recycled content. Based on the results of these trials, it was decided to continue with a recycled content between 10% - 20%. Two yarns were produced, one with 20% recycled content and one with 10%, the rest being virgin BCI cotton. Yarn count was 7,00/s for both, which is at the low end of the range used for denim in general. This means that it cannot be used for fine fabrics and its use is limited to coarse fabrics, such as denim.



Yarn trials

			
100% Cotton	100% PCW Cotton	50/50 Ctn PCW	70/30 PCW Ctn
Dry = 1g Wet = 1.5g = $\frac{\text{Dry}-\text{Wet} \times 100}{\text{Dry}}$ = 50%	Dry = 1g Wet = 2.47g = $\frac{\text{Dry}-\text{Wet} \times 100}{\text{Dry}}$ = 167%	Dry = 1g Wet = 2.68 = (168%)	Dry = 1g Wet = 2.58g = 158%

Dye pick up tests showed the necessary amount of indigo dye, which was 2-3%

3 – Fabric Development

The yarn logs were ball-warped to prepared for rope dyeing with indigo dye. The dyed ropes of yarn were then wound over a beam in sheet form to prepare for sizing, which improves the weavability of warp yarns. The fabric was then developed by interlacing two sets of yarns i.e., weft and warp at a right angle.



Warping; dyeing; rebeaming



Sizing; weaving; final fabric

Two fabrics were manufactured from which the samples were made. The yarn with 10% and 20% recycled PCW was used in the warp. To maintain quality and tear strength, 100% virgin BCI cotton was used in the weft. The amount of recycled content was based on the maximum percentage that could be integrated while allowing for an unchanged continuation of standardised industrial denim production. This way, there was no risk to the denim or process. Fabric 1 contained 86% virgin BCI cotton, 12% PCW cotton and 2% Elastane. Fabric 2 contained 92% virgin BCI cotton, 6% PCW cotton and 2% Elastane.

Name	Composition	Wt. Oz/yd ²		Finish	Yarn				Design	Shrinkage		Fill		Color
		Initial±5%	Wash±5%		Warp	Fill	Full width	Slub		Warp ±2%	Fill ±2%	Stretch±4%	Growth	
Fabric 1	86% Cotton 12% PCW 2% Elastane	12.75	15	Mill Wash	OE (ctn:pcw)	CSL	59	Non Slub	3/1 RHT	-3	-16	28	6	Indigo
Fabric 2	92% Cotton 6% PCW 2% Elastane	12.75	15	Mill Wash	OE (ctn:pcw)	CSL	59	Non Slub	3/1 RHT	-3	-16	28	6	Indigo

Fabric specifications

4 – Garment Development

Two designs for jeans were developed to be used for the sample production. The styles oriented themselves on classics and current trends. Soft patterns were designed and developed to convert the fabric into cut parts ready for stitching using Computer-aided design (CAD). The parts were then assembled into pairs of jeans through stitching. Laser technology and e-Flow washing was used, which drastically reduces the water needed for finishing, producing two different washes (one lighter and one darker). CBL observed international standards of social and environmental compliance during the production. Environmental Impact Measurement (EIM) ratings are used to analyse the environmental impact of garments. The EIM analysis showed a low impact for the two jeans in two different washes.

Sr#	EIM Score	Impact Type	Water Impact(l/garment)	Energy Impact(kWh/garment)	Chemical Impact(garment)	Worker Impact(garment)
1	19	Low Impact	15.84	1.09	14.5	14
2	29	Low Impact	15.36	1.84	22	24
3	11	Low Impact	7.2	0.88	4.5	9
4	31	Low Impact	22.08	1.95	22	24



Inspection; cutting; stitching



Raw denim jeans; laser treatment; E-Flow washing



Final products

5 – Online presentation in Digital Showroom

Close interaction and feedback loops between customers and suppliers are necessary to develop successful new products. Therefore, the final products are presented in a [digital showroom](#), which presents a user-friendly solution with all the features for an efficient sample development process.

The digital showroom is a product communication platform for suppliers and customers with a special focus on sustainability, innovation and marketing. It offers the possibilities to pro-actively showcase new products or ideas with 3D scans, photos and other media in the cloud. Apparel is presented on virtual models which can be freely designed based on individual project or customer needs.



3D image of PCW jeans produced by CBL in digital showroom

Each product listing contains:

- All relevant product details and marketing material including photos, 3D scan and videos
- Descriptions and background information on sustainable materials
- CO2 and water footprint (if available)
- Supplier information such as, location, background information, certifications, staff qualifications, marketing material, video clips, workers' interviews
- Supply chain information
- Certifications such as GOTS, BSCI, SEDEX, SA8000 along the entire supply chain

Individual showrooms can easily be generated to showcase a particular selection of products. The showroom comes with Like buttons and a comment function for easy communication between customer and producer. On the one hand, it can be used as a quick and effective way to exchange samples. On the other hand, customers can discover new and innovative products from selected, certified suppliers in an easy-to-use digital platform. Given the current travel restriction and shipping times, digital presentation of samples will be incredibly helpful in promoting circular products from Pakistan.

Economic feasibility

The price of PCW jeans produced in this study is estimated to be 5% higher than the price of conventional jeans. The market price of virgin BCI cotton is 1.9 USD/kg (as of 01/2021). Conventional cotton is usually priced \$0.5 below BCI cotton, around 1.4 USD/kg, and organic cotton around \$0.35 more, i.e., 2.25 USD/kg. These prices may be heavily influenced by fluctuation in the supply, market and overall economy. Crop failure has contributed to instability of prices in recent months, making it difficult to calculate exact values.

The price of PCW material from Dibella is around \$0.5 to \$0.6 per kg, or \$0.7/kg including shipping to Pakistan. Additional costs occur from handling, such as sorting and tag removal, as well as shredding processes. Moreover, the cost of processes is estimated to be 5% higher than usual as processes have not been routinised yet. Once the recycling process in the factory has been well established and optimised, the cost of it is expected to be equal to processing virgin fibre. Combined with the low price

of material, recycling textiles is an economically feasible option for businesses that leads to added value thanks to its circular story.

Scalability

Based on cost comparison and feedback from CBL, Crestex and Dibella, the textile recycling project is scalable. Besides the expressed interest from the involved parties to continue the project, it is also feasible to be implemented by other companies in Pakistan.

Ideally, factories should have in-house shredding processes or close access to a qualified external shredding partner. This presents an opportunity for future-oriented recycling businesses who could fill that gap by providing high quality, traceable recycled yarn to factories. Besides quality shredding processes, factories must meet international standards of social compliance, quality control and traceability within their production.

As per indicative research, ten suitable companies with on-site shredding units that meet relevant standards of compliance, quality and traceability and are eager to invest in the development of innovative products have been identified (see appendix for non-exhaustive list of suitable business units in Pakistan). While there is increased activity in the EU regarding the availability and recycling of traceable white cotton, the necessary market structures for traceable white PCW are just starting to develop. Given the early stage of this development, estimations about the amount that will be available are difficult to make at the moment. In general, the availability and demand for white traceable cotton and polyester PCW is expected to grow in the coming years, which will likely lead to increasing competition for the limited resource.

Other recycled fibres

Shredding is used to recycle used textiles and clothes made from various materials and blends. However, it is not the only way to bring sustainability and circularity into textiles and might not be an option for some companies. Recycled polyester from PET bottles is a practical circular option in textiles that is increasingly pursued and integrated in products.

Recycled Polyester

According to the WWF, plastics account for 65 per cent of the total waste in Pakistan. 250 million tons of garbage in Pakistan primarily consists of plastic bags, pet bottles and food scraps. Pakistan's Indus River alone contains 164,332 tonnes of plastic waste.^{7,8} With increasing demand for high quality recycled Polyester Staple Fiber (r-PSF), Pakistan has found itself in the middle of a great opportunity which if utilized in the right manner can do wonders for the country's environment, economy and industrial growth. Like other parts of Asia, Pakistan has one of the highest PET bottle collection rates, mainly driven by economic reasons⁹.

Using recycled polyester reduces the dependence on petroleum as raw material for textile fabric needs. Diverting used PET bottles to recycling plants prevents them from landing in landfills or rivers,

⁷ https://www.wfpak.org/issues/plastic_pollution/

⁸ https://wwfasia.awsassets.panda.org/downloads/small_final_dec_print.pdf

⁹ All Pakistan Plastic Recyclers Association

and thus reduces soil contamination, air and water pollution. The textile apparel and garments created from recycled PET bottles minimizes wastage.

Currently, in Pakistan, there are several unorganized r-PSF manufacturers, however most of them only produce fibre for the low-end consumption to offer a low-cost alternative to virgin PSF. The local recycling industry has an informal yet, extensive collection and resale mechanism, spreading from housewives, sanitary workers, scavengers and *kabbariyas*¹⁰, leading to the recycling units, mostly working in the informal sector, with national production capacity of around 40 million bottles a day, or 300,000 tons per annum¹¹.

Most of the r-PET flakes are used in the polyester fiber units. PET bottles are raw material for small-sized industrial units that sort, wash and convert PET Bottles into PET flakes. These PET flakes are procured by r-PSF manufacturers or some other recycling industries. Out of the total PET recycled, 90% goes to r-PSF to be converted into Polyester fibre. Due to lack of structure, individuals involved in the waste collection process consist of the homeless, elderly and also child workers that are exposed to numerous health hazards.

In addition to the local PET waste, there is a small amount of imported PET waste as well, which meets less than 5-10 percent of the total demand. Hence there is a significant potential for increasing the regulated import. Although it is possible to increase the use of imported flakes, due to restrictions such as EPA registration and high import tariff it is difficult and uneconomical to import flakes for the domestic industry consumption.

Considering recycled PET can be used to a certain percentage ratio in the products, there is still a capacity to absorb another 1000 tons per day of recycled material and this can be met through imported PET scrap. This amount is based on domestic market demands, which is an ever-increasing demand and therefore still more would be needed in the years to come. Textiles being the largest export product, there are increasing opportunities with the world favouring green products.

¹⁰ Local term for: Middlemen who purchase recovered waste from itinerant buyers and sanitary workers for onward wholesale supply to industry.

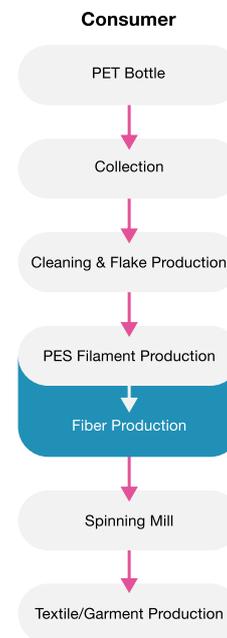
¹¹ Asif Sarwar, December 2020. [Interview] Pakistan Plastic Waste Importer & Recyclers Association.

Process and challenges

Collection

While there are a variety of recycled polyester yarns derived from various sources, PET bottles are the most common one. They are either collected in recycling bins or manually. At this stage, there are a couple of challenges to keep in mind. Transparency and compliance must be provided. Working conditions and pay of workers collecting PET bottles may be difficult to monitor, especially when it comes to voluntary initiatives to clean up the environment, such as beaches. If branded as educational activity, this might include child labour. What is more, quality assurance and control might be difficult. Here we need tools for monitoring and documentation to ensure transparency. To solve the challenges, partnership with selection regions, organisations and NGO's might be necessary. It is also an opportunity for community involvement.

The local recycling industry in Pakistan has an informal yet extensive collection and resale mechanism, with a total production capacity of around 1000 tons per day or 300,000 tons per annum. Recycled PET (r-PET) bottles are raw material for the small-sized industrial units that sort, wash and convert PET Bottles into PET flakes. Out of the total PET recycled, 90% goes to r-PSF (recycled Polyester Staple Fibre). Based on domestic market demands, there is still significant room to grow the r-PSF industry, even by importing PET bottle, showing opportunities for recycled polyester in Pakistan's textile industry.



Fibre Production

After collection, the PET bottles are cleaned and cut into flakes. This process can be energy and water intensive, as the resources are needed for washing and drying. Environmental parameters should be focussed on with the aim to minimise waste, water use and energy. With digital tools for transparency, monitoring and documentation, processes can be optimised and new innovative processes and technologies integrated. They will be complemented with appropriate training to key personnel and an adequate management system.

Similar challenges exist in the following process of PES filament production and fibre production, where quality and transparency must be ensured.

Spinning and final product

The flakes are melted into a mass that is pushed through tiny holes to make a long string. This is then cut into fibre which is spun into the final yarn.

Usually, dyeing takes place after the yarn is woven into fabric, for which the fabric is heated up again to absorb the colour. Another option is spin dyeing which dyes the melted polyester mass before it is made into yarn. This process has several advantages, both in quality and environmental impact. Spin dyeing results in extraordinary colour fastness and technical performance. Furthermore, it

significantly reduces the energy use as there is one less process to perform. However, spin dyeing also comes with its own set of technical challenges and cannot be implemented in many cases, especially when it comes to smaller orders as well as articles not suitable for yarn dyed fabrics.

The fibre is made into yarn in the spinning mill and can then be used for all kinds of textile and garment products. The entire process may involve a large number of organisations, which is why traceability should be paid special attention to. For that, solutions exist and need to be applied with the selected partners.

Other synthetic fibres

Locally, the well-known ICI Polyester Business has been at the forefront when it comes to production of high quality value-added specialized fibre variants for the textile industry. On the sustainability front, ICI Polyester Business has introduced two products; Terylene Clean and Terylene Powered by CiCLO, a product that solves the problem of micro plastic pollution. These two fibres, when combined with cotton or viscose, improve the colour fastness and longevity of the garment without burdening the environment.

The fibre that was produced at ICI Pakistan plant based in Sheikhpura (outside Lahore) has been used by most of the notable local textile and denim units in the country. Many of these are suppliers of international brands. The yarn produced with CiCLO can be procured from any of the top spinning units in Pakistan, both in virgin quality and with recycled content.

Moreover, Repreve by Unifi produced with recycled Polyester from plastic bottles and post-consumer waste is reliable and of durable quality. In addition, the conservation of water and energy resources make it an earth friendly consumer products. Features like wicking, comfort-stretch and soil release is embedded in the fiber.

Lycra is a synthetic elastane fibre that can stretch up to six times its length and return to its original state time and again. It is a relatively new fibre and not yet manufactured in Pakistan. Since the percentage of Lycra in garments is little, it is difficult to extract from garments for recycling, hence the market for post-consumer waste is not large. Therefore, the focus is on recovering Post-Industrial Waste (PIW) where the waste during the manufacturing process is reused. With ICI, there is a local fibre producer that is working on recycled Lycra.

Lessons learnt

Recycling textiles requires a systematic approach as circularity has implications for various stages of the product life cycle. The source material needs to be matched with the product or the other way around. Furthermore, suppliers need to be able to provide the necessary processes, machinery, capabilities and transparency. The product itself needs to meet the requirements of the brand and consumers. The implications for each stage and actor need be considered before taking action using a systematic approach.



Product stages and relevant actors

Transparency & Traceability

Traceability and transparency are necessary in any circular value chain in order to ensure the quality and satisfy buyer requirements as well as to be able to tell a sound sustainability story. For example, certain brands only work with BCI cotton. If they are to integrate recycled fibre into their products, they need to be certain that that fibre is BCI cotton, so the original source of the virgin fibre must be known. To achieve transparency, it is important to only work with partners who are able to provide relevant information about their supply chain and processes, have a good communication infrastructure with the entire supply chain and use effective tools for transparency, which already exist in the market.

- Transparency and traceability are necessary to ensure quality, meet compliance requirements and tell a sustainable story
- Work with partners who can provide transparency
- Make use of digital tools

Concrete actions:

- Designate a circularity manager
- Identify all partners/suppliers involved in the production
- Build up a documentation system based on your demand and situation
- Identify relevant Key Performance Indicators to document your activities and measure your outcome
- Check suitable software solutions

Partnership approach

Circularity needs a systematic approach that involves actors from design to supply chain. As circularity impacts all parts of the product life cycle, a partnership approach is necessary in order to coordinate the product development. This means continuously engaging with suppliers over the long term. Brands and retailers, as well as their designers, need to work together with their supply chain in order to create products that can meet the requirements in terms of quality, design and sustainability. A

partnership approach also facilitates transparency and compliance in the supply chain and helps respond to changing requirements and framework conditions.

The right partners need to be found. Partners should be able to provide transparency and control the quality of the recycling process, which is best achieved if the manufacturer has their own shredding unit on site. Furthermore, appropriate management systems allow for quality assurance and control. Potential deficiencies can be remedied with relevant trainings. Companies that want to work with recycled material but cannot use their own can access a directory of recyclers in the EU and Pakistan provided by CSI. Information about further organisations involved in circular textiles can be found in the annex.

- Circularity has implications for all parts of the product life cycle
- Tackle challenges together and quickly respond to changing requirements

Concrete actions:

- Continuously engage with suppliers and entire supply chain
- Select key partners that are able to provide transparency over their processes and supply chain
- Establish long-term relationship with your key partners
- Engage intensively with your customers

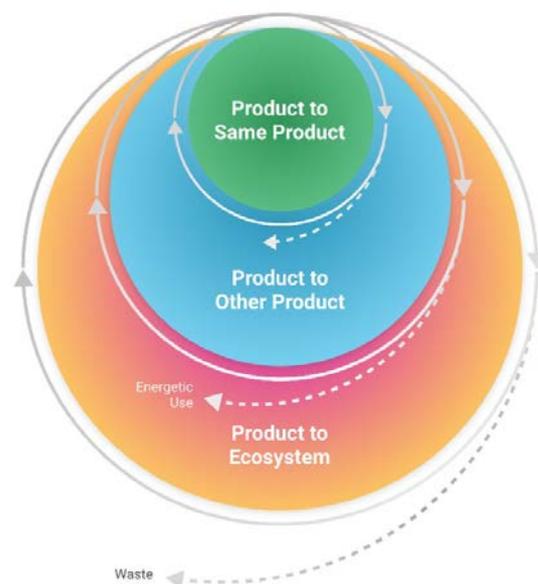
Flexibility

While the idea of a circular economy suggests a tight 'closed loop' where products are recycled back into the same product, this might not always be feasible, nor efficient. Focussing only on product to same product recycling also impedes the realisation of more practical solutions. If transparency and traceability are given, product to other product recycling will be more realistic and favourable in many cases. This does not have to mean that the material goes into products of lower value (downcycling). Different products simply have different requirements, and they can complement each other like that.

- Circularity is not limited to product-to-same-product recycling
- Match source material to the right product considering individual product requirements and material properties

Concrete actions:

- Try to recycle your products back into your own products as much as possible
- If that is not possible, identify customers for your recycled material/product



Design

Design is where a large part of the impact will be generated. Designing products with recycled content will consider both the technical requirements (what materials are needed for this product/what product can be made from this material) as well as the design and quality requirements to make an economically successful product. Here, purposeful collaboration with designers can be of tremendous value.

This process must involve different actors along the supply chain. The brand/retailer and their designer need to interact with suppliers in order to integrate circularity concepts. Designers might have a specific product design in mind, but the perspective of the manufacturer who is able to determine what is realistic on the ground is just as important. Similarly, the suppliers must be in touch with their own supply chain to meet the brand’s requirements. Good communication and cooperation between different part of the supply chain is extremely important in order to make products that are both technically feasible and economically successful.

- Design is crucial to realise circular products
- Working closely with designers helps achieve both technical feasibility and commercial success

Concrete actions:

- Create inventory of core materials within your own production
- Check which of these can be recycled in your own production
- Work with your in-house designer to optimise your own products for circularity
- Find selected partners to recycle core materials that cannot be recycled in your own production
- Work with the designers of your partner to develop an individual circularity approach for your joint project

Practical considerations

Sorting

A systematic approach is also important for sorting by colour and composition. Before collecting the material that is to be recycled, it should be clear what product it will be used in. In general, products can be sorted in nine categories as shown in the following matrix:

	White	Mono colour	Mixed colours
100% cotton			
Cotton/PES			
PES			

White products are the easiest and most versatile to recycle, as they produce white fibre that can be dyed any colour. If coloured products are sorted by colour, they can be turned into mono-coloured

fibre to be used in products of the same shade, or darker shade if overdyed. Products that have not or cannot be sorted by colour can still be recycle but might be limited to use only in dark products.

- Sort by colour and composition
- White products are most versatile
- Mono-coloured products can be used in products of the same colour
- Mixed colour products can be used in dark products

Shipping

One challenge is shipping and customs. Shipping containers from Europe to Pakistan is generally low cost as cargo ships are in less demand this direction. Nevertheless, it is important to pay attention to customs regulations, especially when shipping used textiles to Asia. There might be high tariffs on importing waste, so it is important to classify the products in the right way.

- Check the specific customs regulations for used textiles
- Consult your local partner

Recycled yarn development

Once the material has been shredded into fibre, it needs to be determined in how far the staple length and colour of it are suitable for the targeted product. For mixed colours, further testing and analysis might be necessary to use the right dyeing or printing process for the desired shade. An ongoing partnership approach will help to effectively communicate and develop samples that can meet the buyer's or brand's expectation.

In the bigger context, the recycled yarn does not only need to be fully traceable, but also be in demand by brands and retailers. Feedback loops can help ensure that the yarn produced will be able to meet the brand's requirements.

Once the yarn has been developed, production can start as usual. The recycled material can be complemented with other sustainable and recycled material, such as BCI cotton and recycled polyester. The latter is particularly useful in combination with recycled cotton fibres with short staple length.

- Test if recycled yarn can meet product requirements
- Early feedback from brand ensures yarn meets their expectations
- Add other sustainable fibres to the yarn for an all-round sustainable product
- Blend recycled polyester with short staple recycled cotton for increased yarn stability

Fabric recycling

Another recycling option is fabric recycling, which skips the shredding process entirely. While it is not as versatile as recycled fibre, it is highly sustainable as it requires less processes and energy. Fabrics from hotels and airlines are especially suitable for recycling, as they their material make-up, quality and origin are known. This facilitates sorting and recycling processes and provides transparency. As the majority of institutional fabrics is white, there is little risk of potentially hazardous substances. If the fabrics are white and made of 100% cotton, they can be dyed any colour.

Products from recycled fabric have already been developed. Discarded bedlinen from hotels were collected in Europe and shipped to Bangladesh, where they were cut into large pieces to form shopping bags when sown together. To ensure no material goes to waste, any left-over cut waste is used as material for rag rugs. Similar projects can be realised with almost any fabric. However, it is imperative to work together with designers and manufacturers and provide traceability.

- Skip shredding – just cut
- Suitable for any colour or blend as long as target product matches
- Cut waste can be integrated in rag rugs or shredded into fibre



Shoe bag and shopping bag made from recycled fabric from institutional textiles, rug made from cut waste

Feasibility Study Conclusion

As shown both in the practical tests performed at CBL and Crestex, as well as the research on other options in circular textiles, it is feasible to recycle cotton, polyester and blends in Pakistan, including coloured items. While each product comes with its individual challenges, these can be solved with cooperation and existing solutions. Economic feasibility is dependent on meeting customer requirements, which is feasible as long as the amount of recycled content is kept at a level that maintains an acceptable quality, as demonstrated in the PCW jeans. With water and energy saving processes and clean practices at certified manufacturers, like CBL and Crestex, ecological feasibility is given as well. Furthermore, by integrating recycled polyester from local sources, the local PET collection and recycling industry is strengthened, leading to a reduction of plastic waste. Lastly, the social impact of circular textiles is positive as it provides business opportunities to factories that observe international standards of social compliance, creating jobs in a decent work environment with significant growth potential in the near future.

PSD Toolkit indicators

PSD 7b: 1A25/B80; 2A50/B14600

People reached through the activities within the scope of the project (estimation):

	Direct	Indirect	Explanation
Participants from the Netherlands			
Dibella	2	30	<i>Project participants; total workforce</i>
Event	24	60	<i>Attendees; email invitations, social media likes</i>
Total	26	90	
Participants from Pakistan			
CBL	3	8,000	<i>Project participants; total workforce</i>
Crestex	3	4,500	<i>Project participants; total workforce</i>
Event	44	2100	<i>Attendees; email invitations, social media likes, promotion by Pakistan Textile Journal</i>
Total	50	14,600	
Participants international			
Event	61	220	<i>Attendees; email invitations, social media likes</i>
TOTAL (all regions)	137	14,910	

PSD 7c: Number of identified opportunities for investment and/or follow-up PSD projects: 1

Annex

Stakeholders and key players in Circular Textile & Footwear Industries

Title	URL	Short description
UN		
23.2.2021 United Nations Industrial Development Organization Launch of the Global Alliance on Circular Economy and Resource Efficiency (GACERE)	https://www.developmentaid.org/#!/news-stream/post/84986/circular-	Bringing together governments and relevant networks and organizations, the Global Alliance on Circular Economy and Resource Efficiency (GACERE) aims to provide a global impetus to initiatives related to the circular economy transition, resource efficiency, sustainable consumption, and production patterns, and inclusive and sustainable industrialization. Eleven countries (Canada, Chile, Colombia, Japan, Kenya, New Zealand, Nigeria, Norway, Peru, Rwanda, and South Africa) and the EU have joined the Alliance to date.
2018 Fashion Industry Charter for Climate Action / UNFCCC	https://unfccc.int/climate-action/sectoral-engagement/global-climate-action-in-fashion/about-the-fashion-industry-charter-for-climate-action	Containing the vision to achieve net-zero emissions by 2050.
EU		
1.12.2019 European Green Deal	https://ec.europa.eu/commission/commissioners/2019-2024/timmermans_en	The European textile industry has to waste less and recycle more after being highlighted as a key sector by the European Commission in its industrial strategy for a transition to a circular economy. In its plan for a European Green Deal, the Commission outlined a varied set of measures for resource-intensive sectors varying from construction to textiles. They all aim to align the industries with the EU's goal to become the first climate-neutral bloc by 2050.
2020-2030 Circular Economy Action Plan	https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN	Applying circular economy principles across the EU economy by 2030. EU aims to be climate-neutral by 2050. Goals for the Textile Industry: Extend the responsibility of textile companies and push them a) to offer reusable, durable and repairable products, according to the Green Deal plan, and b) Waste needs to be reduced and, where it cannot be avoided, recycled.

EURATEX - Re-Hubs European Textile Recycling Hubs (ReHubs).	https://euratex.eu/news/re-hubs/	A joint initiative to upcycle textile waste and circular materials all over Europe. The aim is to create 5 hubs to process textile waste and become European coordination centres.
The Green Consumption Pledge	https://ec.europa.eu/info/policies/consumers/consumer-protection/green-consumption-pledge-initiative_en	An initiative for sustainable consumption including textile sector
Business Europe Circularity - Textile, Apparel, Footwear and Leather	http://www.circularity.eu/sectors/textiles-apparel-and-leather/	The platform is a web tool managed by BusinessEurope and its national members that contributes to the EU's agenda on circular economy. Information in this link is supplied by EURATEX. Contains information on recycled yarns and fabric.
SwitchMed Initiative	https://switchmed.eu/	The SwitchMed initiative aims at achieving a circular economy in the southern Mediterranean by changing the way goods and services are produced and consumed. In order to achieve this, the initiative provides tools and services directly to the private sector, supports an enabling policy environment, and facilitates exchange of information among partners and key stakeholders.
Foundations / NGOs / Initiatives		
Launched in March 2017 Fashion for Good	https://fashionforgood.com/about-us/	Fashion for Good connects brands, producers, retailers, suppliers, non-profit organisations, innovators and funders to work together in their shared ambition to make the fashion industry a force for good. The hub in Amsterdam houses Fashion for Good Experience and their Circular Apparel Community.
The Ellen MacArthur Foundation	https://www.ellenmacarthurfoundation.org/	Works in Education & Training, Business & Government, Insight & Analysis, Systemic Initiatives and Communications to accelerate the transition to a circular economy
Global Fashion Agenda	https://www.globalfashionagenda.com/about-us/our-mission/	Global Fashion Agenda's work as a thought leader is further evident in the insightful reports it produces throughout the year. In partnership with Strategic Partners ASOS, BESTSELLER, H&M Group, Kering, Li & Fung, Nike, PVH Corp., Sustainable Apparel Coalition and Target, it spearheads the fashion industry's journey towards a more sustainable future.

Real Circularity Coalition, UK	https://www.realcircularity.org/	Lucy Siegle founded the Real Circularity Coalition in January 2020. The Real Circularity Coalition is campaigning to accelerate the globe's transition from linear and semi-circular systems to a real circular economy. They believe passionately this transition is vital if mankind is to meet the key environmental challenges facing the world in the 2020s and beyond.
The Micro Fibre Consortium, UK	https://www.microfibreconsortium.com/about	Sectorial NGO promoting sustainable fibre
Projects		
2019 Policy Hub (A project of Sustainable Apparel Coalition)	https://www.policyhub.org/	Sustainable Apparel Coalition Launches Policy Hub to Accelerate the Circular Economy Policy Agenda. The Policy Hub unites the textile industry and its stakeholders to speak in one voice and to propose policies that accelerate circular practices in the apparel and footwear industry. The Sustainable Apparel Coalition (SAC), the Global Fashion Agenda (GFA) and the Federation of the European Sporting Goods Industry (FESI) founded the Policy Hub in May 2019.
December 2020 From Fibre to Finish Tracing sustainable viscose (A project by Fashion for Good)	https://mailchi.mp/495b45590093/press-release-new-exhibition-patchwork-2020-by-tess-van-zalinge-at-fashion-for-good-1599128?e=c987195e7a	It brings together a pioneering consortium to pilot a solution that verifies sustainable viscose fibres along the fashion supply chain. Developed in collaboration with BESTSELLER and Kering, the project applies the innovative blockchain technology from TextileGenesis™ (a Fashion for Good Innovator) to trace the viscose in the textile supply chain spanning eight countries. Following the completion of the pilot in late 2021, an aggregated report detailing the key findings and best practices will be shared publicly.
2017 Make Fashion Circular (A project by Ellen MacArthur Foundation)	https://www.ellenmacarthurfoundation.org/our-work/activities/make-fashion-circular	Brings together industrial leaders and brands etc. to stimulate the level of collaboration and innovation necessary to create a new textiles economy, aligned with the principles of the circular economy.
2019-2021 The Jeans Redesign (A project by Ellen MacArthur Foundation)	https://www.ellenmacarthurfoundation.org/our-work/activities/make-fashion-circular/the-jeans-redesign	By employing the principles of a circular economy, the Jeans Redesign ensures positive impacts for the environment, society, and the health of those people working in its industry. Over sixty leading brands, manufacturers, and fabric mills are using our Jeans Redesign Guidelines to produce jeans that will be available on the market by May 2021. Members required to present their circular products no later than May 2021.

Circular Fashion Partnership (A project by Global Fashion Agenda)	https://www.globalfashionagenda.com/circular-fashion-partnership/	A cross-sectorial project led by Global Fashion Agenda with project partners Reverse Resources and BGMEA, to accelerate the transition to a circular fashion industry, by demonstrating a Circular Fashion Business Case in Bangladesh. The project is made possible in collaboration with P4G.
Blue Jeans Go Green (A project by Cotton Incorporated of USA)	https://bluejeansgogreen.org/about-us/	Denim recycling program. Recycled into new and useful items, like UltraTouch™ Denim Insulation.
Textile Exchange (formerly Organic Exchange)	https://walmart.org/what-we-do/advancing-sustainability/waste	2010 received funding from Walmart Foundation for the project Accelerating Circularity Project to begin researching, mapping and identifying links that develop new models for scalable and cost-effective circular textile-to-textile supply chains to reduce textile waste. Walmart.org invests in programs that are researching and testing new models for scalable and cost-effective circular textile-to-textile supply chains. The goal of these programs is to increase the use of recycled fibres, decrease textile waste and reduce the industry's greenhouse gas emissions.
Textile and Fashion 2030. Sweden	https://textileandfashion2030.se/en/what-is-textile-fashion-2030/	The project unites industry players and create a dynamic, strong COMMUNITY to reduce environmental impact at both national and international levels. It offers skills development, activities, and tools that measure the progress of your sustainability work to achieve desirable results and to meet the consumer of the future.
25.2.2021 Nudie Jeans recycles seconds into new denim (A project under UNIDO/SwitchMed)	https://www.ecotextile.com/2021022627459/fashion-retail-news/nudie-jeans-recycles-seconds-into-new-denim.html	Nudie Jeans recycles second hand items into new denim. Two companies in Tunisia are responsible for over half of Nudie Jeans' production value. To develop greener production processes in Tunisia, Nudie Jeans has been working with the United Nations Industrial Development Organization (UNIDO) as part of the European Union-funded SwitchMed project.
House of Denim (Netherlands)	https://www.houseofdenim.org/our-team	Denim Advisory Group. Strong force to promote and develop circular denim.
Modint (Netherlands)	https://modint.nl/	Advisory Group and sponsoring projects. Modint is the business network of manufacturers, importers, agents and wholesalers of clothing, fashion accessories, carpets and (interior) textiles.

Unspun Unveils Its Most Sustainable Jeans (custom and circular)	https://sourcingjournal.com/denim/denim-brands/unspun-genesis-jeans-ellen-macarthur-jeans-resdesign-custom-body-scan-255080/	The San Francisco- and Hong Kong-based company launched Genesis jeans Friday, a line of men's and women's jeans that aligns with the Ellen MacArthur Foundation's Jeans Redesign principles for a circular economy and employs its unique body-scanning technology.
Nudie Jeans Sweden	https://www.nudiejeans.com/selection/rebirth	In 2019, the Swedish denim brand Nudie Jeans Co launched a denim capsule collection called Rebirth. Collected post-consumer Nudie jeans are mechanically degraded into fibres. These fibres in combination with virgin organic cotton are spun into yarns which are turned into new denim fabric, that is used in the manufacturing of new Nudie Jeans garments.
Loop.a Life Netherlands	https://loopalife.com/over-ons/ons-circulaire-productieproces/	Circular Jeans brand: Blue LOOP. Buying textile waste from local textile sorters. Sorting and shredding done in Netherlands. Spinning and Weaving done in France and Italy. The recycled materials will then be turned in new jeans.
Closed GmbH Hamburg	https://www.closed.com/en/about/production/	German fashion brand Closed has teamed up with Italian denim mill Candiani for a 100 percent degradable denim collection. The capsule collection, which comprises jeans and jackets for both women and men, is made using organic cotton and biodegradable stretch yarn Coreva, which is developed by Candiani.
Business Units (EU and others)		
Renewcell Sweden	https://www.renewcell.com/en/about/	Circulose® is a branded 'dissolving pulp' product that Renewcell makes from 100% textile waste such as worn-out jeans and production scraps. Renewcell will work to coordinate and organize sourcing with mills and traders (or waste-handlers) in Bangladesh while overseeing the quality of feedstock.
I:Collect GmbH Germany	https://www.ico-spirit.com/en/	The I:CO take-back system makes it possible to collect used clothing and shoes at a retailer's point of sale and give them a new life through reuse or recycling. Official supporter of the European Clothing Action Plan, which focused on the clothing supply chain in order to build a circular approach to fashion across Europe, reducing the carbon, waste and water footprint of clothing by March 2019. SOEX and I:CO launched world's first recycling system for all footwear types: www.footwear-recycling.com
European Spinning Group Belgium	https://www.esg-group.eu/en/news/2019-11-08-esg-launches-hackyourjeans	A Belgium based company by spinning yarns from discarded denim, marketed as the ESG Green collection. European Spinning Group has joined the REMO Key program, for its recycled yarn collections.

Simco Spinning & Textiles Ltd. Bangladesh	http://cyclofibers.com/	mechanically recycle the textile waste from the garment manufacturers in Bangladesh into new fibers and yarns, without using water, chemicals or dyes. Finished yarn trade mark CYCLO® made with recycled fibres.
Wolkat Fibre B.V. Netherlands	https://wolkat.com/en	Collected textile is transformed in-house to new products for fashion-, car- or furniture-industry. Sorting, recycling, spinning and weaving is all done in-house. The final products are for all buyers interested in textile products.
Infinited Fiber Company Finland	https://infinitedfiber.com/	the material used to make the exclusive jeans consists of 50% organic cotton and 50% Infinna, which comes from 100% reborn textile waste. Infinted Fiber Company's technology is unique in the fashion industry – it can turn textile, cardboard and agricultural waste to new a cotton-like material. The ground-breaking process makes it possible to recycle garments again and again without compromising on the quality, creating a true circular fashion economy. Application: HM Weekday jeans
Ocean Safe Germany	https://oceansafe.de/de/	Home textile fabric. The Krefeld-based start-up OceanSafe developed synthetic textiles that are 100 percent biodegradable, and received for this innovation the German Sustainability Award Design 2021 as a “pioneer”.
HNST Belgium	https://www.letsbehonest.eu/pages/our-production-process	Collecting back jeans from consumers and recycle them back to raw fabric. Sorting done in-house, Shredding done in a German recycling factory, Spinning: weft yarn spun in Belgium, Weaving: warp yarn prepared in an Italian Denim Mill, Sewing done in Portugal.
MUD jeans Netherlands	https://mudjeans.eu/	Have a take-back scheme of jeans. In collaboration with the denim experts at Recover and Tijedos Royo in Valencia new denim fabrics are made, containing 40% post-consumer recycled cotton.
Bossa Denim Turkey	http://www.bossa.com.tr/aboutus	Collecting old jeans, send them to a partner company in Gaizantep, Turkey for shredding and use the shredded pieces for making new fabrics.
Pure Waste Textiles Oy Finland	https://www.purewaste.com/experience-pure-waste/production/the-process	Pure Waste Textiles is a Finnish clothing company that produces 100% recycled yarns, fabrics, and ready-made garments. The company uses pre-consumer textile waste as raw material. The textile waste is collected from near-by factories (in India) and comes in the form of cutting clips and spinning waste. After sourcing the materials, the material is sorted by colour and quality and carded carefully apart without weakening the quality of the fibres. The cotton is then spun into yarns, and finally turned into 100% recycled high-quality textile.

Oritain verification	https://oritain.com/about/our-certification/	The verification represents that the product can be scientifically verified as being from its claimed origin. In September 2020, Cone Denim First Denim Mill first offered forensic verification of cotton traceability.
Reverse Resources One of the partners of Bangladesh: Circular Fashion Partnership	https://reverseresources.net/news/circular-fashion-partnership	Reverse Resources is a tracking and trading platform for textile waste, providing 360-degree transparency of the waste flows. It's like an Uber of textile waste. Service: Keep real-time track of the textile waste in your stock, learn which waste is worth to segregate, make money from selling your waste to recyclers, get circular report to show your buyers where your waste goes.
Remokey, Netherland	https://remokey.com/	REMO has created a quality label & communication solution for textiles made with recycled materials. REMO aims to motivate and promote textile recycling and raise awareness for more sustainable solutions, waste reduction and a more conscious attitude towards 'fast fashion' consumption and textile production.
TextileGenesis™ Hong Kong / India	https://textilegenesis.com/	TextileGenesis™ is a pioneering traceability platform custom built for the apparel ecosystem
Business Units (Pakistan)		
Soorty Enterprise Pvt Ltd.	http://www.soorty.com/	A recycling plant is being established that is GRS v 3.0 by Control Union for fabrics, garments and yarns with a capacity to recycle 2.5 tons of material per day. Collaborating with I:COLLECT to process Post-Consumer Waste as well. The plant has the capability to process different kind of material like spinning waste, denim waste, and garment waste.
AGI Denim (Artistic Fabric and Garment Industries Pvt) AGI Denim Artistic Milliners	https://agidenim.com/who-we-are/	For Spring/Summer 2021, the company also launched new R&D platforms, Bio-Vision and Circular Blue, to support zero waste design product development for fibre technologies and water and energy usage. For Artistic Milliners, which introduced recycled fibres to its production in 2012 for a H&M project, post-consumer waste and recycled polyester are the most popular recycled alternatives. The mill's portfolio of recycled fibres now includes pre-consumer recycled cotton, post-consumer recycled cotton, industrial waste and branded fibres like Tencel's Refibra, Roica by Asahi Kasei and Unifi's Repreve and Ocean Repreve.
Al Rahim Textile	http://www.alrahimtextile.com/products.html	Al Rahim Textile Industries is one of the largest exporters of home textile products. Raw materials used including Bamboo and Modal fibres.
Feroze1888 Mills Limited	https://feroze1888.com/	A leading terry textile manufacturing in Pakistan. Maintain material recycling program which saves more than 1,400 tons of raw cotton through recycling.
Gul Ahmed Textile Mills Ltd	https://gulahmed.com/about-us/company-overview/	Gul Ahmed is a composite unit – making everything from cotton yarn to finished products.

Kamal Ltd.	http://kamallimited.com/about-us-kamal/	Kamal Limited is fully equipped for Innovation, Product development, Manufacturing and Quality Assurance. Spread over Spinning, Weaving, Home Textile Processing, Apparel Dying, Finishing and Fashion.
Mekotex (Pvt.) Limited	http://www.mekotex.com/	Mekotex (Pvt) Ltd is one of the leading manufacturers and exporter of Denim and other cotton fabrics in Pakistan. It is a fully integrated vertical unit with its own in-house Spinning, Denim preparatory, weaving and finishing.
Mustaqim Dyeing and Printing industries	https://www.mustaqim.com/business.php	A yarn and home textile producer with circularity initiatives.
Rajby Industries	https://www.rajby.com/history.html	Rajby is known for its vertically integrated set-up that caters to all processes from manufacturing, fabric, to the final garment. With CSR initiatives and a sustainability driven approach; we wish to challenge contemporary notion and restructure the denim industry.

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