Supplementary Information

Fibre-to-fibre recycling in textiles: strategies, limitations and industrial perspectives

Table S1. Companies and Initiatives for fibre recycling. References for the companies/initiatives listed here are provided in the main manuscript.

Companies/ Initiatives	Input	Description	Output
Frankenhuis / Boer Group (Netherlands)	Post-consumer cotton textiles	Collection, sorting, processing into recycled fibres	Fibres for nonwovens
Wolkat (Netherlands/Morocco)	Post-consumer cotton textiles	Collection, colour/fibre sorting, cleaning, shredding, spinning	Yarns for textiles & nonwovens
Säntis (Switzerland)	Pre-/post-consumer cotton	Spinning into strong 100% recycled cotton fibres	RCO100® yarns
Belda Llorens (Spain)	Pre-/post-consumer cotton	Colour & composition sorting, removal of non-recyclables, spinning	EcoLife® yarns blended with virgin fibres
Velener Textil GmbH (Germany)	Post-industrial cotton yarns	Fibre recovery, blending with virgin cotton, spinning	WECYCLED® cotton yarns
Gebrüder Otto GmbH & Co. (Germany)	Post-industrial cotton	recot²® process for high-quality yarn	recot²® yarns (25–50% recycled cotton)
Hilaturas Ferre (Spain)	Post-industrial/consumer cotton	Cutting, shredding, spinning	Recover® yarns (50% recycled cotton blends)
RCotton (Spain)	Pre-/post-consumer & post-industrial cotton	Cutting, cleaning, shredding, spinning	Recover™ fibres/yarns
WeTurn (France)	Cotton textile waste	Evaluation, collection, spinning	Recycled cotton yarns
Geetanjali Woollens (India)	Cotton waste	Mechanical recycling, weaving, finishing	Recycled cotton fibres/yarns
Usha Yarns (India)	Pre-consumer cotton	Cleaning, shredding, spinning	Yarns (60% recycled cotton, 40% recycled polyester)
Taishoboseki (Japan)	Pre-consumer cotton	Not disclosed	Raffy® recycled cotton yarns
Takihyo Co., Ltd. (Japan)	Pre-/post-consumer cotton	Mechanical recycling, spinning	Upcycled denim & fabrics
Rewoven (South Africa)	100% cotton textiles	Colour sorting, blending with recycled PET, spinning	Poly-cotton fabrics (60/40)
FabScrap (USA)	Pre-consumer cotton scraps	Sorting, cutting, shredding	Textile fibres
Blue Jeans Go Green™ / Bonded Logic (USA)	Post-consumer denim	Mechanical recycling	UltraTouch™ Denim insulation
Circular Systems (USA)	Pre-/post-consumer & post-industrial cotton	Mechanical recycling, spinning	Texloop™ materials
GIOTEX (Mexico/USA)	Post-industrial cotton	Shredding, blending, spinning	Giotex™ yarns (55–90% recycled cotton)
Lenzing AG (Austria)	Pre-/post-industrial cotton + virgin pulp	Blending & spinning	TENCEL®, Modal®, Refibra™
Asahi Kasei (Japan)	Cotton linter, cotton waste	Cupro spinning process	Bemliese™, Bemberg™ fibres
Evrnu (USA)	Post-consumer cellulosic waste	Dissolution, polymerization, spinning	NuCycle™ regenerated fibres
Infinited Fibre (Finland)	Cellulosic waste incl. cotton blends	Separation, carbamation, wet spinning	Infinna™ cellulose carbamate fibres
Aalto University / University of Helsinki (Finland)	Post-consumer cotton waste, paper/cardboard	Ionic liquid dissolution, wet spinning	Ioncell™ regenerated fibres
SaXcell (Netherlands)	Post-consumer cellulosic waste	Chemical decolouration, wet spinning	SaXcell® regenerated fibres

Cardato (Italy)	Post-industrial & post-consumer textiles (≥65%)	Closed-loop mechanical recycling (carding recycled + virgin fibres), CO_2 neutral certified	Cardato Recycled® yarns
ECOALF (Spain)	Post-industrial textiles	Closed-loop mechanical recycling (carding recycled + virgin fibres)	Recycled wool yarns for ECOALF products
Woolagain (USA)	Post-consumer textiles	Closed-loop mechanical recycling (carding recycled + virgin fibres), 31 colours available	Woolagain yarns (80% recycled wool)
Christian Fischbacher Co. AG (Switzerland)	Post-industrial & post-consumer textiles	No dyeing required	BENU® recycled wool blended with PET bottle waste
Datini Fibres	Post-consumer textiles	Not specified	OON by Datini recycled wool fibres
Boer Group (Netherlands)	Post-consumer textiles	Not specified	Wool yarns
WeTurn (France)	Textile waste, production scraps	Partnerships with various companies	Recycled wool yarns
Geetanjali Woollens (India)	Post-consumer textiles (100%)	Not specified	Recycled sheep wool & cashmere
Novetex Textiles Limited (Hong Kong)	Textile waste	Billie System: waterless recycling, ozone sanitization, manual removal of non-textiles, automated colour sorting, mechanical recycling, UV sanitization	100% recycled wool fibres
re:newcell (Sweden)	Industrial & post-consumer cotton waste, textile waste (100% cotton/viscose)	Collection, shredding, removal of non-textiles, polyester separation, drying to high-quality pulp	CIRCULOSE® regenerated fibres for viscose, lyocell, modal, acetate
Asia Pacific Rayon (APR) (Indonesia, pilot scale)	Pre-/post-consumer cotton-rich textiles	Not specified	Viscose fibres
Birla Cellulose (India)	Pre-consumer textile waste (20% cotton), post-consumer (≈5%), wood pulp	Closed-loop process with reduced water use & GHG emissions	Liva Reviva fibres, similar to commercial viscose
Jilin Chemical Fibre Group Co., Ltd. (China)	Pre-consumer cotton linters (100%) Not disclosed	Water recycling with 95% efficiency	Ecojilin viscose filaments
		Not disclosed	White Mountain viscose filaments
Sateri + Södra + Renewcell (China)	Post-consumer textile waste (5–20%) + wood pulp	Blended feedstock for viscose production	Finex™ viscose fibres for apparel, home textiles, nonwovens
Södra's OneMore® (Sweden)	Post-consumer cotton textile waste	Cotton/polyester separation; cellulose (20%) blended with wood cellulose (80%)	OneMore® dissolving pulp for viscose & lyocell
Velener Textil GmbH (Germany)	PET bottles	Not specified	PET WETURNED® woven fabrics
Sinterama (Italy)	Post-consumer PET bottles	Mechanical recycling into polymers; dyeable at 98 °C	NEWLIFE™ recycled polyester yarns
RadiciGroup (Italy)	Post-consumer PET bottles	Production of continuous PET filaments (r-Radyarn®)	r-Radyarn®, r-Starlight®
SEAQUAL Initiative (Spain)	Marine PET waste (10%) + post-consumer PET (90%)	Collection, processing into fibres	SEAQUAL® YARN recycled polyester
ECOALF (Spain)	PET bottles, marine waste	Mechanical recycling to flakes/pellets	Recycled polyester yarns
Stein Fibres (USA)	PET bottles, post-industrial PET	Mechanical recycling into fibres	Infinity Polyester fibres
Unifi (USA)	PET bottles, post-industrial PET	Mechanical recycling	Repreve® polyester yarns
The Movement (Netherlands)	Recycled PET	Extrusion/spinning of Polylana®	Polylana® fibres/yarns
Teijin (Japan)	PET bottles	Mechanical + chemical recycling to pellets	ECOPET™ fibres
Toray (Japan)	PET bottles, post-industrial PET	Mechanical blending with cotton	ECOUSE™ fibres and products
Hyosung (South Korea)	PET bottles, marine PET waste	Mechanical recycling	Regen™ Polyester yarns
Ioniqa (Netherlands)	Coloured PET	Chemical recycling via glycolysis	BHET, rPET

Jeplan (Japan)	Coloured PET	Glycolysis depolymerization (Rewind™ process)	BHET flakes, PET resins
FENC (Taiwan)	PET bottles	Glycolysis depolymerization & repolymerization	TopGreen® fibres
Eastman Chemical (USA)	PET plastics	Molecular recycling (glycolysis/methanolysis)	Recycled PET polymers
Ambercycle (USA)	Post-consumer PET textiles	Enzymatic hydrolysis & purification	Cycora® recycled yarns
Loop™ Industries (Canada)	All PET waste	Depolymerization to PTA & MEG	Loop™ PET
Carbios (France)	PET	Enzymatic depolymerization	EG, PTA monomers
CuRe Technology (Netherlands)	Coloured PET	Low-energy chemical recycling	PET granules
Polygenta Technologies (India)	PET bottles	Chemical glycolysis to pure esters	Recycled polyester yarns
Itochu (Japan)	PET textiles	Chemical recycling	RENU™ PET
Nan Ya Plastics SAYA (USA)	PET textiles	Advanced cleaning & chem/mech recycling	perPETual PET
GARBO SRL. (Italy)	PET waste	ChemPET chemical recycling to BHET	PET-based materials
Indorama + Loop™ (Thailand)	All PET waste	Patented chemical depolymerization	Recycled PET, DMT, MEG
NextChem (Italy)	PET & PET textiles	Alkaline hydrolysis + microwaves	New PET polymers
Fulgar (Italy)	Post-industrial textile waste containing Nylon 6,6	Mechanical recycling of Nylon 6,6 waste from the main production cycle via the MSC process — ~80% CO_2 reduction and ~90% water saving; breathable filaments (EN ISO 62) with dyeable quality	**Q-Nova®** nylon 6,6 (50/50 recycled/virgin; "99% recycled" stated)
ECOALF (Spain)	Discarded fishing nets (Nylon 6, 25%), carpet remnants (25%), and pre-production nylon textile waste (50%)	Discarded fishing nets are collected from oceans (Spain & Thailand) and mechanically recycled into new yarns with properties comparable to virgin nylon	Recycled nylon yarns used in ECOALF garments
	Recycled nylon (50%) + microplastics	Yarns composed of 50% recycled nylon; hydrogen bonding used to "seal" microfibres and prevent microplastic shedding. Conventional fleece yarns shed due to short fibres; a new yarn using longer, continuous fibres resist shedding	**0-RELEASE YARN** and **Meryl®** knit
Chainlon (Thailand)	Post-industrial & post-consumer textiles (Nylon 6 and 6,6)	Mechanical recycling (recycled chips melted and spun); ~8.5% energy saving; ~76.7% CO_2 reduction; 100% water saving	**Greenlon®** recycled yarns (40, 70, 400 denier)
Nilit (Israel)	Post-industrial textile waste (Nylon 6,6), ideally partially oriented yarns	80–90% (w/w) recycled content in the melt-spinning blend; process not limited to Nylon 6,6 (other nylons possible)	**SENSIL® Ecocare** yarn
Toray (Japan)	Post-industrial textile waste, discarded fishing nets (Nylon 6)	Mechanical recycling of off-spec yarns generated in virgin nylon production; ~80% CO_2 reduction reported	**Reycyclon™** yarn (e.g., Patagonia)
Unifi (USA)	Post-industrial & pre-consumer waste (Nylon 6)	Proprietary chip extrusion and texturizing process	**REPREVE® Nylon** fibres
Aquafil – ECONYL® (Italy, commercial)	Post-industrial textile waste (used garments), fishing nets, 100% nylon carpets (Nylon 6)	Closed-loop **ECONYL®** process: waste collection → depolymerisation to recover caprolactam → repolymerisation to virgin-quality nylon → yarn production	**ECONYL®** regenerated nylon-6 yarn; "Econyl® Yarn" (70% recycled nylon, 30% virgin fibre) for flooring/carpets
Hyosung (South Korea, commercial)	Fishing nets, safety nets, nylon ropes, waste yarns & chips (Nylon 6), post-consumer	Locate & collect nets; separation, cutting, cleaning; **chemical recycling**: depolymerise nylon chips to caprolactam → refine/filter impurities → repolymerise to **Mipan® regen ocean** yarn for apparel	**Mipan® regen** yarn (50% recycled nylon, >20 denier) with uniform dyeability, good tenacity; **Mipan® regen ocean**
Toray – CYCLEAD™ (Japan, commercial)	Post-industrial (Toray Nylon 6 production) and post-consumer	**CYCLEAD™** chemical recovery of liquids, residues and caprolactam from Nylon 6 production and post-consumer textiles; heating	**CYCLEAD®** fibres and fabrics

		with a cyclic-amide compound and simultaneous de-colouration	
City University of Hong Kong / HKRITA (Hong Kong)	Post-consumer cotton/PET blends	Bio-route: ferment waste to produce cellulase; alkaline/urea ice pretreatment; enzymatic hydrolysis; filtration	Glucose stream from cotton; high-purity PET for re-spinning
HKRITA (Hong Kong)	Post-consumer cotton/PET blends	Hydrothermal separation; cotton → cellulose powder; PET fibre recovery	Cellulose powder; PET fibres (≈98% recovery in 0.5–2 h)
Worn Again (UK, commercial)	Post-industrial & post-consumer cotton/PET (≤20% other fibres)	Patented solvent-based separation, decontamination and polymer extraction	Circular Cellulosic Pulp; Circular PET Pellets
Blend Re:Wind + RISE + Chalmers (Sweden)	Cotton/PET blends	Selective dissolution of one component; other remains intact	Viscose filaments; PET monomers
Södra – OnceMore® (Sweden, commercial)	Cotton/PET blends	Separation of poly-cotton; decolouration options; PET by-product valorisation	Dissolving pulp for textiles (3–20% post-consumer cotton content)
Pure Waste (Finland, commercial)	Recycled cotton + rPET bottles	100% recycled inputs; colour-sorted mechanical recycling; blend 60% rCotton (mechanical) + 40% rPET (chemical); fabric finishing	Textile fibres and apparel
Circ (Tyton Biosciences) (USA)	Cotton/PET/poly-cotton blends	Hydrothermal separation → PET monomers + dissolving-grade cellulose	Cellulose pulp; PET monomers
BlockTexx (Australia)	Cotton/PET	Proprietary separation returning materials to original PET & cellulose	Cellulose pulp; PET
Circ Technology System (USA, pilot)	Post-industrial/consumer cotton, PET, poly-cotton	Modified chemical (hydrothermal): rapid PET depolymerisation to PTA/EG; cotton preserved; ~90% input recovery; cotton → lyocell-type dope	High-quality outputs from both fractions for new textiles
Novoloop (Biocellection) (USA)	Mixed post-consumer plastics (MRFs)	ATOD™: separates, purifies, converts to base components; catalytic depolymerisation; ~70% conversion	Regenerated chemical intermediates (e.g., for TPU/textiles)
CARBIOS (France)	Single-use PET	Enzymatic depolymerisation/biorecycling	100% bio-recycled PET granules
Aquafil (Italy)	Nylon 6/6,6 + elastane blends (wovens/knits)	Controlled thermal degradation of spandex + solvent wash; solvent recovery	Removed spandex; recovered nylon fibres
Ambercycle (USA)	Post-consumer poly-cotton	Molecular-level separation → high-quality PET	PET pellets and cycora™ products
Novetex Upcycling Factory (pre-industrial)	Post-consumer poly-cotton blends	Hydrothermal method using temperature, water and green solvents	—
Infinited Fibre Company (Finland)	Post-consumer cellulosic textile blends (100% cellulosic)	Separate cellulosic fibres from PET/elastane; dissolve via Cellulose Carbamate (CCA)	**Infinna™** cellulose-carbamate fibre
Circular Systems (USA)	Fibre blends	Mechanical + hydrothermal process for blended textiles	**Texloop™** materials
Leigh Fibres Inc. (USA)	Post-industrial textile waste (broad range)	Mechanical deconstruction; SafeLeigh™ barrier/coarse yarns; QuietLeigh™ acoustic/FR insulation	Reprocessed fibres (shoddy) & nonwovens
Martex Fibre (USA)	Post-industrial & post-consumer textile waste	Mechanical processing and deconstruction	Recycled cotton / cotton-poly products; reclaimed fibres
Phoenix Fibres (USA)	Post-industrial & post-consumer (cotton, cotton/PET)	Mechanical processing and deconstruction	Cotton (e.g., denim) → shoddy for various uses
Chroma (Canada)	Post-consumer textile waste	Colour-sorted recycling (no dyeing); 80% PCW + 20% rPET	Felt products and 100% recycled surface/furniture materials
Le Relais – Métisse® (France)	Post-consumer textiles (cotton; wool/acrylic blends)	85% recycled fibres (e.g., 70:15 or 45:40 cotton/wool/acrylic) + 15% PET; antifungal/antibacterial additives; recyclable at end-of-life	Thermal/acoustic building insulation (nonwoven)
HKRITA (Hong Kong)	Post-consumer wool, cotton, and wool/cotton blends	Mechanical recycling with sanitisation (≈90% microbe reduction, ISO 11737-1:2018); automated sorting (metal & colour detection, AGV)	Sliver for yarn spinning, fabrics, or garment manufacture

Kishco Group (India)	PET/cotton blends	Mechanical recycling	—
Novetex + HKRITA + H&M Foundation (Hong Kong, 2016–2020)	Post-consumer fibre blends	Fibre-to-fibre mechanical recycling	—