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European Commission

CORDIS Results Pack on

the future of textiles

A thematic collection of innovative EU-funded research results

October 2024

Achieving a circular economy for the textile sector

Research and Innovation

Contents

Editorial

The textile industry, while being fundamental to the economy, is both a major consumer of resources and significant emitter of greenhouse gases. This CORDIS Results Pack on the future of textiles highlights how the EU is tackling this challenge, funding research and innovation to create a sustainable, climate-neutral and circular textile sector.

Textiles are an intrinsic part of modern life, providing us not only with clothing and footwear but also carpets, curtains and fabrics for homes, offices and public buildings. The textiles industry is one of the world's largest industrial sectors and forms an important part of Europe's manufacturing base.

Within the EU, the sector employs 1.3 million people with a turnover of EUR 167 billion and over EUR 67 billion in exports. European citizens use on average 26 kg of textiles each year and throw away 11 kg. Although used clothes can be exported outside the EU, most (87 %) are incinerated or sent to landfill.

Currently, in the EU textile production and consumption have the highest impact on the environment and climate change after food, housing and transport. These impacts include overuse of natural resources, water, land and chemicals, and the release of greenhouse gases and pollutants.

Furthermore, the EU Strategy for Sustainable and Circular Textiles focuses on eco-design, waste and pollution prevention, safe and bio-based materials, circular material flows and responsible supply chains. The strategy also covers new business models such as clothing rental, designing products in a way that would make reuse and recycling easier, and convincing consumers to buy clothes of better quality that last longer.

In response, the EU has funded a growing number of research and innovation projects on textile sustainability and circularity. Different Horizon calls have been launched to further develop technologies and processes to scale up repair, improve collection and sorting, scale up textile recycling capacities of the EU industry, and increase fibre-to-fibre recycling and the uptake of recycled fibre content. This is a result of the EU's growing focus on the sustainable transition of the EU economy and society as part of the European Green Deal.

The European Community of Practice for a Sustainable Textile Ecosystem network (ECOSYSTEX) shares among participating projects the latest developments and results of EU research and innovation. By engaging with policymakers and public programme managers it helps them to design effective policies and programmes and support their implementation to foster textile circularity and sustainability. It also organises dissemination activities to ensure the interested public expert community can be informed about latest developments and results of EU research and innovation projects.

Taking the circular path to sustainable clothing and fishing industries

The Glaukos project finds a circular solution for bio-based textile and fishing gear production using marine-friendly polymers.

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Named after the mythical Greek sea god of sailors and fishermen, the EU-funded Glaukos project was launched in 2020 to set up a circular approach to the clothing and fishing industry. As part of its goal, it developed alternative polymers that could help slash the microplastic pollution caused by clothing and fishing gear.

From biomass to yarn

Glaukos used a fermentation process developed through microbial strain selection and strain engineering to convert industrial side streams containing sugars into polymer building blocks. With these building blocks, the team created new bio-based polymers that were tested for spinnability. The resulting polymers were then used to produce yarn and yarns for clothing, fishing nets and fishing net coatings with a low carbon and plastic footprint.

"Glaukos established assessments and technologies concerning biodegradation, mechanical degradation and ecotoxicity, covering the various impacts of plastics on marine life to ensure a healthy marine environment," states bioengineer Dr Zsófia Kádár of Glaukos project coordinator Bio Base Europe Pilot Plant, Belgium. "They can be used in the future to assess new polymers produced by our partners, or in the context of new materials development."

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The circular way to added value

End-of-life plastic must first be depolymerised before it can be turned into value-added chemicals or materials. The researchers therefore searched for and developed enzymes that break down the developed polymer. By engineering bacteria to grow on these plastic

hydrolysates, they can be converted into value-added chemicals or materials through biotechnological processes.

This bio-upcycling would be especially suitable for composites or mixed waste streams that are currently not recyclable due to their complexity. "Our bio-recycling aims at a new outlet for plastic waste: to use it as a feedstock for biotechnology," explains Prof. Nick Wierckx of project partner Forschungszentrum Jülich, Germany.

Glaukos has also developed a new methodology for life-cycle assessment, circularity and plastic leakage. Additionally, it has created a multidimensional model to map the challenges to be addressed for unlocking the potential of bio-based and biodegradable plastics.

The Glaukos (Circular solutions for the textile industry) project's key results were presented at the final Glaukos meeting in Brussels in May 2024 and are now available online. Policymakers and other stakeholders benefited from sharing the project's main exploitable knowledge, methodologies, successes and failures. Besides presenting controversial topics and technical challenges for the clothing and fishing industries, project partners also made recommendations for future research programmes and on how marine-friendly biopolymers could be integrated into innovative market applications in fashion and fishing.

For more information, please see: Glaukos project website.

PROJECT
Glaukos - Circular solutions for the textile industry

COORDINATED BY
Bio Base Europe Pilot Plant in Belgium

FUNDED UNDER
Horizon 2020 - FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/887711

PROJECT WEBSITE
glaukos-project.eu/

Closing the loop with bio-based garments

Manufacturing that is circular, local and bio-based leverages emerging sustainable technologies to produce clothing from man-made cellulose and biopolymers.

In general, textile industries create pollution and over-consume resources. Clothing produced from cotton uses a huge amount of water in cultivation, and polyester clothing is a petroleum-based product. Additionally, most clothing is produced in countries offering low-cost production, often under poor working conditions and far from the brands that order them. To reduce the environmental impact of clothing manufacturing, sustainable solutions that prioritise circularity are needed. The EU-funded HEREWEAR project has a vision for creating bio-based clothing within regional networks.

Emerging technologies

The project targeted cotton and polyester fibres for replacement with bio-based solutions because these materials are widely used and negatively affect the environment. To produce man-made cellulosic (MMC) fibre that can be used instead of cotton, HEREWEAR focused on valorising three waste streams: seaweed, manure and straw.

Whereas cotton is a mechanically spun fibre, HighPerCell® – the MMC produced by the project – makes fibres through chemical transformation. A biorefinery process produces a cellulose pulp which then undergoes ionic liquid-based wet spinning to create high quality filaments. The solvents used in production as well as the filaments themselves are reusable and recyclable.

Making the textile industry more circular and bio-based goes hand in hand with working at a more regional scale.

To replace polyester, HEREWEAR used polylactic acid (PLA) as a base material, adding other biopolymers to increase comfort. The resulting product has a similar profile to its oil-based counterpart. Polyester clothing is a major source of microplastics in the environment, and PLA blends with other bio-based materials have the potential to reduce this environmental impact.

In addition to making new eco-friendly fabrics, the project developed aftertreatment processes as well. HEREWEAR developed bio-based alternatives for coating, printing and dyeing, including polylactic acid- based printing.

HEREWEAR achieved its goal of producing corporate and streetwear clothing from bio-based fibres. Regarding the final products, project coordinator Lien Van der Schueren says: "HEREWEAR's bio-based textiles show promising features such as soft and shiny materials that can be easily recycled."

Regional networks

The project consortium includes several research organisations and small medium enterprises (SMEs). Experts in the fields of polymer chemistry, biorefinery, the textile value chain, fashion design and environmental science all contributed to the production of bio-based garments for the EU market.

The HEREWEAR team models the network of local partners the project envisions for successful implementation of a circular, bio-based clothing industry. As Van der Schueren notes: "Making the textile industry more circular and bio-based goes hand in hand with working at a more regional scale. To make this possible, we need to gather local actors active along the value chain, working at a smaller scale but via networked microfactories."

Keeping the value chain local reduces transportation costs – both financial and environmental. It also increases transparency and gives the consumer greater confidence in the sustainability of the product. Data driven labelling designed by HEREWEAR confirms the authenticity of the bio-based garment.

An encouraging aspect of the project is that all processing of bio-based materials was done with equipment similar to what is used for producing conventional textiles. This fact will enable rapid market uptake of the project's achievements.

By offering both design and materials for recyclable and reusable bio-based garments and building a community of environmentally concerned SMEs, HEREWEAR proposes multiple solutions to sustainability problems in the textile industry.

PROJECT
HEREWEAR – Bio-based local sustainable circular wear

COORDINATED BY
Centexbel in Belgium

FUNDED UNDER
Horizon 2020 - FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/101000632

PROJECT WEBSITE
herewear.eu/, herewear.tcbl.eu/
(HEREWEAR Resources Hub)

Bringing materials made from mycelium fibres to market

With applications in the fashion and automotive industries, fully bio-based materials made from fungi make the fashion industry more eco-friendly.

Modern consumers are looking for socially responsible products that reduce damage to the environment by adhering to the principles of the circular economy. To meet this growing demand, the EU-funded MY-FI project brought together a consortium of scientists, manufacturers and market specialists to produce high-quality next-gen material with low environmental cost.

Making the most of fungi

Most textiles used in contemporary clothing – such as cotton, linen and wool – are plant or animal-based. The resources used to produce these textiles are costly, and the processes for treating them can have negative impacts on the environment. As an alternative to these conventional materials, one grown with mycelium offers an attractive array of characteristics.

Fungi grow in branching structures called hyphae, which are mainly composed of chitin, a polysaccharide. Chitin closely resembles cellulose, a polysaccharide frequently used in textiles. A versatile and adaptable material, chitin is non-toxic and biodegradable.

Innovative technologies and the circular economy

MY-FI employed two fermentation processes for growing mycelium. Dynamic liquid fermentation uses stirred tanks to grow the fibres. Following an alkaline process, a solid is removed, yielding a flexible and semitransparent material. Surface liquid fermentation begins with a substrate on which the fungi grow under specific conditions. Once the material has dried, what remains are soft white sheets of pure mycelium.

Growing mycelium fibres in this way presents many ecological advantages. The fermentation processes can use different side-streams from the agro-food industry or even other industries, such as textile residues and spent grains from breweries, thus contributing to intersectoral circularity. Also, the fermentation processes produce minimal CO_2 emissions and require limited energy. Since fermentation can be managed locally, nearshoring of production is feasible, reducing transportation costs and enabling shorter supply chains.

Not only are mycelium products better for the environment, but they are better for people too. MY-FI prioritised safety in manufacturing materials, and the processes and products are non-toxic for producers as well as consumers.

With these encouraging results, MY-FI sees market adaptation in the near future. According to project coordinator Annalisa Moro: "The Surface Liquid Fermentation process, developed by MOGU, is the most promising method established during the project. Its implementation at an industrial scale will be the focus of the coming years."

The Surface Liquid Fermentation process, developed by MOGU, is the most promising method established during the project. Its implementation at an industrial scale will be the focus of the coming years.

Material characteristics and applications

Mycelium-based next-gen materials are smooth, durable and high-performing. They make an ideal alternative to leather in high-end fashion products, such as wallets, belts, handbags,

© MOGU

footwear and accessories. The nature of the material also lends itself well to certain automotive features, like cushions, headrests and steering wheels.

In the final stage of the project, MY-FI achieved prototypes of four nonwoven textiles made from mycelium fibres. Moro shares: "Project partners were able to manufacture various prototypes for the fashion and automotive industries, including bags, two dresses, a skirt, a bodysuit, a jacket, various wallets, as well as two headrests and a dashboard fascia for cars."

Such applications of next-gen material made from mycelium are just the beginning. As these materials enter the market, other sectors will find new applications for them. The work of MY-FI is only the start of a green transformation in the fashion industry.

PROJECT

MY-FI - Reinventing a smart, circular and competitive textile industry with advanced myco-fibres

COORDINATED BY

MOGU SRL in Italy

FUNDED UNDER

Horizon 2020 - FOOD

CORDIS FACTSHEET

cordis.europa.eu/project/id/101000719

PROJECT WEBSITE

my-fi.eu/

Textile waste becomes new cotton

EU-funded researchers have pioneered a revolutionary method to convert discarded textiles into a unique new textile fibre that looks and feels soft and natural – like cotton.

Every second, the equivalent of a rubbish lorry of textiles is either sent to landfill or burned, causing tremendous environmental and societal damage. The textile industry alone emits 1.2 billion tonnes of CO_2 annually, surpassing the emissions from international flights and shipping combined.

With global apparel consumption projected to reach 102 million tonnes by 2030 – equivalent to over 500 billion t-shirts – the need for sustainable production and consumption is critical. Industry leaders, government officials, environmental organisations and consumers agree that change is imperative.

Unfortunately, current recycling solutions are limited in their ability to recycle the growing piles of discarded textiles. Affordable and sustainable alternatives that also meet functional requirements are highly sought after. The EU-funded New Cotton project was established to transform the textile industry through a circular production model for commercial garment production.

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An eco-friendly alternative

Throughout the project's course, the consortium worked to collect, sort and convert textile waste into a new, man-made, high-quality cellulose fibre that looks and feels like cotton. This new cotton material was based on the textile fibre regeneration technology pioneered by Infinited Fiber Company in Finland.

"Our cellulose carbamate technology transforms textile waste that would otherwise be burned or landfilled into high-quality fibres that resemble cotton. This patented process can efficiently break down cotton-rich textile waste, including mixed fibres and other cellulose-based materials," notes Elias Veijola, project coordinator and process development engineer at Infinited Fiber Company. "By using various feedstocks, this technology significantly reduces the need for virgin raw materials, offering substantial environmental benefits." The fibres are then used to create various types of fabrics for clothing – designed, manufactured and sold by global brands like adidas and H&M.

Our cellulose carbamate technology transforms textile waste that would otherwise be burned or landfilled into high-quality fibres that resemble cotton.

Turning textile waste into high-quality fibres

Using advanced recycling technologies, sorted waste was transformed into high-quality fibres called Infinna™. These fibres, which are made entirely from 100 % textile waste, were spun

into yarns, woven into fabrics and crafted into garments. The cellulose carbamate process used to create Infinna™ fibres is significantly more environmentally friendly than traditional viscose production, avoiding toxic chemicals like carbon disulfide.

Throughout the transformation process, rigorous testing ensured the quality and performance of the new fibres and fabrics, leading to the successful release of circular-designed apparel to the market. "Unlike many recycled fibers, Infinna™ has a unique feel and appearance that allow it to be used on its own, to create 100% recycled garments," outlines Kirsi Roine, Chief Customer Officer at Infinited Fiber Company.

New Cotton demonstrated the feasibility of large-scale textile recycling and fostered collaboration within the fashion industry. By uniting fashion brands, textile manufacturers and researchers, it championed circular fashion and provided valuable insight and lessons to promote sustainable practices and innovation across the industry.

An exemplary model for sustainable practices

New Cotton is poised to make a significant impact by substantially reducing textile waste and decreasing reliance on virgin materials. This should lead to less deforestation and help preserve biodiversity. Furthermore, by establishing a new market for recycled textiles, the project not only adds sustainability value for fashion brands but also fosters economic growth in the recycling sector.

"Setting a benchmark for sustainability within the fashion industry, New Cotton encourages other brands to adopt circular practices, driving a transformation across the sector. Furthermore, it raises consumer awareness about sustainable fashion choices and the importance of recycling," concludes Tanja Karila, Chief Marketing Officer at Infinited Fiber Company.

PROJECT

New Cotton - Demonstration and launch of high performance, biodegradable, regenerated New Cotton textiles to consumer markets through an innovative, circular supply chain using Infinited Fiber technology

COORDINATED BY

Infinited Fiber Company Oy in Finland

FUNDED UNDER

Horizon 2020 - FOOD

CORDIS FACTSHEET

cordis.europa.eu/project/id/101000559

PROJECT WEBSITE

newcottonproject.eu/

Recycling textiles: from collection to retail

Technologies for processing discarded fabrics, digital tools and a focus on the consumer perspective improve the circularity of the textile industry.

© HNST

One of the main challenges we started with was the quality of recycled yarns not aligning with the requirements from fashion brands. What has been crucial for this is the improved sorting and dismantling of textile waste before going to recycling and process improvements in the mechanical recycling process itself.

Textiles and fashion have been identified as priority product groups in the EU's Circular Economy Action Plan. Textiles will have to be collected separately from 2025, yet currently less than 1 % of textile waste is recycled into reusable fibres. Without change from manufacturers and consumers, this situation will create a huge supply-demand gap. The EU-funded SCIRT project addresses this emerging problem by exploring all steps in the production chain of recycled garments.

Tools for recycling, sorting and trimming

SCIRT aims to demonstrate a textile-to-textile recycling system for post-consumer materials. This presents several challenges, notably in effectively separating textiles. According to project coordinator Evelien Dils: "One of the main challenges we started with was the quality of recycled yarns not aligning with the requirements from fashion brands. What has been crucial for this is the improved sorting and dismantling of textile waste before going to recycling and process improvements in the mechanical recycling process itself."

Different paths to recycling were tested in labs and in pilot studies. Enzymatic approaches and thermo-mechanical and mechanical methods were explored. Project partner Valvan developed two mechanical technologies for accurately sorting and trimming textiles at high speed. The Fibersort separates material based on fibre content and colour using robots and near infrared technology. The Trimclean takes the separated fibres and cuts them into small segments ranging from 20 mm to 100 mm in size. The fragments are analysed using cameras and metal detectors to remove non-fibre elements such as tags, buttons and zips.

Tools to improve circularity

SCIRT was designed to address all aspects of the production chain. This structure revealed many challenges, but as Dils says: "This really strengthened the understanding of the involved value chain partners towards the importance of collaboration beyond company borders, a crucial point in the transition towards a more circular system."

Some of the tools developed for value chain partners include the True Cost Calculator, developed to give stakeholders a clear assessment of a garment's real societal cost, taking into account financial, ecological and social concerns. A tool for accessing criteria enabling circularity validation, available through subscription, allows users to assess data related to the circularity of a product.

Centring the consumer

Europe generates more than 15 million tons of textile waste each year. Fast fashion trends exacerbate the problem by increasing the rate of disposal and reducing textile quality. Viable solutions to the problem of textile waste must address consumer demands.

The project conducted workshops with consumers and gained insight into how to motivate sustainable textile consumption practices. Consumers have concerns about the availability and affordability of recycled products, and respond well to financial incentives to recycle old clothes. Due to the prevalence of greenwashing, the need for transparency and accurate labelling related to sustainability claims is important.

Technological innovations and an appreciation for consumer demands are essential, but improving the circularity of the textile industry begins with effective policy frameworks such as Ecodesign for Effective Products Regulation. Educational campaigns and the right incentives are crucial, and in the final months of the project SCIRT worked to maximise visibility of their results. From start to finish SCIRT has delivered, and in good news for stakeholders, select recycled garments will be available for purchase in brand stores by the end of 2024.

PROJECT
SCIRT – System Circularity and Innovative Recycling of Textiles

COORDINATED BY
The Flemish Institute for Technological Research in Belgium

FUNDED UNDER
Horizon 2020 - ENVIRONMENT

CORDIS FACTSHEET
cordis.europa.eu/project/id/101003906

PROJECT WEBSITE
scirt.eu/

Digital platform improves circularity for textile industries

Following the guidelines of ecodesign legislation, a new platform improves transparency, traceability and sustainability across the supply chain.

Textile and clothing (TC) industries are considered major drivers of climate change. In the EU, where the average garment is worn only three times before being discarded, there is a critical need to disrupt disposable clothing culture. Citizens are eager for such a change, with 66 % of consumers stating they are willing to pay more for clothing that is sustainably produced. To meet this growing demand, small and medium-sized enterprises (SMEs) must ensure the eco-friendly nature of their merchandise. The EU-funded project TRICK has established a digital platform to enable reliable data collection about TC traceability, circularity, sustainability, health and social assessment by blockchain.

Ecodesign requirements

In July 2024 the cornerstone of the European Commission's approach to environmentally sustainable and circular products came into force. The Ecodesign for Sustainable Products Regulation (ESPR) is framework legislation intended to guide rules and regulations on a product-by-product basis.

Aspects targeted by ESPR include durability, recyclability and energy and resource efficiency. An electronically accessible Digital Product Passport (DPP) shares information about product performance, the nature and origin of materials and lifecycle environmental impacts, at lot level. The DPP provides manufacturers, retailers and consumers with relevant information about a product's environmental profile, as well as assurance that the product in question has not been subjected to greenwashing.

Supporting the implementation of ESPR is integral to the TRICK approach. According to project coordinator Alessandro Canepa: "The project's overarching goal is to establish a reliable, accessible platform that supports data collection for traceability, transparency, and circularity across the supply chain and in compliance with EU regulations, at single lot level."

A comprehensive digital platform

The platform developed by TRICK was tested in pilot studies involving the TC and food industries. It demonstrated scalability in the TC sector and potential replicability in the food sector. The platform's adaptability across different industries is a promising feature of project results, indicating the possibility for widespread and rapid adoption.

Adaptability is a key feature of the platform. Blockchain enables secure information sharing among many stakeholders and data portability, while AI, used to analyse data, provide business insights and verify the reliability of data declared, prevents from green washing. As Alessandro Canepa shares: "One of the standout aspects of the platform is its ability to integrate various services into a seamless user experience for SMEs, ranging from traceability and preferential certification of origin to circularity and PEF, from consumer health protection to social assessment and AI for anticounterfeiting of data."

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The services provided on the platform help SMEs meet DPP standards while improving sustainability and circularity in business. In addition to collecting and sharing data across the supply chain, the platform provides circularity assessments, product environmental footprint assessments and services to help SMEs procure preferential certification of origin. Alessandro Canepa states: "The services developed under the TRICK project align with key EU regulations, including those related to

© TRICK consortium

environmental sustainability and health protections, making it easier for SMEs to meet regulatory requirements, including the future DPP for TC."

Creating a secure, sustainable and circular future for TC industries is a complex endeavour. By creating a platform designed for SMEs, TRICK has streamlined the process. The potential replicability of the platform in other industries is a promising indication of Europe's green future.

Learn more about TRICK in this video.

PROJECT
TRICK - PRODUCT DATA TRACEABILITY FROM CRADLE TO CRADLE BY BLOCKCHAINS INTEROPERABILITY AND SUSTAINABILITY SERVICE MARKETPLACE

COORDINATED BY
Fratelli Piacenza in Italy

FUNDED UNDER
Horizon 2020 - ENVIRONMENT

CORDIS FACTSHEET
cordis.europa.eu/project/id/958352

PROJECT WEBSITE
trick-project.eu/

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RESULTS PACK ON ALGAE INNOVATION

Algae offer a sustainable means to deliver an almost endless number of valuable products including food, animal feed, nutritional supplements, pharmaceuticals, cosmetics, plastics, fertilisers, biofuels and more. This CORDIS Results Pack highlights 11 innovative EU-funded projects that showcase the potential and versatility of algae production and conversion.

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cordis.europa.eu/article/id/449950

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