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LAYMAN'S REPORT



CIRTECHTEX

Implementation of circular economy processes to reduce textile waste in the manufacture of personal protective equipment



THE PROBLEM / BACKGROUND



Technical textiles are crucial to keep workers safe in high-risk industries such as foundries, petrochemical, electricity generation and manipulation or welding. Those industries need high protective level garments that can prevent burns and injuries (thermal, electric, or chemical). The fabrics for that personal protective equipment (PPE) must meet stringent standards to effectively protect the workers.

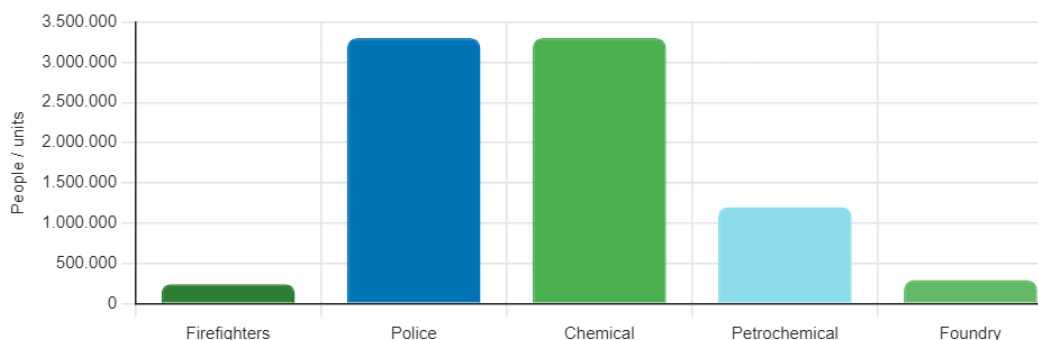
During the manufacture of the different PPE fabrics and garments along the textile value chain, a lot of material waste is generated. This remain material is highly valuable as it is made of high-performance technical materials, which differs from commodities used in fashion. Collection and circular economy practices exist and are applied in the fashion sector, but the complexity of the technical sector makes these processes more difficult to apply in the case of fabrics for PPE. That's why nowadays they are still rarely applied, both in Spain and in Europe



240.000 firefighters professionals that need PPE



~800 tons of potential recyclable PPE textile waste



Workers requiring PPE in Europe



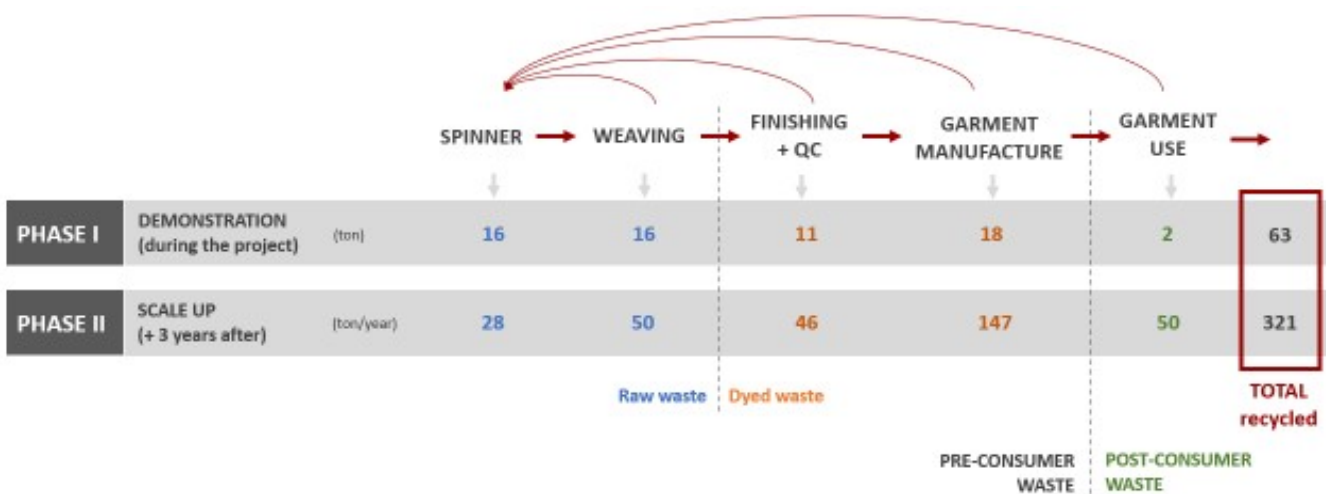
Despite the vast amount of technical material generated by these millions of workers, most of these garments currently end up in landfills. The complex nature of these fabrics makes recycling exceptionally difficult, creating a significant environmental burden that continues to grow alongside these industrial sectors.

This project ambition is to uptake circular economy approach to dramatically reduce technical textiles' waste generation and upcycle them into high-grade PPE fabrics. The consortium envisions a changing paradigm towards sustainability and commits to an environmentally friendly vision in high-end market segments.

PROJECT OBJECTIVES



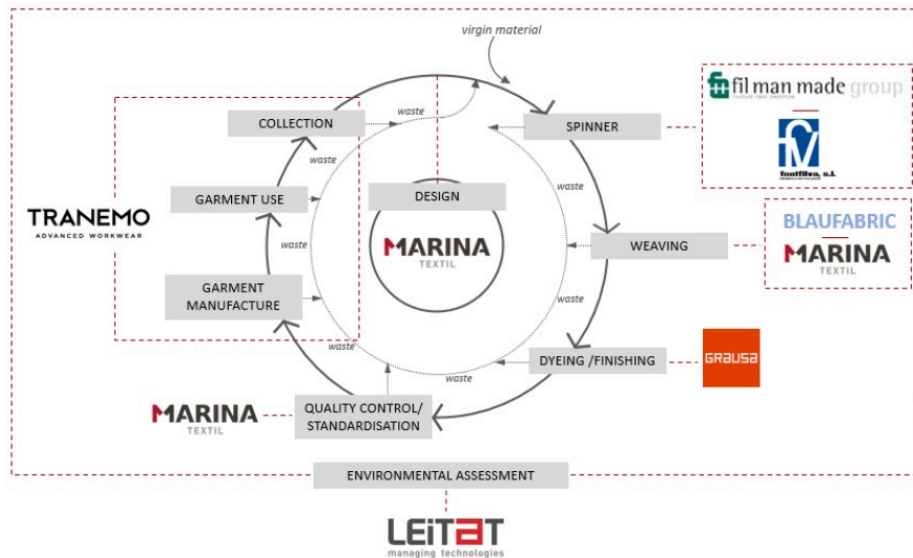
The LIFE-CIRTECHTEX project aims to transform the technical textile industry by integrating at least 20% recycled content into 80% of Marina Textil's production while maintaining rigorous safety certifications. By establishing a recovery system capable of processing 321 tons of textile waste (pre and post consumer) annually, the initiative seeks to prototype recycled versions of the different product lines. This transition is designed to be both environmentally and economically sustainable, aiming to reduce production costs by 12% and avoid over 922 tons of CO₂ eq emissions three years after the end of the project. Ultimately, the project intends to lead the sector toward a circular economy by securing GRS certifications and engaging at least 15 new stakeholders in waste recovery efforts to move away from traditional landfill disposal.



THE CIRTECHTEX PROJECT



The LIFE-CIRTECHTEX project is a European initiative co-funded by the European Union under the LIFE Programme (Environment and Circular Economy). The project is coordinated by MARINA TEXTIL S.L.U., a European leader in technical fabrics for high-risk industries. The consortium consists of eight partners, including textile innovators like TÈXTILS.CAT (Spain), industrial manufacturers such as BLAUFABRIC, FONTFILVA, GRAU (Spain), FIL MAN MADE GROUP (Italy), and TRANEMO TEXTIL (Sweden), along with the technological centre LEITAT.



The project addresses the critical need for a circular economy within the technical textiles sector, specifically for PPE used in multi-risk industries, foundries, petrochemicals, and welding. While recycling programs exist for fashion, the technical textile sector lacks established systems for recovering high-performance materials. LIFE-CIRTECHTEX aims to dramatically reduce waste by upcycling highly valuable technical scraps into high-grade PPE fabrics, ensuring they still meet the stringent safety standards required to protect workers from thermal, electric, or chemical risks.

Key industrial objectives of the project include:

- Recycling 321 tons per year of textile waste from the value chain.
- Integrating a minimum of 20% recycled material into at least 80% of MARINA TEXTIL'S PPE production.
- Implementing a comprehensive waste collection methodology (covering both pre-consumer and post-consumer material).
- Developing an industrial demonstration with a verified capacity of 63 tons.

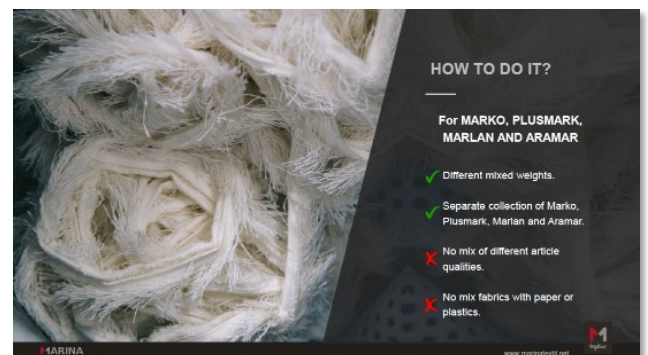
Scheduled to run for 36 months, the project focuses on demonstrating that circularity can enhance sustainability in high-end market segments without compromising worker safety. By the end of the action, the consortium expects to shift the industry paradigm toward an environmentally friendly vision for technical fabrics.



The success of the CIRTECHTEX project hinges on a precise collection system that captures technical textile waste at every stage of the manufacturing process. From the raw yarn leftovers in spinning through the fabric selvages trimmed during weaving to the discarded scraps from garment cutting, each type of waste is systematically recovered. By capturing these materials, specifically from high-performance lines with multi-risk performance among others, the project aims to redirect over 300 tons of waste per year away from landfills and back into the production cycle.

Training workers to distinguish and separate these materials is the most critical step in maintaining the integrity of the recycling loop. Because PPE must meet rigorous thermal and physical safety standards, even minor cross-contamination between different fibre types can render an entire batch of recycled yarn unusable for safety gear. Workers are trained to identify specific technical compositions and ensure that textiles are never mixed with non-wanted materials such as paper, plastics, or non-recyclable membranes that could compromise the mechanical recycling process.

To streamline this separation, the project utilizes a strict visual and organizational protocol that workers must follow. Training focuses on the use of a color-coded system alongside standardized labelling templates that track the weight and origin of each bale. These guidelines ensure that when the material reaches the final inspection stage at Marina Textil, it is high-quality, traceable, and ready to be transformed into new, protective technical yarns.



INDUSTRIAL DEMONSTRATION



Within the LIFE-CIRTECHTEX project, the developed solutions have been tested in practical, real-life conditions across different stages of the textile value chain. Activities have gone beyond laboratory work, including the processing and validation of yarns and fabrics, dyeing processes, and the production of final garments using recycled materials.

A key part of the work has been the collection and management of textile remnants and offcuts generated throughout the value chain. To enable this, specific collection guidelines have been developed, along with a traceability system to ensure proper tracking of materials from their origin through to their recycling and reintroduction into new textile products. In addition, training sessions have been carried out in each participating company to ensure the correct implementation of these guidelines and to support their integration into daily operations.

Throughout the project, more than 74 tonnes of textile material have been collected preventing it from being sent to landfill and significantly surpassing the initial project target at the end of its implementation. Once their quality was verified, selected materials from each stream were processed through mechanical recycling. As this is a continuous process, recycling activities are ongoing and will continue beyond the project end, enabling further processing of materials and supporting the continued production of the developed products. This large-scale effort demonstrates the feasibility and robustness of the proposed system, confirming its capacity to operate under real conditions and over time. Notably, these results validate the main project objective three years after the project's completion.

In addition, a wide range of fabrics and textile products have been successfully developed and validated. The work has involved close collaboration among all industrial partners in the consortium, as well as with external companies. This broad engagement highlights the strong interest in the proposed solutions and demonstrates the potential for industrial symbiosis, as materials are collected and valorised at multiple points along the textile value chain.

Overall, these activities show that circular approaches in the textile sector are not only technically viable but can also be effectively implemented through coordinated efforts across different stakeholders.



ENVIRONMENTAL IMPACT ASSESSMENT

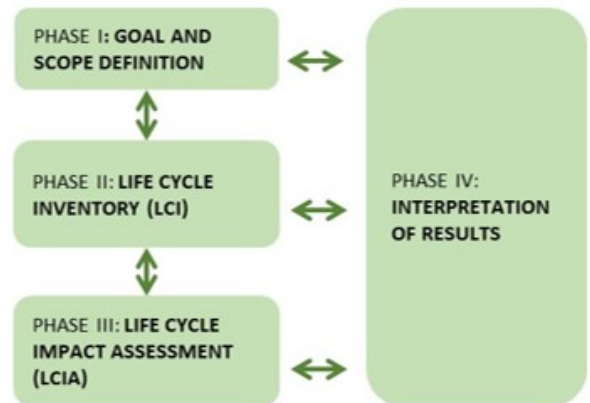


An environmental analysis has been carried out on the circular model promoted by the LIFE-CIRTECHTEX project to identify and quantify the environmental benefits and the hotspots of recovering textile material that are discarded throughout the value chain of technical textiles and using this recovered material to produce new technical textile products.

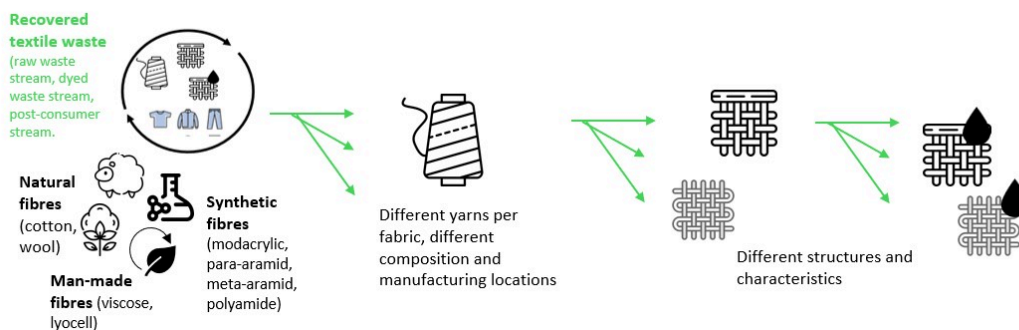
The analysis was done based on the Life cycle assessment methodology (LCA).

The goal: to quantify the environmental benefits, the technical textile products developed within the framework of the project using recovered materials from different waste streams are compared with conventional technical textile products.

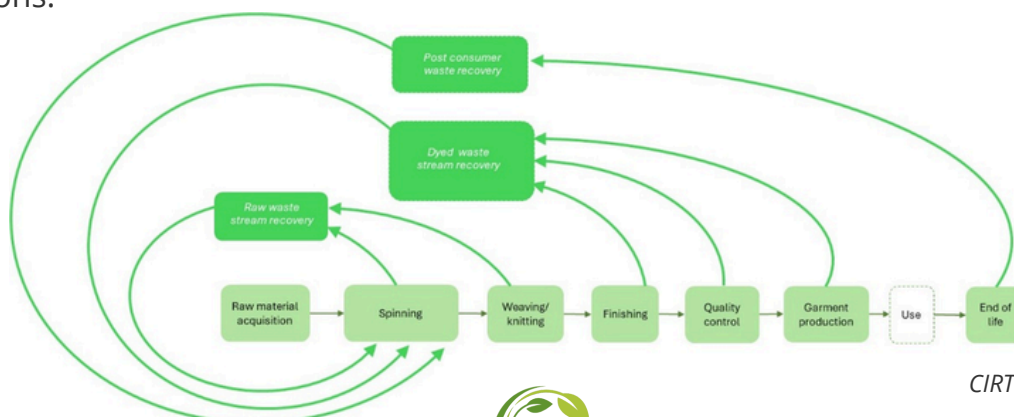
- Three product lines
- Different scenarios:



Steps of the Life cycle Assessment, according to UNE-EN-ISO 14040:2006

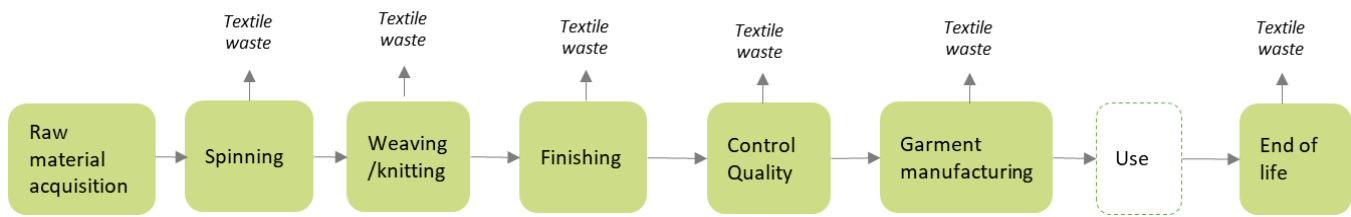


Scope: The system adopts a cradle-to-gate approach, covering all stages from raw and recovered material acquisition through yarn production and fabric manufacturing, up to the finished technical fabric. The final output is a ready-to-use material intended to produce new personal protective equipment (PPE) garments designed for technical sector applications.



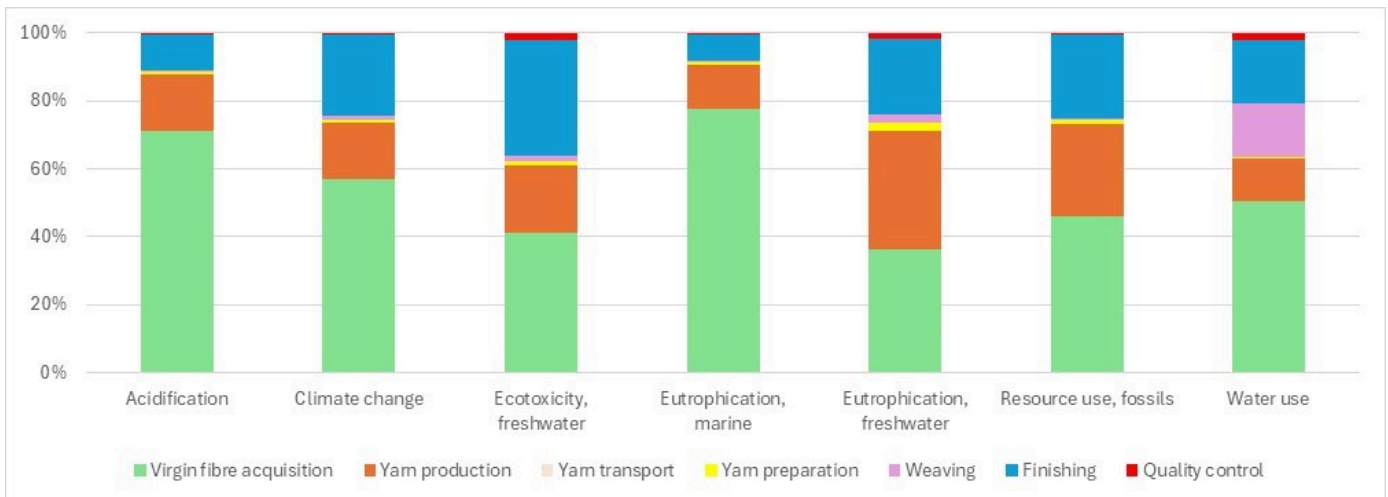
CIRTECHTEX scenario





Baseline scenario

- Fibers play a key role in shaping the environmental footprint of finished fabrics. Recovering and reintroducing them into the production cycle unlocks a powerful opportunity to create more sustainable garments.



The products obtained in the framework of CIRTEHCTEX PROJECT have significant environmental benefits:

- Finished fabrics produced under the modacrylic / cotton / antistatic line achieve an average reduction of 33% in Global Warming Potential (GWP) compared to equivalent products made with virgin fibres.
- In the viscose / wool / polyamide line, the recovery and production process delivers a 37% reduction in carbon footprint compared to the baseline scenario, reinforcing its strong environmental value.
- For the meta- and para-aramid / antistatic line, yarns made from recovered fibres reduce GWP by up to 48% compared to the baseline, positioning this solution as a high-impact driver of sustainability.



POLICY RECOMMENDATIONS



The project facilitated extensive knowledge exchange and strategic networking focused on navigating the complex regulatory landscape of textile waste and Extended Producer Responsibility (EPR).

A key consensus reached was the distinction between pre-consumer materials, which are not viewed as waste, and the more logistically challenging post-consumer flows.

Beyond regulatory mapping, the project focused on practical value chain integration by working directly with end-users and customers to collect recyclable materials. Managed primarily by Marina Textil and Tranemo, these initiatives involve one-on-one consultations and presence at industrial fairs to train stakeholders on circular processes. This grassroots networking is designed to be self-sustaining, continuing beyond the project's lifespan to expand the circular value chain and foster long-term commitment to textile recycling among customers.

SOCIOECONOMIC IMPACT



The successful exploitation of the LIFE-CIRTECHTEX project is poised to generate significant social benefits by embedding circular economy principles within the personal PPEs and technical textile industries. A primary outcome involves a shift in worker and stakeholder perception; by adopting recycled-content fabrics that maintain rigorous safety standards, organizations can bolster employee pride and align their internal culture with environmental, social, and governance (ESG) values. This transition fosters a sense of shared responsibility and encourages the broader adoption of sustainable practices without compromising the fundamental requirement of worker protection.

Furthermore, the project drives public awareness and societal engagement by proving that high-performance safety gear can be manufactured from recycled materials. Through strategic communication at trade fairs and workshops, the project educates industry stakeholders and regulatory bodies on the feasibility of circular technical textiles. This demonstration of quality serves as a catalyst for cultural transformation across the sector, encouraging other manufacturers to move away from traditional production models toward more sustainable, industrial-scale recycling of pre- and post-consumer textiles.





Finally, the project's impact is amplified by its alignment with major European policy frameworks, including the European Green Deal and the Circular Economy Action Plan. By providing a practical roadmap for resource efficiency in a safety-critical industry, LIFE-CIRTECHTEX supports broader policy objectives and builds societal trust in industrial practices. While the immediate social scale may be moderate, the project successfully bridges the gap between technical viability and social acceptance, proving that eco-friendly innovations can be standard practice in even the most conservative industrial sectors.

CONCLUSIONS



The LIFE-CIRTECHTEX project has successfully demonstrated that transitioning to a circular economy is entirely feasible within the highly complex and stringent technical textiles sector. By bridging the gap between technical safety requirements and environmental sustainability, the project has established a robust roadmap for reducing textile waste in personal protective equipment (PPE) manufacturing.

The main conclusions drawn from the project include:

1. **High-performance technical viability and safety validation**

The project successfully developed and validated a wide range of technical fabrics and textile products integrating recycled content. These products maintain the rigorous safety certifications required to protect workers from thermal, electric, and chemical hazards in high-risk industries.

The industrial demonstration proved highly effective under real-life conditions, capturing more than 74 tonnes of textile remnants and offcuts throughout the value chain, significantly surpassing the initial project target at the end of its implementation.

2. **Substantial environmental benefits**

The Life Cycle Assessment (LCA) confirmed that the collection, transport, and preparation of recovered fibers have a minimal environmental footprint. Reintroducing these materials into the production cycle yields dramatic reductions in Global Warming Potential (GWP) across major product lines compared to baseline scenarios using virgin fibres.





3. **Critical importance of workforce education and system traceability**

Because minor cross-contamination can render a batch of recycled yarn unusable for safety gear, training industrial workers to separate technical compositions precisely is the most critical step in the recycling loop. The implementation of strict visual protocols, including color-coded systems and standardized labeling, has proven vital to ensuring the high quality, traceability, and readiness of materials at the final inspection stage.

4. **Policy, industry symbiosis, and long-term socioeconomic impact**

The project fostered close collaboration among consortium partners and external entities, proving that materials can be successfully valorized at multiple points along the textile value chain.

Beyond technical success, LIFE-CIRTECHTEX has catalyzed a cultural shift. It aligns organizational cultures with Environmental, Social, and Governance (ESG) values, fosters employee pride, and builds societal trust by aligning with the European Green Deal and Circular Economy Action Plan.

Because mechanical recycling and grassroots networking initiatives (such as stakeholder consultations and training) are built to be self-sustaining, the circular model will continue to expand and operate beyond the project's official end date, ensuring long-term progress toward the target of recycling 321 tons of textile waste annually.

LIFE-CIRTECHTEX has successfully shifted the industry paradigm, proving that eco-friendly innovations and circular approaches are not only technically and economically viable but can be effectively implemented as standard practice in even the most conservative, safety-critical industrial sectors.

