my·fi

D8.8: Public Summary of the main project results and achievements

Version 2

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Content index

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement No. 101000719

1 Introduction

1.1. Project goal and scope

The aim of MY-FI is to provide the textile industry with a new non-woven material made of mycelium fibres, with improved performances and reduced environmental impact in comparison with current commercially available fibers. Mycelium-based materials are obtained by fungal fermentation, starting from the residues of the textile industry, using a mild process, and can be used to produce sustainable and performing non-woven fabrics.

Mycelium-based materials indeed can extend the field of use of non-woven fabrics to demanding or luxury applications. In virtue of their properties and aesthetics, mycelium fibres can be applied, for example, in automotive or footwear.

In MY-FI, new bio-fabrication protocols are optimized and upscaled together with wet processing and material finishing to provide a set of innovative solutions to help the textile industry in facing the challenges posed by the complex megatrends that are quickly changing markets and customers' lifestyles globally.

Figure 1 First prototypes of DLF mycelium materials

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The mission of MY-FI is to develop a biobased textile, with advanced functionalities, sustainability, and performance, achieving four high level goals:

- Empowering the textile industry to successfully face the challenges posed by the emerging global trends.
- Meet the consumer demand for new functional and sustainable textile products.
- Relief the environmental pressure related to the textile industry, developing a circular and biobased textile that does not generate microplastics.
- Engage textile stakeholders and provide guidance to policy makers.

1.2. Consortium presentation

The H2020 project gathers 14 partners across Europe, contributing to its success. All private companies, research centers, and universities listed below collaborate for the fulfillment of the activities tackled in the following chapters of this document.

mogu — RADICAL BY NATURE

Country: Italy
Type: Manufacturing Company

- Leader partner and responsible for the MY-FI project management.
- Establishment of a surface liquid fermentation protocol and a dynamic liquid fermentation protocol for the production of mycelium fabrics.
- Scale up of SLF protocol.
- Development of the ethics requirements for the project.

AXIA INNOVATION

Country: Germany
Type: Consulting Company

- Take care of the knowledge and IPR management in order to ensure the Freedom-to-Operate, effectively protect the Intellectual Property generated.
- Comparison of the solutions developed within MY-FI with the updated state-of -art.
- Implementation of solutions already available, also in different sectors (technology transfer).
- Avoid confidentiality conflicts with dissemination and communication activities.
- Competitive landscape analysis and exploitation plan.

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Country: France
Type: University

- Development of the wet processing for the enhancement of mycelium fabrics.
- Research and application of dyes, finishing and coatings, in order to deliver performing, aesthetically pleasing and environmentally responsible materials.

Country: Spain
Type: Research Centre

- Characterization of raw and finished mycelium materials.
- Material functionalization for fire reactivity, natural dyeing and surface activation with plasma technology.
- Assess the compliance of the mycelium fabric with the EU Ecolabel certification.

Country: Spain
Type: Non-profit association

- Development of protocols for the valorization of the residues deriving from the manufacturing of mycelium fabric-based materials.
- Lamination of mycelium-based materials.

Country: Germany
Type: Research Centre

- Development of technological solutions to improve the mycelium fabrics properties such as mechanical and chemical performances.

Country: Belgium
Type: Research centre

- Optimization and scale up of DLF protocol.

Country: Italy
Type: Manufacturing Company

- Development of a Performance Index of mycelium fiber for the luxury application.
- Production of a set of technical sheets illustrating the application methods of mycelium-based materials.
- Prototyping for the fashion industry.

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Country: Belgium
Type: Testing Lab

- Evaluation of biodegradation and organic recyclability of mycelium fabrics, in different stages of the production and post-processing processes.

Country: Italy
Type: Research centre

- Definition of requirements and benchmarking for the automotive sector.
- With Volkswagen, design, production, testing, and validation of prototypes for the automotive sector.

Country: Germany
Type: Manufacturing Company

- Definition of requirements and benchmarking for the automotive sector.
- Together with CRF, design, production, testing, and validation of prototypes for the automotive sector.

Country: Italy
Type: Consulting Company

- LCA and LCC of the most promising mycelium materials.
- Development of an LCA/LCC based Decision Support System tool in order to improve and optimize production processes.
- Project communication.

Country: Netherlands
Type: University

- Development and optimization of DLF and SLF protocols.
- Test and analysis of the raw material produced.

Country: France
Type: Manufacturing Company

- Scale-up and industrialization of the wet-processing and finishing applied to mycelium materials.

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2 Biofabrication

In the MY-FI project, raw mycelium fabrics were produced using two different types of fungal fermentation carried out by means of dynamic liquid fermentation (DLF) and in surface liquid fermentation (SLF). By applying the proper growing conditions, the growth of the mycelium can be highly promoted, and a dense continuous network of hyphae is obtained.

The biofabrication represents the starting point of the project, setting the ground for the following activities, therefore providing the unique, natural, and disruptive raw material to post-processing activities.

The improvement of the fungal fermentation processes intended to the production of raw mycelium-based materials is included as one of the objectives of the project.

The target of the MY-FI project was also to scale up biofabrication processes therefore moving from laboratory to pilot scale, with the goal of obtaining high-quality and fully functional prototypes to be employed in the fashion and automotive industries; therefore, the initial methods in place had to be optimized to move from TRL 4-5 to 7. MOGU has taken care of the SLF process: the main process parameters involved in the fungal development have been identified and optimized in order to improve the material productivity and its final performances. Such parameters impact the type and design of the tray bioreactor, but also on the process mass flows of substrates and reagents, and on the main growing conditions such as temperature. The optimization of the selected parameters led to an improved material in terms of its thickness density, homogeneity, process repeatability and material reactivity for the subsequent post-treatment. Therefore, the initial protocol developed for the creation of mycelium fibers was improved to obtain higher quality raw SLF materials.

Figure 2 Biofermentation process, lab-scale

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Figure 3 Lab-scale biofermentation process

Moreover, the main by-product generated during the SLF process was analysed based on its potential valorisation, experimenting different pathways and applications. Its high organic matter content allows to further exploit it as nutrient source for other secondary fermentation processes to produce a protein-rich ingredient for feed or to produce a new mycelium-based material through the application of a dynamic liquid fermentation (DLF) process.

In cooperation with OWS, the residual stream has also been evaluated as waste-to-energy through anaerobic digestion for the production of an energy vector (biogas) that could be integrated into the future SLF upscaled production line, providing the heat and/or the energy necessary for the biofabrication process. Instead, AITEX tested the waste stream as structural component for the fabrication of non-woven fabrics by wet-laid technology in combination with lyocell and PLA.

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Figure 4 DLF lab scale bioreactor

Likewise, the DLF process for the biofabrication of different mycelium materials was optimized by UU and MOGU. In this case, different fungal strains have been grown in different carbon sources to find the best combination of strain and nutrients that could produce the most promising material. The research performed by UU was based on the screening among six different fungal strains grown in four different media. Several analyses based on the strain growth performance, carbon consumption efficiency and final material performance led to the selection of one basidiomycetes strain grown in a glucose minimal medium as the selected protocol for the DLF development at higher scale. In parallel, the research carried out at MOGU delivered a mucoromycetes strain grown in a complex medium as another interesting method to produce myco-materials with great potential. Both protocols were detailed described and transferred for its study at higher production scales.

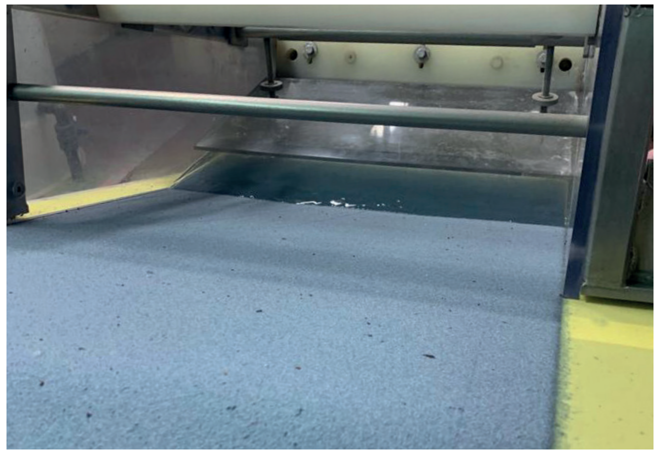

Figure 5 Non-woven textiles produced by AITEX recycling textile fibers

The partners also focused on the development of hybrid materials that combine the fungal biomass with textile fibers. AITEX deployed different strategies to recycle textiles fibres as process residues from the industry or at post-consumer level. Such fibres have been transformed into non-woven textiles with different thicknesses, composition and consolidation levels by wet-laid and carding technologies optimized by AITEX. The further valorisation of these textile waste was tested by MOGU through mycelium fermentation in order to close the loop of textile value chain obtaining novel materials.

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3 Post processing

Processing of the grown mycelium fabrics is necessary to increase the aesthetical, functional, and mechanical properties of the mycelium. The fungal cell wall is a multilayer structure with great plasticity that is vital to maintaining cellular integrity. It is composed of different layers and components. Mycelium fabrics grown under static liquid fermentation conditions exhibit a soft and silky touch. These unique properties would get lost during wet treatment processes and subsequent drying procedures if mycelium fibers were glued together. In order to prevent the fibers from sticking together, they need to be separated. A suitable and effective treatment process is therefore vital for further development of the alternative mycelium material.

FILK investigated the effects of treating the mycelium with different plant-based crosslinkers and fatliquors in the wet stage and its influence on the mechanical properties. Thickness and softness of the material could be enhanced and maintained, respectively, by crosslinking. The tensile strengths of mycelium fabrics are only slightly affected by the crosslinkers. Dyeing was possible both with commercial dyes and with vegetable dyes. Plasticising was necessary because of the brittleness of the initial material when dried. A suitable modified vegetable oil was successfully selected by ITECH for increasing softness and elongation performance.

The wet process has been tested for standard tanning drums and machinery and, which has resulted in the production of prototypes with different colors. A first upscaling at FILK allowed to provide industrial partners with enough materials for prototyping. Fig. 6 gives an overview of the post-processes investigated so far.

Figure 6 Post-processes overview diagram

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The final surface coating of the material increases fastness and serves aesthetic requirements. Coating methods were developed by ITECH based on fully renewable wax compositions and on bio-based polyurethane dispersions thus the final material can reach a high biobased content, up to 91+/- 5% biobased content for the wax-based coatings, and up to 85 +/-5% biobased content for the PU coatings. The coatings increase abrasion resistance and fastness. A lot of designs could be envisaged by embossing and tipping operations. The protocols developed allowed for the production of materials with different colors, aspects, and performances (see Fig. 7).

LEITAT's ongoing research focuses on improving material properties, such as flame retardancy, additional plant-based coloration, and antimicrobial properties. Plasma technology has also been investigated to study the impact on wettability. The final material has been fully characterized to understand its performance and identify points for improvement.

However, the mechanical properties of the final mycelium material are not yet comparable to existing materials employed in the same applications: lamination on another material is still necessary.

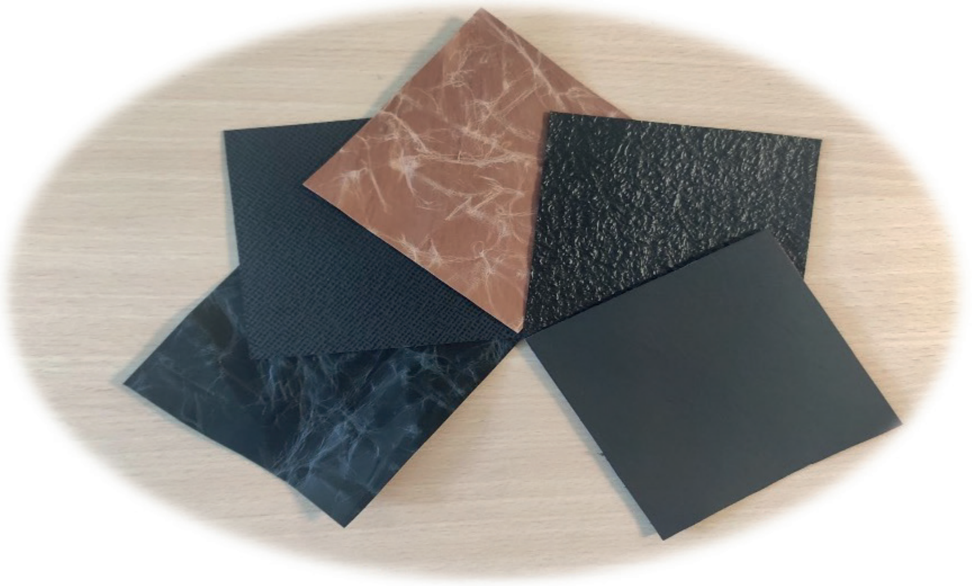

Figure 7 Protocols developed for materials with different colors, textures, and performances

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4 Scale up

One of the major goals of the MY-FI project was to successfully scale up the biofabrication of mycelial biomass via dynamic and surface liquid fermentations (DLF and SLF, respectively). Taking advantage of the expertise and pilot-scale equipment available at the Bio-Based Europe Pilot Plant, the bottlenecks related to the DLF of mycelial biomass have been identified and addressed. The aim was to develop a systematic approach for enhanced growth in stirred tank reactors (STRs), while obtaining an optimized process that could deliver consistent results, easily translatable from bench to commercial scale. In the same way, SLF scale-up has been addressed by MOGU. The idiosyncrasy and particularities of the SLF process developed by MOGU limit its direct standardization using currently known facilities as in the case of the DLF. Instead, equipment and processes already used in different industries must be identified and adapted to create a larger-scale SLF.

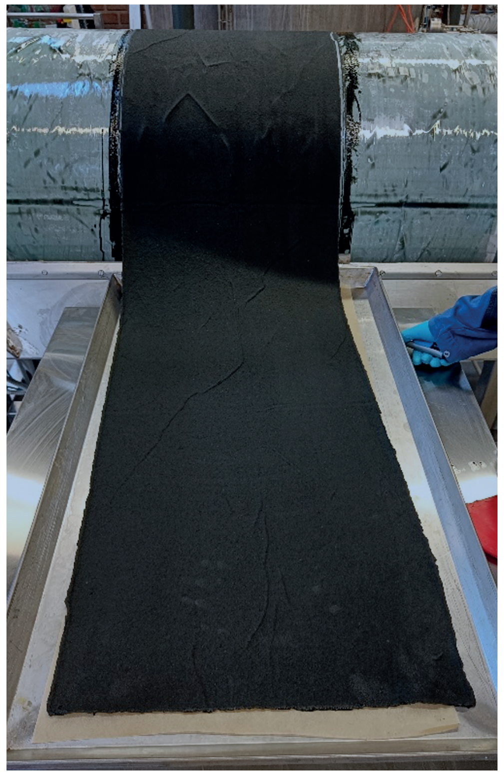

Figure 8 DLF material obtained by 1,500L fermentation run

For the upscaling of the DLF process (developed by UU) BBEPP conducted preliminary evaluation of strain growth in a shake flask test, mimicking the shake flask seed steps of the main fermentations to analyse the fungus's growth before upscaling. After the preliminary tests two 150 L fermentation runs provided valuable insights into the scalability of the process for further scale-up to the 1,500 L. The produced fermentation broth was harvested and transferred to downstream processing where mycelium sheets were produced and distributed to partners for application tests.

Likewise, MOGU has been working on the improvement of the SLF process by optimizing the main operational and biochemical factors that rule the mycelium growth. Bioreactor size was initially doubled and afterwards quadrupled, adjusting the main operational conditions consequently for each size increase. The number of bioreactors operated simultaneously was also increased by 10 times. New and bigger growing rooms were built and properly furnished to allow the optimal incubation of the increased

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Figure 9 SLF bioreactor at MOGU

number of bioreactor trays simultaneously. Moreover, several pieces of equipment were identified, acquired, and set-up, such as a 50L homogenizer, a big-size air-dryer, and a clean room for the preparation of the materials. The protocols used at lab scale were also adapted to the new scale and new procedures were established to ensure product quality and performance. The mycelium fibers post-treatment process has been upscaled by FRANCE CROCO by adapting the preliminary Downstream Processing (DSP) protocols developed inside WP2 in an industrial reality. The type of reactor applied for these downstream steps was carefully studied to allow a proper material treatment while keeping its physical integrity. Further tests were performed for the optimization of the water and chemical consumption as well. The trials allowed the production of promising prototypes, with different colors and finishings. By the end of MY-FI project, FRANCE CROCO has delivered a wide range of finished mycelium fibers, characterized by high-quality, competitive performances and innovative functionalities.

Figure 10 Harvested 1 sqm SLF panels, ready for drying

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5 Prototyping for fashion

The race to develop new materials and processes is gaining momentum thanks to fast-maturing technology and more substantial, profound partnerships between brands and innovators. The partner Bond Factory has focused its work on creating a procedure for making prototypes in line with the European standards, which require the use of less toxic chemicals and more sustainable materials in addition to a completely waste-free production.

The prototyping and validation activities of the mycelium fabric developed in the context of the MY-FI project were carried out using all the techniques and technologies that are normally employed for the development of samples and of finished products in the Luxury Fashion sector. The ultimate goal was to create luxury application prototypes by refining the most successful techniques from previous technology tests, focusing on thermowelding, laser cutting, high frequency, embroidery, and padding for leather goods.

Technologies applied to MY-FI materials

Thermowelding

Thermowelding, a common technique in the fashion industry, involves bonding fabrics using heat and pressure. This study explored suitable materials for bonding with mycelium to create enhanced prototypes. Instead of merely improving mechanical performance, thermowelding was also assessed for its aesthetic qualities. The materials tested included:

• **Wool**: Combining mycelium with Woolmark wools resulted in a unique material with good grip and softness.

• **Dinamica**: This solvent-free suede paired well with mycelium, showing promising aesthetic and functional results.

• **Knitted Fabric**: Mycelium was heat-sealed to knit fabrics, using scraps for decorative appliqués.

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Laser cutting

Laser cutting employs focused beams to precisely cut textiles, ensuring clean edges and reducing waste. This technique allowed for precision in material usage and the creation of intricate designs without additional trimming.

High-Frequency Forming

High-frequency thermoshaping uses heat and vacuum conditions to mould fabrics without adhesives, preserving the desired shapes. Mycelium products were branded using high-frequency with the MY-FI monogram.

Embroidery

Modern embroidery techniques were used to create detailed designs on fabric using needle and thread guided by digital files. Two types of embroidery were tested:

- One-Level Embroidery: Produced a flat effect.
- Two-Level Embroidery: Created a 3D effect.

Padding

Padding adds volume and structure to garments. This technique involved combining thermowelding with impregnation to laminate materials along glue strips, creating a 'PUFFY' effect by leaving sections free for feather filling.

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Prototyping Flow:

Material-Driven Design: The MY-FI project adopted a new approach where the design process was driven by material properties. From the first prototypes, Bond Factory focused on analyzing fiber usage, converting skills, and re-characterizing machines. Prototyping phases were driven by the intrinsic properties and sensory aspects of materials. Testing included performative, sensorial, and interpretative analyses, ensuring compliance with eco-friendly guidelines and corporate social responsibility.

Prototyping steps: The iterative prototyping process involved several stages, each aimed at refining the design before mass production:

1. Design Concept and Sketching
2. CAD Pattern Making
3. Fabric and Material Selection
4. First Prototype
5. Digital Prototyping
6. Technological Testing
7. Graphic Design
8. Second Prototype
9. Production

Prototype Production:

Leather Applications: Bags and accessories were heavily tested due to material features and market demand.

Examples include:

PC Holder:
Used heat-sealing, laser cutting, and printing with Bio-Pu material.

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Padded Bag:
For the production of the bag several techniques were combined: padding, heat-sealing, and high-frequency, employing Wax-finished mycelium material.

Embroidery Pochettes:
The pochettes employed Bio-PU mycelium material for dense embroidery designs.

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Shopper with Insert:
This prototype was produced with the heat-sealed and embroidered mycelium patches made using the wax-finished material.

Outerwear:

Jacket:
The project tested combining mycelium with various natural fabrics to broaden its applications. Pairing mycelium with wool was particularly promising, leading to the design of a modern coat.

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6 Prototyping and validation in the automotive sector

In the path of sustainability, thanks to MY-FI project, the automotive sector represented by CRF/Stellantis and Volkswagen, evaluated potential application of mycelium-based fabrics on interior trimming. Indeed, the main goals in this work package were the definition of specific requirements for automotive applications, design and realization of automotive interior prototypes, and extensive prototype testing according to automotive specifications like e.g. abrasion, color fastness, tensile strength, and tearing strength. For all demonstrators general properties fundamental for homologation, durability and safety are evaluated.

Figure 11 Cars interior: examples of possible mycelium-materials application

Textile, leather and leather-like materials characterize most of the automotive interior finishing in both rigid and soft trims, often combined on complex components. The use of a soft coating, as well as the use of real and imitation leather, is considered distinctive of high-end trim levels and highly characterizing on customer-based approach. Trims, as all materials and components that enter automotive composition need to contribute to product sustainability at whole scale (recyclability, substances management, sustainable content) and overall carbon footprint reduction of the industrial sector.

Figure 12 Mycelium-materials performances are tested for ensuring their suitability for automotive application

Figure 13
Final demonstrator for soft headrest of ID.4

Automotive partners of MY-FI project (CRF/Stellantis and Volkswagen) received from the partnership first samples from the upscaled mycelium production processes. In material testing and prototyping some minor brittleness were detected caused by the chosen embossing. As a consequence, the finishing were optimized within the consortium, leading to the formulation of a final finish and to the definition of a biobased bamboo knit for backing and support to ensure mechanical strength. On those further consolidated samples of mycelium-based materials, both OEMs performed a cycle of characterization and validation tests – accordingly to performances, parameters, and methods previously shared - to evaluate mechanical, thermal, ageing behavior of the innovative materials under standard automotive configurations to maximize the potential applicability of the innovation. Although ageing under severe conditions have not reached the requirements for extensive applications, several promising results were found, confirmed by the production of both soft and hard demonstrators, under standard automotive transformation processes. CRF/Stellantis produced a press-covered rigid dashboard fascia of Fiat 500e, while Volkswagen focused on a soft headrest of electric vehicle ID.4. The applied standard industrial manufacturing includes processes like sewing, tempering and pressurized forming. Both demonstrators have shown good formability under these conditions and confirm the applicability of mycelium-based materials for interiors.

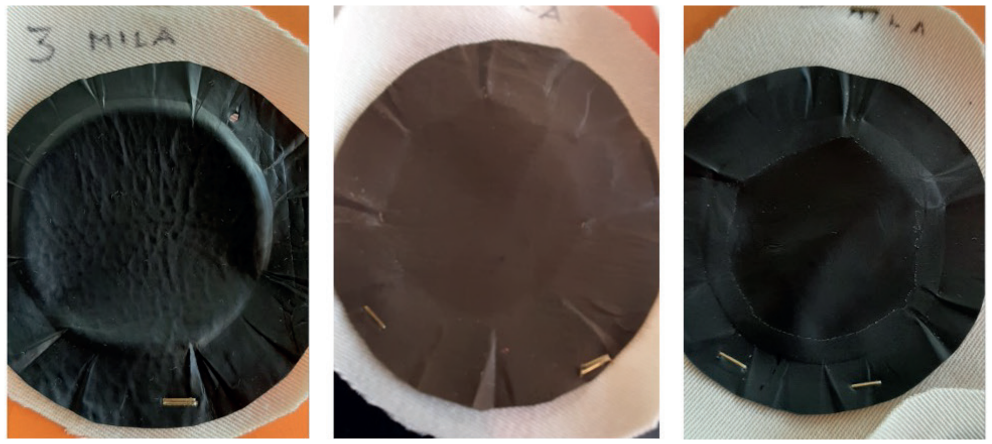

Figure 14 Mycelium-materials tests for ensuring their suitability for application in car interiors

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7 Sustainability

7.1. LCA and LCC

Figure 15 For the MY-FI project, SPIN is assessing the impact of both SLF and DLF materials, from the biofabrication stage, until the finishing one.

As part of the MY-FI project, SPIN 360, in collaboration with project partners, measured and evaluated the environmental impacts of the most promising mycelium-based materials produced by MY-FI partners.

Among the different possible methods, SPIN 360 employed the Life Cycle Assessment, following the standard ISO 14044, which is one of the most acknowledged and recognized sustainability assessment tools for the European Union. The methodology adopted for the calculation is EF 3.1, taking into account 16 impact categories, published by the Joint Research Center and the European Commission.

The LCA study does not constitute a point of arrival, but rather a science-based approach that can promote a better knowledge of processes and performances, to kickstart an improvement plan.

For materials still in the research and development phase, the LCA provides an opportunity to refine and optimize processes from a sustainability perspective, providing insights for an efficient scale-up. For example, the assessment delivers information on resource use efficiency and the interconnection between production options and final product impact.

Moreover, SPIN 360 is also conducting the Life Cycle Costing (LCC) analysis, assessing the economic cost related to the whole life Cycle of the mycelium-based material. This analysis will help optimize production costs and resource use. The LCA and LCC system boundaries for the MY-FI materials are from raw materials to the gate of the post-processing facility.

Finally, the partner developed a tool to facilitate the simulation analysis of the materials' environmental impacts. The tool facilitates the experimentation and optimization of the biofabrication and post processing processes. By modifying process parameters such as operations, dosages, and chemicals, the tool supports the formulation of scenarios and hypotheses for improving the environmental performance of the recipe. It allows for the simultaneous evaluation of process performance, environmental efficiency, impacts such as carbon footprint or water footprint, costs, and the quality of the resulting products.

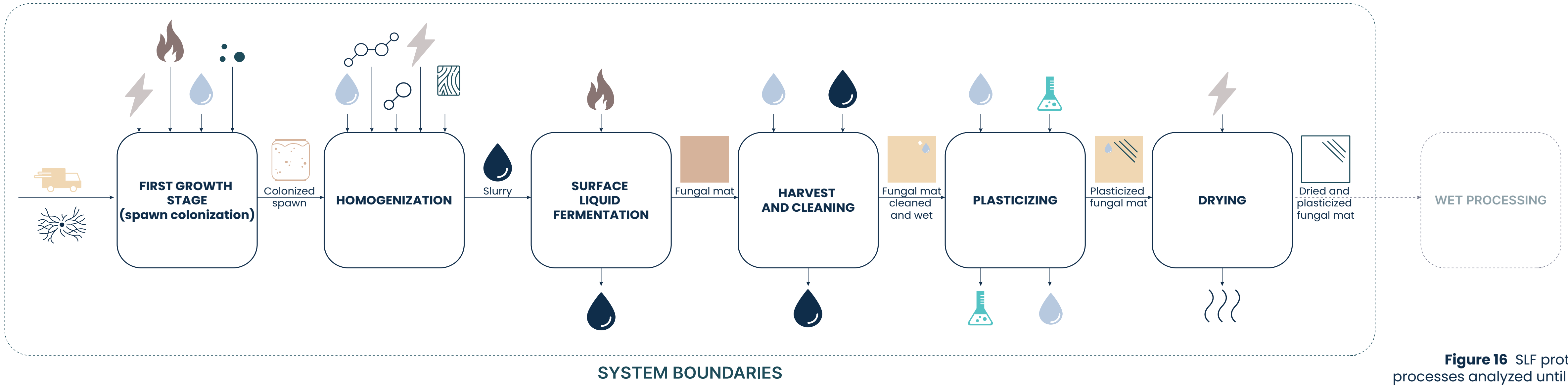

Figure 16 SLF protocol processes analyzed until now

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7.2. Biodegradability and Compostability

Figure 17 Biodegradability tests performed on mycelium-materials at OWS

Besides being produced from waste resources, it is MY-FI's ambition to develop a mycelium-based fabric that is biodegradable and does not release micro-plastics, to drive the textile industry to lower its environmental impact. Therefore, within the MY-FI project, Normec OWS investigated the biodegradation behavior and the suitability for treatment by organic recycling such as industrial compostability and anaerobic digestion. The basic mycelium produced through surface liquid fermentation (SLF) by MOGU or via dynamic liquid fermentation (DLF) by University of Utrecht and BBEPP showed complete biodegradation as defined by the European norm EN 13432 Requirements for packaging recoverable through composting and biodegradation – Test scheme and evaluation criteria for the final acceptance of packaging (2000). The DLF fibers showed a faster degradation compared to the SFL fibers. However, under anaerobic conditions no complete biodegradation could be achieved, demonstrating the role of fungi in the degradation process. The disintegration trials of MY-FI textiles under pilot-scale composting conditions showed that various treatment steps significantly influence the disintegration rate. These treatments, including several processing steps and coatings, are essential for high-end applications in the automotive and fashion industries. However, due to these necessary treatments, the developed MY-FI nonwoven fabric is no longer fully biodegradable under industrial composting conditions. Despite this, for less demanding applications, composting may still be a viable option for organic recycling at the end of the product's life. While the crosslinking of the DLF material also affected biodegradation, it did so to a much lesser extent, suggesting that the material may still meet the stringent biodegradation requirements outlined by current standards.

7.3. Ecolabelling

Within MY-FI, LEITAT has the objective of identifying potential compliance of the mycelium fabric with the EU Ecolabel criteria for textiles (Commission Decision EU 2014/350)1, as well as formulating recommendations to support a potential future certification. Other recommendations will be aimed at a revision of the EU Ecolabel and Green Public Procurement criteria for textiles, to promote recognition of mycelium products as sustainable textile solutions.

So far, it has been found that the EU Ecolabel, in its current state, does not seem to allow certification of predominantly mycelium-based fiber products (>20% by weight mycelium fiber content). This issue arises since the existing EU Ecolabel definitions of textile fiber categories (e.g. various natural cellulosic seed, bast, keratin, or synthetic fibers), and corresponding criteria, do not cover novel materials, such as mycelium, and therefore cannot be applied. The reasons for that may lie in the EU Ecolabel focus on more common materials with relevant market shares and environmental impact implications, but may, in part, also be traced back to the fundamental labeling requirement and fiber names regulation (EU) 1007/2011, which does not yet list the relatively novel material and subsequently complicates its recognition in other textile-related EU legislation. Contrastingly, other EU Ecolabel criteria relating to the use of chemicals in later production stages (fabric formation, pre-treatment, dyeing, etc.) and fitness for use criteria (e.g. dimensional changes and color fastness during washing), could be applied to the mycelium-based at its final production stage.

Following this conclusion, the partner has investigated other Type I ecolabels for textiles, such as OEKO-TEX or GOTS, to determine the potential for alternative certifications with EU relevance. The investigation also extended to potential labeling implications that may result from the newly proposed EU Green Claims Directive. Entirely new fibre-specific categories and criteria may need to be defined, for example, based on insights from sustainability impact assessments such as LCA, and integrated into existing ecolabeling frameworks, to recognize and support novel and more sustainable material solutions, such as those offered by mycelium-based fabrics.

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8 Gear-up-to market

As the MY-FI project concludes, the gear-up-to-market activities have been completed. The partners have produced very important results that bring them closer to the commercialization of their outcomes. The gear-up-to-market phase is a critical stage in introducing an innovative product or service to the market. It involves thorough planning, strategizing, and execution to ensure a successful market entry. This phase encompasses a comprehensive analysis of target markets, competitor research, and identification of key customer segments. In the MY-FI project, collaboration with project partners played a crucial role in coordinating the various actors involved in the production of the final product.

AXIA's role in the MY-FI project was to develop an exploitation strategy that assists partners in commercializing their products. The methodology employed involved analyzing the external and internal environment, including market and competitor analysis. This included qualitative and quantitative assessments to determine market volume, size, customer segments, and key actors. Additionally, individual business plans were created for the main collaborating companies. These plans encompassed defining the company's value proposition, designing a business model canvas, conducting SWOT and PESTLE analyses, assessing risks, and performing economic projections with the estimation of CAPEX (Capital Expenditures) and OPEX (Operational Expenditures). The creation of individual business plans was essential for strategic clarity, market analysis, resource allocation, risk mitigation, and performance evaluation as shown in Figure 18.

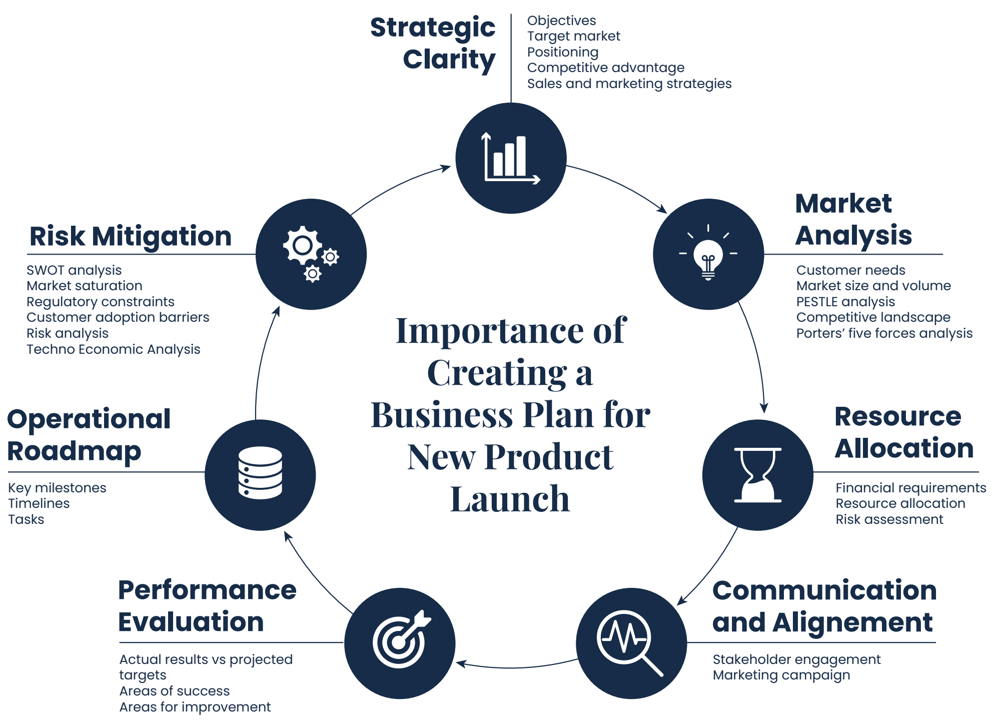

Figure 18 The importance of the creation of individual Business Plan

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All the foreseen exploitation analyses have been conducted, resulting in excellent findings. The strong interaction with the partners allowed the development of customized financial analysis for main companies with promising results for future investment. Specifically, the financial analysis was performed for the three commercial partners, MOGU, BOND and France Croco estimating both the CAPEX and OPEX cost for their respective processes. As illustrated in Figure 20, CAPEX encompasses all direct costs, while OPEX includes all indirect costs. To better understand the economic outcomes of both cost categories, a hot spot analysis was performed, highlighting the primary contributors to each. In addition, to gain insight into the inflow and outflow of cash within the company business, AXIA projected the cash flow for the next ten years. Considering the economic instability, it has also conducted a sensitivity analysis of the cash flow, taking into account various potential scenarios. Consequently, all possible changes were calculated, and the Net Present Value (NPV) and Pay Back Period (PBP) were reported for each scenario.

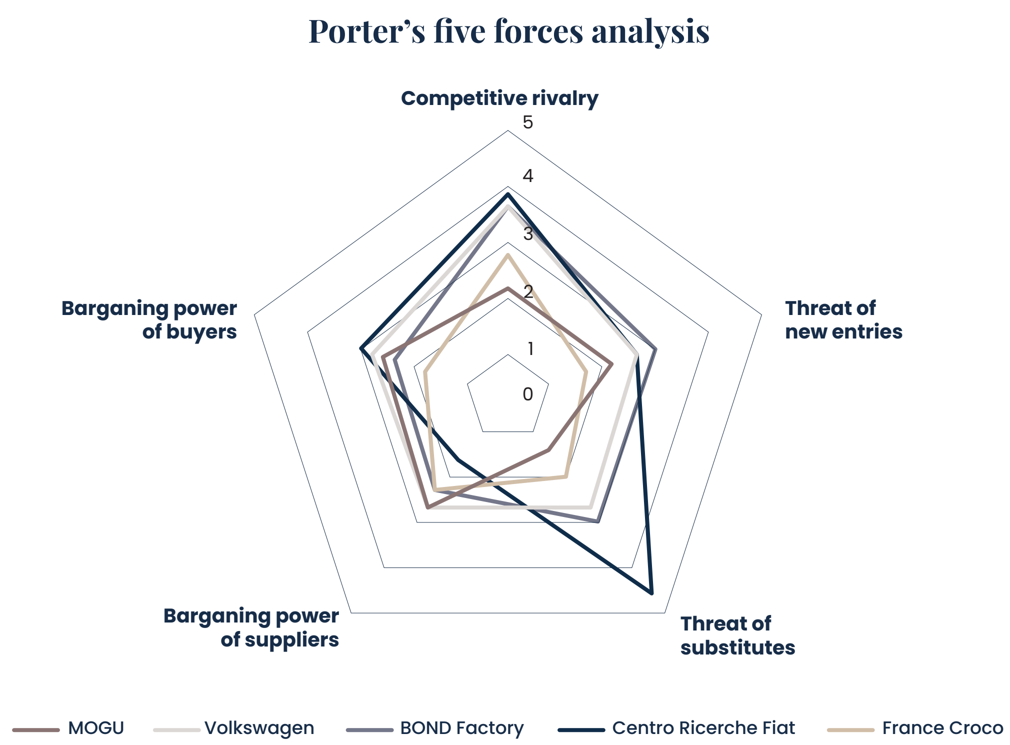

Figure 19 Porter's five forces analysis for MY-FI partners

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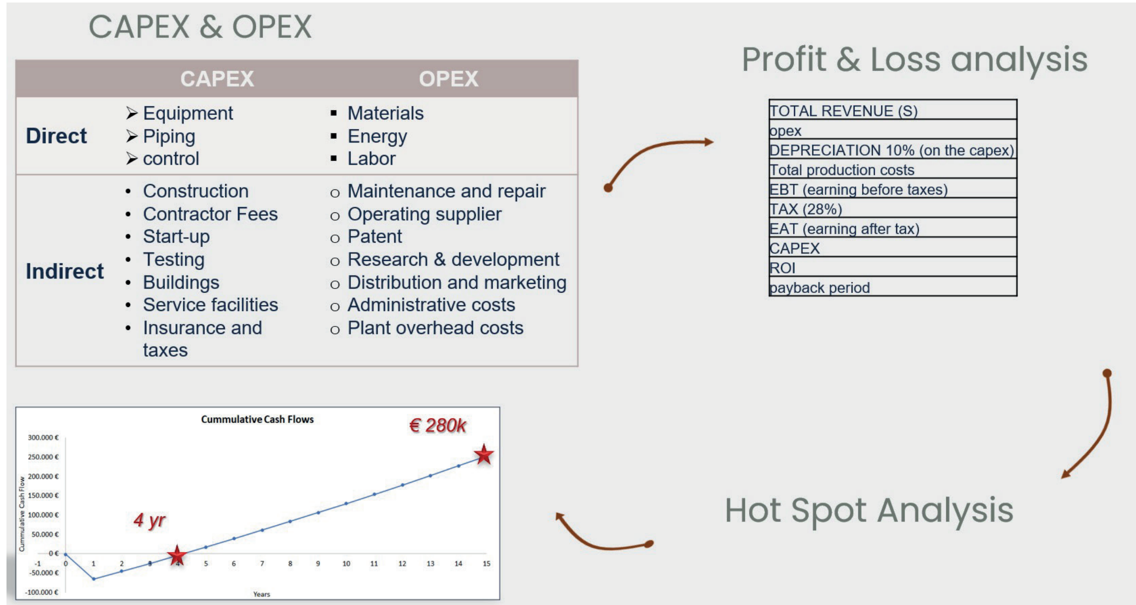

Figure 20 Financial analysis strategy

At the time writing, there is high competitiveness in the textile production field using mycelium and alternative materials. During the MY-FI project, dedicated market and competitive analyses were conducted to provide partners with an overview of the opportunities and challenges in this sector. The identified competitors were categorized into four groups: indirect, direct, aspirational, and perceived, based on their association with MY-FI products. Competitor benchmarking was conducted, identifying several international companies as direct competitors for MY-FI. Additionally, AXIA developed a Perceptual Matrix with contribution from MY-FI end users, in order to understand how the direct competitor's products are positioned and to build up a strategy for market positioning. The two main criteria considered were quality and price. The analysis revealed that all considered direct competitors scored highly on both criteria, indicating that there is open space for MY-FI in the market.

AXIA implemented an extensive and dedicated patent mapping that was updated every year in order to provide insights of the intellectual property landscape related to mycelium products and technologies. The Intellectual Property Rights (IPR) strategy and protection scheme was produced to assist partners in the implementation of their exploitation activities. The number of patents that were detected through all the searches was 124 patents, which 64 of them were published or applied in 2023, indicating the dynamic nature of mycelium based materials in the field. To support partners, AXIA provided a list of patents with additional topic characterization and competitors comparison considering several features such as application trends, application in top countries and portfolio evaluations. Analyzing patents and their related information allows researchers and industry professionals to gain a deeper understanding of the existing knowledge base, identify key players, evaluate the novelty and uniqueness of innovations, and identify potential areas for research and development.

In summary, the gear-up-to-market activites aim to enhance the MY-FI's outcomes by providing partners with insights into the competitive landscape, an overview of potential profits, and strategies to maximize market potential.

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9 Communication

The activities related to the communication of project progress and outcomes were led by SPIN 360, but all partners have been involved. The main objectives of this set of activities were to:

- Promoting more awareness of mycelium materials among relevant stakeholders (TCLF - Textile Clothing Leather Footwear industry, automotive sector, Consumers) as well as among national and European regulatory authorities.
- Gather, produce, and disseminate information about the project's objectives and results, primarily targeted at opinion leaders, educators, and other stakeholders.
- Engage stakeholders in disseminating results of the project: opinion leaders/regulators, relevant industries, scientific community, and consumer organizations.
- Deliver guidelines for policymakers to support the market gain of a biobased textile industry in Europe.

Dissemination activities have been undertaken by all project participants at both internal and external level. The main target audiences to reach for creating awareness and promoting market demand for mycelium fabrics were industry and consumers.

A comprehensive dissemination and communication campaign has been designed and implemented to actively share MY-FI's objectives, activities, and results to the target audiences in accordance with the dissemination and communication strategy agreed by the Consortium.

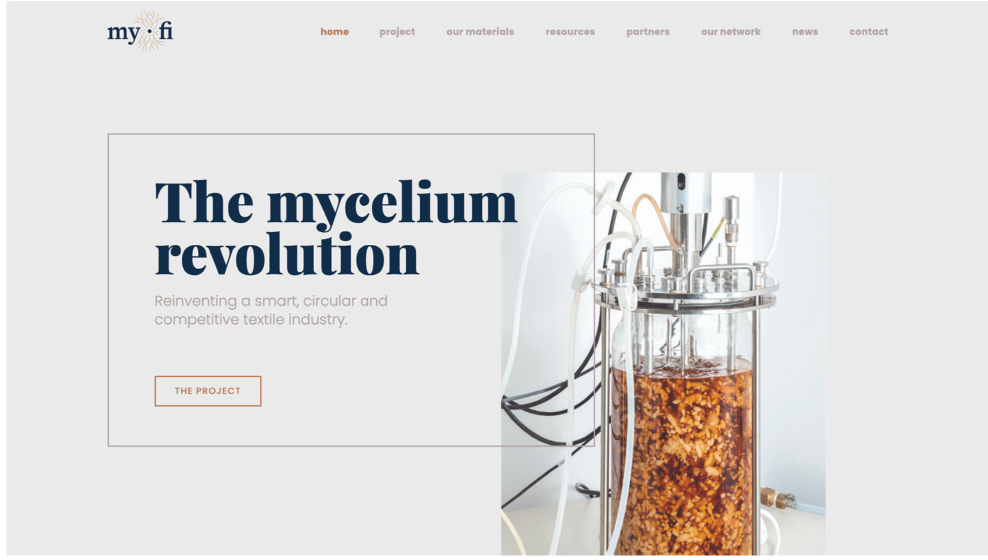

Figure 21 MY-FI website in english

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Figure 22 MY-FI newsletter issue 4

The strategy included:

- Active presence on socials (Linkedin and X) and on other digital media channels (a project website in English and a newsletter published three times a year).
- Publishing of scientific articles in journals and conferences.
- Targeted placement of articles and features in relevant trade and industry-focused media outlets.
- Networking with other projects initiatives and networks.
- Participation in relevant conferences with high impact, trade fairs (Lineapelle and Future Fabrics Expo 2023), exhibitions, workshops, seminars, conferences, and round tables (Lineapelle).

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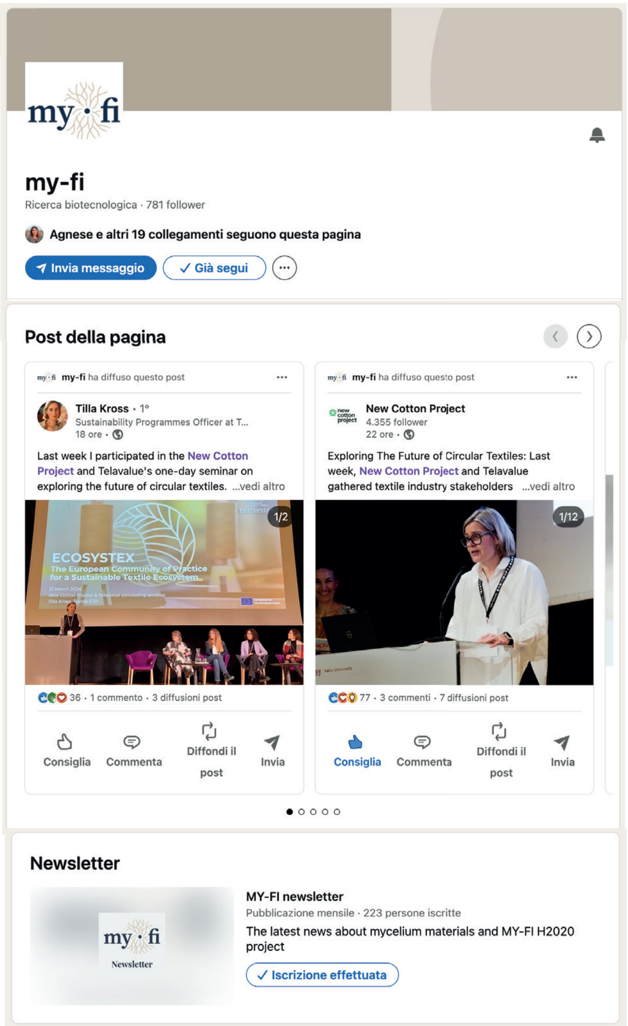

Figure 23 MY-FI Linkedin and X profiles

A Stakeholder Advisory Board (SAB) has been established to ensure the active engagement of key stakeholders in the project. The SAB has already met twice, serving as a consultation body.

Considering feedback obtained from the interactions with stakeholders, the consortium is defining a structured document to be disseminated to policymakers and aiming at supporting the development and market gain of a biobased textile industry in Europe. Once developed, the guidelines will be disseminated to target stakeholders such as EU policymakers, National public authorities, Industrial Associations at the EU and National level, and Trade Unions.

To stay updated about MY-FI project latest news, please
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suscribe to our MY-FI Newsletter
and follow us on Linkedin and X

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