PENGUIN

Bioinspired and advanced fibres and materials for sustainable outdoor textiles with biomimetic functionalities

NEWSLETTER
October 2025

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Our coordinator ***speaks***

The consortium has made great progress over the past 18 months! We have a work plan that requires a high level of collaboration and communication among project partners. Within the PENGUIN team, there is a great deal of openness and willing learn from each other.

The consortium has produced several batches of fibres with improved properties, found efficient finishing treatments for the cellulosic fibres, produced several insulation material and yarn samples in laboratory scale and experimented with recyclable constructions for textile integrated electronics. In experimental work challenges with equipment can cause unexpected delays but open communication has been the key to handle delays together and adjust plans to new schedules. These are small hiccups which can turn into bigger trouble without proper communication.

Good spirit and efficient ways of working within the consortium are probably the most important highlights that has enabled the great progress. Accomplishing the goals of the PENGUIN project requires a high level of collaboration among project partners due to the numerous dependencies in material development. I would say that good collaboration has been the key enabler to reach the current status.

Second period will focus on piloting some of the key technologies we've been assessing in lab-scale. More work is still needed in the laboratory to find the best formulations and receipts and it will be interesting to see how material production will be in pilot scale.



VTT team working on PENGUIN. Image (VTT)

Biocelsol and SPINNOVA® fibres vs *Commercial fibres*

The textile industry is at a necessary turning point. For decades, it has relied on a limited range of dominant fibres, often ignoring the environmental and chemical impacts associated with both their production and end of life. Even naturally sourced materials such as viscose and conventional cotton have contributed significantly to these challenges. As consumer awareness grows and brands face increasing pressure to reduce their environmental footprint, the demand for sustainable, circular and highperformance alternatives is redefining the sector's priorities.

In this context, the PENGUIN project is at the forefront, using two revolutionary Finnish fibres to produce bio-based, Safe and Sustainable-by-Design (SSbD) textile materials that meet the demanding requirements of outdoor use. Developed by VTT and, these fibres embody two distinct but complementary approaches to sustainability. The key characteristics of each technology are detailed below.



Biocelsol fibres. Image (VTT)



SPINNOVA® fibres. Image (Spinnova)

Biocelsol and SPINNOVA® fibres vs *Commercial fibres*

Biocelsol: The Porous Innovator

Biocelsol fibres, developed by VTT, belong to the family of man-made cellulosic fibres. They are produced by dissolving cellulose-based raw material, typically wood pulp, and then regenerating the bio-based polymers into textile fibres through a controlled spinning process.

Structurally and functionally, Biocelsol fibres are very similar to commercial viscose fibres, exhibiting comparable softness, moisture absorption and breathability. Their fineness and mechanical performance can be precisely adjusted during spinning, allowing them to be used in a wide range of textile applications. Also, the tenacity of Biocelsol fibres is currently lower than that of viscose. Their high elongation at break contributes to the fibre's characteristic softness and drape.

A key aspect of its sustainability is that the Biocelsol production process does not generate coloured compounds. This allows the bleaching stage to be omitted, simplifying manufacturing and reducing the use of chemicals. From a circularity perspective, this feature improves process efficiency and supports more sustainable manufacturing.

For those interested in more technical details, see the **comprehensive overview of Biocelsol fibre production and development by VTT Senior Scientist Marianna Vehviläinen, PhD.**



Biocelsol fibres. Image (VTT)

Biocelsol and SPINNOVA® fibres vs Commercial fibres

SPINNOVA®: The textile material innovation

SPINNOVA® fibre offers a feel and appearance similar to natural fibres such as cotton, but is distinguished by a fundamentally different production process. While other artificial cellulose fibres rely on chemical dissolution processes, Spinnova's technology is based on the mechanical refinement of the raw material.

This method converts cellulose into textile fibre without the use of harmful chemical solvents. As a result, the environmental indicators of the process are remarkable: it generates no side waste streams, has minimal CO_2 emissions and very low water usage. This gives Spinnova a significantly lower environmental footprint compared to conventional materials.

In addition to its sustainability advantages, SPINNOVA® fibre is biodegradable, recyclable and offers adjustable moisture management, contributing to a feeling of comfort, dryness and warmth for the user.



SPINNOVA® fibres. Image (Spinnova)

Recap of recent ***progress & milestones***

Functional cellulosic fibres

VTT

citeve

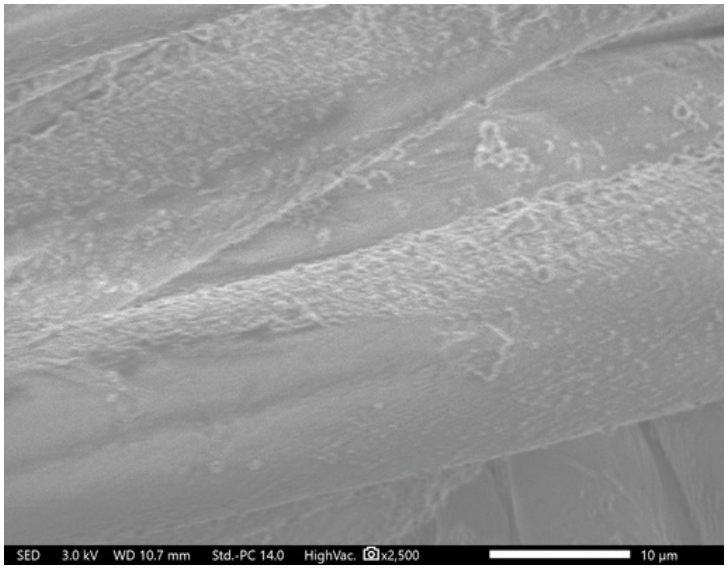
OrganoClick®

SPINNOVA®

Advances in this area have focused on both functional finishes and the integration of new technologies.

The **OrganoClick** team has achieved promising results in PFAS-free water repellency (WR) treatment, reaching a level of 4 out of 5 on the ISO 4920 scale on a reference cellulose fabric. This finish is key to ensuring that the final material repels rain, is breathable and maintains its performance after multiple washes.

Meanwhile, **VTT** has been developing and testing various heating panel constructions for the final prototype of the padded jacket. Following testing, the best-performing alternative has been identified, which also stands out as a solution designed to facilitate recycling, in line with the project's circularity objectives.



Cellulosic fibre functionalised with biomimetic hydrophobic finish. Image (VTT)

Recap of recent ***progress & milestones***

Advanced insulation material

A key quantitative advance has been achieved in the optimisation of loose-fill insulation material. The **Molina S.p.A.** team has managed to reduce the material's water absorption by almost 35%, from 230% to 150% (according to standard EN 13543:2001).

This improvement has a direct impact on the usability of the final product, as it significantly optimises the washability of garments, allowing for faster drying and better preservation of thermal properties after washing.



Insulation material.
Image (Molina S.p.A)

PENGUIN

Recap of recent ***progress & milestones***



Advanced fabrics

VTT

PANGAIA GRADO ZERO

COLMAR

citeve

SPINNOVA®

A fundamental breakthrough has been achieved in fabric development, with the successful manufacture of the first yarns incorporating the new material blends. This milestone represents a critical step in the project's production capacity and is complemented by a tangible improvement in the quality of the final product, as a significant reduction in loose fibres has been achieved.

The result is a high-performance cellulose fabric that keeps the wearer warmer and drier in cold and wet conditions. The material repels rain, is breathable to prevent condensation, dries quickly and maintains its performance after multiple washes, all with a soft and quiet feel.

Building on this achievement, this advance strategically positions the material in a new category of 'recyclable performance': European-sourced textiles, recyclable fibre by fibre, ready for the Digital Product Passport (DPP) and compliant with PFAS and microplastics regulations. This offers brands a lower-risk alternative to down or fossilbased synthetics and a differentiated and credible circularity argument.

Recap of recent ***progress & milestones***



Computational modeling + SSbD

idener.ai

RINA

Within the Safe and Sustainable by Design (SSbD) activities, **RINA** and **IDENER.AI** have worked together to ensure that safety and sustainability are embedded throughout every stage of innovation. The first milestone focused on assessing the new fibres, providing initial recommendations to guide their design toward safer and more sustainable solutions. Building on these results, the research are now extending the assessment to insulation materials, while also carrying out benchmarking activities to compare their performance with conventional options such as polyester.



Stakeholder awareness

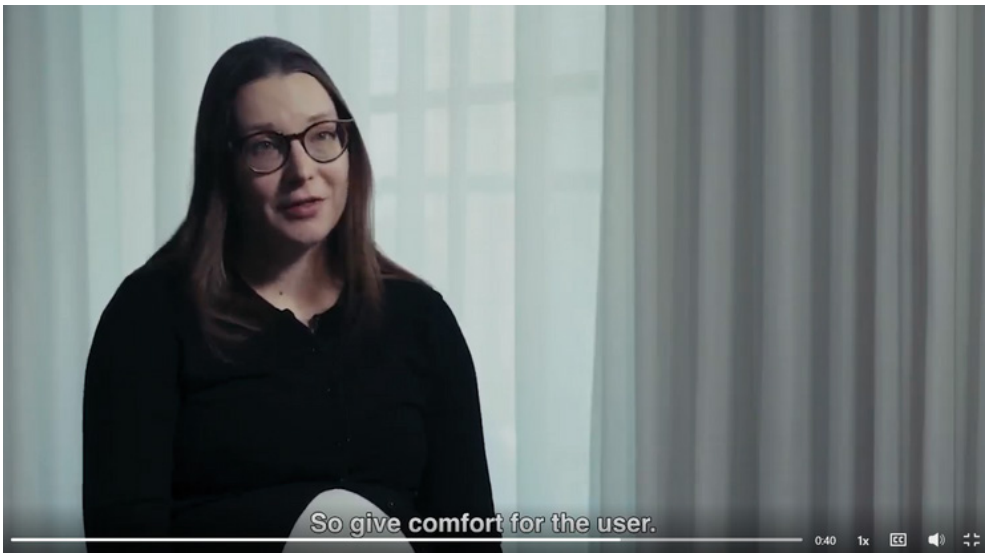
idener.ai

CONFINDUSTRIA MODA FEDERAZIONE TESSILE E MODA

Over the past few months, the PENGUIN project has gained significant international visibility thanks to its active participation in high-profile trade shows and conferences. Its presence at key events such as the **Milano Unica** trade fair and the **Circular Bioeconomy Event** has allowed the project's objectives and results to be presented to a broad and specialized audience, positioning our innovations at the center of the debate on sustainability and new materials.

In addition to external dissemination, a strategic effort has been made to strengthen collaboration within the European innovation ecosystem. Participation in platforms such as **ECOSYSTEX** has been essential for connecting with other Horizon Europe initiatives. This dialogue has facilitated a valuable exchange of technical knowledge and best practices, fostering synergies that open the door to future collaborations and ensuring that the project evolves in line with the latest developments on the continent.

Communication and ***dissemination***



New section: Coordinators corner

As part of its ongoing communication activities, the **PENGUIN project** is excited to launch a new video series called "Coordinators corner" that will provide continuous insights into its mission, progress, and achievements.

The first installment in this series is now available and serves as a foundational introduction to the initiative. In this video, project coordinator **Emmi-Maria Nuutinen** of **VTT** offers a comprehensive overview of PENGUIN's ambitious goals to revolutionize the outdoor textile industry. She also introduces the expert consortium behind the project, showcasing the diverse competences that are collaborating to pioneer eco-friendly, high-performance alternatives for outdoor apparel.

This introductory video can be viewed on the PENGUIN project's social media channels. We invite our community to watch this first episode and stay tuned for future videos that will delve deeper into our work.

Click here to watch the video

News

PENGUIN at Milano Unica in Milan



PLACE: Milan, Italy

DATE: July 8-10

PARTNER: Confindustria Moda

The PENGUIN project made a significant impact at the prestigious **Milano Unica** trade fair, where its partner **Confindustria Moda** successfully demonstrated the project's latest advances in sustainable textiles. The demonstration showcased a groundbreaking, highperformance material engineered from cellulose for a truly circular economy, offering the industry a viable path toward combining premium quality with full recyclability. The enthusiastic reception in Milan energized the project team, reinforcing its commitment to finalizing the research and contributing to a more sustainable future for the textile industry.

PENGUIN at ECOSYSTEX webinar series



PLACE: Online

DATE: September 19th

PARTNER: VTT

In a recent **ECOSYSTEX webinar**, the **PENGUIN project** was prominently featured, with project coordinator **VTT** presenting on its behalf. VTT provided a comprehensive overview of the project's objectives and its significant contributions toward creating a more sustainable and circular future for the textile industry. The ECOSYSTEX webinar series serves as an excellent platform for disseminating knowledge on key EU-funded projects, and this presentation offered stakeholders valuable insight into the innovations being developed within the PENGUIN initiative.

News

Our innovation stood out at ECOSYSTEX conference



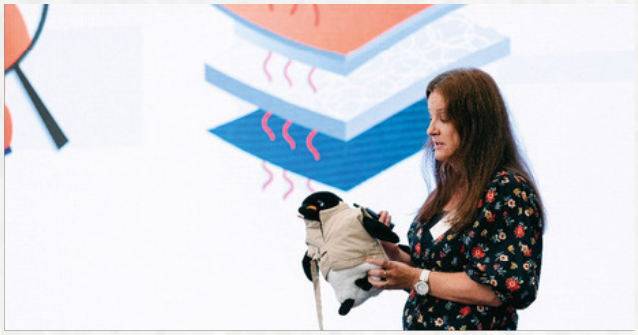
PLACE: Gothemburg, Germany

DATE: September 29th

PARTNER: Confindustria Moda, RINA and CITEVE

The recent **ECOSYSTEX conference** in Gothenburg provided a key platform for the PENGUIN project to demonstrate its latest innovations. At the event, the project team presented a groundbreaking insulation democase, designed to offer attendees a firsthand experience of the bio-based material's superior performance and sustainable properties, moving beyond traditional datasheets. This hands-on approach generated valuable feedback and insightful conversations. The successful showcase was supported by expert demonstrations from project partners **RINA, Confindustria Moda,** and **CITEVE,** who were instrumental in conveying the project's vision for a more sustainable fashion industry.

PENGUIN featured at Circular Bioeconomy Event



PLACE: Brussels, Belgium

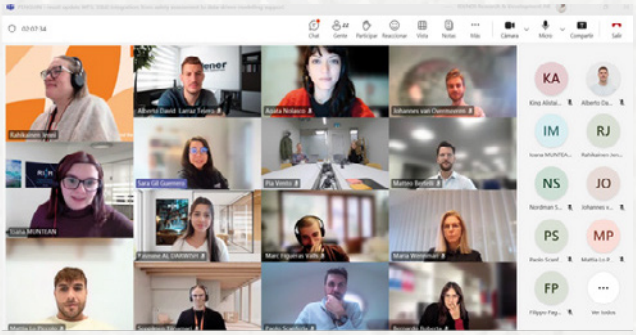
DATE: September 17th

PARTNER: VTT

VTT took the stage at the **Circular Bioeconomy Event** to showcase the latest breakthroughs from the **PENGUIN project.** VTT's presentation focused on key advancements in developing sustainable technologies that transform bio-based side streams and waste into valuable, high-performance products. Elina Ilen (VTT) presented our work on replacing synthetic textiles with wood-based textiles to an inspiring audience of policymakers, industry leaders, and researchers – including European Environment Commissioner Jessika Roswall.

News

PENGUIN explores the practical application of SSbD



PLACE: Online

DATE: October 21st

PARTNER: All

The PENGUIN project recently held a key meeting focused on its significant progress in ensuring the safety and sustainability of its new materials. The session provided a comprehensive showcase of the project's integrated Safe and Sustainable by Design (SSbD) framework, presenting concrete results on chemical safety, fibre Life Cycle Assessments (LCA), and the development of data-driven computational models. This collaborative forum generated insightful discussions and reinforced the project's datacentric strategy. The successful showcase was driven by expert presentations from partners **IDENER.AI, RINA,** and **VTT,** who were instrumental in demonstrating how PENGUIN is ensuring its material innovations are fundamentally safe and environmentally sound.

PENGUIN project takes center stage at Venice Sustainable Fashion Forum



PLACE: Venice, Italy

DATE: October 23-24th

PARTNER: Spinnova and Confindustria Moda

A key highlight from the recent Venice Sustainable Fashion Forum, an event promoted by industry leaders including **Confindustria Moda**, was the PENGUIN presentation featuring Shahriare Mahmmood, Chief Product & Sustainability Officer of our partner **Spinnova**. He showcased the groundbreaking work of Project Penguin, detailing how this initiative is pioneering sustainable, circular textile solutions. His insights emphasized the vital role of technological innovation, like Spinnova's, in driving the fashion industry toward a more regenerative and competitive future.

News

UPCOMING *events*

PARTNER	EVENT	YEAR	DATE	LOCATION
MOLINA	Heimtextil Frankfurt	2026	13-16 January	**Frankfurt,** Germany
MOLINA	Performance Days Munich	2026	18-19 March	**Munich,** Germany

If you don't want to miss any of the latest news from the PENGUIN project, remember to follow us on our social medias and check out our website.

@penguin-project | **@penguin_heproj** | **@penguin_heproj**

Voices from our consortium

VTT

"Biobased finishing provides completely new properties for cellulose-based textile fibres – this broadens their use potential in new application areas where synthetics are used today!"

VTT

CONFINDUSTRIA MODA FEDERAZIONE TESSILE E MODA

"We are excited to see how our joint efforts are already making a difference, paving the way for a more sustainable and circular textile future."

CONFINDUSTRIA MODA

idener.ai

"IDENER.AI uses predictive modeling and in silico safety assessment to guide the early-stage optimization of materials and devices. This "safety-bydesign" approach aims to make innovation safer and more sustainable before physical prototyping. The main drawback is slow industrial adoption, as these digital tools require a shift in R&D practices and do not offer immediate cost savings. However, the PENGUIN consortium is working to validate this approach and demonstrate its long-term benefits for efficient and safe manufacturing."

IDENER.AI

PENGUIN

Voices from our consortium

citeve

CITEVE

"Following the first reporting period, PENGUIN has demonstrated promising progress toward market-ready bio-based textiles and innovative fibres. Key challenges remain in scaling up production, ensuring consistent performance, and optimizing durability and water repellency with sustainable chemistries. Addressing these barriers is essential to move from lab validation to commercial deployment."

OrganoClick

ORGANOCLICK AB

"We are pleased to see that our products add value to the project, demonstrating enhanced properties and a strong sustainability profile across several work packages."

RINA

RINA

"Completing the Stage 1 LCA on fibres through the SSbD framework marks an important milestone. It strengthens our ability to drive the project's sustainability assessments forward and supports evidence-based decision-making."

Molina Since 1890 in Italy

MOLINA

"PENGUIN's loose fill fibreballs are currently at TRL 6–7. The product has already been successfully tested under relevant conditions, but the main remaining challenges concern process repeatability, scalability and reducing the polyester content (currently 50%). So far, production has been limited to small batches using semi-manual processes."

Voices from our consortium

SPINNOVA®

SPINNOVA

"We see a strong alignment with the PENGUIN project's aim to discover bio-based and advanced fibres for sustainable insulation materials for outdoor textiles. We continue to explore further applications for our fibres and see great value in this collaboration."

PANGAIA GRADO ZERO

PANGAIA GRADO ZERO

"Within PENGUIN, our focus lies on transforming bioinspired concepts into tangible, high-performance materials for outdoor applications. We are currently developing sustainable insulation structures and textile prototypes that combine thermal comfort, lightness, and biodegradability — bridging biomimicry with advanced engineering. This collaboration demonstrates how design, material science, and circular innovation can merge to redefine the future of functional textiles."

PENGUIN

PARTNERS

VTT

CONFINDUSTRIA MODA FEDERAZIONE TESSILE E MODA

idener.ai

PANGAIA GRADO ZERO

COLMAR

citeve

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