



Bionanopolys



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OITB
NEWS
NO. 4

EDITORIAL

HOW BIONANOPOLYS MEETS THE



SUSTAINABLE DEVELOPMENT GOALS

KATRIN WEINHANDL, ACIB

The 17 Sustainable Development Goals (SDG), defined by the UN in 2016, aim at securing the sustainable development globally in terms of economic growth, resource management, equality, ecosystem and the enhancement of resilience. The central topic of BioNanoPolys, which is the safe and sustainable development of bio-based nanomaterials, perfectly fits into this Agenda 2030. In particular, BioNanoPolys addresses the goals 8 ([Decent work and economic growth](#)), 9 ([Industries, innovation and infrastructure](#)), 12 ([Responsible consumption and production](#)), and 13 ([Climate action](#)). Let's have a look, how these goals can be connected with the BioNanoPolys mission.

RESPONSIBLE CONSUMPTION AND PRODUCTION

The major objective of goal 12 is to reduce waste and pollution, improve the resource efficiency and enable a circular bioeconomy. This is exactly what the Open Innovation Test-Bed (OITB) BioNanoPolys offers: a comprehensive portfolio of technologies and services proposes to extract valuable compounds from lignocellulosic biomass, generate nanocomposites from them and use them for functional nanomaterials that are relevant for different industrial sectors. These novel bio-based materials are going to be tested in terms of recyclability, safety and sustainability and will lead to a reduced amount of waste while enabling recycling and reuse.

CLIMATE ACTION

Goal 13 is subjected to combatting climate change by the reduction of greenhouse gas emissions. By replacing conventional (fossil-based) materials with bio-based alternatives, greenhouse gas emissions can definitely be reduced and therefore, bionanomaterials can contribute

to mitigating climate change. A sound life-cycle assessment is included in the holistic service portfolio of BioNanoPolys, which allows to determine environmental impacts of a particular approach.

DECENT WORK AND ECONOMIC GROWTH

BioNanoPolys is an OITB for SMEs, for start-ups and for companies that are willing to develop innovative solutions for a better future. It intends to significantly improve resource efficiency and – as target 8.4 states – to “decouple economic growth from environmental degradation”. The crucial aspect on the way to a successful technology is to join forces within a network of experts and close the gaps of expertise. BioNanoPolys supports innovative ideas, which on the long term creates new job opportunities and business cases.

INDUSTRIES INNOVATION AND INFRASTRUCTURE

In terms of Goal 9 BioNanoPolys goes into the same direction: the OITB environment enables young entrepreneurs and innovators to find their position in a particular value chain and to accelerate the integration of technologies into the market by providing access to business services. Bio-based nanomaterials can significantly contribute to advancements in technology and innovation and offer new possibilities for various industrial sectors such as packaging, construction, textile, or cosmetics. **Let's create an impact and meet the global goals in a joint approach!**



Visit United Nations SDGS
<https://sdgs.un.org>

USER VOICES

GREEN CHEMISTRY AND BIOTECHNOLOGY INNOVATIONS IN COSMETICS: AMBROSIA LAB'S JOURNEY WITH BIONANOPOLYS

PAOLA ZIOSI, **AMBROSIA LAB**

WHAT IS AMBROSIA LAB'S MISSION?

Ambrosia Lab is dedicated to the innovative development and formulation of new ingredients for cosmetics and medical devices. Our focus is particularly on valorizing ingredients emerging from green chemistry and biotechnology, employing cutting-edge formulation techniques. We place a special emphasis on creating sunscreens with a safety-first approach, crafting unique strategies to ensure product safety. Through strategic partnerships with other companies and research institutions, we strive to forge new pathways and foster innovation in the use of bio-based raw materials. These collaborative efforts are crucial for sharing knowledge and expertise, thereby enhancing the development and use of sustainable materials. With a full range of instruments and a team of skilled professionals, Ambrosia Lab is adept at assessing the effectiveness of cosmetic ingredients and finished products, both *in vitro* and through *in vivo* tests with volunteers.

WHERE DO YOU SEE CURRENT CHALLENGES THAT REQUIRE A MORE EFFICIENT OPEN INNOVATION PROCESS?

The recent global crises have highlighted the critical issue of raw material supply. The disruption of supplies, rising logistics costs due to the instability of governments in several countries that are the main suppliers of raw materials have led to a growing awareness of the

need for a circular economy and an approach that reduces the cost of sourcing raw materials by utilising by-products from agriculture and the food industry. One of the current challenges in the cosmetics sector is certainly the development of safer, more effective and more environmentally friendly ingredients obtained through sustainable syntheses or biotechnological approaches that could replace fossil-based additives in order to reduce harmful emissions, stop the depletion of non-renewable raw materials and integrate anthropogenic production processes into natural material cycles.

WHAT IS YOUR USE CASE ABOUT?

In our use case, we're pioneering the transformation of cellulose extracted from lignocellulosic biomass into advanced materials—namely nanocellulose and nanocapsules. This is part of our effort to develop sustainable and renewable alternatives to traditional, fossil-based cosmetic ingredients. Our work specifically focuses on leveraging these nanomaterials to enhance cosmetic products, offering improved hydration, water retention, and sun protection. We've successfully formulated cosmetic emulsions incorporating nanocellulose and nanocapsules, marking a significant step towards replacing ingredients derived from fossil sources. Furthermore, we've explored innovative applications beyond cosmetics, including the incorporation of functionalized nanocapsules into food products, like tomato sauce, showcasing the versatility and potential of our research.

WHICH SERVICES OF BIONANOPOLYS ARE RELEVANT FOR YOUR USE CASE AND WHY?

The most pertinent service offered by BioNanoPolys for our project is the technical capabilities of their Pilot Plant 2, which specializes in creating bio-based additives like nanofibers and nanocrystals (CNF and CNC). In the cosmetic industry, there's an increasing demand for renewable alternatives to replace fossil-based materials. This shift aims to lessen environmental impact and open up new possibilities for formulations. Cellulose from sustainable sources stands out as an excellent candidate, thanks to its scalability and effective performance.

At the ITENE facility, we've developed nano-based materials as nanodispersions, significantly enhancing their integration into products. By producing these materials in a liquid form using an emulsifier, we've managed to drastically cut down on mixing time, lower processing temperatures, and minimize dust generation. These improvements lead to notable energy savings.

One of the most promising aspects of nanocellulose we've explored, albeit in the initial stages, is its potential as an SPF booster in sunscreen emulsions. This discovery is particularly exciting as it suggests that biopolymers could replace traditional fossil-based SPF boosters. This could reduce the reliance on organic and inorganic UV filters in sunscreens, offering a sustainable alternative for UV protection. By leveraging nanocellulose, we not only utilize a renewable resource but also aim to mitigate the impact of UV filters on marine ecosystems.

WHAT ARE THE BENEFITS OF THE BIONANOPOLYS OITB FROM YOUR PERSPECTIVE?

BioNanoPolys OITB allows us to join a network of partners with skills complementary to ours and to expand our knowledge and expertise. It enables us to find new solutions for a more sustainable development and increase our visibility in the cosmetics industry.

DO YOU - AS A USER OF THE OITB - HAVE ANY RECOMMENDATIONS FOR OTHER (FUTURE) OITB USERS?

As participants in the OITB initiative, whose core mission revolves around the sharing of knowledge, we strongly encourage future users to view the exchange of information not as a potential threat to their proprietary know-how, but rather as a unique opportunity for growth and innovation. Embracing the collaborative spirit of the network can significantly enhance individual capabilities and lead to outcomes that are far more substantial and impactful than what one could achieve in isolation. We believe that adopting this perspective will yield richer, more valuable results for all involved, as the collective expertise and insights of the entire network can drive advancements that surpass the sum of their parts.



Visit **AMBROSIA LAB**
<https://www.ambrosialab.it>



AMBROSIALAB
 health and wellness research



SERVICES IN SPOTLIGHT

ENSURING SAFETY AND COMPLIANCE: THE CORNERSTONE OF INNOVATION IN BIONANOPOLYS

ARANTXA BALLESTEROS, RAÚL DÍAZ, ITENE

WHY IT IS SO IMPORTANT TO CONSIDER SAFETY ASPECTS DURING THE DEVELOPMENT OF NEW PRODUCTS?

Ensuring safety during the development of new products, particularly those involving innovative nano-enabled bio-based materials and polymer bionanocomposites, is crucial for several reasons. At the forefront is the commitment to human and environmental health, alongside the necessity to meet stringent safety regulations—a fundamental prerequisite for introducing new products to the market. In response, BioNanoPolys offers a suite of specialized services tailored to the unique requirements of each project. These services are designed to identify and address any potential challenges throughout the product's life cycle, ensuring safety and compliance from conception to disposal.

Our approach to implementing safety measures adheres to established European guidelines for nanosafety assessments and follows the EC's recommendations for creating products that are safe and sustainable by design (SSbD). This comprehensive strategy encompasses hazard profiling to assess the potential impact of new bionanomaterials, thorough exposure assessments, and diligent risk management practices. Additionally, we ensure regulatory compliance for products intended for food contact and cosmetics by conducting precise testing to fulfill these specific standards.

HOW CAN WE ASSESS SAFETY?

Assessing safety involves a thorough two-step process:



Hazard Profiling Assessment:

This first step utilizes a comprehensive set of experimental *in vitro* tests, aligned with OECD guidelines for chemical testing and specific recommendations for nanomaterials. The goal is to evaluate potential impacts on both human and environmental health. For human health, we employ representative human cell lines to simulate the main routes of exposure, assessing their effects on cell function, viability, DNA, and potential inflammatory responses. For environmental health, bioassays are performed to examine the acute effects on aquatic organisms, providing a holistic view of the potential hazards.

Risk Assessment and Risk Management:

The second step focuses on both assessing and managing risks, particularly concerning occupational exposure. This involves three key actions:



1. Identification of Occupational Exposure Scenarios: We start by pinpointing potential emission or release sources in workplace environments, mapping out scenarios where exposure could occur.

2. Experimental Characterization of Exposure: Through real-time analysis conducted directly at industrial sites, we characterize potential exposure to nanoparticles, including their number concentration, size distribution, and surface area. This detailed profiling helps in understanding the exposure level during critical tasks.

3. Implementing Risk Management Measures: We define and apply stringent risk management strategies to mitigate risks throughout the entire life cycle of engineered nanomaterials (ENMs) and nano-enabled products (NEPs). This includes evaluating personal protective equipment and engineering controls for their effectiveness in reducing particle penetration and ensuring particle removal efficiency.

By systematically addressing these components, we ensure a comprehensive safety assessment that not only identifies risks but also provides effective strategies for risk management, safeguarding human health and the environment.

HOW DOES THE BIONANOPOLYS PROJECT ENSURE ITS DEVELOPMENTS ARE SUITABLE FOR FOOD CONTACT APPLICATIONS?

The BioNanoPolys project is dedicated to developing safe additives and materials suitable for food contact. This commitment is grounded in strict adherence to European legislation, particularly Regulation (EC) No. 1935/2004.

This regulation mandates that materials and articles coming into contact with food must not compromise human health, alter the composition of the food, or degrade its taste and smell under normal use conditions. Ensuring this level of safety requires manufacturing practices that prevent any harmful constituents from transferring to food in significant amounts.

To align with these requirements, the project specifically follows the guidelines set out for various materials, including plastics, as outlined in Regulation (EU) No. 10/2011. This detailed regulation covers all plastic materials intended for food contact, setting standards for their composition, safety, and the requirement for a declaration of conformity, ensuring that all used substances are listed in the Union List (Annex I of the Plastics Regulation).

For non-plastic materials, such as paper and board, which the BioNanoPolys project also explores, there isn't a unified European legislation. However, these materials must still demonstrate their safety for food contact purposes. Various national legislations and industry guidelines within the EU provide frameworks for assessing the safety of paper and board, such as the German Recommendations (BfR XXXVI) for paper and board intended for food contact and the French national legislation (Fiche MCDA n°4) concerning organic materials based on plant fibers for foodstuffs.

These guidelines universally emphasize the importance of using substances that have been evaluated and approved for safe use, conducting thorough tests for any potential migration of substances, and adhering to good manufacturing practices (GMP). Through these rigorous standards and practices, the BioNanoPolys project ensures the development of food contact materials that are safe, compliant, and uphold the highest quality and safety standards.

HOW TO ENSURE THE SAFETY OF COSMETIC PACKAGING DEVELOPED IN THE FRAMEWORK OF THE BIONANOPOLYS PROJECT

Ensuring the safety of cosmetic packaging aligns with the rigorous standards set by the EU Cosmetics Regulation (EC) No. 1223/2009. This regulation stipulates that all cosmetic products introduced to the market

must not pose any harm to human health under normal or foreseeable conditions of use. Achieving this level of safety necessitates that the packaging materials not only be safe but also fully compatible with the cosmetic formulations they contain.

To fulfill these requirements, the BioNanoPolys project follows the guidelines for materials intended for food contact, leveraging this framework to guarantee the safety and inertness of cosmetic packaging. This approach ensures that the packaging materials are devoid of any banned or restricted substances outlined in the relevant cosmetic legislation. Additionally, the project adheres to the REACH Regulation, specifically avoiding Substances of Very High Concern (SVHC), heavy metals, and carcinogenic, mutagenic, or reprotoxic (CMR) substances as mandated by Regulation 1272/2008/EC. Through this comprehensive compliance strategy, the BioNanoPolys project upholds the highest safety standards for cosmetic packaging, safeguarding both product integrity and consumer health.

NANOMATERIALS AND THEIR USE IN FOOD PACKAGING AND COSMETIC APPLICATIONS

The use of nanomaterials in food packaging and cosmetics presents unique challenges due to their distinct chemical and physical characteristics, which can differ

significantly from their larger-scale counterparts, potentially altering their toxicological profiles. Consequently, the standard risk assessments for substances based on their conventional particle sizes are not sufficient for engineered nanoparticles. This necessitates a detailed, case-by-case risk assessment process overseen by the European Food Safety Authority (EFSA), culminating in an authorization and listing of the nanoform substance for use in material and product formulations.

Within the scope of the BioNanoPolys project, we offer specialized services focused on navigating the complex landscape of European regulations for food contact materials (FCM) and cosmetic packaging. Our approach includes comprehensive conformity assessments of the materials we develop, detailed risk analyses tailored to each case, evaluations of substance migration, checks for non-intentionally added substances (NIAS), and overall risk assessments tailored to the specific end-use of the material. This holistic methodology ensures that nanomaterials used in our project are not only innovative but also safe and compliant with the highest regulatory standards.



Visit ITENE

<https://www.itene.com>



BUSINESS ADVISOR

SHAPING THE FUTURE: THE BIONANOPOLYS PROJECT'S INFLUENCE ON THE BIO-BASED MATERIAL MARKET

MARÍA C. NARANJO, AXIA INNOVATION

A key pillar for a sustainable future lies in conserving fossil resources by replacing them with biomaterials, which hold great potential as an alternative. Yet, enhancing the functional properties of these biomaterials is essential for their competitive edge in the market. BioNanoPolys targets this opportunity by aiming to introduce safe, nano-enabled bio-based materials and polymer bionanocomposites suitable for multifunctional uses and advanced applications. Utilizing high lignocellulosic feedstocks, the project produces cellulose nanofibers, cellulose nanocrystals, nanolignin, and metallic nanoparticles. Moreover, BioNanoPolys stands out for its innovative approach in using feedstocks with a high sugar content to produce essential building blocks, organic acids, PHAs, and active compounds for nanocapsule creation. The goal is to fabricate bionanocomposites and bio-based nano-products from sustainably sourced feedstocks for use in a variety of sectors including packaging, textiles, agriculture, cosmetics, pharmaceuticals, and food.

To enhance the adoption of biomaterials in the market, the BioNanoPolys project has strategically focused on key application areas - packaging, textiles, and consumer goods - offering a comprehensive service model through the Single-Entry Point (SEP). This approach ensures that clients and stakeholders have streamlined access to a suite of services. At the heart of this initiative, the BioNanoPolys SEP serves as the central hub where partners from the OITB come together to offer their expertise, granting clients easy access to essential

pilot lines and services for the safe development and scaling of materials and products. Interested parties can engage with the BioNanoPolys SEP via an interactive online platform, where they can create an account and submit their project requests. This process includes the option to sign a Non-Disclosure Agreement before formally submitting their application, which outlines the specific test case and requested service. The BioNanoPolys SEP is designed to be the exclusive gateway to its comprehensive service portfolio, positioning it to make a significant impact on the global market for bio-based materials.

BIO-BASED MATERIAL MARKET

Bio-based materials or biomaterials, are derived from renewable sources like agricultural byproducts, plants, and microorganisms. These materials are key to promoting a circular and sustainable economy, offering significant environmental benefits. According to a 2023 market analysis, the global market for bio-based materials was valued at approximately 41 billion USD. Projected to grow at a compound annual growth rate (CAGR) of 25.60% from 2024 to 2032, it is anticipated to reach an estimated 295.61 billion EUR by 2032.

The growth of the bio-based material market is propelled by various critical factors, including government regulations and incentives that support renewable resources and sustainable practices. These policies encourage the development and use of bio-based mate-

rials. Additionally, increasing public awareness of climate change and environmental sustainability is shifting consumer preference towards products with a lower environmental footprint, further boosting market growth. As a result, the bio-based material market is experiencing rapid expansion, with an ever-growing range of bio-based materials available. Innovations in technology and improvements in production processes are making bio-based materials more cost-effective and efficient. The market for bio-based materials is diverse, with applications ranging from rigid and flexible packaging to textiles, automotive, consumer goods, and construction, among others.

MARKET TRENDS

The environmental impact of fossil-based materials, especially their growing carbon footprint, is a significant concern. As a result, bio-based materials are becoming crucial in the shift toward sustainability, driven by the escalating demand for eco-friendly alternatives. The market is increasingly oriented towards sustainable yet functional bio-based materials. Among these, bio-based plastics, derived from renewable sources like crops, are in higher demand for products including disposable utensils and food packaging. Additionally, the use of bio-based composites - materials combined with fibers, resins, or minerals - is on the rise. These composites offer greater durability and lighter weight compared to traditional materials and are versatile enough for various uses, from building materials to automobile parts.

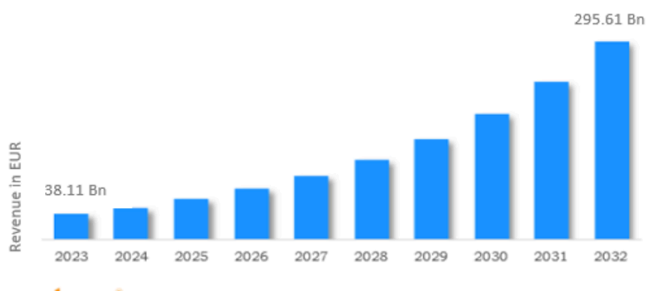


Figure 1: Global Bio-Based Materials Market¹

Visit AXIA INNOVATION
<https://www.axia-innovation.com>

¹<https://www.zionmarketresearch.com/report/bio-based-materials-market#:~:text=Based%20on%20applications%2C%20the%20market,electrics%20and%20electronics%2C%20and%20others.>



AXIA INNOVATION



GET TO KNOW OUR NETWORK

COORDINATING THE TECHNICAL SERVICES TO BIONANOPOLYS PARTNERS

PABLO LÓPEZ, AITEX

AITEX is a private research association whose main objective is to create and transfer knowledge of textiles to the private sector, increasing the competitiveness of the industry. It has a large R+D department comprising a multidisciplinary team of researchers that promotes, executes and participates in industrial research projects of strategic character, including national and European funding. AITEX is the leader of the Work Package 7 of the BioNanoPolys project, in which it coordinates the execution of several User Cases aiming to demonstrate the technical feasibility of BioNanoPolys services and pilot plants included in the OITB. Our role is to ensure the proper development of technical tasks, both by directly participating in them and giving support and guidance to the rest of the partners in their respective User Cases.

AITEX has been involved at different levels in all the User Cases of the Work Package 7, from carrying out experimental trials to merely supervising and coordinating tasks, contributing to defining the framework of how the OITB will operate once its establishment is fully implemented. 21 user cases have been developed by using the pilot plants and services available in the OITB; starting from the first proposals based on expected impacts and objective KPIs, each one of the 8 industrial partners has achieved great results in different areas, thanks to their collaboration with the corresponding technical partner of the pilot plant needed for conducting the action plan and with the knowledge and expertise to support their work correctly.

AITEX has actively participated in UC1 and UC2 of TEXTISOL and UC20 and UC21 of Hilos Técnicos San Miguel (HTSM), carrying out compounding, polymer modification and spinning trials.



SUCCESS THROUGH SYNERGY

Within the 21 User Cases developed, some of them can already be considered successes, as objectives and KPIs have been achieved, resulting in a potential product/technology that can be exploited by the industrial.

UC1/Product 2, in which TEXTISOL alongside AITEX and STFI have developed a non-woven material composed of 85% viscose + 15% PLA chemically modified

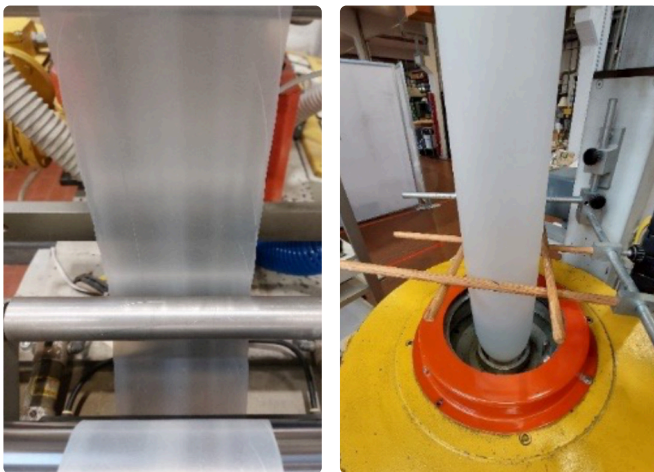


for cleaning wipes with antimicrobial properties that are 100% compostable.

In UC3, DS SMITH with the help of ITENE and CTP has obtained a cellulose nanofiber-reinforced paper-based material with excellent oxygen and grease barrier (80 and 40% improvement respectively) through wet lamination.

Efforts in UC6 and UC9 of NOVAMONT have resulted in the development of block copolymers by ITENE for their use as additives in NOVAMONT's biomaterials for the obtaining of compostable films with properties suitable for secondary packaging and nanoclays by ITENE for their use as additives in NOVAMONT's biomaterials for the obtaining of compostable films with properties suitable for application as carrier bags and bags for organic waste collection.

Thanks to the works done in UC10, AMBROSIA has



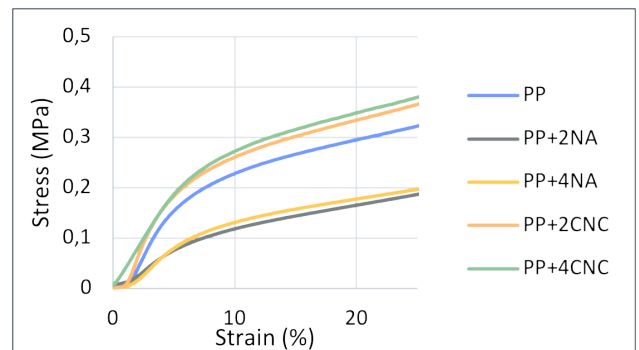
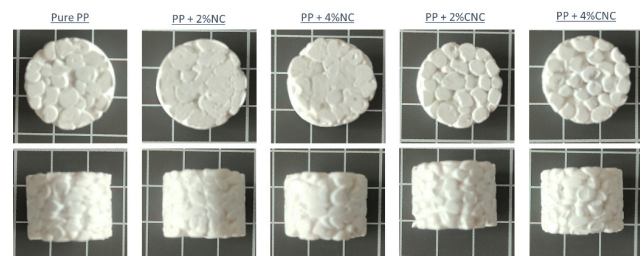
achieved the inclusion of CNF and CNC as film forming agent in cosmetics formulations, like a sunscreen formula with 1,3% CNF showing good stability and sun protection factor or a sunscreen formula with 5% CNC having a stable emulsion with good viscosity and homogeneous appearance.

Related to the previous UC, LOGOPLASTE together to NOVAMONT has produced a bottle made of material

100% compostable reinforced with nanoclays to be used as cosmetic packaging.

For UC17, CELLMAT, using ITENE nanoclays, has produced complex shaped foamed part for the automotive sector using BioPP as the base instead of PP with improved mechanical properties.

All these results, achievements and success stories have demonstrated the capabilities of the OITB to conduct perfectly the required research, studies and trials to help and support industrial partners to improve their competitiveness and reach new heights in terms of efficiency and sustainability.



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LET'S MEET AND INTERACT

UPCOMING EVENTS 2024

23rd April (3pm - 4pm)

Fundraising and Investor Relations Workshop, powered by Bionanopolys, [more information](#)

7th May (3pm - 4pm)

Pitchdeck Clinic Workshop, powered by Bionanopolys, [more information](#)

20 - 22 May

EBAN Annual Congress 2024 in Tallinn, Estonia, [more information](#)

21st May

Bionanopolys Pitching Session at the EBAN Congress 2024, [more information](#)

30 - 31 May

Biorefine Cluster Europe Conference in Ghent, Belgium, [more information](#)

12 - 14 June

Annual Congress Supporting sustainable industry in Nantes, France, [more information](#)

12 - 14 November

European Summit of Industrial Biotechnology (esib) in Graz, Austria, [more information](#)

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