EnXylaScope

Unleashing Xylan's Potential with Enzymes for a Scope of Consumer Products

EXS Business Case Toolkit

How to adopt the innovation

Funded by the European Union

Index of contents

1 Biotechnology drives sustainable transformation

The biochemistry and biotechnology sectors are significantly growing due to global demand for sustainable and eco-friendly products.

Market trends move towards biobased solutions, driven by regulatory measures to reduce dependence on fossil-based resources and the rising consumer awareness of environmental issues. This situation involves both challenges and opportunities for business seeking to align with sustainability goals.

This toolkit provides a concise guide for businesses in the biochemistry and biotechnology sectors to adopt innovative circular economy solutions and specifically EXS outcomes. The reader will discover the market trends in biotechnology, how to be part of the transformation and information about how to implement specific innovations.

Biotechnology is a critical driver of European economic growth in sectors such as healthcare, pharmaceuticals, cosmetics, feed or energy enable important innovations since efficient food processing and sustainable industrial processes to fermentation and enzyme biocatalysis.

Industrial biotechnology, recognized as one of the six Key Enabling Technologies (KETs) by the European Commission, supports the modernization of European industries. The biotechnology market in Europe grew at a CAGR of over 7% from 2015 to 2019, reaching more than $78 billion in 2019. It is expected the creation of 900,000 new jobs by 2030. Germany, France, and Spain lead the European market.

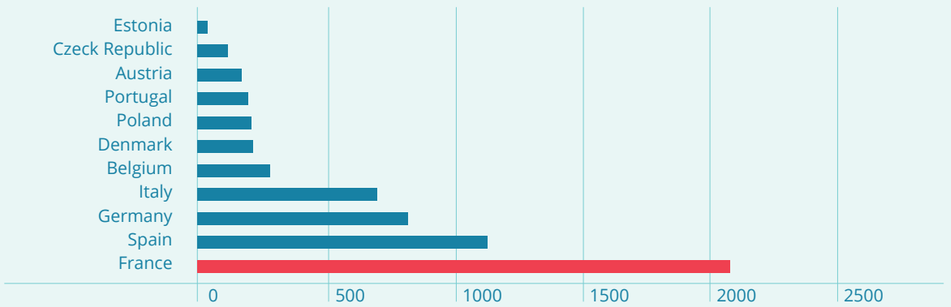

Figure 7 - Biochemicals market share, 2020. Source: EUBIA

The Chemical industry is led by Germany, Italy, and France. The manufacturing intensity of the chemicals market is projected to be 2.5% in 2025, with a value added margin of 30%. Despite Europe's current dominance in global chemical exports, Asia, particularly China, is expected to be a significant driver of chemical consumption growth in the coming years.

1.1 The expanding market of Enzymes

The global enzymes market is expected to reach $8.3 billion by 2029, growing at a CAGR of 6.5%. Industrial enzymes are key to develop environmentally friendly innovations in several sectors like food, cosmetics, and textiles which address consumers' environmental concerns and the need for cost-effective, resource-efficient processes. Enhanced R&D has led to new products, including genetically engineered enzymes, with the enzyme manufacturing sector as a primary niche.

North America dominates the market, with Asia-Pacific expected to grow fastest. European companies, including Novozymes, Chr. Hansen, BASF, Merck, and DSM, play a significant role, producing 74% of global enzymes. Europe's potential lies in diversifying enzyme applications, such as novel xylan-debranching enzymes, to meet rising demand in cosmetics, personal care, and feed sector.

1.2 Cosmetic and personal care market, the green revolution

Cosmetics market has been experimenting recently a growing demand on natural and bio-based ingredients that is expected to continue in the following years. Companies are transforming their formulations and processes from synthetic chemicals towards biobased and sustainable raw materials. The range of biochemical products using biotechnology techniques based on enzymes includes cosmetics and personal care products which are directly influenced by the end consumer attitudes, the same can be said for feed products. Consumers are willing to pay more for greener products specifically for those related to their wellness.
The following chart shows the consumer attitudes in relation to ethics, environmental responsibility and sustainability which are considered at least as "moderately important" by 77% of consumers.

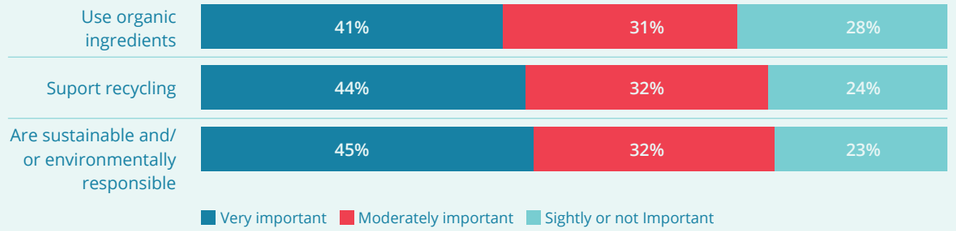

Figure 8 – Consumers' attitudes trends. Source: IBM

1.3 The Feed Market is committed to sustainability

The European feed market, part of the broader food industry, is experiencing significant growth and transformation. In 2025, the food market in Europe is projected to generate revenue of US$2.12 trillion, with an expected annual growth rate of 5.24% from 2025 to 2030[1]. The industry is experiencing shift towards more sustainable animal nutrition. The food manufacturing sector in Europe, which includes animal feed production, is expected to employ 6.25 million people in 2025, with a projected annual growth rate of 0.94% from 2025 to 2029[2]. The industry's value added is estimated at US$343.28 billion in 2025, with an annual growth rate of 0.88% expected through 2029[1]. These figures underscore the economic importance of the feed market within the broader food industry in Europe.

[1] Statista. (2025). Food - Europe. Statista. https://www.statista.com/outlook/cmo/food/europe

[2] Statista. (2025). Food - Europe. Statista. https://www.statista.com/outlook/io/manufacturing/consumer-goods/food/europe

2 Be part of the Biotech challenge

The biochemical and biotechnological industries are experiencing exponential growth driven by technology innovations and social demand of environmentally friendly solutions. Key sectors such as healthcare, cosmetics, and feed present unique opportunities due to their high demand and growth potential.

Those companies which want to implement new business lines need to carry out deep market analysis to understand customer preferences, identify needs, and pinpoint target demographics and geographic regions. Besides, a proper evaluation of the Technology Readiness Level (TRL) of innovations ensures they are ready for commercialization. Additionally, identifying the required infrastructure (e.g. production facilities, supply chains, distribution networks etc.) is critical for smooth operations. Other critical aspect is to be compliance with strict regulatory standards in these sectors without which market access is not possible.

2.1 Circular and Innovative Business Models for a Changing Industry

Circular business models are at the forefront of innovation in the biochemical and biotechnological sectors, addressing the pressing need for sustainability and resource efficiency. These models focus on minimizing waste, optimizing resource use, and creating value through closed-loop systems that benefit both businesses and the environment. By embedding circularity into their operations, companies can achieve economic growth while meeting environmental and societal goals.

Among the most important circular business models are:

- **Closed-Loop Production Systems:** This approach focuses on reusing materials and by-products throughout the production cycle. For instance, in biotechnology, residues like biomass can often be redirected into other industries as raw materials—think fertilizers, bioenergy, or even innovative biochemical products.

- **Prolonging Product Lifespans:** Developing goods that are robust, fixable, or adaptable contributes to lengthening their useful life, thereby reducing the demand for raw materials. Within bioindustrial applications, this might involve employing biomaterials or enzymes repeatedly in several production cycles.

- **Transforming Waste into Resources:** A core feature of circular practices is repurposing waste into valuable outputs. For instance, agricultural by-products could be processed into biofuels or bioplastics, which not only minimize waste but also open up fresh economic possibilities.

- **Products as a Service Model:** Shifting from selling tangible products to delivering services enables companies to maintain control over materials, facilitating better recovery and recycling. In the biotech sector, this could translate into renting out laboratory instruments or providing tailored bioprocessing solutions.

- **Eco-friendly and Decomposable Alternatives:** Creating products that naturally degrade without harming the environment reinforces circularity principles, particularly in fields like packaging or personal care.

The implementation of circular models brings significant benefits for businesses. First, they help increase economic efficiency by making the most out of resources. This way, companies can rely less on raw materials, reduce costs, and improve their profits. At the same time, these models bring clear environmental advantages, like lowering carbon emissions, producing less waste, and decreasing the use of resources made from fossil fuels. In addition, circular practices match perfectly with the expectations of today's consumers, who care a lot about sustainability when deciding what to buy. By adopting these models, businesses can better respond to the demand for eco-friendly solutions, improving their image and gaining a stronger position in the market.

Still, while circularity is gaining momentum, other business models like direct-to-consumer (DTC), business-to-business (B2B), licensing, and service-based approaches remain essential. These can work alongside circular strategies, giving businesses more ways to generate revenue while keeping sustainability at their core.
A B2B firm, for example, might integrate waste-to-value processes into its operations to provide sustainable raw materials to its partners.

2.2 Safety and Sustainability. The regulatory European landscape

[3] https://echa.europa.eu/regulations/reach/understanding-reach

[4] https://www.ema.europa.eu/en/homepage

[5] https://eur-lex.europa.eu/legal-content/EN/

[6] https://food.ec.europa.eu/food-safety/novel-food_en

[7] https://eur-lex.europa.eu/legal-content/en/

European regulatory frameworks within the biochemical and biotechnological industries play a vital role in guaranteeing the safety, effectiveness, and quality of products introduced to the market. Following these guidelines is more than just a legal requirement—it also strengthens consumer confidence and streamlines entry into the European market.

Abiding by these standards serves not only as a prerequisite for market participation but also as a strategic asset for fostering a credible and sustainable presence in these industries.

Outlined below are the principal regulatory considerations for initiating your innovative biotechnology venture:

- **REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals)[3]:** Regulates the production and use of chemical substances in the EU, ensuring they do not harm human health or the environment.

- **European Medicines Agency (EMA)[4]:** Oversees the scientific evaluation, supervision, and safety monitoring of medicines and medical devices in the EU, ensuring their effectiveness and safety.

- **Cosmetic Regulation (EC) No 1223/2009)[5]:** Provides guidelines for cosmetic products, protecting consumers and ensuring product quality.

- **Novel Food Regulation (EU) 2015/2283)[6]:** Covers innovative foods and ingredients, ensuring their safety before being introduced to the European market.

- **Biotechnology Directive 2009/41/EC[7]:** Regulates the contained use of genetically modified microorganisms, ensuring safe research and production practices.

2.3 Empower Innovation with Strategic Intellectual Property

Protecting intellectual property (IP) is essential for thriving in today's dynamic innovation landscape. A robust IP strategy not only safeguards a company's unique creations but also strengthens its competitive edge and attracts critical investment. Fundamental intellectual property mechanisms include patents, which shield innovative creations, unique formulations, and proprietary methods from unauthorized exploitation. Trademarks serve to preserve brand identity and product recognition, linking them exclusively to their legitimate owners and reinforcing consumer confidence and brand loyalty. Trade secrets, on the other hand, safeguard confidential practices or techniques that grant businesses a competitive edge.

Additionally, licensing agreements offer a strategic pathway for organizations to generate revenue from their intellectual assets while retaining control over how third parties may utilize them.

By prioritizing intellectual property considerations, businesses not only protect their assets but also create a strong foundation for sustainable growth and long-term success in competitive markets.

3 The EXS Solution

EXS solution is transforming the way industries like cosmetics, personal care, and feed address the challenge of reducing polymers. By replacing traditional thickening, emulsifying, and stabilizing agents with eco-friendly alternatives, EXS is paving the way for a greener future. Leveraging cutting-edge biotechnology and advanced software, EXS develops customized enzymes to unlock the potential of xylan—the third most abundant biopolymer on Earth. These modified xylan derivatives are crafted to create sustainable ingredients that seamlessly replace microplastics in consumer product formulations, driving innovation while protecting the planet.

3.1 Why adopt EXS innovations?

Be ready to address industry challenges. The EXS innovations tackle key issues such as resource inefficiency, waste management and environmental impact. Resource inefficiency often results in higher operational costs and unsustainable practices, while poor waste management can lead to environmental and reputational risks.

By adopting these innovations, businesses can streamline their processes, minimise waste and contribute positively to environmental sustainability.

Unlock value through the efficient use of biomass. Every fraction of biomass should be efficiently used and appropriately modified to obtain the desired properties. Companies putting sustainability as a priority often get better customer loyalty and attract environmentally conscious investors.

Stay ahead of the market. EXS innovations respond to evolving regulatory frameworks and consumer demand for sustainable products. Governments worldwide are tightening regulations around environmental impact, pushing industries to adopt greener alternatives. At the same time, consumers are actively seeking products that align with their values, creating a competitive advantage for early adopters.

3.2 EXS Packages, solutions tailored for your business

EXS comprises eight innovations. They work individually or can be packaged to satisfy specific needs.

EXS Industrial Process for Enzymes	EXS Strain	EXS Enzymes
Technology to produce specific enzymes for debranching xylan.	Strain of selected microorganisms targeted to optimized production of xylan debranching enzymes.	Strain of selected microorganisms targeted to optimized production of xylan debranching enzymes.
EXS Cocktail Design Software	EXS Industrial Process for Xylans	EXS Xylans
Software to design enzyme formulation to achieve the desired outcome.	Protocols for industrial production of enzymatically modified xylans.	Xylan derivatives for feed / cosmetics / personal care.
EXS Formula for Food and Feed Products	EXS Ingredient Line for Cosmetics & Personal Care Products	
Different enzyme formulations: Thickening and texture enhancers.	Unique ingredient line based on the EXS xylans.	

Here there are three EXS Packages for three different business cases.

3.2.1 EXS Package for Enzyme Producers

EXS Industrial Process for Enzymes	EXS Strain	EXS Cocktail Design Software
Technology to produce specific enzymes for debranching xylan.	Strain of selected microorganisms targeted to optimized production of xylan debranching enzymes.	Software to design enzyme formulation to achieve the desired outcome.

EXS Package for Enzyme Producers offers a novel sustainable biotechnology process to exploit the value of biomass by developing customized enzymes able to debranch xylan. The solution incorporates a software guidance tool for enzyme cocktail design.

Key benefits:

- Improve enzyme production efficiency.
- Enhance customized enzymes design.
- Reduce waste.
- Create competitive advantages through advanced biotechnological processes.

Implementation needs:

- Process optimization: perform a detailed analysis of current enzyme production workflows to identify inefficiencies and bottlenecks.
- Integration of new predictive software for enzyme cocktail design (e.g EXS Cocktail Design Software) to enhance enzyme formulations and process predictability.
- Equipment upgrades: invest in state-of-the-art bioreactors and monitoring systems to support optimized production conditions.
- Include training programs for technical staff to ensure proficiency in new methodologies and tools.

Revenue opportunities:

- Optimize enzyme production processes to significantly reduce material and energy consumption, resulting in lower operational costs.
- Minimize waste generation, turning by-products into valuable resources that can be reintegrated or sold.
- Enhance production scalability, enabling business to meet increasing market demands at reduced incremental costs.

3.2.2 EXS Package for Xylan Producers

EXS Enzymes	EXS Industrial Process For Xylans	EXS Xylans
Xylan debranching enzymes.	Protocols for industrial production of enzymatically modified xylans.	Xylan derivatives for feed / cosmetics / personal care.

EXS Package for Xylan Producers offers specialised xylan-debranching enzymes and innovative protocols for industrial production of enzymatically modified xylans to fabricate xylans derivatives to integrate them into consumer products particularly for the feed and cosmetic sectors to offer greener and more sustainable end-consumer products.

Key benefits:

- Enhance extraction processes.
- Lower production costs.
- Minimise environmental footprint through enzymatic modification of xylans.

Implementation needs:

- Upgrades to extraction and processing technology to accommodate enzymatic methods and mild chemical processes.
- Standardised clear and replicable methods for enzymatically modified xylan production.
- Partnership with suppliers to build a robust supply chain.

Revenue opportunities:

- Implement enzymatically modified xylans.to lower dependency on costly raw materials.
- Reduce environmental compliance expenses by adhering to sustainable production standards, positioning your business ahead of regulatory changes.
- Establish long-term partnerships with biomass suppliers to secure cost-effective and consistent raw material supplies.

3.2.3 EXS Package for consumer products manufacturers

Exs formula for food and feed products	Exs ingredient line for cosmetics & personal care products
Different enzyme formulations: Thickening and texture enhancers.	Unique ingredient line based on the EXS xylans.

EXS Package for feed sector offers unique enzyme and xylan-based ingredient lines to provide bakery, cereal processing, animal and human nutrition benefits.

EXS Package for feed sector for cosmetics and personal care sector offers xylan-based ingredients for new greener formulations keeping or exceeding the performance of classical emulsifiers for cosmetics and personal care products.

Key benefits:

- Develop biobased products.
- Improve sustainability credentials.
- Meet consumer expectations for greener alternatives.

Implementation needs:

- Redesign product lines to incorporate xylan-based ingredients.
- Collaborate with suppliers for sustainable material sourcing.
- Conduct market trials to refine product positioning and address consumer feedback before market launches.

Revenue opportunities:

- Launch innovative biobased consumer products that cater to the growing demand for green alternatives in cosmetics, food and personal care sectors.
- Build brand loyalty by addressing consumer preferences for ethical and eco-friendly offerings, thereby capturing premium market segments.

3.3 How to implement EXS innovations

Evaluate Current Operations: Assess how things are done now to find inefficiencies, areas of waste, and places where improvements can be made.

Work with your internal teams, and if needed, ask for help from external consultants to map the processes where the EXS solutions could fit.

Select the Right Solution: Choose the option that fits better with the goals of your business. Don't forget to consider customized solutions that might be more adapted to your specific needs.

Plan the Integration: Create a detailed plan to include the solution into your processes. This plan should have clear timelines, an estimated budget, and show who is responsible for each task. Collaborate with technology providers, suppliers, and experts in the industry to make the transition as easy as possible.

Involve Key People: Work closely with the important stakeholders to make sure the implementation goes well. Explain the benefits and value of the changes clearly to get their support and to encourage collaboration across the organization.

Monitor Progress: Measure results and keep improving processes based on what you learn. Adjust the plans as necessary to keep aligned with the changing goals of the business and the market conditions.

4 Next steps and contact information

GETTING STARTED

Contact us to schedule a consultation or pilot program.

Access training materials and technical support.

READY TO INNOVATE?

Reach out to explore how these solutions can transform your business.

CONTACT US

Email: info@enxylascope.eu

Website: https://www.enxylascope.eu/

Partner organisations of the EnXylaScope Project

aitiip centro tecnológico

Celignis Analytical

ifeu INSTITUTE FOR ENERGY AND ENVIRONMENTAL RESEARCH HEIDELBERG

LOBA®

SEPPIC

divis intelligent solutions

RI. SE

LUNDS UNIVERSITET

TU Delft

SINTEF

KERRY

FERMENTATION EXPERTS

METGEN

more information at:
www.enxylascope.eu
info@enxylascope.eu

Follow the EnXylascope Project:

/enxylascope

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000831