



**Microbial ecology as a
pathway to sustainable
industrial practices**



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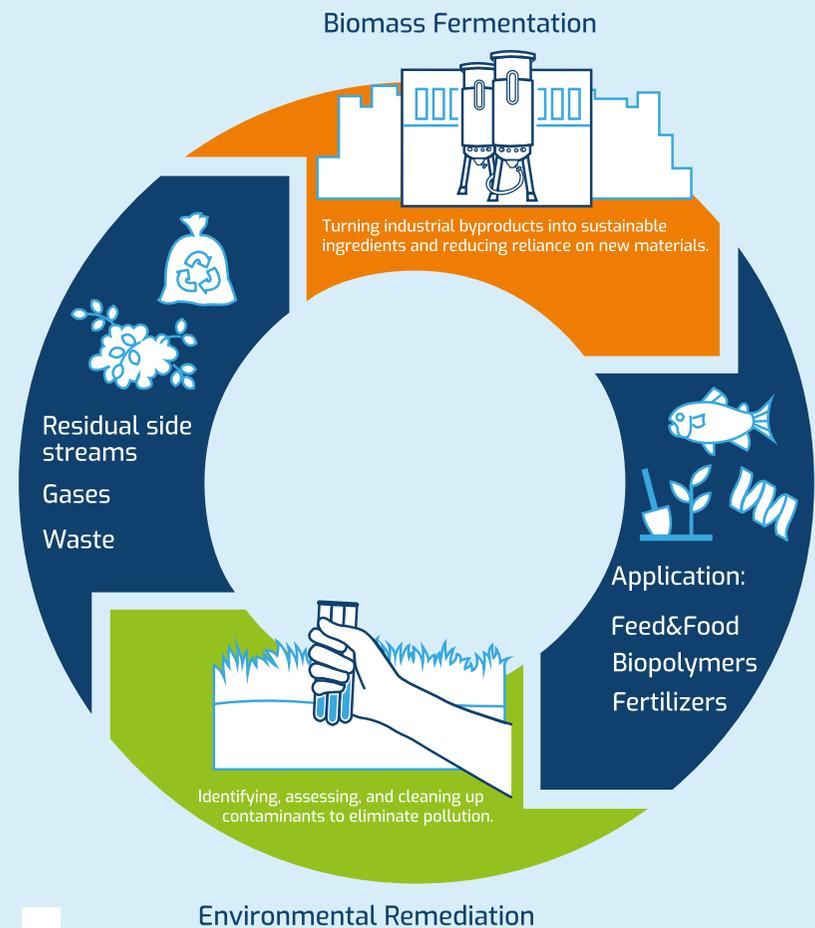
Incorporating circularity with biomass fermentation

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Balancing profit with planet and people

Industrial companies today face a number of challenges. For starters, they need to balance profitability with environmental responsibility and CSRD (Corporate Sustainability Reporting Directive) reporting regulations. At the same time supply demands continue to increase at a staggering pace due to an ever-growing global population. This puts enormous pressure on production systems, that are already having to deal with the consequences of climate change and worldwide political conflicts.

Responsible resource management

Fossil fuel elimination has been high on the agenda for years. Combined with an **increased resource scarcity**, this has created an important shift in resource management. Many organizations have started looking for **alternative solutions** to traditional industrial practices. Virgin material dependence not only poses a risk in terms of unstable supply chains. It is also a financial burden due to volatile prices and costly waste streams.

It is no wonder that interest grew in **safe, cost-effective and environmentally friendly alternatives**. Industrial environmental stewardship spurred the creation of solutions like **biodegradable plastics, organic fertilizers and microbial proteins**. Concerns about the cost tied to waste streams stimulated the establishment of **circular biomass fermentation** projects. And sometimes, taking responsibility over your organization's impact can also mean looking into **environmental remediation** as a means to mitigate any negative consequences such as **pollution**.

Turn a challenge into an opportunity

Implementing a sustainability strategy offers a chance to increase the **profitability** of your operations. By **limiting** your company's **waste output** and **optimizing side-stream valorization**, for instance, you would be **reducing expenses and virgin material dependence** simultaneously.

Struggling to **clean your contaminated soil, water, or air**? Or looking for ways to **create value from your industrial side streams**? Avecom has a range of **eco-friendly** and **cost-effective** alternatives to standard industrial practices.

The impact of Green Deal legislation

The **European Green Deal** is a framework built with the ambition of transforming Europe to a modern, resource efficient and competitive economy. One of its goals is to reduce carbon emissions by 55% by 2030 and achieve **net zero** emissions by 2050. The EU Green Deal encompasses a number of initiatives and **regulations**. Amongst them, the **CSRD** or Corporate Sustainability Reporting Directive, and the **ESRS** or European Sustainability Reporting Standards.

The CSRD sets the legal framework and reporting obligations, while the ESRS provides the roadmap for compliance. Large organizations* need to meet the CSRD as of 2024, but it will also impact their suppliers indirectly. In essence, the CSRD and ESRS will compel companies to embed sustainability at the heart of their supply chain management, driving them to make data-driven decisions to reach their sustainability goals.

- ◆ **ESRS E2:**
When it comes to the environment, the standards aim at transparency about all types of pollution, from air to water and soil.
- ◆ **ESRS E5:**
Resource use and implementation of circular economy principles will need to be disclosed as well, where applicable.

Another interesting source of information for implementing sustainable measures, is the **Science Based Target initiative**, otherwise known as SBTi. This corporate climate action organization offers standards and tools to take concrete and measurable action.

EFRAG's 1,178 ESRS Data Points

Cross-cutting standards	Topical sector-agnostic standards		
ESRS 1 General principles	Environment	Social	Governance
ESRS 2 General, strategy, governance, and materiality assessment disclosure requirements 193 datapoints	ESRS E1 Climate change 220 datapoints	ESRS S1 Own workers 199 datapoints	ESRS G1 Business conduct 51 datapoints
	ESRS E2 Pollution 68 datapoints	ESRS S2 Workers in the value chain 67 datapoints	
	ESRS E3 Water & marine resources 48 datapoints	ESRS S3 Affected communities 65 datapoints	
	ESRS E4 Biodiversity & ecosystem 119 datapoints	ESRS S4 Consumers & end-users 64 datapoints	
	ESRS E5 Resource use & circular economy 84 datapoints		

*Large EU companies (listed or not) and non-European large companies listed on EU regulated markets: with more than 250 employees, with a total balance sheet of more than 20 million euros or with a turnover of more than 40 million euros (2 criteria out of three)

Tackling pollution with environmental remediation

Industrial companies need to mitigate any negative impact their activities might have on the environment. Both industry and agriculture have a high environmental footprint. As a responsible organization, it's important to minimize your impact, but it can be challenging to do so alone.

What is environmental remediation?

A negative side-effect of industrialization is the increased pollution caused by the release of toxic chemicals into the environment. To counteract this, remediation solutions are necessary. Environmental remediation encompasses efforts to address and mitigate the adverse effects of pollution and contamination on natural ecosystems and human health. Contaminants in various forms, such as pollutants in wastewater, air and soil, pose significant threats to environmental integrity and can result in regulatory fines due to non-compliance.

By implementing remediation strategies, your company aims to not only mitigate immediate environmental risks but also restore ecosystems to a healthier state. Overall, environmental remediation efforts are essential for safeguarding ecosystems, protecting human health, and ensuring regulatory compliance. By addressing contamination and restoring environmental quality, companies contribute to sustainable development and demonstrate responsible stewardship of natural resources.

Why choose bioremediation over other methods?

Remediation methods such as physical or chemical remediation have been used for years to deal with pollution. However, both have disadvantages. Not only are they expensive, but they produce a lot of waste and are in and of themselves a source of environmental pollution.

Depending on the situation, bioremediation involving microbes can be more efficient, eco-friendly and cost-effective. Microbes are very versatile which means this method is flexible in its application and can be tailored to the exact needs of the situation at hand, targeting very specific pollutants in a direct and precise manner.

Our approach is always tailored to your needs and the final action plan is made in co-creation.

How can Avecom assist with bioremediation?

We provide a range of microbial solutions to help you manage and solve these problems, keeping in mind that each situation is unique:



- ◆ Feasibility tests for wastewater treatment, digestion processes, and soil and groundwater remediation



- ◆ Biodegradation tests in soil and water (OECD 301 F + ASTM D5988-18)



- ◆ Molecular monitoring
- ◆ Support in solving microbial corrosion problems



- ◆ Bacterial cultures for soil and groundwater remediation



- ◆ Specialized nutrient blends
- ◆ Resource recovery
- ◆ Process optimization at lab and pilot scale

Our goal is to determine the most effective solution tailored to your specific situation, ensuring the best possible outcome. We partner with industrial companies and academic institutes to co-develop new and innovative microbial products and processes. Our commitment to working closely with our partners ensures that we achieve our desired goals together.





Multidechlorobac

Chlorinated volatile organic compounds (Cl-VOCs) contaminating your soil and groundwater can pose quite a challenge. Multidechlorobac offers an **effective, cost-efficient**, and **eco-friendly** solution to hazardous pollutants like chlorinated VOCs. It is a bioaugmentation application, meaning that it enhances natural degradation processes, giving them the boost they need to successfully **degrade Cl-VOCs**.

- ◆ **Composition:** microbiome of reductively dechlorinating cells, including:
 - ◇ *Dehalococcoides* ◇ *Desulfitobacterium*
 - ◇ *Dehalobacter* ◇ *Dehalobium chlorocoercia*
- ◆ **Activity:** 500 µg TCE per liter per day.

[Read more](#)

Case study

Project: LVM Biocells

Production of monovinyl chloride, as raw material to produce polyvinyl chloride (PVC)

- ◆ **Problem:**
 - ◇ Soil and groundwater contaminated with chlorinated aliphatic hydrocarbons.
 - ◇ Main contaminant: 1,2-dichloroethane (1,2-DCA).
 - ◇ Groundwater contamination has spread to a depth of 80 m below ground level.
 - ◇ Project area with very low groundwater velocities.
 - ◇ The contamination is limited to the company site.
 - ◇ Remediation with traditional techniques technically difficult and not cost-efficient.
- ◆ **Solution: Double technological innovation**
 - ◇ Bioremediation at full scale using Avecom's Multidechlorobac
 - ◇ Application of hydrogeobiocells to improve the groundwater velocity. This technique employs a pump and injection regime, which eliminates the need to remediate contamination above ground.
- ◆ **Result:**
 - ◇ In 54 days, the 1,2-DCA was reduced until underneath detection limits.
 - ◇ We were able to detect the (harmless) end product ethylene.





ABIL

Ponds, aquaria and aquaculture systems are complex and delicate ecosystems that require careful management to maintain healthy conditions for aquatic organisms. One crucial aspect of managing these systems is ensuring that the nitrification process in the biofilters function properly. Without effective biofilters, the water quality can quickly deteriorate, leading to stress, disease, and mortality of aquatic organisms.

ABIL is a carefully developed **nitrifying culture** designed to significantly **enhance the nitrification process in your biofilters and shorten their start-up period**. Our culture consists of concentrated and viable bacteria, including ammonia and nitrite-oxidizing bacteria, ready to **efficiently operate in diverse practical conditions**.

[Read more](#)



"At Inagro vzw's Aquaculture Practice Centre, we use ABIL to quickly activate our filter's biological processes in recirculation systems with many fish and insufficient bacteria. This ensures efficient conversion of fish-produced ammonium into nitrate."

– Stefan Teerlinck, Inagro vzw

Learn more

[Find out more about our solutions in environmental remediation.](#)



Incorporating circularity with biomass fermentation

The agri-food sector and the industry at large generate significant amounts of co-products and residual side streams are often wasted. The burden of dealing with waste disposal, combined with the increased awareness of natural resource scarcity, have spurred the creation of circular solutions.

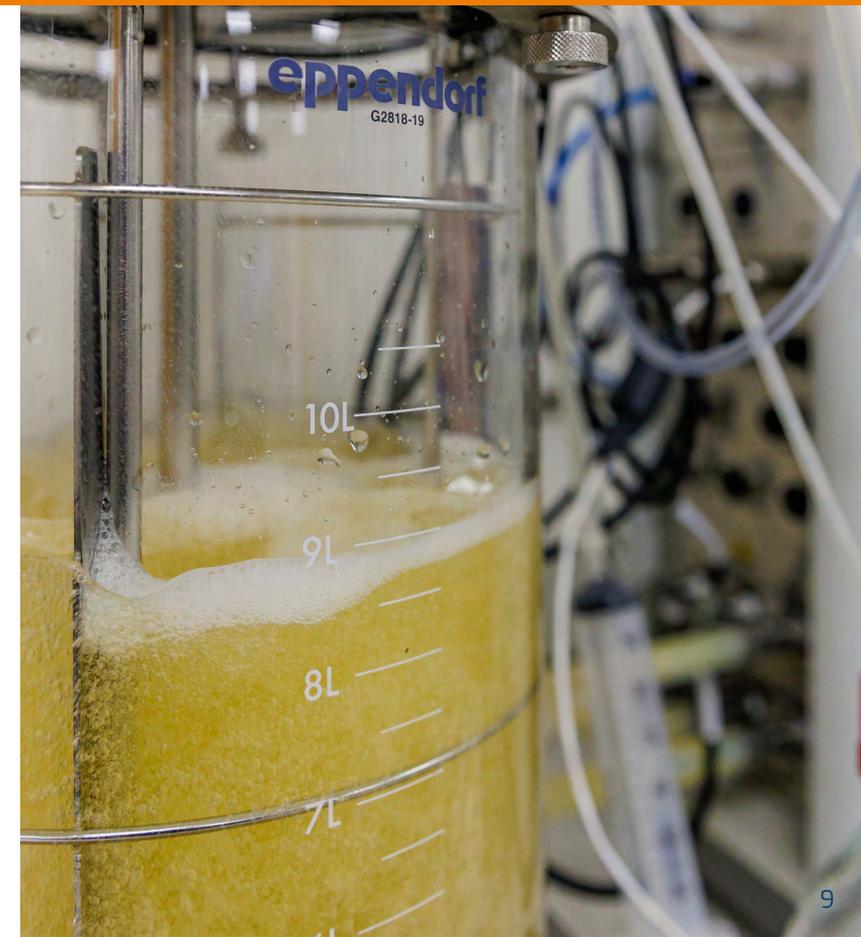
What is biomass fermentation?

Biomass fermentation is a process that involves the **conversion of organic materials**, such as agricultural or industrial side streams, by micro-organisms. This process results in **the production of valuable products such as proteins, biopolymers, and organic fertilizers**.

It is a **sustainable** and **environmentally friendly** process that harnesses the natural power of micro-organisms to upcycle organic materials into valuable products, contributing to the transition towards a more renewable and sustainable bio-based economy.

Why biomass fermentation?

When it comes to **waste management**, organizations are familiar with scenarios involving landfills or burning waste. In some cases, the waste can be converted to biogas to generate heat and electricity. However, when looking at a **product's life cycle** from a **circular** perspective, there's another dimension: **revalorizing** a product before it reaches its final stage. Biomass fermentation is a promising way of doing that. It can be implemented as a tool to convert an otherwise lost flow into a new product.



How can Avecom help you with resource optimization and circularity?

Our patented biomass fermentation platforms use 100% natural micro-organisms to:

- ◆ **Valorize industrial side streams**
- ◆ **Limit virgin material dependence**
- ◆ **Reduce water use and land exploitation**

In other words: biomass fermentation is an incredibly powerful tool to wield not only for its **sustainable potential**, but also for its **cost-effectiveness**.

We have developed several biobased processes, using our proprietary fermentation platforms to turn otherwise lost flows into high-value ingredients, such as:

- ◆ **Single-cell proteins for feed and food applications**
- ◆ **Biobased and biodegradable polymers**
- ◆ **Organic fertilizers**



We have the **facilities** and **expertise** to help you develop **new, tailor-made biobased ingredients** and **explore opportunities to scale up** innovative production processes.

- ◆ We design and optimize microbial protein fermentation processes for applications in food, feed and pet food
- ◆ We co-develop biobased and biodegradable alternatives for polymers for the bioplastics industry. Our production facilities are Feed Chain Alliance certified.
- ◆ We support sustainable agriculture with a range of unique slow-release organic fertilizers
- ◆ We collaborate with industrial companies and universities to develop and test innovative products and processes, providing laboratory testing and support for scaling up.



Power To Protein

Food - human consumption

Protein is an essential part of any diet. Different sources of protein vary in their ability to provide us with the essential amino acids we need. Animal sources provide the full range of essential amino acids, but livestock production is not always environmentally, economically or ethically sustainable.

Power To Protein is a revolutionary **gas fermentation platform**, revolutionizing the future of food production. It uses **clean water, green energy** and **consumes CO₂** to provide a **protein-rich microbial food ingredient** that contains **all the essential amino acids** and even **vitamin B12**.

Compared to traditional animal and plant proteins, our product offers:

- ◆ Very high protein content (> 70%)
- ◆ Drastically reduced environmental footprint
- ◆ Considerably lower land use
- ◆ Significant decrease in fresh water consumption
- ◆ Avoids the usage of pesticides
- ◆ Very high nutrient efficiency
- ◆ An animal-friendly production system, decoupled from the impacts of climate change such as extreme weather and droughts
- ◆ The gas fermentation process consumes CO₂ rather than emitting the greenhouse gas to the environment



[Read more](#)



- ◆ No GMO's
- ◆ Sustainable
- ◆ No animal interference
- ◆ Highly digestible
- ◆ No waste products
- ◆ Contains vitamin B12



ProMic

Animal feed - livestock

Microbes are powerful upgraders, and a perfect match to create sustainable and innovative feed solutions. Our **patented** processes are designed to **upcycle low-value side streams** from the agro-food industry into high-value **protein-rich feed ingredients**, making use of **circular** economy principles.

Our ProMic **fermentation platform** technology meets all regulatory requirements, ensuring that our products are of the highest **quality** and **safety**. When it comes to **sustainable** and high-quality biomass fermentation process design, choose Avecom.

The end product is a high-quality source of proteins that goes above and beyond by offering additional benefits:

- ◆ **Highly digestible**
- ◆ **Low in anti-nutritional factors**
- ◆ **70% protein content**
- ◆ **Rich in essential amino acids**
- ◆ **Natural immune responsive function**
- ◆ **High nutrient efficiency**

The **scalable** fermentation platform produces proteins faster, with **less water use, lower land area requirements** and **avoids eutrophication**. In addition, production is **climate independent** and can be done **locally**, without depending on imported proteins.

With ProMic, you're choosing a product that's not just nutritionally superior, but also environmentally responsible. ProMic is revolutionizing the way we look at protein production, leading the way toward a more circular and efficient future.

[Read more](#)





Biopolymers

Bioplastics industry

Plastic pollution plagues our planet, but a fascinating solution might lie within the realm of microscopic life: **microbes**. These tiny organisms, like bacteria, offer a two-pronged attack on plastic pollution – **breakdown** and **bio-based plastic production**.

1. Degrading Plastic: Carefully selected microbes possess enzymes that can biodegrade specific types of pretreated plastic. This natural process breaks down the plastic, offering a sustainable alternative to traditional methods like landfills and incineration. In collaboration with our partners for the pretreatment and downstream processing phases, Avecom takes care of the entire process, offering you peace of mind and the liberty to focus on your core activities.

2. PHBV Production: Beyond degradation, some microbes can be harnessed to produce polyhydroxyalkanoates (PHAs), particularly Poly(3-hydroxybutyrate-co-3-hydroxyvalerate)(PHBV). PHBV is a microbial biopolymer with excellent biocompatible and biodegradable properties that make it a potential candidate for substituting petroleum-derived polymers. Avecom has gained expertise in converting both food waste and plastic waste streams into sustainable biopolymers. This process involves cultivating these microbes under controlled conditions. The microbes then naturally accumulate PHB as an energy reserve within their cells.

3. Biodegradability tests: Our lab is equipped to carry out biodegradability testing in soil and water:

- ◆ OECD 301 F, for the screening of chemicals for ready biodegradability in water
- ◆ ASTM D5988-18, determining aerobic biodegradation of plastic materials in soil

Within our ongoing research projects, we have proven that innovative microbial biomass-based bioplastics can be considered a promising alternative to certain synthetic polymers.

[Read more](#)



"B4Plastics cooperates with Avecom since several years to validate its novel backbones in an early phase of the development. This 3rd party validation by Avecom especially supports the growing B4Plastics business in those biomaterials innovations where biodegradability has an important added value."

- Stefaan De Wildeman, B4Plastics



Key R&D projects:



 [Read more](#)

There is an increasing awareness of the need to develop innovative packaging materials that maintain or extend the shelf life of foodstuffs to reduce food waste and minimize the environmental footprint of packaging materials.

The ideal packaging involves lower carbon and water footprints, is biodegradable and/or compostable, makes use of wastes or by-products, is properly eco-designed, safe and has the right preservation properties to minimize food waste.



 [Read more](#)

Waste plastic biotransformation into high market demand bioproducts and bioplastics.



 [Read more](#)

EcoPlastiC develops novel technologies that convert **mixed plastic waste** into **high-performance biopolymers** that can be **perpetually recycled**.





Fertilizers

Many of today's soil and crop management systems are unsustainable, due to the overconsumption of mineral fertilizers. Fertilization by industrial N-fertilizer suffers from substantial inefficiencies, leading to losses through runoff, leaching, ammonia volatilization and denitrification. The nitrogen use efficiency in Europe is estimated to be lower than 20%, and for livestock intensive regions such as Flanders, even as low as 11%.

Avecom aims to close the loop and to tackle the underexploited potential of **nutrient recycling**.

Results:

- ◆ Lower the environmental impacts of agriculture
- ◆ Improve biodiversity
- ◆ Positively impact human health
- ◆ Cost efficiency
- ◆ Minimum input of fresh water, fossil-based energy and non-recovered materials.

We want to overcome key technological and non-technological barriers to establish an **innovative sustainable value chain** that **upgrades inorganic nutrients** from safe **industrial side streams** to a **high-quality organic fertilizer** for professional growers as well as for the retail sector.

Nutrients are immobilized microbially through aerobic mechanisms. The processing of the microbiota to organic fertilizer in low impact crop growing media is directed to maximally align the nutrient release from the fertilizers with the plants' needs.



Key R&D projects:



 [Read more](#)

This project aims to eliminate technological and non-technological issues to establish an innovative sustainable value chain that upgrades inorganic nutrients from safe industrial side streams to a high-quality organic fertilizer.



 [Read more](#)

Combining carboxylic acid production and fibre recovery as an innovative, cost effective and sustainable pre-treatment process for heterogeneous bio-waste



 [Read more](#)

The RUSTICA projects provides a technical solution to convert organic residues from the fruit and vegetable sector into novel bio-based fertiliser products of high quality that address the needs of modern (organic) agriculture.

The project's ambition goes beyond the simple recovery of nutrients, and also includes the developments of economically viable and environmentally sustainable alternatives to mineral fertilisers with the same or improved agronomic value.



About us

Avecom has the scientific knowledge and experience plus the resources to be a well-rounded partner to outsource to in all confidence and ease. Our versatility and capability to provide solutions in all stages of an industrial production process, combined with our expertise in environmental remediation as well as biomass fermentation, truly sets us apart.

Our mission

Avecom's mission is to make the world a better and healthier place by developing innovative and sustainable solutions for environmental and industrial problems.

With our **strong scientific background and decades of experience**, we have developed into a leader in our field.

Our **highly qualified team** of engineers and lab technicians specializes in **biodegradation, biosynthesis** and **engineering microbial consortia for sustainable and cost-efficient solutions**.

Our **biobased products and applications** have been proven successful time and time again, thanks to our **collaborations with industrial partners** for **research and development** as well as the **scaling** of innovative microbial processes.

From wastewater treatment to digestion processes, soil remediation and microbial fermentation: Avecom excels at **environmentally friendly microbial resource management**.

Avecom's history

Avecom was founded in 1995 as a spin-off from the Faculty of Bioscience Engineering (Ghent University, Belgium) by em. prof. dr. Willy Verstraete.

His influence can still be seen in Avecom's innovative and effective solutions in applied microbial ecology.

His legacy is continued by Kim Windey and Stijn Boeren, Avecom's executive team.

What makes us stand out?

- ◆ We operate autonomously. Tests can be done in-house and therefore independently from external organizations, gaining in speed and efficiency
- ◆ Our tailor-made tests go beyond standard tests and take into consideration the specific parameters and characteristics of your project
- ◆ We don't just execute tests, we always support you with advice and have all the knowledge in-house to help you map out an action plan
- ◆ We provide the research, development and scaling up in our facilities to assist you with product development
- ◆ Next to our services, we provide the necessary microbial blends and nutrients.

Flexibility at industrial scale

Our **expertise** and **facilities** allow us to **collaborate** and **co-develop** with our industrial partners. Our state-of-the-art laboratories and multiple production facilities allow us to offer a range of services:

- ◆ Lab- and pilot scale feasibility tests
- ◆ R&D, from preliminary lab testing to proven pilot-scale applicability
- ◆ Small-scale contract manufacturing.

Get in touch

Incorporating sustainable practices into your industrial production process, while taking into account reporting standards as well as profitability, might seem daunting at first. But what we hope to have shown is that there are already a lot of solutions out there. Optimizing microbial processes specifically is a versatile tool that can help you implement sustainability and circularity across the board. From sustainable product development to responsible waste management: it is possible to make sustainable choices during every step of your production process. From start to finish and beyond.

Do you have any questions about our products or services?
Would you like to receive more information regarding a specific topic?

Reach out

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We look forward to exploring future collaboration possibilities together!



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