

Policy Brief

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Strengthening the 2018 EU Bioeconomy Strategy through Microbiome Analysis and Synthetic Microbial Consortia Technologies

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PROMICON

Harnessing the power of nature through productive microbial consortia in biotechnology –
Measure, model, master

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INTRODUCTION

The 2018 EU Bioeconomy Strategy aims to create a sustainable, circular, and low-emissions economy, based on the use of renewable biological resources. The strategy focuses on the development of new bio-based products and markets, the promotion of sustainable and efficient use of resources, and the support of research, innovation, and skills development in the bioeconomy sector. The main objectives of the strategy are to:

- Accelerate the deployment of bio-based products and services to reduce Europe's dependence on fossil fuels and promote the transition to a circular economy;
- Optimise the use of renewable biological resources to ensure food security, while also protecting the environment and biodiversity;
- Promote sustainable and efficient use of natural resources, reduce waste, and minimize greenhouse gas emissions;

- Develop innovative, sustainable, and competitive bio-based industries and value chains that create jobs and support economic growth, particularly in rural areas;
- Support research, innovation, and skills development in the bioeconomy sector to drive technological advancements, enhance the competitiveness of the EU's bio-based industries, and address societal challenges such as climate change, food security, and public health.

The EU Horizon 2020 PROMICON project is a pioneering initiative that directly addresses the objectives of the 2018 EU Bioeconomy Strategy. By focusing on the production of biopolymers, energy carriers, feedstocks, and antimicrobial molecules from natural microbiomes, the project is promoting the sustainable production and use of renewable biological resources while also supporting research and innovation in the bioeconomy sector.

EVIDENCE AND ANALYSIS

The PROMICON project aims to develop technologies for the study and understanding of microbial consortia, with a focus on biotechnology applications. The project is developing methods for the assembly of minimal functional consortia for production, while still maintaining the self-stabilising characteristics of natural microbiomes. These synthetic microbial consortia will consist of bacterial farmers, producers, and stabilisers, and will be optimised through systems metabolic engineering and synthetic biology to provide optimal production of target metabolites.

The PROMICON project, through two of its work packages, will generate policy-relevant findings that are important for the EU's 2018 bioeconomy strategy. Work package 1 is focused on developing analysis and modelling approaches for microbiomes, including a standardised platform for obtaining data sets, which will enable the optimisation of microbiomes for industrial applications. The development of these approaches will facilitate the identification of key species and processes that can be leveraged for the production of biopolymers, energy carriers, drop-in feedstocks, and antimicrobial molecules.

Work package 3, on the other hand, aims to optimise the minimal functional metabolic modules in a target bioprocess and reassemble them in the context of a synthetic microbial consortium for optimal production of target metabolites. This approach will allow for the selection or optimisation of bacterial farmers, producers, and stabilisers through systems metabolic engineering and synthetic biology. The findings of these two work packages are highly relevant to the EU's Bioeconomy Strategy, which seeks to transition to a sustainable, circular, and low-carbon economy. By harnessing the potential of microbiomes for the production of valuable products, the PROMICON project can contribute to the EU's goal of reducing its dependence on fossil fuels and promoting the efficient use of resources. Furthermore, the project's focus on synthetic biology and systems metabolic engineering aligns with the EU's objective of fostering innovation and developing new technologies for sustainable production. Overall, the PROMICON project's work packages 1 and 3 provide important insights into how microbiomes can be optimised for industrial applications, which can contribute to the achievement of the EU's bioeconomy strategy goals.

POLICY IMPLICATIONS AND RECOMMENDATIONS

In an effort to strengthen and update the 2018 EU Bioeconomy Strategy, PROMICON proposes the following policy recommendations:

- Supporting research and development efforts focused on learning from nature and developing enabling technologies for microbiome analysis and modeling, particularly targeting academic institutions, research organisations, and scientific communities involved in microbiome research.
- Encouraging companies from the agriculture, biotechnology, or pharmaceuticals sector to invest in the development of synthetic microbial consortia for the production of target metabolites, as outlined in Work Package 3 of the EU Bioeconomy Strategy.
- Ministries, policymakers, and regulatory bodies should promote regulatory frameworks that support the use of synthetic biology in industrial applications, fostering interdisciplinary collaboration and knowledge-sharing among researchers, policymakers, and industry stakeholders. The target groups include government bodies responsible for bioeconomy policies, regulatory agencies, research institutions, and industry associations.
- Encouraging the adoption of circular economy principles in the bioeconomy, with a focus on reducing waste and promoting resource efficiency. This recommendation specifically targets industries and businesses operating in the bioeconomy sector, waste management organisations, and relevant government bodies responsible for promoting circular economy initiatives.

SUSTAINABILITY AND LEGACY

Deliverable D1.9, explores the natural microbial community and highlights the value of learning from nature. On the other hand, D3.3 and D3.6, focuses on creating a suitable *Pseudomonas* strain for labor purposes, specifically by modifying its sucrose metabolism and eliminating negative traits. D3.6 involves developing an optimised set of *P. taiwanensis* VLB 120 balancer strains with increased c-di-GMP levels. These two deliverables complement D1.9 by providing comprehensive information on genetically modified strains that can produce sucrose, PHA, and acetate. There is a strong relationship between these latter two deliverables and D1.1, D1.4, and D1.8 because the results in each report are interconnected. This connection allows PROMICON experts to conduct a coherent assessment of performance and characterise potential effects or changes in the production processes based on the information presented in D3.3 and D3.6.

PROJECT OBJECTIVES AND METHODOLOGY

The overall objective of the PROMICON project is to learn from nature how microbiomes function in order to steer their phenotypes towards the production of biopolymers, energy carriers, drop-in feedstocks, and antimicrobial molecules. The project will achieve this by developing novel analysis and modeling approaches targeting essential key species in productive microbiomes, as well as whole microbiomes. PROMICON also aims to establish a standardised platform for obtaining quantitative single-cell data and connected coherent OMICS and Meta-OMICS data sets for complex microbiomes.

The methodology involves the analysis and modeling of both essential key species in productive microbiomes and whole microbiomes using a combination of data mining tools, mechanistic process models, and machine learning and deep learning approaches. The project also employs synthetic biology and systems metabolic engineering to optimise and assemble bacterial farmers, producers, and stabilisers, providing optimal production of target metabolites. The project focuses on developing sustainable bioproducts that can contribute to the circular economy, thus aligning with the objectives of the EU 2018 bioeconomy strategy.

PROJECT IDENTITY

PROMICON

Project name

Harnessing the power of nature through
PROductive **MI**crobial **CON**sortia in biotechnology –
measure, model, master

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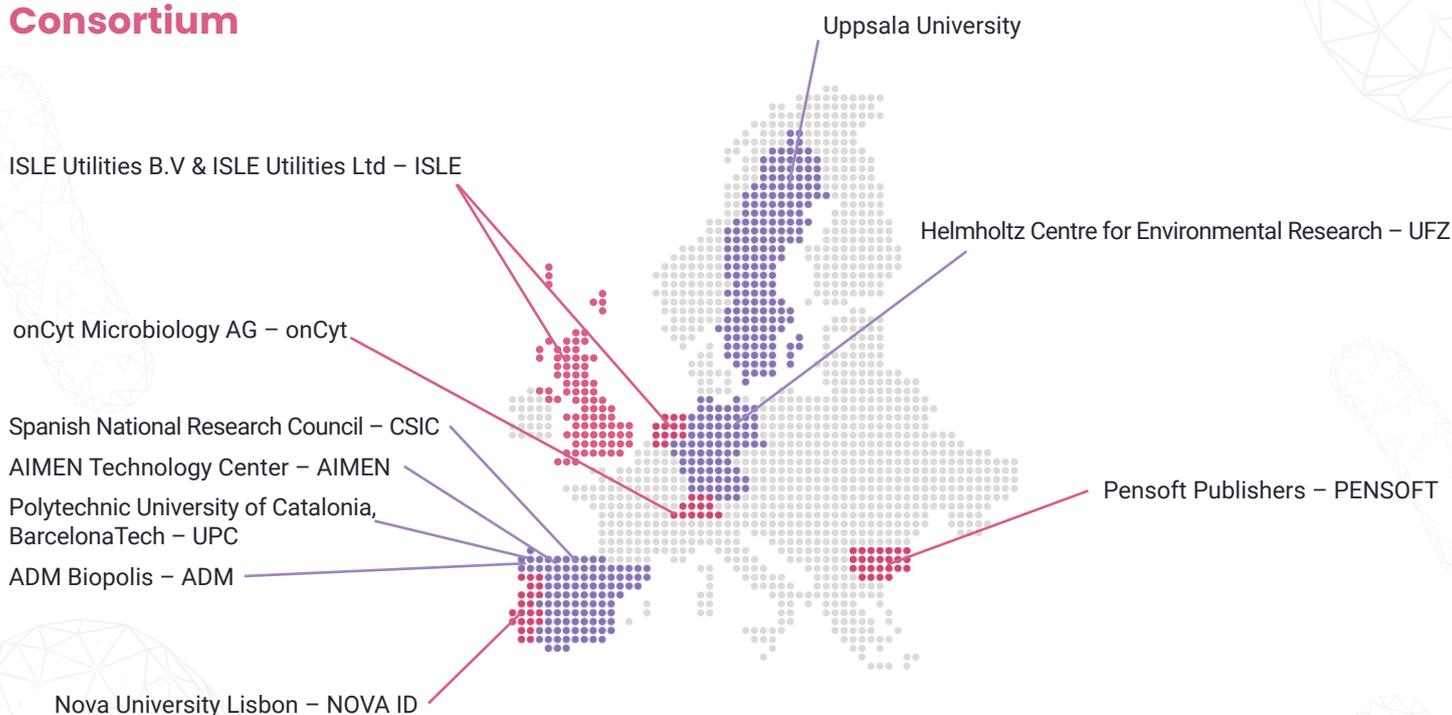
Duration

 1 June 2021 – 31 May 2025 (48 months).

For more information

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Consortium



Budget

EU contribution: 5 999 712,50 €

Further reading

- D1.4:** Running on-line single cell analysis platform
- D1.5:** Connecting on-line single cell data with automatic evaluation pipelines
- D1.8:** Quantitative MS-based metabolomics dataset

Funding scheme

Call: Food and Natural Resources (H2020-FNR-2020)
Topic title and ID: FNR-12-2020 - Industrial microbiomes – learning from nature

- D1.9:** NMR-environomics dataset
- D3.3:** A *P. putida* strain suitable as labor module including sucrose metabolism and lacking negative traits
- D3.6:** A set of optimized *P. taiwanensis* VLB 120 balancer strains with enhanced c-di-GMP levels

