

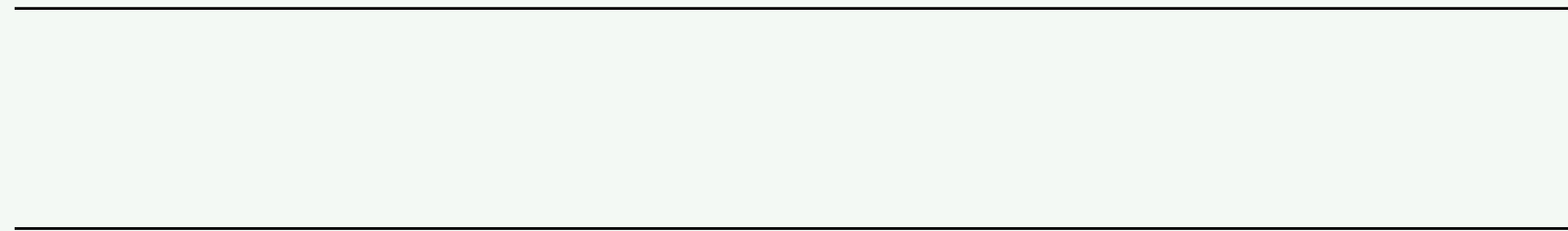


# Contents

3 ●

4 ●

5 ● **Case Studies**



8 ● **Interview**

9 ● **Interview**

10 ● **Boosting Europe's future: the case for more biomanufacturing**



## ● Message from the BIC Executive Director / Dirk Carrez



The EU's leadership in technology and biomanufacturing innovation is transformative and enables Europe's long-term competitiveness and strategic autonomy. The bio-based industries sector can create new industrial ecosystems and cross-sectorial collaboration. This is underlined by existing impact and investments of the bio-based industry across Europe's regions and Member States.

To position the EU as a global leader for economic growth and prosperity, it is essential to drive innovation and sustainability across key sectors and industrial processes.

There is no lack of good and cutting-edge business cases to be scaled-up in the EU. However, the impact of (R&I) projects is limited if their results don't reach market level. Our sector offers a broad range of bio-based solutions, including in food and feed, chemicals, materials and consumer sectors. Europe needs to better capitalise on existing and future investments and ensure that innovative projects make it to market and grow.

Key to this success is continuing to accelerate the pathway to technology, including biotechnology, and biomanufacturing at scale.

In March 2024, the European Commission sent a strong signal to the bio-based industries with the publication of the Communication on *Boosting Biotechnology and Biomanufacturing in the EU*.

In the next five years, we have to build on this vision, and revive its breadth and ambition, and to meet the calls for action in recent EU high-level reports such as the Draghi or the Letta Report.

'Biomanufacturing' should be embraced not only in the EU Biotech Act, but also in other EU initiatives such as the Clean Industrial Deal, the Circular Economy Act, the Vision for Agriculture and the EU Bioeconomy Strategy.

In the BIC Trend Report 2025, we:

- look at the current situation and possible future of biomanufacturing regulations in Europe,
- provide case studies from companies effectively using biomanufacturing,
- see what results can be achieved by better combining biomanufacturing with artificial intelligence and also with the textile industry,
- compare how biomanufacturing is treated other parts of the world, and
- make policy recommendations for improving and increasing biomanufacturing based on best practices and commercial needs.

Our aim is to show concrete suggestions and examples of what can be done and how.

# ● Biomanufacturing in Europe: what regulation will it take?

## Insights from BIC workshops series

The Bio-based Industries Consortium (BIC) hosted in October 2024 a workshop to explore how to turn political commitments on biomanufacturing into better regulation that enhances competitiveness, supports the green transition and promotes strategic autonomy in Europe.

This section of the Trend Report details the outcome of this workshop in the form of key take-aways and policy recommendations.

This document is a result of the discussions we had with workshop participants, including industry stakeholders, policymakers and civil society representatives.

## Take aways

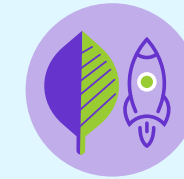
The workshop highlighted the innovative power in biomanufacturing across industrial sectors to help the planet move away from fossil resources for the benefit of greater sustainability.

Yet, participants recognised that the current EU's regulatory framework is still tilted towards fossil incumbents and requires urgent and thorough rectification, also in light of the global competition in the technology and manufacturing sectors.

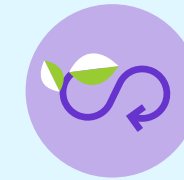
The European Commission sent a strong signal with the Communication on *Building the future with nature*. The time has come to include biomanufacturing in the EU priorities and relative legislative actions.

A strong political mandate to accelerate the path from lab to factory by empowering biomanufacturing would be welcomed, including broader range of bio-based solutions, such as food and feed production technologies, chemicals, materials and consumer products.

## Policy Recommendations



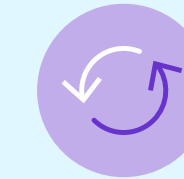
**Propose a “EU defossilisation accelerator”** e.g. support lead markets for biomanufacturing sectors helping making Europe independent of fossil raw materials. The accelerator should include a package of measures.



**Ensure a reliable and affordable supply of sustainably sourced biomass**, respecting the cascading and food first principle.



**Create and expand market opportunities** for bio-based products.



**Establish harmonised rules across Member States on key issues of circularity**, such as end-of-waste criteria and recycling.



**Leverage the potential of the Capitals Market Union for more investments** towards bio-based industries.



**Further develop instruments and metrics** to measure the contribution of the bioeconomy and biomanufacturing to the EU industry.

For the EU to become a hub for bioeconomy innovation, it is essential to create a preferred playing field for these bio-based alternatives.

The next years will thus be crucial for the EU to set in place the right framework with a coherent set of regulations and funding to enable the bioeconomy to meet its full potential.

Such actions are essential for the EU to remain competitive and prosperous, and also contribute to solutions that curb global emissions and reduce environmental pollution.

## ● Case studies

### L'Oréal for the Future

## Accelerating Scope 3 Transformation through R&I: enabling sustainable value chains

L'Oréal is transforming its business activities with a deep understanding of planetary boundaries. This translates into a holistic approach to sustainability, considering climate change, biodiversity loss, resource depletion, and water scarcity across its entire value chain.

While the company has been actively reducing its direct environmental impact (Scope 1 and 2) since the early 2000s, L'Oréal is now accelerating its efforts with a renewed ambition, particularly focusing on Scope 3. This involves a rigorous, science-based methodology grounded in comprehensive product lifecycle analysis, placing eco-design at the very heart of product development.

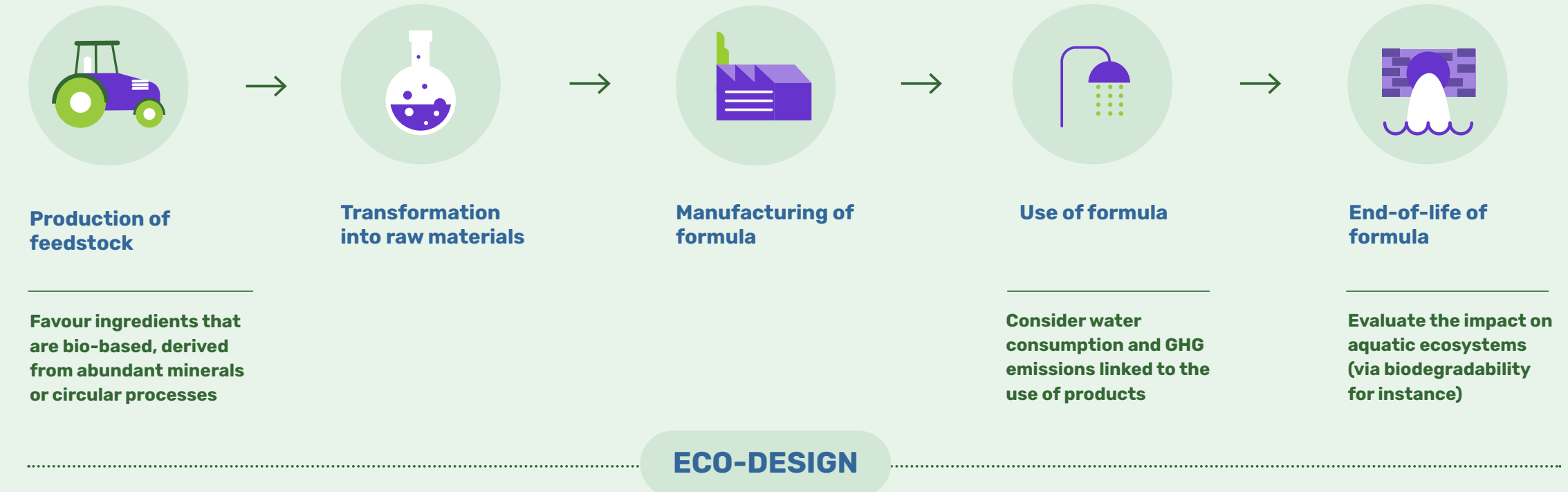


### Measure and assess impact: the Sustainable Product Optimization Tool (SPOT)

L'Oréal carries out Life Cycle Analysis on its products to identify, evaluate and improve their environmental impact, including the carbon footprint. Since 2017, a dedicated tool, SPOT, based on a rigorous scientific methodology for assessing environmental impacts, has been rolled out to all Group brands (except recent acquisitions).

This tool calculates the environmental footprint of a product in accordance with the European Commission recommendation. SPOT is an important part of L'Oréal's product launch processes, putting sustainable innovation at the very heart of product development.

### Scope 3: levers of actions - a focus on ingredients



### Internal "Green Sciences" program: a multidisciplinary approach to sourcing and transforming raw materials sustainably

Four key pillars drive this approach:

1. **Sustainable cultivation practices** that aim to minimise environmental impact while respecting local ecosystems,
2. **Eco-extraction methods** that obtain ingredients from natural sources without chemical alteration\*,
3. **Green chemistry** according to the 12 principles published by Anastas and Warner in 1998, and

4. **Biotechnology**, which utilises microorganisms and plant cell cultures to create ingredients.

With Green Sciences solutions, deployed with its partners, L'Oréal aims to offer consumers more sustainable, high performing, safe products.

\* with the exception of enzymatic action on sugars and proteins.

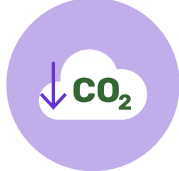


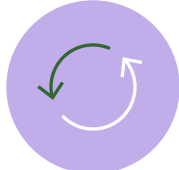
# ● Case studies

## I'm green™ by Braskem From sugarcane plantation to bio-based products

Braskem is the largest producer of thermoplastic resins in the Americas and a global leader in the production of biopolymers on an industrial scale.

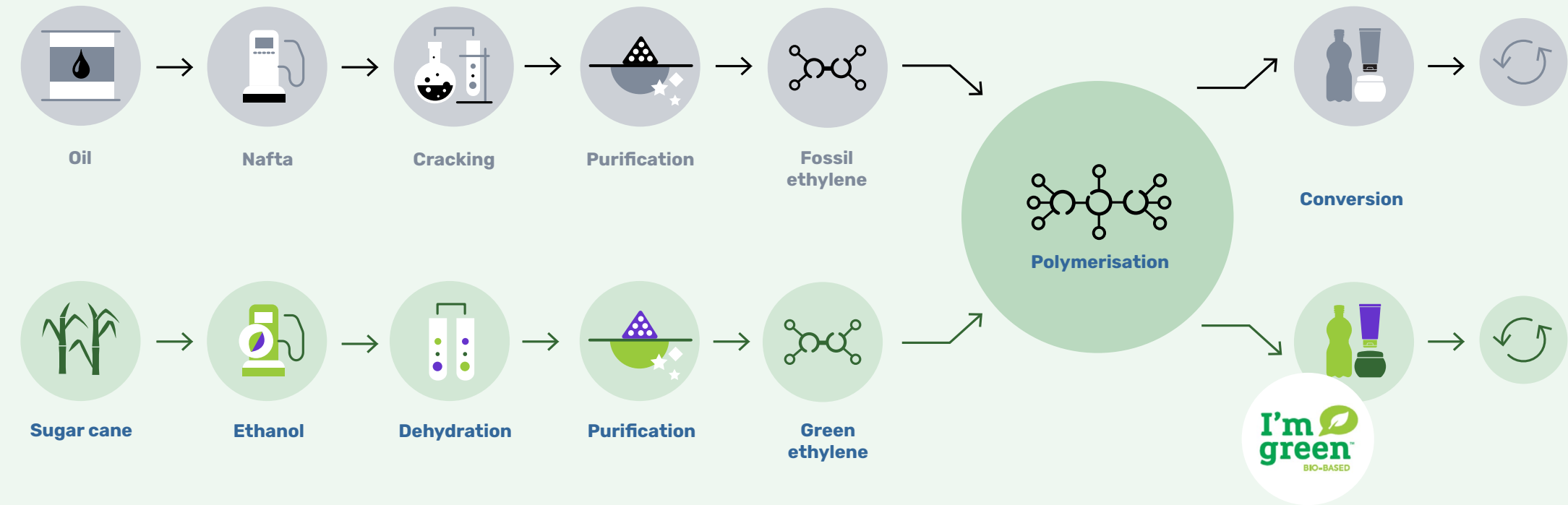
**Braskem's I'm green™ bio-based is a line of bioplastics produced from renewable resources, primarily sugarcane ethanol.** This innovative approach offers a sustainable alternative to traditional fossil-based plastics, contributing to the reduction of greenhouse gas emissions.

### The bio-based drop-in solution

- 
**Contributes to carbon reduction**  
 Sugarcane removes CO<sub>2</sub> from the atmosphere, helping to slow down climate change.
- 
**No compromise in functionality**  
 Replaces conventional resin with no investment in new plastic conversion machinery.
- 
**Measurable and traceable bio-based content**  
 Verifiable via ASTM D6866 analysis and following a responsible ethanol sourcing programme, ensures globally recognised sustainability criteria are followed.
- 
**Recyclable**  
 Uses the same recycling chains developed for conventional resins.




### Process

The production route is exactly the same, therefore the bio-based polymer has the same characteristics, quality and properties as the fossil equivalent.



As shown in the Process (above), abundant renewable sources such as biofuels can be used as feedstock to make recyclable plastics.


However, costs are still higher and therefore, targeted EU policies, are needed to close this gap, stimulate demand, and attract investment in Europe by:

- 
**Integrating biobased plastics into the revised EU Bioeconomy Strategy**  
 The revised EU Bioeconomy Strategy in 2025 must fully incorporate bio-based plastics. Recognising their role in climate mitigation while increasing our strategic autonomy.
- 
**Set mandatory product-specific targets for bio-based plastics**  
 The EU should establish mandatory product-specific targets for bio-based plastics in key sectors like packaging and vehicles.
- 
**Set robust sustainability criteria for bio-based plastics**  
 Scaling up bio-based plastics requires strict sustainability standards. The EU should establish comprehensive sustainability criteria that are feedstock agnostic and in line with Article 29 of RED-III.

 Expand portfolio from **260KT** to 1MT by 2030

Deliver a **15%** reduction of GHGs by 2030

Achieve **carbon neutrality** by 2050

 Expand portfolio to include **1MT** of thermoplastic resins and chemicals with recycled content by 2030

## ● Case studies

### Fibenol and the SWEETWOODS project

### Creating the future for wood industry

SWEETWOODS was a collaborative European research & innovation project led by Fibenol, driving the transition away from fossil-based resources and redefining the future of wood processing.

Traditional wood industries focus on specific end products, often using by-products for low-value energy solutions. In contrast, SWEETWOODS has successfully implemented a first-of-a-kind wood fractionation demo plant in Estonia, converting over 90% of hardwood biomass into high-value biomaterials and bioproducts.

This breakthrough enables the production of a wide range of sustainable products and establishes novel bio-based value chains with a low ecological footprint. At the core of the project is an advanced pre-treatment technology, combined with innovative enzymatic



#### Fibenol today

**20.000T**

C5 and C6 lignocellulosic sugars

**6.500T**

LIGNOVA™ lignin

Specialty cellulose on ton scale

processes, achieving sugar recovery levels above 90% and producing exceptionally high-quality lignin. The plant is fully operational, showcasing how these cutting-edge solutions can be scaled for industrial applications.

By providing sustainable alternatives to fossil-based materials, SWEETWOODS is actively shaping the future of the bioeconomy.

### SWEETWOODS impact



The SWEETWOODS project has transformed the way we think of wood valorisation.



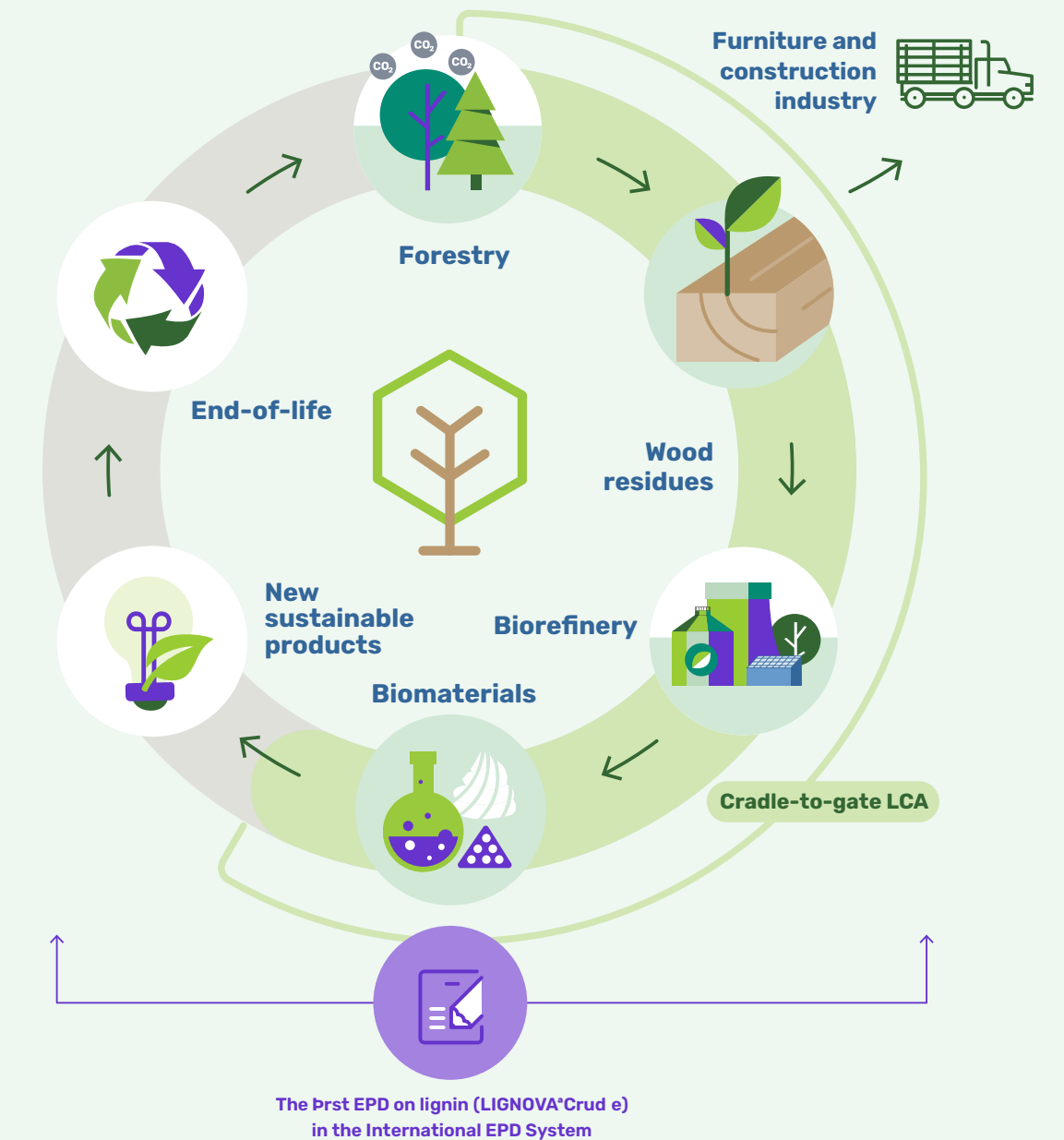
We are now delivering sustainable alternatives to fossil resources, powered by next-generation biomaterials.



Through state-of-the-art pre-treatment technology, we have demonstrated how to maximise woody biomass valorisation to over 90%, significantly surpassing the industry standard.

As the next step, scaling up these bio-based innovations will be achieved through an industrial-scale plant by 2030, supporting defossilisation of EU industry. For this to happen, a supportive regulatory framework must be established by 2026 at the latest.

### Science based and data driven Life Cycle Analysis (LCA)



## ● Interview

# Harnessing the power of artificial intelligence to boost biomanufacturing



Jon Goriup is Co-Founder and CEO of VCG.AI, a German company specialising in an AI- and data-driven process for developing circular solutions for industry.

### Q: What is the potential of AI in biomanufacturing?

AI is already being used in the scaling of biomanufacturing by **interpreting vast amounts of data generated on biomanufacturing processes, materials, and the underlying business models.**

Future AI solutions like natural language processing, predictive analytics, pattern recognition, and anomaly detection will play a role in scaling and industrialising biomanufacturing. Companies will be able to leverage data generated worldwide to discover biomanufacturing opportunities they have not considered before; empower their teams to get a detailed understanding of processes; make better investment decisions; and optimise their processes and impacts. Therefore, **AI holds the potential to simplify decision-making, reduce complexity and scale biomanufacturing solutions** faster and more efficiently.

### Q: Could you give us an example?

Companies looking to develop new products and production inputs from alternative feedstocks face years-long, costly R&D processes before achieving a commercially-viable solution.

Specialised AI solutions, like VCG.AI, fundamentally transform this journey by **reducing the risks, complexity and costs of innovation, while identifying new sustainable opportunities** that were previously hidden.

**For example, a food manufacturer aiming to valorise its by-products gets up to 10x more value from them through a solution developed with AI. Currently, the company diverts tens of thousands of tons of by-products annually to a local biogas plant, achieving limited valorisation while missing significant financial and climate impact opportunities.**

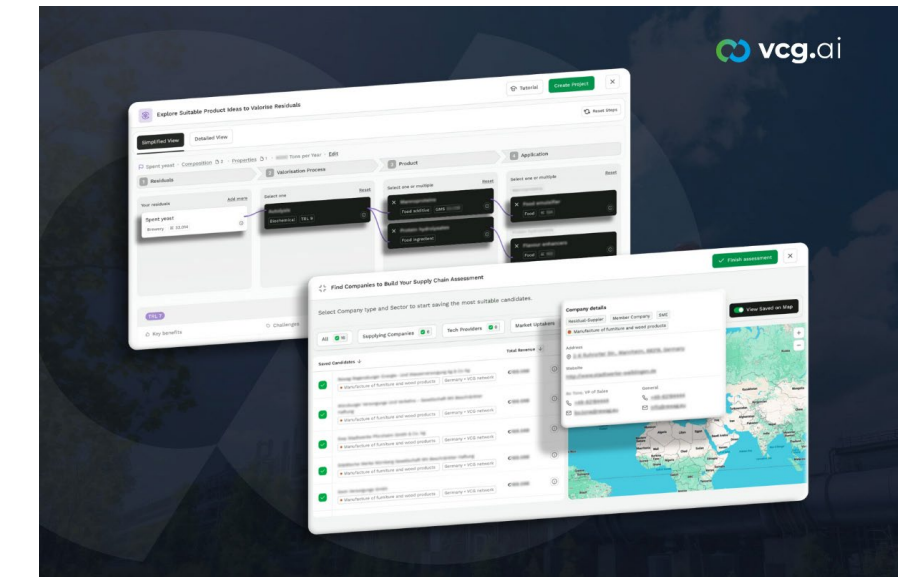
**By applying AI, the company can analyse and validate the possible valorisation opportunities based on the quantities and material compositions of its by-products.**

The AI system ranks these opportunities using multiple factors, such as the readiness of valorisation technologies, market trends, CO<sub>2</sub> emission reductions, revenue potential, and potential off-takers. This approach enables the manufacturer to maximise financial returns while delivering substantial environmental benefits.

### Q: What can European regulators do to increase the potential of AI in biomanufacturing?

In my view, the primary responsibility of European regulators regarding AI, is to **foster an innovative and supportive business environment while ensuring safety.**

**The standardisation and sharing of data are essential for the continued advancement of AI solutions,** particularly for transforming the biomanufacturing industry. Currently, a significant amount of data and knowledge remains siloed, inconsistent or inaccessible. This fragmentation prevents us from seeing the bigger picture and limits progress, even when it would be in everyone's best interest to consolidate and leverage this information. We are



living in a time of too much data. AI has the potential to finally utilise it for the better when this is managed well.

To support this, it would be beneficial for EU regulators to introduce **special incentives for AI solutions that align with the EU's Green Deal goals.** Promoting the free flow of data and providing incentives for sustainable AI innovations would create a highly supportive ecosystem, positioning Europe as a leader in both AI and biomanufacturing. At VCG.AI, we are already seeing growing interest in data-driven, AI-powered analyses of cities and regions.



## ● Interview

# Biomanufacturing for a greener textile industry



Walter Lutz is Secretary General for The European Technology Platform for the Future of Textiles and Clothing (Textile ETP), an organisation of companies, associations and clusters representing the research and innovation interests of the entire manufacturing value chain from fibres to final textile-based products.

### Q: What potential does the textile industry (production) hold for biomanufacturing?

Today, two thirds of all textiles produced globally are made of synthetic fibres based on fossil feedstock, and their share has been rising constantly over the last 50-60 years. Over time, we need to work towards replacing this fossil-based material share by renewable materials and feedstocks.

Natural fibres and fibre-to-fibre recycling are part of the solution, they provide a significant opportunity. However, they are unlikely to be able to ever cover the bulk of the textile material needs. Therefore, the manufacturing of man-made fibres from sustainable bio-based feedstocks is the best bet to close the gap.

### Q: Could you give us an example?

The largest volume of bio-based man-made fibres are wood-based cellulosics such as Viscose, Lyocell and other smaller varieties in total making up about 5-6% of global textile fibre production. The viscose production process relies on harsh chemistry with high pollution potential. Therefore, cleaner and more resource-efficient processes need to be scaled up to provide sustainable man-made cellulosic fibres at a higher volume.

Another example are bio-synthetics i.e. conventional fibres such as polyester, polyamides etc. made from bio-based feedstocks.

### Q: On textiles, biomanufacturing and regulation: what can European regulators do to increase the potential of textile production in biomanufacturing?

The goal of EU regulators is to make the textile industry into a more sustainable and circular sector with lower environmental impacts. Several specific regulations that could positively impact biomanufacturing are being prepared.

As part of the **Ecodesign for Sustainable Products Regulation (ESPR)**, textiles has been identified as a high priority product class. Specific performance requirements for clothing products sold on the EU market will be defined over the coming 2-3 years. Criteria such as lower product environmental footprints could benefit certain bio-based textiles.

Another upcoming regulation concerns **Extended Producer Responsibility (EPR)** for clothing and other textile products, requiring brands and retailers to



organise and finance proper end of life management of post-consumer textile waste. An EPR fee will be charged with every product sold to collectively cover these costs.

A mechanism called **Ecomodulation** can ensure that products with lower environmental footprints or easier recyclability qualify for lower EPR fees, or be exempted altogether. This could incentivise companies to produce more such products, including those made of bio-based materials.

# ● Boosting Europe's future: the case for more biomanufacturing

The EU Competitiveness Compass identifies the bioeconomy as a growth engine to invest in. In addition, the bioeconomy can increase the EU's strategic autonomy and security, for example, by **providing raw materials security and via setting-up more EU-centric supply chains, taking a circular economy approach by sourcing, processing, manufacturing and re-using renewable feedstock.**

One key element, and as outlined in the Draghi report, is to **put research and innovation at the centre of the EU's strategic priorities**, including a strategy to establish competitive research and innovation systems. Bio-based solutions are at different levels with regard to their maturity and go-to-market ability.

It is vital to allow those products to enter the market. This should include dialogue between industry, policymakers and other stakeholders to develop a transition path for our sector to better contribute to the EU's long-term competitiveness.



## EU 2025 Policy Recommendations

From 2025 onwards, the EU should consider the following points for making policy choices:



### 1 Let's agree on a kind of defossilisation accelerator

→ Going from lab to fab to market typically has four crucial elements: you need the permit, the financing, people with the right skills and a market (demand).

A "defossilisation" accelerator" should address those four elements and help to create lead markets to make Europe more independent of fossil raw materials. The accelerator should include a package of measures to support biomanufacturing "made in Europe".



### 2 Let's strategically use renewable feedstock

→ If the ambition is to accelerate defossilisation, this cannot be done in a cost-competitive way with residues and waste only. The bio-based industry needs to know how much renewable feedstock can be sustainably sourced.

This is underlined by the Letta Report, which says that "the strategic use of biomass for high-value applications, such as materials and chemicals that can substitute for fossil-based or critical raw materials, is another crucial element."



### 3 Let's create a regulatory framework for the business case of today and tomorrow

→ A more innovation-prone EU policy framework will increase the attractiveness of investments in Europe. Bio-based industries, including the many start-ups, should benefit more strongly from the EU Single Market through simplification and coordination, to overcome fragmentation and to ensure coherence. To make it a business case for companies active in the bio-based sector, the regulatory framework should be fit for purpose.

That includes addressing regulatory bottlenecks, using regulatory opportunities and ensuring regulatory foresight e.g. via regulatory sandboxes and an interdisciplinary policy design before EU regulation is drawn up.

# Bioeconomy and biomanufacturing: a global perspective

A global technology race is underway in the technology and manufacturing sectors, with the winners leading global manufacturing and trade. The EU should be smart and reinforce the industrial dimension of the bioeconomy, including via the Bioeconomy Strategy review.

In doing this, let's take inspiration from and build on the examples of other successful initiatives from around the world. These examples include:



## USA: building a vibrant domestic biomanufacturing ecosystem

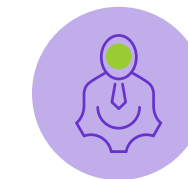
→ The US has taken the approach of defining specific, measurable, assignable, realistic and timebound (SMART) actions in the Executive Order on the Bioeconomy.

→ The most recent report on the implementation of the Bioeconomy Strategy has promising insights into how the US is building a vibrant domestic biomanufacturing ecosystem.

→ Bio-based products are an increasing contributor to America's economy. Job creation through the bio-based sector impacts every state, not just to the states where agriculture is the main industry.

→ The report identifies four key drivers of biomanufacturing capacity and includes economic factors, technological advancements, infrastructure and workforce availability.

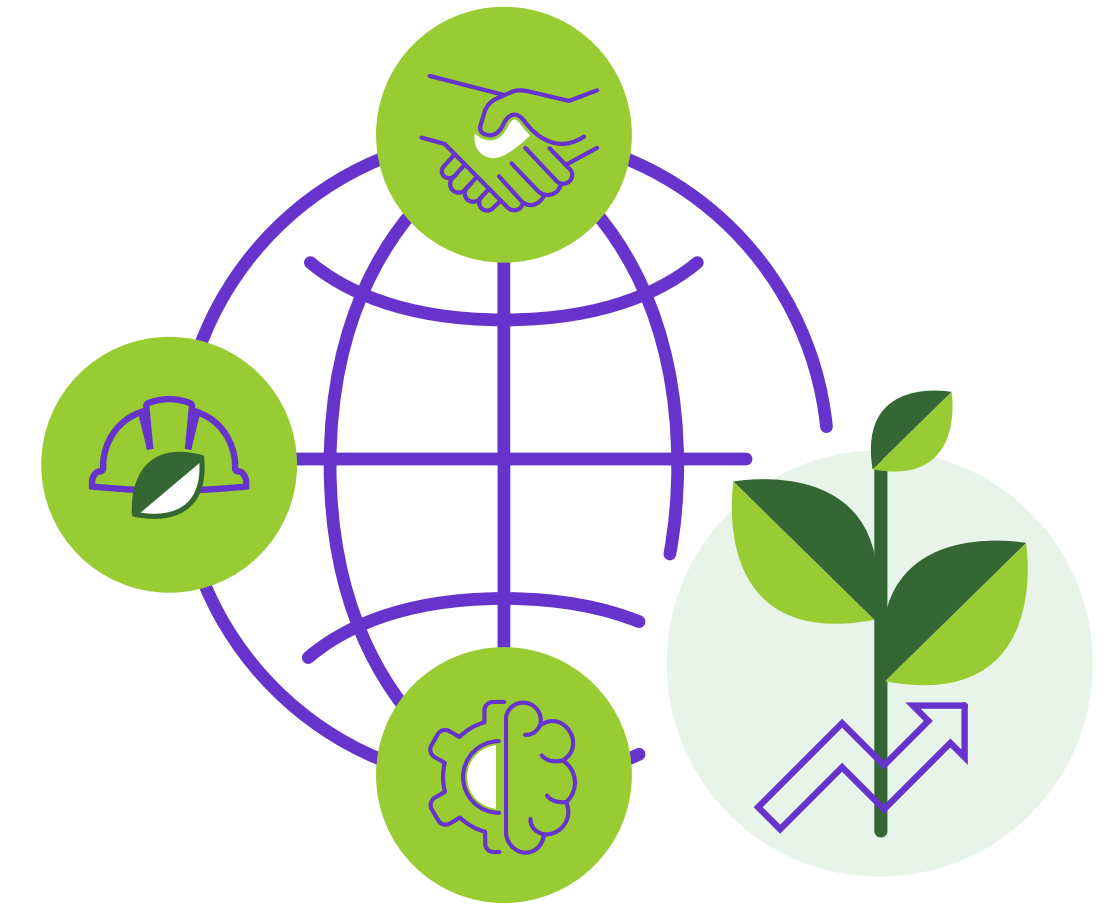
→ **Key take-away:** let's be S.M.A.R.T. on the bioeconomy and bolster biomanufacturing capacity in the EU.



## G20: for the first time, a decision on High-Level Principles for the bioeconomy

→ The G20 initiated the debate on the bioeconomy as an "innovative, complementary productive paradigm". In November 2024, High-Level Principles for the bioeconomy were decided, recognising the bioeconomy's potential to contribute to building a sustainable future and fostering economic growth.

→ These principles include the advancement of sustainable consumption and production patterns through the efficient and circular use of biological resources.



→ The principles can have significant implications for future global governance.

→ **Key take-away:** whilst global initiatives will not become easier to progress in the coming years, the EU should support South Africa in preparing and steering the G20 agenda on the bioeconomy.



## Global Bioeconomy Summit (GBS) 2024: public-private cooperation as a solution to global challenges

- The GBS was held in October 2024 in Kenya. The topic was “One Planet - Sustainable Bioeconomy Solutions for Global Challenges”.
- BIC hosted a workshop to discuss the role of public-private cooperation in the bioeconomy as a driver for (re)-industrialisation.
- Public-private cooperation was seen as driver to set-up new bio-based industrial ecosystems and transition away from fossil-based industry systems, but blueprints for such cooperations at regional/national and at global level are needed.



➤ *Picture above: Marco Rupp, BIC and Ruth Oniang'o, Sasakawa Africa Association.*

- **Key take-away:**
  - Let's work together to develop recommendations for defining and developing blueprints of **public-private** cooperation in the bioeconomy to drive the (re)-industrialisation, and
  - Welcome and support the FAO project to develop a Global Bioeconomy Partnership.



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 Bio-based Industries Consortium