

Europe needs

a strong, explicit policy in support of Industrial Biotechnology to accelerate sustainable transitions and avoid its demise in this strategic area.

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SUMMARY

To be the first climate-neutral continent and strengthen its global competitiveness, Europe needs to instigate and implement a robust, explicit policy that promotes the development of Industrial Biotechnology and Biomanufacturing.

Biotechnology innovations can transform our economies, societies, and lives while tackling existential threats to Europe and the world, from climate change to pandemics. Already recognised by the European Commission as an advanced technology for industry, biotechnology contributed € 34.5 billion gross value added and supported 230,000 jobs in 2018 alone. In 2030, biotechnology is expected to contribute up to €100 billion to the EU economy and support one million jobs.

Building on its long-lasting commitment to promoting biotechnology and biomanufacturing (partly as a reaction to increasingly strong China's own priorities

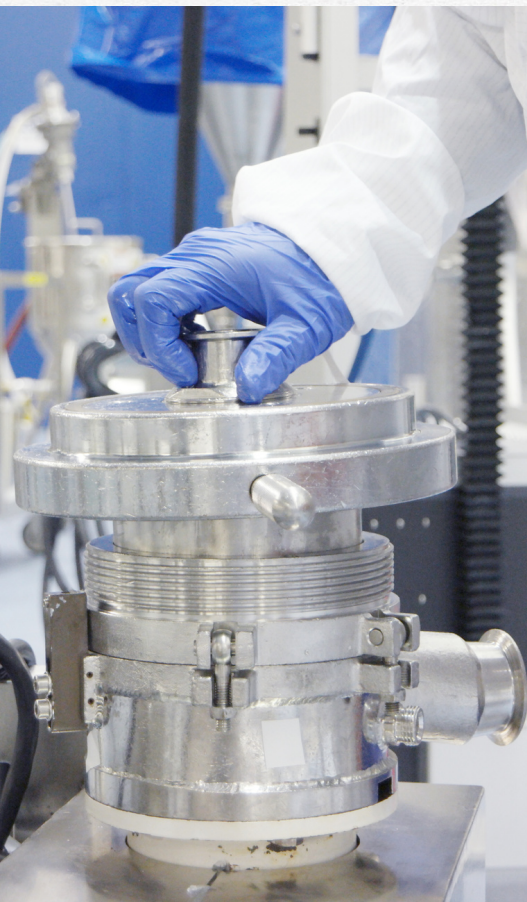
in the field), the US government has recently declared an executive order on advancing biotechnology and biomanufacturing innovation supported by a \$2 billion investment.

In contrast with the US government, Europe lacks a strong and consistent pathway to Industrial Biotechnology and Biomanufacturing. Although Several Member States have launched national initiatives, there is an overall deficit of European coordination. This is regrettable because creating a strong synergy between national initiatives is the best way to draw benefits that will have an impact at the European scale. By playing a leading role in Industrial Biotechnology and Biomanufacturing and helping bring solutions that can change our lives, Europe can also close the innovation and technology gap with other major regions that are currently threatening its competitiveness, security, and long-term resilience.

Industrial Biotechnology from a US perspective

On the 12th of September 2022, the US government announced new measures to support national capacity development in biotechnology and biomanufacturing (<https://bit.ly/3AGlpp3>). The initial \$2 billion programme targets multiple commercial sectors, with measures aimed at developing new biotechnologies to manufacture various/new products, lower prices, create good jobs, strengthen supply chains, improve health outcomes, and reduce carbon emissions.

During the White House Summit on Biotechnology and Biomanufacturing (Box 1), several ambitions were laid out: strengthening supply chains, expanding the domestic biotechnology market, notably through increased manufacturing of biobased products, fostering innovation (including in the regulatory area) and training a new generation of biotechnologists. Furthermore, data sharing and standards development were cited as key funded measures.



Industrial Biotechnology and Biomanufacturing

Biotechnology uses biological systems (whole living cells or parts derived from these) to catalyse reactions, converting feedstocks into products. It creates the basis for products and services in a wide range of sectors. Modern biotechnology exploits major developments in biology, for example, the ability to make, read and modify DNA, combining these with the increasing ability to understand and engineer biological systems. The field of biotechnology is interdisciplinary because, to build productive systems, it draws upon knowledge and know-how from chemical engineering and increasingly relies on the use of advanced digital technologies to harness the power of big data and AI. Biomanufacturing is the deployment of biotechnology in industrial-scale processes designed to create products, such as fuels, chemicals, materials or ingredients for the agri-food, cosmetics, chemical, pharmaceutical or energy industries.

The US government announcement represents the latest phase in many years of consistent policy support for biotechnology and biomanufacturing. To a considerable extent, this effort also stems from increasing pressure from China's own stepped-up investments in Biotechnology and Biomanufacturing over the last few years (<https://bit.ly/3FgYDGU>, <https://bit.ly/3BvO55F>).

Earlier US initiatives, including ones aimed at supporting the development of synthetic biology (SynBERC, EBRC), provided the necessary impetus, leadership, and public-private partnership to launch BioMADE in April 2021 (www.biomade.org). This major funding initiative, financed by the Department of Defense (DoD), created a distributed research infrastructure headquartered in Minnesota.

BioMADE is a national network of universities and companies that aims to bridge the gap between lab-scale research and at-scale domestic manufacturing. Notably, this research and innovation infrastructure was preceded in 2016 by the launch of the Agile BioFoundry, a consortium of national laboratories collaborating with industry as a distributed biofoundry.

Funded by the Department of Energy's Bioenergy Technologies Office, the Agile BioFoundry also aims to accelerate biomanufacturing and decarbonisation of the economy (www.agilebiofoundry.org). Significantly, both BioMADE and the Agile BioFoundry benefit from large investments that combine federal, state-level and private funding sources. This announcement is also triggering a range of other national and regional initiatives across the US (<https://bit.ly/3iWMQ99>). The US DoD announced in March 2023 that BioMADE's budget ceiling has increased from the initial 87 million to over 500 million. Quoting Stephen Luckowski, the DoD MII Program Director, the press release noted that this increase "is representative of national interest in the power and promise that biomanufacturing holds for America's future".

Industrial Biotechnology from a European perspective

Biotechnology has the transformative potential to improve lives and help us reach many of the Sustainable Development Goals (<https://bit.ly/3Hx3JRV>).

Figure 1

If Europe does not improve on transversal technologies, European companies may miss out on a €2 trillion to €4 trillion value-added opportunity by 2040.

(McKinsey & Company's report, 2022)

Photo credit
McKinsey & Company

This optimistic message echoes many previous reports from a variety of sources, including those from OECD (already in 2008) and EuropaBio, both of which have successfully contributed to the European Commission's recognition of biotechnology, first as a key enabling technology and, more recently, as an advanced technology for industry (<https://ati.ec.europa.eu/>).

Moreover, the European Manufacturing Technology Platform has recently identified "Biointelligent manufacturing" as a key manufacturing technology for the future (www.biointelligentmanufacturing.org).

This vision combines biotechnology, in particular synthetic biology, with AI and physical device development to create unforeseen possibilities in product development. Nevertheless, despite these initiatives and wide recognition of the importance of biotechnology and biomanufacturing, European investments have been rather piecemeal, mostly relying on individual national initiatives.

Europe's Green Deal is a bold policy that provides an ideal opportunity to promote biomanufacturing. However, within the scope of this policy document, no specific actions in favour of biomanufacturing are announced, nor are any foreseen in Horizon Europe's Missions. Similarly, the Circular Biobased Europe joint undertaking is a promising initiative that offers opportunities to support biomanufacturing. However, while biomanufacturing is clearly a technology option meriting support through this programme, it does not explicitly support developments in the field and remains tightly focused on using biomass as a raw material.

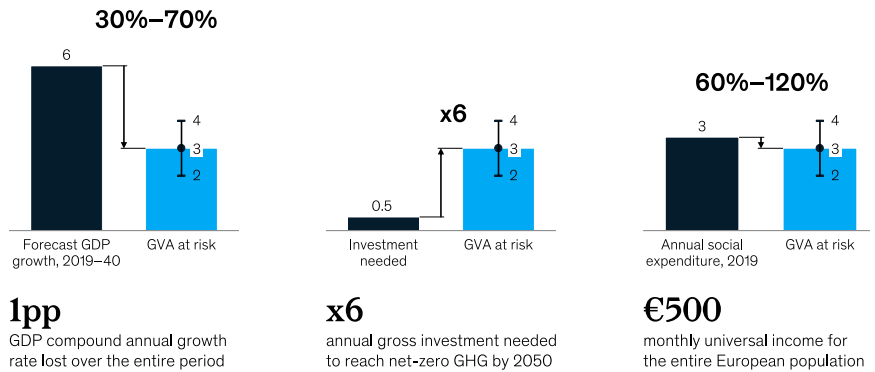
Value at stake is equivalent to half of GDP growth to 2040, six times the annual expected cost of the net-zero transition, and close to annual social expenditure.

€ trillion

Growth
GVA¹ at stake represents ~50% of GDP growth 2019–40

Sustainability
GVA at stake represents 6x annual gross investment needed to reach net-zero GHG by 2050

Inclusion
GVA at stake represents ~90% of European yearly social expenditure



¹Gross value added.
Note: Figures may not sum to 100% because of rounding.
Source: Oxford Economics Base Scenario; European Commission; McKinsey Sustainability; McKinsey Global Institute analysis

McKinsey
& Company

While biomanufacturing is a major opportunity for biomass conversion, it offers much more than this since it can use a wide range of raw materials, including carbon monoxide and CO₂.

Industrial Biotechnology in Member States

Industrial Biotechnology already plays a vital role across Europe and has been acknowledged as a key enabling technology for implementing the circular bioeconomy. Therefore, biotechnology is being developed to some extent in most of Europe's member countries. However, the country that has done the most in recent years to promote biomanufacturing is the United Kingdom, which is no longer a member of the European Union. In other EU countries, focus on biotechnology and biomanufacturing is present but is mainly fragmented and dependent on the efforts of individual institutions.

Mirroring European Commission policies, biomanufacturing in Member States is often confused with technologies solely for a biomass-based economy, meaning that focused development initiatives are lacking. This contrasts sharply with the USA's approach, which makes explicit technology choices to address future economic challenges.

Avoiding a technological crisis

Europe has an excellent history in traditional biotechnology, which has led in the past in areas such as chemicals, materials or food products. However, in a recent rather discomfiting report (<https://mck.co/3ERNGfL>), McKinsey & Company asserted that Europe's future economic growth and competitiveness are endangered by a slowdown in innovation and technology development, in particular when considering the increasing competition worldwide (Figure 1). The report states that several sectors are endangered, but foremost in this respect, artificial intelligence (AI), the so-called BioRevolution (biomanufacturing and biobased products), and cloud technology. All three are cross-cutting technologies that hold the potential to impact multiple (if not all) commercial sectors.

Moreover, the recent \$350 billion Inflation Reduction Act in the USA will likely put European competitiveness at a further disadvantage due to the substantial (also fiscal) incentives to domestic biomanufacturing, as intensively debated by the European Parliament (<https://bit.ly/42upt9t>).

"It is urgent to raise awareness among Member States regarding what's at stake"

These same concerns have already been raised in previous reports, forecasts and fora, all of which emphasised that avoiding a technology crisis is of vital importance for the European Union and its capacity to address major societal challenges, from climate change and geopolitical tensions to food security, population well-being and economic growth.

A call for action: Europe needs to adopt policy and support strategies that explicitly promote the development of biomanufacturing

Europe must act quickly and decisively to avoid an irremediable loss of competitiveness in biotechnology and biomanufacturing. It is urgent to raise awareness among member countries regarding what's at stake. National initiatives must be encouraged, beginning with each Member State's call for national strategic planning. Understanding where efforts are being furnished to coordinate future investments better is vital. As part of national strategies, biotechnology and biomanufacturing networks should be established and supported, bringing together the vital forces in each member country. Beyond this, Europe must encourage supra-national cooperation in the field and provide the mechanisms (legal, logistic, and financial) to enable it at a meaningful scale.

Like the USA, the EU must invest in intelligent biomanufacturing. Substantial investments are needed that span research through various technology readiness levels (TRL), enabling both the development of novel technologies, products and processes and the translation thereof into market innovations with economic, societal, and sustainable impacts. Furthermore, it is essential to build and support infrastructures that enable innovative R&D, help de-risking investments, and reduce time to market for an increasing range of sustainable products [Box 2]. Also, it is paramount to set the basis for fit-for-purpose educational curricula to train a new generation of professionals with the skills required to handle the complex, multidisciplinary concepts and technologies underpinning biomanufacturing. These actions align with those recently mapped on empowering a biotech future that require a strong focus on building capacity, increasing cooperation and agreeing on common principles and frameworks that will shape innovation and development in the future (<https://bit.ly/3FNVks7>).

Looking to the future

In the past, Europe has demonstrated its ability to act collectively, investing strategically in specific technologies and building commercial champions. Faced with new urgent challenges, such as climate change and global security issues, Europe must repeat past successes, developing smart industrial solutions that provide a pathway to sustainable and clean growth, energy sovereignty and manufacturing resilience. Biomanufacturing can achieve these goals. However, to reach this target, it is urgent to launch an ambitious R&D and demonstration flagship programme to build a distributed intelligent biomanufacturing facility, with advanced biotechnology and digital technologies being mobilised to achieve this. In doing so, the EU will invest in its future and position European industrial biotechnology at the forefront of global competition.

Box 2

The European infrastructure IBISBA is a driver for innovation in biotechnology and biomanufacturing.

IBISBA (www.ibisba.eu) is part of the strategic roadmap of the European Science Forum for Research Infrastructure (ESFRI). As a strategic, distributed research infrastructure, IBISBA coordinates a network of European biotechnology platforms to deliver end-to-end innovation services in the field. To achieve this, IBISBA actively develops standards and promotes interoperability between facilities. Data is at the core of IBISBA's ambitions, with data generation, management and sharing being central features. As a leading research infrastructure in its field, IBISBA is also actively embracing advanced technologies, such as AI and cloud technologies, to better design and control biomanufacturing processes. In this regard, at the beginning of 2023, IBISBA launched the BIOINDUSTRY 4.0 project. Funded by Horizon Europe this project aims to devise a series of advanced digital technologies and address the key question of secure data sharing within trusted networks. IBISBA's overarching ambition is to federate Europe's strengths in biotechnology, creating a strong Unique Selling Proposition for the EU in international competition and contributing to reaching many Sustainability Development Goals (<https://bit.ly/3Hx3JRV>).