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The UK's bioeconomy

A case for building growth, resilience and sustainability

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Summary

The bioeconomy opportunity

The United Kingdom has a large, productive and internationally competitive bioeconomy – a major economic system that encompasses all economic activity that depends on, processes or transforms biological resources, i.e. plants, animals, microorganisms and the ecosystems that sustain them. As such, it spans farming, pharmaceuticals, forestry, biofuels, food manufacturing, scientific research, bio-based materials and the services that connect them. The UK's bioeconomy is the fourth-largest in Europe by value added, generates approximately £325 billion in output and supports 6.4 million jobs though it ranks only 21st out of 28 European countries for growth.

The UK can connect growth, resilience, regional renewal and nature recovery through a bioeconomy framework for sustainable, bio-based industrialisation. The importance of the bioeconomy lies in the potential for biological innovation to upgrade existing industries while improving the sustainability and resilience of the wider economy. Advances in engineering biology, precision breeding, biomanufacturing, advanced biomaterials and synthetic biology are increasingly being applied across established sectors including food, chemicals, construction, energy, manufacturing and waste management. These technologies can improve resource efficiency, reduce dependence on fossil-derived inputs and increase productivity in legacy sectors, which in turn provide the necessary scale for the innovative industries to build a domestic base. This is what we refer to as 'the bioeconomy agenda'; it offers a practical mechanism through which the UK can translate its scientific strengths into commercial deployment, industrial competitiveness and long-term economic growth.

The UK already possesses many of the assets required for developing the bioeconomy, such as world-leading research institutions, globally competitive life sciences and engineering biology capabilities, sophisticated financial markets, strong regional manufacturing bases and, despite significant degradation of biodiversity, a natural capital base. We propose an effective policy and finance architecture that could create a coordinating framework capable of connecting these assets into a coherent strategy for growth, productivity, inclusion and industrialisation.

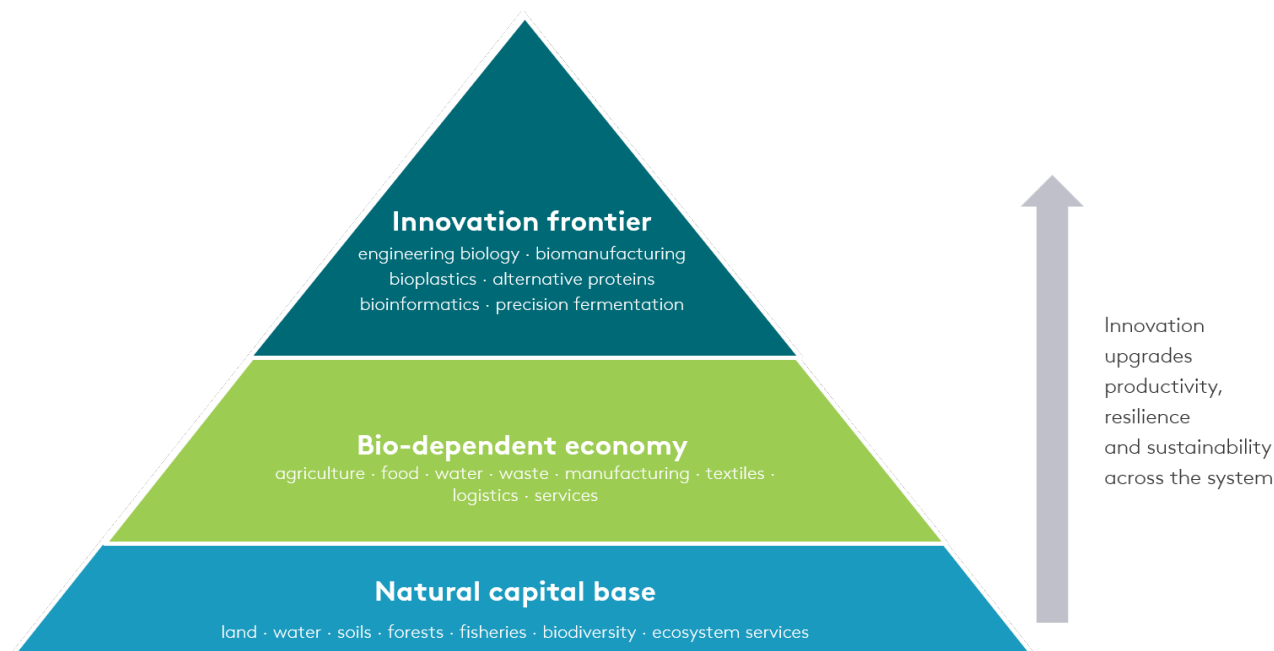
With the right policy and finance frameworks, the bioeconomy can also be guided to become nature-positive – halting and reversing nature loss while generating economic value within ecological limits – and carbon-negative. Indeed, the bioeconomy represents a significant part of the opportunity to transition to a nature-positive economy given that a large share of UK output and employment is bio-dependent; this transition is important for the UK and cannot be delivered through conservation policy alone.

The G20 Presidency in 2027 and G7 Presidency in 2028 present a rare opportunity for the UK to shape the emerging global bioeconomy agenda. Few countries combine the UK's strengths in science, finance, standards, regulation, professional services and international convening power. The UK therefore has the potential not only to build a competitive domestic bioeconomy, but also to become a global centre for bioeconomy finance, services, innovation and international partnership.

Form, size and distribution of the UK bioeconomy

The bioeconomy can be viewed as a pyramid (see Figure S.1): a natural capital base forms the foundation, bio-dependent sectors sit in the middle and an innovation frontier forms the top whose technologies can upgrade the whole system.

Figure S.1. The UK bioeconomy pyramid



Note: Frontier innovation (at the top) upgrades the wider bio-dependent economy and natural capital base beneath.

Source: Authors' framework

Strategies for growth developed through the lens of the bioeconomy for the UK offer four connected levers: (1) productivity and devolved growth, by using frontier innovation to upgrade a broad regional base; (2) sustainability and a nature-positive transition, by embedding circularity and reducing resource intensity across established sectors; (3) investment, by mobilising public and private capital across a legible pipeline; and (4) resilience and security, by reducing exposure to imported feedstocks, food shocks and volatile fossil inputs.

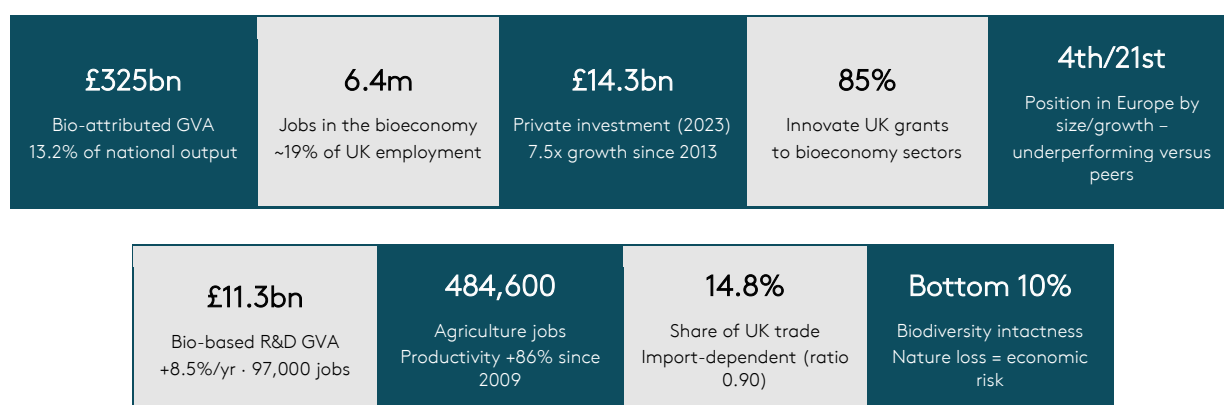
The UK bioeconomy is already economically significant but it lacks a coherent coordinating strategy that could increase its productivity. It accounted for **13.2% of UK gross value added (GVA)** and around **19% of employment** in 2023, too large a proportion to be treated as a niche policy agenda (see Figure S.2). Yet it has grown at just 0.73% per annum since 2009, against a national GVA rate of 1.62%.

Because such a large share of UK output and employment is bio-dependent, the transition to a nature-positive economy cannot be delivered through conservation policy alone; it must also reshape production, processing, services and innovation across the wider economy, with the bioeconomy representing a significant part of that opportunity. The bioeconomy is not inherently sustainable. But it is a part of the economy that can, with the right policy guidance, provide pathways for growth and nature recovery to work together.

The bioeconomy is geographically distributed in ways that make it particularly relevant to the Government's regional growth agenda. London and the Southeast account for only 32% of bioeconomy value added, compared with approximately 40% of total national economic output. Food manufacturing, pharmaceuticals, industrial biotechnology, marine industries, forestry, environmental services and natural capital assets are concentrated in locations such as North Yorkshire and Liverpool, whose economic growth prospects depend partly on the extent to which these activities can be connected to frontier innovation, investment and industrial strategy.

These patterns suggest that a well-designed bioeconomy framework would strengthen regional economies as well as national growth.

Figure S.2. The UK bioeconomy at a glance



Note: Figures for 2023. GVA figures are in nominal prices.

Sources: ONS GVA (2025e); ONS BRES (2025); The Data City (n.d.a); Lasarte-López et al. (2025); Natural History Museum (2025)

Strengthening the UK bioeconomy

In spite of its potential, bioeconomy sectors are currently fragmented and do not yet operate as a coherent system. The UK has the components needed for a thriving bioeconomy – a large bio-dependent sector, expertise in research, a highly skilled workforce and deep trade links – but unlocking their further potential requires an architecture that connects these strengths, bridges existing policy frameworks and addresses five related barriers to growth (see Table S.1).

Table S.1. Barriers to growth in the UK bioeconomy and corresponding policy actions

Barrier	Description	Policy actions
Visibility barrier	The bioeconomy remains poorly measured and therefore difficult to govern, invest in or prioritise. Without a consistent statistical framework, policymakers cannot readily track performance, identify investment opportunities or make the case for coordinated action.	Define and measure the bioeconomy through a shared national definition, an annual ONS Bioeconomy Account and a common evidence base for government, investors and regions.
Coordination barrier	Responsibility is fragmented across multiple departments, innovation bodies, environmental regulators and sector strategies. Policies spanning life sciences, industrial strategy, biomass, nature recovery, food, waste and finance are managed through separate frameworks with limited alignment.	Coordinate policy and regulation through joint leadership spanning economic and environmental priorities, aligning industrial strategy, life sciences, biomass, nature recovery and innovation policy within a common delivery framework.
Market-formation barrier	Many frontier bio-based firms face difficulty in generating predictable commercial demand. Without credible and stable demand signals, industries cannot attract the capital required for demonstrators, manufacturing capacity and commercial deployment.	Create demand and secure sustainable supply through procurement, standards, product labelling, bio-content requirements and sustainable biomass frameworks that create lead markets for bio-based products and services.
Place-based delivery and innovation barrier	Mechanisms are lacking to connect regional assets – including manufacturing capacity, feedstocks, natural capital, universities, small- and medium-sized enterprises and innovation centres – to coherent, investable growth propositions.	Scale up innovation and regional clusters by supporting demonstration facilities, biomanufacturing infrastructure, biofoundries and cluster development that connect frontier innovation to local manufacturing, natural capital assets and regional growth opportunities.

Finance barrier	Available capital does not match the investment needs of the bioeconomy. Funding is reaching research and early-stage innovation but not consistently reaching commercial scale-up, industrial transition and natural capital investment.	Build the enabling financial environment by making opportunities visible and investable, creating revenue certainty and lead markets, bridging the scale-up and transition finance gap, and developing regional investment pipelines supported by the appropriate mix of grants, venture finance, blended finance and institutional capital.
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Together, these actions provide a practical policy architecture for sustainable, bio-based industrialisation, connecting frontier innovation, mature industries and natural capital within a single growth agenda. They also provide the foundations for a coordinated financial market architecture that can match different opportunities across the bioeconomy pyramid to the right stage and form of capital.

While the UK enjoys relatively easy access to capital, the financial challenge lies in a shortage of mechanisms that connect capital to investable opportunities across the bioeconomy pyramid. This requires a **coordinated financial market architecture** that can integrate the differing requirements of sectors within the bioeconomy. This architecture should match each opportunity to the right stage of capital, using grants and venture finance for frontier innovation, blended and scale-up finance for demonstration and deployment, and institutional capital for mature infrastructure and natural capital assets. A robust financial market architecture for the UK would incorporate the following principles:

- **Make the bioeconomy visible and investable** through a UK Bioeconomy Investment Platform, shared definitions, investable project pipelines and standardised information that allows investors to identify opportunities across frontier innovation, industrial transition and natural capital.
- **Create revenue certainty and lead markets** through procurement, advance market commitments, bio-content standards, long-term offtake arrangements and outcome-purchase agreements that convert uncertain future demand into bankable revenue streams.
- **Bridge the scale-up and transition finance gap** through blended finance, first-loss capital, guarantees, venture debt, transition finance and deployment vehicles that support frontier firms, industrial upgrading and natural capital investments.
- **Build regional investment pipelines and support system-wide resilience** by developing place-based project pipelines, cluster investment platforms and natural infrastructure opportunities that connect local assets with capital while improving productivity, resilience and long-term economic performance.

Together, the policy and financial architecture can provide a practical route to converting the UK's scientific strengths, regional assets, natural capital and financial capabilities into a coherent programme for growth, resilience and nature-positive bio-industrialisation. Rather than creating a new sector, it provides the coordinating framework needed to transform existing strengths into a system capable of delivering productivity gains, investment and long-term competitiveness.

1. Introduction

1.1. An introduction to the bioeconomy approach

As the world contends with the interconnected challenges of climate change, nature degradation, food insecurity and economic stagnation, the bioeconomy has become increasingly significant for governments, international organisations and researchers.

The bioeconomy refers to the economic value derived from biological resources and processes. This report sets out what a coordinated bioeconomy could look like in a developed, nature-depleted economy like the UK, and highlights how the bioeconomy lens can consolidate the UK's assets into a unified whole. With the right infrastructure, policy and finance architecture, the bioeconomy can be used to drive a programme of sustainable, nature-positive, bio-based industrialisation. It can provide a pathway for new industries, increasing productivity and inclusion, strengthening resilience, and driving growth.

The bioeconomy is best understood as a pyramid – with a wide natural capital base, a broad middle of bio-dependent sectors, and an innovation frontier at the top. This pyramid can act as a coordinating lens across food, energy, materials and natural systems, showing where biological resources can support nature-positive growth, energy independence, circular resource use and long-run socioeconomic and ecological resilience (Yang et al., 2024; Feuerbacher et al., 2026). The EU's renewed bioeconomy strategy positions the bioeconomy as an operational vehicle for reducing dependence on fossil-based feedstocks, circularising linear value chains, strengthening supply chains and meeting biodiversity, climate and economic resilience goals (European Commission, 2025a). This framing is also reflected in the G20 High Level Principles published under the Brazilian G20 leadership in 2024 (GIB, 2024).

A strong bioeconomy depends on a strong natural capital base. Biomass¹ production relies on biological and non-biological inputs, including healthy soils, functional hydrology, pollination, climate regulation and other ecosystem services provided by natural capital. Without these underlying functions, biomass production declines, reducing the economy's ability to generate further value through biomass conversion or bioeconomy services (Feuerbacher et al., 2026). The UK is one of the most nature-depleted countries in the world, ranking in the bottom 10% for biodiversity intactness (NHM, 2025). This has increased dependence on food and energy imports, with approximately 50% of all UK nature-related risks originating overseas (Defra, 2026a; Ranger et al., 2024). Despite this depletion, the UK's natural capital still contributes the equivalent of 72% of GDP stock and could contribute more significantly to economic growth and climate resilience if properly maintained and restored (ISEP, 2026). For the UK to build economic and ecological resilience, it must invest in its natural capital base. Nature conservation and restoration are therefore preconditions for the UK bioeconomy's growth, not a parallel agenda (Defra, 2026a; ISEP, 2026).

Report aims and structure

This report describes the current state of the UK bioeconomy: its scale, geography, innovation footprint and finance landscape. Drawing on this analysis, we identify policy and finance actions needed to unlock its potential. The aim is deliberately practical: to move the conversation from concept to implementation through a concrete, sequenced agenda. To do so, we present five analytical stories that emerge from the data, alongside UK anchor case studies that demonstrate how the bioeconomy is already creating value in practice, and international

¹ Biomass refers to renewable organic material from biological sources, such as plants, animals or microorganisms, that can serve as an input in the production of energy, chemicals and bioproducts.

comparators that offer lessons from economies with developed bioeconomy strategies. The objective is to equip policymakers, investors and institutions with the evidence and practical tools needed to act.

The rest of the report is structured as follows. The remainder of the introduction covers definitions, the value of the bioeconomy approach, how the bioeconomy can be used to build a nature-positive economy and why the UK needs to undergo a nature-positive transition, and explains the statistical framework needed to progress a bioeconomy strategy.

Section 2 applies the framework to the UK's existing statistical system, telling five system-level stories: the bioeconomy's contribution to growth and employment; its trade profile and relevance to resilience; the geographic distribution of activity across UK regions; the innovation footprint revealed through bio-patenting; and a benchmarking of the UK against its European peers.

Section 3 turns to the high-growth, high-value sectors that sit at the top of the bioeconomy pyramid but are hidden in the aggregate data. Following signals from growth, investment and innovation, it examines engineering biology, biofuels and biorefineries, agritech, and precision breeding, and bio-based materials, using UK case studies to show how frontier innovation can upgrade the wider economy.

Section 4 draws these findings together, showing how a coordinated bioeconomy acts as a lever for four national priorities: inclusive growth, sustainability and nature-positivity, investment, and resilience.

Section 5 makes the argument for the UK's role in shaping the global bioeconomy agenda, drawing on its strengths in services, finance and research and its convening power at the G20 (2027) and G7 (2028).

Section 6 then sets out the international and domestic policy context and a tiered set of recommendations, from a full UK bioeconomy strategy to a lighter-touch cross-government framework, spanning statistics and measurement, governance, regulation and standards, finance, delivery through demonstrators and clusters, and international positioning.

Section 7 concludes.

1.2. Defining the bioeconomy

The bioeconomy does not have a universally agreed definition (Bugge et al., 2016); however, most definitions share a common starting point: the bioeconomy encompasses the value generated by sectors that use biological resources to function. This focuses on biotic natural resources, such as plants, animals and micro-organisms, and excludes abiotic resources such as water and minerals. Biological resources possess four distinctive properties that underpin their economic potential: renewability, carbon-friendliness, inherent circularity (particularly in closing cycles in waste processing, recycling and cascading use in biorefineries) and the capacity to offer new and improved functions such as higher stability, longer lifetime and lower toxicity relative to fossil-derived alternatives (Patermann and Aguilar, 2017).

Beyond this common foundation, definitions vary considerably in scope and context, as countries seek to define the bioeconomy in relation to their own ecosystems and growth priorities. For instance, the United States frames the bioeconomy around the sustainable utilisation of renewable biomass resources, focusing on biomanufacturing, biofuels, bio-based chemicals, advanced materials, biotech-based food ingredients and algae-based materials (NatureFinance, 2024). China similarly adopts a sector-based taxonomy consisting of seven domains: biomedicine, biomedical engineering, biological agriculture, biomanufacturing, bioenergy, bio-environmental technologies and biological services (Konstantinis et al., 2018). Brazil's approach

builds on its position as one of the world's most biodiversity- and nature-rich countries, defining the bioeconomy as a model of productive and economic development that is fair, ethical and inclusive, based on the sustainable use, regeneration and conservation of biological diversity, guided by both scientific and traditional knowledge (Da Silva et al., 2024). Ireland's Bioeconomy Action Plan takes a notably expansive approach, defining the bioeconomy as encompassing all sectors, associated services and investments that conserve, produce, regenerate, process, distribute or consume biological resources, including ecosystem services, knowledge, science, technology and innovation (Department of the Environment, Climate and Communications & Department of Agriculture, Food and the Marine, 2023). The Irish definition is distinctive in its explicit inclusion of investments in biological resources and its strong emphasis on circularity.

In this report we adopt the definition used by the European Union, which defines the bioeconomy as encompassing the production of renewable biological resources and their conversion into value-added products such as food, feed, bio-based products and bioenergy (Befort, 2020). The EU's 2018 updated definition expanded this further to include "all sectors and systems that rely on biological resources, their functions and principles", referring to the sectors that create value from biological resources and their direct derivatives, while also explicitly incorporating land and marine ecosystems and their associated services (Neill et al., 2020). This is a definition that works for the UK's position as a nature-poor but highly nature-dependent country, with a rich offering of knowledge and innovation that can support the transition of traditional sectors to become more productive, efficient and sustainable.

1.3. The value of the bioeconomy approach: the bioeconomy pyramid

The value of the bioeconomy concept lies in making visible a broad economic system that already depends on biological resources, biological processes and natural capital, but is currently governed through fragmented sectoral policies. For the UK, this lens is especially useful because it connects activities that are usually treated separately, including food production, life sciences, chemicals, waste, water, textiles, forestry, marine resources, environmental services, logistics, research and finance.

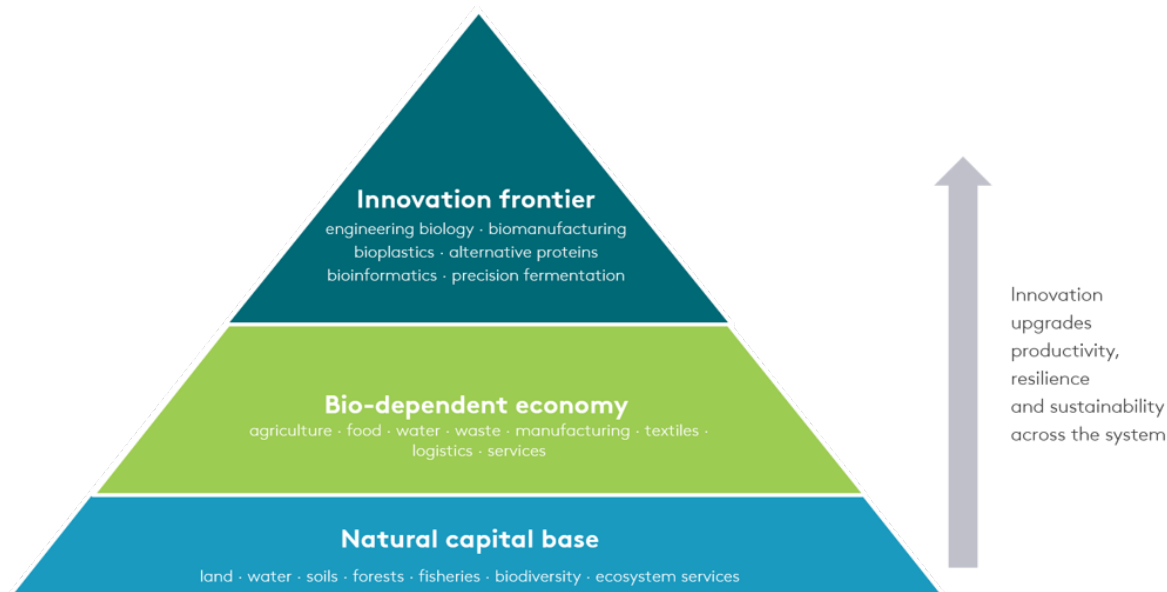
The bioeconomy can be understood as a pyramid (see Figure 1.1). Its base is the natural capital that enables biological production: land, water, soils, forests, fisheries, biodiversity and ecosystem services. This base performs two economic functions. The first is to support the bio-dependent economy, including the innovation frontier. It also directly supplies climate, water and resilience services to the wider economy.

The middle layer consists of the bio-dependent sectors that directly use biological resources and processes, including agriculture, food, water, waste, manufacturing, textiles, logistics and services. These are economic sectors that sit at the heart of the economy, providing goods, services and jobs, drawing on the wider natural capital base.

At the top of the pyramid sits the innovation frontier: advanced and high-tech activities such as engineering biology, biomanufacturing, bioplastics, alternative proteins, bioinformatics, synthetic biology and precision fermentation. This is the cutting-edge, where sectors convert small portions of biomass into very high value-added products, boosted through innovation and technology.

The strategic value of this innovation frontier lies not only in its own growth potential, but in its ability to 'upgrade' the wider bioeconomy beneath it. These technologies can use the scale of existing bio-dependent sectors to generate productivity gains, strengthen resilience and support a transition to a more sustainable economic system.

Figure 1.1. The UK bioeconomy pyramid



Note: Frontier innovation (top) upgrades the wider bio-dependent economy and natural capital base beneath it.

Source: Authors' framework; Ronzon et al. (2017, 2022).

Taken together, these activities form a bio-dependent economic superstructure that is far larger than the high-tech sectors normally associated with the modern bioeconomy. Many of these outcomes can be financed and delivered without explicitly using the term 'bioeconomy'. The terminology becomes limiting when it simply adds another label without changing priorities, incentives or market behaviour. However, the label helps make the economy's dependence on biological systems visible, aggregates dispersed sectors into a market deep enough to sustain a specialist investor base, and creates a basis for coordinated policy action. The bioeconomy is therefore not only a sectoral growth agenda; it is a way to organise economic activity so that biological resources, ecosystem services and innovation support a transition towards a nature-positive economy.

The renewables sector provides a useful precedent, where a shared label helped bring together a range of technologies and formats, including geothermal, solar and battery storage, and mobilised policy, finance, standards and demand around a common transition objective. The bioeconomy can play a similar role, bringing components of the economy that are bio-dependent together under one umbrella. This grouping can, in turn, support more holistic growth, offering a pathway to expand frontier sectors using the wider base, in the way digital technologies have been deployed across the wider economy: as a general-purpose platform for productivity, resilience and system transformation. Sectors such as engineering biology, biomanufacturing, bioplastics and alternative proteins should therefore be understood as enabling technologies for the wider bioeconomy, not as isolated frontier industries.

1.4. Ensuring a sustainable bioeconomy

A nature-positive economy is one in which economic activity contributes to halting and reversing nature loss, restoring ecosystem functions and increasing the resilience of natural capital over time. For the bioeconomy, this means that growth cannot simply substitute biological inputs for fossil inputs; it must improve circularity, reduce pressure on land and water, and reinvest in the ecosystems that make biological production possible.

The bioeconomy lens can be a useful tool to build a nature-positive economy. However, a bioeconomy is not inherently sustainable, circular, nature-positive or equitable. Bio-based activity can still degrade ecosystems, increase emissions or intensify resource pressures if it expands without safeguards. Biofuels, for example, can deliver neutral or even negative climate outcomes once land-use change is accounted for (Konstantinis et al., 2018). Biological resources are renewable, but they are not infinite: ecological limits determine the pace and scale at which biomass can be used sustainably (Dasgupta, 2021).

The sustainability of the bioeconomy therefore depends on deliberate design. Three related concepts are especially important for making that design coherent:

Circularity: The circular economy and the bioeconomy overlap in their focus on biomass flows and the shift away from linear production systems. However, the bioeconomy is not automatically circular. It can still rely on unsustainable and linear inputs, including chemical fertilisers in agriculture. Circularity must therefore be built into the bioeconomy through cascading biomass use, waste recovery, nutrient cycling, water reuse and the substitution of fossil-based feedstocks with bio-based and circular alternatives. Drawing on circular design principles for food systems, this means designing products, ingredients, supply chains and business models to avoid waste and pollution, valorise by-products, cycle nutrients back into productive use, and ensure biological resources are produced in ways that regenerate rather than deplete natural capital (Ellen MacArthur Foundation, 2026).

Natural capital and ecosystem services: Natural capital provides both the biomass used by the bioeconomy and the ecosystem functions that make bio-based activity possible, including soil health, hydrology, pollination, climate regulation and biodiversity. Natural capital accounting helps identify the value and condition of this base, but it does not by itself determine how economic value should be generated from biological resources. A sustainable bioeconomy must therefore treat natural capital as productive infrastructure, not as an external input.

Conservation and restoration: Nature conservation and restoration are preconditions for a sustainable bioeconomy. Conservation reduces the risk of further nature loss, while restoration rebuilds the natural capital base on which biomass production and bio-based services depend. These activities are not the same as the bioeconomy itself, but they are essential investments in the asset base that allows the bioeconomy to grow without degrading the systems on which it relies.

A sustainable bioeconomy must therefore organise biomass flows within ecological limits. This means designing systems in which biomass is first used for higher-value applications, then reused, recycled or recovered where possible, including through energy recovery only after other uses have been exhausted. Cascading use can help close key loops in urban waste, nutrient cycling, especially phosphorus and nitrogen, and water, reducing the resource intensity of primary biomass production while improving productivity. With better biomass production and stronger bio-circularity, lower bio-share industries can also begin to shift towards bio-based and circular feedstocks, supporting a more climate- and nature-positive industrial transition (Feuerbacher et al., 2026; EC, 2025a).

The purpose of outlining the bioeconomy in the UK is to understand the scope of economic activity that can potentially be transformed for nature-positivity. A supportive policy environment can structure the bioeconomy so that its growth strengthens natural capital, improves circularity and delivers productivity gains within ecological limits.

1.5. The UK's bioeconomy

The UK economy is one of the most nature-depleted in the world, ranking in the bottom 10% globally for biodiversity intactness (NHM, 2025). However, it remains significantly dependent on

ecosystems, both domestic and overseas, that contribute to its socioeconomic security (Burns et al., 2023; Defra, 2026a). Currently, at least half of UK financial institutions' £4 trillion in assets are at least moderately dependent on ecosystem services (Ranger et al., 2024). The UK also has the capacity to transform its economy to be nature-positive by leveraging its financial expertise, biotechnological research and investment in the agri-food sectors (Defra, 2026a; BB-REG-NET, 2025b; Barclays, n.d.; Environmental Audit Committee, 2025).

The UK's dependence on nature, whether domestic or overseas, is well documented. The country imports around 40% of its food, the majority of which comes from Europe, particularly fresh fruit, vegetables and sugar. It is also dependent on imported animal feed to sustain current levels of animal agriculture, with South American soy alone accounting for 18% of supply (Defra, 2025). Despite being significantly nature-depleted, the UK's ecosystem services in 2022 amounted to £1.8 trillion, approximately 72% of national GDP (ISEP, 2026). Yet only 900 UK nature-related businesses are directly engaged in activities that reduce nature loss, employing 21,445 people and generating £2.2 billion in turnover in 2024 (Purdie, 2025). The UK is therefore exposed to global nature-related risks on both the supply side and the demand side, while the productive activity that could build resilience to those risks remains small-scale relative to the total activity creating value from, or depending on, nature.

The UK economy already derives and creates significant value from biological resources. The life sciences sector, which comprises pharmaceuticals and MedTech, employed 304,200 people in 2021–22, generating around £108.1 billion in turnover (HM Government, 2025a). The UK has also recognised biomass as a key channel through which it can simultaneously achieve net zero targets and support sustainable transitions in non-energy sectors such as chemicals and materials (DESNZ, 2023). Overall, clean energy and life sciences are two of the eight sectors that underpin the UK's Modern Industrial Strategy and form part of its bioeconomy (DBT, 2025a). Additionally, the UK's financial and business services sector is uniquely placed to design and intermediate instruments for both the UK and the global bioeconomy (DBT, 2025c; Purdie, 2025; Environmental Audit Committee, 2025). The UK can therefore invest in its food and energy security and resilience through the bioeconomy, while contributing to the structuring and financing of the global bioeconomy.

Drawing on these insights, it is clear that the UK needs to undergo a nature-positive transition that focuses on delivering economic growth by leveraging its unique sectoral strengths and strengthening food and energy security. The bioeconomy offers a lens that cuts across industrial strategy, nature, trade, innovation and finance. It captures the productive activity that depends on biological resources and processes, links it to the natural capital base that sustains it, and connects it to the trade, investment and innovation systems through which that activity scales up. This necessitates a cross-sectoral bioeconomy framework that coordinates how the UK can create more value from biological resources while conserving and restoring its natural capital base.

1.6. A UK bioeconomy framework: measuring the bio-dependent economy

A bioeconomy strategy requires a statistical framework, because what is not defined and measured cannot be governed, financed or upgraded. **The UK currently lacks a framework that defines the bioeconomy and quantifies its contribution to the country's socioeconomic and environmental outcomes.** Previous estimates of the UK's bioeconomy suggested the sector added £220 billion in value to the economy in 2013, supporting around 5 million jobs. In the absence of a replicable framework, this statistic, while widely cited (Bagshaw et al., 2018; BBSRC, 2018), has not been systematically updated, despite the evolution of approaches that measure the bioeconomy within existing national or supranational statistical systems (Ronzon et al., 2017, 2022). Defining the sector through a consistent analytical framework, measuring its

economic contribution and tracking its regional, trade, innovation and investment profile, gives government and investors the baseline needed to coordinate policy and allocate capital.

Major economies have moved from treating bio-based activity sectorally to coordinating it under explicit, cross-cutting bioeconomy strategies that address multiple socioeconomic and environmental objectives. The UK is the conspicuous absence among comparable economies, having allowed its previous strategy to lapse without replacement.

A clear framework that aligns with existing statistical systems can help policy engage with the scope and scale of the bio-dependent economy, support international comparability, and guide investments that can anchor growth, regional resilience and inclusion while remaining nature-positive. A coherent framework forms a necessary backbone that structures which economic activities count as 'bio-based', how inputs and outcomes are measured and which stakeholders are involved. A framework should therefore perform three functions:

1. **Establish a common definition** to enable coordination among policymakers across departments, investors, innovators and researchers
2. **Provide a baseline statistical account** of what the UK bioeconomy is and how its size, composition and trajectory have evolved
3. **Support benchmarking against other countries**, particularly major partners or countries and regions with comparable economic or demographic structures, such as the EU.

To build such a framework, this report adopts the methodology drawn from the EU's approach to the bioeconomy. The EU/Joint Research Centre (JRC) methodology provides the most practical foundation for a UK framework because it maps bio-based shares onto existing industrial classifications and can therefore be translated into the UK's Standard Industrial Classification (SIC)-based statistical system. The methodology was first developed for biomass producing and converting sectors by Ronzon et al. (2017) and then extended to services by Ronzon et al. (2022). Including bioeconomy-related services is especially important for the UK because a services-heavy economy creates substantial bioeconomic value through distribution, knowledge, finance, logistics, environmental management and support activities.

This framework has the advantage of being aligned with the strategic typology developed by NatureFinance, which was developed through a bottom-up approach as part of the discussions at the 30th meeting of the Conference of the Parties (COP30) to the United Nations Framework Convention on Climate Change (UNFCCC) in Belém, Brazil, in 2025 (Kantola and Zadek, 2024). This report therefore adopts a framework that measures the breadth of the bio-dependent economy while identifying the strategic frontier where innovation can create higher-value, lower-impact forms of growth. This supports an integrative approach to the UK's bioeconomy. An integrative and coordinated approach is needed to create market depth, cultivate a specialist investor base, and build supportive infrastructure that individual subsectors cannot sustain alone. Coordination is also needed to bridge gaps in policy where the current fragmented landscape does not support overall growth in the economy.

We note that there are limitations to this approach, presenting a case for better data and reporting to improve approaches to the UK's bioeconomy. The EU's statistical framework does not include services, which we add to incorporate the UK's strengths in the services sector. In addition, the framework is useful for measurement and comparability, but it leaves a biodiversity gap: a more accurate account of the UK's dependence on the bioeconomy would need to capture both domestic nature depletion and the country's dependence on resilient relationships with nature-rich partner countries.

The statistical framework

The current framework followed by the EU was developed by the JRC and trifurcates the bioeconomy into three broad categories (Ronzon et al., 2017, 2022):

1. **Biomass production** – Industries that produce biomass such as agriculture
2. **Biomass conversion** – Industries which convert biomass from one form into another, such as food processing, or biogas production
3. **Bioeconomy services** – The distributional, knowledge, environmental or support activities that are linked to biomass production and conversion such as scientific research on biofuels.

The framework maps directly onto the EU's NACE (Statistical Classification of Economic Activities in the European Community) classification and can be translated to the UK's SIC codes, which are used to organise industrial data, enabling clear and comparable measurement of bioeconomy trends across countries over time (Lasarte-Lopez and M'barek, 2025; ONS, 2009). Services are further sub-categorised into knowledge-based services, natural environment-related services, services related to tangible bio-based goods and bioeconomy support services. Indirect contributors to the bioeconomy, such as financial services or information technologies, are excluded from this framework, as are non-monetised ecosystem services (Ronzon et al., 2022).

At the heart of this mapping exercise are the '**bio-based shares**', which estimate the extent to which each sector's outputs can be attributed directly to the bioeconomy. This allows our analysis to calculate the size and scale of the UK's economy that derives directly from the bioeconomy.²

The full set of UK bioeconomy sectors and their bio-based shares, grouped into the three JRC sector groups, is provided in Appendix C. The methodology used to derive these shares and apply them to UK statistics is set out in Appendix B, alongside the methods for measuring innovation and investment. The full set of excluded sectors and shares, with the rationale for exclusion, is provided in Appendix A.

NatureFinance's bioeconomy framework (Kantola and Zadek, 2024), developed through engagement with stakeholders, organises sectors of the bioeconomy into the following categories:

- **Nature-intensive Bioeconomy:** sectors directly dependent on biological resources such as agriculture, forestry or textiles
- **Advanced Bioeconomy:** sectors that integrate modern technologies to produce higher value outputs such as biofuels or bioplastics
- **High-tech Bioeconomy:** sectors generating the maximum value with minimal direct biomass input such as genomics, bio-informatics or engineering biology.

The Nature-intensive Bioeconomy maps directly into the 'Biomass Producing' sectors in the JRC framework, which have a 100% bio-based share. Advanced Bioeconomy and High-tech Bioeconomy align with the 'Biomass Conversion' sectors, with a positive bio-based share. For clarity throughout this report, our discussion focuses on the JRC sector groups, which are better defined and support comparison with economies in the EU.

² Bio-based shares by SIC division are available from 2008 onwards, derived from JRC estimates (Ronzon et al., 2022) and carried forward from the last observed value for years beyond the original series endpoint.

2. The UK's bioeconomy in data

The framework outlined above provides a way of understanding the bioeconomy that aligns with the UK's existing statistical system and identifies the parts of the economy directly dependent on biological resources. While it is less suited to capturing frontier systems, it enables an assessment of the scale and characteristics of the UK's bio-dependent economy. This section highlights the key insights that emerge from that analysis.

By examining the data through policy-relevant lenses, including growth and employment, trade and resilience, geographic spread, innovation, and benchmarking the UK against its European peers, we find that the UK bioeconomy is already economically significant, highly trade-dependent, regionally distributed and characterised by strong innovation potential. While there are bright spots across productivity, sectoral growth and innovation, these strengths have yet to be coordinated as a coherent economic system.

A note on methodology

To estimate the size and structure of the UK bioeconomy, we use the approach developed by the EU's Joint Research Centre (JRC). Every sector of the UK economy, as defined by the Standard Industrial Classification (SIC), was assigned a 'bio-based share' reflecting the proportion of that sector's output that results from the use of biological resources (Ronzon et al., 2017, 2022). These bio-based shares were sourced from the JRC (n.d.) and applied to data from the UK statistical system on employment, gross value added (GVA), output per job and business counts. PATSTAT patent applications at the UK Intellectual Property Office (UKIPO) were used to examine innovation. Private funding data from Dealroom and Innovate UK grant funding data were retrieved from The Data City for a sample of UK companies to examine investment in frontier bioeconomy sectors. Further details on the methodology are available in the appendices.

2.1. Growth and employment

The measurable UK bioeconomy is economically significant, but its growth profile is fragmented across industry divisions. It accounts for 13.2% of UK GVA with associated employment representing approximately 19% of total UK employment in 2023 (see Figure 2.1; Table 2.1).

The bioeconomy has grown more slowly than the wider economy over the past decade and a half: GVA for the bioeconomy grew at 0.73% per annum in real terms between 2009 and 2023, while the UK economy as a whole grew at 1.62%, and employment attributable to the bioeconomy grew at 0.9% per annum, marginally below the national rate of 1.0% ONS, 2025e) (see Table 2.1). Compared with EU member countries, this shows that the UK has the fourth-largest bioeconomy in Europe by size but ranks 21st out of 28 for growth in nominal terms.

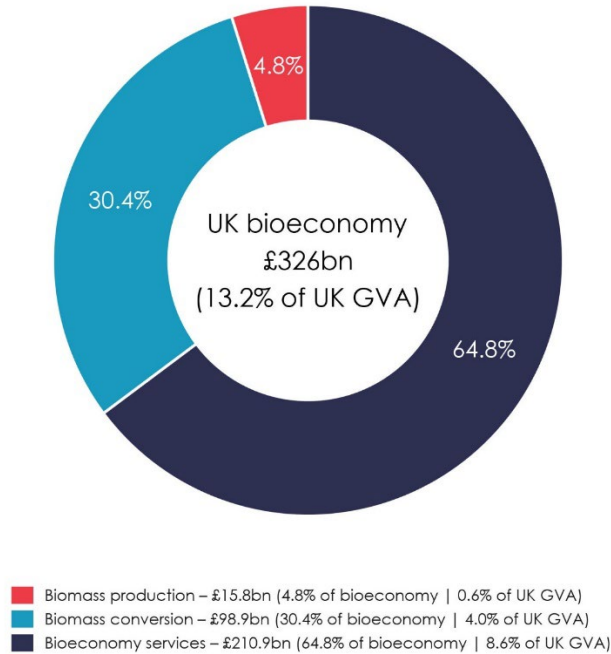
This is a substantial share of the UK's economy, making it too large to be treated as a niche environmental or technology agenda and highlighting its potential as a cross-sectoral framework for sustainability and nature positivity.

Size and composition

Following the structure of the UK's economy, services dominate the bioeconomy in 2023, contributing nearly two-thirds of GVA attributable to the bioeconomy, with services related to tangible bio-based goods (SATBG) being the largest single category at £129.1 billion, led by food and beverage services (£50.0 billion GVA attributable to the bioeconomy), retail trade (£32.4 billion), and wholesale trade (£20.4 billion). Knowledge-based services (KBS) contribute £29.4 billion, led by scientific research and development (£11.3 billion) and veterinary activities (£6.3 billion). In biomass conversion sectors, food manufacturing is the largest contributor at £27.4

billion, followed by construction (£12.5 billion), pharmaceuticals (£10.4 billion), and beverages and tobacco (£9.9 billion). Biomass production is overwhelmingly driven by agriculture and animal rearing (£13.8 billion), with forestry (£1.1 billion) and fishing (£0.9 billion) much smaller.

Figure 2.1. Bioeconomy composition based on GVA, 2023



Source: Authors' calculations from ONS GVA (2025e) and applying bio-based shares obtained from Ronzon et al. (2017, 2022) and Lasarte-López and M'barek (2025)

Table 2.1. UK bioeconomy by category, 2023

Sector group	SICs	Bioeconomy GVA (£m)	Bioeconomy employment (000s)	Productivity in the bioeconomy (£/job)	GVA CAGR	Emp CAGR
Biomass production	3	15,768	518	46,515	3.0%	-0.2%
Biomass conversion	18	98,864	1,004	65,460	2.9%	0.8%
Bioeconomy services	25	210,940	4,870	21,010	3.9%	1.1%
Total bioeconomy	46	325,573	6,393	£35,743	3.5%	0.9%
National	–	2,464,587	33,117	72,306	4.1%	1.0%

Note: All bio-GVA and employment figures use average bio-based shares. Compound Annual Growth Rate (CAGR) computed for 2009–23. GVA at current prices.

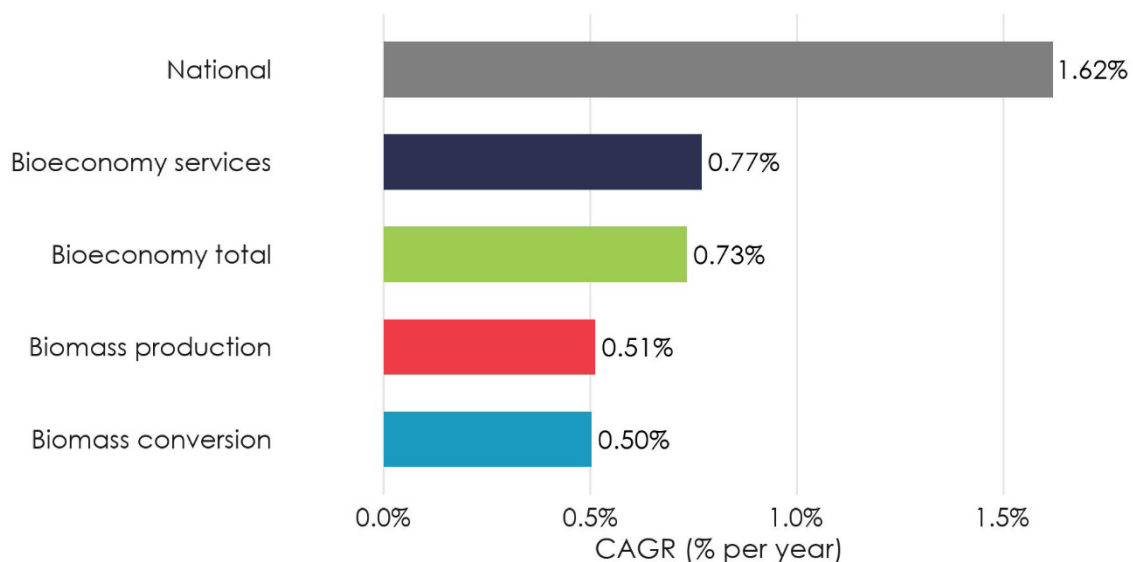
Source: Authors' calculations from ONS (2025e); ONS BRES (2025); ONS LPROD (2025) applying bio-based shares obtained from Ronzon et al. (2017, 2022) and Lasarte-López and M'barek (2025)

Employment follows a similar pattern: biomass production employs around 518,000 people; biomass conversion approximately 1 million; and bioeconomy services between 3.8 and 5.7 million, accounting for roughly three-quarters of bioeconomy employment. This contrast reflects the lower bio-based share of high-employment service sectors.

Growth

While the UK's bioeconomy has lagged the wider economy on growth, the headline figure masks sectoral differences. Knowledge-based services (1.65% Compound Annual Growth Rate [CAGR]) marginally exceed the national rate of growth (1.62%). Natural-environment-related services (1.42%) and bio-based services in trade and goods (0.56%) follow. Biomass production (0.51%), biomass conversion (0.50%), and bioeconomy support services (0.52%) grew at broadly similar, slower rates (see Figure 2.2).

Figure 2.2. GVA growth: bio-based sector groups versus national (CAGR 2009–23)



Notes: Bioeconomy subsector level real growth rates are computed using Laspeyres-type chain-volume aggregation to account for chained volume measures (CVM) non-additivity across industries. Each SIC's annual bio-GVA real growth rate (from the bio-share-adjusted CVM series) is weighted by its prior-year current-price bio-GVA share within the group, and the resulting weighted growth rates are chained annually into an index from which the CAGR is derived. Regional CAGRs use each region's own CVM growth rates and current price (CP) weights.

Source: Authors' calculations from ONS (2025e) applying bio-based shares obtained from Ronzon et al. (2017, 2022) and Lasarte-López and M'barek (2025)

The fastest-growing sectors outpaced both bioeconomy and national benchmarks but are small in magnitude. Remediation and other waste management services grew at 12.32% per annum in real terms, while electricity, gas and air conditioning grew at 6.22%, potentially reflecting the rising bio-share of the energy sector (JRC, n.d.), where bioenergy already provided 8.6% of total UK energy supply in 2022 (DESNZ, 2023, p. 6). Veterinary services (3.14%), wood manufacturing excluding furniture (1.65%), and pharmaceutical products (1.26%) also grew faster than the UK's national average of 1.62%.

The largest absolute contributors to bioeconomy GVA, by contrast, are growing slowly or contracting. Food manufacturing (0.30% CAGR), retail trade (0.67%), and food and beverage services (0.35%) all sit well below the national 1.62% benchmark. Beverages and tobacco contracted at -1.46% per annum, as did scientific research and development (-0.12%). The part

of the pharmaceuticals sector attributed to the bioeconomy, despite its identification as a strategic priority in successive industrial strategies and life sciences plans (HM Government, 2025a, 2025b), grew at only 1.26% per annum, below the national rate between 2009 and 2023.

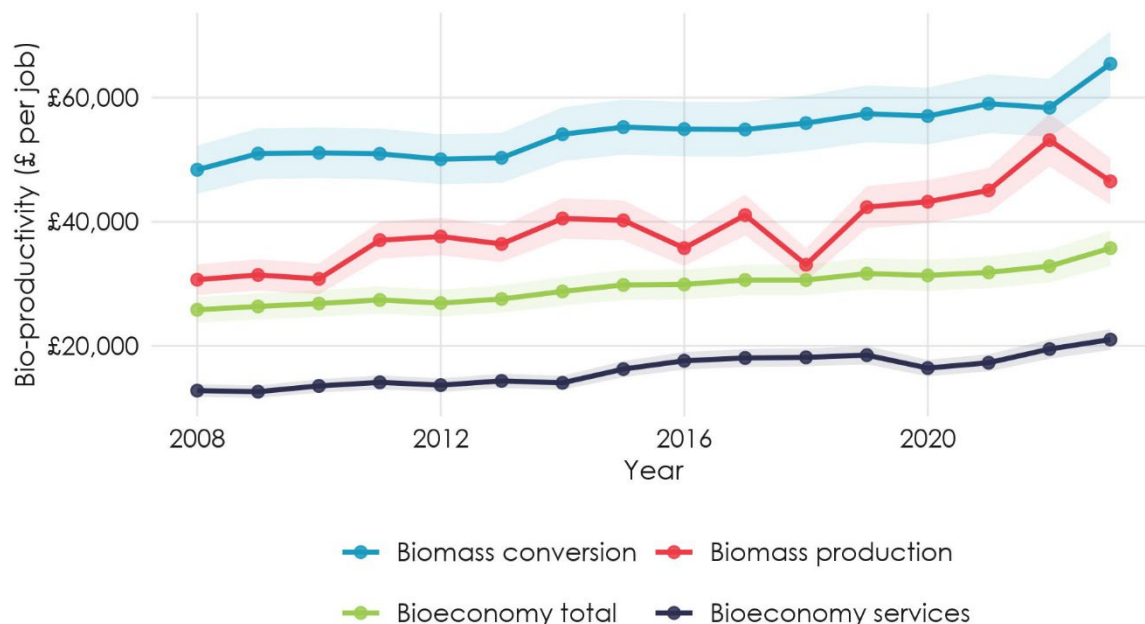
Productivity

Productivity in the parts of the economy attributable to the bioeconomy, using sector-level ONS output per job scaled by average bio-based share, varies substantially among sectors, as shown in Figure 2.3. Overall, productivity across all bioeconomy sectors has been steadily increasing since 2009, from around £26,000 to around £36,000 in 2023. Biomass conversion sectors lead at £65,000 per job in 2023; biomass production sectors stand at £47,000, though they are notably volatile year-on-year; and bioeconomy services average around £21,000 per job, with knowledge-based services substantially higher at £35,000 (ONS LPROD, 2025).

Sectoral leaders sit at the top of the distribution. Pharmaceuticals is by far the most productive sector, at approximately £215,000 per job in 2023, followed by beverages and tobacco manufacturing at £186,000, and scientific research and development at £88,000 per job. These sectors represent the frontiers of the bioeconomy, with high levels of value added. However, the granularity of the ONS data does not allow for further analysis to distinguish the frontier activities driving that growth. We look at these in more detail in the following section.

Productivity growth has concentrated in less expected places. Between 2009 and 2023, the fastest gains in productivity attributable to the bioeconomy were in electricity, gas and air conditioning supply (a 4.18-fold increase), leather manufacturing (2.53-fold), apparel manufacturing (2.49-fold), and travel and tour agency services (2.56-fold). Pharmaceuticals grew at only 1.4-fold over the period.

Figure 2.3. Bio-based productivity by sector group, 2009–23 (£ per job, current prices)



Source: Authors' calculations from ONS LPROD (2025) applying bio-based shares obtained from Ronzon et al. (2017, 2022) and Lasarte-López and M'barek (2025)

Sectoral growth patterns suggest a missing-middle pattern. The largest UK bioeconomy sectors are slow-growing while the fastest-growing sectors are smaller in GVA terms (see Figure 2.4). No

major sector sits in the high-growth, high-share category that could anchor the bioeconomy industrially. By comparison, clean energy, artificial intelligence (AI) and advanced manufacturing each have anchor firms and identifiable scale-up pathways supported by current policy environments and strategy. The Modern Industrial Strategy identifies all three among its eight priority growth sectors, each with a dedicated Sector Plan, named investment commitments and projected growth targets (DBT, 2025a). The bioeconomy has no equivalent.

Figure 2.4. Growth in GVA and employment attributable to the bioeconomy per sector

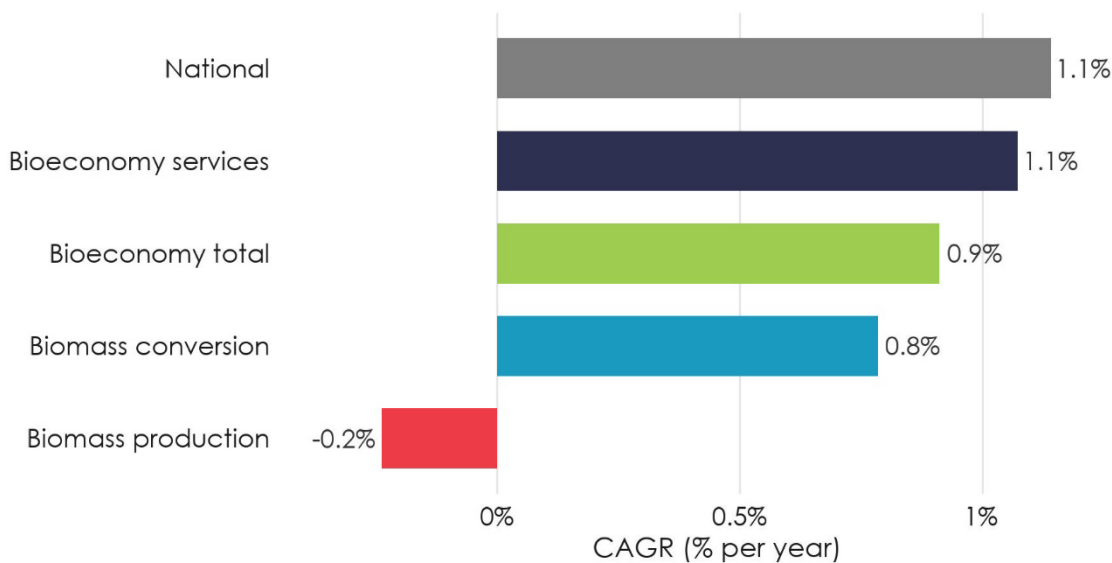


Notes: Size of dot represents the nominal GVA of the sector. Only the sectors in coloured dots have shown higher growth than the UK economy between 2013 and 2023.

Source: Authors' calculations from ONS GVA at Chained Volume Prices (2025e) from Ronzon et al. (2017, 2022) and Lasarte-López and M'barek (2025)

Employment trends align with the growth in value added (see Figure 2.5). Services employment grew at 1.1% and biomass conversion sectors at 0.8% from 2009 to 2023, while biomass production sectoral employment declined at –0.2% per annum, mainly driven by agriculture (–0.4%) and partly offset by forestry (+3.4%) and fishing (+3.0%). This reduction in the agricultural labour force was experienced throughout the European continent (Ronzon et al., 2017). Given the number of sectors recording positive GVA growth attributable to the bioeconomy alongside negative employment growth, the UK’s growth story indicates productivity gains rather than expansion.

Figure 2.5. Employment growth: bio-based versus national (CAGR 2009–23)



Source: Authors’ calculations from the ONS Business Register and Employment Survey (ONS BRES, 2025), Table 2b – total employment (employees + working owners), 2009–23, applying bio-based shares obtained from Ronzon et al. (2017, 2022) and Lasarte-López and M’barek (2025)

The growth story therefore underscores the theme we find in the UK’s bioeconomy: there is a large bio-dependent economy and promising frontier capabilities, but the two are not yet organised as a coherent growth proposition. A bioeconomy lens, seen as a pyramid (see Figure 1.1), can allow the UK to connect its frontier strengths in engineering biology, life sciences and bio-based innovation to the larger industrial sectors where productivity and sustainability gains are most needed. It provides a mechanism that connects large, slower-growing bio-dependent sectors with faster-growing frontier capabilities, addressing the challenge of turning a dispersed economic base into a coordinated productivity agenda.

2.2. Trade and resilience

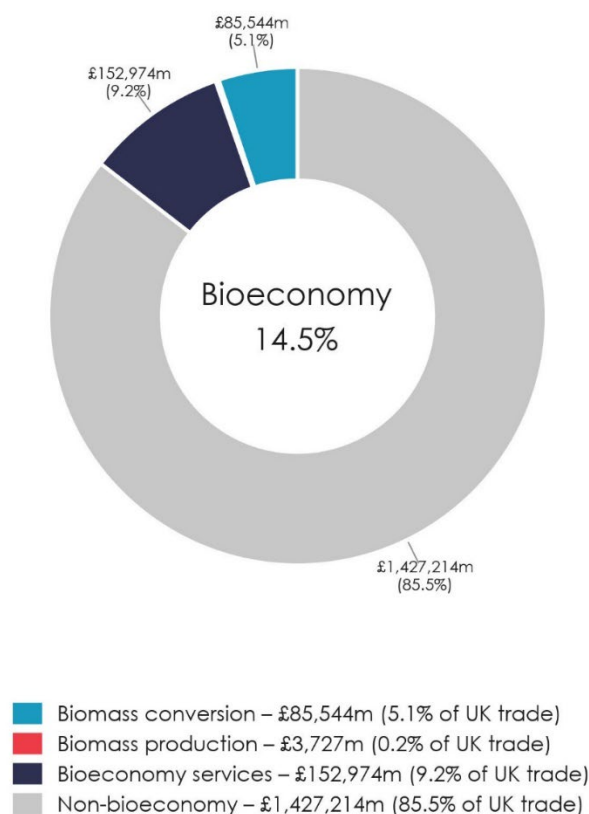
Trade is integral to the UK bioeconomy, with bio-dependent sectors deeply embedded in international supply chains for food, feed, materials, chemicals, services and knowledge. As a result, the bioeconomy accounts for a significant share of UK trade, reflecting its broader contribution to economic output. UK trade attributable to the bioeconomy largely mirrors the wider economy in being services-dominated and having stagnated, despite the UK economy being relatively open to trade in line with the OECD average (Anil et al., 2025).

For this section, we examine ONS data on trade, with three findings defining the UK bioeconomy’s trade story. First, the bioeconomy is more import-dependent than the wider economy: it accounts for 16.1% of imports and has an export–import ratio of 0.90, compared

with 1.07 for the UK economy overall. Second, the UK's comparative strength lies in bioeconomy services, which are export-oriented and diversified, alongside a continued and deep dependence on imported bio-based goods and inputs. Third, the geography of trade is fairly concentrated – the EU remains the dominant partner, while selective diversification with nature-rich and fast-growing economies can strengthen supply-chain resilience and create new markets for UK services and innovation (see Figure 2.6).

As of 2023, the UK bioeconomy accounted for 14.5% of all UK trade across goods and services, comparable to the UK bioeconomy's GVA share of around 13.2%. The largest sector of the bioeconomy is bioeconomy services, which accounts for the majority of trade at 9.3% of the country's overall trade. The next largest sector is biomass conversion, accounting for 5.2% of trade. Biomass production accounts for just 0.2% of trade in value terms (£3,727m), a number much smaller than the UK's food imports of £85.5 billion in 2023 (Defra, 2025).

Figure 2.6. UK trade attributable to the bioeconomy in proportion to total UK trade, 2023

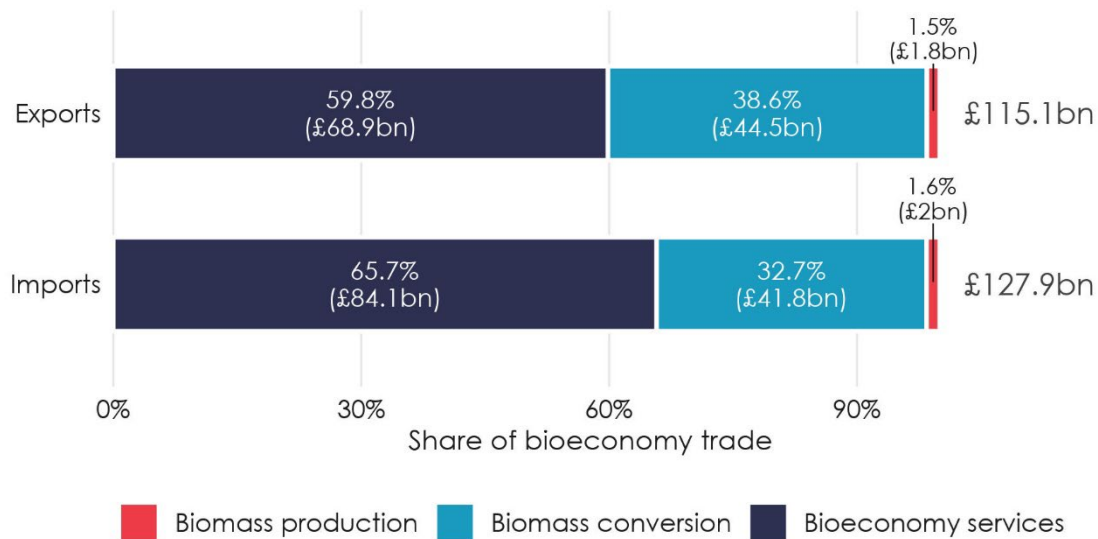


Note: Bioeconomy (biomass conversion + biomass production + services) = 14.5% of total economy.

Source: ONS (2025a, 2025b, 2025c, 2025d)

In terms of exports, the UK bioeconomy accounted for 13.5% of total UK exports in 2023, a ratio slightly lower than its share of overall trade. Bioeconomy services remain the largest sector within the bioeconomy, accounting for 8.1% of exports. Biomass conversion sectors hold a stable 5.1% of exports, similar to their share of overall trade, while biomass production's share is 0.2% (see Figure 2.6). For imports, the bioeconomy accounts for 16.1% of all UK imports by value, with bioeconomy services accounting for the largest share of imports within the bioeconomy at 10.6%. The data suggest that the UK bioeconomy is more import-dependent than the UK economy as a whole, accounting for a larger proportion of imports than exports (see Figure 2.7).

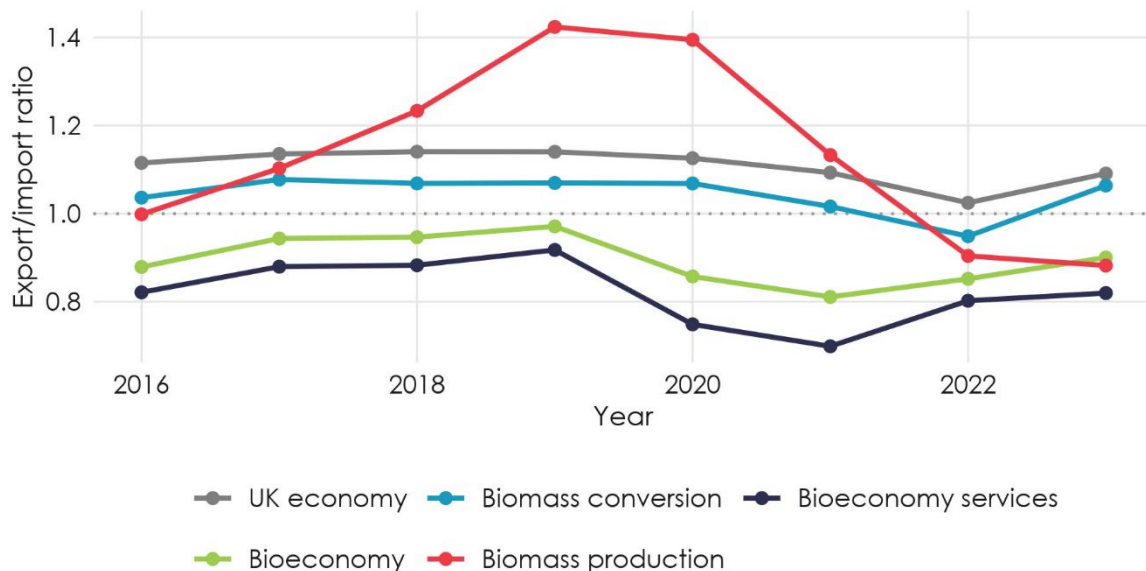
Figure 2.7. UK bioeconomy trade composition, including goods and services, 2023



Source: ONS (2025b, 2025d)

Using data from the ONS (2025a, 2025b, 2025c, 2025d), we find that the UK economy ran a positive but narrow trade surplus in 2023, aligning with more recent analysis on the UK balance of payments (Jozepa, 2026). The UK economy in 2023 had an export-import ratio of 1.07, significantly higher than the bioeconomy, at 0.90 (see Figure 2.8).

Figure 2.8. UK export-import ratio by bioeconomy sector group (2016-23)



Note: The dashed line represents balanced trade (ratio=1).

Source: ONS (2025a, 2025b, 2025c, 2025d)

Focusing on trade in bioeconomy-related services, a few interesting patterns emerge. First, the UK maintains a large net export position in services, with ONS data indicating that service

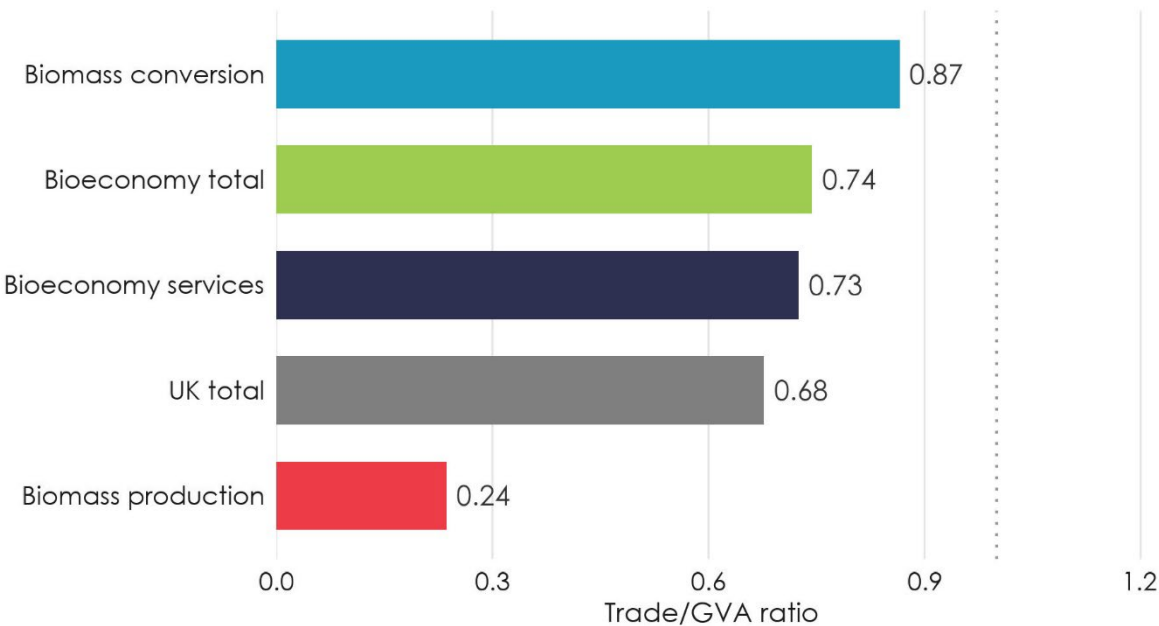
exports outvalue imports by around 2.48 times, aligning with more recent research (Jozepa, 2026). Notably, the bioeconomy services sector appears to be more export-oriented than the UK economy as a whole, with a ratio of 2.76.³ Further sub-sector-level analysis points towards a high level of diversification and a consistent increase in knowledge exports associated with frontier sectors such as scientific research.

The biomass conversion sector is a net exporter in services, while the biomass production sector is a net importer. This suggests structural dependence in the UK economy on biological inputs, intermediate goods and material supply chains from overseas.

Overall, in almost all sectors, the trade balance is more favourable in services than in goods, reflecting the UK's strength in services. However, this does not appear to substantially exceed the negative balance in goods trade, both within the bioeconomy and overall (Jozepa, 2026; Webb, 2024).

Calculations of trade intensity suggest that bioeconomy sectors are more open to trade than the UK economy as a whole (see Figure 2.9). The UK economy's ratio of trade (imports and exports combined) to GVA stands at 0.67, which aligns with estimates of a trade-to-GDP ratio of 65% (Anil et al., 2025), while the UK bioeconomy has a trade-to-GVA ratio of 0.74, higher than the UK economy overall. This is pulled upwards in particular by higher trade intensity among biomass conversion sectors, at 0.87. Biomass production appears to be notably more closed to trade, with a ratio of just 0.24, suggesting a more domestic orientation.

Figure 2.9. UK trade intensity by sector, 2023



Note: Total trade (exports = imports)/GVA. Dotted line at 1.0 = trade equals GVA.

Source: ONS (2025a, 2025b, 2025c, 2025d)

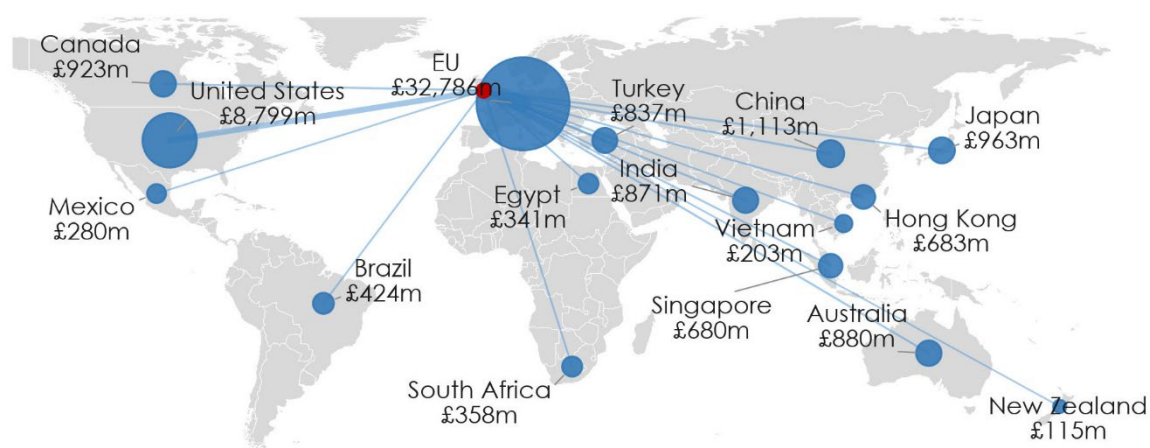
³ This ratio refers to imports and exports in services by bioeconomy services sectors. ONS trade data attributes some general trade in services to non-service sectors such as agriculture or manufacturing. As a result, biomass-producing and biomass-converting sectors can also register trade in services, despite being predominantly goods-producing sectors.

Geography of trade: EU dominance and diversified non-EU partners

The EU is the UK's largest trade partner in both goods and services trade, amounting to £814 billion in 2024 (DBT, 2025b). The EU accounts for 49% of imports and 41% of exports as of 2025, and 46% of all UK trade in 2024 (DBT, 2025b; Anil et al., 2025).

The EU remains the single largest export destination for British bio-based goods, accounting for £32.8 billion in 2023 (see Figure 2.10). The US is the largest non-EU destination. Among other non-EU partners, China is the next largest destination at £1.1 billion, followed closely by Canada and Japan at £963 million and £923 million respectively. Overall, non-EU bio-based goods exports are concentrated in Asia, especially East Asia. Nonetheless, the EU absorbed roughly half of the UK's £65.6 billion in bio-based goods exports in 2023, underscoring the continuing importance of EU market access and the UK-EU Trade and Cooperation Agreement for the bioeconomy (DBT, 2025b).

Figure 2.10. UK goods exports attributable to the bioeconomy by partner, 2023



Notes: Line thickness and bubble size = bio-trade value (£m, 2023). Non-EU aggregate not shown – individual non-EU partners displayed separately.

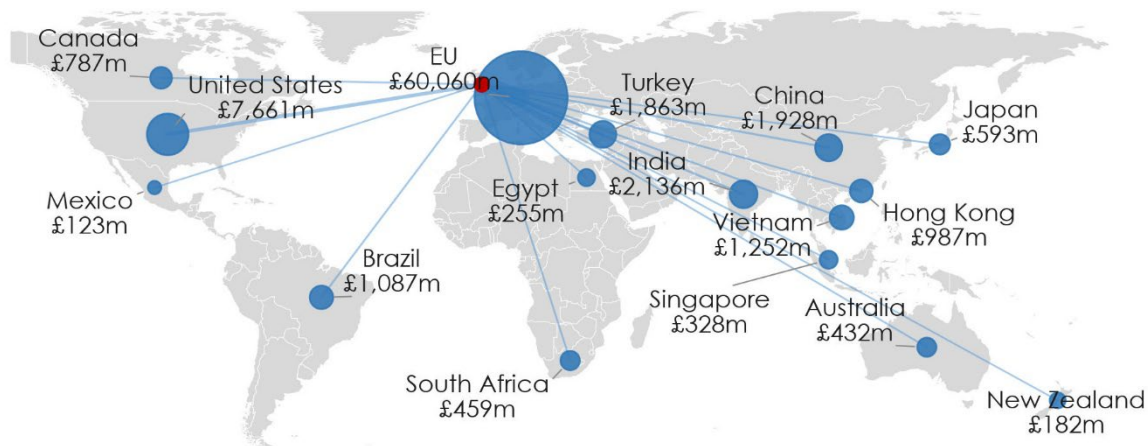
Source: ONS (2025a)

The EU also dominates UK bio-based goods imports, accounting for £60.1 billion, or 57.6%, of the UK's £105.2 billion total in 2023 (see Figure 2.11). This points to a significant UK goods trade deficit with the EU attributable to the bioeconomy, likely compounded by weaker exports and higher trade frictions. The UK runs a trade surplus with the US and with several other high-income partners, including Canada, Australia, New Zealand, Japan and Singapore. By contrast, imports exceed exports with China, India, Brazil and South Africa, with India slightly ahead of China as a source of imports. Overall, UK bio-based goods trade is EU-centred, import-dependent and marked by surpluses with some high-income partners but deficits with major Asian and nature-rich economies.

UK bio-based services exports totalled £49.3 billion in 2023, with the EU accounting for £20.5 billion, or 41.6% (see Figure 2.12). Although the EU remained the largest destination, services exports were more diversified than goods exports. Outside the EU, the US was the largest market at £8.3 billion, followed by China at £2.4 billion and India at £1.5 billion, with Asia the largest non-EU regional destination. UK bio-based services exports exceeded imports with almost all

partners, often by a factor of two to ten, particularly with India, Canada, Australia, New Zealand and South Africa. Japan was the only major partner with a services surplus over the UK, underscoring the UK's broad strength in bio-based services trade.

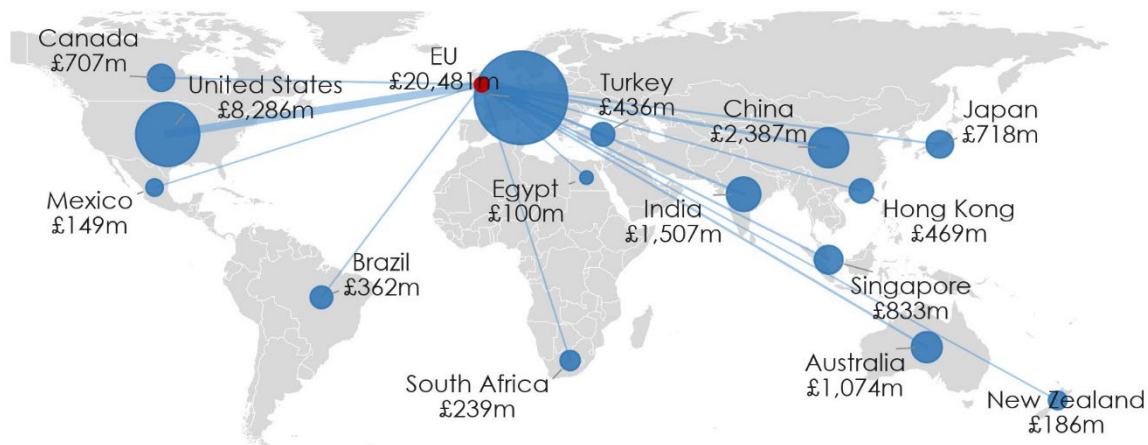
Figure 2.11. UK goods imports attributable to the bioeconomy by partner, 2023



Notes: Line thickness and bubble size = bio-trade value (£m, 2023). Non-EU aggregate not shown – individual non-EU partners displayed separately.

Source: ONS (2025b)

Figure 2.12. UK services exports attributable to the bioeconomy by partner, 2023



Notes: Line thickness and bubble size = bio-trade value (£m, 2023). Non-EU aggregate not shown – individual non-EU partners displayed separately.

Source: ONS (2025c)

UK bio-based services imports, on the other hand, were around £22.7 billion in 2023, of which £10.1 billion, or 44.5%, originated in the EU. After the EU and the US, Asia remains the third-largest origin for bio-based service imports into the UK, with Japan being the largest source of imports at £1.4 billion. Overall, the geography of bio-based service imports is relatively diversified, although the volume is rather small given the UK's position as a services exporter (Jozepa, 2026).

Because the EU remains the UK's dominant bioeconomy trade partner, regulatory alignment on bio-based goods, circular materials, food systems and product standards is central to competitiveness, especially for frontier sectors reliant on global value-chain demand. The UK should therefore strengthen EU ties while selectively diversifying with nature-rich and fast-growing economies such as Brazil, China and India, where bio-based value chains and common standards could support services-led trade growth. Overall, the trade story shows that the UK bioeconomy cannot be governed as a domestic industrial agenda alone: its goods are supply-chain exposed, imports remain EU-linked, and export strengths are concentrated in services and knowledge-intensive activities. A growth framework must therefore address supply-chain resilience, standards and market access so British businesses remain productive and competitive.

2.3. Geographic spread and devolution of growth

The geography of the UK bioeconomy provides a key policy pathway for linking sustainable growth to regional economic renewal, aligning with the government's focus on "good growth in every postcode". While overall GVA and bioeconomy services concentrate in London and the South East, biomass production and biomass conversion are dispersed across the rest of the UK. This dispersion makes the bioeconomy a natural lever for inclusive growth and regional rebalancing. The current policy environment pursues this through separate strategies without recognising the bioeconomy thread that runs through them (DBT, 2025a).

This matters now because England's devolution and local government reorganisation agenda is creating new institutional vehicles for place-based growth. New and emerging unitary authorities, mayoral combined authorities and shadow teams are beginning to define their early economic priorities. The bioeconomy offers a practical way to connect those priorities to local resource bases, existing economic sectors, local small- and medium-sized enterprises (SMEs), university capabilities and national missions around growth, resilience and nature recovery.

The regional analysis highlights how the bioeconomy is more geographically distributed than the wider economy, with a majority of activity happening in England outside London and the South East. The bioeconomy is structurally more important to several regional economies outside the South East, particularly where biomass production, food, forestry, aquaculture, waste, materials and manufacturing are embedded locally. We also note the importance of regional clusters, providing a working example of how the bioeconomy serves as a bridge linking high-value-added sectors to regional bioresources.

Regional distribution of bioeconomy activity

When seen through the lens of the bioeconomy, there is significant variation in the distribution of economic activity across the three sector groups (see Table 2.2). In 2023, biomass production is the most geographically dispersed: London and the South East account for only 9% of BP GVA attributable to the bioeconomy, compared with 62% for the Rest of England, 18% for Scotland, 6% for Wales, and 5% for Northern Ireland. Biomass conversion is moderately dispersed, with London and the South East accounting for 21%. Bioeconomy services are more concentrated, with London and the South East accounting for 39%, approaching but still below their 37.8% share of total UK GVA. Across the total bioeconomy, London and the South East account for 32% of bioeconomy GVA – below their approximately 40% share of total UK GVA (ONS, 2025e).

Table 2.2. Regional distribution of bioeconomy GVA by sector group, 2023 (£ millions)

Bioeconomy sector group	London & SE	Rest of England	Wales	Scotland	N. Ireland	Total
Biomass production (BP)	1,416 (9%)	9,707 (62%)	1,009 (6%)	2,855 (18%)	781 (5%)	15,768
Biomass conversion (BC)	21,240 (21%)	58,385 (59%)	5,076 (5%)	11,171 (11%)	2,995 (3%)	98,866
Bioeconomy services	81,510 (39%)	101,458 (48%)	6,585 (3%)	16,115 (8%)	4,980 (2%)	210,940
Total bioeconomy	104,166 (32%)	169,551 (52%)	12,670 (4%)	30,140 (9%)	8,755 (3%)	325,283

Notes: London & SE = London + South East England; Rest of England = all other English regions. Regional totals sum to £325,283m versus national £325,573m due to extra-regio/unallocated residuals. GVA is current price.

Source: Authors' calculations from ONS (2025e)

Interpretation: The regional distribution shows that the bioeconomy's production and conversion base is substantially concentrated outside London and the South East, making it a natural vehicle for regionally distributed growth, while services remain more spatially concentrated.

Regional growth patterns

Growth in bioeconomy GVA was 0.73% per annum in real terms across the UK from 2009 to 2023 (see Figure 2.13 and Figure 2.14). Wales recorded the highest regional bio-GVA growth at 1.13%, followed by London and the South East at 1.10%. Scotland (0.62%) and the Rest of England (0.60%) grew at broadly similar rates below the UK average. Northern Ireland was the only region group to contract, at -0.49%. The regions where the bioeconomy is structurally more important, i.e. Northern Ireland (73.5% of firms) and Wales (68.4% of firms), show divergent growth trajectories rather than uniformly stronger or weaker performance. This is consistent with the absence of regionally targeted bioeconomy policies.

The regional bioeconomy, guided by the right policy and finance steers, can offer both long-term industrial opportunity and also near-term 'quick wins' for devolution. A coherent bioeconomy strategy would link assets that already exist locally, such as food-processing capacity, ports, forestry and timber supply chains, waste streams, universities, further education colleges, innovation centres and SMEs. Local authorities do not need to create new sectors from scratch; they need the policy, project development and finance capacity to connect existing firms, feedstocks, infrastructure, universities and natural capital assets into investable regional pipelines.

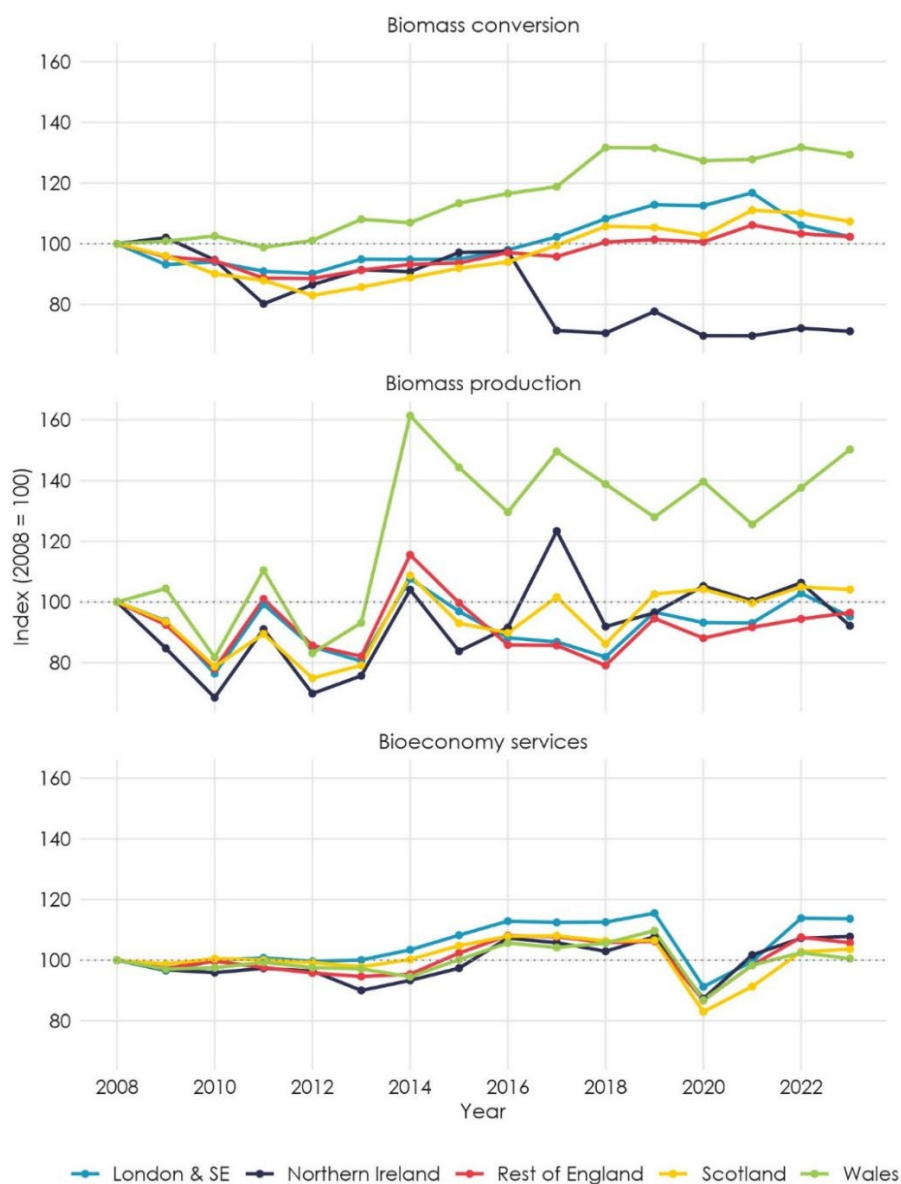
Firms and regional structure

At the firm level, 73.5% of all firms in Northern Ireland operate within the bioeconomy, including 23.7% in biomass production, which is more than double the next region, Wales, at 12.7% (see Figure 2.15). Wales records 68.4%, Scotland 66.6%, and the Rest of England 62.7%. London and the South East record the lowest share at 54.5%. The bioeconomy is structurally more important to regional economies outside the South East than to the South East itself.

The regional bioeconomy is largely SME-based (see Figure 2.16). Large firms in biomass production are concentrated in London and the South East and in Scotland. Northern Ireland and Wales have no biomass-production firms with 250 or more employees, indicating that the primary bioeconomy activity in these regions is entirely SME-scale. Biomass conversion shows a

similar concentration of larger firms in the Rest of England and London and the South East. Given the nature of business, this implies that effective regional bioeconomy policy for these regions would need to lean more on scale-up support, cluster development and regional finance than on large-firm anchoring.

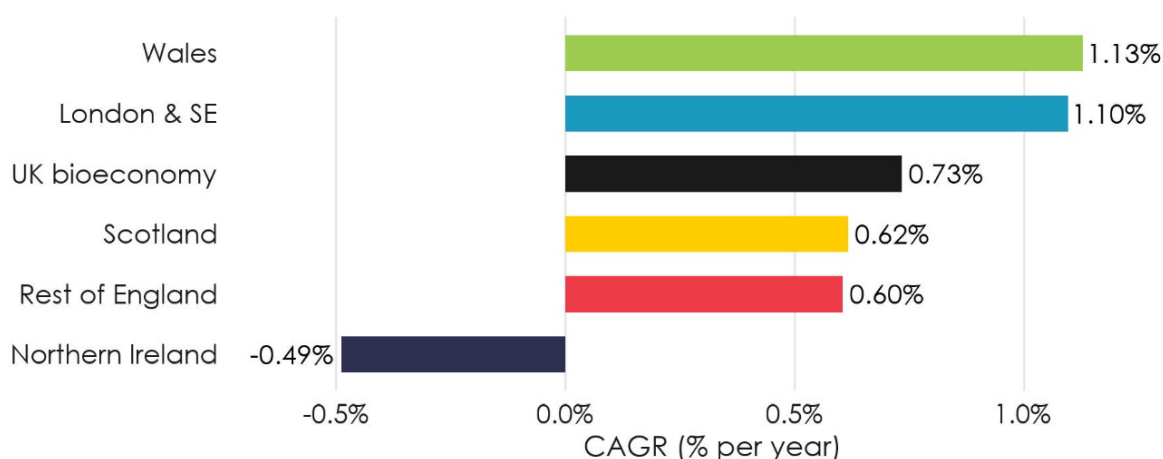
Figure 2.13. Regional Bio-GVA Growth Index by sector group, 2008–23



Notes: Chained index (2008 = 100) from weighted-growth method (prior-year CP shares). Index constructed using Laspeyres-type chain-volume aggregation (prior-year current-price bio-GVA weights). Regional groupings: London & SE (ITL1 codes TLI, TLJ); Rest of England (TLC-TLK excl. London & SE); Scotland (TLM); Wales (TLL); Northern Ireland (TLN).

Source: Authors' calculations based on ONS Regional Gross Value Added (Balanced) by Industry (2025e), Tables 1b and 1c, applying bio-based shares from Ronzon et al. (2017, 2022) and Lasarte-Lopez and M'barek (2025)

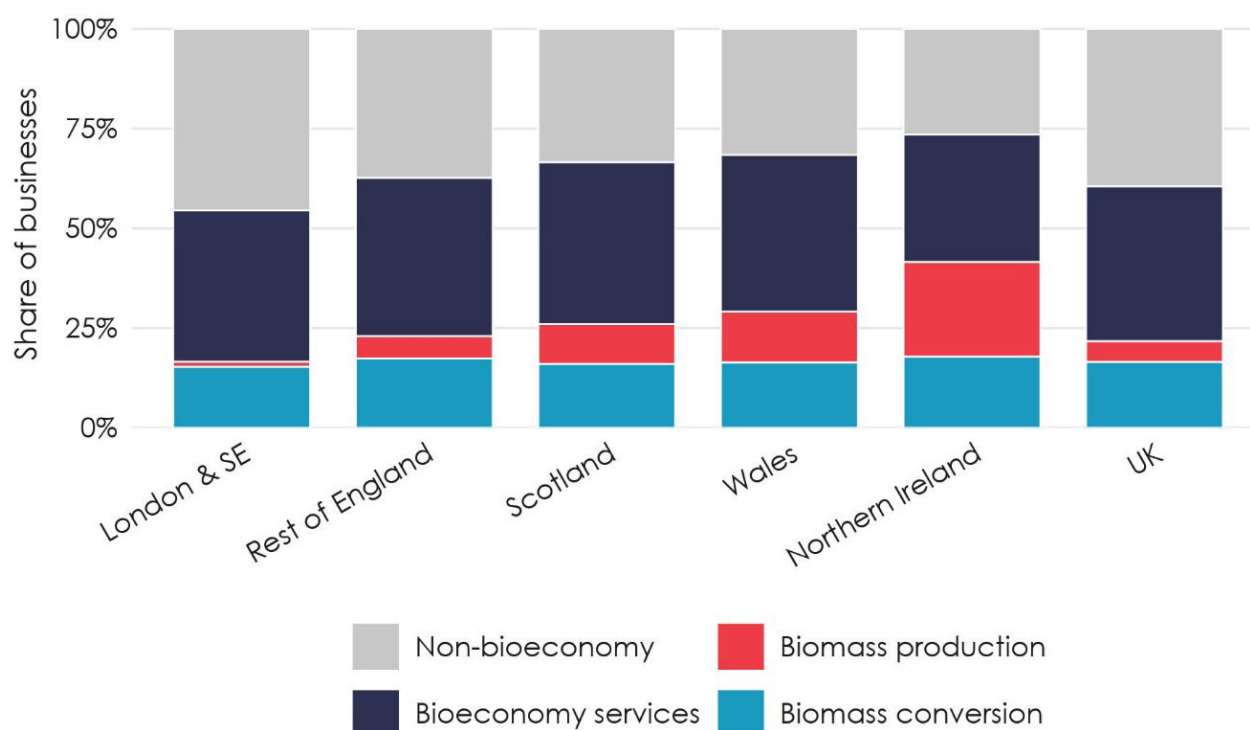
Figure 2.14. Regional Bio-GVA compound annual growth rate by region group, 2009–23



Note: Bioeconomy total = weighted-growth method (prior-year CP shares, chained). Growth rates are computed at the individual SIC × ITL1 region level from the bio-share-adjusted CVM series, then aggregated within each region group using prior-year current-price bio-GVA weights (Laspeyres-type chain-volume aggregation). No CVM levels are summed across regions or industries. Regional groupings: London & SE (TLI, TLJ); Rest of England (TLC–TLK excl. London & SE); Scotland (TLM); Wales (TLL); Northern Ireland (TLN).

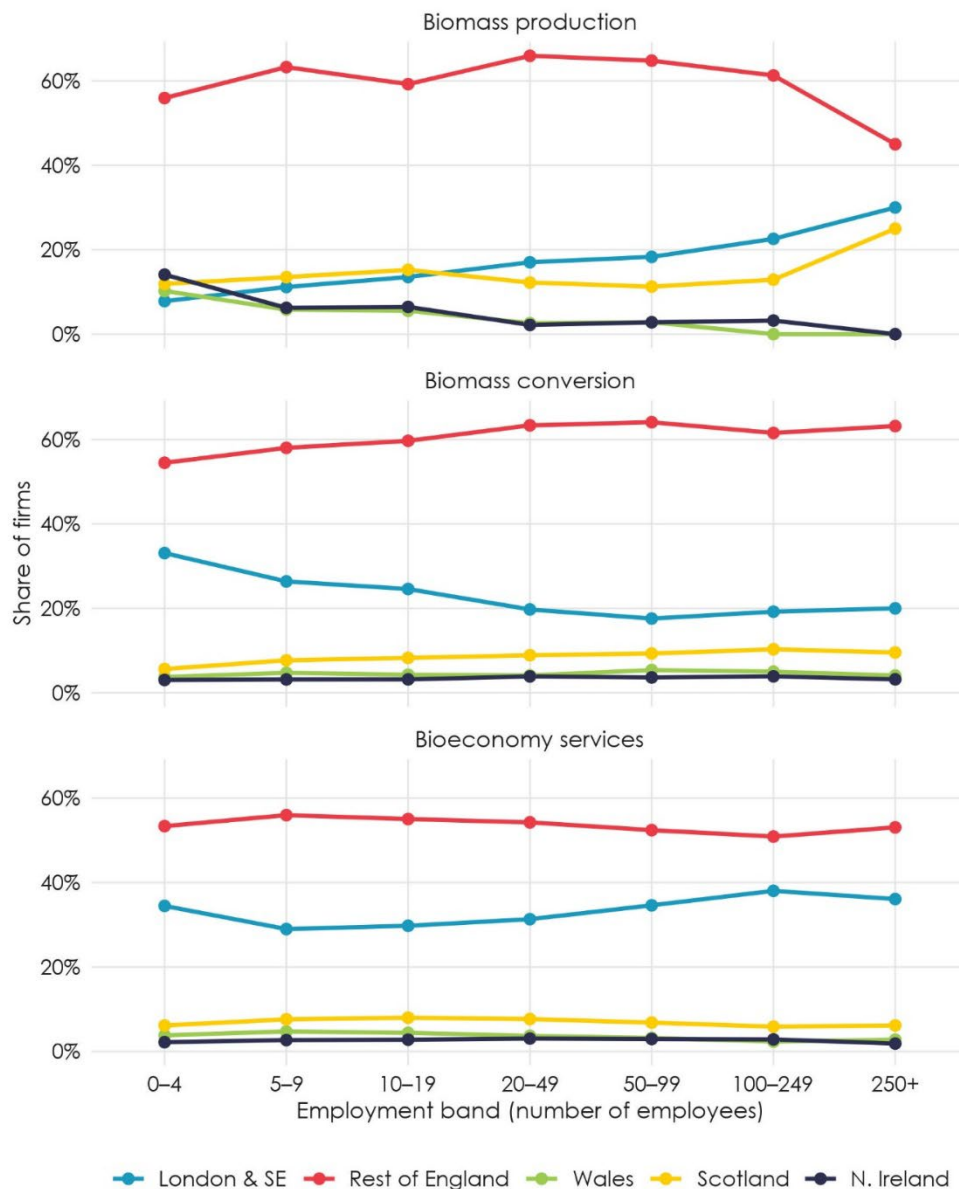
Source: Authors' calculations based on ONS Regional Gross Value Added (Balanced) by Industry (2024), Tables 1b and 1c, applying bio-based shares from Ronzon et al. (2017, 2022) and Lopez and M'barek (2025)

Figure 2.15. Bio-based share of business counts by region, 2023



Source: ONS BC (2025)

Figure 2.16. Regional share of firms by employment band, 2023



Source: Authors' calculations from ONS BC (2025)

Clusters and inclusive growth

The primary production and conversion sectors of the bioeconomy are dispersed across the UK, away from the high-income areas of London and the South East, aligning with the distribution of the resource base: agricultural land, forests, coastal waters and biomass feedstocks. The value of the bioeconomy lens is to link these with high-growth sectors for efficient growth in proximity to resource bases. Frontier sectors can raise the value of regional bioeconomy clusters by connecting local feedstocks, industrial capabilities and research assets to higher-productivity applications.

This idea already exists in the cluster-based approach encouraged by current sectoral and place-based policies. Knowledge clusters with bioeconomy specialisations already exist outside the South East: chemicals, biotechnology and bioenergy in Hull; advanced manufacturing and

engineering biology in Sheffield and South Yorkshire; plant science and agritech in the Norwich–Cambridge corridor; marine bioeconomy and aquaculture in Aberdeen; and biorefining and biocomposites in Bangor (see also Case Study 1 below). These are valuable examples of how the bioeconomy serves as a bridging sector, combining the UK’s expertise in cutting-edge innovation with the bioresources available across regions.

Case Study 1: Bio-Industrial Cluster North (BICN)

Bio-Industrial Cluster North (BICN) is an ecosystem connecting York and North Yorkshire with the Tees Valley to drive industrial biomanufacturing and sustainable chemistry. It is a regional partnership that links discovery to export through five integrated stages: university research (University of York, Teesside University), pilot development (Biorenewables Development Centre [BDC]), industrial scale-up (CPI and High Value Manufacturing Catapult), manufacturing (Wilton Centre and Pioneer Group sites), and global export (Tees Valley Combined Authority Freeport). The cluster hosts 20% of UK bioengineering businesses, 50% of sector turnover, 39% of sector employment, and 55% of all large bioengineering enterprises with 250+ employees (BICN, 2026). Companies are already moving through the system: Azotic, a University of Nottingham biofertiliser spinout, was advanced through the BDC in York, scaled at Wilton, and is now manufacturing in the UK and exporting globally (BICN, 2026).

Policy environment

BICN responds directly to the UK’s Engineering Biology Strategy 2025 and aligns with the Industrial Strategy’s priorities on advanced manufacturing, life sciences and place-based growth. The cluster’s prospectus identifies two systemic market failures constraining delivery: a conversion gap (the UK does not consistently translate research into scalable businesses outside the Golden Triangle research cluster [Oxford, Cambridge, London]) and a scale-up gap (no effective investment model exists for first-of-a-kind manufacturing in the £10–100 million range) (BICN, 2026). These are mutually reinforcing: insufficient early-stage capital reduces the pipeline of investable firms, while the absence of First-of-a-kind (FOAK) finance prevents those that emerge from anchoring manufacturing in the UK. While 69% of UK research strength sits outside the Golden Triangle, only approximately 15% of spinout venture capital (VC) investment flows to these areas, over 85% is concentrated in London, Oxford and Cambridge (Henham Strategy et al., 2026). The cluster identifies four priorities for government: long-term biomanufacturing infrastructure investment, targeted skills and innovation funding, dedicated SME and cluster growth support, and a shared industrial challenge fund (York & North Yorkshire and Tees Valley Combined Authorities, 2025).

Impact

The BICN demonstrates the scale of the opportunity that coordinated, place-based bioeconomy development can unlock. The combined Yorkshire and North East bioeconomy already contributes £34.8 billion in bio-based GVA and supports approximately 449,000 jobs, with particular strengths in food manufacturing, pharmaceuticals, chemicals and bio-based research and development (R&D) (ONS, 2025e; ONS BRES, 2025). Bio-based pharmaceuticals, anchored by firms including FUJIFILM Diosynth Biotechnologies, contribute £2.0 billion across the two regions (19% of the UK total), having grown 130% from 2008 to 2023 (ONS, 2025e). Bio-based R&D also expanded by 164%, reaching £876 million over the same period. Food manufacturing contributes £4.2 billion (ONS, 2025e). The cluster estimates that addressing current scale-up constraints could create more than 4,000 additional jobs and generate £300–500 million in annual GVA, while supporting the growth of 100 bio-based start-ups and expanding the regional bioeconomy by a further £5 billion.

The BDC has delivered 1,500 projects; the University of York has secured over £140 million in bioeconomy grants since 2004; and CPI operates the National Industrial Biotechnology Facility. The BICN Lab-to-Export Accelerator model is designed to select 100 technologies, advance 50 to pilot, demonstrate 20, and deliver 10 companies exporting globally within five years, with matched VC funding and business incubation across partners (BICN, 2026). The Tees Valley Employment and Skills Strategy targets 10,000 job openings annually and 41,000 additional roles by 2030 in clean energy, biotechnology and advanced manufacturing. However, skills gaps are acute: only 37.2% of Teesside's working-age population holds qualifications equivalent to a first-year bachelor's degree or higher (versus 47.2% nationally), and experienced C-suite talent is cited as a primary bottleneck for growth (Department for Business and Trade and ONS, 2023; BICN, 2026).

The BICN offers potential for building resilience. The cluster's Wilton Centre, operated by Pioneer Group within the Tees Freeport, with over £4.3 billion in cumulative investment and support for over 1,400 companies, provides industrial sites for bio-based chemical manufacturing (York & North Yorkshire and Tees Valley Combined Authorities, 2025). However, without intervention and support from the UK policy landscape, companies like Plume Bio (agricultural waste to food colourings, University of Sheffield spinout) and DEScycle (advanced metals recovery, University of Oxford spinout), both scaled and de-risked at Wilton, are likely to locate first commercial manufacturing overseas due to UK investment constraints (BICN, 2026).

There is a clear opportunity to use the bioeconomy as a devolution-era growth lens: a way for new and existing authorities to identify quick wins, package investable local projects, and connect regional regeneration outside the South East to national priorities on productivity, sustainability, resilience and nature recovery.

2.4. Innovation

The UK's position as a leader in innovation and R&D has been amply reflected across its industrial strategies and innovation policy. This is also reflected in its bioeconomy-relevant research capability, even though it is currently spread across different strategies. For instance, the Life Sciences Sector Plan notes that the sector contributes around 17% of all business R&D spending in the UK as of 2023, ranking only behind the US and China by 2035 (HM Government, 2025a). In terms of research citation quality in bioeconomy-relevant topics, UK research has historically shown a very high level of citation impact (Bauen et al., 2016).

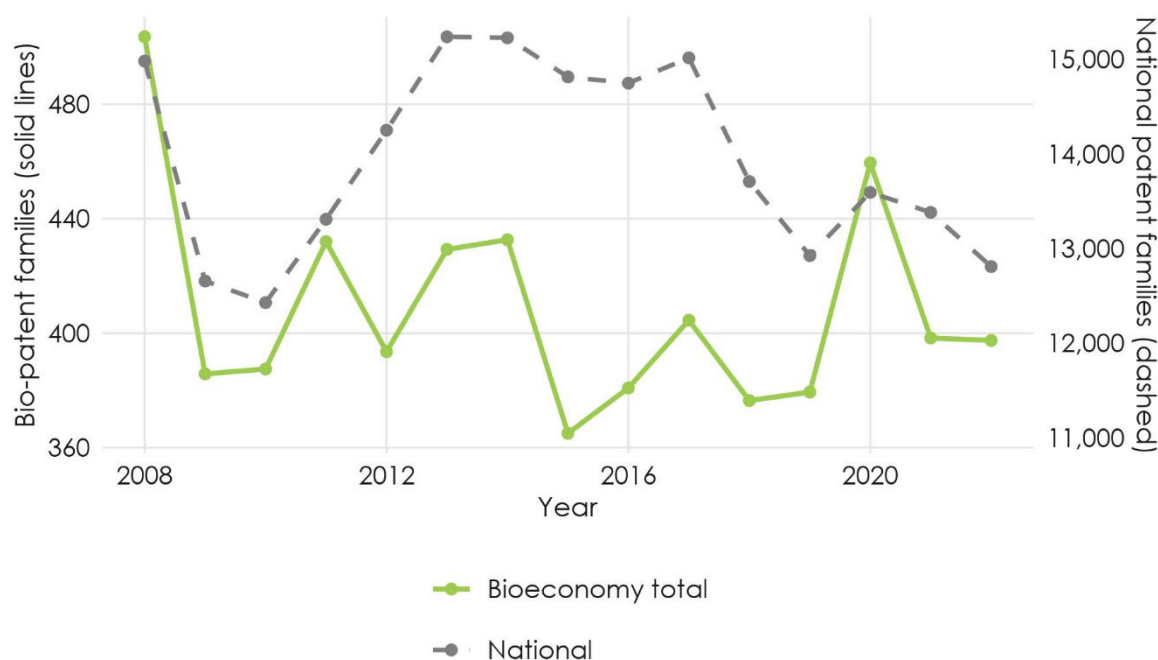
In this section, we examine innovation in the bioeconomy using patent data. Our analysis suggests that while there is a robust bioeconomy-relevant research base, bio-patents make up a smaller share of total patenting than in the EU. This suggests that the innovation frontier is not yet fully reflected in formal intellectual property (IP) outputs. In addition, UK involvement in bio-patents is higher than in patents overall, indicating that bioeconomy innovation is more domestically rooted than many other areas of UK innovation.

We define bio-patents as patents that can be considered directly linked to the bioeconomy, following the methodology proposed by the EC JRC in Grassano et al. (2025). This methodology produces patents that fall under the biomass conversion sectors. It is important to note that while patents are a key manifestation of IP, sectors within and outside the bioeconomy use a range of other strategies, including trademarks, copyrights and registered designs (UKIPO, 2022).

Trends in UK bio-patents

Overall, UK patent applications have declined consistently since 2008, as has the number of bio-patents (see Figure 2.17). The total number of patents dropped from 22,827 in 2008 to under 17,185 in 2022. Bio-patent applications dropped from 504 applications in 2008 to approximately 365 in 2015 and have fluctuated around 400 annually since. This drop and subsequent gradual rise in bio-patent applications mirrors the EU pattern, which fell from around 2,400 in 2008 to under 2,000 in 2013 and gradually returned to around 2,250 in 2020. In absolute terms, the UK's bio-patent applications resemble those of France, albeit slightly higher in number (EPO, 2025; Grassano et al., 2025).

Figure 2.17. UK bio-patents versus total UK patent applications to UKIPO, 2008–22



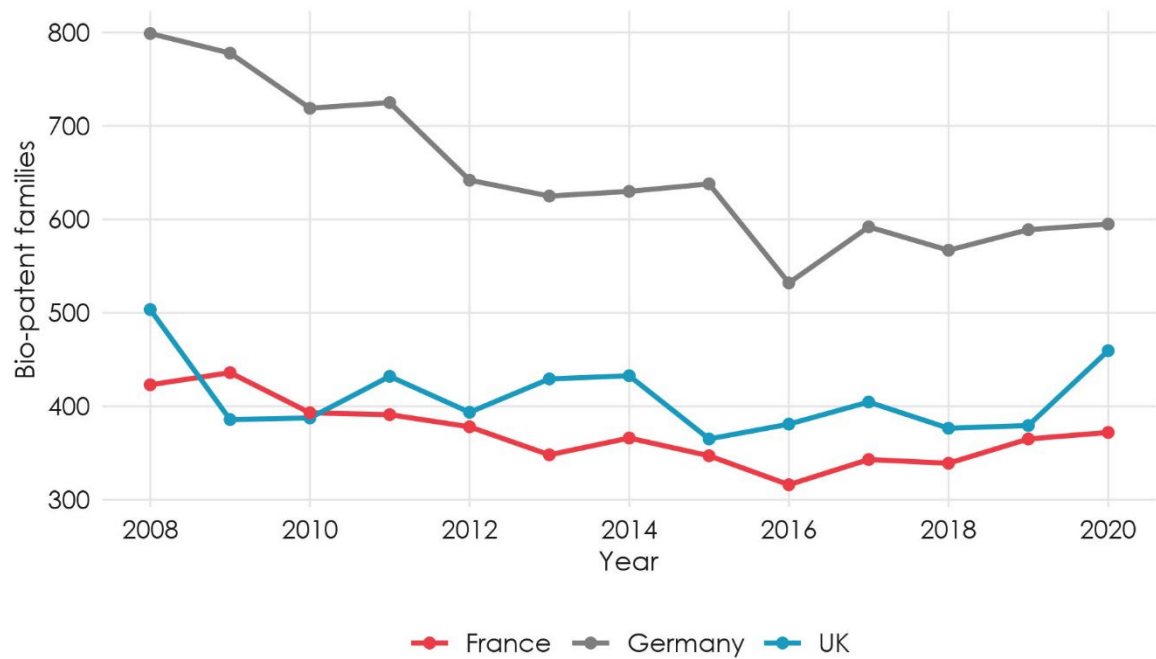
Source: EPO (2025)

Bio-patents account for a substantially smaller share of patent applications in the UK than in the EU. The UK average between 2008 and 2022 was around 2.1%, whereas between 2008 and 2020, the EU's bio-patent ratio was 5.2%. The UK, in absolute terms, has more bio-patents than France, but less than Germany (see Figure 2.18). However, as a ratio of total patents, the UK does worse than Germany, which had the lowest bio-patent share among the EU-27 at around 3.5% at that time. The UK's change in bio-patent share mirrors the EU's sharp drop until the mid-2010s and subsequent rise. However, while the EU's ratio has not yet surpassed its 2008 value, the UK's has (EPO, 2025; Grassano et al., 2025).

If we look at the sectoral composition of bio-patents, the proportion of patents within the UK is directionally aligned with those in the EU as shown in Figure 2.19.

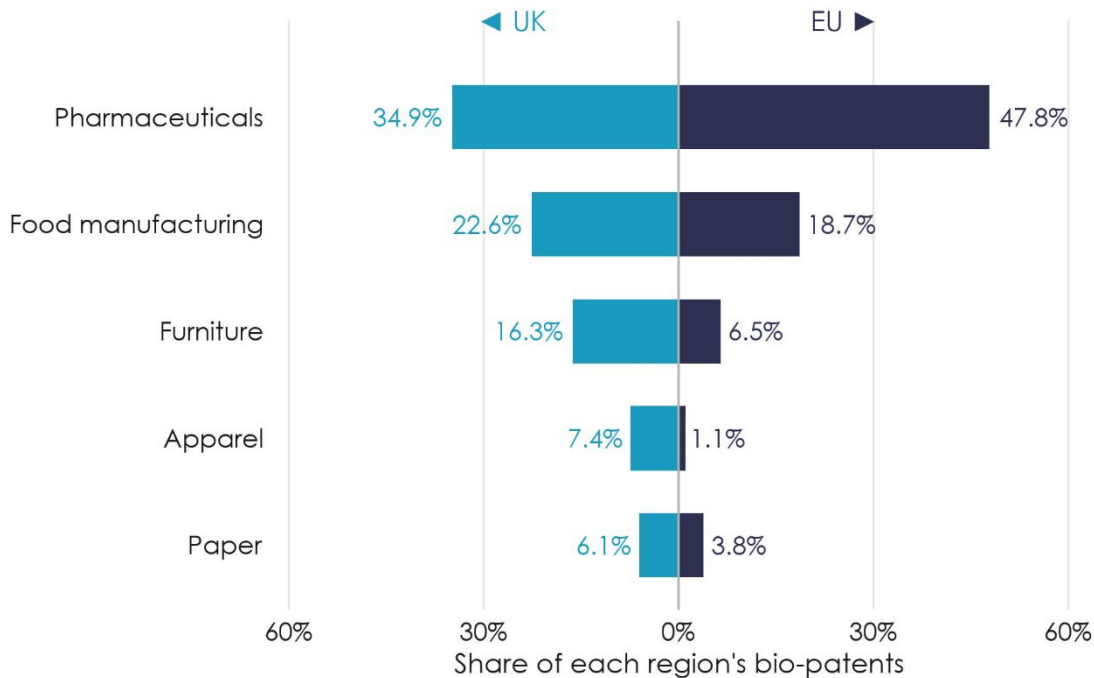
UK bio-patent shares by industry relative to the EU do vary, indicating that some sectors in the UK are particularly innovative relative to EU counterparts, such as furniture, apparel and paper manufacturing. These are, however, lower-productivity sectors relative to pharmaceuticals, which takes up the largest share in both the UK and the EU. The UK share for pharmaceuticals is substantially lower than the EU share (EPO, 2025; European Commission, 2025b). This suggests a higher level of innovative activity in the UK in more 'traditional' sectors of the bioeconomy.

Figure 2.18. Bio-patents in the UK versus France and Germany, 2008–20



Source: Grassano et al. (2025)

Figure 2.19. Bio-patents in the UK versus the EU, 2008–20



Note: The UK over-indexes in furniture, apparel and paper; pharma leads both but is a far bigger share of EU bio-patents.

Source: Grassano et al. (2025); PATSTAT (2025)

In addition, the UK's involvement in bio-patent applications was proportionally higher than in patenting activity overall. As of 2023, the share of bio-patents with UK involvement was 52.1%, around 67% higher than for all patents at 31.9%. The trend between 2008 and 2022 shows that UK involvement was roughly 1.6 to 2 times higher in bioeconomy patents. This suggests that innovation in the UK bioeconomy is possibly more closely linked to local R&D and has a greater degree of domestic ownership than overall UK innovation (EPO, 2025).

In summary, the above data indicates that the UK remains innovative and IP-rich; however, this does not necessarily translate to the bioeconomy, with UK bio-patents forming a proportionally smaller share of total patents relative to the EU. While overall innovation appears to be declining with the continued decrease in patent applications, the UK bioeconomy has seen an increase in bio-patents and presents an opportunity for innovation-led growth with the right commercialisation infrastructure. In particular, given the more domestic orientation of bio-patents relative to non-bio-patents, investment and policy support could help translate this leadership in research into domestic growth.

2.5. Benchmarking the UK against Europe

The UK bioeconomy is large and productive but slow-growing. Comparisons with EU countries suggest the problem is the absence of a coordinating mechanism that can turn scale and productivity into growth (see Table 2.3).

Table 2.3. Bioeconomy headline benchmarks: UK and key EU comparators (narrow BP + BC scope), 2023

Indicator	UK	EU-27	Germany	France	Netherlands	Belgium
Bio VA (£bn, 2023)	79.4	751.5	136.4	106.8	40.6	27.1
Bio Employment (m)	1.24	17.09	2.12	1.74	0.41	0.23
Productivity (£k/worker)	64.3*	44.0	64.2	61.3	98.3	118.0
Bio VA / Sector VA†	3.5%	5.6%	4.1%	4.8%	4.9%	5.8%
VA CAGR 2013–23	3.6%	5.0%	5.0%	4.2%	5.2%	6.3%
Emp CAGR 2013–23	+0.7%	–0.6%	+0.6%	+0.7%	+0.9%	+1.0%
Top sector (% of VA)	Food 47%	Food 35%	Food 42%	Food 43%	Agri 38%	Food 46%

Note: The UK productivity measure is per job while the EU measure is per person, creating a systematic downward bias in the UK-level figure that does not affect growth-rate comparisons. All country-level figures use the JRC narrow scope (biomass producing [BP] and converting [BC] sectors only), excluding bioeconomy-related services. Exchange rate (FX): £1 = €1.149 (2023 ECB annual average, fixed). *UK productivity is per job (ONS denominator); EU figures are per person – directional comparison only. †Bio VA as a share of total sector VA from JRC dataset, not GDP; the JRC policy brief reports EU bioeconomy ≈5% of GDP using a broader GDP denominator (Lasarte-López and M'barek, 2025, p. 2). Nominal current prices throughout.

Source: JRC Bioeconomics Dataset (Lasarte-López et al., 2025); authors' calculations from ONS (2025e); ONS BRES (2025); ONS LPROD (2025)

The UK can be placed within a European comparative context using the JRC dataset (Lasarte-López and M'barek, 2025) which provides consistent value added and employment series for all EU-27 Member States from 2008 to 2023. An important methodological caveat is that the JRC dataset covers only biomass-producing and bio-based converting sectors, excluding bioeconomy-related services at the country level. In 2023, the benchmarked UK bio-GVA of £79.4 billion (excluding services) represents roughly 24% of the full UK bioeconomy (£325.6

billion). The remaining 76% comprises bioeconomy-related services (£210.9 billion) and BP/BC sectors excluded from the JRC scope (see Table 2.4).

Table 2.4. Top 6 EU countries plus the UK for bioeconomy value added and growth, 2023

Rank	Country	Bioeconomy VA (£bn)	Bioeconomy Emp (000s)	Bioeconomy productivity (£k/worker)*	Bioeconomy VA CAGR	Bioeconomy Emp CAGR	VA % of total GVA	Emp % of workforce
1	Germany	136.4	2,125	64.2	5.0%	+0.6%	4.1%	5.3%
2	France	106.8	1,743	61.3	4.2%	+0.7%	4.8%	6.4%
3	Italy	100.8	1,935	52.1	3.5%	+0.3%	6.0%	Yes %
4	UK	79.4	1,235	64.3	3.6%	+0.7%	3.2%	3.7%
5	Spain	75.6	1,509	50.1	4.4%	+1.3%	6.4%	7.3%
6	Poland	47.9	2,292	20.9	6.7%	-1.2%	8.1%	13.7%
7	Netherlands	40.6	413	98.3	5.2%	+0.8%	4.9%	4.8%

Note: *UK productivity per job; EU productivity per person – levels not directly comparable but directional. CAGR in native currency (2013–23). VA and Emp cover biomass production and biomass conversion only (JRC definition, excluding services). Total GVA: Eurostat nama_10_a64 (2023, current prices, total NACE); UK: ONS (2025e). Workforce: Eurostat (2023, 20–64 age, thousand persons); UK: ONS BRES (2025). FX: £1 = €1.149 (2023 ECB).

Source: JRC Bioeconomics Dataset (Lasarte-López et al., 2025); authors' calculations from ONS (2025e); ONS BRES (2025); ONS LPROD (2025)

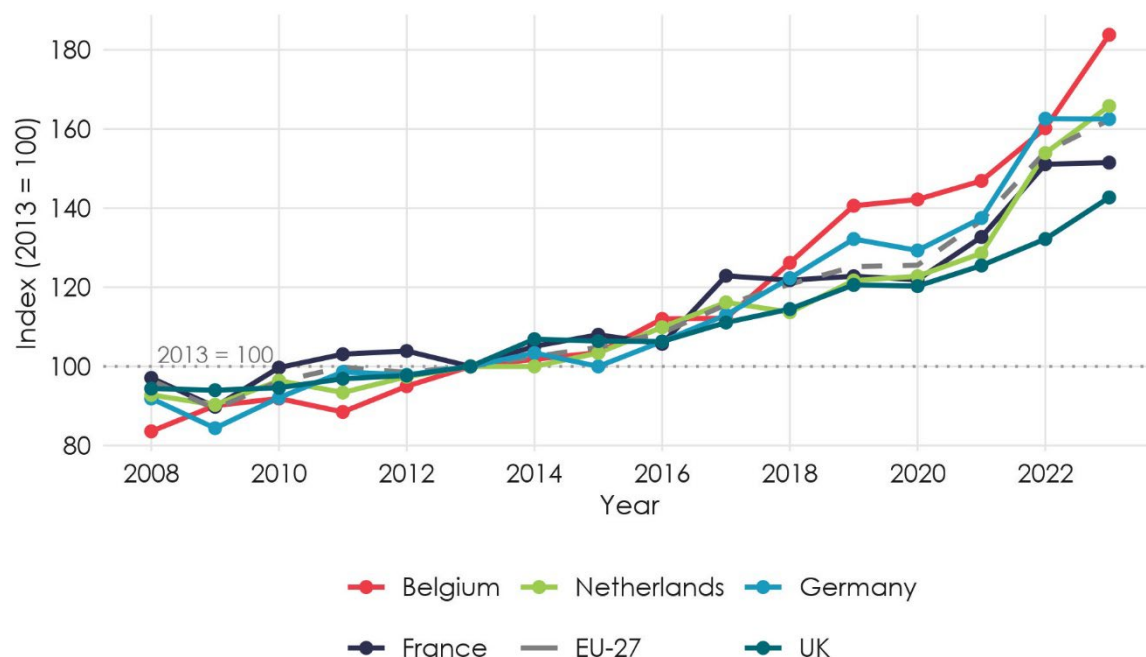
The comparison suggests the UK has clear strengths and scale, along with similar levels of productivity as Germany. However, the lack of coordination has allowed comparator economies to translate similar or smaller assets into faster growth. Five findings emerge from the benchmarking.⁴

First, the UK is one of Europe's few large and productive bioeconomies. On the narrow biomass production and conversion measure, the UK ranks fourth by value added, ahead of Spain, Poland and the Netherlands, while its productivity is broadly level with Germany and above France. At £79.4 billion and 1.24 million jobs, the UK sits in a small group of economies with both scale and high value added per worker, rather than in the lower-productivity, agriculture-heavy segment of the European bioeconomy. However, at 3.6% CAGR (2013–23), it is growing more slowly than 20 of 28 EU countries (see Figure 2.20). Only Italy (3.5%) among the large economies is comparably sluggish. Belgium, whose pharma-heavy bioeconomy (26.5% of bio-value added) benefited from stronger pricing power, grew at 6.3%, nearly double the UK rate.

Second, the UK has strengths in the food and pharmaceutical sectors, which are mature sectors ready for upgrades. Food, beverages and tobacco account for 47% of UK bioeconomy value added, the highest share among comparators, while UK bio-based pharmaceuticals are the second-largest absolute pharmaceutical contribution after Germany. This gives the UK large domestic anchor markets through which precision breeding, biomanufacturing, circular feedstocks, alternative proteins and bio-based materials can diffuse into established sectors.

⁴ There is an important caveat to this exercise, the narrow-scope comparison structurally understates the UK. The £79.4 billion JRC-scope figure omits bioeconomy services, where the UK is comparatively strong. If the EU's 2.2–3.1x narrow-to-full multiplier were applied to the UK, the comparable full-scope figure would be £175–246 billion; the actual UK full-scope figure of £325.6 billion (a 4.1x multiplier) suggests the UK's bioeconomy is materially more services-oriented than the EU average.

Figure 2.20. Bioeconomy value added growth trajectory (UK versus EU-27, Germany, France, Netherlands, Belgium)



Note: By 2023: Belgium 183.8, Netherlands 165.8, Germany 162.5, EU-27 162.3, France 151.5, UK 142.7. GVA at current prices.

Source: JRC Bioeconomics Dataset (Lasarte-López et al., 2025)

Third, the UK's bioeconomy is less exposed to structural agricultural employment decline than comparators in the EU. Agriculture accounts for a smaller share of UK bioeconomy value added than in the EU as a whole, and UK bioeconomy employment grew at +0.7% annually while EU-27 employment declined at -0.6%. This suggests that the bioeconomy is less reliant on labour-intensive primary production and better positioned around conversion, services, R&D and higher-value applications. In part, this reflects the UK's lower agricultural employment share, which insulates it from the structural agricultural workforce decline which has weighed down the EU aggregate, primarily concentrated in Central and Eastern European Member States (Lasarte-López and M'barek, 2025).

Fourth, the UK's competitive edge lies in its service sector. Services account for most of the UK's full bioeconomy and are a recognised UK strength. This matters because the next phase of bioeconomy growth can build on the UK's strengths in areas such as finance, logistics, standards, scientific services, environmental management, data, insurance, certification and professional services. Under this broader definition, the UK holds advantages that many biomass-rich European comparators do not.

Fifth, UK productivity at £64.3k per job is comparable to Germany (£64.2k) and France (£61.3k) but substantially below the Netherlands (£98.3k) and Belgium (£118.0k). For instance, in Belgium, strong value-added growth (6.3%) with modest employment growth (1.0%) shows productivity-led growth. The central gap is therefore growth rather than efficiency. Comparator economies have been better able to turn productive bioeconomy assets into faster value-added growth, particularly where bio-based pharmaceuticals, agri-food systems, logistics and industrial policy are connected through clearer national or EU-level coordination.

Together, these findings point to how the UK's competitive advantages, along with a large but fragmented bioeconomy, offer a pathway for inclusive growth. The UK's edge over European comparators lies in the combination of scale, lower exposure to low-productivity agricultural employment, large food and pharmaceutical sectors, and a strong services sector that can draw on its research and skills base. While Germany, France, the Netherlands and Belgium have translated sectoral strengths into faster bioeconomy growth, the UK can organise its bioeconomy to chart a distinctive route to competitiveness: using finance, R&D, standards, professional services and frontier biology to upgrade a broad bio-dependent economy. A UK bioeconomy framework could therefore bring the fragments of the UK's economy together in a manner that can activate its comparative advantages for growth.

3. The bioeconomy frontier

While the wider bioeconomy encompasses a broad range of activities dependent on biological resources, much of the current momentum is concentrated at the tip of the bioeconomy pyramid: a set of high-value, high-growth sectors attracting capital, policy attention and entrepreneurial activity. These frontier areas offer the UK an opportunity to translate its scientific and financial strengths into innovations that can transform the wider bioeconomy. With the right policy and finance frameworks, they can drive productivity growth across sectors while creating pathways to a more nature-positive economy. In doing so, they can help to reduce pressures on land, water, biodiversity and material use while improving the sustainability, resilience and productivity of existing sectors. This section identifies six frontier areas where the UK has emerging strengths, examines the growth, investment and innovation signals that support them, and illustrates each through a UK company already operating at that frontier.

3.1. The frontier at a glance

The UK's bioeconomy frontier is highly innovative and evolving rapidly. This, together with the absence of official statistics, makes it difficult to create a rigid taxonomy that organises the sector neatly. For this section, we create an illustrative grouping of six areas that have shown potential for growth (see Table 3.1). The groups are defined by their outputs, build on the UK's scientific or engineering capabilities, and have shown the potential to scale up. There are other areas where UK activity is either nascent or has not scaled up in the UK, which we exclude from the list. The rest of this section focuses on the evidence behind each frontier area and the companies operating within it.

Table 3.1. The UK bioeconomy frontier at a glance

Frontier area	Details	Growth/market signal
Engineering biology and biomanufacturing	Engineered enzymes and microbes that build or break down materials	Bio-R&D £11.3bn GVA
Bio-based materials and textiles	Fermentation-grown leather and fibres replacing animal or petrochemical inputs	Leather is a highly patent-intensive sector (137 per £bn GVA); productivity
Biofuels and bio-chemicals	Waste and residue streams converted to fuels and green chemicals	Bioenergy GVA has increased from £0.8bn to £2.5bn, 6.22% real CAGR, with a 4.2x productivity gain
Agritech and precision breeding	Gene-edited, disease-resistant, higher-yield crops	Agricultural productivity has increased from £28k to £52k/job
Advanced therapeutics	Engineered immune cells and gene therapies for cancer and inherited disease	Bio-pharma has a GVA per job of £214,609 attributable to the bioeconomy
Precision fermentation and novel foods	Microbial production of proteins, fats and functional food ingredients	Global market ~20% CAGR to ~US\$9bn by 2030

Source: Authors

3.2. Signals: growth, productivity and investment

While official data do not provide sufficient detail on the bioeconomy frontier, we combine the analysis from Section 2 with financial and company data from sources such as The Data City to provide more granular details for frontier sectors. In particular, we look at growth in GVA, employment and productivity; the flow of private investment and public grants; and innovation intensity measured through R&D and patents. Together, these point to areas where the UK has strengths that can be translated into competitive advantage.

Growth signals

While the UK bioeconomy as a whole has broadly tracked UK GVA, employment and productivity growth, there have been a few bright spots that correspond to the UK's general strengths and emerging policies. In general, services and manufacturing/biomass-converting sectors are the most common top-ranking sectors across all three forms of growth. This reflects the UK economy being predominantly service-based, with some manufacturing and limited biomass production compared with the EU or other nature-rich countries. Many top-performing sectors account for a small slice of UK GVA or employment, indicating that the most rapidly growing sectors may not make a large contribution to absolute growth. Remediation and other waste management services (E39) and bioenergy (D35) have experienced rapid growth in GVA and employment but account for low shares of UK growth overall due to their small relative size. The sectors that emerge from this analysis include:

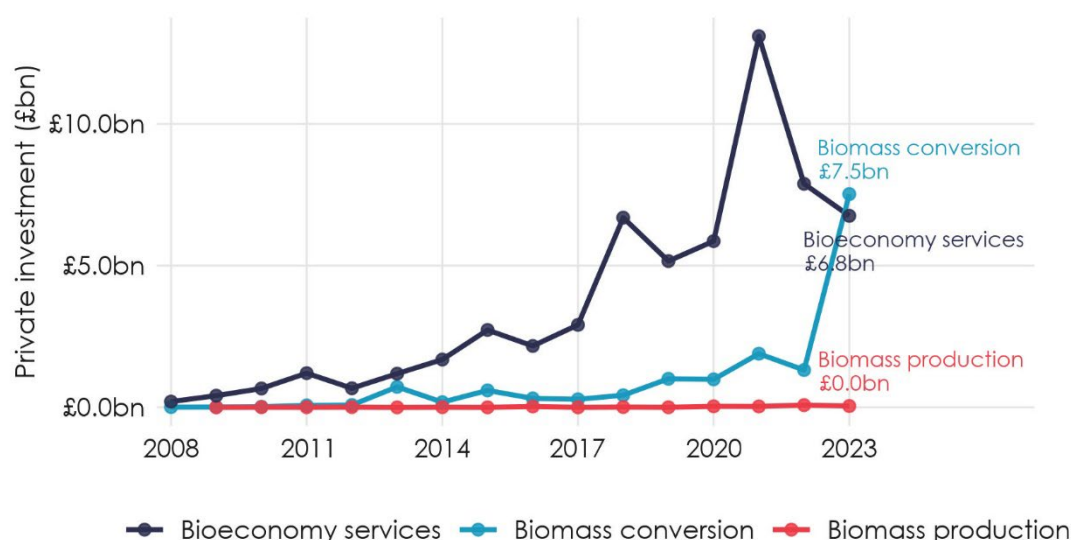
- **Scientific research and development provides the clearest all-round growth signal in the UK bioeconomy.** Bio-based scientific R&D (M72) has grown strongly across GVA, employment and productivity: employment rose by 5.13% annually between 2013 and 2023, adding over 38,000 jobs; Bio-GVA grew by 2.72% annually in real terms, adding £2.49 billion to UK bio-GVA; and productivity reached £87,720 per job in 2023. This reflects the UK's established position as a global research hub in bioeconomy-relevant fields, including engineering biology and genomics (Bagshaw et al., 2018; DBT, 2025a; UKRI, 2026).
- **Bio-pharmaceuticals demonstrate the UK's existing capacity to translate bio-based research into high-value economic activity.** Pharmaceuticals remain one of the most productive parts of the bioeconomy, with GVA attributable to the bioeconomy growing by 3.55% annually in real terms between 2013 and 2023 and productivity reaching £214,609 per job in 2023. The sector also sits within a wider opportunity for sustainable bioeconomy growth that spans 'biosolutions' that connect pharmaceutical, synthetic biology and biomanufacturing capabilities to wider industrial and environmental applications (NatureFinance, 2026). The wider life sciences sector generated £108 billion in turnover and £25.6 billion in pharmaceutical exports in 2021/22, but the UK's declining share of global R&D suggests that further regulatory reform, R&D investment and targeted manufacturing support will be needed to sustain this advantage (HM Government, 2025a; ABPI and PwC, 2022; Barlow, 2025).
- **Bio-based energy is a fast-growing sector that is directly linked to the green transition.** The bio-attributed energy supply sector (D35) has grown rapidly from a small base, with employment rising by 5.95% annually, bio-GVA by 5.23% annually in real terms, and productivity by 13.42% annually between 2013 and 2023. Its expansion has been supported by policy instruments such as the Renewable Transport Fuel Obligation, the Green Gas Support Scheme and the Biomass Strategy, indicating that clear incentives and regulation can help bio-based energy contribute to net zero, energy security and future bioeconomy growth (DESNZ, 2023; DfT, 2013; DESNZ et al., 2024; Colechin and Colechin, 2025).

Investment signals

In order to identify the sectors that are attracting attention from capital markets, as well as receiving additional government support, we looked at company-level financial data from The Data City. The analysis highlighted the following four trends:

1. **Investment in the bioeconomy has increased 7.5-fold since 2013.** Private investment in JRC-classified bioeconomy sectors grew from £1.91 billion in 2013 to £14.33 billion in 2023, a 7.5-fold increase and a CAGR of 22.3% (see Figure 3.1 and Table 3.2). The growth is broad and directionally similar across all bioeconomy sector types. Analysis of the financial data available from The Data City (n.d.a) suggests that corporates are the largest investors, followed by financial institutions, including venture capital and sovereign wealth funds. University and government funding has also played an important role in supporting the sector. Funding for services grew from £1.19 billion to £6.76 billion (CAGR 19.0%), while biomass conversion grew from £723 million to £7.52 billion (CAGR 26.4%). Average investment per company for the sample in bioeconomy sector groups also increased substantially between the early (2008–11) and late (2020–23) periods across all groups.

Figure 3.1. Private investment in bioeconomy sector groups, 2008–23

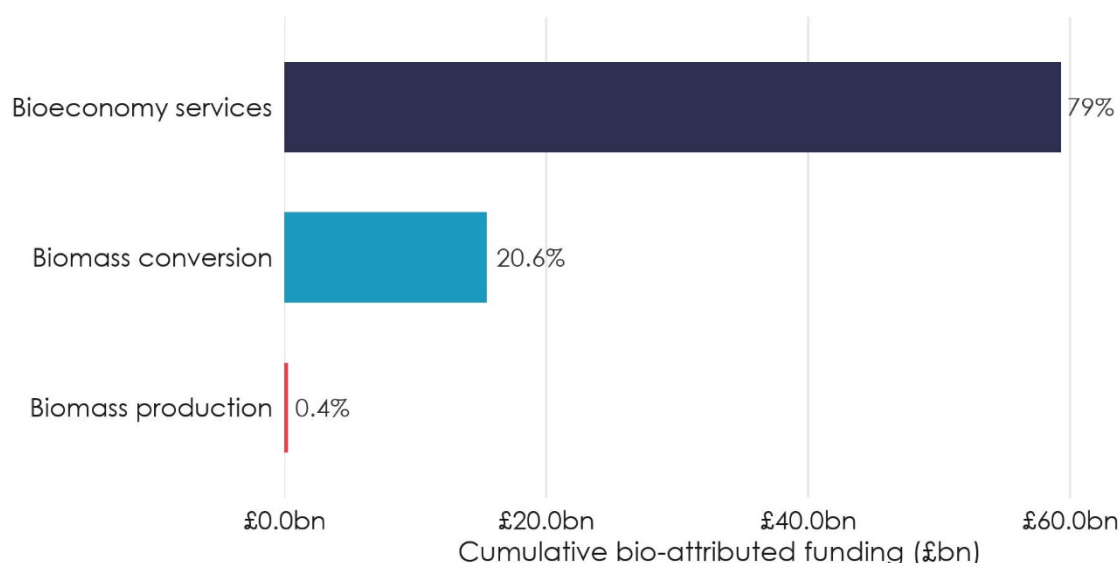


Note: C17 (paper) and C18 (printing) were excluded due to anomalous base-year investment concentration.

Source: Authors' calculations from a company funding sample from The Data City (n.d.a); JRC sector classification from Ronzon et al. (2017, 2022)

2. **Services dominate the investment base, led by knowledge and trade sectors.** Services account for £59.3 billion, or 79.0%, of cumulative investment from 2008 to 2023, with biomass conversion contributing £15.45 billion (20.6%) and biomass production £0.27 billion (0.4%) (see Figure 3.2 and Table 3.2). Within services, two sub-categories dominate: knowledge-based services, primarily scientific R&D (M72), account for £33.7 billion (44.9% of the total sample), while services related to tangible bio-based goods, including wholesale, retail, transport and food service, account for £21.5 billion (28.6%). This concentration of investment in knowledge and trade services reflects the UK's structural economic strengths, but could also indicate a lack of capital, instruments and enabling policy environments that would make bio-based manufacturing, agricultural supply chains and nature-based services legible or attractive to private capital.

Figure 3.2. Cumulative private investment in JRC-classified bioeconomy sectors by group, 2008–23



Note: C17 and C18 excluded due to anomalous base-year investment concentration. Services = Knowledge-based services (KBS) + Services related to tangible bio-based goods (SATBG) + Natural environment-related services (NERS) + Bioeconomy support services (BSS).

Source: Authors' calculations from a company funding sample from The Data City (n.d.a); JRC sector classification from Ronzon et al. (2017, 2022)

- Biomass conversion is a fast-growing sector group.** Biomass conversion accounts for £15.45 billion, or 20.6%, of cumulative investment from 2008 to 2023, second only to services (see Table 3.2), though year-on-year investment is volatile and concentrated in a small number of large transactions, particularly in food manufacturing (C10), construction (F41–F43) and pharmaceuticals (C21).

Table 3.2. Private investment in JRC-classified sectors by group, 2008–23

Sector group	Total (£bn)	Share of total (%)	CAGR 2013–23	Company obs.
Services	59.30	79.0	+19.0%	103,335
Biomass conversion	15.45	20.6	+26.4%	14,619
Biomass production	0.27	0.4	+70.1%	1,285

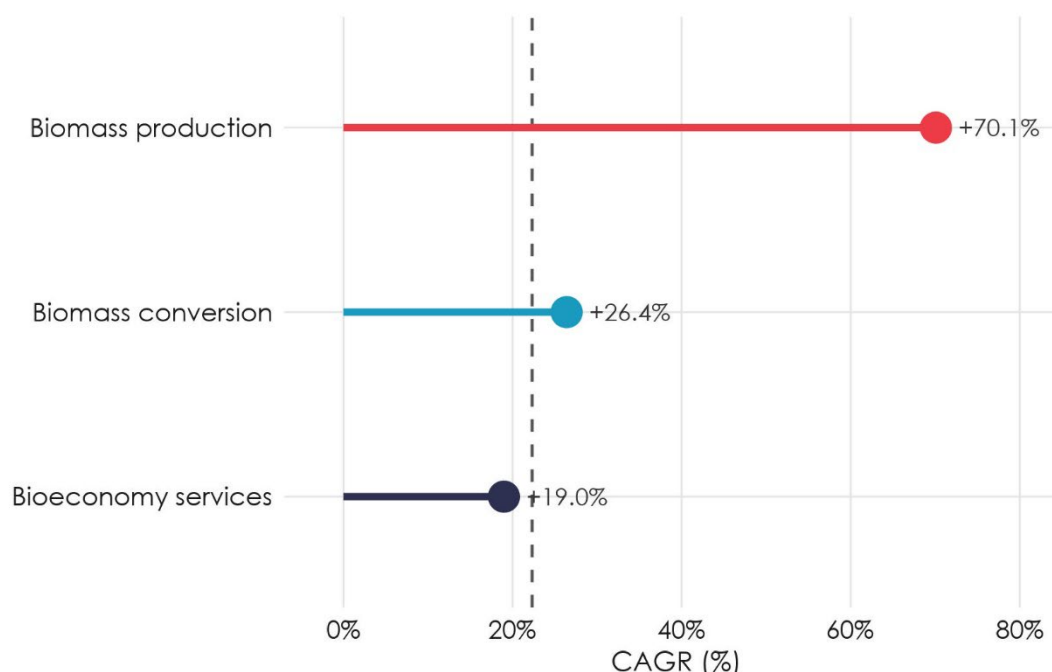
Note: Cumulative (company sample), 2008–23. CAGR computed 2013–23. C17 (paper) and C18 (printing) excluded due to anomalous base-year investment concentration.

Source: Authors' calculations from a company funding sample (The Data City, n.d.a); JRC sector classification from Ronzon et al. (2017, 2022)

- Public and private finance are flowing in the same direction, with public funding overweighting the bioeconomy.** Comparing private investment with Innovate UK (IUK) grants shows directional alignment rather than complementarity across sector groups (see Figure 3.3). Services attract both the largest share of private capital (£59.3 billion, 79%) and the largest share of IUK grants (£8.11 billion, 92% of the total IUK sample). Within the IUK sample, grants are progressively more bioeconomy-focused, even as

private capital has not followed as quickly, suggesting a delay or absence in crowding-in by the private sector.

Figure 3.3. Private investment CAGR by JRC sector group, 2013–23



Note: Based on a sample of UK companies. Dashed line = all-sector average CAGR (22.3%). Services CAGR reflects combined KBS, SATBG, NERS and BSS. C17 and C18 excluded due to anomalous base-year investment concentration.

Source: Authors' calculations from company funding sample (The Data City, n.d.a); JRC sector classification (Ronzon et al., 2017, 2022)

Finance flows are misaligned with the infrastructure needed to scale up the frontier bioeconomy.

Private investment growth in bioeconomy-relevant sectors between 2013 and 2023 was concentrated in two areas. First, construction was the single largest contributor, accounting for £5.67 billion, or 46%, of total investment growth, likely reflecting growth in bio-based materials, green building and sustainable infrastructure investment. Second, knowledge-intensive services accounted for £4.75 billion, or 38%, of growth, driven principally by scientific research and development (£2.40 billion, 19% of total growth). Together, these two sections account for 84% of all investment growth in the period. By contrast, investment in manufacturing scale-up, demonstrator facilities, bio-based materials, nature-based services and regional deployment remains inadequate. This means capital is flowing towards physical construction and research activity but not yet into the broader industrial infrastructure and nature-based businesses needed to translate UK bioeconomy innovation into commercial production, regional growth and system-wide sustainability gains.

This suggests that capital is beginning to recognise the UK bioeconomy, but is not yet reaching the forms of scale-up, manufacturing, demonstrator, regional and nature-based infrastructure needed to turn frontier innovation into system-wide growth. This points directly to the financing barriers we discuss later in the report, particularly the need for instruments that can bridge early-stage innovation and first-of-a-kind deployment, crowd in private capital, package regional project pipelines and connect industrial transition finance with nature-positive outcomes.

Identifying frontier industries in the UK bioeconomy

Aggregate SIC-level data capture established sectors but tend to obscure the frontier company populations sitting within and across them. To reveal these, we use The Data City's Real-Time Industry Classifications (RTICs), using UK company-level turnover and employment data (The Data City, n.d.b). The analysis identifies five RTICs that have shown high levels of growth in both output and employment between 2020 and 2024: **Land Remediation, FoodTech, Bioenergy, Agri-Tech and Biopharmaceutical** (see Table 3.3). Methodological details are provided in the Appendix.

Table 3.3. Turnover and employment CAGR for the RTICs identified, 2020–24 (%)

RTIC	Turnover CAGR	Employment CAGR
Land Remediation	16.0%	10.7%
FoodTech	15.8%	1.2%
Bioenergy	14.9%	6.5%
Agri-Tech	7.1%	5.4%
Biopharmaceutical	6.3%	1.5%

Source: Authors based on data from The Data City (n.d.b)

The three fastest-growing RTICs by turnover were Land Remediation (16.0%), FoodTech (15.8%) and Bioenergy (14.9%), which aligns with the official data for the remediation, food services and energy sectors (see Figure 3.4). Together with Agri-Tech and Biopharmaceutical, they populate five of the six frontier areas in Table 3.1. The sixth, bio-based materials and textiles, is captured through patent intensity: leather (C15) generated 33 bio-patent applications at the UKIPO against £242 million of bio-attributable GVA in 2013 – a patent intensity of 137 per £bn, the highest of any sector and 5.9 times more patent-intensive than pharmaceutical manufacturing in the same year.

3.3. Case studies from the bioeconomy frontier

The following case studies illustrate the sectors described above (see Case Studies 2–7). In high-growth sectors such as these, illustrative case studies are important for showcasing the potential for growth and providing insights that can guide policy decisions.

Engineering biology and biomanufacturing

Engineering biology is the clearest combined growth, investment and innovation signal in the frontier bioeconomy (see Figure 3.5). Bio-based scientific R&D (M72) generated £11.3 billion in nominal GVA in 2023, employed nearly 97,000 people and grew by 2.72% annually in real terms between 2013 and 2023. It exceeds bio-pharmaceutical manufacturing in GVA attributable to the bioeconomy in 2023 (in both nominal and real terms).

The opportunity lies in connecting this research strength to manufacturing-adjacent sectors where the bio-share remains low but the potential for transition is high.

Figure 3.4. The frontier industries: growth signals, UK policy landscape and technologies for scale

A. Turnover Growth CAGR by RTIC, 2020–24

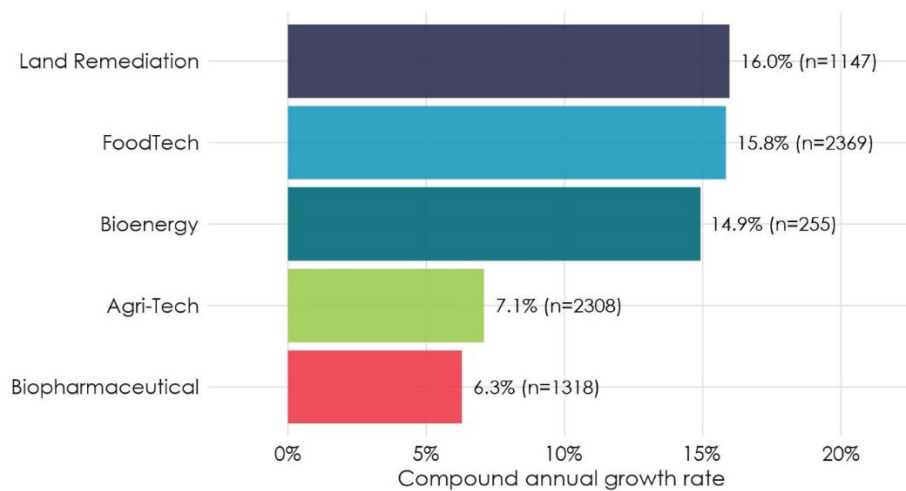
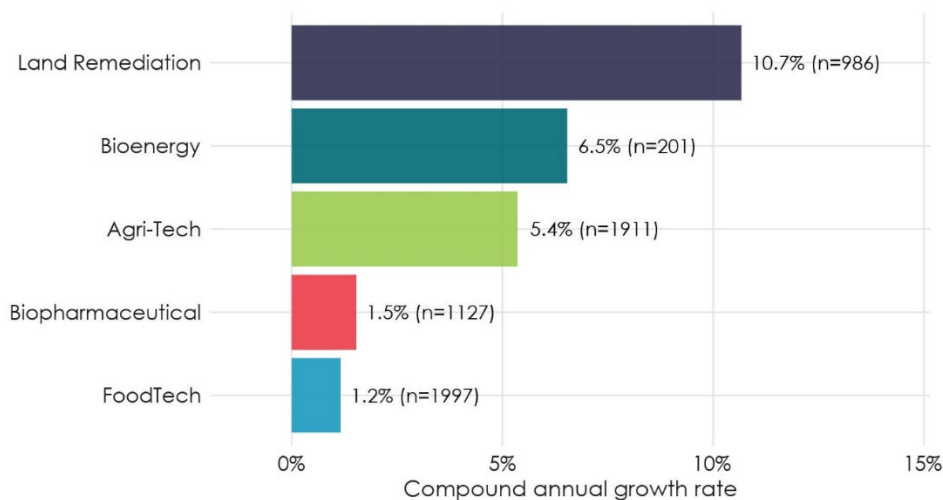


Figure B. Employment CAGR by RTIC, 2020–24

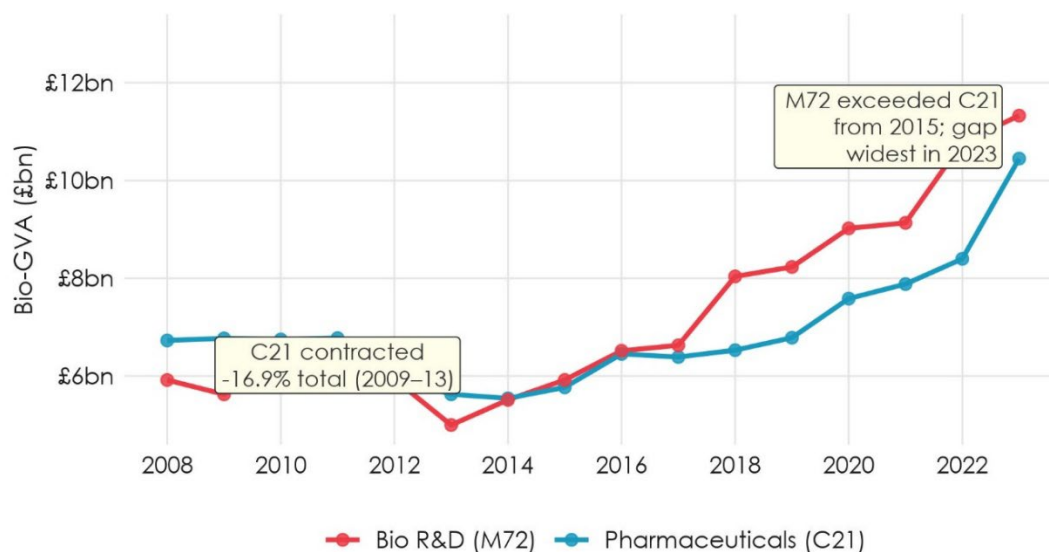


Note: Labels show estimated number of companies (n) for 2024. Figures are estimated totals projected from a sample of reporting companies, not directly observed totals for the whole economy.

Source: Company sample and projections from The Data City (n.d.b)

The data clearly highlight this gap. Rubber and plastics products (C22) have a bio-based share of just 3.3% of total sector GVA, generating only £272 million in estimated output attributable to the bioeconomy from an £8.2 billion sector. Each additional percentage point of bio-share in this sector would be worth approximately £82 million in additional GVA attributable to the bioeconomy. Remediation and waste management (E39) provide the contrasting growth signal: GVA attributable to the bioeconomy grew from £53 million in 2009 to £375 million in 2023, while firm numbers in the sector rose from 165 to 1,225 in the same period. Together, these figures show why circular materials are a central frontier application for UK engineering biology.

Figure 3.5. GVA attributable to the bioeconomy, C21 Pharmaceuticals and M72 Bio R&D, 2009–23 (£bn)



Source: Authors' calculations from ONS (2025e), applying bio-based shares obtained from Ronzon et al. (2017, 2022) and Lasarte-López and M'barek (2025)

Case Study 2: Epoch Biodesign

AI-designed enzymes that break down unrecyclable plastics at room temperature

Epoch Biodesign, founded in London in 2019, engineers enzymes that depolymerise PET (polyethylene terephthalate), nylon 6 and nylon 6.6 into their pure chemical building blocks. This breaks down synthetic materials into their chemical building blocks at ambient temperatures, without the high heat, pressure or toxic solvents that conventional chemical recycling requires. The recovered monomers are chemically identical to virgin material and can be repolymerised directly into new fibres or packaging, closing the material loop without quality loss. In February 2026, Epoch signed a commercial partnership with Invista, the original inventor of nylon 6.6 and licensor of the LYCRA and CORDURA brands, to advance textile-to-textile recycled nylon production globally (INVISTA, 2026). In the third quarter of 2026, Epoch is set to open the world's largest nylon 6.6 biorecycling demonstration plant at Grapht Works, Imperial College London's pilot and demonstration manufacturing facility in North Acton, aiming to process hundreds of tonnes of post-consumer nylon annually (Hutton, 2026). The commercial-scale plant planned for 2028 is projected to process over 20,000 tonnes per year, preventing that volume from being incinerated or reaching landfill and cutting emissions from nylon 6.6 production by over 80%, approximately 80,000 tonnes of carbon dioxide equivalent (tCO₂e) per year. As the CEO notes, the fact that a nylon recycling plant can operate in Greater London "is not incidental; it is a feature of the clean, low-energy process", showcasing that waste reduction can be achieved without requiring heavy infrastructure.

The wider lesson is that the UK's frontier strength depends on scale-up infrastructure. Epoch shows how bio-based R&D can upgrade plastics, textiles and waste, but commercial value capture depends on demonstration plants, patient capital, standards and demand from large buyers.

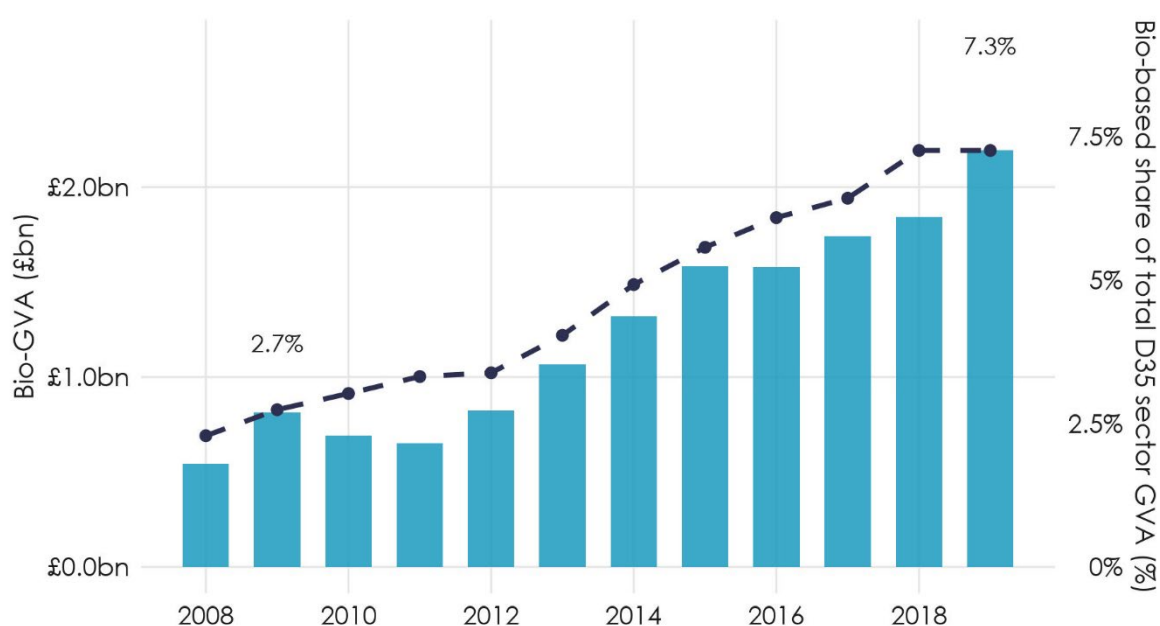
Biofuels and bio-chemicals

With recent volatility in fuel prices due to geopolitical tensions, there is increased interest in biofuels and the role they can play in building resilience for the British economy. Industrial symbiosis, the principle that one industry's waste becomes another's feedstock, highlights how the bioeconomy's circularity can operate in practice to embed sustainability into existing supply chains.

Energy is the UK bioeconomy's most transformed sector over the past 15 years. GVA attributable to the bioeconomy in the sector grew from £805 million in 2009 to £1.9 billion in 2023 in real terms, at 6.22% CAGR (ONS, 2025e) (see Figure 3.6). This was supported by policies such as the Renewable Transport Fuel Obligation (2008) (DfT, 2013), the Green Gas Support Scheme (2021) (Ofgem, 2021), and the Biomass Strategy (DESNZ, 2023). Productivity grew 4.18-fold from £6,500 to £27,200 per job between 2009 and 2023, one of the highest-growth multipliers among bioeconomy sectors.

The bio-share data capture the policy-driven expansion, reflecting regulatory frameworks supporting bio-based growth in the sector. The bioenergy (D35) sector's total current price GVA reached £34.9 billion in 2023, making it one of the largest sectors in the UK bioeconomy by economic scale. Each additional percentage point of genuinely bio-based activity in this sector is worth approximately £349 million in additional output attributable to the bioeconomy. The enabling policy environment has helped grow the sector, but has yet to maximise it.

Figure 3.6. D35 Bioenergy: GVA attributable to the bioeconomy and bio-based sector share, 2009–19



Note: Bio-GVA = total D35 GVA × JRC bioshare coefficient. Left-hand y-axis = Bio-GVA (columns); right-hand y-axis = Bio-based share (dashed line).

Source: Authors' calculations from ONS output data; JRC bioshare coefficients from Ronzon et al. (2017, 2022).

Case Study 3: Celtic Renewables

Whisky by-products turned into bio-acetone, bio-butanol and bio-ethanol – regional waste valorised into green chemicals

Celtic Renewables, a spinout from Edinburgh Napier University founded in 2011, converts whisky distillation by-products, including pot ale and draff, into bio-acetone, bio-butanol and bio-ethanol through a patented fermentation process based on acetone–butanol–ethanol (ABE) technology. Its commercial biorefinery at Grangemouth links three parts of the UK bioeconomy that are usually treated separately: Scotland’s beverages sector (C11), the chemicals sector (C20) and the bioenergy sector (D35). The beverages sector provides a large and fully bio-based feedstock base, while green chemicals and biofuels create a higher-value use for residues that would otherwise be treated as low-value by-products. In doing so, Celtic Renewables demonstrates the principle of industrial symbiosis and circularity, with the conversion of waste into feedstock (Celtic Renewables, 2024, 2026).

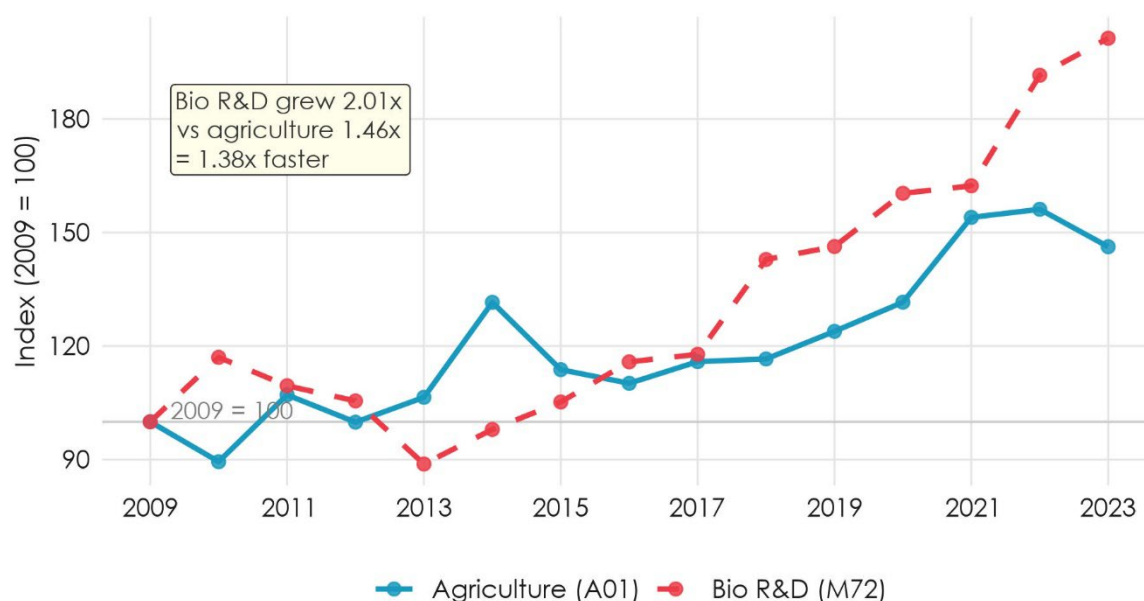
This case study shows that while the UK has the waste streams, process-engineering capability and industrial sites needed to support biorefining, a coordinated national architecture to connect them is absent. Bio-chemicals (C19/C20) grew at 2.84% CAGR in real terms between 2013 and 2023, above the national benchmark, yet the bio-based share of this £13.7 billion sector remains just 5.4%, generating only £743 million in bio-attributed GVA (0.25% of the total bioeconomy). This indicates that the chemistry and feedstocks exist but the coordinating value-chain policy does not. A stronger bioeconomy framework could link sustainable feedstock mapping, regional industrial strategy, green-chemicals demand, standards, patient capital and demonstrator infrastructure. Celtic Renewables therefore shows both the growth potential of biorefineries and the kind of coordination needed to turn isolated projects into a scalable circular manufacturing system that supports regional industrial renewal.

Agritech and precision breeding

A nature-positive economy is one that actively regenerates and restores nature and biodiversity, in addition to reducing harm. This makes a well-designed bioeconomy one of the key levers for sustainability. Agriculture is the largest employment base in the UK bioeconomy and sits at the base of the bioeconomy pyramid, shaping land use, food resilience, soil health, water use and biodiversity. The aggregate data show a constrained sector: agricultural current price GVA attributable to the bioeconomy grew from £9.4 billion in 2009 to £13.8 billion in 2023 (see Figure 3.7), below the bioeconomy and national benchmarks, while employment fell from 514,400 to 484,600. Productivity rose from £28,000 to £52,000 per job, showing that agriculture is producing more value with fewer workers.

Precision breeding provides a route to upgrade this base. The growth comparison between agriculture and bio-based R&D shows the scale of the gap: agriculture has continued to generate value from a shrinking labour force, while the UK’s scientific R&D base has expanded much faster. The UK’s agritech R&D base has deep and historical foundations, driven by institutions such as the John Innes Centre and Rothamsted Research. The policy challenge is to connect these two parts of the bioeconomy more systematically, so that plant science, genomics and precision breeding translate into deployed crop varieties, input efficiency and climate resilience.

Figure 3.7. Indexed growth in GVA attributable to the bioeconomy (2009 = 100) for A01 Agriculture and M72 Bio R&D, 2009–23



Source: Authors' calculations based on ONS Regional Gross Value Added (Balanced) by Industry (2024), Table 1c (current basic prices), applying JRC bioshare coefficients (Ronzon et al., 2017, 2022)

Case Study 4: Tropic Biosciences

Gene-edited, disease-resistant crops – UK plant science applied to the resilience of global food supply chains

Tropic Biosciences, founded in 2016 and based at Norwich Research Park, uses CRISPR-based gene editing and its proprietary GEiGS platform to develop disease-resistant, higher-yielding and more climate-resilient crops, including bananas, coffee and rice (Tropic Biosciences, 2026). Its work is relevant to the UK bioeconomy in two ways. First, it demonstrates how the UK's plant science base (M72), one of the fastest-growing parts of the bioeconomy, can generate commercially valuable crop traits. Second, it shows how frontier biology can strengthen food-system resilience by reducing vulnerability to disease, post-harvest loss and climate stress in globally traded commodities, reducing dependence on pesticides, fertilisers and irrigation.

Post-Brexit, the UK now has a clearer regulatory opening, with the Genetic Technology (Precision Breeding) Act 2023 (UK Government, 2023) offering a more proportionate route for gene-edited crops in England than the retained EU GMO framework. The kind of work done by Tropic Biosciences demonstrates how the UK's plant science base can generate commercially valuable crop traits. It also shows how frontier biology can strengthen food-system resilience by reducing vulnerability to disease, post-harvest loss and climate stress in globally traded commodities. These are valuable innovations that build on the UK's unique knowledge base and offer opportunities for global collaboration, particularly with partners such as Brazil and India, which rely heavily on agriculture but are also vulnerable to climate change.

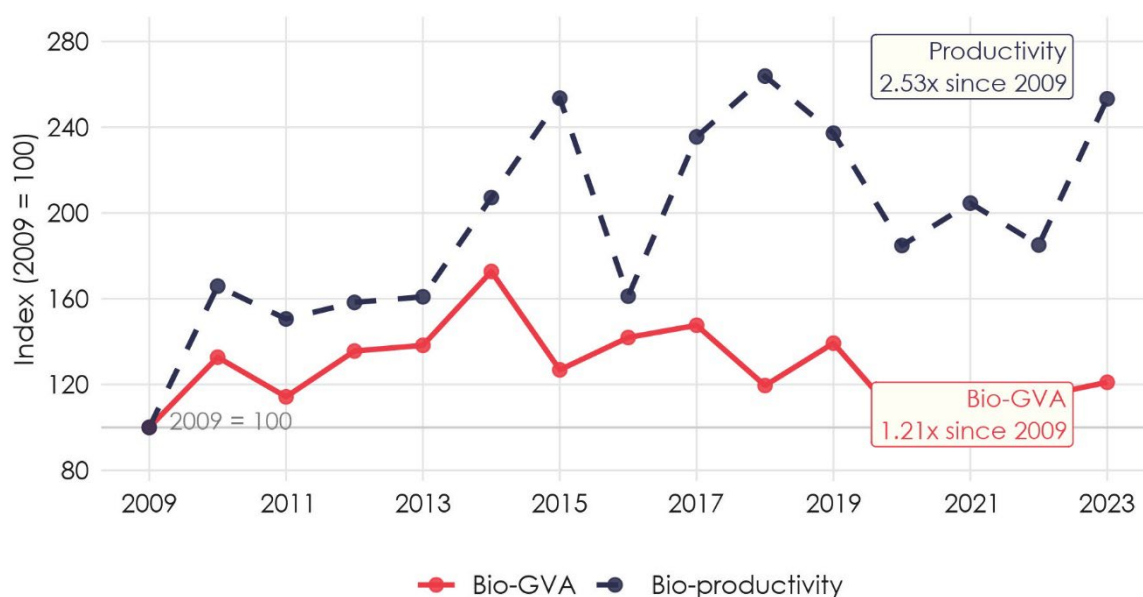
Bio-based materials

The fashion and textiles industry is one of the most water-intensive and water-polluting industries on earth. Conventional textile dyeing accounts for approximately 20% of global clean water pollution (European Parliament, 2025). Animal leather production is also resource intensive, requiring 15,000–16,500 litres of water per kilogramme of finished leather, and relying on chromium tanning processes that generate toxic wastewater requiring specialist treatment (European Commission, 2022).

The UK leather and textile sectors are generating the biological innovations that could transform the sector. Our analysis shows a high concentration of patenting activity in this sector. In 2013, leather (C15) generated 33 bio-patent applications at the UKIPO against £242 million of bio-GVA, a patent intensity of 137 per £1 billion of bio-GVA, the highest of any sector in the bioeconomy and 5.9 times more patent-intensive than pharmaceutical manufacturing in the same year. The leather sector is inventing at a higher rate per unit of economic output than any other sector in the UK bioeconomy.

However, its GVA contracted at –2.39% CAGR in real terms (2009–23), suggesting a high-potential sector that builds on the UK’s unique heritage and strengths. Productivity in the leather sector grew at 6.9% CAGR between 2009 and 2023, the second-fastest rate in the bioeconomy behind bioenergy, from £15,800 to £39,900 per job (see Figure 3.8). Apparel follows a diverging path, with its bioeconomy GVA growing at 3.17% CAGR in real terms since 2009, above the national benchmark, but its employment falling at –1.79% CAGR.

Figure 3.8. C15 Leather: growth in GVA and productivity attributable to the bioeconomy, 2009–23



Source: Authors’ calculations based on ONS Regional Gross Value Added (Balanced) by Industry (2024), Table 1c (current basic prices), ONS Labour Productivity by Industry Division (2024); JRC bioshare coefficients (Ronzon et al., 2017, 2022)

Case Study 5: Modern Synthesis

Bacterial nanocellulose grown into leather – UK synthetic biology applied to one of the world's most resource-intensive industries

Modern Synthesis, a London-based biotech founded in 2021, uses engineered bacteria to produce nanocellulose composites that replicate the functional properties of animal leather without livestock farming, chromium tanning chemistry, or the associated land use, water consumption and toxic wastewater. The fermentation-based process grows sheets of nanocellulose that can be layered, reinforced and finished for fashion, footwear and automotive interiors. Early support from Innovate UK enabled the transition from laboratory prototype to manufacturing demonstrator. Modern Synthesis's bacterial nanocellulose process eliminates both the water-intensive soaking and liming stages and the chromium tanning step entirely: fermentation uses a small aqueous growth medium, generates no toxic effluent, and requires no significant freshwater abstraction beyond basic fermentation inputs (Modern Synthesis, n.d.).

Modern Synthesis has established commercial partnerships with H&M Group's CO:LAB innovation arm (Modern Synthesis, n.d.), supported by the EU's extended producer responsibility schemes approved in September 2025 and the 2026 ban on destroying unsold clothing (European Parliament, 2025). The Engineering Biology Infrastructure Programme sustains the research base from which companies like Modern Synthesis emerge (DSIT, 2023). EU textile recycling mandates and the forthcoming EU Corporate Sustainability Due Diligence Directive will create binding obligations that make animal leather progressively more commercially disadvantaged relative to bio-based alternatives (European Commission, 2022).

Innovations such as those developed by Modern Synthesis offer methods that can help rebuild industrial processes in the wider bioeconomy so that they become efficient, productive and sustainable at the same time. At commercial scale, transitioning UK leather production to biological alternatives would represent a quantifiable reduction in both freshwater withdrawal and wastewater discharge, directly contributing to the UK's objectives under the Environmental Improvement Plan (Defra, 2023).

Precision fermentation and novel foods

Precision fermentation involves using engineered microbes to produce specific proteins, fats and functional ingredients without animal inputs, and sits at the intersection of engineering biology (M72), food manufacturing (C10) and food services (I56), and thus reaches the widest part of the UK bioeconomy pyramid.

Food and beverage services grew from £42.9 billion to £45.1 billion in real bio-attributable GVA between 2009 and 2023 (+5%), with firm counts rising from 118,755 to 154,345 (+30%). Bio-attributable employment grew from 1.54 million to 2.11 million (+37%). The modest real GVA growth (0.35% CAGR) alongside strong employment expansion suggests the sector absorbed substantially more workers without a corresponding increase in real output. The RTIC data show FoodTech turnover growing at 15.8% CAGR (2020–24) but employment at 1.2%, suggesting that growth was achieved with limited net new employment and an increase in productivity.

Case Study 6: Meatly

Real chicken meat grown from cells – frontier biology applied to food manufacturing and protein production

Meatly, founded in Newcastle in 2022, produces cultivated chicken meat from cells originally derived from a fertilised chicken egg, removing the need for livestock slaughter. In 2024 the company became the first in Europe to receive regulatory approval for cultivated meat following clearance by the Animal and Plant Health Agency for use in pet food. It subsequently launched the world's first commercially available cultivated pet food and, in 2025, secured a £10.4 million Series A funding round, bringing total funding to £17.4 million. The investment will support the development of a 20,000-litre cultivated-meat production facility, expected to become the largest in Europe and begin commercial production from 2027.

Meatly's progress illustrates how advances in cell cultivation, tissue engineering and food biotechnology can create entirely new forms of food production. It also demonstrates how post-Brexit regulatory flexibility can support commercial deployment. The company emerged through the Alternative Protein Regulatory Sandbox, which brought together Defra, the Food Standards Agency and the Animal and Plant Health Agency to create a regulatory pathway for cultivated protein products (Food Standards Agency, 2023). The resulting approval process was considerably faster and less costly than comparable international routes, highlighting the importance of coordinated regulation in supporting innovation.

The wider significance of Meatly extends beyond pet food. Food manufacturing is already the UK's largest bio-based manufacturing sector and one of the country's most regionally distributed industries. Cultivated protein demonstrates how frontier biology can complement and upgrade this industrial base rather than replace it. Domestic production of alternative proteins can reduce dependence on imported agricultural commodities, support supply-chain resilience and create new manufacturing opportunities built on the UK's strengths in life sciences, engineering biology and food innovation.

The economic implications are particularly important for regions such as the North East, which currently has the smallest bioeconomy of any UK region. Meatly's planned manufacturing facility creates a pathway for high-value employment in biotechnology manufacturing, process engineering and cell-culture production, helping to anchor frontier industries in places that have traditionally struggled to attract knowledge-intensive manufacturing investment.

This case study also illustrates a broader resilience opportunity. Cultivated protein production can require substantially less land and water than conventional livestock production while diversifying the UK's protein supply base. As the sector scales up, it could strengthen food security while reducing exposure to climate, land-use and commodity-price shocks. By becoming the first European jurisdiction to approve cultivated meat products, the UK has also created an opportunity to position itself as a destination for investment, research and manufacturing in next-generation food systems.

Advanced therapeutics

Bio-attributable pharmaceutical manufacturing (C21) contributes £10.4 billion in GVA (current prices) and is the second-largest biomass-conversion contributor to the UK bioeconomy, with productivity of £214,609 per job – the highest of any bioeconomy sector (Authors' calculations from ONS, 2025e; ONS LPROD, 2025). The frontier science underpinning it – engineered cell and gene therapies, mRNA vaccines, and early-stage work on synthetic-biology-based smart drugs – sits at the tip of the pyramid. Engineering biology is one of only five technologies the government

has designated critical to its science and technology strategy (DSIT, 2023; HM Government, 2025b).

Case Study 7: Liverpool City Region Cell and Gene Therapy Cluster

The Liverpool City Region hosts one of the UK's most significant advanced therapeutics clusters, centred on the Cell and Gene Therapy Catapult Manufacturing Innovation Centre in Speke (Cell and Gene Therapy Catapult, 2024; Liverpool City Region Combined Authority, 2024). The facility was established to address a critical barrier facing cell and gene therapies: the lack of manufacturing infrastructure needed to move innovations from the laboratory into commercial production and patient use (Cell and Gene Therapy Catapult, 2024; Office for Life Sciences, 2023).

The cluster demonstrates how strategic investment in shared manufacturing capability can help convert the UK's strengths in life sciences, engineering biology and clinical research into economic growth and industrial capacity. By providing specialised facilities that individual firms would struggle to build alone, it supports the scale-up of advanced therapies, attracts private investment and strengthens the UK's position in one of the fastest-growing areas of biotechnology (Cell and Gene Therapy Catapult, 2024; HM Government, 2025a; Office for Life Sciences, 2023).

Liverpool highlights the importance of the 'missing middle' in the bioeconomy. Scientific excellence alone is not enough; success depends on the infrastructure that connects discovery to deployment. The cluster provides a model for how shared scale-up facilities can help retain manufacturing, investment and value creation in the UK while supporting high-skilled regional growth (Cell and Gene Therapy Catapult, 2024; Liverpool City Region Combined Authority, 2024; Office for Life Sciences, 2023).

3.4. Connecting the frontier to the wider economy

The case studies examined in this section highlight examples that have successfully attracted capital and generated solutions that foreground productivity, sustainability and growth. These are examples from the tip of the pyramid that offer a potential upgrade to the wider bioeconomy and supply chains for scaling up. Three themes stand out:

- 1. Frontier innovation is cross-cutting across sectors.** For instance, engineering biology sits within scientific R&D but transforms plastics, textiles, chemicals and waste, while bio-based materials emerge from synthetic biology but reshape leather and apparel. Approaches that target only a specific sector would not be able to develop the cross-sector solutions that can emerge through a bioeconomy approach.
- 2. These sectors are rooted in regional innovation and growth.** Epoch Biodesign draws on London's engineering biology base, Celtic Renewables links Scotland's whisky residues to the industrial transition of Grangemouth, and Tropic Biosciences builds on the Norwich-Cambridge plant science cluster. New ideas and companies are highly reliant on local resources and infrastructure. Some of these examples rely on EU-wide supply chains, but policy can help embed them into local industrial and agricultural supply chains to support an 'upgrade' and offer a route to regional economic growth.
- 3. Scaling for growth through the bioeconomy needs a coordinated push.** This includes both policy and finance instruments that can help bridge the 'valley of death' – the difficult period for startups between successful product development and large-scale operations. It would require a coordinated approach, engagement with existing businesses, and instruments such as demonstration plants, patient capital and procurement signals,

alongside supportive regional infrastructure, to turn frontier innovation into commercial production.

The Green Finance Institute's technology-prioritisation work provides external corroboration of the same structural gap. The Institute screened 85 Bloomberg-identified transition technologies against market size, growth potential, nature impact, financial impact and UK policy alignment, and shortlisted three: Water Treatment, Biologicals and Cement Alternatives – each mapping thematically onto industries identified above (Green Finance Institute, 2026a). Its barrier analysis diagnoses the same absence of mid-stage patient capital between early grant funding and growth-stage investment, compounded by a shortage of specialist investors able to price emerging technologies.

Each case presented here demonstrates the potential to upgrade upstream sectors, such as plastics, textiles, chemicals, energy and agriculture. Taken together, the six frontier areas point to four operational gaps that a coordinated bioeconomy strategy would need to address:

1. **Weak demand formation** – an absence of bio-content standards, labels and procurement signals that would let brands, industrial buyers and public bodies substitute bio-based alternatives at scale.
2. **Insufficient scale-up finance** – a shortage of mid-stage patient capital and specialist investors in the £5m–£50m range where frontier bioeconomy companies most often stall.
3. **Limited demonstrator infrastructure** – too few first-of-a-kind commercial demonstration facilities of the kind Epoch, Celtic Renewables, Modern Synthesis and Autolus depend on.
4. **Fragmented regional delivery** – regional clusters that individually work but are not connected into a national industrial architecture.

Closing these gaps sustainably – rather than through one-off interventions – would allow the UK to do at scale what bioenergy's own trajectory already demonstrates is possible: converting frontier science into commercial industry fast enough to generate productivity gains across the base of the pyramid, not only at its tip. Given the UK's acknowledged research strength in engineering biology and the wider bioeconomy, a coordinated strategy is a genuine opportunity for UK leadership.

4. The bioeconomy as a lever for the UK

The UK bioeconomy is large, research-rich and regionally distributed, yet remains under-coordinated and is growing more slowly than many of its European peers. The analysis presented so far suggests that a bioeconomy approach could help advance several national priorities simultaneously. Rather than focusing narrowly on a small number of high-profile sectors, it provides a systems-level policy framework that connects the UK's expertise in innovation with its traditional sectors. A bioeconomy strategy would offer four policy levers: inclusive growth, sustainability and nature-positivity, investment and resilience. This section explores how these levers would operate in practice and how a bioeconomy framework can help address barriers to growth related to visibility, coordination, demand, finance and place-based delivery.

4.1. A lever for productivity and devolved growth

The bioeconomy is already a substantial contributor to national output, accounting for 13.2% of UK GVA and around 19% of employment in 2023. Its growth performance, at 0.73% CAGR in real terms between 2009 and 2023 against the national 1.62%, reflects a sector that needs a systems-wide upgrade.

Comparators from the EU, as seen in the benchmarking exercise in Section 2, highlight the potential for growth. The UK holds the fourth-largest bioeconomy in Europe by value added but ranks 21st of 28 countries by growth, with a majority of activity coming from food and beverages (47% of total value added, excluding services). Growth has come through employment expansion rather than productivity gains, despite the UK's strengths in innovation and R&D. A coordinated bioeconomy approach can address this gap. The European Commission published a renewed EU-wide Bioeconomy Strategy in November 2025 (European Commission, 2025a), and 11 EU Member States, including Germany, France and Spain, have adopted national bioeconomy strategies to address precisely this gap (European Commission, Joint Research Centre, 2026).

The sectors at the bioeconomy frontier provide examples of the growth potential of the sector. For instance, scientific R&D attributable to the bioeconomy grew at 2.72% CAGR in real terms between 2013 and 2023, adding £2.49 billion in GVA (2022 prices) and over 38,000 jobs. Similarly, energy sectors grew at 5.23% in real terms with an increase in the biological component of their production. These are the sectors at the top of the bioeconomy pyramid, and the case studies in Section 3 show how they translate into wider economic activity. For instance, Epoch Biodesign connects engineering biology to the large, low-bio-share plastics and textiles sectors.

The bioeconomy is a lever for the kind of good-quality, inclusive growth that policymakers are looking for today. Its productive base is far more geographically dispersed than the wider economy, with rich economic activity outside London and the South East. At the firm level, the bioeconomy is structurally more important to regional economies: 73.5% of Northern Irish firms, 68.4% of Welsh firms and 66.6% of Scottish firms operate within the bioeconomy, compared with 54.5% in London and the South East. This activity is largely SME-based, with knowledge clusters around regional resource bases, such as plant science in the Norwich–Cambridge corridor and marine bioeconomy in Aberdeen, offering pathways to well-rounded growth. By connecting local feedstocks, industrial capabilities and research assets to frontier applications, a bioeconomy approach could reinforce both regional renewal and national growth, turning dispersed clusters in regions such as Yorkshire into nationally significant hubs.

To address the challenge of scaling up, and to transform small-scale successes into a large coordinated strategy, the UK can look to countries such as Germany and the Netherlands, which have delivered growth by connecting frontier innovation to their mature industrial base through

coordinated national strategies. For the UK, the growth lever lies in using engineering biology, biomanufacturing and precision breeding to raise productivity across the wider bio-dependent economy, turning scattered strengths into a more coherent industrial proposition.

4.2. A lever for sustainability and nature-positivity

The UK is one of the most nature-depleted countries in the world, yet its ecosystem services were valued at £1.8 trillion in 2022, equivalent to around 72% of GDP. This combination of depletion and dependence, reinforcing the need to protect and restore nature as the foundation of economic stability and growth, makes sustainability an economic necessity rather than an aspiration. As established in Section 1, the bioeconomy delivers benefits for nature only when it is deliberately designed to do so. The frontier case studies in Section 3 demonstrate what that design looks like in practice. Using the bioeconomy lens can help identify where and how the UK's nature-positive transition can succeed, because it covers the sectors that depend most directly on land, water, biomass and ecosystem services.

The bio-based materials and circular manufacturing cases demonstrate how frontier innovation can embed sustainability into existing industrial processes, providing pathways for nature-positive production. Modern Synthesis grows bacterial nanocellulose that substitutes for animal leather, eliminating the 15,000–16,500 litres of water per kilogramme and the chromium tanning effluent associated with conventional production, while Epoch Biodesign's enzymatic recycling keeps synthetic polymers in use without quality loss.

This nature-positive potential is increasingly being formalised through the development of Nature-Positive Transition Pathways (NPTs), which translate nature targets into plans for sectoral investment and action (Green Finance Institute, 2026b). Much of the current momentum is concentrated in three priority sectors: agrifood, water utilities and the built environment. These priority sectors map directly onto the bioeconomy: agrifood and water sit within biomass production and conversion, while the built environment draws on bio-based materials at the innovation frontier. A coordinated bioeconomy, combined with the NPTP process, can support a coordinated approach to upgrading bioeconomy sectors while embedding nature-positivity into the outcomes. This alignment matters economically as well as environmentally: the Green Finance Institute estimates that continued nature degradation, compounded by climate change, could reduce UK GDP by 6% by 2030, outweighing the gains from current growth initiatives (Ranger et al., 2024).

Internationally, Brazil's socio-bioeconomy framing shows how sustainability and nature-positivity can be built into a national strategy from the outset. The UK's opportunity, as a nature-poor but research- and industry-intensive economy, is to structure its bioeconomy so that innovation in the frontier sectors, at the apex of the pyramid, can upgrade the resource-intensive sectors that sit in the middle of the pyramid. This would strengthen natural capital and improve circularity within ecological limits, making sustainability a source of competitive advantage rather than a compliance cost.

4.3. A lever for investment

Capital is increasingly recognising the bioeconomy, guided by the public sector. While the exact magnitude depends on the definition, investment data suggest very large increases – 7.5-fold – in the level of capital flowing to bioeconomy sectors between 2013 and 2023. Public finance, channelled through Innovate UK grants, has provided funding that is directionally aligned with private flows, usually exceeding them. This alignment of public appetite and private momentum makes the bioeconomy a credible lever for mobilising investment.

The frontier case studies in Section 3 reflect the importance of credible and stable policy signals for growth. Tropic Biosciences attracted a US\$105 million investment round co-led by Corteva

once the Precision Breeding Act created a credible route to market; Celtic Renewables grew within the policy environment created by the Renewable Transport Fuel Obligation and the Green Gas Support Scheme; and Modern Synthesis drew early capital as EU extended-producer-responsibility rules created binding demand for bio-based materials.

With the development of the EU bioeconomy strategy, there is likely to be increased market interest in the sector over the next 5–10 years. In particular, the convening of a Bioeconomy Investment Deployment Group, aimed at building a pipeline of bankable bio-based projects, sharing risk and crowding in private capital, with a particular focus on start-ups and SMEs, is likely to focus investor attention on European bioeconomy sectors (European Commission, 2025a). It is accompanied by a Bio-based Europe Alliance, a coalition of companies aiming to collectively purchase €10 billion in bio-based solutions by 2030, and by the alignment of existing and future EU funding programmes behind bio-based priorities. This creates a large, coordinated pool of demand and deployment capital across plastics, textiles, chemicals, fertilisers, construction materials and advanced fermentation.

For the UK, this is both a signal and a warning. UK firms already rely on EU demand and standards to scale up, and in the absence of comparable domestic deployment finance and lead markets, the most promising UK bio-based companies may increasingly locate their scale-up, manufacturing and value capture in the EU. Acting soon to mobilise the UK's own investment capability would allow the country to upgrade its own bio-dependent sectors rather than exporting the returns on its research base overseas.

4.4. A lever for resilience and security

The UK bioeconomy is highly reliant on international trade, accounting for 16.1% of UK imports, with an export–import ratio of 0.90 compared with 1.07 for the economy as a whole. With around 40% of food imported and roughly half of UK nature-related risks originating overseas, the bioeconomy is as much a resilience agenda as a growth one (Defra, 2026a). A coordinated bioeconomy approach offers a lever for reducing this exposure while building productive domestic capacity.

Recent geopolitical shocks have underscored the vulnerability of the global economy to trade chokepoints. For instance, the Strait of Hormuz accounts for roughly 20% of global petroleum and liquefied natural gas flows (EIA, 2025). Exposure to volatility in energy and commodity prices is acute because the UK imported around 41% of its energy in 2023, as North Sea oil and gas production continued to decline (DESNZ, 2024). Because so much of the wider economy still depends on imported fossil feedstocks, these external shocks transmit quickly into domestic prices and supply-chain disruption – a dynamic the European Central Bank has termed “fossilflation” (Schnabel, 2022).

The bioeconomy can offer a pathway to resilience against these shocks by providing alternatives to fossil fuels that either support more efficient use of existing resources or allow for substitution with bio-based alternatives that reduce sensitivity to volatility. The biofuels and biorefinery examples in Section 3, such as Celtic Renewables' conversion of whisky residues into green chemicals, show how circularity turns domestic waste streams into industrial inputs, replacing imported fossil feedstocks while building resilience to external shocks and lowering emissions. These examples demonstrate how frontier innovation can be embedded into local feedstocks and industrial capabilities to strengthen regional economies.

A key dimension of resilience is food security, which can be supported by a robust bioeconomy. Food security is perhaps the clearest expression of the resilience case for the bioeconomy. The UK imports around 40% of its food, relies heavily on European supply chains for fresh fruit, vegetables and sugar, and depends on imported animal feed such as South American soy, leaving its food system exposed to climate shocks, trade disruption and price volatility (Defra,

2025). A coordinated bioeconomy can use advances in precision breeding and agritech to raise domestic agricultural productivity and resilience against disease, drought and input shocks. Biofertilisers and circular and bio-based inputs can reduce dependence on imported inputs in the agriculture supply chain. These capabilities also create an opportunity for trade, where UK R&D can help develop resilience in food systems in agriculture-intensive partner countries such as India and Brazil, providing further opportunities for growth.

The natural capital base of the bioeconomy serves a second economic function in addition to supplying biomass. Functioning ecosystems act as physical infrastructure, providing flood attenuation, drought resilience, water purification, urban cooling and coastal protection that safeguard companies, communities, public assets and economic output. They also support climate mitigation through carbon sequestration and storage.

Related natural capital outcomes are increasingly being measured, contracted and financed through Biodiversity Net Gain,⁵ nutrient mitigation, water payments for ecosystem services, domestic carbon codes and Landscape Recovery (see Case Study 8). Direct outcome-based payments for physical resilience are also emerging. This creates an opportunity for the UK to treat nature recovery not only as an input to the bioeconomy, but as natural infrastructure capable of supporting an emerging investment market and an exportable resilience-services industry.

Case Study 8: Evenlode Landscape Recovery

A farmer-led catchment attracting infrastructure investment for flood resilience

The Evenlode Landscape Recovery project in the North Cotswolds is one of the first UK Landscape Recovery schemes to enter delivery, and the first led by a farmer cluster. It works with more than 50 farmers and land managers across over 3,000 hectares in Oxfordshire, Gloucestershire and Warwickshire to restore floodplain meadows, wetlands, woodland, soils and river systems while maintaining productive farming. The broader 20-year programme is anchored in long-term public implementation funding administered through Natural England, to provide support while private nature-market revenues develop (Defra, 2026b; Environment Agency, 2026).

The project has received direct investment from downstream infrastructure beneficiaries. In May 2026, Scottish and Southern Electricity Networks, Network Rail and Oxfordshire County Council committed more than £3 million for upstream natural flood management through the project. The funding will support farmers and land managers to create and restore habitats that slow, store and absorb water, helping protect electricity networks, rail lines, bridges and roads from growing flood risk (SSEN, 2026). This reflects the wider adaptation investment challenge identified by the Climate Change Committee: the UK needs to move from reactive repair towards planned investment in resilience, including nature-based and catchment-scale solutions (Climate Change Committee, 2026).

The initial infrastructure funding is focused on natural flood management, while the wider Evenlode programme is exploring revenues from water quality, biodiversity, carbon and other ecosystem outcomes (Defra, 2026c). The project has also participated in Defra and the British Standards Institution's Nature Investment Standards Early Adopter Programme, testing its governance, measurement and market approach against BSI Flex 701, the emerging overarching framework for high-integrity UK nature markets (Defra, 2026b; BSI, 2026). The model therefore combines long-term public support for landscape recovery with direct beneficiary funding for specific ecosystem services.

⁵ A policy approach that requires developments to leave biodiversity in a measurably better state than before development.

This case study shows how the natural capital base of the bioeconomy serves as functioning infrastructure. A single catchment can aggregate land managers and infrastructure beneficiaries around measurable resilience outcomes, with farmers delivering interventions and downstream organisations paying because the resulting ecosystem services protect assets, customers and public services.

It crystallises the kind of enablers and policies, such as identifiable beneficiaries, a defined physical risk, landscape-scale delivery, credible monitoring, long-term public support and direct beneficiary funding, that can support financing for the natural capital base of the bioeconomy. It offers a practical demonstration of nature as infrastructure and of the project development, contracting, measurement, standards and financing capabilities the UK could replicate domestically and export internationally.

4.5. The bioeconomy as a connective framework

The real value of the bioeconomy approach is in providing a systems-level framework that bridges different sections of the British economy and underscores its utility as a highly policy-relevant framework. It can turn a fragmented set of sectors into a system that can deliver growth and productivity, working with large, legacy sectors that can support the devolution agenda. This is necessary to support the emergence and scaling up of a competitive bio-based industrial base in the UK.

The bioeconomy label supports this approach by making biological dependence visible, connecting frontier innovation to the sectors that need upgrading, and creating investable project pipelines across regions, industry, infrastructure and natural capital. In practice, the bioeconomy approach removes five barriers that currently prevent the UK's bio-dependent economy from becoming more productive, resilient and nature-positive.

1. **The visibility barrier.** The UK bioeconomy is economically large, but has not been a formal part of any statistical and institutional accounting, making it invisible. It spans agriculture, food, forestry, pharmaceuticals, materials, energy, waste, environmental services, logistics, retail, research and finance, yet these activities are measured and governed through separate systems. A shared definition, regular statistical account and common taxonomy would make the scale, geography, productivity, trade exposure and investment needs of the bioeconomy visible to government, investors and local authorities.

Policy Response: Addressing this barrier calls for policy to define and coordinate the bioeconomy, providing a common baseline for its identification, governance and financing.

2. **The coordination barrier.** The UK already has a fragmented policy landscape across life sciences, biomass, industrial strategy, innovation, biosecurity, food, nature recovery, clean energy, waste and financial services. A bioeconomy approach provides a mechanism to connect these agendas around shared outcomes. It can link feedstock policy to industrial strategy, nature recovery to productive investment, and frontier biology to mature sectors such as food, textiles, chemicals, energy and construction, serving as a bridging framework.

Policy Response: Addressing this barrier requires a clear owner of the bioeconomy within the UK Government, responsible for coordinating and leading on governance, standards and regulation, with the aim of turning scattered policies into a coherent delivery system.

3. **The market-formation barrier.** Many frontier bio-based products and processes face uncertain demand, higher early costs and competition from incumbent fossil-based alternatives. In the absence of clear demand signals, firms struggle to move from pilot to

commercial scale, and investors cannot underwrite manufacturing capacity or first-of-a-kind infrastructure. A bioeconomy approach can create lead markets through public procurement, bio-content standards, product labelling, sustainability regulation and long-term offtake mechanisms.

Policy Response: The bioeconomy approach can address this barrier by leading markets through market creation, creating bankable demand with tools such as public procurement, bio-content standards, labelling and sustainability regulation. This would build demand and secure supply to give frontier firms the confidence to scale domestically.

4. **The place-based delivery and innovation barrier.** The bioeconomy is especially useful for devolution because many of its assets are local: food-processing capacity, ports, forestry, waste streams, universities, further-education colleges, innovation centres, SMEs and natural capital assets. Yet these are rarely packaged as coherent local growth propositions. A bioeconomy approach helps local and devolved authorities identify clusters, map feedstocks, connect firms to innovation assets, and develop investable projects. This is where the bioeconomy can link national industrial strategy to local economic renewal, by offering a framework for turning regional biological resources and capabilities into productivity, resilience and nature-positive growth.

Policy Response: To address this barrier, innovation and regional clusters should be scaled up to generate the agglomeration economies needed for the development of specialised bioeconomy clusters that build on, and can support the upgrade of, local economies.

5. **The finance barrier.** The evidence in Section 3 shows that capital is beginning to recognise the UK bioeconomy, but is not yet flowing sufficiently into assets that can support a scaling up of the sector, such as demonstrator plants, biomanufacturing assets, regional clusters, industrial transition projects and nature-based infrastructure. The bioeconomy approach helps identify where different forms of finance are needed across the pyramid, as we discuss later in the report. At the innovation frontier, the priority is patient capital, grants, guarantees, venture debt and first-of-a-kind risk sharing. In the middle layer, mature bio-dependent sectors need transition finance, cluster funds and sustainability-linked instruments. At the natural capital base, projects often need blended finance, aggregation, long-term public support and beneficiary payments for ecosystem services.

We discuss the policy response for this barrier in Section 6.3, 'A financial architecture for the bioeconomy'.

Taken together, these functions show what the bioeconomy approach delivers in practice. It converts fragmentation into coordination. It makes a large but dispersed economy visible, connects research strengths to established sectors, creates demand for frontier products, mobilises the right kinds of finance, and turns regional and natural capital assets into investable propositions. The bioeconomy is not only a sectoral lens or a taxonomy. It is an operating framework for delivering productivity, sustainability, resilience and inclusive growth through one connected agenda.

5. A case for UK leadership in the global bioeconomy

Global momentum around the bioeconomy has increased in recent years, with Brazil's COP30 Presidency outlining an agenda for investment in biodiversity and nature protection. As the UK prepares to assume the G20 Presidency in 2027 and the G7 Presidency in 2028, there is an opportunity to build on this momentum and expand the policy architecture to include nature-depleted but nature-capable economies.

The core agenda that the UK will inherit from previous G20 leadership, including South Africa and Brazil, and G7 leadership, including France and Canada, incorporates sustainable growth, closer bilateral and multilateral ties for development, energy security, critical minerals, climate adaptation and, increasingly, nature (Binetti, 2026; PMO, 2025). The bioeconomy offers a framework within which the UK could continue the precedent set by its Brazilian and South African predecessors while addressing many of these areas of cooperation simultaneously (GIB, 2024).

With nature-rich countries such as Brazil and South Africa shaping the agenda for the global governance of the bioeconomy and setting their priorities within it, the UK's sequential G20 and G7 presidencies offer a window of opportunity to steer these developments and create a stake for nature-depleted countries by drawing on its historic convening power and ability to build international consensus as a regionally significant middle power (Patrick, 2026; Jeffs and Townsend, 2022).

The UK has the opportunity to draw on its world-class professional and business services, deep financial markets, research and innovation base, and trusted convening power to position itself as a leader in a bioeconomy approach that supports the whole bioeconomy pyramid while providing levers for domestic growth, inclusion and resilience. Realising this potential, however, requires domestic organisation and progress first. The UK can only lead internationally if it has a good domestic story to tell.

5.1. Expertise in services

The UK has broad strength in professional and business services and has long been a global leader in this area. This strength also translates into the bioeconomy, where services maintain an export-import ratio of 2.76, exceeding the national services average of 2.48 (DBT, 2025c). Beyond sectors considered fully or partially bio-based, the UK also holds a leadership position in a range of services that enable the bioeconomy, including information and communication technology (ICT), satellite intelligence, finance and insurance (DBT, 2025c; TheCityUK, 2026; Ronzon et al., 2022).

Current bioeconomy strategies place less emphasis both on the role of bioeconomy services and on the non-bioeconomy services that could enable investment, innovation and growth in the bioeconomy.

There appears to be growing demand for services that enable and facilitate the development of the bioeconomy across the UK's partner countries, particularly around technology transfer (Da Silva et al., 2024). The UK has already played a key role in bioeconomy-adjacent sectors, such as earth observation for forests and coffee plantations (UK Space Agency, 2019; Earth-i, 2020). Furthermore, the UK has positioned itself as an open middle ground for nature-rich countries, including by being a signatory to the Nagoya Protocol and playing a key role in supporting the continued economic transformation of the Commonwealth (DSIT et al., 2015; Ramontsho,

2025). For partner countries seeking technical assistance and technology transfer without strong geopolitical attachment, the UK's middle-power positioning and trust architecture make it a credible partner (Bates, 2026).

The UK's strength in services sits outside current definitions of the bioeconomy but is nonetheless central to delivering emerging bioeconomy strategies around the world, particularly in feedstock-rich countries such as India and Brazil. Activating this strength would require recognising the UK's advantages in bio-enabling services and deploying them through bilateral and multilateral channels.

5.2. Leadership in finance

The UK plays a disproportionately large role in global finance through the City of London and its overseas territories (TheCityUK, 2026). Alongside its strength in professional and business services, the UK is one of the few global economies that offers sophisticated financial infrastructure to support global growth. Across the world, evidence points to a lack of proper financing mechanisms as a key obstacle to scaling up the bioeconomy (Kantola and Zadek, 2024; BB-REG-NET, 2025b; European Commission, 2025a). In addition, reductions in overseas development assistance (ODA), despite rising requirements for nature, biodiversity and bioeconomy finance, place further emphasis on the need to mobilise additional capital from private and blended sources at scale (OECD, 2025; McCarthy et al., 2025; Kantola and Zadek, 2024).

The UK's strength in financial services has enabled it to play a pioneering role in stimulating green investment. As countries seek to build nature-positive, climate-resilient and bio-based growth models, the bioeconomy will require new investment vehicles, standards, insurance products, blended finance structures, and transition-finance instruments. The UK has a strong comparative advantage, hosting one of the world's leading financial centres in London, with deep capabilities in capital markets, insurance, asset management, legal services, standards and professional services across the UK.

The UK's financial and insurance services sector contributed £208.2 billion to the economy in 2023, equal to 8.8% of total UK economic output, and supported 1.17 million jobs in the first quarter of 2024 (House of Commons Library, 2024). The sector is also one of the UK's strongest export assets: financial services exports were worth £91.8 billion in 2023, against imports of £18.6 billion, generating a £73.2 billion trade surplus (House of Commons Library, 2024). Wider ONS-based analysis reports an even broader financial-services export figure of £120.3 billion in 2023 and a £92.2 billion financial-services trade surplus, with the UK remaining the world's largest net exporter of financial services (City of London Corporation, 2024). These capabilities matter because the global bioeconomy is already estimated at around US\$4 trillion and could rise to US\$30 trillion by 2050 (NatureFinance, 2024). If the UK positions itself early, bioeconomy finance can become a new frontier for financial-services exports, inward investment, standards-setting and international climate-and-nature leadership.

The UK has already used finance to strategically invest in and unlock frontier markets and new sources for a range of bio-feedstocks and commodities. British International Investment invested US\$25 million in the Democratic Republic of Congo to expand financing available to coffee, cacao, rubber, cassava and palm oil producers (BII, 2026; Assocle, 2026). London has consistently ranked as one of the world's leading green finance hubs (Wardle et al., 2025). Partnerships for Forests, supported by the Foreign, Commonwealth and Development Office (FCDO) and NatureFinance, shows that forest-friendly bioeconomy models can generate climate and socioeconomic benefits, but only when finance is structured to help viable enterprises move from fragmented pilots into investable value chains supported by market demand, local partnerships and enabling policy conditions (Partnerships for Forests, 2023). There is further

room to grow, including by leveraging UK public finance to bring in more private finance (Ranger et al., 2025). The following case study illustrates how the UK has provided leadership and technical expertise to deliver programmes that support blended-finance investments in Brazil's bioeconomy (see Case Study 9).

Case Study 9: Eco Invest Brasil

A UK-backed Brazilian programme using blended finance and currency hedging to crowd private capital into green fuels, bio-inputs and biomaterials

Eco Invest Brasil, launched in 2024, is a blended-finance programme developed by Brazil's Ministério do Meio Ambiente e Mudança do Clima and Ministério da Fazenda in partnership with the Inter-American Development Bank, with support from the UK (OECD, 2024; UK PACT, n.d.). It targets one of the central barriers to attracting international investment into sustainable projects in Brazil: exchange-rate volatility, whereby projects earn revenues in local currency while investors assess returns in hard currency, increasing risk and limiting investor appetite. By combining blended finance, liquidity facilities, foreign-exchange hedging and project structuring, the programme mitigates these risks and unlocks private capital at scale, mobilising approximately £20 billion through financial auctions across green fuels and bioenergy, sustainable fertilisers and bio-inputs, biomaterials and waste management, and other transition sectors (OECD, 2024).

The UK has been a key partner from the outset. Through programmes such as the UK Sustainable Investment Programme (UKSIP) and UK PACT (Partnering for Accelerated Climate Transitions), it has provided the technical assistance needed to design robust, investment-ready financial solutions and build a bankable project pipeline (UK PACT, n.d.). This illustrates how the UK deploys its world-leading financial and professional services to help invest in growth and nature in partner countries. The partnership also deepens the UK-Brazil Strategic Partnership 2026–2030, creates opportunities for UK businesses and reinforces London's position as a global hub for green finance.

There is an opportunity for major financial stakeholders to position the UK as the capital-mobilisation hub for the global bioeconomy, using its asset-management, banking, private-equity, venture-capital and public-finance institutions to structure investable pipelines across biomanufacturing, sustainable agriculture, circular materials and nature-based infrastructure. The UK can build bioeconomy finance partnerships with nature-rich and fast-growing economies, as demonstrated by Eco Invest. Countries such as Brazil, India, Indonesia, Colombia and South Africa are central to the future global bioeconomy because they combine major biological resources, food-system importance and growth needs. The UK can support these partnerships through blended finance, standards, project preparation, risk-sharing and services exports, while helping ensure that value is retained fairly in producer countries.

5.3. Research and innovation

The UK has been a global base for research in bioeconomy-relevant fields, with a very high level of research citation impact (Bauen et al., 2016) and forming one of the strongest ecosystems for engineering biology research outside the US and China (Bagshaw et al., 2018). However, this strength in research has remained under-commercialised relative to competitors in the US, China and the EU. International deployment of UK research could be unlocked through technical assistance, research partnerships and IP licensing, creating an opportunity for the UK to grow its knowledge exports (DBT, 2025a).

Engineering biology has already received £184 million in support under the Engineering Biology Infrastructure Programme, forming part of around £350 million in public investment between

2013 and 2020. Overall, public investment in research is expected to play a key role in building a nucleated and robust research environment, with each £1 attracting up to £6 in private investment within engineering biology (DBT, 2025a; Kitney, 2021). Additionally, the UK's life sciences sector already generates around £108 billion in turnover and is underpinned by pioneering research in areas such as genomics and agritech (HM Government, 2025a; Payne et al., 2025). With bio-patenting having risen gradually since 2015 and accounting for a growing share of UK innovation, this creates an opportunity for commercialisable, innovation-led growth amid a broader decline in patent applications overall.

6. A practical agenda for the UK

6.1. The policy context

Internationally, major economies are increasingly coordinating bio-based activity under explicit, cross-cutting national strategies rather than managing it sector by sector. The EU frames the bioeconomy as a competitiveness pillar, Brazil as socio-bioeconomic development, the United States as biosecurity and biomanufacturing, and China as strategic industrial capability, but each pairs its framing with a coordinating owner, a monitoring system and dedicated finance (European Commission, 2025a; McCarthy et al., 2025; Office of Management and Budget, 2023; Xinhua News Agency, 2026). The UK is the conspicuous exception, having allowed its 2018 strategy to lapse without replacement.

Domestically, the UK does not so much lack bio-relevant policy as a framework for coordinating the policies it already has. The Life Sciences Sector Plan, the Biomass Strategy, the Modern Industrial Strategy and the Biological Security Strategy each govern a part of the bioeconomy, but none shares a common definition, statistical baseline or coordinating mechanism. As a result, the UK is repeatedly described as “IP-rich” but commercially under-developed (BB-REG-NET, 2025a, 2025b; ISEP, 2026). A UK approach to the bioeconomy therefore does not need to start from scratch. Rather, it needs to build on an existing but fragmented base through greater coordination. The policy challenge is not to create entirely new institutions or strategies, but to align existing strategies, institutions and instruments around the specific barriers identified in Section 4.

Appendix D reviews this international and domestic policy landscape in detail. The remainder of this section sets out a practical agenda: a tiered policy framework that can be adopted at whatever level of ambition the government chooses, from a light-touch reference framework to a full national strategy.

6.2. A policy framework to develop the bioeconomy

Translating the case for a UK bioeconomy into action requires a coordinated approach across different policy domains that can support a system-wide transition. The central challenge is to overcome a set of structural barriers that prevent the UK’s biological resources, natural capital, industrial capabilities and frontier innovations from operating as a coherent growth system. The role of policy is therefore to provide the institutional, regulatory and market conditions through which the bioeconomy can deliver productivity growth, resilience, sustainability, investment and industrialisation.

A carefully designed policy proposal is essential to embed sustainability and nature-positivity within any bioeconomy-driven agenda. As noted earlier, the bioeconomy is not inherently sustainable. Realising its potential requires the right mix of policy and finance frameworks to promote circularity, conservation and restoration, while supporting the protection and enhancement of natural capital.

The policy challenge is one of bio-industrialisation. Delivering a competitive UK bioeconomy requires a policy framework that supports the development, scaling and commercialisation of bio-based industries. This demands coordinated action across innovation, infrastructure, demand creation, market formation and investment mobilisation. As we noted in Section 4.5, the UK bioeconomy is constrained by five interrelated barriers: visibility, coordination, market formation, place-based delivery and innovation, and finance. The bioeconomy approach helps address these barriers by making a large but fragmented bio-dependent economy visible, connecting policy agendas around shared outcomes, creating demand for bio-based products

and services, supporting regional delivery and cluster development, and improving the flow of capital into innovation, industrial deployment and natural capital investments. In addition, policy must address a set of cross-cutting enablers that, while not specific to the bioeconomy, facilitate and enable the economic activity around it. These cut across all policy domains and determine whether implementation succeeds in practice:

1. **Skills and workforce development** are required throughout the system, from technicians and process engineers to scientists, project developers, regulators and finance professionals capable of supporting emerging bioeconomy value chains.
2. **Public legitimacy and social licence** are increasingly important for areas such as engineering biology, precision breeding, biomass utilisation and nature markets. Transparent engagement and trusted governance help create confidence for investors, businesses and communities.
3. **International engagement and standards cooperation** ensure the UK remains connected to major markets, research networks and supply chains while leveraging its strengths in services, finance, regulation and innovation.

These enabling conditions provide the connective tissue that allows the wider bioeconomy framework to function effectively across growth, sustainability, resilience and investment objectives.

To provide a robust and holistic framework for the bioeconomy, we translate the barriers and the cross-cutting enablers identified above into a set of policy functions. Together, these functions form an operating framework for connecting currently fragmented sectors and assets into a shared agenda for growth, regional development and nature-positive economic transformation. The following points outline high-level policy options for addressing four key barriers and their associated enablers, with finance addressed separately in Section 6.3.

1. Define and measure the bioeconomy

This function addresses the need for a shared understanding of what the bioeconomy is, and how it can be measured consistently. Despite its size, as noted earlier, the bioeconomy remains difficult to track, as it cuts across multiple sectors, departments and statistical classifications. Adopting a common definition and establishing a regular statistical framework capable of tracking the size, productivity, employment, trade, innovation and investment profile of the bioeconomy would support the creation of a robust bioeconomy. This report aligns with the EU JRC approach because of its flexibility, the structural similarity between the UK and EU economies, and its shared foundations with existing statistical systems. An annual UK Bioeconomy Account, developed with the ONS, would provide policymakers, investors and regional authorities with a shared evidence base and allow progress to be monitored over time. This function would also support international benchmarking and increase the visibility of the UK bioeconomy among domestic and international investors.

2. Coordinate policy and regulation

The UK already possesses many of the policy ingredients needed for a successful bioeconomy, including initiatives relating to engineering biology, life sciences, food systems, industrial decarbonisation, biomass, natural capital and regional development. A bioeconomy strategy would need to bridge all of these, providing a mechanism for coordination across government without necessarily displacing ongoing work. This could include shared ministerial oversight, a cross-government delivery structure and a coherent regulatory agenda spanning biotechnology, biomanufacturing, biosecurity, sustainable biomass, natural capital and circular economy policy. With their current agendas and remits, Defra and the Department for Business, Innovation, Science, and Trade (DBIST) would be well placed for leadership on the bioeconomy.

Such coordination would help ensure that innovation, environmental objectives and industrial competitiveness are pursued in a mutually reinforcing manner rather than through disconnected policy initiatives. This includes coordination on regulation and standards, for instance on biomass sustainability rules, biotech and biomanufacturing regulation, and IP support.

3. Create demand and secure sustainable supply

Innovation can succeed only when there is successful market creation. Innovative and novel products and services often face uncertain demand, immature value chains and competition from established alternatives. Policy has an important role in creating the conditions under which bioeconomy solutions can scale up.

Instruments such as public procurement, standards, product labelling, bio-content requirements and other demand-side instruments are needed to stimulate adoption of bio-based products and services. These measures can provide the long-term market signals needed to support investment in production capacity and commercial deployment.

At the same time, a sustainable supply framework is required to ensure the long-term availability of biomass, land resources and circular feedstocks. This framework should establish principles for resource efficiency, cascading use and the allocation of biological resources across competing uses while safeguarding environmental outcomes.

4. Scale innovation and regional clusters

The UK's research capabilities are world-class, but commercialisation remains a persistent challenge. Policy should therefore focus on strengthening the pathways between research, demonstration, industrial deployment and regional growth.

This includes support for pilot facilities, demonstrators, biofoundries, and shared infrastructure, as well as mechanisms that help firms move from laboratory innovation to commercial production. It also means recognising that bioeconomy opportunities are place-based.

Regional bioeconomy clusters should be supported through devolved delivery models, local innovation ecosystems, project-development capacity and targeted investment in infrastructure. This would enable regions to build on existing strengths in areas such as food processing, forestry, marine industries, biomanufacturing and natural capital restoration. This is closely tied to the current government's agenda for devolution, providing opportunities for local governments to upgrade their economies.

5. Build skills, social licence and international leadership

The final function focuses on the capabilities required for long-term implementation. A growing bioeconomy will require new technical, scientific and managerial skills together with a workforce capable of operating across biological and digital systems.

Public confidence and social licence will also be critical, particularly in areas such as engineering biology, novel foods and nature markets. Government, industry and research institutions should therefore invest in transparent public engagement, evidence-based communication and appropriate governance arrangements.

Finally, the UK should position itself as an international leader in sustainable bioeconomy development. Building on strengths in science, finance, standards, regulation and professional services, the UK can help shape international markets and support bioeconomy development in partner countries while creating opportunities for exports, investment and international collaboration.

Taken together, these functions provide a practical framework for converting the UK's existing scientific strengths, natural assets and industrial capabilities into a coherent bioeconomy strategy. Rather than creating an entirely new policy field, the objective is to align existing policies around a shared set of economic, environmental and resilience outcomes. The financial architecture required to support this transition is discussed in Section 6.3 below.

Ownership

For the policy agenda to be translated into action, it needs a clear owner within the UK Government. With the focus on bio-resources, innovation and industrialisation, the policy framework here is well-suited for joint leadership from Defra and the new DBIST. However, given the cross-departmental nature of policies, operationalising a bioeconomy agenda would require coordinated action across a number of departments. A more detailed mapping of the functions, with suggestions organised around three levels of ambition and identifying lead departments, is set out in Appendix E.

6.3. A financial architecture for the bioeconomy

The bioeconomy approach requires a rethink and restructuring of the financial flows currently supporting the sector. As a sector with potential for stable returns, pathways for nature and climate action, and opportunities to deliver system-wide productivity improvements, it can attract larger volumes of capital if that capital is directed to the right areas.

The evidence presented throughout this report suggests that while there is no shortage of capital, there is a shortage of mechanisms capable of connecting appropriate forms of capital to investable opportunities at the right scale and stage of development. The existing fragmentation in the bioeconomy, in terms of structure, operation and policy, reinforced by market structures, disperses the capital inefficiently. Hence, the solution needs to address the entire financial architecture rather than focus on specific instruments.

Viewed through this lens, the bioeconomy offers a way to ensure investments that can support a de-risking at the systems level. It is a framework for investing in the resilience, productivity and sustainability of the wider economy. Universal owners, whose portfolios ultimately reflect the performance of the economy as a whole, face systemic risks that cannot be diversified away at portfolio level. A systems-wide lens offers a means of reducing systemic exposure to nature loss, climate impacts, resource insecurity and supply-chain vulnerability.

The financial architecture proposed here draws on discussions with market stakeholders as a part of the research for this project, and complements the policy framework outlined in Section 6.2. This should be viewed as an instrument of bio-industrial policy. It addresses the visibility, coordination, market-formation, place-based delivery and innovation, and finance barriers identified in Section 4.5 while providing the capital structures needed across the three layers of the bioeconomy pyramid.

Each layer of the bioeconomy pyramid faces different challenges and operates in structurally different markets. At the base, natural capital investments generate public-good returns that are hard to monetise and slow to accrue. In the middle layer, bio-dependent sectors face thin margins, misaligned incentives and costs associated with transitioning to a higher-productivity state. At the frontier, innovative sectors face the kinds of risks typically associated with capital-intensive start-ups. For instance, first-of-a-kind plants face high capital intensity, long lead times to revenue and technology risk. These often combine to create a 'valley of death', with a lack of suitable scale-up capital to support the transition from a successful pilot to a mature project.

Discussions with stakeholders suggest that challenges facing innovative sectors have received greater policy attention, driven by three factors. First, there are too few specialist investors capable of evaluating complex biological technologies and leading priced financing rounds. Second, biological innovations often require lengthy data-gathering, validation and commercial-testing periods before revenues become visible. Third, policy signals remain inconsistent, with innovators increasingly designing business models capable of succeeding without the need for future policy support as future demand signals are uncertain. This represents a significant weakness in the current market environment and highlights the importance of stronger coordination between innovation and demand creation.

For a coordinated approach to the bioeconomy, the policy framework will need to be accompanied by a strategy for finance that identifies the set of instruments required for each of the three layers of the pyramid. And these should address the barriers that we have identified – visibility, coordination, market formation, place-based delivery and innovation, while supporting a general flow of finance towards the bioeconomy. In what follows, we outline some policy ideas that could help build this architecture.

1. Making the bioeconomy visible and investable

The current fragmentation of the bioeconomy across sectors, regions and policies renders it largely invisible to investors. For the fragmented industries and sectors to be translated into an investment opportunity, shared definitions, taxonomies, project pipelines and standardised reporting can provide investors with a more consolidated view of the market.

At the frontier, investors often struggle to identify credible commercial opportunities because technologies are spread across engineering biology, agritech, biomanufacturing and advanced materials, with limited market intelligence and few specialist intermediaries. In the bio-dependent economy, opportunities are hidden within larger firms and supply chains. Investors may understand food manufacturing, chemicals or construction, but rarely see bioeconomy-related transition opportunities as a coherent investment theme, in spite of the potential for an increase in productivity and sustainability outcomes. At the natural capital base, opportunities are often dispersed across landowners, ecosystem projects and environmental outcomes, making them difficult to identify, compare and evaluate.

A UK Bioeconomy Investment Platform, comparable in function to the European Union's Bioeconomy Investment and Deployment Group, could provide a common project pipeline, shared definitions and a mechanism through which public and private investors can identify opportunities across the bioeconomy.

2. Create revenue certainty and lead markets

The policy architecture needs to address revenue risks associated with the bioeconomy sectors. Investments in production and manufacturing capacity are likely to be limited in the absence of assured future demand. This is why market formation is needed for increasing investment flows.

Demand-side mechanisms can play the same role in the bioeconomy that Contracts for Difference played in renewable energy – they create sufficient revenue visibility to unlock investment. The specific instruments differ by market, but mechanisms such as advance market commitments, procurement-backed offtake, bio-content standards, minimum-revenue mechanisms and long-term outcome-purchase agreements support the conversion of uncertain future demand into bankable cash flows. Links to corporate offtakers, and connecting innovators and large corporate buyers, can also support demand creation.

This principle applies across the entire pyramid. At the innovation frontier it can support emerging products such as advanced biomaterials or bio-based chemicals. In legacy bio-dependent sectors it can accelerate adoption of new technologies and production systems. At

the natural capital base it can help establish markets for verified resilience, biodiversity and ecosystem services. As demonstrated in the Evenlode Landscape Recovery project, the identification of consumers for resilience outcomes provides foundations that future investors can underwrite.

3. Bridge the scale-up and transition financing gap

The scaling up of both production and adoption of innovation requires instruments that can support risk-sharing. Different parts of the pyramid face different financing barriers, but all involve a gap between early promise and commercial deployment.

At the frontier, firms require patient capital, guarantees, venture debt and first-of-a-kind deployment finance to bridge the valley of death between successful innovation and commercial-scale production. First-loss structures, venture debt, milestone financing, demonstration support and revenue-risk mechanisms can also support innovative sectors. In mature bio-dependent sectors, firms need transition finance capable of supporting investment in new equipment, production systems and supply chains. Relevant instruments also include sustainability-linked lending, industrial transition funds, cluster-based investment vehicles and deployment finance.

Within natural capital markets, projects often require blended finance and catalytic capital to absorb early development risk, supported by public or philanthropic capital. Thematic funds, beneficiary-pay models, biodiversity and carbon markets, resilience-outcome contracts and long-term public co-investment can offer the necessary support.

Establish dedicated scale-up vehicles that combine public capital, concessional capital and catalytic first-loss capital to crowd private investment into first commercial facilities, manufacturing deployments and demonstrator infrastructure. The purpose of public and catalytic finance is not to replace private capital, but to crowd it in. By reducing technology, deployment and revenue risks, risk-sharing mechanisms allow institutional investors and commercial lenders to participate at scale.

4. Build regional investment pipelines

The bioeconomy in the UK is differentiated from other sectors by its geographic diffusion and dependence on SMEs. Feedstocks, industrial facilities, natural capital assets, research institutions and SMEs are often present in the same regions, yet they remain disconnected from consolidated investment flows. A steady flow of investment can be supported through project preparation and efforts to build investable pipelines.

Regional project-development facilities, cluster investment platforms, and technical-assistance programmes therefore become important components of the financial architecture. Their role is to aggregate opportunities, create local markets, reduce transaction costs, and transform dispersed local assets into investable propositions. This function links directly to the devolution agenda described earlier in the report. Rather than financing isolated projects, the objective is to finance regional bioeconomy ecosystems.

5. Align finance with system-wide resilience and productivity

The final function is systems-level investment to support greater flows of investment into the bioeconomy sectors.

The bioeconomy provides a framework through which investors can reduce exposure to system-wide risks including climate impacts, nature loss, resource insecurity and supply-chain vulnerability. A bioeconomy architecture therefore enables capital to support economy-wide resilience and productivity. For instance, investments in engineering biology can improve

resource efficiency across multiple sectors; investments in industrial upgrading can strengthen competitiveness; and investments in natural infrastructure can reduce physical climate risks while creating new markets for ecosystem services.

Seen this way, the bioeconomy label can become greater than the sum of its parts, offering an investment strategy for strengthening the resilience, productivity and sustainability of the wider UK economy. And this strategy should be deployed alongside broader industrial, innovation and market-creation policies, as a part of a coordinated strategy for developing bio-based, sustainable industries for growth.

7. Conclusion

The bioeconomy can be a useful lens for a country like the UK: nature-depleted but highly nature-dependent, with a strong knowledge base and an opportunity to drive growth and resilience. Its value lies in outlining a system within the wider economy that is directly dependent on nature. Understood as a pyramid – with a natural capital base, a broad middle of bio-dependent sectors, and an apex of innovative frontier sectors – the bioeconomy demonstrates how the UK can deploy its strengths in knowledge- and R&D-based sectors to provide an ‘upgrade’ to the bio-dependent sectors in the middle.

The data analysed in Section 2 confirm that the UK’s bioeconomy accounted for 13.2% of total GVA and employed around 19% of the total workforce in 2023. This is a sector that is highly trade-dependent, geographically distributed across the UK and rich in innovation potential. However, it is also a sector with limited growth and it has underperformed its European peers over the past decade. In Section 3, we outlined some of the growth and investment signals that lead us to the frontier bioeconomy, with case studies from sectors that are not yet fully captured by official statistics. These case studies demonstrated the opportunity the bioeconomy has to raise productivity, embed sustainability and strengthen resilience across sectors.

Framed this way, the bioeconomy becomes a lever for four national priorities at once. It is a lever for inclusive growth, connecting frontier innovation to a productive base that is far more regionally dispersed than the wider economy. It is a lever for sustainability and nature-positivity, offering pathways to regenerate natural capital and circularise industrial processes within ecological limits. It is also a lever for investment, with private capital flowing into bioeconomy sectors having grown 7.5-fold between 2013 and 2023 and public finance already pointing in the same direction. And it is a lever for resilience and security, reducing exposure to volatile fossil feedstocks and fragile food supply chains.

Importantly, the bioeconomy acts as a connective bridge – between modern and heritage sectors, rural and urban economies, SMEs and large firms, and above all between growth and nature. It also offers a practical route to building a nature-positive economy, that can restore the natural capital base while using innovation, finance and standards to raise productivity across bio-dependent sectors. Bringing this connective bridge to life requires a coordinated approach to policy and finance instruments that can allow frontier sectors to scale up while preparing legacy sectors for transition and upgrade. Bioeconomy approaches already underway in partner countries and regions, including the EU, Brazil, Ireland and South Africa, can help showcase pathways for growth and resilience that are nature-positive.

The UK has genuine strengths: a world-leading research base, deep and sophisticated financial markets, a globally competitive services sector, and an opportunity to demonstrate international leadership through upcoming forums such as the G20 in 2027 and the G7 in 2028. It can build on the momentum around the bioeconomy from Brazil’s COP30 Presidency to take the lead on what the bioeconomy means for advanced economies that are nature- and biodiversity-depleted. As the EU moves to make further investments in its bioeconomy, the UK should act quickly to ensure its most promising bio-based firms scale up, manufacture and capture value at home rather than overseas.

The bioeconomy does not require the creation of a new sector from scratch. Rather, it requires better coordination: bringing together the UK’s bio-relevant policies, research strengths, entrepreneurial energy, financial depth and traditional bio-dependent sectors in need of an upgrade. Providing this coordination through the lens of the bioeconomy can help turn scattered strengths into a coherent strategy for growth that supports nature, strengthens resilience and enables the UK to lead internationally.

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Appendix A. Sectors excluded from the UK bioeconomy framework

The SIC sections and divisions listed in Table A.1 are not included in the UK bioeconomy framework. Exclusion follows the EU methodology developed by Ronzon et al. (2017, 2022) and applied by Lopez and M'barek (2025), with rationale retained for transparency.

Table A.1. Excluded sectors and rationale

SIC Code	Sector	Rationale for exclusion
B05	Mining of coal and lignite	Non-renewable, non-biological resource base
B06	Extraction of crude petroleum and natural gas	Non-renewable, non-biological resource base
B07	Mining of metal ores	Non-renewable, non-biological resource base
B08	Other mining and quarrying	Non-renewable, non-biological resource base
B09	Mining support service activities	Supports non-biological extraction
C19	Manufacture of coke and refined petroleum products	Fossil-based output; no biological content
C23	Manufacture of other non-metallic mineral products	Mineral-based, non-biological output
C24	Manufacture of basic metals	Non-biological output
C25	Manufacture of fabricated metal products	Non-biological output
C26	Manufacture of computer, electronic and optical products	Non-biological output
C27	Manufacture of electrical equipment	Non-biological output
C28	Manufacture of machinery and equipment n.e.c.	Non-biological output
C29	Manufacture of motor vehicles, trailers and semi-trailers	Non-biological output
C30	Manufacture of other transport equipment	Non-biological output
C32	Other manufacturing	Heterogeneous; no consistent bio-based output
C33	Repair and installation of machinery and equipment	Service to non-biological capital stock
J59	Motion picture, video and television programme production	No biological content in output
J60	Programming and broadcasting activities	No biological content in output
J61	Telecommunications	No biological content in output
J62	Computer programming, consultancy and related activities	No biological content in output
J63	Information service activities	No biological content in output
K64	Financial service activities, except insurance and pension funding	Supports the bioeconomy commercially but produces no biological output; indirect contribution avoids attribution and double-counting
K65	Insurance, reinsurance and pension funding	As above
K66	Activities auxiliary to financial services and insurance	As above
L68	Real estate activities	Land-based but not biomass-producing; non-biological output

M69	Legal and accounting activities	Indirect support; no biological content
M70	Activities of head offices; management consultancy	Indirect support; no biological content
M78	Employment activities	Indirect support; no biological content
M80	Security and investigation activities	No biological content in output
M82	Office administrative and other business support activities	Indirect support; no biological content
Q86	Human health activities	Excluded to avoid double-counting with pharmaceuticals (C21) and veterinary activities (M75), which already capture the bio-based components of health-related production
Q87	Residential care activities	As above
Q88	Social work activities without accommodation	As above
U99	Activities of extraterritorial organisations and bodies	Outside scope of national bioeconomy accounts

Sources: Ronzon et al. (2017, 2022); Lopez and M'barek (2025); authors' compilation

Three broad rationales underpin these exclusions. First, sectors drawing on non-renewable or non-biological resources (mining, fossil refining, basic metals, mineral products) are excluded because their material base sits outside the bioeconomy by definition. Second, sectors whose outputs have no biological content (most of information and communication, telecommunications, motor vehicles, electronics) are excluded even where they may use bio-based inputs in small proportions, because the bio-share would be negligible and inclusion would dilute the analytical value of the framework. Third, sectors that support the bioeconomy commercially or institutionally – finance, insurance, real estate, legal and management services – are excluded because their contribution is indirect: they enable bio-based activity but do not produce bio-based outputs themselves. Human health and social care sectors are excluded to prevent double-counting against pharmaceuticals and veterinary activities, which are already retained within the framework as biomass-converting sectors.

Appendix B. Methodology

This appendix brings together the methodologies underpinning the empirical analysis in Sections 2 and 3, covering the measurement of economic value added and employment, innovation (bio-patents) and private investment. Across all three, the unifying approach is to apply sector-level 'bio-based shares' – the proportion of a sector's activity attributable to biological resources and processes – to existing UK statistics, following the framework developed by the European Commission's Joint Research Centre (JRC).

B.1. Measuring economic value added, employment and output

To estimate the size and structure of the UK bioeconomy, the approach developed by the JRC was used (Ronzon et al., 2017, 2022; Lasarte-López and M'barek, 2025). Each sector of the UK economy, as defined by the Standard Industrial Classification (SIC), was assigned a bio-based share reflecting the proportion of output derived from the use of biological resources. The JRC methodology was first developed for biomass-producing and biomass-converting sectors (Ronzon et al., 2017) and later extended to bioeconomy-related services (Ronzon et al., 2022). It maps directly onto the EU's NACE classification, which translates to the UK's SIC codes, enabling comparable measurement of bioeconomy trends across countries and over time (Lasarte-López and M'barek, 2025; ONS, 2009).

The framework trifurcates the bioeconomy into three broad categories: biomass production (industries that produce biomass, such as agriculture), biomass conversion (industries that convert biomass from one form into another, such as food processing or biogas production), and bioeconomy services (the distributional, knowledge, environmental or support activities linked to biomass production and conversion, such as scientific research on biofuels). Services are further sub-categorised into knowledge-based services, natural-environment-related services, services related to tangible bio-based goods, and bioeconomy support services. Indirect contributors such as financial services and information technology are excluded, as are non-monetised ecosystem services (Ronzon et al., 2022). This report assumes that the bio-based shares calculated for the EU are applicable to the UK. Bio-based shares were sourced from the JRC (n.d.) and applied to UK statistical data (e.g. GVA and employment data from ONS, 2025e; ONS BRES, 2025) to estimate the bioeconomy's economic output, employment, innovation, trade and investment. The full set of sectors and their bio-based shares is provided in Appendix C, and the excluded sectors, with the rationale for exclusion, is provided in Appendix A.

This framework is lightly aligned with the strategic typology developed by NatureFinance (Kantola and Zadek, 2024), which organises the bioeconomy into a nature-intensive bioeconomy (sectors directly dependent on biological resources, such as agriculture, forestry or textiles), an advanced bioeconomy (sectors integrating modern technologies to produce higher-value outputs, such as biofuels or bioplastics), and a high-tech bioeconomy (sectors generating maximum value with minimal direct biomass input, such as genomics, bioinformatics or engineering biology). The nature-intensive bioeconomy maps onto the JRC's biomass-producing sectors, while the advanced and high-tech categories align with biomass-converting sectors. For clarity and comparability with the EU, the analysis focuses on the JRC categories.

B.2. Measuring innovation (bio-patents)

Innovation in the bioeconomy is measured using patent data. Bio-patents are defined as patents directly linked to the bioeconomy, following the methodology proposed by the European Commission's JRC in Grassano et al. (2025). This methodology identifies patents falling under the biomass-converting sectors. Patent data were drawn from the European Patent Office's

PATSTAT database (EPO, 2025), and UK bio-patent applications to the UK Intellectual Property Office (UKIPO) were compared with the EU and individual Member States. It is important to note that while patents are a key manifestation of intellectual property, sectors within and outside the bioeconomy also use trademarks, copyrights and registered designs, so patent counts understate total innovative activity (UKIPO, 2022). Bio-patents therefore capture only part of the innovation frontier.

B.3. Measuring private investment

To identify the sectors attracting private capital and public support, company-level financial data from The Data City (n.d.a) were used and classified using the JRC sector framework (Ronzon et al., 2017, 2022). Sectors C17 (paper) and C18 (printing) were excluded owing to anomalous base-year investment concentration. Compound annual growth rates were computed over 2013–23. Private investment was compared with Innovate UK grant awards over the same period to assess the alignment between public and private finance.

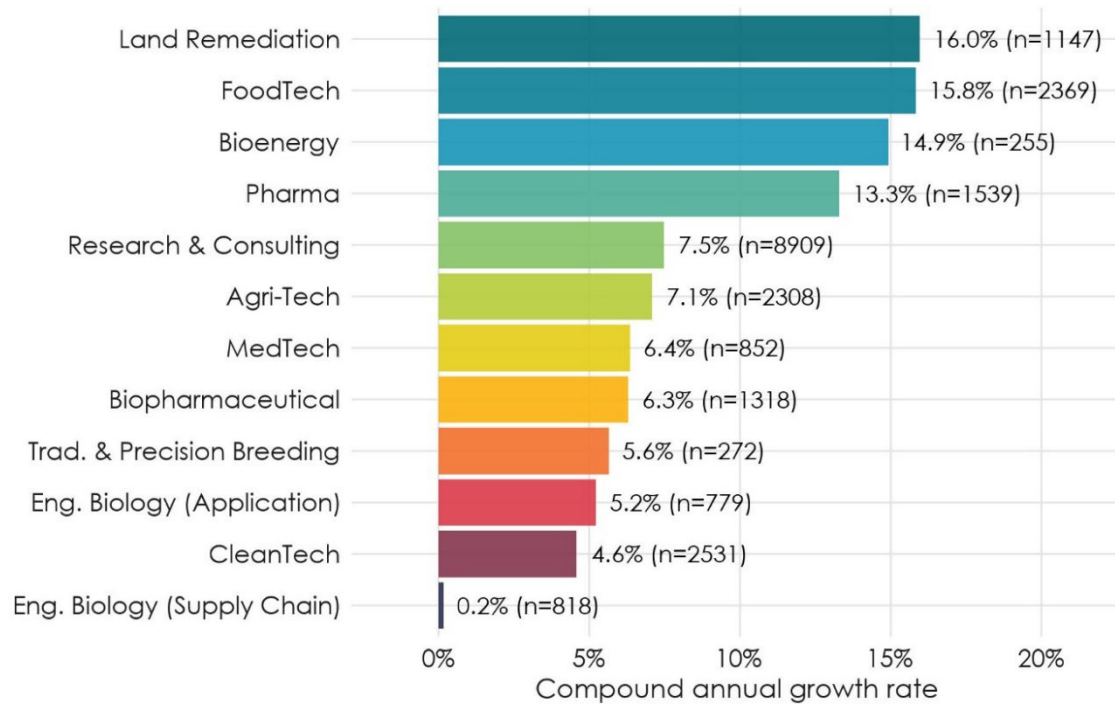
To contextualise the company-level figures against a whole-economy benchmark, ONS national accounts data were used. Total private business investment across all UK sectors grew from £176 billion in 2013 to £291 billion in 2023, a 1.6-fold increase at a CAGR of 5.1% (ONS, 2025f). For gross fixed capital formation (GFCF), which includes public-sector and retained-earnings investment, ONS data matched to JRC-classified bioeconomy SIC codes show bio-sector GFCF growing from £58 billion in 2013 to £98 billion in 2023, a 1.7-fold increase at a CAGR of 5.3%, broadly in line with total-economy GFCF growth of 5.8% per annum (ONS, 2025g). The divergence between these whole-economy figures and the company-level sample (7.5-fold growth, CAGR 22.3%) reflects the increasing formalisation of venture capital and private equity financing in bioeconomy sectors over the period, rather than a step-change in total capital deployed. The company sample captures only equity and debt deals visible to formal capital markets – a small but rapidly growing layer of bioeconomy finance operating alongside the broader economy-wide investment base.

B.4. Methodology for selecting the frontier bioeconomy RTICs

The five Real-Time Industry Classifications (RTICs) showcased in Section 4 were not selected by a single indicator alone. Of the 12 RTICs in the underlying DataCity sample identified as relevant to the bioeconomy, several, such as Research and Consulting, CleanTech and MedTech, post comparable or higher absolute growth on individual metrics but were not carried forward because the selection criterion was fitted to the bioeconomy pyramid framework developed earlier in this report, not headline growth in isolation. We applied four indicators in combination, in the same spirit as the Green Finance Institute’s prioritisation method (Green Finance Institute, 2026a):

1. **Growth signal strength** – turnover and employment CAGR, 2020–24 (The Data City, n.d.b), used as a first-pass filter to identify RTICs with genuine commercial momentum rather than static or declining company populations (See Figures B.1 and B.2).
2. **Comparison with SIC-based bioeconomy data** – whether the RTIC’s growth story could be cross-validated against this report’s separate ONS/JRC-based analysis of the corresponding SIC division(s), rather than resting on The Data City’s company-level projections alone. Land Remediation (SIC E39), Bioenergy (SIC D35), Agri-Tech (SIC A01) and Biopharmaceutical/Pharma (SIC C21) all cleared this bar; RTICs without a traceable SIC-level counterpart in the earlier analysis were deprioritised.

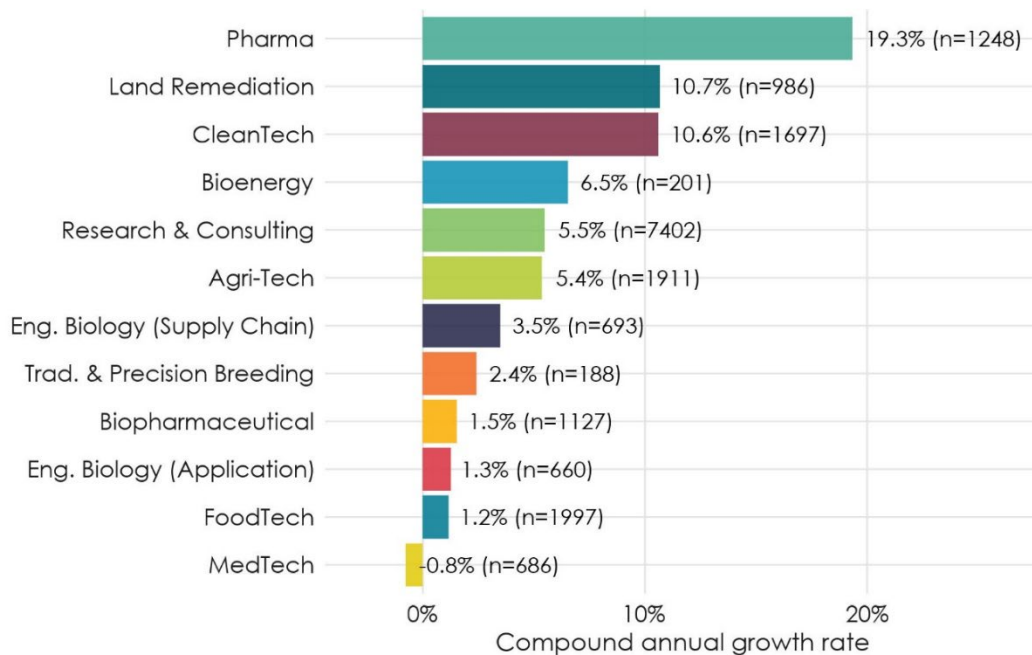
Figure B.1. Turnover by growth CAGR, 2020–24



Note: N is the number of companies with data projected in 2024.

Source: Company sample and projections from The Data City (n.d.b)

Figure B.2. Employment growth by RTIC (CAGR, 2020–24)



Note: N is the number of companies with data projected in 2024.

Source: Company sample and projections from The Data City (n.d.b)

3. **Position within the bioeconomy pyramid** – whether the RTIC could be characterised, using this report’s own framework, as either upgrading a large existing base (Agri-Tech, FoodTech), demonstrating a policy-built frontier industry from a small base (Bioenergy), or representing a frontier tip not yet pulling its base up with it (Biopharmaceutical) – ensuring the five RTICs collectively illustrate the pyramid’s different mechanisms rather than five examples of the same one.
4. **Existing UK policy salience** – whether a named UK government strategy, programme or funding commitment (the Industrial Strategy, the National Vision for Engineering Biology, sector-specific Barclays or UKRI research) already engages with the RTIC, distinguishing industries with an identifiable policy hook which a coordinated bioeconomy strategy could build on from those with none.

Limitations

1. All turnover and employment figures are sample-based projections to an estimated population, not observed totals, and the underlying reporting sample is smaller still.
2. Turnover and employment estimates for the same RTIC are drawn from different populations and should not be combined into a single per-employee productivity measure.
3. Companies may carry multiple RTIC tags; cross-RTIC comparisons may involve some double-counting and should be read as directional.
4. The selection reflects a blend of growth signal and policy support identified, not growth rate alone.
5. The analysis focuses on currently active companies alone.

Appendix C. Bioeconomy sectors and bio-based shares

Tables C.1 and C.2 set out the full set of UK bioeconomy sectors and their average bio-based shares, ordered by SIC code and grouped into the three JRC categories (JRC, n.d.). These shares are applied to UK statistical data throughout the report to estimate the size and structure of the bioeconomy.

Table C.1. UK bioeconomy by SIC code, 2023

SIC	Name	JRC category	Bioshare	Bio-GVA (£m)	Bio-Emp (000s)	Bio-Prod (£/job)	GVA CAGR 2009–23	Emp CAGR 2009–23
A01	Crop and animal production, hunting and related service activities	BP	1.000	13,795	485	51,682	2.8%	-0.4%
A02	Forestry and logging	BP	1.000	1,077	21	43,931	5.5%	3.4%
A03	Fishing and aquaculture	BP	1.000	896	13	43,931	3.9%	3.0%
C10	Manufacture of food products	BC	1.000	27,445	419	67,715	2.5%	1.2%
F41_F43	Construction of buildings + Civil engineering + Specialised construction activities	BC	0.081	12,485	133	6,605	4.1%	-0.3%
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	BC	0.500	10,448	21	214,609	3.1%	1.2%
C11_C12	Manufacture of beverages + Manufacture of tobacco products	BC	1.000	9,866	47	185,783	2.8%	1.2%
E36	Water collection, treatment and supply	BC	1.000	9,213	45	167,674	2.8%	2.3%
E37	Sewerage	BC	1.000	8,982	27	129,608	1.5%	2.8%
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	BC	0.996	4,422	78	51,239	6.5%	1.1%
C17	Manufacture of paper and paper products	BC	0.995	4,091	55	82,633	2.0%	0.3%
D35	Electricity, gas, steam and air conditioning supply	BC	0.073	2,534	9	27,182	8.5%	7.6%
C18	Printing and reproduction of recorded media	BC	0.492	2,225	48	31,618	-1.6%	-2.2%
E38	Waste collection, treatment and disposal activities; materials recovery	BC	0.195	1,926	30	25,301	3.4%	2.1%
C31	Manufacture of furniture	BC	0.386	1,675	36	22,060	1.8%	0.4%
C13	Manufacture of textiles	BC	0.344	1,186	22	23,947	2.3%	0.2%
C14	Manufacture of wearing apparel	BC	0.338	764	9	23,290	6.0%	-1.8%

C19_C20	Manufacture of coke and refined petroleum products + Manufacture of chemicals and chemical products	BC	0.109	741	11	12,310	3.4%	-0.3%
E39	Remediation activities and other waste management services.	BC	0.500	375	5	64,804	15.0%	5.6%
C22	Manufacture of rubber and plastic products	BC	0.033	272	5	2,022	3.2%	1.2%
C15	Manufacture of leather and related products	BC	0.579	211	5	39,889	1.4%	1.0%
I56	Food and beverage service activities	SATB G	1.000	49,998	2,107	23,441	4.7%	2.3%
G47	Retail trade, except of motor vehicles and motorcycles	SATB G	0.282	32,380	788	10,768	3.0%	-0.5%
G46	Wholesale trade, except of motor vehicles and motorcycles	SATB G	0.219	20,354	259	18,129	3.9%	0.4%
H52	Warehousing and support activities for transportation	SATB G	0.240	6,953	161	12,643	4.2%	4.7%
J58	Publishing activities	SATB G	0.423	5,594	53	38,910	1.7%	-2.3%
N77	Rental and leasing activities	SATB G	0.154	4,478	27	26,468	5.4%	1.0%
H49	Land transport and transport via pipelines	SATB G	0.107	3,483	59	4,727	1.6%	-1.1%
H53	Postal and courier activities	SATB G	0.240	3,240	70	10,348	2.1%	0.2%
T97_T98	Activities of households as employers of domestic personnel + Undifferentiated goods- and services-producing activities of private households for own use	SATB G	0.500	1,089	-	26,659	2.1%	-
H51	Air transport	SATB G	0.211	722	17	12,507	0.8%	-0.8%
H50	Water transport	SATB G	0.128	691	2	63,762	2.8%	-1.3%
S95	R Repair of computers and personal and household goods	SATB G	0.039	122	2	1,530	3.9%	1.3%
M72	Scientific research and development	KBS	0.528	11,328	97	87,720	5.1%	3.6%
M75	Veterinary activities	KBS	1.000	6,343	83	71,003	7.4%	4.3%
P85	Education	KBS	0.035	5,365	96	1,775	4.4%	1.0%
M74	Other professional, scientific and technical activities	KBS	0.300	4,151	61	12,008	5.6%	1.3%
M71	Architectural and engineering activities; technical testing and analysis	KBS	0.078	2,226	45	4,363	2.9%	1.3%
R93	Sports activities and amusement and recreation activities	NERS	0.500	7,968	251	14,019	4.9%	1.4%
I55	Accommodation	NERS	0.271	5,301	129	11,585	6.7%	1.7%

N79	Travel agency, tour operator and other reservation service and related activities	NERS	0.310	3,758	25	37,367	7.4%	-0.4%
R90_R92	Creative, arts and entertainment activities + Libraries, archives, museums and other cultural activities + Gambling and betting activities	NERS	0.139	2,489	40	6,108	2.9%	-0.3%
N81	Services to buildings and landscape activities	NERS	0.091	1,527	70	1,545	0.6%	-3.7%
O84	Public administration and defence; compulsory social security	BSS	0.195	24,262	291	15,088	2.7%	-0.7%
S94	Activities of membership organisations	BSS	0.500	5,498	123	16,639	3.3%	0.5%
M73	Advertising and market research	BSS	0.064	1,622	12	7,046	5.6%	0.5%

Notes: CAGR computed 2009–23. JRC categories: BP = Biomass Production, BC = Biomass Conversion, SATBG = Services related to tangible bio-based goods, KBS = Knowledge-based services, NERS = Natural environment-related services, BSS = Bioeconomy support services.

Source: Authors' calculations from ONS (2025e); ONS BRES (2025) and ONS LPROD (2025). Bio-based shares from Ronzon et al. (2017, 2022) and Lopez and M'barek (2025)

Table C.2. Bioeconomy sectors and bio-based shares (JRC, n.d.)

Category	Subsector	SIC Code	Avg. bio-based share
Biomass Production	Crop and animal production	A01	100%
Biomass Production	Forestry and logging	A02	100%
Biomass Production	Fishing and aquaculture	A03	100%
Biomass Conversion	Manufacture of food products	C10	100%
Biomass Conversion	Manufacture of beverages	C11	100%
Biomass Conversion	Manufacture of tobacco products	C12	100%
Biomass Conversion	Manufacture of textiles	C13	34%
Biomass Conversion	Manufacture of wearing apparel	C14	34%
Biomass Conversion	Manufacture of leather and related products	C15	58%
Biomass Conversion	Manufacture of wood and wood products	C16	100%
Biomass Conversion	Manufacture of paper and paper products	C17	100%
Biomass Conversion	Printing and reproduction of recorded media	C18	49%
Biomass Conversion	Manufacture of chemicals and chemical products	C20	11%
Biomass Conversion	Manufacture of pharmaceuticals	C21	50%
Biomass Conversion	Manufacture of rubber and plastic products	C22	3%
Biomass Conversion	Manufacture of furniture	C31	39%
Biomass Conversion	Electricity, gas, steam and air conditioning supply	D35	7%
Biomass Conversion	Water collection, treatment and supply	E36	100%
Biomass Conversion	Sewerage	E37	100%
Biomass Conversion	Waste collection, treatment and disposal	E38	20%
Biomass Conversion	Remediation and other waste management	E39	50%
Biomass Conversion	Construction	F	8%

Bioeconomy Services	Wholesale trade	G46	22%
Bioeconomy Services	Retail trade	G47	28%
Bioeconomy Services	Land transport and transport via pipelines	H49	11%
Bioeconomy Services	Water transport	H50	13%
Bioeconomy Services	Air transport	H51	21%
Bioeconomy Services	Warehousing and support activities	H52	24%
Bioeconomy Services	Postal and courier activities	H53	24%
Bioeconomy Services	Accommodation	I55	27%
Bioeconomy Services	Food and beverage service activities	I56	100%
Bioeconomy Services	Publishing activities	J58	42%
Bioeconomy Services	Architectural and engineering activities	M71	8%
Bioeconomy Services	Scientific research and development	M72	53%
Bioeconomy Services	Advertising and market research	M73	6%
Bioeconomy Services	Other professional, scientific and technical	M74	30%
Bioeconomy Services	Veterinary activities	M75	100%
Bioeconomy Services	Rental and leasing activities	N77	15%
Bioeconomy Services	Travel agency, tour operator and other reservation service and related activities	N79	31%
Bioeconomy Services	Services to buildings and landscape	N81	9%
Bioeconomy Services	Public administration and defence	O84	20%
Bioeconomy Services	Education	P85	4%
Bioeconomy Services	Creative, arts, libraries, museums, gambling	R90-92	14%
Bioeconomy Services	Sports activities and amusement and recreation activities	R93	50%
Bioeconomy Services	Activities of membership organisations	S94	50%
Bioeconomy Services	Repair of computers and personal and household goods	S95	39%
Bioeconomy Services	Activities of households as employers of domestic personnel	T97	50%
Bioeconomy Services	Undifferentiated goods- and services-producing activities of households	T98	50%

Appendix D. The international and UK policy landscape

D.1. International policy on the bioeconomy

Major economies have increasingly moved from treating bio-based activity sector by sector to coordinating it under explicit, cross-cutting strategies (see Table D.1). The EU and Brazil have built their strategies around circular material flows and an equitable, nature-positive model respectively (European Commission, 2025a; McCarthy et al., 2025). The United States had taken a more biosecurity- and bio-innovation-led approach (Office of Management and Budget, 2023) under the Biden administration.

China has shifted towards bio-manufacturing and biosecurity in its 15th Five-Year Plan relative to the 14th (Xinhua News Agency, 2021, 2026).

Progress remains mixed: in China, public acceptance of bio-based products remains low (Zhu et al., 2026); in the EU, the bioeconomy has grown faster than the overall economy even as employment has declined (Lasarte-López and M'barek, 2025); and South Africa, a long-standing champion, still requires significant investment in human capital and R&D to move up the value chain (Department of Science and Technology, 2013; Reed, 2025). Across countries, a recurring challenge is the need to commercialise innovation, and initial policies are beginning to respond (Hall, 2026; Kantola and Zadek, 2024).

Table D.1. International bioeconomy strategies: coordination mechanisms compared

Country	Strategy and year	Cross-cutting framing	Governance and coordination	Statistical/ monitoring system	Finance and delivery instruments
EU	EU Bioeconomy Strategy (2025)	Competitiveness pillar linking industrial scaling, climate, and nature	DG-level coordination; Member State action plans	EU Bioeconomy Monitoring System (JRC); NACE-mapped indicators	Horizon Europe; Bio-Based Industries Joint Undertaking; InvestEU
Brazil	National Bioeconomy Strategy (2024)	Socio-bioeconomy framing; productive, ethical, inclusive development	Inter-ministerial coordination; CEBDS Bioeconomy Taskforce	Sectoral monitoring across 30+ policies	Thematic bonds; rural credit; PGPMBio minimum price guarantees
Ireland	Bioeconomy Action Plan 2023–2025	Seven pillars: governance, RD&I, climate, agri-food, communities, industry, skills	High-Level Implementation Group reporting to government	Output, value-added, employment indicators within national accounts	Exchequer + EU co-funding; research support infrastructure
South Africa	Bioeconomy Strategy (2013, refreshed); 2025 G20 presidency agenda	Industrial, agricultural and health bio-innovation	Department of Science, Technology & Innovation lead	National R&D and bio-innovation indicators	G20 High-Level Principles on the Bioeconomy adopted under SA presidency

United States	Executive Order on Biotechnology and Biomanufacturing (2022); National Biotechnology and Biomanufacturing Initiative (suspended under current administration)	Renewable biomass for economic and national security	Federal inter-agency coordination	US Department of Agriculture, Department of Energy and federal R&D monitoring	BioPreferred procurement programme; federal R&D funding
United Kingdom	Growing the Bioeconomy (2018) – dormant; no current strategy	No cross-cutting framing in force	No dedicated ministerial owner or cross-Whitehall mechanism	No bioeconomy satellite account or monitoring system	Bio-relevant activity dispersed across British Business Bank (BBB); UK Infrastructure Bank (UKIB), Innovate UK without a bioeconomy mandate

D.2. The UK's policy environment for the bioeconomy

While the UK has a range of strategies for the life sciences sector and biomass management and an encompassing modern industrial strategy, it does not frame the bioeconomy as a productive system that cuts across sectors, unlike the EU and other countries (DBT, 2025a; DESNZ, 2023; HM Government, 2025a; European Commission, 2025a). The last comprehensive strategic document for the UK bioeconomy was produced in 2018, with no subsequent update (Bagshaw et al., 2018).

The sectors that make up the bioeconomy are currently served by a fragmented landscape of strategies that do not provide a coordinated approach that can facilitate an upgrade. The Life Sciences Sector Plan covers pharmaceuticals and MedTech but does not address the biological feedstocks the sector depends on or its material circularity beyond net zero (HM Government, 2025a). The UK Biomass Strategy maintains a focus on net zero, with limited consideration of biomass uses beyond energy, such as chemicals and materials (DESNZ, 2023). The Modern Industrial Strategy does not explore in depth how its eight priority sectors could contribute to nature-positive growth (DBT, 2025a). BB-REG-NET (2025a) finds that the UK bioeconomy has consistently been "IP-rich" but under-commercialised owing to a lack of coherent regulation. And while Defra (2026a) addresses nature-related risks, it does not set out how to grow productive activity built on biological resources, although ISEP (2026) suggests recognising nature as infrastructure is one such route. Each document addresses part of the bioeconomy, but together they do not produce a shared definition, a statistical baseline or a mechanism to coordinate policy towards a single objective.

The 2025 Modern Industrial Strategy positioned the bioeconomy within a broader growth framework, identifying eight growth-driving sectors, including Life Sciences and Clean Energy, and five frontier technologies, of which engineering biology is one (HM Government, 2025b). It introduced significant financial instruments, including the expansion of the National Wealth Fund to £27.8 billion and additional capital for the British Business Bank, and committed to cutting the administrative cost of regulation by 25% through the Regulatory Innovation Office.

The UK Biomass Strategy (2023) provides the most detailed treatment of biomass use, coordinating deployment across heat, electricity and transport from 2020 to 2050 (DESNZ, 2023). It identifies potential domestic feedstocks, sets sustainability criteria, highlights engineering biology as a critical technology, with the UK Biomass Feedstocks Innovation Programme funded by approximately £36 million. The UK Biological Security Strategy frames the

bioeconomy through the lens of national resilience, focusing on biological threats, antimicrobial resistance and the dual-use potential of engineering biology and AI (Cabinet Office, 2025). The Life Sciences Sector Plan sets a target for the UK to attract more life sciences foreign direct investment than any other European economy by 2030 (HM Government, 2025a).

On natural capital, the UK's 25 Year Environment Plan and instruments such as Local Nature Recovery Strategies represent a growing commitment. However, ISEP (2026) notes that the National Biodiversity Strategy and Action Plan lacks clear natural capital targets and that the term remains undefined in the National Infrastructure Strategy. The estimated funding gap for nature restoration over the next 10 years stands at £44 billion (ISEP, 2026), a disconnect that represents a significant vulnerability for the UK's bioeconomy ambitions.

Given this context and the UK's broad comparability with the EU in economic composition and industrial structure, the EU's two-part categorisation provides a suitable foundation for the UK's working definition. Following Lasarte-López and M'barek (2025), this defines the bioeconomy as biomass-producing and -converting sectors together with bioeconomy-related services. This distinction between primary and manufacturing activities and services is particularly fitting for the UK given its services-oriented structure: in the EU, services already generate more bioeconomy value than industry, and this pattern is even more pronounced in the UK.

Appendix E. Bioeconomy policy framework

Table E.1 sets out the full policy framework referenced in Section 6.2, mapping five policy functions and the cross-cutting enablers against the three levels of ambition – Stimulate (C), Prioritise (B) and Grow (A) – and identifying lead departments, with Defra coordinating throughout.

Table E.1. Policy framework for strengthening the bioeconomy

Structural barrier	Policy function	Package A – Grow	Package B – Prioritise	Package C – Stimulate	Lead departments
1. Visibility barrier	Define and measure the bioeconomy	Adopt a common UK bioeconomy definition; establish an annual ONS Bioeconomy Account.	Publish annual performance reporting, regional dashboards and international benchmarking.	Integrate bioeconomy metrics into Treasury, Industrial Strategy and national mission reporting.	ONS, HM Treasury, DSIT, Defra
2. Coordination barrier	Coordinate policy and regulation	Create a cross-government bioeconomy unit and delivery framework.	Establish ministerial oversight and align regulation across biotechnology, biomass, natural capital and industrial strategy.	Create a Bioeconomy Council with public, academic and industry representation.	HM Treasury, DSIT, DBT, Defra
3. Market formation and supply barrier	Create demand and secure sustainable supply	Introduce procurement pilots, voluntary standards and sustainable biomass principles.	Develop bio-content standards, product labelling and lead-market programmes.	Use procurement mandates, advance market commitments, outcome-purchase agreements and resilience markets to drive adoption at scale.	DSIT, Defra
4. Place-based delivery and innovation barrier	Scale innovation and regional clusters	Support demonstrators, pilot facilities and cluster mapping.	Establish regional bioeconomy hubs and dedicated cluster programmes.	Create a national Bioeconomy Cluster Fund and large-scale deployment programmes linked to devolved growth strategies.	DSIT, UKRI, ARIA, MCA Authorities, Defra
5. Finance barrier	Financial architecture (addressed in Section 6.3)	Project preparation support, blended-finance pilots and investor engagement.	Sector deployment funds, guarantees and co-investment programmes.	Bioeconomy Investment Platform, first-loss facilities, thematic bonds, nature-finance vehicles and institutional investor mobilisation.	HM Treasury, National Wealth Fund, British Business Bank, GB Energy
Cross-cutting enablers	Skills, social licence and international leadership	Skills mapping, curriculum development and stakeholder engagement.	Workforce strategy, public dialogue and international partnerships.	UK leadership on standards, finance and bioeconomy cooperation through G7, G20 and strategic bilateral partnerships.	DSIT, DfE, FCDO, Defra

Appendix F. Financial instruments to scale up the bioeconomy

Table F.1 sets out the layer-by-layer financing framework referenced in Section 6.3, mapping each layer of the bioeconomy pyramid against its characteristic barrier, candidate instruments, relevant UK vehicles and an international example. Barriers are drawn from the report's own findings (Sections 2.5 and 4.3) and precedents from Section 6.2 and Section 5.3. It is intended as a menu to be pressure-tested, not a set of recommendations.

Table F.1. Instruments for a financing framework for the UK bioeconomy

Pyramid layer	Barrier/market failure	Candidate instruments	UK vehicles/actors	Example
Frontier – scale-up/ first-of-a-kind	High capital expenditure (capex), long time-to-revenue, technology and offtake risk ('valley of death')	Blended finance; first-loss layers and guarantees; venture debt; milestone grant-to-equity; catalytic public equity	British Business Bank (BBB); UK Infrastructure Bank (UKIB)/National Wealth Fund (NWF); Innovate UK; Advanced Research and Invention Agency (ARIA)	Eco Invest Brasil (blended finance + FX hedging) as a structuring precedent
Frontier → base – demand creation	No lead market; demand uncertainty deters investment	Advance market commitments; offtake guarantees; procurement-backed revenue; bio-content mandates	Department for Business, Innovation, Science and Trade (DBIST); Crown Commercial Service; BSI (standards/labels)	EU Bio-based Europe Alliance (€10bn collective purchasing by 2030)
Middle – sector transition	Thin margins, split incentives, transition capex in established sectors	Transition finance; sustainability-linked loans and bonds; supply-chain finance; cluster and infrastructure funds	BBB; UKIB/NWF; mayoral and devolved/regional funds	Netherlands National Growth Fund and Invest-NL
Base – natural capital	Non-bankable public-good returns; revenue timing and measurement	Nature/biodiversity credits; green and 'nature' thematic bonds; blended nature funds; outcome-based payments	Green Finance Institute; British International Investment (BII)/MOBILIST; Defra	UK nature-finance ecosystem (Ranger et al., 2025)
Cross-cutting – pipeline and legibility	Sector is illegible to capital without a shared definition, baseline and project pipeline	A bioeconomy investment platform; standardised taxonomy and labelling; a bankable-project deployment group	HM Treasury + BBB; ONS (baseline)	EU Bioeconomy Investment Deployment Group

Appendix G. Private investments in bioeconomy sectors

Table G.1. Top round investment types, 2010–25

Round type	Count
GRANT	4,815
SEED	4,706
EARLY VC	1,669
SERIES A	1,024
SPINOUT	812
SUPPORT PROGRAM	639
ACQUISITION	509
SERIES B	428
LATE VC	420
ANGEL	303

Note: Data filtered for bioeconomy-relevant SIC companies; GRANT and SEED rounds together account for over half of all recorded funding rounds by count.

Source: The Data City (n.d.a)

Table G.2. Primary investor type by group, 2010–25

Group	Primary investor type	Rounds	Companies	Total funding (£m)
BC	Fund	786	415	17,831.84
BC	Government Non Profit	226	170	460.86
BC	Corporate	195	149	6,130.88
BC	Crowd Funding	156	116	121.71
BC	University	47	43	1.02
BC	Investor	40	31	125.59
BC	Other	2	2	0.39
BP	Fund	83	38	207.83
BP	Government Non Profit	38	29	76.42
BP	Corporate	8	8	41.04
BP	Crowd Funding	6	6	5.95
BP	University	4	4	0.00
BP	Investor	2	2	3.50
Services	Fund	5,719	2,524	123,816.38
Services	Government Non Profit	1,129	874	2,180.57
Services	Corporate	990	768	129,503.39

Services	University	561	527	8.44
Services	Crowd Funding	379	297	297.67
Services	Investor	326	271	3,704.09
Services	Other	11	10	122.92

Note: Restricted to rounds with a known investor type (10,708 of 16,310 rounds; 5,602 excluded). Primary investor type decided by mode in each round, as there can be multiple investor types in a single round. Fund is the dominant investor type by round count in every group. Total funding figures are raw sums (£ millions) and are sensitive to a small number of very large deals and to sector-level company concentration.

Source: The Data City (n.d.a)
