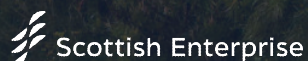


National Plan for Industrial Biotechnology

Scaling innovation, securing resilient supply chains and driving cluster growth.



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Ministerial foreword



Alyn Smith MSP
MINISTER FOR INNOVATION,
TECHNOLOGY AND TERTIARY
EDUCATION

Scotland's future prosperity will be shaped by our ability to turn world-class research and innovation into economic opportunity. As we build a more productive, resilient and sustainable economy, industrial biotechnology and engineering biology have an increasingly important role to play in creating high-value jobs, attracting investment and contributing to Scotland's transition to net zero.

Supported by Scotland's world-class research, entrepreneurial talent and strong focus on sustainability, Scotland has established itself as a global leader in industrial biotechnology. Alongside advances in engineering biology, artificial intelligence and digital technologies, the sector is creating new opportunities to develop sustainable products, strengthen domestic supply chains and build globally competitive industries.

Recent global challenges have highlighted the importance of resilience and reducing reliance on fragile international supply chains. Scotland is well placed to respond, with the expertise, renewable resources and innovation ecosystem needed to develop home-grown solutions. Realising this potential will require continued focus on accelerating the commercialisation of innovation, attracting investment and supporting the scale-up of new technologies and businesses.

The progress achieved since the previous National Plan demonstrates what can be delivered through ambition, innovation and collaboration. Industrial biotechnology is already making an important contribution to Scotland's economy, supporting businesses, employment and investment across the country. Looking ahead, the ambition to continue growing the sector's turnover, economic contribution and highly skilled workforce is both welcome and necessary, setting out a clear pathway for sustainable growth and long-term competitiveness. Strategic investments, including the Grangemouth Sustainable Manufacturing Campus, which forms a key part of the Falkirk and Grangemouth Growth Deal, will be instrumental in advancing this ambition and establishing the conditions necessary for sustainable future success.

Collaboration across industry, academia and the public sector continues to play a vital role in fostering innovation, attracting investment and developing the skilled workforce the sector requires. I welcome this refreshed National Plan and the actions it sets out for government, industry, academia, investors and enterprise agencies to build on Scotland's achievements and capture future opportunities. By working together, Scotland can remain at the forefront of industrial biotechnology, delivering sustainable growth, supporting the transition to net zero and creating lasting benefits for communities across the country.

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Scaling innovation, securing resilient supply chains and driving cluster growth.

SCOTLAND'S BIOECONOMY

What is Industrial Biotechnology?

Industrial Biotechnology (IB) uses biological processes to turn waste, plants and other renewable resources into everyday products, such as consumer products, food ingredients, plastics, textiles, construction materials, fuels and medicines, offering cleaner, more sustainable alternatives to fossil-based products.

It generates innovative products with added-value benefits for consumers and end users alike, while using less energy and creating less waste during production.

A rapidly emerging technology, Engineering Biology (EngBio), is fast-tracking IB application development. EngBio involves the design, scaling, and commercialisation of biology-derived products and services to transform sectors and

produce existing products more sustainably. As an example, microbes can be genetically engineered to perform new and useful tasks of commercial value. As one of the six frontier technologies identified in the *UK Industrial Strategy*, EngBio is recognised as a key driver of future economic growth, productivity and competitiveness.

Artificial Intelligence (AI), machine learning and digital technologies are also empowering IB. For example, digital twins (virtual models of systems) can accelerate the optimisation of bioprocesses, avoiding more costly and time-consuming iterative strategies, while AI-driven tools can expedite the design of new drugs, enzymes and even new organisms.

Today, IB, EngBio and AI are converging to create more efficient and sustainable ways of making products that meet both current and future societal needs.

THREE CONVERGING TECHNOLOGIES



Industrial Biotechnology

Biological processes turn waste, plants and renewable resources into everyday products.



Engineering Biology

Design, scaling and commercialisation of biology-derived products. One of six frontier technologies in the *UK Industrial Strategy*.



Data and AI

Digital twins and AI-driven tools accelerate bioprocess optimisation and the design of new enzymes and organisms.

Industrial Biotechnology in action

Industrial biotechnology is a means to convert raw materials (biomass) such as non-food crops, agricultural waste and food processing (e.g. seafood) residues into valuable everyday products. It can harness the power of microbes as living 'biofactories' to manufacture a wide range of novel products or to convert non-biological waste (e.g. plastic, textiles) into chemicals. A few examples are provided here, but the possibilities are limitless.

10 REAL SCOTTISH EXAMPLES

the possibilities are limitless



About the National Plan

The National Plan for Industrial Biotechnology (the Plan) was published in 2013 with an ambition to realise the benefits of applying biotechnology across multiple sectors. The Plan set out a roadmap to harness Scotland’s natural resources and intellectual assets to create new companies, more sustainable products and processes, and economic growth.

In 2013, just a handful of Industrial Biotechnology (IB) companies existed; today, Scotland is home to a vibrant cluster of innovative spinouts, start-ups and SMEs developing products for multiple markets, including energy, consumer goods, bioplastics, textiles, environmental protection and novel foods. (Medical biotechnology companies involved in developing medicines, diagnostics and cell and gene therapies are not included in this Plan but are covered through the *Scottish Life Sciences Sector Vision*.)

There has never been a more urgent need to reduce our dependence on petrochemicals. Geopolitical turmoil has exposed weaknesses in global supply chains and our vulnerability to volatile energy prices. IB, together with advances in Engineering Biology (EngBio), data and Artificial Intelligence (AI), is part of the solution, offering more sustainable ways to make products and services, reduce dependence on fossil resources and strengthen local supply chains.

Continued support for, and growth of, IB is vital if Scotland is to deliver many of the national ambitions outlined in Net Zero 2045, the *National*

Strategy for Economic Transformation (2022), the *National Innovation Strategy* (2023), Scotland’s *Life Sciences Strategy* (2025), the *Circular Economy Strategy* (2026), and many aspects of the UK’s *Modern Industrial Strategy* (2025). IB will be a foundational pillar within Scotland’s upcoming *Bioeconomy Roadmap* (due 2027), which will be co-designed with key stakeholders through an inclusive, cross-sector partnership led by Zero Waste Scotland.

Scotland’s critical mass of capability in EngBio offers an excellent platform from which to leverage further investment from the UK Government’s £2 billion *National Vision for Engineering Biology* (2023). Indeed, industrial applications of EngBio were identified as a specific strength and opportunity for the nation in the Scottish Science Advisory Council Report *Engineering Biology: Opportunities for Scotland* (2026).

Scotland’s IB sector has come a long way, but the nation needs to work harder and smarter to ensure its full value is realised. We must not lose momentum in the face of global headwinds. This refreshed Plan highlights areas where focused attention and effort are urgently required to maintain Scotland’s reputation as a leader in biotechnology.

Strategic Themes

Strategic themes identified in this Plan include the need to:

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Key achievements

Scotland's industrial biotechnology sector, 2013 to 2026.

- 2013**  **One of Europe's first National Plans**
Scotland publishes one of Europe's first National Plans for Industrial Biotechnology.
- 2014**  **IBioIC launches**
Launch of IBioIC with £10 million funding from the Scottish Funding Council.
- 2015**  **First Biorefinery Roadmap**
The first *Biorefinery Roadmap* for Scotland is published.
- 2016**  **Edinburgh Genome Foundry**
£5 million Edinburgh Genome Foundry launched.
- 2016**  **FlexBIO opens**
IBioIC's FlexBIO bioprocess scale-up centre opens at Heriot-Watt University.
- 2017**  **A world first**
Celtic Renewables powers a car using residue from Scottish whisky, a world first.
- 2019**  **Scottish feedstocks mapped**
Scottish Bioresources Mapping Tool launched.
- 2020**  **Bioeconomy Cluster Builder**
Launch of the Bioeconomy Cluster Builder collaboration with Innovate UK Business Connect and Scottish Enterprise to grow the Scottish bioeconomy.
- 2021**  **ENOUGH raises €42 million**
ENOUGH raises €42 million to scale production of ABUNDA mycoprotein.
- 2022**  **First Bioeconomy Week**
Scotland hosts its first Bioeconomy Week.



- 2023**  **Launchpad funding won**
Scotland wins £7.5 million from UKRI Innovate UK Launchpad funding to support bio-based manufacturing.
- 2024**  **Advanced Plant Growth Centre**
£33 million Advanced Plant Growth Centre opens at James Hutton Institute Campus.
- 2024**  **MiAlgae Series A raise**
MiAlgae completes a £14 million Series A funding round.
- 2025**  **A 300-litre fermenter**
FlexBIO launches Scotland's first open-access 300-litre fermenter.
- 2025**  **Grangemouth campus confirmed**
Grangemouth Sustainable Manufacturing Campus confirmed with £20 million investment through the Falkirk and Grangemouth Growth Deal to anchor bio-based manufacturing scale-up.
- 2026**  **Engineering Biology report**
Scottish Science Advisory Council publishes *Engineering Biology: Opportunities for Scotland* report.
- 2026**  **A £120 million biorefinery**
Celtic Renewables raises £16 million towards construction of a new £120 million biorefinery with ten times the capacity at Grangemouth Sustainable Manufacturing Campus.
- 2026**  **Carbon-Loop Hub launches**
£14 million EPSRC-funded Carbon-Loop Sustainable Biomanufacturing Hub launches at the University of Edinburgh.

Scotland's Vision

Scotland will be an exemplar of a supportive, responsible and joined-up ecosystem that attracts and nurtures innovative biotechnology businesses, creating the products and processes to secure supply chains, build national resilience and accelerate economic growth.

Scotland has all the elements needed to become a go-to destination for incubating and growing bio-based businesses. The nation has world-class universities and institutes, state-of-the-art technologies and expertise, abundant feedstocks, accessible local scale-up infrastructure, a pool of industry-ready skills, a vibrant cluster of bioeconomy businesses, excellent cluster support and tailored local funding and business support. The ecosystem will soon be anchored by nationally significant infrastructure hubs, including Grangemouth, Scotland's potential primary location for IB and EngBio demonstration, scale-up and manufacturing investment.

The IB sector in Scotland has seen steady growth since 2013 and has largely met the targets set out in the previous refresh of the Plan (2022). This

progress has been delivered in the face of significant headwinds caused by a prolonged recovery from the Covid pandemic, the economic impact of Brexit and, more recently, the consequences of wars, geopolitical turbulence and escalating energy costs.

The number of companies active in IB has risen from 43 in 2013 to over 175 today, falling slightly short of the ambitious target of 200 set in the 2022 Plan refresh. Turnover has, however, grown from £189 million to over £1.6 billion in the same period (2023, most recent available ONS data), and the sector now employs well over 4,000 people. The sector contributes around £500 million in Gross Value Add (GVA) to the economy.

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We chose Scotland because our partner, Scottish Shellfish, is based near Glasgow, giving us easier access to bulk byssus, the by-product we use as our feedstock. Combined with more affordable industrial space for establishing our

Sander Nevejans Founder and CEO, Seastex

pilot facility than was available in London, where Seastex was founded, and strong industry and academic expertise across bio-manufacturing, aquaculture and marine sectors, the move to Scotland was a no-brainer.

National Plan targets

The new, more conservative, targets set for 2030 reflect the realities of today's economy and wider economic environment, while remaining confident in the potential of this sector for Scotland.

	2013	2020	2023 MOST RECENT	2030 TARGET
Companies active in IB	43	147	175	220
Estimated turnover	£189m	£797m	£1.6bn	£2bn
Direct employees	1,103	>3,000	>4,500	>5,500
GVA contribution	£61m	>£235m	>£500m	>£650m

- Companies active in IB
- IB-associated turnover



01

Position Scotland as a competitive location for industrial biotechnology



Scotland's established leadership in IB, coupled with emerging strengths in EngBio, AI and digital technologies, creates a significant opportunity to strengthen its position as a global leader in innovative bio-based solutions (biosolutions).

Partners must now work collaboratively to swiftly harness these opportunities and further consolidate Scotland's reputation and attractiveness as a place to innovate, develop and scale a bio-based manufacturing company, both across the UK and internationally.

Actions needed to maintain Scotland's global competitiveness and further build on its reputation as a leading location for bio-based innovation and include the following:

Create an expert taskforce to champion growth and articulate sector needs

- IBiolC will support the creation of an IB Taskforce, led by industry and comprising key stakeholders, to advocate for the unique needs and opportunities of the sector. The Chair of the IB Taskforce will have representation on the Life Sciences Industry Leadership Group and advocate for the IB cluster.

- The IB Taskforce will provide authoritative and visible leadership and insight, strongly backed by Government, to advise and guide the growth of Scotland's IB cluster, while providing expert input into the wider *Scottish Life Sciences Vision and Strategy*.

Showcase excellence to strengthen Scotland's position

- Scottish Enterprise (SE) and its international offices, alongside the IB Taskforce, will develop and deliver an IB and EngBio proposition to strengthen Scotland's global reputation for excellence and generate new opportunities for trade and inward investment in target regions, including North America, Europe and Asia Pacific countries.
- IBiolC will collaborate with strategic partners to grow its Annual Conference as the leading UK IB event, attracting wider UK and international participation.
- All stakeholders will work together to showcase Scotland's strengths by promoting examples of successful IB projects, innovative businesses and academic excellence across multiple media channels. The forthcoming Life Sciences Cluster Development Organisation (due 2027) will be well placed to coordinate this activity.



Develop, deliver and promote high-profile flagship projects to build capacity and attract inward investment

- SE and partners will deliver the Grangemouth Sustainable Manufacturing Campus (GSMC) as a national hub for sustainable chemicals through IB and EngBio demonstration, scale-up and inward investment, integrated with advanced manufacturing infrastructure.
- Highlands and Islands Enterprise (HIE) will lead the delivery of Inverness Campus, including development plots within the Inverness and Cromarty Firth Green Freeport. The Campus will attract and support investment in renewable energy, life sciences and biotechnology. HIE will also continue to develop the European Marine Science Park (Oban) to support the growth of a marine science innovation cluster. Both sites will support the development of new high-value products from the region's rich marine resources and biological feedstocks, including seaweed, aquaculture and whisky co-products.
- South of Scotland Enterprise (SOSE) will enable IB scale-up in rural regions by connecting local feedstocks, supply chains and bio-based innovation through assets such as its regional academic base, the Dairy Nexus, Digital Dairy Chain and the Borderlands Deep Tech Accelerator Hub (Hawick).

CASE STUDY

Showcasing Scotland’s success

Scotland has achieved significant success in IB over the past four years, and its growing reputation is gaining international recognition. While measuring visibility and engagement can be challenging, IBiolC has tracked the reach and impact of its own communications as a proxy measure of public engagement success.

Targeting mainstream media has increased the visibility of Scottish biotechnology success stories, with several recently featured in publications with significant national and international online reach, including *The Times* and

The Guardian. Regular coverage in Scottish publications such as *The Scotsman*, *The Herald*, *The National* and *Scottish Business Insider* has further strengthened awareness of Scotland’s biotechnology sector.

IBiolC typically achieves an audience reach of around 600,000 per quarter. Some stories have captured significant public interest, including *The Herald* online coverage of Quas Drinks in late 2025, which reached more than 2.2 million people. Quas Drinks was founded by a former IBiolC student.



02 Accelerate the translation of innovation for cluster growth



Scotland prides itself on being an ‘innovation nation’, demonstrated by the world-class research and innovation conducted across academia and industry. The nation’s universities are successful in securing funding for exciting and ambitious research programmes. However, despite this investment, fewer than ten biotechnology start-ups and spinouts are launched each year. More needs to be done to leverage research assets into economic benefits.

Patent filings are one proxy measure of levels of innovation activity. Recent IP landscaping (Inevus Analytics, 2026) showed that a greater proportion of IB patents are assigned to academic groups compared with industry in Scotland than in other UK regions. While no definitive conclusions can be drawn from these data, this suggests that valuable IP remains untapped within academic institutions.

Encouragingly, the IP analysis also indicated that the rate of growth in patent filings for IB applications was five times greater in Scotland than in the rest of the UK, suggesting that innovation in IB could be a unique selling point for Scotland.

Scotland prides itself on being an ‘innovation nation’

Actions are urgently needed to address barriers to translating early-stage innovation into new business opportunities and include the following:

Accelerate translation of innovation into biosolutions

- The IB Taskforce will work across Governments and funders to ensure comprehensive funding support is in place for bio-based manufacturing innovation, creating a frictionless pathway from research and innovation through to companies of scale.
- IBioIC will continue to function as a cluster coordinator and broker of collaborative research and development partnerships between Scotland's research base and industry, capturing opportunities in circularity, resource efficiency and supply-chain resilience.

Harness and exploit high-profile flagship projects across academia

- All stakeholders will promote high-profile research investments in Scotland's universities and institutes (see Showcasing Scotland's Leadership in EngBio and Advanced Technologies). These investments provide evidence of critical mass, research excellence and international leadership, while creating a pipeline of new companies and impactful collaborations.

Address gaps in support for the identification and translation of IB and EngBio innovation

- IBioIC will continue to support the identification and exploitation of IB and EngBio innovation through its IB Champions initiative and the design and delivery of bespoke support for Technology Transfer Offices.
- IBioIC will monitor the Scottish IP landscape to identify opportunities and ongoing challenges that could be addressed through timely interventions.



CASE STUDY

Showcasing Scotland's leadership in EngBio and advanced technologies



Scotland has positioned itself as a leader in EngBio and sustainable advanced technologies, securing several high-profile investments in research and translation over recent years.

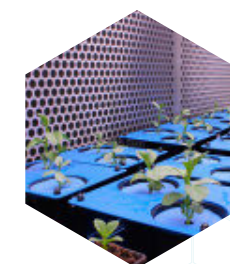
The Advanced Plant Growth Centre at the James Hutton Institute received £27 million through the Tay Cities Region Deal to advance world-leading plant science, including high-throughput phenotyping, vertical farming and controlled environment platforms.

The University of Edinburgh led Carbon-Loop Sustainable Biomanufacturing Hub, supported by £14 million in funding, including contributions from the Engineering and Physical Sciences Research Council (EPSRC), is transforming carbon-based industrial waste into high-value materials such as pharmaceuticals, cosmetics and speciality chemicals. This complements the University's £14.25 million Engineered Genetic Control

Systems for Advanced Therapeutics Hub, funded through the UKRI Technology Missions Fund, which focuses on using EngBio strategies to improve gene therapy for patients with serious conditions. In total, Scottish universities either led or partnered on approximately £54 million of funding through the recent UK National Engineering Biology Programme (2025 data).

Nationally, Great British Chemicals is funded by £22.5 million from EPSRC and the Natural Environment Research Council (NERC). Bringing together ten universities, including St Andrews, the centre works to replace fossil-derived petrochemicals with sustainable alternatives and scale industrial waste recycling technologies.

Together, these investments position Scotland at the forefront of sustainable, biology-driven industrial transformation, using IB, EngBio, data and AI and advanced manufacturing.



03

Deliver infrastructure and supply chains to scale

To take products to market, companies need access to state-of-the-art research equipment (e.g. genome editing, genomic and metabolomic analyses), expensive large-scale bioreactors and reliable and accessible sources of feedstock.

Scotland is well placed to provide these capabilities to biotechnology businesses but must become smarter at connecting and harnessing available facilities before seeking funding to address capability gaps. Improving access to scale-up expertise and supply chain development is also critical to supporting companies to grow.

Forging new partnerships across food production and processing sectors (e.g. agriculture and fisheries) will help realise new commercial opportunities from existing and emerging biomass.

Together, action across all the following fronts will enable indigenous companies to scale faster and increase inward investment opportunities.

Develop and promote an integrated development pathway from genome design to pilot-scale production

- IBiolC will create an online platform to enable innovators to quickly identify and connect with specialist expertise, equipment and facilities, including genome assembly, cell engineering, strain development, bioprocess optimisation and scale-up, as well as access to future demonstration and scale-up facilities at national infrastructure hubs such as Grangemouth.

- Interface, IBiolC and other stakeholders will continue to catalogue and promote existing capabilities, facilities and infrastructure available within Scotland's universities, colleges and industry to ensure optimal accessibility and use.

Unlock biomass and feedstock opportunities to secure supply chains

- Zero Waste Scotland and IBiolC will further develop existing digital supply chain mapping tools (i.e., the Scottish Bioresource Mapping Tool) to support the identification of usable feedstocks, their availability, suppliers and distributors. (Zero Waste Scotland recently updated the data, converting it from dry to wet weight (reflecting the full weight of the material, including its moisture content) to better align with real-world arisings).
- IBiolC, the enterprise agencies, Zero Waste Scotland and other relevant partners (e.g. the Resource Management Association Scotland) will continue to scope and evaluate the potential of new feedstock for bio-based manufacturers, working with industry bodies to connect suppliers and buyers and encouraging the development of new technologies and practices that generate value.

- The IB Taskforce will lead analysis to scope where the development of biosolutions could secure national supply chains in critical resource areas. This will define which products are at highest risk and which could be generated through local supply chains and Scotland's growing company base.

Build accessible and sustainable infrastructure for growth

- The IB Taskforce will drive public-private partnerships to improve access to specialist facilities, infrastructure, skills and networks, supporting company spinouts, scale-up and manufacturing.
- SE will scope a business case for a dedicated, affordable bio-manufacturing space (Biotech Incubator) that will offer bioprocess infrastructure, office space and technical and business support aligned with geographical need.
- SE and partners will anchor demonstration and scale-up facilities at Grangemouth Sustainable Manufacturing Campus, complemented by appropriate industrial manufacturing infrastructure and specialist utilities.
- HIE will deliver innovation, office and laboratory space at Inverness Campus and the European Marine Science Park, creating prime locations for life sciences, biotechnology and blue economy companies. In parallel, HIE can support biomanufacturing scale-up, enabling businesses to grow from research and development through to commercial production.

CASE STUDY

Unlocking supply chains for Scotland’s bio-based industries

Bio-based manufacturing companies need a secure and accessible supply of feedstock, whether that is ‘waste’ from existing industries or virgin plant material. These greener, renewable sources of biomass can replace petrochemical feedstocks used across many markets. A comprehensive understanding of Scotland’s available biomass is therefore critical to developing a viable bioeconomy.

To support this, SE and IBiolC have supported research to scope potential feedstocks, including sugar beet, hemp and grass, exploring their cultivation, processing and aggregation to supply bio-manufacturing processes.

Equally important is the Scottish Bioresource Mapping Tool, jointly developed by SE, Zero Waste Scotland and IBiolC. This unique, open-access dataset provides guidance on typical annual arisings of bio-based residues across Scotland. While representing a snapshot in time, it has strengthened understanding of

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At Vaste, we’ve benefited from a highly interconnected ecosystem of partners and stakeholders committed to helping industrial biotechnology companies launch, scale and succeed. The inward investment support available in Scotland has enabled us to accelerate the development of our Feedstock Intelligence Platform, providing greater resilience and transparency across feedstock supply chains for IB companies.

Evans Chelal

CEO, Vaste Technologies

Scotland’s feedstock potential and informed strategic planning for new bio-based ventures. The data can help innovators identify potential feedstock availability at a local authority level and support business decision-making, from selecting manufacturing sites to developing investment cases.

Building on this, in 2025 IBiolC funded an industry-led collaborative project to develop a digital platform for real-time trading of bio-based feedstocks. Developed by Vaste, in partnership with Edinburgh College, the platform connects producers with end-users, enabling these materials to function as conventional commodities for the first time in Scotland.

By supporting research, mapping and digital innovation, Scotland is helping to create transparent, accessible and reliable supply chains that accelerate scale-up, unlock commercial opportunities, and maximise the economic value of Scotland’s biomass.

04 Unlock investment and finance



Over the past 11 years, Scottish IB companies have raised approximately £550 million in investment. Encouragingly, fundraising activity has increased significantly over this period, quadrupling in value from £72 million across 71 deals (2015-2019) to £365 million across 137 deals (2020-2024).

Early-stage financing is strong in Scotland, supported by an active angel investor community. However, access to later-stage private investment to support scale-up remains limited. Analysis shows that only 12 companies raised more than £10 million between 2015 and 2025. Raising significant investment for non-medical biotechnology companies is challenging across the UK (see also *BBIA Bio-based Solutions: Financing the Future*, March 2026), highlighting the need for targeted action.

The prominence of EngBio within Innovate UK’s 2026 strategy presents a significant opportunity for Scotland’s IB sector. Innovate UK’s new approach provides a more joined-up package of support for innovative businesses, strengthening opportunities for Scottish IB companies to commercialise innovation, attract investment and scale.

Urgent action is needed to strengthen coordination across Scottish public funders while attracting greater private and growth capital to ensure companies can progress from innovation through to commercial deployment in Scotland. This includes ensuring that public funding is sequenced effectively to de-risk opportunities and attract private co-investment.

Actions needed to strengthen Scotland's investment landscape include the following:

Deliver a robust funding and investment landscape to scale innovation

- Public funders must work collaboratively to deliver a joined-up funding pathway that is better aligned with the needs of emerging technologies in IB and EngBio. This should include non-dilutive, proof-of-concept funding, SE's high-growth spinout programme and Scottish National Investment Bank (SNIB) funding for scaling, and improved access to the wide range of UK and European funding initiatives.

- Enterprise agencies and private investors should co-create and deliver a dedicated Bioeconomy Accelerator programme, with associated funding, to support IB and EngBio start-ups and entrepreneurs.

Increase inward investment

- SE will promote Grangemouth as Scotland's principal location for IB and EngBio inward investment, offering access to demonstration and scale-up infrastructure alongside established industrial supply chains.
- SE and its international offices will actively showcase Scotland's capabilities and assets globally to attract targeted investment from both UK and international organisations.
- IBiolC will work with universities and colleges to deliver dedicated investor engagement activities, including pitch training and investor showcase events to raise awareness of Scotland's critical mass of biotechnology investment opportunities.



CASE STUDY

Scotland, a magnet for innovative global businesses

Scotland has built a compelling reputation for IB and EngBio by connecting public agencies, universities and industry through a coordinated innovation ecosystem. Through targeted investor engagement, international showcases and support from partners including SE's international offices, Scotland is attracting companies looking to scale, collaborate and bring ideas to market.

Recent activity suggests Scotland is becoming a destination of choice for innovative bio-businesses seeking a supportive environment in which to grow. Examples include LiYF Bioethanol, founded by a Swiss entrepreneur, which relocated to Scotland to develop its second-generation biofuel platform, attracted by feedstock availability, integrated supply chains and strong local partnerships.

Vaste, a digital biomass trading platform, established its operations in Edinburgh, drawn by academic expertise, funding from Interface and IBiolC, innovation support, and eager customers across Scotland's thriving bioeconomy.

Xias Bio designs and licenses next-generation, animal-free recombinant proteins for multiple markets. Although originally established in Nottingham, the company chose to relocate to

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Scotland stands out as a location where advanced biofuel technologies can move beyond R&D into real-world implementation. For LiYF, establishing here is a strategic step towards industrialising our technology, supported by a collaborative ecosystem that aligns policy, infrastructure and innovation. Collaboration with IBiolC has been particularly valuable in enabling this progress.

Hangama Wanner

Founder and CEO, LiYF Bioethanol

Scotland, attracted by strong funding support from SE during the COVID pandemic and access to highly skilled graduates from IB Master's and PhD programmes. It initially operated from the University of Strathclyde before moving into larger, purpose-built laboratory and office facilities at the University of the West of Scotland.

Seastex, founded by a Belgian entrepreneur, also relocated to Scotland to access the mussel farming by-products used to manufacture low-carbon building materials and cosmetic ingredients, as well as the country's supportive and collaborative innovation ecosystem.

Together, these examples demonstrate that companies are attracted to Scotland not only by individual assets but also by the strength of the ecosystem and its ability to connect the right people, expertise, infrastructure and resources. By combining international promotion with hands-on local support, Scotland is strengthening its position as a destination where innovative bio-based businesses can thrive.

05

Drive market adoption and economic impact



IB is already a significant contributor to the Scottish economy, with GVA having grown almost tenfold over the past decade alone. IB and EngBio can be further positioned at the heart of the Scottish and UK economies by catalysing new company creation, unlocking high-value jobs and delivering long-term economic growth.

Scottish biotech businesses can create biosolutions that are 'Made in Scotland for the World', advancing sustainability, enhancing supply chain resilience and supporting global net zero ambitions.

Place-based manufacturing hubs such as Grangemouth will be critical in enabling these biosolutions to move from innovation to market. However, these products must also be affordable for end users and customers. Incentives that encourage market adoption of

bio-based alternatives to typically cheaper fossil-derived products will be needed to drive changes in buyer behaviour.

Action is needed to accelerate market adoption and maximise economic impact, including the following:

Increase public and government awareness of biotechnology's role in addressing national and global challenges

- ◆ The IB Taskforce should participate in the Scottish Parliament Cross-Party Group on Life Sciences and champion the role of biosolutions.

- ◆ SE and IBioIC will develop case studies and impact data aligned with national initiatives, including the *National Innovation Strategy* and *Circular Economy Strategy*, to demonstrate the economic and strategic value of IB and EngBio across the economy.

- ◆ The IB Taskforce and key stakeholders will develop and annually update an 'IB Dashboard', providing evidence of the economic impact and competitiveness gains generated through the application of IB and EngBio.

- ◆ The IB Taskforce and partners will communicate the benefits and opportunities of biosolutions in a transparent, evidence-based way through trusted organisations such as the Royal Society, the Society of Chemical Industry and the Scottish Science Advisory Council.

- ◆ The IB Taskforce and relevant partners will consider incentives to encourage the use of IB and EngBio to reduce the environmental impact of existing and future manufacturing processes.

Build public and market confidence in the products of IB and EngBio

- ◆ Key public sector partners will explore the implementation of public procurement strategies to promote the adoption of 'Made with Biology' products in Scotland, similar to the USDA BioPreferred Program and comparable initiatives in the Netherlands and Sweden.
- ◆ Scottish Government will review and strengthen relevant policy and public procurement frameworks to encourage the development of early markets and demand for bio-based solutions.
- ◆ The IB Taskforce will define the scope of, and work with key partners to develop, the expertise and tools needed to measure and benchmark emissions reductions and the environmental benefits associated with IB and EngBio innovation.

'Made in Scotland for the World'

CASE STUDY

Launchpad for success



A multi-million-pound UKRI Innovate UK Launchpad programme has boosted Scotland’s bio-based manufacturing cluster, supporting 32 innovative research and development projects across 30 SMEs. Several awardees have already filed patents, secured follow-on funding, validated new products, and are seeking investment to scale.

Innovate UK developed the Launchpad programme as part of the UK Government’s Levelling Up agenda to drive regional economic growth. SE, in partnership with IBioIC and Forth Valley College, successfully secured £7 million through the programme in 2023. Its overarching aim is to strengthen Scotland’s bioeconomy by enabling sustainable, scalable innovation that creates high-value jobs and regional economic impact.

IBioIC secured funding to be the Cluster Management Organisation (CMO), providing targeted support to Launchpad funding recipients and emerging companies. The CMO delivers networking events, one-to-one business support, investor readiness training and investor forums. A further initiative is the Biotech Innovators ‘Train to Scale’ Accelerator, a 16-module programme designed to equip early-stage bio-entrepreneurs with the technical, commercial and strategic skills needed to grow their ventures.

Together, these UKRI investments have strengthened Scotland’s biotechnology cluster by supporting innovation, attracting investment and laying the foundations for a globally competitive bio-based manufacturing sector.

06

Develop the future industrial biotechnology workforce



A sector cannot grow without ‘people power’, and we must ensure that the skills and talent needs of the rapidly growing sector are met. Scotland’s wider life sciences sector currently supports more than 46,000 jobs and is forecast to continue growing over the next decade (*Life Sciences Strategy for Scotland, 2026*). IB is expected to play an increasingly significant role within this expansion, particularly in EngBio, sustainable manufacturing and bio-based chemicals.

IB offers high-value, future-focused careers that combine scientific innovation, advanced manufacturing and sustainability, supporting Scotland’s ambitions for economic growth, regional prosperity and the transition to net zero.

However, skills development must reflect the changing world of work and the diversity of educational pathways now available for new

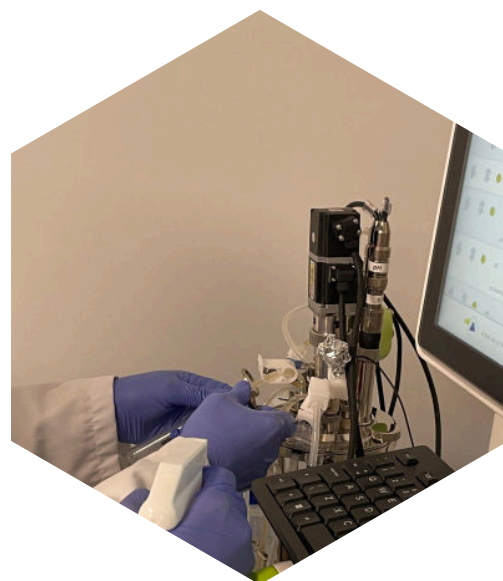
entrants to the workforce, as well as those upskilling or reskilling from more traditional industries. Development should start early, with specialist resources for schools and careers advisers, alongside flexible routes through apprenticeships, colleges and universities, and opportunities for those already in work to ensure a credible workforce for the future. Education and training providers must embed industry readiness, professional behaviours and applied workplace skills across learning pathways.

Future skills provision should take account of regional needs and student populations, leveraging the opportunities available through Scotland’s university and college sector across the country.

Ambitions and associated actions to meet the sector's needs include the following:

Improve intelligence about the current workforce and future needs

- IBioIC, with support from Skills Development Scotland (SDS) and in partnership with universities and colleges, will develop an IB Skills Observatory to support ongoing workforce intelligence. This will use AI-driven labour market analysis, alongside the *Life Sciences Sectoral Skills Assessment* and industrial data, to understand skills gaps and intervention needs, providing regular insight sharing across industry, education and government.
- IBioIC, through the Life and Chemical Sciences Skills Group, will convene industry, education and government partners to coordinate workforce planning and skills development. This will ensure alignment between industry and education curricula, and that training addresses future skills needs, including areas such as regulation, quality, industry-readiness and transferable skills.



Build and sustain a strong talent pipeline, with flexible education and skills routes informed by industry

- IBioIC, working with SDS and Developing the Young Workforce, will strengthen awareness of IB careers through improved pathways resources, engagement with educators and careers advisers, and promotion of the sector's contribution to innovation, sustainability and net zero.
- The Scottish Government and other funders will support regional skills planning aligned with Scotland's innovation clusters and local industrial strengths, embedding industry readiness and professional skills throughout education and training. Improved access for SMEs to skills provision, workforce development and specialist training is needed.
- IB stakeholders will encourage entrepreneurship training across colleges and universities to expand opportunities for exploiting Scotland's vibrant IB ecosystem.

Embed sustainability skills across the workforce

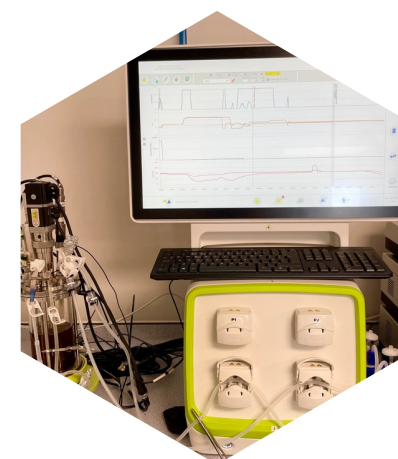
- IBioIC will work with industry, academia and skills partners to support the development of sustainability competencies, practical Life Cycle Assessment (LCA) capability and guidance tools for businesses adopting IB.
- Enterprise agencies and Zero Waste Scotland will investigate and deliver practical sustainability tools and guidance for SMEs adopting biotechnology to support workforce development.

CASE STUDY

Transitioning skills

The new Skills Transition Centre (STC) represents a major investment in the region's future workforce. Part of the Falkirk and Grangemouth Growth Deal, a transformative collaboration between the UK and Scottish Governments, Falkirk Council and local partners, the STC will drive innovation, upskill and reskill the local workforce and contribute to more than 1,660 jobs and £628 million in economic benefit over the 10-year project.

The £4 million STC will support Scotland's Just Transition by helping learners access sustainable employment opportunities in lower-carbon industries over the coming decade. Focusing on emerging sectors and industries undergoing transition, the STC will play a central role in building a skilled workforce aligned with the evolving needs of industry. Key areas of focus include Clean Energy and Net Zero, Industrial Digitisation, Advanced Manufacturing, Industrial Biotechnology, and Hydrogen Technologies.



07

Create an enabling policy and regulatory environment



Regulation and policy are essential to protect end users, consumers and the environment. An effective regulatory system should be proportionate and adaptive to the benefits and risks associated with innovative technologies. It should enable safe and effective products to reach the market in a timely and affordable manner, while eliminating products presenting unacceptable risks early in the development process.

However, current governance processes were developed to address the challenges of 20th-century chemical technologies and are not well suited to assessing today's biosolutions, which have markedly different benefit-risk profiles. As a result, Scottish biosolution developers may be disadvantaged compared with international competitors operating in countries with more enabling regulatory systems.

Greater clarity, consistency and predictability in regulatory pathways are needed to support innovation and investment. Stronger alignment across policy areas, alongside the use of demand-side levers, such as procurement, can also help facilitate market adoption.



Ambitions and associated actions to achieve this include the following:

Enable a coordinated and effective policy and regulatory environment

- ◆ The IB Taskforce will establish a coordinated regulatory interface to act as single point of contact for the Scottish Environment Protection Agency (SEPA), other regulatory organisations and permitting and planning bodies. The aim is to provide earlier clarity and make regulatory pathways easier to navigate for new products and services, while taking account of forthcoming changes to UK-EU trading arrangements that may streamline exports and reduce bureaucracy.

- ◆ The IB Taskforce will work to clarify roles and responsibilities across government and the organisations involved in IB and EngBio policy and delivery. It will identify and address policy, regulatory and market barriers that limit the uptake of bio-based solutions where these deliver clear environmental, economic and system-wide benefits compared with fossil-based alternatives. This will include improving clarity on regulatory alignment, for example between the Precision Breeding Act of England and Wales, Scotland's policy on gene editing and relevant developments under the proposed EU Biotech Act II.

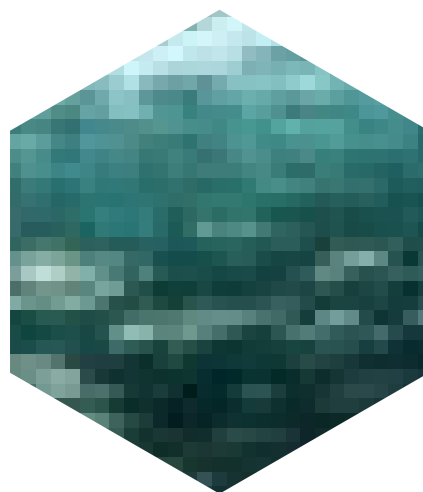
Embed IB and EngBio within climate, net zero and just transition frameworks

- ◆ Policymakers should integrate IB and EngBio into relevant climate, circular economy and Just Transition policies to ensure they are consistently recognised across policy and delivery frameworks.
- ◆ Zero Waste Scotland, in collaboration with the enterprise agencies and relevant partners, will develop and promote standardised approaches to evidence environmental impact. This could include biodegradability certification, LCA, carbon accounting and sustainability metrics, building on approaches already adopted in sectors such as farming and food and drink production.



CASE STUDY

Creating opportunity through collaboration, Scottish Ocean Cluster



Launched in 2025 with funding from Zero Waste Scotland, Seafood Scotland and Marine Fund Scotland, the Scottish Ocean Cluster (SOC) builds on a model pioneered by the Iceland Ocean Cluster, which showed how coordinated action can transform seafood side streams into high-value products such as construction materials and medicines.

The SOC demonstrates how cross-sector collaboration can unlock value from seafood by-products. By mapping feedstocks and connecting innovators, while aligning research, infrastructure and investment, the SOC is helping to realise the value of a joined-up approach to developing Scotland's bioeconomy.

The SOC brings together Seafood Scotland's industry connections, Zero Waste Scotland's circular economy expertise, IBioIC's industrial and academic biotechnology networks and the regional development expertise of ONE Opportunity North East and Aberdeenshire Council. Together, the partners bring complementary expertise and perspectives while sharing a common goal of maximising the value of seafood side streams.

The catalyst for the SOC was an IBioIC-funded workshop delivered in collaboration with Seafood Scotland and University of Stirling's Institute of Aquaculture. The event brought together stakeholders from Scotland's seafood and biotechnology sectors and generated substantial interest in developing high-value products from side streams. It also highlighted the need for more integrated value chains and a deeper shared understanding of feedstock availability, industry priorities and the broader ecosystem needed to commercialise innovation. The workshop laid the foundations for a collaborative approach, with Seafood Scotland championing the formation of a steering group to establish the SOC.

This initiative shows how a cluster-based approach can accelerate scale-up, strengthen supply chains and create new commercial opportunities, providing a model that other sectors could replicate to maximise the value of Scotland's natural resources.

CASE STUDY

Freeport investments offer regional growth opportunities

The Inverness and Cromarty Firth Green Freeport is one of two Green Freeports in Scotland, spanning approximately 520 hectares across a portfolio of strategically important ports, industrial sites and innovation assets. The Freeport includes Inverness Campus, a world-class location that supports growth in life sciences and technologies, including biotechnology, complementing the

Highlands and Islands' wider blue and green economy strengths.

The Green Freeport's geography and industrial heritage create distinctive opportunities for industrial biotechnology. Neighbouring Speyside is home to more than half of Scotland's distilleries, offering significant potential for industrial collaboration, by-product valorisation and access to new commercial environments.



CASE STUDY

Marine biotechnology offers an economic boost to the Highlands and Islands

Scotland is a powerhouse for marine biotechnology, a multi-billion-pound sector globally. Estimates suggest that the marine biotechnology sector in the Highlands and Islands alone could be worth up to £600 million per year by 2030.

At the heart of Scotland's marine biotechnology ecosystem is the European Marine Science Park, a purpose-built science and innovation campus on the west coast of Scotland. The campus offers high-quality laboratory, pilot-scale and business incubation facilities, located close to abundant, high-quality marine raw materials.

Co-location with the Scottish Association for Marine Science gives businesses direct access to over 100 marine scientists and researchers, as well as international scientific networks. This concentration of expertise and facilities creates significant opportunities for collaboration and partnerships, helping to translate scientific excellence into commercial successes.

The campus is particularly well positioned to support growth in aquaculture-related biotechnology, algae and seaweed bioprocessing, marine by-product valorisation, and environmental and nature-positive biotechnology applications.



CASE STUDY

Grangemouth Sustainable Manufacturing Campus



The Grangemouth Sustainable Manufacturing Campus (GSMC) is a flagship initiative within the Falkirk and Grangemouth Growth Deal, being developed to support the UK's ambition to translate world-class innovation into commercially viable industries.

Located within Scotland's largest manufacturing cluster, the GSMC will play a pivotal role in delivering the *UK Industrial Strategy's* priorities for advanced manufacturing, clean growth and frontier technologies such as EngBio.

The UK has world-leading capabilities in research and early-stage innovation, but many technologies struggle to scale, attract private investment or remain anchored in the UK. The GSMC will help address this challenge by providing shared, near-commercial manufacturing infrastructure that enables companies to test, prove and scale new bio-based and low-carbon processes under real industrial conditions. By reducing costs, risk and time to market, the GSMC will help innovative businesses to start, scale, and stay in the UK.

Crucially, the GSMC will be more than a single facility. It will anchor a place-based innovation ecosystem in Grangemouth, bringing together established industry, SMEs, universities, the Catapult network, and skills and innovation partners. This collaborative approach will strengthen supply chains, attract inward investment, create high-value jobs and support the transition of existing industrial assets and skills towards sustainable manufacturing. In doing so, it will help secure Grangemouth's long-term economic resilience.

Through the GSMC, Grangemouth is well positioned to become the UK's national hub for scaling EngBio and sustainable chemicals, supporting productivity, resilience and a Just Transition.

CASE STUDY

Invest to scale, a new fermenter for FlexBIO



Translating lab-based science into industry-ready processes remains a major challenge for bio-based businesses. The prohibitive cost of infrastructure, such as large-scale fermenters, is a major barrier, and many companies lack the in-house expertise needed to scale up.

FlexBIO, IBiolC's bioprocess scale-up facility, hosted by Heriot-Watt University in Edinburgh, has spent over eight years providing access to much-needed equipment and expertise. During that time, it has delivered 90 projects, supported 53 companies and provided hands-on training to approximately 400 individuals.

In 2025, Scottish Enterprise granted £847,000 to IBiolC to purchase and install the nation's first open-access 300-litre fermenter. The investment expanded IBiolC's scale-up capabilities, increasing upstream bioprocessing capacity tenfold, from 30 litres to 300 litres.

The fermenter, a type of bioreactor used to cultivate microorganisms, provides a crucial bridge between lab-scale development and commercial production, allowing businesses to conduct scale-up trials without disrupting day-to-day operations or bearing the high cost of purchasing the equipment themselves.

Addressing this well-recognised 'valley of death' in IB has become a strategic priority for the Scottish Government and a central element of the nation's commitment to achieving net zero by 2045.

CASE STUDY

A flexible, work-based pathway into industrial biotechnology



Scotland's IB skills system enables flexible, work-based progression, as demonstrated by Jack Kay at Ingenza. Joining the company as an apprentice at 16, Jack chose a hands-on route alongside employment rather than traditional full-time university study. Through a flexible pathway, he combined work with education, completing an HND at Forth Valley College through day release before progressing directly into third year at Heriot-Watt University.

While continuing to work full-time, Jack progressed to doctoral level, undertaking a PhD with the University of Plymouth focused on protein engineering to address drug-resistant infections. His studies were supported by industry and a prestigious fellowship from the Royal Commission for the Exhibition of 1851, demonstrating how employers and funders can work together to support long-term skills development.

Throughout his journey, Jack remained embedded in industry, ensuring his learning was directly applied to commercial challenges. Additional support from IBiolC provided specialist training and access to a wider innovation network.

Now a senior scientist, Jack's career highlights the impact of flexible, work-based learning pathways, enabling progression from apprenticeship to PhD while remaining in employment. His experience demonstrates how coordinated support from employers, education providers and IBiolC can build deep technical expertise, strengthen the talent pipeline and support the continued growth of Scotland's IB sector. Embedding flexibility across the skills ecosystem will be critical to ensuring that individuals, regardless of background or preferred learning style, can access a pathway into IB.



National Plan for Industrial Biotechnology

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This document was prepared by IBioIC on behalf of
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