ANNEX G

SSAC REPORT – Engineering Biology: Opportunities for Scotland

OVERVIEW OF SCOTTISH ACADEMIC LANDSCAPE

National science funding landscape for EngBio

The UK's National Engineering Biology programme (NEBP) defines four main "application-inspired themes and challenges", in addition to three "discovery-inspired themes and challenges" as key research areas to guide the development of the bioeconomy in the UK. These are supported by a £125 million investment from UKRI over the next five years to fund:

- Six mission-led engineering biology hubs; five years (£70m total)
- 22 mission-led awards; two-year period (£30m total)
- 48 industry-led collaborative research and development projects; 18 months (£13.5m total)
- Proof of concept awards; two years, (£3m total)
- An accelerator programme to help start-ups; two years (£2m total)
- Seed corn funding; two years (£4m total)

The key themes are:

Application-inspired themes:	Discovery-inspired themes:
• Biomedicine • Clean Growth • Food systems • Environmental solutions	• Bioinspired design • Bioengineered cells & systems • Novel materials

Furthermore, certain areas were identified to require cross-cutting research and technology development to unlock the full impact of Engineering Biology. These include: rational design, sensors, scalability and scale-up, metrology and standardisation.

While UKRI is currently the principal explicit funder of EngBio across the UK, other bodies (most notably Wellcome, Cancer Research UK, and British Heart Foundation) are technology/approach agnostic to delivery of their missions and are open to EngBio-based applications. For example, the British Heart Foundation's largest (£30M) programme (CureHeart) could be defined as EngBio-based. There are also sources of international funding accessible to UK-based researchers for EngBio-related projects (e.g., NSF Global Centers, UK-Japan Engineering Biology collaborative funding, Gates Foundation and Horizon Europe).

The Scottish EngBio academic landscape

Scotland is very strong in Life Sciences. According to HESA data (2018 to 2022), Scotland received 20.3% of UK Bioscience Research funding and 10.5% of UK Clinical Research funding. This, and the associated high-quality undergraduate and post-graduate offerings, gives Scotland a powerful foundation for all aspects of Life Sciences, including EngBio.

The Scottish epicentre for EngBio is currently the University of Edinburgh, which houses several large EngBio initiatives, centres and facilities (see below). However, at least another seven Scottish HEIs (Aberdeen, Dundee, Edinburgh Napier, Glasgow, Heriot-Watt, St Andrews, Strathclyde) also have significant positions in EngBio.

Scottish HEIs (especially the University of Edinburgh) have been effective in securing recent EngBio-focussed UKRI funding:

- University of Edinburgh leads on one of the UKRI EngBio Mission Hubs (Engineered Genetic Control Systems for Advanced Therapeutics) and is a partner in two others and in three UKRI EngBio Mission Awards.
- Dundee, Glasgow and Heriot-Watt universities are all partners in other UKRI EngBio Mission Hubs and/or UKRI EngBio Mission Awards.

Scotland also has significant expertise within several highly-relevant Research Institutions. The Roslin Institute (part of the University of Edinburgh) is globally leading for engineering of livestock with unique combinations of capabilities and facilities. The James Hutton Institute, Moredun Insitute and SRUC (Scotland's Rural College) have expertise in agricultural and crop science, and marine science is expertise is based at SAMS (Scottish Association for Marine Science).

Information on EngBio activities and EngBio-adjacent activities gathered from publicly available sources and from HEI responses to a request for information are provided in Appendix Tables 1 & 2.

EngBio centres and facilities

Scottish HEIs and research institutes house several EngBio-relevant Centres, Facilities, Groupings and Units, including:

- The Centre for Engineering Biology (University of Edinburgh)
- Centre for Mammalian Synthetic Biology (University of Edinburgh)
- Edinburgh Genome Foundry (University of Edinburgh)
- Institute for Complex Systems & Mathematical Biology (University of Aberdeen)
- Scottish Biologics Facility (University of Aberdeen)
- Centre for Targeted Protein Degradation (University of Dundee)
- Drug Discovery Unit (University of Dundee)
- National Phenotypic Screening centre (University of Dundee)
- National Robotarium (Heriot-Watt University)

- IBioIC FlexBio (bioprocess scale-up facility) (Heriot-Watt University)
- Advanced Plant Growth Centre (James Hutton Institute)

Furthermore, many relevant smaller research facilities and groups exist across Scotland for ‘omics technologies (genomics, transcriptomics, proteomics, metabolomics etc.), stem cell production, cell and gene therapies, cell and tissue engineering, enzyme design and engineering and so on. Such facilities are enablers for EngBio, providing core technologies and materials for EngBio R&D. More details are included in Appendix Table 1 & 3.

Industrial collaboration and commercialisation

There is significant collaboration between Scottish HEIs and industrial partners. A minority of this is specifically in EngBio (e.g. through collaborative projects and PhD studentships). Nevertheless, as the EngBio industrial sector grows in Scotland and elsewhere, we might expect this academic-industry EngBio interface to expand. Much of what is classified as Biotechnology–based industry today could tomorrow be EngBio-enabled.

However, while Scottish HEIs overperform, per-capita, in terms of Life Sciences research grant income from UKRI, charitable and other sources (see above), they underperform in terms of commercialisation of their IP and expertise across the board (Scotland houses only 6% of the UK Life Sciences industry, according to ONS).

The Universities of Edinburgh and Dundee are leading in terms of EngBio-specific tech-transfer measured by spin-out creation in Scotland. However, company retention is still a challenge; two high profile spin-outs from the University of Dundee (Exscientia and Amphista Therapeutics) have since re-located to England.

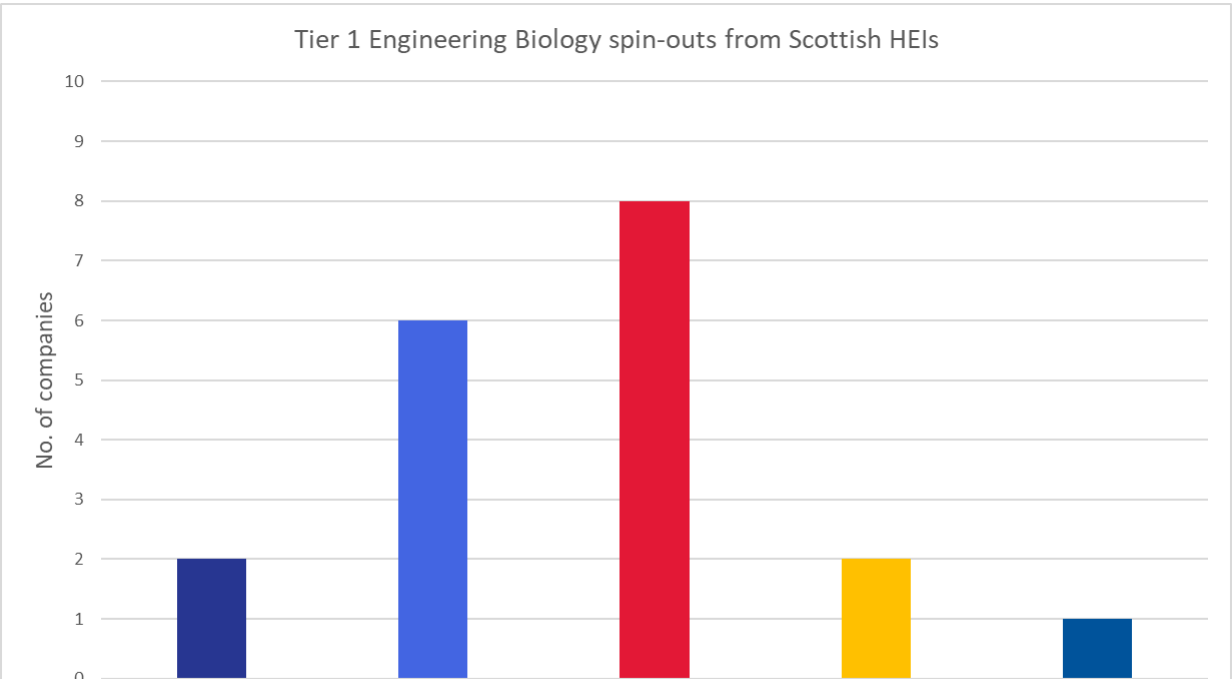

Figure 1 Engineering Biology spin-outs from HEIs in Scotland. For information on the Tier allocation for companies, see Annex H

Impediments to commercialisation of HEI IP and expertise in Scotland

With respect to commercialisation of biosciences in Scotland, including EngBio, impediments include:

- Lack of Proof-of-Concept funding to convert innovations to investible assets (leading to underinvestment)
- Lack of general laboratory space for spinouts (leading to loss of invested companies to elsewhere)
- Lack of appropriate scale-up facilities (and affordability thereof)
- Lack of energy cost certainty

The facility affordability point is exacerbated by how HEI-based facilities operate, which is that, generally, facility capital expenditure is provided by funders but not operational expenditure (which is supposed to be cost-recovered – a procedure that is complex and expensive). This leads to underused facilities.

Education, training and skills for EngBio

Recruiting, training and maintaining a diverse talent pool of interdisciplinary scientists in the UK is highlighted as a key requirement in both the National Vision for Engineering Biology and House of Lords report.

Post-graduate level

The eight Scottish universities named above all train some PhD students in Biotechnology/Synthetic Biology/EngBio through general bioscience UKRI Doctoral Training Partnerships (DTPs) and other mechanisms (Appendix Table 4). IBioIC has also supported 13 cohorts of PhD Students so far through their Collaborative Training Partnership. However, Scotland does not yet hold any of the dedicated UKRI Central Doctoral Programmes (CDTs) in EngBio or Synthetic Biology. A recent (2025) UKRI call for applications might alter this.

The University of Edinburgh is the only university to offer MSc degrees relating specifically to EngBio (Synthetic biology & Biotechnology and Systems and Synthetic Biology). Furthermore, IBioIC provide an MSc in Industrial Biotechnology, with a 10-week industry placement (taught across HEI's throughout Scotland and awarded by the University of Strathclyde). Glasgow and Dundee universities notably offer the opportunity to combine Biological sciences with management, business or entrepreneurship at Masters level. There was previously a scholarship scheme funded by the Scottish Funding Council as part of the Highly Skilled Workforce PGT programme that supported Scottish or EU students to study postgraduate taught courses in biotechnology. This was discontinued in 2019/20. Other relevant postgraduate programmes are detailed in Appendix Table 4.

Undergraduate level

Currently, there are no dedicated EngBio undergraduate degrees, with the closest being Systems Biology (Glasgow), Industrial Biotechnology (Glasgow, Strathclyde), and Biotechnology (Aberdeen, Edinburgh, Glasgow UWS, Napier). Nevertheless, the

Biosciences offering across Scotland's HEIs is very strong and most, if not all, of the BSc degree offerings would provide a suitable basis for moving into an EngBio-based business or onto an EngBio higher degree (MSc or PhD).

Relevant modules on these courses include Molecular Biology, Biotechnology, and Bioprocessing, Systems & Synthetic Biology, Bioinformatics, Gene Regulation and Expression, Molecular Microbiology, Genetics and Molecular biology, Omics and Applications of Synthetic Biology.

The University of Edinburgh and the University of St Andrews have recently entered either undergraduate or postgraduate teams in iGEM (the International Genetically Engineered Machine competition) and iDEC (International Directed Evolution competition).

Further education

The IBioIC provide a Higher National Diploma (HND) Industrial Biotechnology course at SCQF level 8. This is run at two further education colleges (Forth Valley College, and Glasgow Clyde college) and aims to prepare students for employment in careers such as Science Laboratory Technician; Research Scientist; Process Operator and Production Scientist, or for progression to degree-level further study. They also provide opportunities for continued professional development/in-work learning through their training courses in practical skills (with topics including fermentation, upstream and downstream processing, process costing and bioinformatics), offered at cost to participants from academia and industry.

The Leaders in Science programme - in alignment with the National STEM Strategy - supplements the career development pathways by hosting 3-day work experience courses for teachers.

Other FE courses and skills training options with a broader focus also exist, and could be modified in the future to better prepare the workforce for EngBio-based careers. These are documented in Appendix Table 6. If there was significant industry demand, Skills Development Scotland could work to develop the appropriate training opportunities to fill existing skills gaps.

Appendix A

Information on EngBio activities and EngBio-adjacent activities was gathered from publicly available sources and from HEI responses to a request for information. It is not intended to be a comprehensive record. No current research activities directly relevant to Engineering Biology were identified in the following universities: Abertay University; Glasgow Caledonian University; Queen Margaret University; Robert Gordon University; University of Stirling; University of the Highlands and Islands; University of the West of Scotland.

Table 1 Summary of Engineering Biology (EngBio) research activities by institution (listed in alphabetical order)

University	Current UKRI EngBio funding	Other relevant research activities and areas of expertise
Edinburgh Napier University	None	**Centre for Artificial Intelligence & Robotics (CAIR)**- relevant expertise and skills for supporting EngBio in collaboration with the National Robotarium. Open to external consultancy but no current EngBio based projects. **Centre for Biomedicine and Global Health**- relevant research areas include adoptive T-cell therapy, advanced drug screening, peptide-based therapeutic development and antimicrobial resistance. Member of the Advanced Therapies Skills Training Network (ATSTN).
Heriot-Watt University	**Partner in Cranfield-led EngBio mission hub** - Environmental Biotechnology Innovation Centre [BB/Y008332/1, £11.6 m]	**Institute of Biological Chemistry, Biophysics and Bioengineering** within the School of Engineering and Physical Sciences has a strong interdisciplinary focus, linking research strength in the chemical, physical, and engineering sciences to the life sciences. No current research involving EngBio, but many that could support EngBio advances. Plans for a new Centre for Sustainable Brewing and Distilling to replace the International Centre for Brewing and Distilling (ICBD). Supporting facilities: • National Robotarium - see Facilities table for description

University of Aberdeen	None	**Centre for Genome-Enabled Biology and Medicine (CGEBM)** - provision of various genomic technologies, including next generation sequencing (NGS), and specific training. **Institute for Complex Systems and Mathematical Biology (ICSMB)** – cross-disciplinary institute, applying mathematical theory to complex systems across physics, biology, engineering and medical sciences. Supporting facilities: • **Scottish Biologics Facility (SBF)** – see Facilities table for description
University of Dundee	**Partner in Nottingham-led EngBio mission hub** - GlycoCell Engineering Biology Mission Hub: Transforming glycan biomanufacture for health [BB/Y008472/1, £11 m]	**Drug Discovery Unit (DDU)-** Likely the largest academic drug discovery facility in the world (>130 full-time equivalents). Main two areas of activity are anti-infectives drug discovery and identifying innovative drug targets. Takes discoveries through screening, hit-to-lead, lead-optimisation and pharmacokinetic analyses to yield clinical candidate drugs or drug targets. Although the current portfolio is currently primarily conventional pharmaceuticals rather than EngBio/advanced therapies, the DDU integrates advanced technologies to their workflow (including ML/AI driven automated compound design-make-test-analyse cycles), and part of their work involves cloning, expression and purification of protein targets, using *E.coli, Pichia pastoris*, Baculovirus and mammalian expression systems. A world-leading facility with a high level of industrial collaboration, with partners including GSK, Takeda, and others. The closest (smaller) comparator is Calibr at Scripps, California. **Medical Research council Protein Phosphorylation and Ubiquitylation Unit (MRC PPU)-** a major research centre that focuses on the understanding of the biological roles of phosphorylation and ubiquitylation and how disruption of these processes cause human diseases such as neurodegeneration, cancer, hypertension and immune

		disorders. The centre also offers a range of services to industrial and academic clients worldwide, including a DNA sequencing and fragment analysis facility, Protein expression and purification, cDNA cloning, Antibody production and a range of screening and profiling platforms. **Centre for Targeted Protein Degradation-** One of only two such centres worldwide (the other at Dana Faber, Harvard) driving innovation in small molecule protein degraders to modulate (engineer) biology for therapeutic gain. High level of industrial collaboration (>40 staff supported by international Pharma companies, including Boehringer Ingelheim, Almirall, Eisai). Excellence in tech-transfer: The University of Dundee was ranked as the top university in the UK for developing spinout businesses in 2022 [Octopus Ventures, 2023]. The new **Life Sciences Innovation hub** (launching 2025) supported by the Tay Cities regional deal, Scottish Enterprise, The Wolfson Foundation and Garfield Weston foundation will provide 5,000m^2 space for spinout and start-up companies in the area, including synthetic biology/engineering biology companies. Supporting facilities: • **National Phenotypic Screening centre (NPSC)-** specialist facility in high throughput phenotypic screening, funded by the Bill and Melinda Gates Foundation and EU- Innovative Medicines Initiative 2 • **FingerPrints Proteomics facility** - advanced proteomics facility, working with academic and industrial clients • **Human pluripotent stem cell facility-** offering collaborative research projects and consulting services

University of Edinburgh	**Lead on EngBio mission hub** - Engineered Genetic Control Systems for Advanced Therapeutics Hub **[BB/Y008545/1, £12.7 m]** **Partners in Portsmouth-led EngBio mission hub** (Preventing Plastic Pollution with Engineering Biology), and **Cranfield-led EngBio mission hub** (Environmental Biotechnology Innovation Centre) [BB/Y007972/1, £11.5 m; BB/Y008332/1, £11.6 m] **EPSRC Carbon-Loop Hub** – one of four new UK wide Manufacturing Research Hubs for a Sustainable future, in partnership with Universities of Manchester, Nottingham, UCL and Imperial College Partner in three EngBio Mission Awards • Scalable production of precisely engineered proteins using an expanded genetic code (Manchester-led, BB/Y00812X/1, £1.7 m) • A powerful directed-evolution tool for exploitation of chloroplast engineering biology (UCL-led, BB/Y008162/1, £1.2 m)	**Excellence in securing strategic research funding:** The University of Edinburgh has demonstrated consistent excellence in securing strategic EngBio investment from UKRI, being the only UK university to succeed at every strategic call: the Centre for Systems Biology at Edinburgh (2007), The UK Mammalian Synthetic Biology Research Centre (2014), the Edinburgh Genome Foundry (2014 & 2019), Engineering Biology Transition Awards (2021) and the recent EngBio Mission Hub (2024). Over £70M of strategic funding has been secured to date. **Centre for Engineering Biology** - 50 research groups and 200 researchers, applying synthetic biology tools across a variety of research areas from plant, microbial, mammalian, microbial and anti-microbial resistance, systems modelling, circular bioeconomy, and biotech in space. Unique focus on responsible research and innovation with a team of social scientists also part of the centre. It includes the UK's **Centre for Mammalian Synthetic Biology** which has 16 commercial partners, as well as UK-wide and international collaborators, and the new UKRI **Engineered Genetic Control Systems for Advanced Therapeutics Hub,** directed by Prof Susan Rosser**.** **The EPSRC Carbon-loop hub** - will develop engineered microbes capable of converting industrial waste into high-value, sustainable chemicals and materials. The hub will also launch the UK's first 'BioFactory'; a national platform for scaling up bioprocessing innovations that cut emissions, reduce landfill, and help build a fossil-free manufacturing base. Over 45 partners, including UK and global chemical companies from across seven industry sectors are involved. Special research excellence in the following areas: • Cell and gene therapies • Synthetic biology interface with synthetic chemistry • Biological recovery and upcycling of critical metals

	• Cyanobacteria engineering for restoring environments (Bristol-led, BB/Y007638/1, £1.6 m) Three EngBio collaborative R&D projects (Innovate UK) • Production of alternative, innovative and natural-based technologies for styrene (10075624, £390k) • Continuous oscillating baffled reactor-with-biocatalysts-for accelerated-reactions (10073778, £390k) • Engineering cyanobacteria into bio-solar cell factories for scalable carbon capture utilisation and storage (10073574, £280k)	• AI/ML, cybergenetics and the integration between biological and digital systems • Livestock health, well-being and productivity (Roslin Institute) Supporting facilities: • **Edinburgh Genome Foundry –** see Facilities table for description • **EdinOmics-** small research facility for proteomics and metabolomics • **Edinburgh Genomics-** Genomics & Bioinformatics Core Facility, providing short and long-read sequencing, bioinformatics analysis and training.
Roslin institute - *within the Royal (Dick) School of Veterinary Studies at the University of Edinburgh*	Linked to University of Edinburgh funding The Roslin Institute jointly proposed a Mission Hub on Engineering Biology for the Food System, together with three other BBSRC-sponsored Institutes and leading organisations engineering crops, however it was not successful.	**Excellence in securing strategic research funding:** The Roslin Institute were awarded £35.5M of strategic investment from the Biotechnology & Biological Sciences Research Council (BBSRC) for 2023-28, part of which supports rare expertise, resources and infrastructure for genome editing and transgenesis in farmed animals. This includes Core Capability Grant funding from BBSRC (£16.5M) for animal resources, technical staff and facilities, which supports their National Avian Research Facility and Large Animal Research & Imaging Facility. £16.8M has been allocated for Institute Strategic Programmes

		(ISPs) in two key areas related to Food Systems ('Genes & Traits for Healthy Animals' and 'Prevention & Control of Infectious Diseases') where EngBio can be applied. Also recently received Global Challenges research funding of £2.4m (2017-2023) for an "**International Veterinary Vaccinology Network**" to aid technology-transfer and vaccine development research. Proposed EB^2 hub: *The Roslin Institute are pursuing funding for a new hub, proposed for innovation in Agri-Tech to advance genome engineering in farmed animals. EB^2 will be one of six hubs supported by a programme for data-driven innovation in the Edinburgh & SE Scotland City Region Deal.* Industrial partnerships: Many of the Institute's Engineering Biology projects are performed in collaboration with animal breeding companies with global reach e.g. Genus PIC (licensed IP for CD163-edited pigs), Cobb-Vantress (key global breeder of broiler chickens), Hendrix Genetics, lifeArc, Geno, Aviagen UK. Supporting facilities: • **National Avian Research Facility** - for gene editing and transgenesis in poultry • **Large Animal Research & Imaging Facility**- for gene editing and transgenesis in large animals (pigs, sheep and cattle), opened in 2021 • **Aquaculture genetics research facility**- for fish and shellfish • Biological Research Facility- for rodents

		• Equipment platforms for proteomics and metabolomics, bioimaging, flow cytometry, genomics and high-performance computing • **Easter Bush Science Outreach Centre-** a purpose-built teaching laboratory offering a hands-on curriculum-linked workshops for school pupils, activities and online resources for teachers, and interactive laboratory-based sessions for community groups.
University of Glasgow	**Partner in Cranfield-led EngBio mission hub** - Environmental Biotechnology Innovation Centre [BB/Y008332/1, £11.6 m] **Lead on one EngBio Mission Award** (Synthetically engineered microalgae for improved gut function and human health) [BB/Y00857X/1, £2.0 m]	**Synthetic Biology and Industrial Biotech** research grouping brings researchers with an interest in synthetic biology together from across the James Watt School of Engineering and the College of Medical, Veterinary and Life Sciences. Main areas of research interest include metabolic modelling and microbial engineering, energy, water/waste treatment and tool development. Recent Global challenges research funding to a total of £4.6 m for EngBio-relevant projects (2017-2022). **Centre for Doctoral Training**: EPSRC and SFI CDT in "Engineered Tissues for Discovery, Industry and Medicine" (2019-2027) [EP/S02347X/1, £7.3 m] Supporting facilities: • **Glasgow Polyomics-** research facility offering next generation sequencing, transcriptomics, proteomics, metabolomics and research computing
University of St Andrews	None	**Biomedical Sciences Research Complex (BSRC)** includes over 50 academics across the Schools of Biology, Medicine, Chemistry and Physics, with relevant research specialisms in CRISPR and DNA repair, enzyme engineering (in particular halogenase enzymes and sugar-processing enzymes), enzyme immobilisation, and pathway engineering. Notable applications include biocatalysis for pharmaceutical and agrochemical synthesis reactions, sustainable antibiotic production,

		production of novel nucleoside and peptide therapeutics and diagnostics for low-resource settings. They have over 19 industrial partnerships with both UK and international companies. **Integrated Institute of Engineering** has Engineering Biology as one of its Five Pillars and is currently seeking to recruit a Global Fellow in Engineering Biology. Supporting facilities: • **BSRC Mass Spectrometry and proteomics Facility-** mass spectrometry and omics for internal and external academic and non-academic clients • **Single Cell Sequencing Platform-** next-generation single cell sequencing • **Centre of Biophotonics -** application of light based technologies to investigate biological process at molecular, cellular and tissue scales
University of Strathclyde	**Lead on one EngBio Mission Award** (Engineering Streptomyces bacteria for the sustainable manufacture of antibiotics) [BB/Y007611/1, £896k]	Three relevant research groupings: • Biomedical engineering (With a focus on Cell, tissue & organ engineering) • Microbiology and industrial biotechnology • Bionanotechnology and analytical chemistry (focus on biosensors and bio-inspired materials) Relevant areas of research excellence include: • Therapeutics & diagnostics - Production of antibiotics, new antibiotics, drug delivery; Biologics and therapeutic oligonucleotides; Medical devices and diagnostics • Cell, tissue & organ engineering

		• Manufacturing - with strategic partners including the IBioIC and Medicines Manufacturing Innovation centre (MMIC) • Food and environment - microbially mediated mineral precipitation, biological restoration of soils, soil hydrogel systems in areas scare in water, mathematical modelling and analysis e.g. plant and bacterial dynamics, complex network analysis

Table 2 Research institutions in Scotland with relevant roles or capabilities for EngBio

Research Institution	Institute details	Activities
Industrial Biotechnology Innovation centre (IBioIC)	IBioIC is one of four Centres funded by the Scottish Funding Council [ref]. It was established in 2014 to fulfil the aims of the National Plan for Industrial Biotechnology to support the identification and translation of innovations arising from Industrial Biotechnology research in Scotland to boost the Scottish economy. It has over 200 member organisations (from the UK and Europe) and 19 academic partners in Scotland.	Activities include: • **Support** for de-risking early-stage collaborative R&D between industry and Scottish Universities and Colleges • **Skills and Training** – HND through to PhD and CPD • Industry engagement and signposting • Support for start-ups and spin outs • Outreach and Public Affairs • Facilities for bioprocess scale up (to 300L) and hands on training

James Hutton Institute	An independent scientific research organisation established in 2011 as the merger of the Macaulay Land Use Research Institute (MLURI) and the Scottish Crop Research Institute (SCRI), with a focus on the sustainable management of land, crop and natural resources.
	
	One of the six for Scottish Environment, Food and Agriculture Research Institutions (SEFARI)
		• **Research services:** offer a range of analytical, commercial research, crop science, consultancy and scientific project services
		• Innovation centres:
		  ○ **Advanced Plant Growth Centre (APGC)** and **International Barley Hub (IBH),** funded through the Tay Cities Region Deal.
		  ○ New **National Potato Innovation Centre** at Invergowrie to support world class research in potato science, linked with its unique Commonwealth Potato Collection.

Moredun Research institute	The Moredun Research institute conducts research into infectious diseases of farmed livestock and provides education and information to the farming industry, established by Scottish farmers in 1920. One of the six for Scottish Environment, Food and Agriculture Research Institutions (SEFARI)	• **Facilities:** extensive Home Office Licensed laboratory and animal facilities, equipped to handle a broad range of livestock pathogens including bacteria, viruses and parasites up to Containment Level 3.
SAMS (The Scottish Association for Marine Science)	SAMS is an academic partner of the University of the Highlands and Islands, co-located with the European Centre for Marine Biotechnology Incubator. Research areas relating to EngBio include marine biotechnology with commercial application	• SAMS hosts the **Culture Collection of Algae and Protozoa (CCAP),** a national service culture collection (also called a Biological Resource Centre) funded by the Natural Environment Research Council. The collection is the most diverse of its kind in the world, with 3000 strains of marine and freshwater algae, protists and seaweeds. • **Training**: Delivers BSc, Masters and doctorate programmes in the marine science field. The taught programmes do not have a focus on engineering biology.

SRUC (Scotland's Rural College)	Scotland's Rural College (SRUC) was established in 2012 through the merger of the Scottish Agricultural College (SAC) with Barony, Elmwood and Oatridge Colleges.
	
	One of the six for Scottish Environment, Food and Agriculture Research Institutions (SEFARI).
		• **Research** e.g. Biorefining and advanced materials research (BAMRC)
		• Research services:
		  ○ Crop trial facilities
		  ○ Edinburgh GENetic Evaluation Services (EGENES)- a centre for the development and delivery of genetic improvement tools for livestock industries

The Rowett Institute	The Rowett Institute, based at the University of Aberdeen, conducts research into nutritional topics. One of the six for Scottish Environment, Food and Agriculture Research Institutions (SEFARI).	Some research areas could be relevant to emerging Engineering Biology applications in food: • Nutrition, Obesity and Disease • Microbiome, Food Innovation and Food Security • Healthy Lifecourse and Nutrition Neuroscience

Table 3 National facilities supporting EngBio in Scotland

National Facility	Facility details and access
Edinburgh Genome Foundry	A research facility based at the University of Edinburgh specialising in the modular assembly of DNA constructs using a highly automated robotic platform, with additional testing facilities. A UK leading facility, member of the Global Biofoundries Alliance and International Gene Synthesis Consortium, funded as part of the Synthetic Biology for Growth (SBfG) programme in 2014.
IBioIC FlexBio Bioprocess Scale Up facilities	A bioprocessing scale-up facility based at Heriot-Watt University with expertise in upstream and downstream processing at semi-pilot (up to 300L scale as of Q1 2025) A recognised centre for bioprocess training through the RESILIENCE program.
Scottish Biologics Facility (SBF)	An international hub for generating customised recombinant antibodies for research and commercialisation, screening candidates using phage-display technology, and producing re-formatted antibodies in various bacterial and mammalian expression vectors. Also works in other areas of biologics drug discovery.
National Robotarium	World-leading centre for Robotics and Artificial Intelligence based at Heriot-Watt University in partnership with The University of Edinburgh.
Advanced Plant growth Centre (APGC)	A James Hutton Institute innovation centre which partners with University of Dundee, Abertay University, University of the Highlands and Islands, International Barley Hub, among others working in agritech.

Table 4 Doctoral training programmes supporting bioscience training in Scotland

Doctoral training programme	Partners	Funding information
EASTBIO DTP (UKRI-BBSRC)	Lead by The University of Edinburgh, partnering with the University of St Andrews, the University of Dundee, Stirling University, the University of Aberdeen, SRUC, the James Hutton Institute, Moredun Research Institute, SULSA, IBioIC and the Cool Farm Alliance.	Has awarded over 600 studentships since 2012 and delivered over 400 days of training • £7 million 2012-2018, BB/J01446X/1 • £10 million 2015-2024, BB/M010996/1 • £20 million 2020-2028, BB/T00875X/1 Recently awarded 19 BBSRC-funded studentships per year for a further 3 years through the UKRI Doctoral Landscape Awards. The co-funding model and investments from partner institutions will mean ~38 studentships will be funded per cohort, with 25% being CASE studentships with industry partners. Theme areas include: “Understanding the Rules of Life”, “Bioscience for Sustainable Agriculture and Food”, “Bioscience for renewable resources and Clean Growth” and “Bioscience for an integrated understanding of Health”
NorthWestBio DTP (BBSRC)	Led by University of Glasgow, University of Strathclyde, Queen’s University Belfast and Lancaster University, in collaboration with the Moredun Research institute, the James Hutton Institute and IBioIC	A new programme supporting a cohort of 25 students in 2023. • £5 million 2023-2028, BB/X010902/1 Theme areas include: Animal Biology in Health and disease; Understanding Pathogens, from Molecules to Phenotypes; Plant Health, Resilience, Yield and Growth; and Underpinning Bioscience
IBioIC collaborative training programme (CTP*)*	Studentships led by an IBioIC academic partner or N8 Research Institution in collaboration with industry.	IBioIC support industrially relevant PhD Projects that bring biotechnology closer to industrialisation. So far has supported 13 cohorts of students. Theme areas include: Industrial Biotechnology and Bioenergy (including Sustainable Feedstocks, Integrated Bioprocessing and Downstream

		Processing) and World Class Underpinning Bioscience (Synthetic Biology and Bio-catalysis and Biotransformation).
EaStChem	Joint Chemistry research school of the University of St Andrew's and University of Edinburgh formed in 2004.	Funded by the universities, the Scottish Funding council for Further and Higher Education and the Office of Science and Technology. Chemical biology is one of the six key research themes, which can link with EngBio.
EPSRC Centre's for Doctoral training	65 CDTs were funded by EPSRC in 2023 across the UK in inter-disciplinary topics. Of these, 3 EngBio-relevant or EngBio-adjacent CDTs were funded at Scottish HEIs	• University of Glasgow (EPSRC & SFI) CDT in Engineered Tissues for Discovery, Industry and Medicine (£7 million 2019-2027) • Heriot-Watt University CDT in Green Industrial Futures (£10 million 2024-2032) • University of Strathclyde CDT in Cyber-physical systems for Medicines development and Manufacturing (£10 million, 2024-2032)
Wellcome funded PhD programmes	4-year programmes at several Scottish universities	• One Health Models of Disease: Science, Ethics and Society; Hosts, pathogens and global health; Integrative Cell mechanisms; Translational neuroscience (University of Edinburgh) • Cellular regulation; Protein modification; Infection and immunity; Drug discovery and translation (University of Dundee) • Integrative infection biology (University of Glasgow)

Table 5 Selection of Postgraduate courses relevant to EngBio offered at Scottish HEIs

MSc course title	**Institution (s)**
Biotechnology	Edinburgh, Glasgow, UWS
Biotechnology and Management	Glasgow
Biochemistry and Biotechnology	Glasgow
Industrial Biotechnology	Glasgow (with Biocon), Strathclyde
Medical Biotechnology	Edinburgh Napier
Biotechnology and Bioinformatics	Aberdeen
Biomedical engineering/technology	Dundee, Glasgow, Robert Gordon
Stem Cell Engineering for Regenerative Medicine	Glasgow
Animal breeding and genetics	Edinburgh
Medical genetics and Genomics	Glasgow
Molecular Genetics	Glasgow
Plant Science *(mentions SynBio)*	Glasgow
(Molecular) microbiology	Strathclyde, Aberdeen, Glasgow
Bioinformatics and mathematical approaches	
Bioinformatics	Edinburgh, Glasgow
Systems Biology	Glasgow
Data Science for Biology/Biological Data Science	Edinburgh, Dundee
Quantitative Genetics and Genome analysis	Edinburgh
Mathematical Biology	St Andrews
Analytical Science for the Biosciences industries	Heriot-Watt
Biochemistry and biomedical	
Advanced biochemistry	Strathclyde
Advanced Pharmaceutical manufacturing	Strathclyde
(Advanced) Biomedical Sciences	Edinburgh Napier, Strathclyde, Abertay, Glasgow, UWS
Biomedical Sciences with Industrial Practise	Abertay
Biomedical and molecular sciences with business/management/entrepreneurship/marketing	Dundee
Chemical Biology	Glasgow

Digital Cancer Technologies	Glasgow
Drug Design and Biomedical Science	Edinburgh Napier
Drug discovery and Translational Biology	Edinburgh
Drug discovery and Development	Aberdeen
Immunology and immunotherapy; Immunology and inflammatory disease; Advanced Immunology	Aberdeen; Glasgow; Strathclyde
Molecular medicine	Aberdeen
Medicinal and Biological Chemistry	Edinburgh
Precision medicine	Aberdeen
Other	
Management of Bioeconomy, Innovation and Governance	Edinburgh
Science and Technology studies	Edinburgh
Laboratory Management	Glasgow

Table 6 Further education opportunities in Scotland

Further education option	**SCQF level (if available)**	**Offered by**	**Details**
Higher National Diploma (HND) Industrial Biotechnology	8	IBioIC at Forth Valley College and Glasgow Clyde college	Aims to prepare students for employment in careers such as Science Laboratory Technician; Research Scientist; Process Operator and Production Scientist, or for progression to degree-level further study.
National Qualification (NQ) and Higher National Certificate (HNC) courses	4-7	New College Lanarkshire	Courses available in: Bioscience, Animal Biology and Science, Engineering & Manufacturing engineering
SWAP courses	4-7	New College Lanarkshire	Specifically for change of careers, with 37 week courses for access to “Chemical and Life Sciences”, “Health Sciences” and “Zoology, Marine Biology and Environmental Science”
Foundation apprenticeships	6	At school	Scientific Technologies apprenticeship includes a work placement and prepares students for jobs as lab technicians and similar. Equivalent to a SQA Higher, contributes to 3 units of the Modern Apprenticeship in Life Science and Related Science Industries.
Modern Apprenticeships	5-7	Within industry	1-4 years of learning in work Apprenticeships available specialising in: Life Science and Related Science Industries (technical), Science Industries Quality Technician, Scientific, Technical and Formulation Processing, Engineering (Manufacturing), Process Manufacturing, Industrial Applications etc.

Manufacturing Skills Academy	N/A	National Manufacturing Institute Scotland	Offers advanced manufacturing training and development opportunities for individuals at all levels of their career.
RESILIENCE Medicines manufacturing programme	N/A	RESILIENCE Medicines manufacturing centre of excellence at Heriot-Watt University	Creates and delivers training courses for the UK medicines manufacturing community, including industry, NHS and education providers, engaging with end users to ensure training adapts to keep pace with evolving technology and sector priorities, such as digital technology, artificial intelligence, data analysis and environmental sustainability.
Advanced therapies skills training network (ATSTN)		Co-ordinated by Cell and Gene therapy catapult RoslinCT training academy & Edinburgh Napier University	The ATSTN includes three strands: ATSTN: Online Training Platform, three UK national Training Centres and a career converter, funded by the Department for Business, Energy and Industrial strategy through UKRI to help drive development of opportunities emerging in vaccine manufacturing, cell and gene therapy. In Scotland, the Network's delivery is being led by **RoslinCT** – a cell and gene therapy/ATMP Contract Development and Manufacturing Organization (CDMO) – via the RoslinCT Training Academy and The School of Applied Sciences at Edinburgh Napier University. Other delivery partners are North Ayrshire College, IBioIC, Skills Development Scotland, Scottish Universities Life Science Alliance and Scottish Enterprise.
IBioIC Continued Professional Development training courses	N/A	IBioIC (FlexBio facility)	Training courses in practical skills including fermentation, upstream and downstream processing, process costing and bioinformatics, offered at cost to participants from academia and industry.