

Life and Chemical Sciences Future Skills Needs

May 2026

Executive summary

Scotland's life sciences and chemical sciences are key industrial sectors, contributing around £4.7 billion and £2.6 billion respectively in GVA to the Scottish economy in 2025. The life sciences workforce was 22,700 in 2025 and is expected to grow to 25,900 by 2035. In contrast, the chemical sciences workforce was 9,200 in 2025 and expected to be the same size in 2035.

Skills needs in both sectors continue to be shaped by policies across Scotland and the UK, which in turn are influenced by global technological and regulatory trends. Scottish Government strategies such as the National Strategy for Economic Transformation and the National Innovation Strategy emphasise the importance of building a skilled workforce, exploiting new market opportunities, and scaling advanced manufacturing, industrial biotechnology and data-driven innovation. The Circular Economy Act and Just Transition Plan for Grangemouth reinforce the importance of climate-aligned industrial transformation and sustainability skills.

At a UK level, life science sector-specific plans highlight investment in innovation, regulation, advanced manufacturing, digitalisation and attracting talent in areas such as Artificial Intelligence (AI), robotics, and bioprocessing. For chemicals, UK industrial decarbonisation and net-zero policies are driving demand for skills in carbon capture utilisation and storage (CCUS), hydrogen and green chemistry.

A persistent challenge affecting both sectors is the shortage of technicians and mid-career specialists, alongside the need for multidisciplinary capabilities that blend science, digital, engineering and regulatory competencies.

Scotland has distinct opportunities to grow in areas aligned to national and UK strengths and global demand:

- advanced therapy and digitalised medicines manufacturing supported by the Medicines Manufacturing Innovation Centre and Continuous Manufacturing and Advanced Crystallisation facilities
- engineering biology and bio-based chemicals building on capabilities within the Industrial Biotechnology Innovation Centre and several university bio-foundries
- decarbonisation and CCUS developments at Grangemouth requiring reskilling/upskilling of existing workforce
- digital health and AI in medical technologies, supported by NHS data assets and regulatory innovation
- clinical trial delivery and market access expertise leveraging integrated health infrastructure
- automation and advanced manufacturing across supply chains
- circular economy specialisms in Medical Technology focusing on reuse, recycling and sustainable design.

This study engaged with a range of stakeholders across industry, further and higher education and public agencies to understand skills supply and demand affecting both sectors.

It identified:

- the critical importance of digital, data and AI skills to Scottish companies now and in the future
- issues regarding a lack of technical and practical skills, as well as a lack of 'work-readiness', mainly in younger recruits
- a skills shortage of experienced people, particularly in regulatory and leadership roles
- the importance of early and sustained engagement with young people to demonstrate the range of career opportunities in the life and chemical sciences sectors
- a need to develop new skills and training approaches to reflect changing skills needs, and to ensure that the existing workforce continues to be upskilled
- a growing need to combine different skillsets across both technical and commercial competences
- the loss of international graduates from Scottish universities, impacting the skilled workforce.

A number of recommendations were identified as a result:

- strengthen STEM engagement at school level through engaging and supporting teachers and careers advisers to become more aware of the breadth of industry careers, thus helping to inform and influence early career decision making, and in turn expanding the workforce pipeline
- enhance practical and industry-readiness skills through work placements, internships, and apprenticeships
- develop modular content to both enhance existing further and higher education curricula and to provide continuing professional development to those in the workforce
- foster and encourage stronger industry-education partnerships based on coordinated national skills planning.

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Glossary

AI	Artificial Intelligence	MHRA	Medicines and Healthcare products Regulatory Agency
API	Active Pharmaceutical Ingredient	ML	Machine Learning
ATMP	Advanced Therapy Medicinal Products	MMIC	Medicines Manufacturing Innovation Centre
ATRm	Alternative Transitional Registration model	MSc	Master of Science
BSc	Bachelor of Science	NC	National Certificate
CCUS	Carbon Capture Utilisation and Storage	NHS	National Health Service
CMAC	Centre for Continuous Manufacturing and Advanced Crystallisation	NICE	National Institute for Health and Care Excellence
COSHH	Control of Substances Hazardous to Health	NMIS	National Manufacturing Institute Scotland
CPD	Continuous Professional Development	PAT	Process Analytical Technology
CPI	Centre for Process Innovation	PFAS	Perfluoroalkyl and Polyfluoroalkyl Substances
EHS	Environment, Health and Safety	QA	Quality Assurance
FA	Foundation Apprenticeship	QC	Quality Control
FE	Further Education	QP	Qualified Person
GA	Graduate Apprenticeship	REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
GLP	Good Laboratory Practice	RNA	Ribonucleic Acid
GMP	Good Manufacturing Practice	RTD	Research and Technology Development
GVA	Gross Value Added	SAF	Sustainable Aviation Fuel
HE	Higher Education	SCQF	Scottish Credit and Qualifications Framework
HEOR	Health Economics and Outcomes Research	SDS	Skills Development Scotland
HESA	Higher Education Statistics Agency	SFC	Scottish Funding Council
HNC	Higher National Certificate	SIC	Standard Industry Classification
HND	Higher National Diploma	SIP	Skills Investment Plan
IBioIC	Industrial Biotechnology Innovation Centre	SME	Small and Medium-sized Enterprise
ICT	Information and Communication Technology	SSA	Sector Skills Assessments
IT/OT	Information Technology and Operational Technology	STEM	Science, Technology, Engineering, and Mathematics
LCA	Life-Cycle Analysis	TQM	Total Quality Management
MA	Modern Apprenticeship	UKRI	UK Research and Innovation

1 Introduction

This study was commissioned to provide an update to the 2022 report “Growth Opportunities and Skills Requirements for the Life and Chemical Sciences Sectors”, recognising that there has been:

- a change in UK Government and the publication of both UK and Scottish Government policies and strategies for the sectors
- operational closures affecting several companies at Grangemouth, including Petroineos, INEOS’s ethanol plant, Versalis and Fujifilm Imaging Colourants, altogether impacting the chemical sciences sector in Scotland
- the emergence of Artificial Intelligence (AI) applications and their adoption in a range of sectors including life and chemical sciences
- new investment throughout Scotland including Freeports on the Forth and Cromarty Firths, and regional investment deals including the Falkirk Growth Deal and Glasgow City Region Innovation Zone.

The purpose of this study was to identify:

- Scottish and UK policy and strategies that are likely to have implications for the sectors and identify the skills implications
- the key sector, sub-sector or cross sector growth opportunities and skills needs over the next five to ten years

- skills challenges (including skills gaps, skills shortages, and labour shortages), facing the sectors, and any sub-sectors
- the supply provision and any gaps in the current training provision (encompassing the full pipeline) to meet future demand
- recommendations in response to the key findings.

This was achieved through a combination of desk research and stakeholder and industry engagement.

2 Overview of relevant strategies, policies and skills requirements

The life sciences and chemical sciences sectors make a significant contribution to Scotland's economy. The Life Sciences Strategy for Scotland 2025 Vision¹ set a target of £8 billion in turnover from the sector by 2025. This was surpassed in 2021 achieving £10.9 billion. The Life Sciences Strategy for Scotland was updated and published in 2025, with a new ten-year goal of reaching £25 billion turnover by 2035.² The strategy identifies a number of actions, to be delivered collaboratively across the public and private sectors, that will drive growth in life sciences:

- formation of a new industry-led **cluster development organisation** to coordinate and lead the life sciences sector in Scotland
- targeted support from enterprise agencies to ensure that companies have access to the necessary **infrastructure** to start and scale in Scotland
- support for **advanced manufacturing** to be embedded at the earliest stages of research and technology development (RTD)
- support better access to **investment** for companies looking to scale
- support the **commercialisation** of Scotland's RTD and raise the international profile of its research capabilities, thus encouraging foreign direct investment
- ensure that **skills and talent** pipelines can satisfy the needs of the growing life sciences sector

- enhance opportunities within the life sciences sector through support and development of **data, digital and AI** tools and services
- embedding **sustainability** in life sciences manufacturing and RTD
- working with the **UK Government** and UK programmes to deliver synergies
- position **NHS Scotland** as a global centre for clinical trials and improve connection to industry via regional innovation hubs.

In terms of Gross Value Added (GVA), in 2025 life sciences was estimated to be around £4.7 billion (2.8% of total Scottish GVA), demonstrating an average growth rate of 1.6% per annum between 2015 and 2025.³

This growth has been underpinned by significant infrastructure investment, including:

- £88 million of public and private investment for the Medicines Manufacturing Innovation Centre (**MMIC**)⁴ in Renfrewshire
- £40 million for **ONE BioHub**⁵ in Aberdeen
- £87.5 million funding from a combination of the UKRI's Strength in Places Fund, industry investment and funding from the Glasgow City Region Deal for a **Living Laboratory for Precision Medicine**⁶ at the University of Glasgow

- £25 million for the **Tayside Biomedical Cluster**⁷
- £14 million investment at the University of Edinburgh in a new **Engineering Biology Mission Hub** for the development of novel gene therapies.⁸

There is strong collaboration between academia, industry, the health service and government to foster innovation, particularly in cell and gene therapy, RNA therapeutics, and digital health. The life sciences sector is also closely aligned with national priorities around healthy ageing and personalised medicine.

Chemical Sciences GVA was estimated to be around £2.6 billion (or 1.5% of total Scottish GVA) in 2025, an average growth rate of 2.5% per annum between 2015 and 2025.⁹ In contrast to life sciences, chemical sciences has faced more challenging structural changes. While the sector remains highly productive – more than five times the Scottish average – it has seen consolidation, particularly around Grangemouth, with growth concentrated in smaller, R&D-led firms. The main drivers have been to move from petrochemical feedstocks to sustainable and bio-based ones. This has been supported by significant infrastructure investments such as the Industrial Biotechnology Innovation Centre (IBioIC) at the University of Strathclyde, a **Carbon Capture and Utilisation (CCU) demonstration facility** and **Bioeconomy Accelerator Pilot Plant**, to exploit waste feedstocks for the production of sustainable materials, both of which are planned as part of the **£100M Falkirk Growth Deal**.¹⁰

2.1 Life and chemical sciences strategy and policy in Scotland and the UK

For the life sciences and chemical sciences sectors to remain globally competitive and productive, Scotland will require a highly skilled and adaptable workforce. The skills context is shaped by Scottish, UK and international strategies and by wider structural and technological drivers of change.

The Skills Investment Plan (SIP) for Life and Chemical Sciences¹¹ set out key drivers (innovation, regulation, circular economy, Grangemouth) and priority skills themes (engineering, digital/data, regulatory/quality, biomanufacturing, cross-disciplinary skills). These drivers and themes are still very relevant but there are new Scottish and UK-wide strategies, net-zero legislation and regulatory reform to be considered.

2.1.1 Strategies and policies

Scotland-level policies and strategies:

- The **National Strategy for Economic Transformation**¹² sets out a 10-year plan centred on a wellbeing economy with programmes on Skilled Workforce, New Market Opportunities and Productive Businesses & Regions.
- The **National Innovation Strategy 2023–2033**¹³ places health and life sciences, industrial biotechnology, advanced manufacturing and data/digital among priority clusters for growth and commercialisation.
- **Circular Economy (Scotland) Act 2024**¹⁴ introduces duties to publish a circular economy strategy and targets. It will have an impact on the demand for skills in domains like resource efficiency, product design for reuse, and Extended Producer Liability/compliance.

- Scotland's first place-based **Just Transition Plan for the Grangemouth industrial cluster** was published in 2025¹⁵, with 21 actions to decarbonise the cluster while supporting jobs and inward investment. There is forecast to be an increase in demand for skills in domains such as process decarbonisation, industrial biotechnology, hydrogen and sustainable aviation fuel (SAF), carbon capture utilisation and storage (CCUS), and environmental management (particularly in the Forth Valley region).
- The **Life Sciences Strategy for Scotland 2035 Vision**¹⁶ was published in November 2025 and sets out the roadmap for Scotland's life sciences sector to become a £25 billion industry by 2035. It connects business, industry, research and NHS Scotland to achieve this ambition and describes a number of thematic actions which will need to be delivered for the vision to be realised. One of these themes is skills and talent, including updates to apprenticeship frameworks, expanding work-based learning and better aligning workforce development with industry needs. It also recognises the importance of digital, data and AI, with the AI Scotland¹⁷ programme established to support business adoption of AI; and the potential for NHS Scotland to be developed as a global centre for commercial clinical trials.

UK policies and strategies influencing Scotland's skills demand:

- The UK Government's new 10-year **Life Sciences Sector Plan**¹⁸ includes several actions to support sector growth, such as actions to accelerate clinical trials, improve market access, cut red tape, and mobilise NHS data. It is anticipated that this will raise demand for clinical research operations, regulatory/ Quality Assurance (QA), health data, biostatistics and artificial intelligence (AI) and machine learning (ML) skills, as these will be required to address the six headline actions of:
 - 1) realising a Health Data Research Service
 - 2) reducing (clinical) trial set up times to under 150 days
 - 3) backing (life sciences) manufacturing with a dedicated fund
 - 4) streamlining regulation and market access
 - 5) introducing low-friction procurement for the NHS, and
 - 6) partnering with industry to drive growth and innovation.
- **Science and Technology Framework**¹⁹ sets cross-government levers and priorities that cascade into sector plans (including life sciences and advanced manufacturing), emphasising talent pipelines in AI, engineering biology, and data-intensive science.
- The **Advanced Manufacturing Plan**²⁰ and Advanced Manufacturing Sector Plan²¹ set out plans to support clean/digital manufacturing and improve supply-chain resilience, amongst many other initiatives. This reinforces the need for skills in automation, digital production, and process optimisation.
- **National Vision for Engineering Biology**²² sets out the UK government ambitions for the direction in which government investment, policy and regulatory reform will deliver through the various strands. In terms of skills, there will be growing demand for capabilities in synthetic (engineering) biology and bioprocessing, in turn signalling growth in fermentation, downstream processing, Quality Control (QC), and biofoundry operations.
- The **Medical Technology Strategy**²³ sets out the government's plan to support the UK Medical Technology (medtech) sector. A key objective of the strategy is the growth of domestic manufacturing of medtech/diagnostics. This will increase demand for skills in the domains of regulatory affairs and development of software/ firmware.

- The policy paper **Powering Up Britain**²⁴ sets out how the government will enhance the UK's energy security and seize the economic opportunities of the transition to net zero. Plans include maintaining momentum behind low-carbon fuels, hydrogen, CCUS and electrification, which could result in greater demand for chemical/process engineering, environment health and safety (EHS), and lifecycle assessment (LCA) capabilities.

2.1.2 Drivers of change and skills implications

The skills needs of Scotland's life sciences and chemical sciences sectors are being shaped by a rapidly evolving set of drivers that extend well beyond the boundaries of individual companies or subsectors. Since the publication of the SIP in 2018, the operating environment has been transformed by regulatory reform, the acceleration of digital and data-driven technologies, global supply chain disruptions, and the imperative to transition to net zero. At the same time, new opportunities have emerged in advanced therapies, engineering biology, and digital health.

Understanding these drivers is critical to anticipating how demand for skills will change over the next decade. Some drivers, such as regulation, are well-established but have taken on new forms (e.g. AI regulation, chemicals compliance under UK REACH). Others, such as the net zero transition and engineering biology, represent more recent and fast-growing sources of skills demand. Collectively, they point towards **an increasing need for interdisciplinary knowledge, the blending of scientific and digital capabilities, and a stronger pipeline of technician and regulatory professionals.**

Table 1 summarises the key strategic and policy driven changes shaping the future of life sciences and chemical sciences in Scotland and highlights the range of skills that will, potentially, be required to respond to these changes. Current skills gaps and shortages are described in section 2.2.



Table 1 – Key strategies and policies that are driving change

Driver (2025)	What is changing	Skills requirements
Regulations and standards	Regulatory frameworks are evolving quickly across medicines, devices and chemicals. The MHRA's new International Recognition Procedure (from January 2024) allows UK approvals to rely on trusted regulators, while reforms to software and AI as a medical device introduce stricter evidence and lifecycle controls. In parallel, the UK Government is implementing an Alternative Transitional Registration model (ATRm) for UK REACH, with extended deadlines now under consultation, and exporters remain affected by the EU's Chemicals Strategy for Sustainability and PFAS restrictions.	There will be a requirement for the following skills: ■ regulatory affairs ■ quality assurance ■ toxicology ■ pharmacovigilance ■ post-market surveillance ■ data management ■ regulatory science
Net zero and the circular economy	The drive towards net zero and resource efficiency is accelerating. The Circular Economy (Scotland) Act 2024 creates new duties on national targets and waste reduction, while the Grangemouth Industrial Just Transition Plan (2025) outlines 21 actions to decarbonise Scotland's largest chemicals hub. UK-wide strategies such as Powering Up Britain further reinforce the push for CCUS, hydrogen and clean manufacturing.	There will be a requirement for the following skills: ■ process engineering ■ decarbonisation ■ hydrogen ■ CCUS operations ■ green chemistry ■ life cycle analysis ■ environmental compliance
Digitalisation and AI	Digital technologies are transforming discovery, development and manufacturing. The UK's Science and Technology Framework and the Life Sciences Sector Plan highlight AI in clinical trials, NHS data access and digital production. Also, the importance of embedding automation, robotics and data-driven quality into manufacturing systems is highlighted in the Advanced Manufacturing Plan.	There will be a requirement for the following skills: ■ artificial intelligence/machine learning ■ bioinformatics ■ data engineering ■ automation and robotics ■ digital quality systems ■ cyber-secure manufacturing ■ IT/OT (integration of information technology and operational technology)

Table 1 – Key strategies and policies that are driving change continued

Driver (2025)	What is changing	Skills requirements
Engineering biology and advanced therapies	Engineering biology is a national priority, as highlighted in the UK's Vision for Engineering Biology. This aligns with Scotland's established strengths in industrial biotechnology and emerging opportunities in advanced therapy manufacturing.	There will be a requirement for the following skills: ■ bioprocess engineers ■ fermentation and downstream specialists ■ GMP (Good Manufacturing Practice) technicians ■ quality control analysts ■ biofoundry operatives ■ specialists in biosecurity-by-design.
Market access and NHS adoption	Policy is increasingly orientated towards shortening the path from licensing to patient access. Joint MHRA–NICE working, the proposed “innovator passport” and health system reforms all signal a stronger emphasis on evidence generation, post-market monitoring and rapid NHS adoption of new products.	There will be a requirement for the following skills: ■ market access ■ health economics and outcomes research (HEOR) ■ medical affairs ■ human-factors engineering ■ post-market surveillance Together, these will support safe and effective uptake.

2.1.3 Opportunities for Scotland

The analysis of drivers of change highlights that Scotland's life sciences and chemical sciences sectors are being reshaped by regulatory reform, digitalisation, the transition to net zero, and the emergence of new technologies such as engineering biology and advanced therapies. While these trends create pressures on skills supply, they also open up clear opportunities for Scotland to strengthen its position as a globally competitive and resilient hub.

Building on the country's existing assets, such as world-class innovation centres, strong university-industry partnerships, and established industrial clusters, there is scope to target growth niches where Scotland can lead internationally, while ensuring local workforces are equipped for industrial transitions such as those underway at Grangemouth. The opportunities outlined below translate the drivers into practical areas of focus for the next five years, identifying where skills investment could have the greatest impact on sector competitiveness and inclusive growth.

Advanced therapies and continuous medicines manufacturing

Scotland is well placed to take advantage of the global shift towards advanced therapies and new ways of producing medicines. Facilities such as CMAC (Continuous Manufacturing and Advanced Crystallisation) at the University of Strathclyde and CPI's Medicines Manufacturing Innovation Centre (MMIC) are already demonstrating leadership in continuous processing and digitalised quality systems. As industry and the NHS look for faster, more efficient routes to bring treatments to patients, there will be growing demand for people who can operate GMP bioprocesses, apply digital quality management, and manage automated manufacturing environments.

Engineering biology for medicines, materials and chemicals

The UK's new focus on engineering biology creates an opportunity for Scotland to build on its industrial biotechnology strengths. With the IBioIC and university biofoundries providing research and scale-up capabilities, companies are increasingly seeking to develop new therapies and diagnostics or exploring how to replace fossil-based inputs with renewable feedstocks. This will require technicians and scientists trained in fermentation, downstream recovery, analytical quality control, and bioprocess scale-up, alongside specialists who can design safe and sustainable products from the outset.

Sustainable Just Transition at Grangemouth

The publication of Scotland's first Just Transition Plan for Grangemouth marks a turning point for the country's largest industrial cluster. The plan sets out a pathway towards cleaner fuels, hydrogen production, CCUS and safer chemical formulations. Delivering this transition will demand a new generation of process engineers, instrumentation specialists and environmental scientists, as well as upskilling for the existing workforce to work with hydrogen, electrified plant systems and advanced monitoring technologies.

Digital health, diagnostics and AI in medical devices

Healthcare innovation is increasingly driven by data and digital technology. Scotland's strength in digital health, combined with UK regulatory reforms such as the MHRA's "AI Airlock", creates opportunities to develop and adopt new diagnostics and software-based medical devices more rapidly. To take advantage of this, the sector will need data scientists, software engineers and regulatory specialists who understand both health data and device safety, alongside professionals skilled in human-factors design and post-market monitoring.

Health data, clinical trials and market access

Scotland's integrated health system and strong research base position it well to deliver faster and more effective clinical trials. UK and Scottish strategies both stress the importance of getting innovations into the NHS more quickly, supported by better use of patient data. This opens opportunities for Scotland to attract more clinical trials and investments, provided the workforce has the right mix of skills in the operation and delivery of trials, biostatistics, data management, health economics, and market access expertise.

Advanced and digital manufacturing across supply chains

Manufacturing across both the life sciences and chemical sciences is becoming more digital and more automated. The UK's Advanced Manufacturing Plan highlights the importance of robotics, data-driven quality assurance and supply-chain resilience. The National Manufacturing Institute for Scotland (NMIS) provides the infrastructure to support this shift, but a skilled workforce is essential. There will be increasing demand for technicians and engineers who can integrate automation, manage industrial data flows, and ensure quality in digitally connected production systems.

Circular economy in MedTech

New legislation in Scotland and Europe²⁵ is accelerating the move towards a circular economy, and this is particularly relevant to medical devices and diagnostics, where waste reduction, reuse, and recycling are rising priorities. Companies will be required to design products with end-of-life recovery in mind, adopt safer and more sustainable materials, and comply with extended producer responsibility requirements. This will create demand for engineers and designers skilled in sustainable product development, specialists in lifecycle assessment and materials substitution, and regulatory experts who understand compliance frameworks for both environmental standards and patient safety.

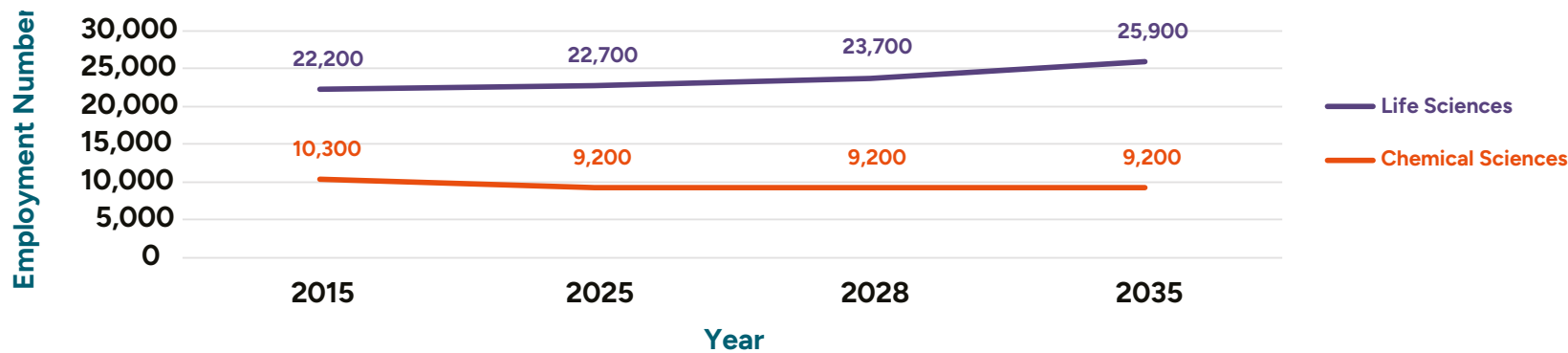
Building Scotland's regulatory science and quality base

Across all parts of life sciences and chemical sciences, regulatory compliance and quality assurance are becoming more demanding and more central to competitiveness. With new approval pathways, evolving chemical regulations and greater use of real-world evidence, Scotland needs to expand its pool of regulatory and quality professionals. This means creating clearer career pathways into these areas (from technician-level apprenticeships through to advanced CPD) so that companies of all sizes can meet both UK and international standards.

2.2 Skills demand analysis for the life and chemical sciences sector

Scotland's life sciences and chemical sciences workforces have exhibited different dynamics in the last ten years. While life sciences has grown from around 22,200 in 2015 to reach 22,700 in 2025³, chemical sciences has declined from around 10,300 to 9,200 over the same period.⁹ Looking ahead, the life sciences workforce is expected to grow to 25,900 in 2035 due to both expansion and replacement demand³, while the chemical sciences workforce is expected to remain broadly the same at 9,200 due to replacement demand⁹ (Figure 1).

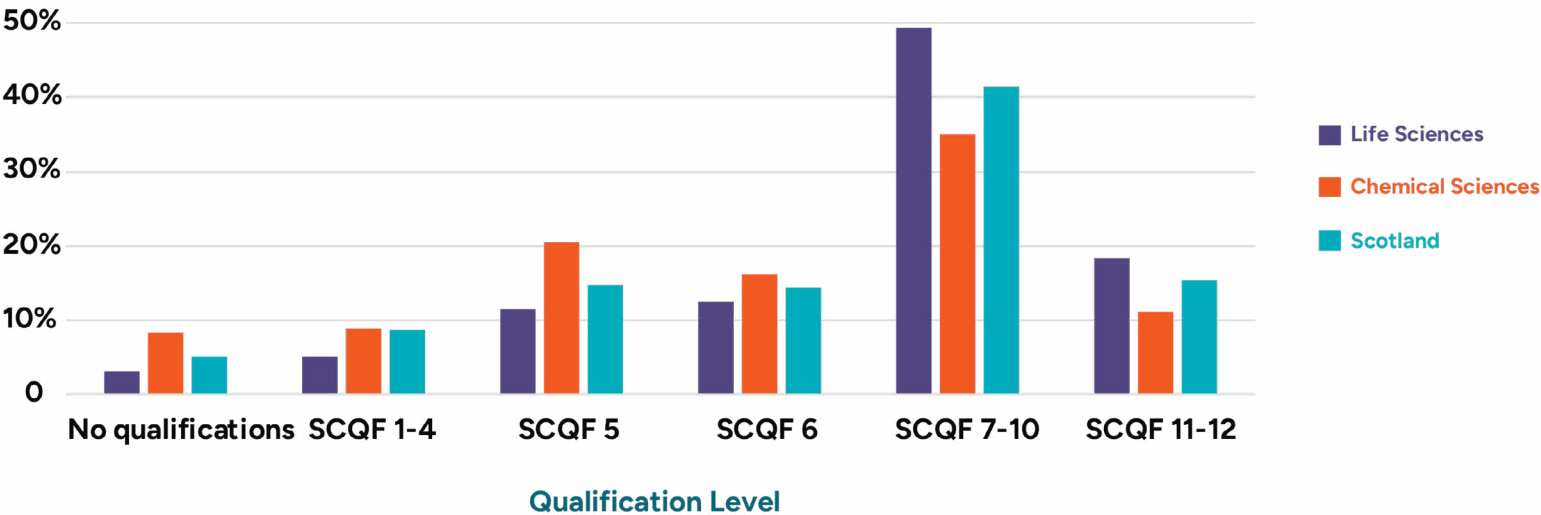
Figure 1. Employment forecasts in the life sciences and chemical sciences sectors



Data from the Sector Skills Assessments for Life Sciences³ and Chemical Sciences.⁹

Qualification structures of the sectors also differ. In 2025 a higher proportion of the life sciences workforce was educated to SCQF L7 and above (68%) than the rest of Scotland (57%) whereas for chemical sciences, a lower proportion was educated to SCQF L7 and above (46%) than the rest of the Scottish workforce, and a higher proportion was educated to SCQF L5 and L6^{3,9} (Figure 2).

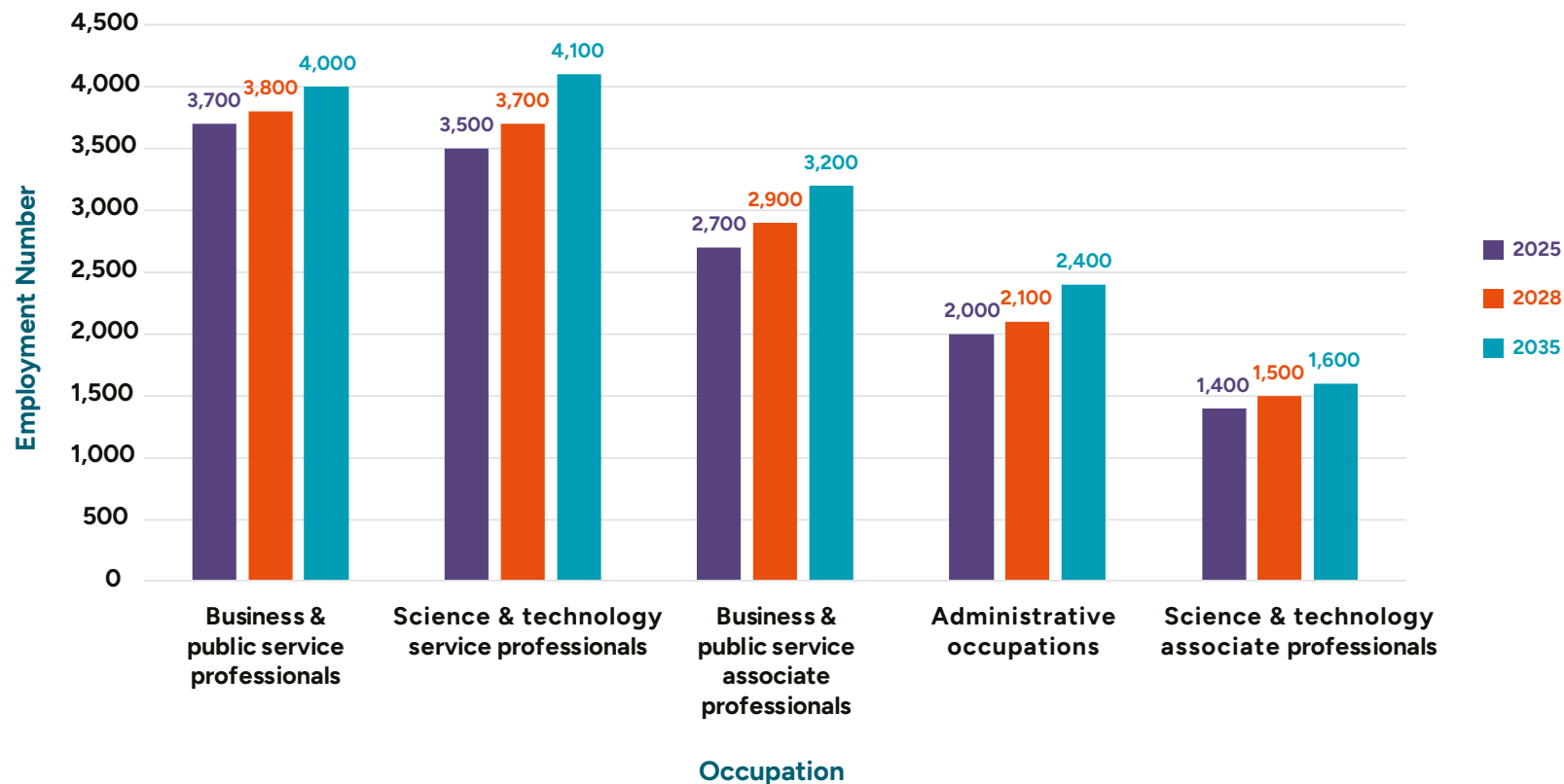
Figure 2. Workforce qualifications in the life sciences and chemical sciences sectors in 2025



Data from the Sector Skills Assessments for Life Sciences³ and Chemical Sciences.⁹

In life sciences, the largest occupation groups are business & public service professionals (3,700 people or 16.3% of total employment), science & technology professionals (3,500 or 15.4%) and business & public service associate professionals (2,700 or 11.9%).³ These are expected to remain the top three occupations in 2035, with science and technology professionals at 4,100, business & public service professionals at 4,000 and business & public service associate professionals at 3,200 (Figure 3).

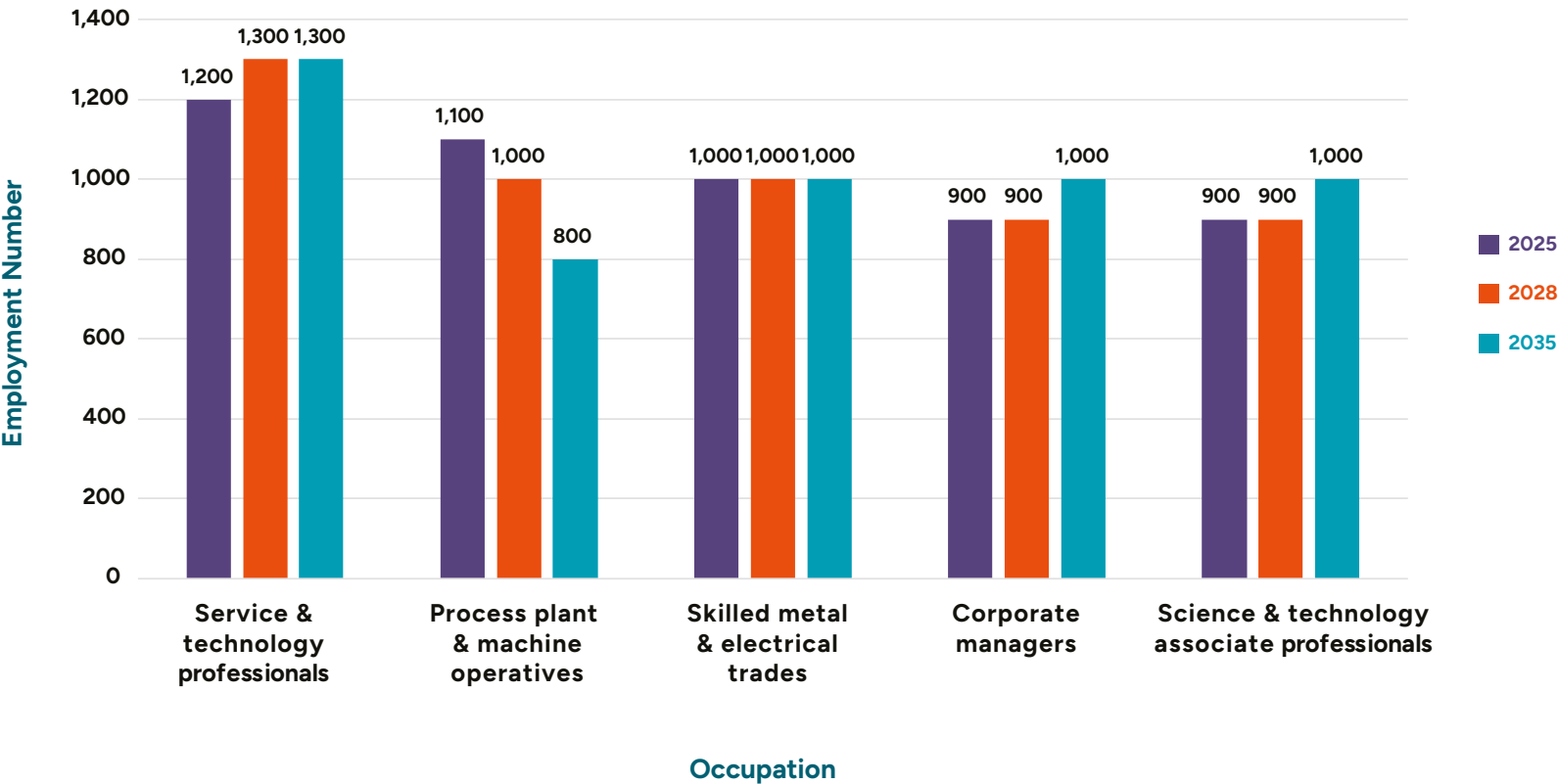
Figure 3. Life sciences sector employment numbers for largest occupation groups 2025-2028



Data from the Sector Skills Assessment for Life Sciences.³

For chemical sciences, the current largest occupation groups are science & technology professionals (1,200 or 13.0%), process, plant & machine operatives (1,100 or 12.0%), and skilled metal & electrical trades (1,000 or 10.9%). In 2035 the expectation is that the top three occupation groups will be science and technology professionals at 1,300 followed by corporate managers at 1,000, science & technology associate professionals at 1,000 and skilled metal & electrical trades at 1,000. Operative numbers are expected to reduce by 300 over the period⁹ (Figure 4).

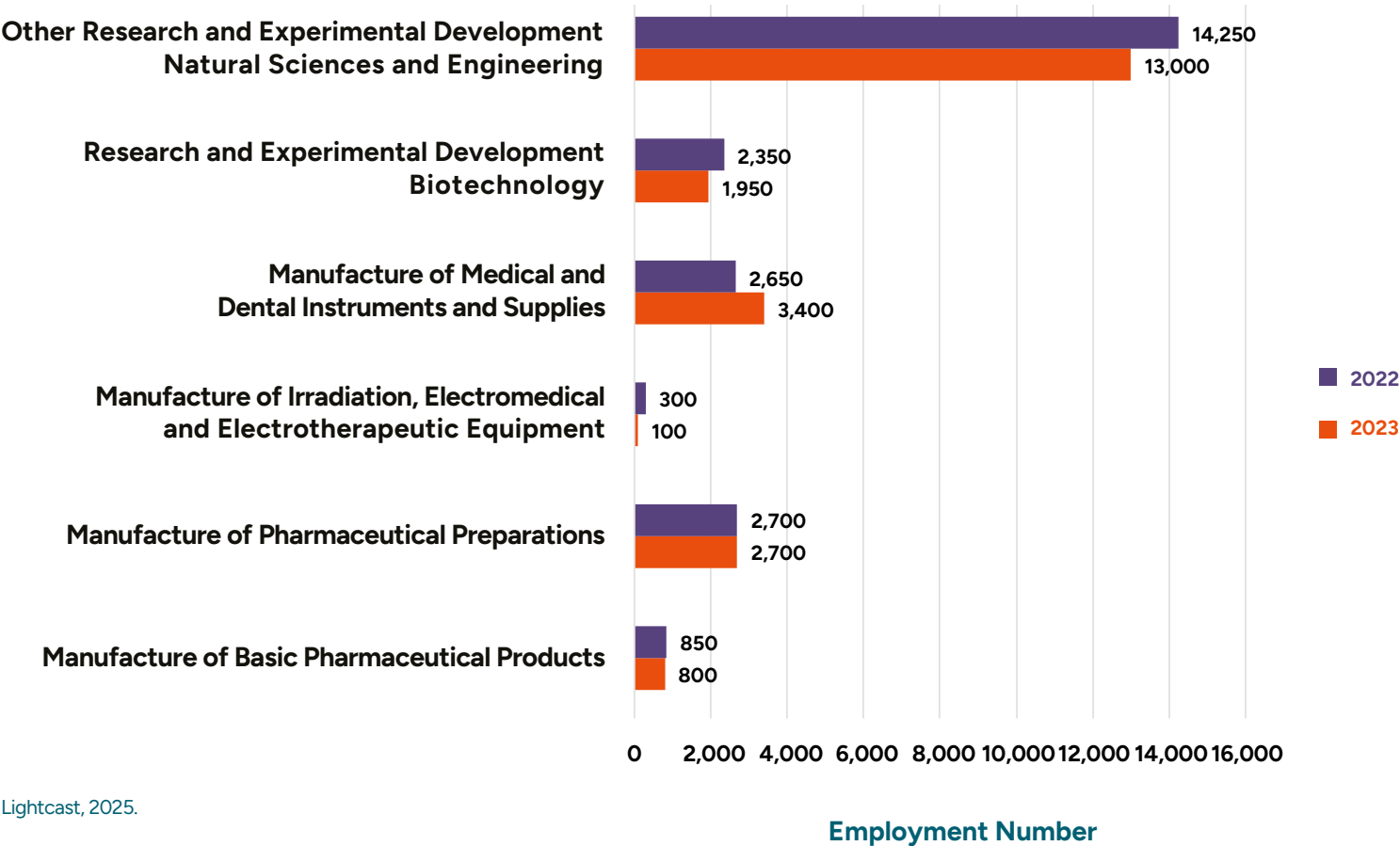
Figure 4. Chemical sciences sector employment numbers for largest occupation groups 2025-2028



Data from the Sector Skills Assessment for Chemical Sciences.⁹

Data from Lightcast shows how life sciences employment is spread across different industrial sectors (by SIC code), indicating that 59% of life sciences employment was in 'Other Research and Experimental Development on Natural Sciences and Engineering' (which includes research activities undertaken at universities and other research institutions), 15.5% in 'Manufacture of Medical and Dental Instruments and Supplies' and 12.3% in 'Manufacture of Pharmaceutical Preparations' (Figure 5).

Figure 5. Life sciences employment in Scotland by SIC code



Lightcast, 2025.

2.2.1 Current skills issues

The life sciences and chemical sciences sectors face skills issues including skills gaps (where individuals within an organisation lack the necessary skills) and skills shortages (where there are not enough people in the wider workforce with particular skills).

Skills shortages impacting the sectors were identified as:

- **Engineering** – across the UK as a whole, there is a skills shortage of between 37,000 and 59,000 engineers each year.²⁶ This will continue to impact both sectors in terms of availability of process engineers, biomedical engineers and electrical, mechanical and electronics engineers that are necessary to install, operate and maintain increasingly complex and automated equipment upon which the sector's businesses depend.
- **Technicians** – across both sectors there are shortages of people that can provide technician roles, for operating and maintaining equipment, performing lab operations, and supporting quality control and assurance. Increasing the number of people undertaking apprenticeships and vocational qualifications could help address this skills shortage given the typical entry level nature of this occupation.²⁷

Skills gaps impacting the sectors were identified as:

- **Leadership** – remains an issue across many sectors, not least in life sciences and chemical sciences. However, the evolution of life sciences and chemical sciences and merging of different chemical and bio-based approaches with data and digital technology, while at the same time being cognisant of

wider societal concerns; makes this far more challenging than before. Multi-disciplinarity is increasing and global industry has highlighted the need for greater skills in strategic planning, stakeholder engagement and managing complex budgets.³² These skills gaps could be addressed through upskilling individuals.

- **Innovation** – closely tied with commercial leadership, both sectors increasingly require people that have the skills to effectively combine and integrate innovations across different disciplines to drive new product discovery, process development and commercial manufacturing, while at the same time addressing sustainability concerns.^{3,9,31} This skills gap could be addressed through upskilling individuals.
- **Manufacturing** of Advanced Therapy Medicinal Products (ATMPs), RNA, and Active Pharmaceutical Ingredients (APIs) will require skills in continuous manufacturing, Process Analytical Technology (PAT), automation, real-time monitoring, and advanced process control.^{28,29} These skills gaps will need to be filled through engagement of companies with equipment vendors and with skills providers.
- **Total Quality Management (TQM)** to deliver continuous improvement in products and processes across the whole organisation and ensure consistent quality, safety, efficacy, and regulatory compliance.^{28,29} This skills gap could be addressed through upskilling individuals.
- **Digital skills** – ranging from basic skills including proficiency with Microsoft Office and similar applications, to an increasing need for staff to be skilled in software packages bespoke to certain sectors (e.g., for running and analysing clinical trials) and

for staff to have some programming ability to automate tasks.³⁰ These skills gaps could be addressed through additional training at educational establishments or within companies.

- **Meta skills** – including critical thinking, problem solving, and creative thinking are not specific to the life sciences or chemical sciences but have been highlighted as critical and in short supply, in recent employer surveys.³¹ These skills gaps are particularly prevalent in young people entering the workforce.

Roles where there are both skills shortages and skills gaps were identified as:

- **Bioinformatics and data science** – this is a global issue since individuals with such skills are required across many different sectors. Within life sciences and chemical sciences, individuals are needed that can integrate advanced analytical tools into process technology development, drug discovery and clinical trial design, amongst others, to enable more insightful analyses to be performed.^{31,32} There is both a shortage (insufficient numbers of data scientists being trained) and a gap, as there is a need to combine an understanding of life sciences and/or chemical sciences with data science and informatics.
- **Regulations** – the life sciences and chemical sciences sectors need a range of individuals with different types of regulatory experience, including for health and safety, environment and sustainability, medical devices and pharmaceuticals, and to understand and comply with differences in these regulations across different global regions.^{31,33} These are both skills shortages and gaps, as companies continually need to keep pace with the changing regulatory landscape in both the UK and abroad.

A common challenge facing employers is recruiting people with the required level of skills and/or qualifications, that also have job-specific knowledge and/or industry experience.³¹ While sustainability and meeting net zero emissions are seen as challenges to the sectors, employers do not perceive any specific skills gaps, rather they expect these to be addressed through changes of mindset, adapting existing knowledge and skills to new process technologies and equipment, and having a standardised approach to calculating carbon footprints.³¹ These skills will be implemented to reduce and recycle waste streams and enable the recovery of high value raw materials.

2.2.2 Future skills demands

Analyses indicate that both sectors will become more automated, employing AI, ML and big data to interrogate information, model outcomes and predict new solutions for a range of life sciences and chemical sciences opportunities that will in turn enhance and accelerate all aspects of businesses.^{31,33} These include:

- discovery of new pharmaceuticals and biologicals using new bioprocess technologies through, for example, intelligent design of (bio)molecules to deliver a desired biological effect, such as novel antibiotics³⁴
- development and validation of new biological and chemical process technologies, for example using waste feedstocks to produce sustainable feedstocks and materials³⁵
- development of new diagnostic and analytical tools, for example, for the detection of disease, or presence of chemical or biological contaminants³⁶

- enabling commercial scale manufacturing through modelling and understanding the different factors affecting (bio) chemical process efficiencies, for example, as developed and implemented by the University of Glasgow spinout, Chemify.³⁷

Much of this will be driven by expected trends towards personalised medicine, addressing global warming, and delivering more sustainable manufacturing solutions.³⁸

There is concern from industry that the current education system will not be able to deliver the skills required, particularly around incorporating digital, sustainability and regulatory compliance into core course work.³¹ As such there is expectation from industry that in the short-term continuous professional development (CPD) will be required, and in the medium-term, the education sector will need to incorporate relevant materials covering these non-core life sciences and chemical sciences subjects, to address future skills gaps.

Life sciences

In life sciences, demand remains strong for biological scientists and laboratory technicians with molecular/microbiology, pathology and analytical capabilities. Expectations for the future are towards automation, robotics, digital twins, data science and manufacturing informatics, reflecting the digitisation of discovery and GMP operations. Advanced therapy manufacturing and API processes are also priorities that will require process-systems, automation and quality roles to be developed for commercial scale processes.^{3,28,29,33}

Chemical sciences

In chemical sciences, demand centres on process engineers, chemical scientists and fermentation/industrial biotechnology specialists. These will need skills in green chemistry, regulatory affairs, GMP/quality, process safety and digital manufacturing (including data analytics, modelling, PAT). Feedback from employers suggests a greater reliance on apprenticeships, HNC/HND pipelines and CPD to sustain technician capacity.^{9,31}

Cross-sector skills demands

There are many skills that are sought after across different sectors, and in the future these will broadly be the same, although demand and specific combinations and competences are likely to change.³⁸

- **Digital and data skills** – AI, big data, machine learning, automation, coding, digital twins.
- **Sustainability and net zero** – green chemistry, LCA, resource efficiency, carbon reduction.
- **Leadership and management** – succession planning, entrepreneurial leadership, scaling innovation.
- **Regulatory and compliance** – health and safety, GMP, international alignment of regulatory frameworks.
- **Interdisciplinary STEM** – bioinformatics, bioengineering, process engineering, materials science.
- **Transferable skills** – problem-solving, creativity, communication, project management.

- **Technician development** – addressing shortages and ensuring long-term career progression.

Each will be essential to realise the full potential of the life sciences and chemical sciences sectors. While there will be significant demand globally for AI, ML and data analytics to support life sciences and healthcare, there will be equally strong demand from the financial services sector (which has a larger workforce and contribution to Scotland's GVA), as well as information and communication technologies (ICT), manufacturing, retail and e-commerce, transport and logistics, and the energy sectors.^{39,40} This will lead to competition amongst sectors to attract the best candidates.

2.2.3 Impacts on Scotland

Scotland's life sciences workforce is expanding strongly, with rising demand for advanced scientific and digital skills, while the chemical sciences sector is contracting in workforce size but evolving towards greener, digitally-enabled production. Both sectors face pressing skills shortages, particularly at technician and specialist levels.

Cross-cutting skills in digitalisation, sustainability, and regulation will be essential not only to these sectors but also to the wider Scottish economy. However, with Scotland's working age population expected to peak in 2027³⁸, immediate action will be required to both upskill and reskill people that are already in the workforce, while attracting new entrants, through active and early engagement

with schools and ensuring an effective system is in place to attract and retain international talent. Addressing these challenges will require coordinated action between industry, academia, and government to ensure that Scotland remains competitive in life sciences and chemical sciences in the years ahead.

2.3 Skills provision for life sciences and chemical sciences

Scotland has comprehensive life sciences and chemical sciences skills provision, with secondary school education feeding through to more than 300 relevant courses in 15 universities and 14 colleges.ⁱ

2.3.1 Secondary school attainment

Official statistics from the Scottish Government were reviewed to identify the number of secondary school pupils achieving National 5 (SCQF L5), Higher (SCQF L6) and Advanced Higher (SCQF L7) passes in biology, chemistry and human biology, as well as those attaining a Foundation Apprenticeship in Scientific Technologies (Table 2). The data shows a significant relative increase in student numbers in human biology National 5 (67%) and Foundation Apprenticeships (105%), whereas student numbers in Biology and Chemistry Advanced Highers decreased by 13% and 20%, respectively over the period 2019 to 2024.

ⁱ Analysis was undertaken to determine the level of provision in terms of courses on offer to public through skills providers' websites and associated numbers of enrolments based on the analysis of HESA data. The analysis included all courses relevant to the broader definition of biological and chemical sciences (biology, chemistry, biochemistry, biomedicine, microbiology etc). The analysis excluded health sciences (medical, nursing, mental health, sports, veterinary), agricultural and food sciences, geography and earth sciences, climate/environment sciences, physics and mathematical disciplines.

Table 2 – Number of secondary school leavers by highest SQA qualification in chemical sciences and life sciences⁴¹.

Subject	SQA Qualification	2019/20	2020/21	2021/22	2022/23	2023/24	Relative change over 2019-2024
Biology	National 5	8,221	9,428	9,949	9,104	9,435	15%
Biology	Higher	3,816	4,020	3,849	3,705	3,800	0%
Biology	Advanced Higher	1,826	2,035	1,985	1,872	1,589	-13%
Chemistry	National 5	4,506	4,873	5,961	5,043	5,049	12%
Chemistry	Higher	4,665	5,234	4,784	4,443	4,812	3%
Chemistry	Advanced Higher	1,944	1,862	1,852	1,821	1,551	-20%
Human Biology	National 5	574	561	806	776	960	67%
Human Biology	Higher	4,148	4,969	4,757	4,142	4,295	4%
Scientific Technologies	Foundation Apprenticeship	40	44	55	65	82	105%

Overall, these figures mean that around 28% of pupils achieving an SQA qualification obtained at least a National 5 in biology and 22% a National 5 in chemistry, while 11-12% achieve passes at Higher and around 3.5% at Advanced Higher (Table 3).

Table 3 – Percentage of all pupils that achieve SQA qualifications, at different levels, in biology, chemistry and human biology

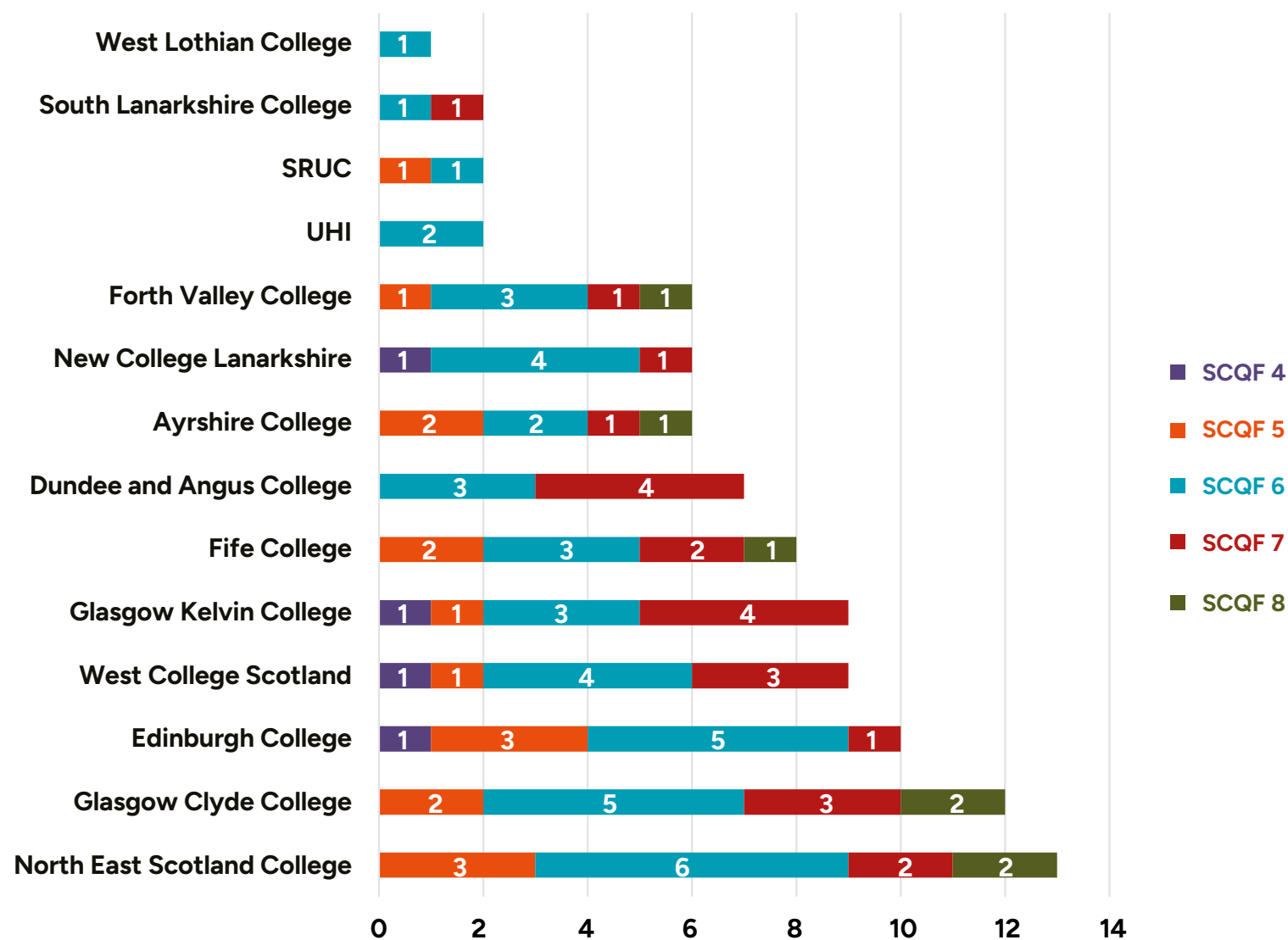
Subject	National 5	Higher	Advanced Higher
Biology	28.3%	10.8%	3.5%
Chemistry	22.2%	12.5%	3.4%
Human Biology	9.9%	8.5%	n.a.

Figures averaged over the period 2019-24.⁴¹

2.3.2 Colleges

Online research of all Scottish Further Education Institution websites identified 93 courses relevant to life sciences and chemical sciences skills provision in Scotland at a range of levels from SCQF 4-8 (Figure 6). North East Scotland College (13), Glasgow Clyde College (12), and Edinburgh College (10) have the highest numbers of courses relevant to the sectors.

Figure 6. Number of life sciences and chemical sciences courses in Scottish colleges



Academic year 2024/2025, derived from a review of Further Education Institution websites.

Colleges provide a comprehensive entry point into Scotland's life sciences and chemical sciences workforce, supporting both early-stage learners and upskilling needs. Provision demonstrates significant integration across biology, chemistry, physics, data, and applied technology; some examples of these course titles include:

- Applied Science (Chemistry/Biology) and Applied Science (Chemistry/Physics)
- Specialist HNC/HND pathways link directly with higher education programmes, such as Applied Science – Life Science (Glasgow University) and Applied Science – Pharmacology and Biomedical Science (Glasgow Caledonian University)
- Applied Sciences, Biomedical Science, Applied Biological Sciences, and Industrial Biotechnology, providing a strong route into specialist technical roles.

Data from the Scottish Funding Council (SFC) showed that life sciences and chemical sciences enrolments in Scottish colleges accounted for up to 1.5% of the total college enrolment (in 2022/2023 and 2023/2024).

The relative change in student enrolments in life sciences and chemical sciences has varied over the analysed period: the number of enrolments increased by 44% in 2022/2023 (to 5,080 from 3,525 in 2021/2022), following a reduction of 23% in 2023/2024 (from 5,080 to 3,920). The overall relative change in life sciences and chemical sciences enrolments in Scottish colleges over the analysed period is an increase of 30%.

The analysis showed that the number of students in chemical sciences has been relatively low over the timeframe of 2019/2020 to 2023/2024, ranging from 280 to 405 enrolments annually, with the largest proportion of skills provision taking place in Forth Valley College (Table 4). The relative number of enrolments increased by 45% in 2020/2021, followed by a 14% reduction in the following academic year. The overall relative change of enrolments in the analysed timeframe is an increase of 12%.

In comparison, life sciences courses had a substantially higher number of enrolments, from 2,670 in the academic year 2019/2020 and peaking at 4,730 in 2022/2023. The largest proportion of these enrolments were in Fife College, which had over half of all life sciences course enrolments in Scotland (54% in 2022/2023). This data is shown in Table 5. In the academic year 2022/2023, the relative number of enrolments sharply increased by 52%, followed by a reduction of 25% in the following academic year. The total relative change of enrolment numbers over the analysed timeframe is an increase of 33%. Contextually, the percentage change in total college enrolment numbers in 2023/2024 compared to the baseline year 2019/2020 is -11%.

Table 4. Number of chemical sciences course enrolments in Scottish colleges

College/Academic Year	2019/20	2020/21	2021/22	2022/23	2023/24
Ayrshire College	10	*	*	*	*
Dundee and Angus College	10	20	10	*	20
Edinburgh College	30	15	20	15	15
Forth Valley College	225	140	245	210	235
Glasgow Clyde College	25	20	25	25	30
Glasgow Kelvin College	*	20	30	40	35
Inverness College	*	5	5	5	5
Moray College	15	15	10	10	20
New College Lanarkshire	5	20	10	5	*
North East Scotland College	10	*	15	20	15
Perth College	8	*	*	*	*
West College Scotland	*	25	35	20	*
Total	335	280 (-16%)	405 (45%)	350 (-14%)	375 (7%)
Total college enrolments in Scotland	302,092	277,620 (-8%)	322,332 (16%)	329,920 (2%)	267,668 (-19%)

*Low number, not reported – data from the Scottish Funding Council. The figures in brackets denote year-on-year percentage change from the previous year.

Table 5 – Number of Life Sciences course enrolments in Scottish colleges

College/Academic Year	2019/20	2020/21	2021/22	2022/23	2023/24
Ayrshire College	125	140	125	105	95
Borders College	20	20	15	5	15
City of Glasgow College	20	*	*	*	*
Dumfries and Galloway College	70	*	35	85	30
Dundee and Angus College	85	55	70	50	45
Edinburgh College	220	270	260	160	140
Fife College	1,145	1,570	1,090	2,535	1,555
Forth Valley College	265	165	240	315	270
Glasgow Clyde College	195	250	240	245	250
Glasgow Kelvin College	*	210	210	210	210
Inverness College	5	5	5	5	*
Moray College	40	70	60	30	15
New College Lanarkshire	145	165	150	125	120
North East Scotland College	40	65	80	60	70
Orkney College	5	5	5	5	10
Perth College	5	*	*	*	*

*Low number, not reported – data from the Scottish Funding Council. The figures in brackets denote year-on-year percentage change from the previous year.

Table 5 – Number of Life Sciences course enrolments in Scottish colleges continued...

Shetland College	5	5	5	*	*
Shetland College of Further Education	*	*	*	5	5
South Lanarkshire College	*	15	15	10	*
West College Scotland	245	290	485	720	670
West Lothian College	35	15	30	60	45
Total	2,670	3,315 (24%)	3,120 (-6%)	4,730 (52%)	3,545 (-25%)
Total college enrolments in Scotland	302,092	277,620 (-8%)	322,332 (16%)	329,920 (2%)	267,668 (-19%)

*Low number, not reported – data from the Scottish Funding Council. The figures in brackets denote year-on-year percentage change from the previous year.

There is one Foundation Apprenticeshipⁱⁱ and five Modern Apprenticeships (MA)ⁱⁱⁱ relevant to life sciences and chemical sciences skills provision. This small but growing ecosystem of applied skills provision in life sciences and chemical sciences suggests that the emphasis on practical skills is growing. Table 6 illustrates that the majority of MA enrolments are in process manufacturing, followed by life science and related science Industries (data from the MA statistics published by Skills Development Scotland on a quarterly basis). The new Science Industries Quality Technician modern apprenticeship was launched at the end of 2024.

Table 6 – Q4 data for Modern Apprentices in training by Framework

Framework	2019/20	2020/21	2021/22	2022/23	2023/24
Life Science and Related Science Industries	54	64	66	62	60
Life Science and Related Science Industries Technical Apprenticeship	*	*	*	*	*
Process Manufacturing	141	144	144	174	168
Scientific, Technical and Formulation Processing	0	10	6	7	6
Science Industries Quality Technician	N/A	N/A	N/A	N/A	N/A

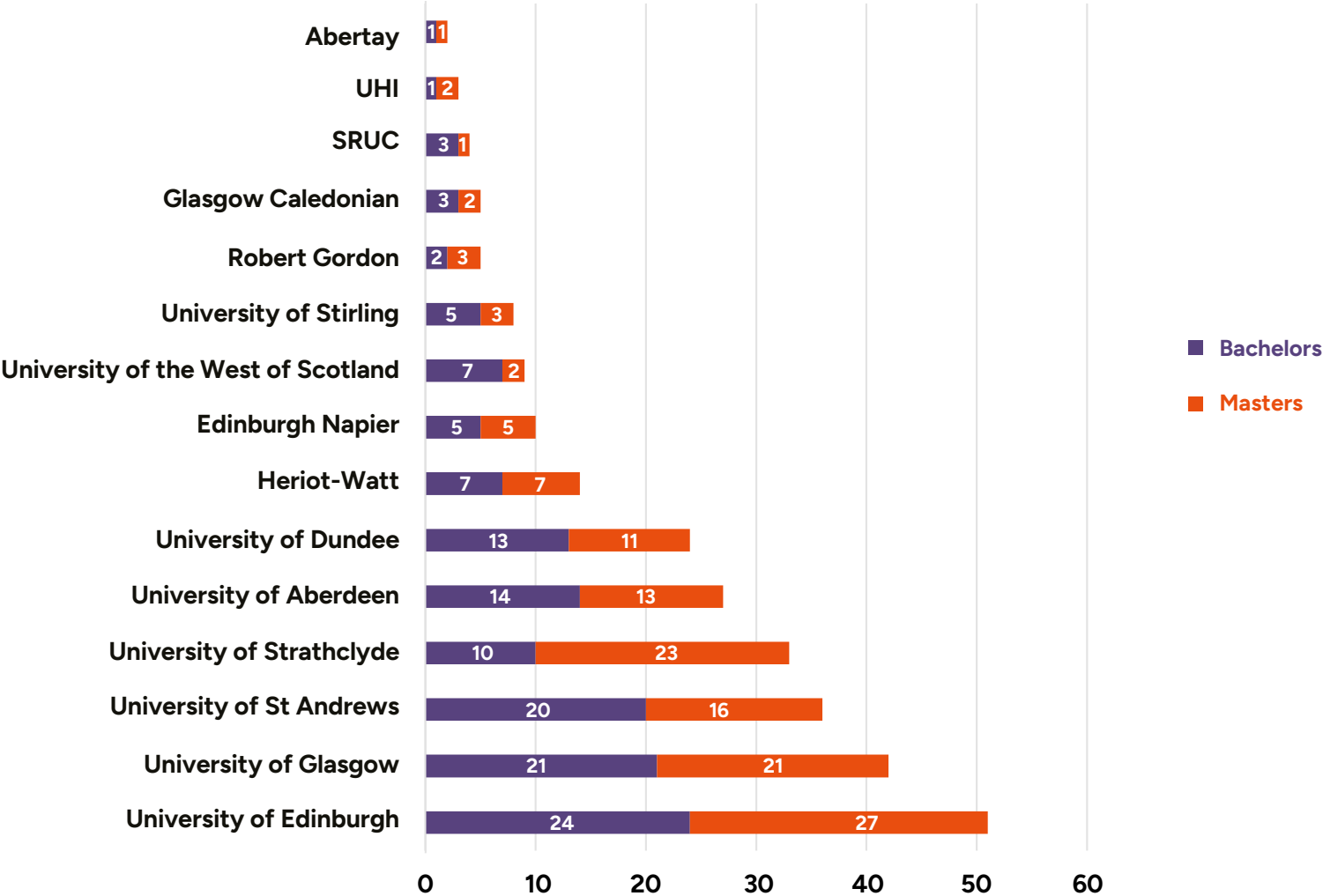
*Low number, not reported – data from Skills Development Scotland.

2.3.3 Universities

A total of 273 higher education courses at Bachelors and Masters levels spanning both life sciences and chemical sciences were identified across 15 higher education institutions, indicating strong institutional capacity across the country. Provision ranges from generalist disciplines such as biology, chemistry, and biomedical science, to more specialised or applied fields including pharmacology, toxicology, industrial biotechnology, and aquatic veterinary studies. Figure 7 illustrates that the largest life sciences and chemical sciences skills providers at Bachelors and Masters by course number are University of Edinburgh, University of Glasgow, and University of Strathclyde.

- ii Scientific Technologies at SCQF L6
- iii Life Science and Related Science Industries; Life Science and Related Science Industries Technical Apprenticeship; Process Manufacturing; Scientific, Technical and Formulation Processing; and Science Industries Quality Technician

Figure 7 – Number of taught Life Sciences and Chemical Sciences courses in Scottish universities



Academic year 2024/2025.

A notable feature is the extent of cross-disciplinary provision. Many courses are positioned at the intersection of life sciences and chemical sciences, such as:

- Medicinal and Biological Chemistry
- Pharmaceutical and Analytical Science
- Chemical Engineering and Applied Chemistry
- Synthetic Biology and Biotechnology.

In addition, there is integration with adjacent STEM disciplines that illustrate a growing focus on interdisciplinary skillsets relevant to Life Sciences and Chemical Sciences and STEM overall:

- Chemistry with Mathematics
- Chemistry and Physics
- Chemistry with Artificial Intelligence.

A number of programmes show a strong applied focus, with titles including Advanced Pharmaceutical Manufacturing, Applied Poultry Science, Advanced Drug Delivery, and Pharmaceutical Analysis. Provision extends into highly specialised and emerging fields that reflect Scotland's academic research expertise, predominantly at the Masters level:

- Stem Cells and Translational Neurology
- Catalysis
- Nanoscience
- Cancer Biology and Precision Oncology
- Quantitative Genetics and Genome Analysis.

To understand the number of students that are undertaking course relevant to life sciences and chemical sciences, HESA enrolment data was analysed to understand the life sciences and chemical sciences skills provision in absolute enrolment numbers.^{iv}

The number of students enrolled in the relevant courses has reduced by 6% from 15,130 in 2020/2021 to 14,235 in 2023/2024. The breakdown of student numbers by institution in this timeframe is presented in Table 7. Over the analysed timeframe, these numbers account for 5% of the total university student population in Scotland. Relative percentage change of student numbers in Life Sciences and Chemical Sciences courses per institution is shown in Table 7.

vi We included the following disciplines in the analysis, based on HESA degree classifications and excluding disciplines highlighted in the introduction: Biosciences (non-specific); Biology (non-specific); Microbiology and Cell science; Zoology; Genetics; Molecular Biology, Biophysics and Biochemistry; Others in Biosciences; Pharmacology; Toxicology; Biomedical Sciences; Chemistry; Sciences (non-specific); Natural Sciences (non-specific).

Table 7 – Total number of student enrolments in Life Sciences and Chemical Sciences courses (HESA) per institution over 2020-2024.
The figures in brackets denote year-on-year percentage change from the previous year.

University/Academic year	2020/21	2021/22	2022/23	2023/24
The University of Aberdeen	1,235	1,255	1,170	1,150
Abertay University	135	120	100	90
The University of Dundee	1,020	1,075	1,045	1,020
Edinburgh Napier University	515	500	500	460
The University of Edinburgh	3,055	3,265	3,060	3,195
Glasgow Caledonian University	625	585	560	625
The University of Glasgow	2,945	2,820	2,675	2,685
Heriot-Watt University	565	595	550	495
The Open University	525	520	455	415
Queen Margaret University	80	40	0	0
Robert Gordon University	265	240	235	215
The University of St. Andrews	1,275	1,275	1,340	1,255
SRUC	25	0	0	0
The University of Stirling	325	325	315	290

Table 7 – Total number of student enrolments in Life Sciences and Chemical Sciences courses (HESA) per institution over 2020-2024.
The figures in brackets denote year-on-year percentage change from the previous year continued

University/Academic year	2020/21	2021/22	2022/23	2023/24
The University of Strathclyde	1,845	1,875	1,790	1,745
University of the Highlands and Islands	170	125	145	195
The University of the West of Scotland	550	545	470	400
Total	15,130	15,150 (0%)	14,420 (-5%)	14,235 (-1%)
Total university enrolments in Scotland	282,875	301,230 (6%)	292,240 (-3%)	281,455 (-4%)

This data shows that 53% of Life Sciences and Chemical Sciences skills provision by number of student enrolments occurs in the central belt: 22% in the University of Edinburgh, 19% in the University of Glasgow, and 12% in the University of Strathclyde.

2.4 Conclusions

The life sciences and chemical sciences sectors make a significant contribution to Scotland's economy and expectations are that they will continue to do so through the next decade and beyond. However, skills provision must adapt and evolve to realise this economic impact. The analysis indicates that chemical sciences and life sciences companies are integrating multidisciplinary skills within teams and even individuals, in order to fully exploit new efficiencies and approaches that digital technologies including AI and automation will afford research, technology development and innovation (RTDI) and manufacturing. There is also a greater merging of life sciences with natural sciences and engineering. There are both shortages in the delivery of these skills, and gaps in providing new combinations of skills that industry needs. Further and higher education institutions will need to be supported to address these issues. This is further compounded by a shortage of people with core skills that will be fundamental to both sectors, including engineers and data analysts.

The analysis that has been undertaken, however, suggests that the necessary building blocks exist in terms of skills and training providers, infrastructure and companies. What is needed is a means to connect these different components and ensure that there are sufficient resources to address both skills shortages and gaps.

3 Stakeholder and industry insights on skills needs for the life sciences and chemical sciences sectors

Key stakeholders and industry were consulted comprising life sciences and chemical sciences companies, skills providers from further and higher education, and other stakeholders representing research institutes, public agencies and professional bodies.

The interview and survey programmes ran between early September and the end of October 2025. In total, 25 individual organisations were interviewed, and 20 individuals completed an online survey. A full list of organisations is provided in Appendix A and survey responses are provided in Appendix B.

Feedback provided during this process identified and validated themes and key skills issues, some of which are specific to sub-sectors of the chemical sciences and life sciences sectors and others that are more widespread.

3.1 Digital, data and AI skills

Recent analysis of the Digital Economy Labour Market⁴² highlights the importance of digital skills requirements across all sectors in Scotland. This analysis reveals that adverts for many life sciences and chemical sciences job roles are now requesting specific data and digital skills, including data analysis, programming, automation, bioinformatics, forecasting and software engineering. Between 2019 and 2024, the number of job adverts including digital skills increased by 18% for natural and social scientists, 11% for biochemists and biomedical scientists, 11% for biological scientists and 10% for laboratory technicians.

The latest sectoral skills assessments (SSA) for life sciences and chemical sciences underline the importance of digital skills. The life sciences SSA³ estimates that 58% of people employed in the life sciences sector in 2022 were in digital practitioner roles, i.e., individuals that are either creating or integrating digital technologies into other disciplines as part of their core job.³ This can be contrasted with a digital user role where individuals are using digital tools rather than creating or developing them. In Scotland's chemical sciences sector, it was estimated that 33% of all people employed in 2022 were in digital practitioner roles⁹. In contrast, only 15% of all job roles across the Scottish economy in 2022 were assessed to be digital practitioner roles.⁹

In this study, and across all stakeholder groups, digital, data and AI skills were identified as being the most critically important, and major drivers of growth. This is particularly true for those companies in the life sciences sector which are generating significant amounts of data through their research and technology development (RTD) activities and can also, potentially, exploit data available from other sources, such as the NHS. Such companies are looking for individuals with expertise in bioinformatics and those who can apply programming and automation skills to enhance and accelerate both discovery pipelines and manufacturing. In addition to the use of specialised digital, data and AI skills for the delivery of technical and scientific activities, stakeholders highlighted the growing importance of responsible use of generative AI as a general productivity-enhancing tool (e.g., for generation of written reports, emails, meeting summaries) that was seen as a way of freeing time for higher value-added (e.g., research) activities. In this

context, critical thinking and information assessment was noted as an increasingly important factor in the workforce.

AI and data analytics are less important for the chemical sciences than the life sciences sector in Scotland. An explanation for this is that the chemical sciences sector in Scotland mainly comprises large-scale manufacturing of chemicals and is dependent on well-established chemical and process engineering skills. That said, stakeholders in education and professional associations noted that many aspects of chemical sciences would benefit from such skills, e.g., in the design of new catalysts.

There is, however, concern that these skills will not be readily available to the life sciences and chemical sciences workforces. The majority of this training is provided by universities, and here, the focus tends to be on offering these subjects as pure disciplines, with most graduates employed in other sectors, such as technology and finance. There is a growing recognition that these subjects need to be combined with life sciences and chemical sciences subjects, and the education system is adapting to these needs, however, few universities are currently offering such combined courses. For those that do, it is mainly at post-graduate, Masters, level. For example:

- Chemistry with Data Science (University of Strathclyde)
- Biological Data Science (University of Dundee)
- Bioinformatics (University of Edinburgh)
- Biotechnology and Bioinformatics (University of Aberdeen).

Only the University of Edinburgh (biomedical informatics) and the University of St Andrews (biology and computer science) offer undergraduate degrees in relevant areas. In reality, there are few people currently coming through the higher education system with digital and data skills, that are combined with life sciences and/or chemical sciences skills. Additionally, some life sciences stakeholders report that, in their workforce, employees with data, digital and AI expertise are predominantly self-taught as opposed to having acquired these skills in formal education.

At a minimum, there will be a need to provide CPD courses in data and digital skills, so that those already in the workforce can have a greater understanding of their importance and utility, and to aid in communication between the wider workforce and those developing digital tools or curating data. In this regard, The Data Lab has developed a suite of online and in-person training that encompasses data literacy, data security, data management, Big Data and AI⁴³. However, it is apparent that more will need to be done to promote the life sciences and chemical sciences sectors as destinations for those considering careers in data science, informatics and AI, and to integrate more advanced digital skills within life sciences and chemical sciences curricula.

3.2 Technical and work-ready skills

As already presented in section 2, several studies have highlighted that many employers in the life sciences and chemical sciences sectors find it difficult to recruit people with the necessary technical and work-ready skills. This study was no different, with companies noting that securing the right talent has become more difficult in recent years. Most of those interviewed were of the opinion that there is a general lack of 'work-readiness' in

younger recruits. This encompasses both technical and meta skills, regardless of which training/education route they have taken (direct from school, apprenticeship, college or university).

In terms of technical skills, feedback was that in some universities, but not all, there was too much focus on theoretical knowledge and insufficient time spent on imparting basic laboratory skills that would be required by all companies across the Life Sciences and Chemical Sciences sectors. This means that companies need to spend time training new graduate employees in these basic skills before they can then undertake training in skills needs that are more bespoke to the company. Several of the larger companies have addressed this by providing their own in-house training programmes for at least the first few weeks of employment, with this sometimes extending to several months. However, this is something that smaller companies lack the capacity to do. To address this, it was suggested that first year university courses could focus more on imparting good laboratory practice (GLP) and the importance of QC, illustrated by real-world examples, within practical laboratory programmes.

In terms of more specialist technical skills, employers noted the following skills shortages (in addition to data and digital skills):

- fermentation and bioprocessing – to support the shift towards industrial biotechnology and biomanufacturing across both life sciences and chemical sciences sectors. Training tends to be delivered at post-graduate level, so numbers are low. In addition, the knowledge and ability to scale bioprocesses to commercial levels is lacking
- microbiology – particularly combined with other skillsets needed to develop and manufacture the next generation of more complex biological therapeutics

- chemists – in particular those with experience for industry roles, but also individuals to enter teacher training
- instrumentation, inspection and electrical engineers – required for chemical manufacturing processes, where there appears to be lower interest from people with these particular skillsets in the chemical sciences sector and greater interest in other sectors such as renewable energy
- quality assurance and control (QA/QC) – where there is a real shortage of experienced people for these essential roles
- regulations – where businesses report difficulties in securing experienced people and courses to train people, in order to keep up to date with the highly regulated and changing environment that both life sciences and chemical sciences companies operate in.

Addressing these skills shortages will require significant investment of time and resources; from engaging with people from an early age to present the range of job and career opportunities, to providing the necessary content and opportunity for skills development within further and higher education courses. For example, it is recognised that training for new biomanufacturing processes is expensive, requiring equipment that is limited to only a few sites within Scotland (such as IBiolC-run facilities at the University of Strathclyde and Heriot Watt University). These are focused on supporting RTD, which limits their availability for training purposes. In addition, industry believes that knowledge of QA/QC and GMP/GLP needs to be imparted in a more systematic manner to students, e.g., in the context of performing practical work, and ideally in an RTD or industrial scenario. At present these topics appear to be delivered as add-on lectures to core course work, with no standardised approach, despite their criticality to business operations.

In terms of meta skills, companies reported that many younger recruits lacked communication skills, critical thinking and problem-solving capabilities, all of which are essential to both RTD and process manufacturing roles. For the life sciences sector there was also feedback that graduates lack the necessary skills in mathematics, that are increasingly required to support the move from more traditional life sciences to digitally-enabled approaches.

Some of the larger companies are addressing both technical and meta skills issues by offering internships and summer work placements to students, so that the company can identify potential future employees at an early age and that students obtain a better understanding of what the world of work is like. There was general consensus that this should be more structured and less ad hoc, through compulsory placements and real-work experience for all students, even if this is in a university laboratory rather than a company setting. It was noted that smaller companies are interested in providing internships, placements and apprenticeships but they generally lack the resource to support these activities in terms of administrative and supervisory overheads. A suggestion was made that a centralised support system to alleviate the administrative burden and/or help with overhead expenses would greatly help smaller companies to engage with the trainee workforce.

Finally, there were reports of difficulty in securing cross-sectoral expertise, such as procurement, sales/business development, finance and human resources. However, it should be noted that these difficulties are common across many sectors as demand for a cross-skilled workforce grows.

3.3 Shortage of experienced people

Previous reports have highlighted the issues facing companies of replacing experienced people as they retire and to recruit people with specific experience for more senior roles, required as companies grow^{31,30}. Companies engaged in this study reported similar issues. Most report that it is relatively easy to hire graduate employees. The difficulty comes when trying to recruit more experienced people, particularly in regulatory and quality roles. In this regard, several companies, but not all, noted challenges in attracting more experienced people to relocate to Scotland from the rest of the UK and from Europe. As a result, companies report having to support people to step up into roles when they are unable to source a suitable, experienced external candidate, and in at least one case, having more senior people stepping down to cover a vacancy. There was also feedback that some companies are now relying on specialist regulatory consultancy firms to provide these services (e.g., Qualified Person, QP) because they cannot source, or cannot afford to employ, people with these skills on a full-time basis.

In other cases, particularly in young life sciences companies, there is a dearth of candidates with commercial experience, leading to these companies extending their search to other sectors where there are greater numbers of commercial deals taking place (such as in renewable energy). These new recruits then need to be transitioned into the life sciences sector, however, this is seen as an easier or more effective option than trying to instil commercial acumen in life scientists.

Several companies also highlighted the importance of recruiting from other companies within their sector, presumably as these individuals have existing experience. For larger companies, there

was feedback that employees are moved/recruited from different sites within the company to address talent shortages.

For regulatory, technical and leadership roles, many companies are addressing a lack of experience by upskilling staff. This has the benefit that individuals already have a good understanding of the business but presents challenges in terms of identifying the right support, e.g., flexible, modular courses. In some cases, companies have struggled to identify staff members with the right aptitude for leadership and management roles.

During discussions with a range of stakeholders in both industry and supporting organisations, it became apparent that there was an underlying risk that companies, particularly young ones, may look to relocate outside of Scotland and perhaps the UK if they perceive an experienced, skilled workforce is lacking, which they will need to tap into as they grow. In fact, one company, no longer based in Scotland, cited a lack of skilled people as one of the factors in its decision to relocate.

3.4 Education and training pipeline

A number of studies and assessments have indicated the importance of engaging with young people during primary and secondary education to impart the relevance of life and chemical sciences and the range of careers that are available^{27,30}. Feedback from those interviewed in this study, is that younger people and their influencers (parents, guardians, network, and teachers) are not aware of the range of job opportunities and careers in the life sciences and chemical sciences sectors. This means that people with skills that are now sought by, but were perhaps not traditionally associated with, these sectors are not aware of such

career opportunities. In turn, this suggests the need for a broader engagement with young people, in particular those who may have an interest in human health and/or sustainability but are not directly interested in life sciences and chemical sciences. This would require additional support for teaching staff, who may also be unaware of the wide scope of opportunities in life sciences and chemical sciences.

Feedback from employers in the life sciences and chemical sciences sectors is that they require a range of different levels of training and qualifications, from school-leavers through to postgraduate degree qualified. Although, responses suggest that larger companies will recruit more broadly, from schools to university, while earlier stage and smaller companies tend to recruit more at post-graduate level.

Several companies expressed concern that there was a shortage of trained technicians, with university graduates often applying for such roles. This is a concern for companies as employing graduates in lower-skilled roles raises the risk of them leaving in a relatively short period of time when they a) gain some relevant industry experience and b) realise the career progression may not be as rapid as they may have been expecting. One of the causes for this situation appears to be a decrease in the numbers of people studying for HNC and HND qualifications in life sciences and chemical sciences. Overall, life sciences and chemical sciences account for a minor fraction of total college enrolments (up to 1.5%). Whilst chemical sciences experienced a peak in enrolment numbers in 2021/2022 and life sciences saw a significant peak in enrolment numbers in 2022/2023, these figures experienced an immediate decrease in enrolments in the following academic years, decreasing by 14% and 25%, respectively.

Stakeholders in both industry and the skills sectors stated that it was now easier to secure a place on a university course, and that (young) people (and their influencers) still perceive this to be a far better option than pursuing a further education qualification. Furthermore, feedback from colleges is that many of those taking HNC/HND courses then go onto university to study for a degree rather than pursuing technical employment. There was further feedback that some colleges are now focusing on delivering National Certificates (NC) rather than National 5 and Highers (both at SCQF L5 and 6), as the former are not accepted as part of the entry requirements to university, so by only offering NCs they expect to retain students for longer within the college system, thus providing greater financial security for the college.

There is wide support for apprenticeships, particularly amongst larger companies in both life sciences and chemical sciences. These are seen as a way of bringing people into businesses to gain a relevant skills baseline, who can then be further developed for other roles as required. Several companies mentioned there was a greater loyalty and lower turnover amongst individuals who entered by this route compared with graduates. However, there was recognition that there needs to be greater numbers of apprentices supported, as well as new frameworks, particularly a Graduate Apprenticeship in life sciences. Despite the attractiveness of apprenticeships, smaller companies struggle to engage because of the costs and commitment involved, and the concern that investment could be lost if the apprentice leaves after completing their training. Additionally, a company who hosts apprentices might not be able to commit to employment of apprentices after training, especially if they are an SME. A suggestion was made regarding apprentice exchange across SMEs to derisk apprenticeship training and the recruitment process nationwide.

Finally, there was concern from universities that there was a decline in enrolment in certain subjects, including chemistry, despite, in at least one case, significant investment in infrastructure and marketing. One interviewee noted that a common question from potential students is now 'what sort of job can I get when I graduate?'.

3.5 Lifelong learning and flexible models

The life sciences and chemical sciences sectors are continually evolving, and as noted earlier, automation, big data and AI approaches are becoming more prevalent, particularly in life sciences companies. In practice this means that staff working in the life sciences and chemical sciences sectors will need support for lifelong learning that flexes with their work requirements. However, companies engaged in this study report that they struggle to find appropriate courses to train staff. One approached a university about the possibility of adapting some of its toxicology courses to CPD modules, while another sent staff on a medical regulatory course as they were unable to identify an industry-specific one. Process safety was also highlighted by another company, with the lack of suitable courses leading it to develop its own in-house training to ensure succession planning.

There is high interest from industry in such modular courses, particularly those offering micro-credentials. One of the reasons for such interest is that these types of courses enable people to 'hop-on and-off' as necessary while they work, reducing employee downtime for the employer, and, to the employee, they offer security of recognised transferrable skills, should their career pathway take them to a different employer. For example, one

company identified opportunities to transition people from both the offshore oil and gas, and the brewing and distilling sectors to chemical manufacturing because of parallels in process skills. However, there are not the range of courses available to support all such transitions, and funding constraints and minimum cohort numbers can limit the ability of colleges and universities to develop and run such courses. Of those modular courses that are available, many are focused on business and enterprise skills, which are also sought after by employers, however, feedback from skills providers is that these are often over-subscribed.

The further and higher education sector is responding to these needs in terms of delivering more flexible learning. For example, Fife College has developed a programme that allows individuals to gain different life sciences qualifications from vocational through HNC and HND to degree. Several modular courses have been or are being developed to provide technical skills training to individuals already in the workforce that may not have received these during their initial studies, for example:

- IBiolC offers hands-on bioprocessing training⁴⁴
- Edinburgh Napier University offers clinical and laboratory skills training for life science companies⁴⁵
- Fife College and IBiolC are developing an advanced GLP course that includes aseptic techniques, molecular techniques, risk assessment, COSHH, hazards and QC⁴⁶.

In this regard, it is interesting to note that while many companies evidently do engage effectively with training providers to influence course content to better meet their needs, several do not.

The need for funding underpins lifelong learning and flexible training. While larger companies are able to pay for training, many smaller companies, particularly in the Life Sciences sector are not, and feedback was that the loss of the Flexible Workforce Development Fund had reduced their access to training. In addition, several companies highlighted the need for not just access to additional funding for training but, more generally, guidance on what training is available.

3.6 Future skills needs

Future skills needs will be dominated by automation, AI, ML and big data, and there will be increasing blurring of lines between disciplines, which employers in this study confirmed as necessary in order for them to operate efficiently and be effective in the future. As mentioned earlier, combining traditional life sciences and chemical sciences disciplines with data and digital skills remains the most important consideration, for example, to improve RTD and manufacturing efficiencies, and, in some cases, marketing of company services and products.

There was an identified need to combine other skillsets, such as microbiology and process chemistry (reflecting the increasing complexity of the development and manufacture of new biotherapeutics), technical skills with business and soft skills, and, more generally, for greater flexibility within the workforce to adopt new digitally-enabled and cross-skilled ways of working. In this regard, there are a number of multidisciplinary Masters courses offered by Scottish universities, such as drug design and biomedical science, analytical sciences for biosciences industries, mathematical biology, and chemistry with drug discovery. Additional modules in entrepreneurship and business skills are also being offered by some universities, which can include lectures from industry.

Employers noted that regulatory and quality assurance skills will become more important and that while there is also a need for sustainability skills to support the transition to net zero, this is more related to ensuring that employees approach the manufacturing process and RTD with a sustainable mindset, rather than developing specific sustainability skillsets as such.

Of interest is that companies believe that they are impeded in accessing relevant courses because they are either too expensive, not readily available or not easy to find. Many, therefore, undertake in-house training, and several have concerns they may be unable to satisfy their future skills needs.

3.7 Policy alignment and coordination

As presented and discussed in section 2, there are many relevant policies at Scottish and UK levels to support the life sciences and chemical sciences sectors to remain globally competitive and deliver socioeconomic benefits. These include specific skills strategies and sector development plans. However, many of those consulted believe that coordination of skills policy is fragmented. Although some highlighted the strength of the secondary curriculum review's inclusive approach, there was a belief that a whole-system approach was needed from secondary through further to higher education. This would foster closer collaboration between different parts of the education system so that each benefits and learns from the other, and as a result those going through the system have a far better integrated understanding of how to apply the knowledge and skills they have gained. There were examples provided of universities working with colleges, schools and local authorities on Foundation Apprenticeships while others are engaged at HNC/HND and degree levels. Furthermore, there was a suggestion that more could be done between peer-institutions where a modular approach to course delivery could be developed, each institution playing to its strengths and students

benefiting as a result. Such modules could, in turn, feed into Graduate Apprenticeship (GA) frameworks, particularly a new GA in life sciences, which many in industry are calling for.

With the recognition that many companies, particularly in life sciences, are RTD intensive and therefore require a higher proportion of university educated staff, there was strong support for universities, and in particular their teaching capabilities, to be recognised as critical national infrastructure and essential to deliver the skilled workforce needed for long-term economic competitiveness.

This could also exploit regional initiatives, such as the Sustainable Manufacturing Campus which is part of the Falkirk Growth Deal, and Project Willow, to revitalise the chemical cluster in Grangemouth; to leverage opportunities for skills delivery and in particular support the development of commercialisation and scale-up capabilities in the workforce.

Secondary education

A consistent message from the stakeholder interviews was that the life sciences and chemical sciences career journey begins at school, and there was clear support to improve CPD for teachers, so that they understand the broad spectrum of job roles and why they are needed to realise the economic potential of the life sciences and chemical sciences sectors. In addition, there needs to be greater investment in technicians to support teachers in delivering practical classes in schools, while at the same time recognising that not all schools may be able to offer a wide range of practical classes, because of a lack of facilities or for safety reasons. In such cases, the opportunity to visit, and ideally use, facilities in colleges and universities would be a significant benefit to the secondary school curriculum.

3.8 Barriers to skills supply and retention

There may be large numbers of people graduating in appropriate subjects each year from Scottish universities, but the fact is that many do not enter the Scottish workforce. Although the data for graduate outcomes on a course-by-course basis is unavailable, HESA data shows that in 2022/2023, the total number of graduates from Scottish universities was 76,010, of which 50% had a Scottish permanent address. This could indicate that half of Scottish university graduates are no longer based in Scotland post-graduation. Of those remaining in Scotland, 73% of known outcomes reporters were in full time or part time employment. More research is required to understand graduate outcomes in life sciences and chemical sciences courses, which is beyond the scope of the present study.

The financial teaching models of most universities are skewed towards recruiting overseas students who can pay £10,000 - £35,000 per year in tuition fees.⁴⁷ Overseas students who choose to remain, will normally do so through the Graduate route visa, which allows non-UK nationals graduating from a UK university to remain and work in the UK for at least 18 months following graduation⁴⁸. Following this, employers are able to sponsor individuals to remain under the Skilled Worker visa programme.⁴⁹ However, several employers report that a combination of costs and compliance requirements mean that they are unable to retain individuals beyond the initial Graduate visa. The issue is that it is difficult to find UK citizens to replace these people. Furthermore, one interviewee confirmed that many of the Scottish resident students also choose to move out of Scotland after graduating, often to England where the job market is larger.

4 Future outlook and strategic priorities

The life sciences and chemical sciences sectors in Scotland face both significant opportunities and challenges. Stakeholders that were consulted are optimistic about growth prospects in biologics, advanced therapies, diagnostics, and digitally-enabled research. However, proactive action is required to strengthen the workforce and future-proof skills supply.

Scotland's life sciences and chemical sciences sectors are entering a transformative phase where securing a strong talent pipeline is every bit as critical as scientific and technological innovation. Demand for specialised skills is growing, across all sectors, and the nature of work is becoming increasingly multidisciplinary, digital, and globally interconnected. To meet this challenge, a coordinated response across education, industry, and government is required to ensure work-readiness through investment in continuous learning and collaborative capability building.

The following recommendations were identified as a result of this work:

- strengthen STEM engagement at school level through engaging and supporting teachers and careers advisors to become more aware of the breadth of industry careers, thus helping to inform and influence early career decision making, and in turn expanding the workforce pipeline
- enhance practical and industry-readiness skills through work placements, internships, and apprenticeships

- develop modular content to both enhance existing further and higher education curricula and to provide continuing professional development to those in the workforce
- foster and encourage stronger industry–education partnerships based on coordinated national skills planning.

Life sciences and chemical sciences sectors are entering a transformative phase where securing a strong talent pipeline is every bit as critical as scientific and technological innovation. Demand for specialised skills is growing, across all sectors, and the nature of work is becoming increasingly multidisciplinary, digital, and globally interconnected. To meet this challenge, a coordinated response across education, industry, and government is required to ensure work-readiness through investment in continuous learning and collaborative capability building.

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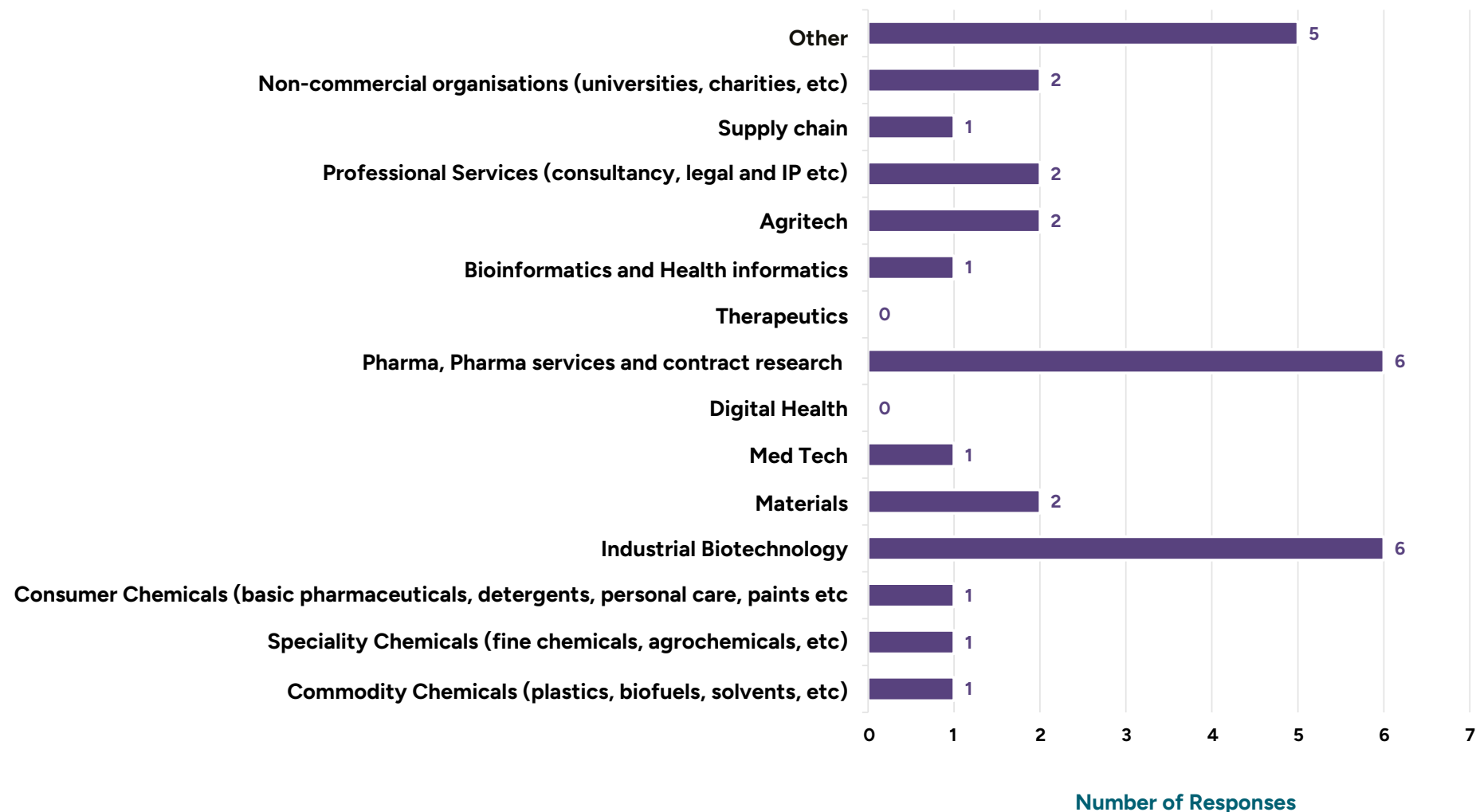
Appendix A: Stakeholders consulted

Aberdeenshire Council
Association of British HealthTech Industries
Almac
Bioascent
Cellogy
Charles River
Consumer Safe
Curia (Scotland)
Digital Health & Care Innovation Centre
DSA
Enough
Fife College
Frontier Science Scotland
Highlands & Islands Enterprise
IBiolC
ILC Therapeutics
INEOS
Lantra
Liaqat Corp
LifeScan
Medicines Manufacturing Innovation Centre
MSD

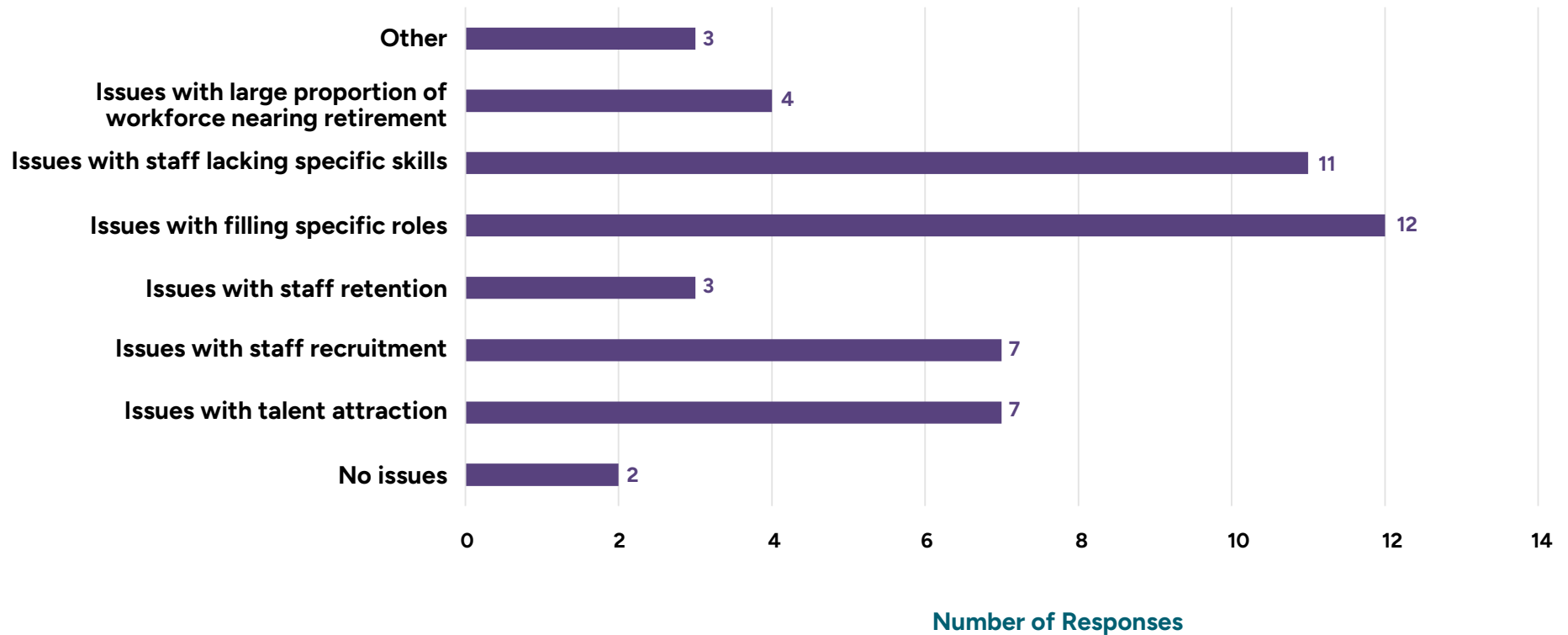
NHS Lothian
NHS Scotland
NHS/University of Edinburgh
NMIS
NovaBiotics
OCS
Platinum Discovery
REPROCELL
Roslin CT
Royal Society of Chemistry
Scottish Government
ScotChem
Scottish Enterprise
SULSA
Sustainable Extricko
Syngenta
University of Aberdeen
University of Glasgow
Valneva
West College Scotland
Wobble Genomics
Xias Bio

Appendix B: Stakeholder survey

Which sector(s) best represents your business?



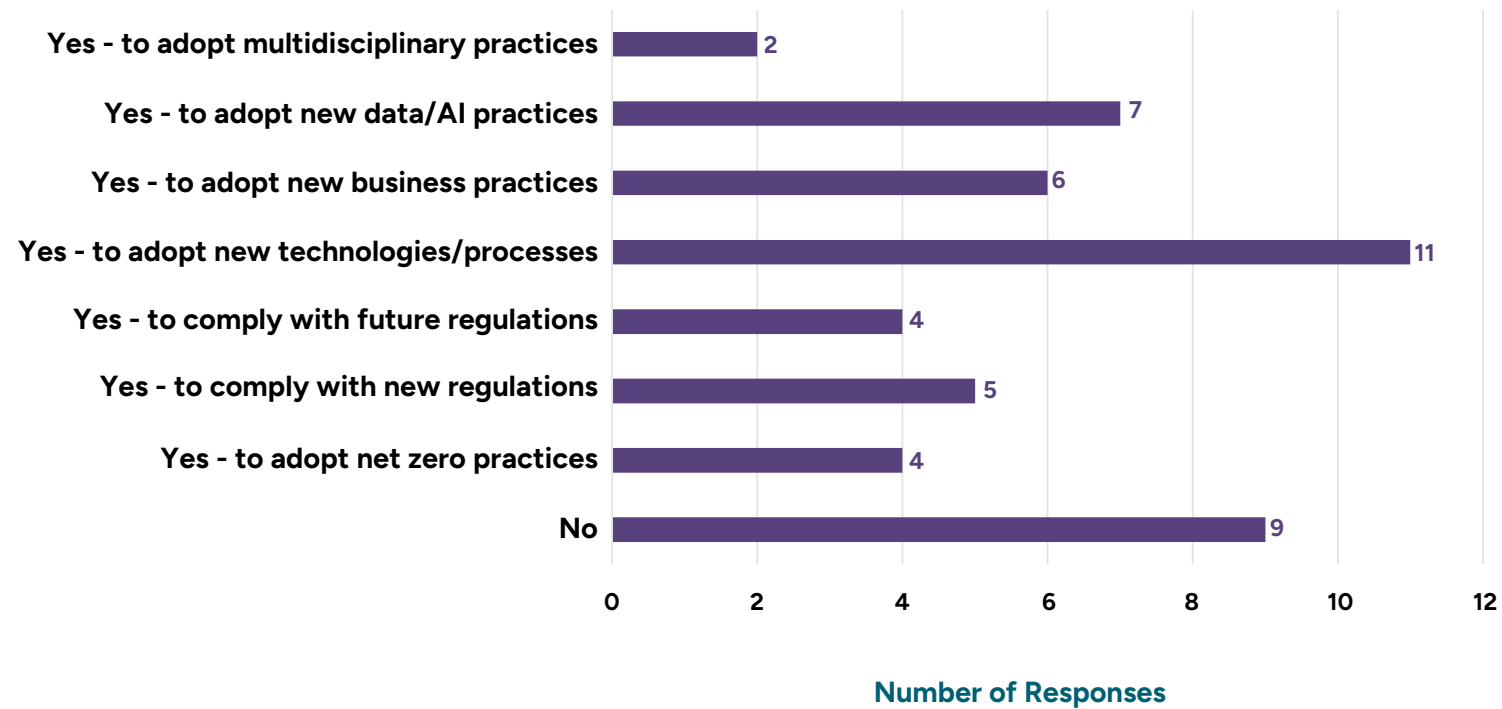
What (if any) staffing issues have you experienced in the last 5 years?



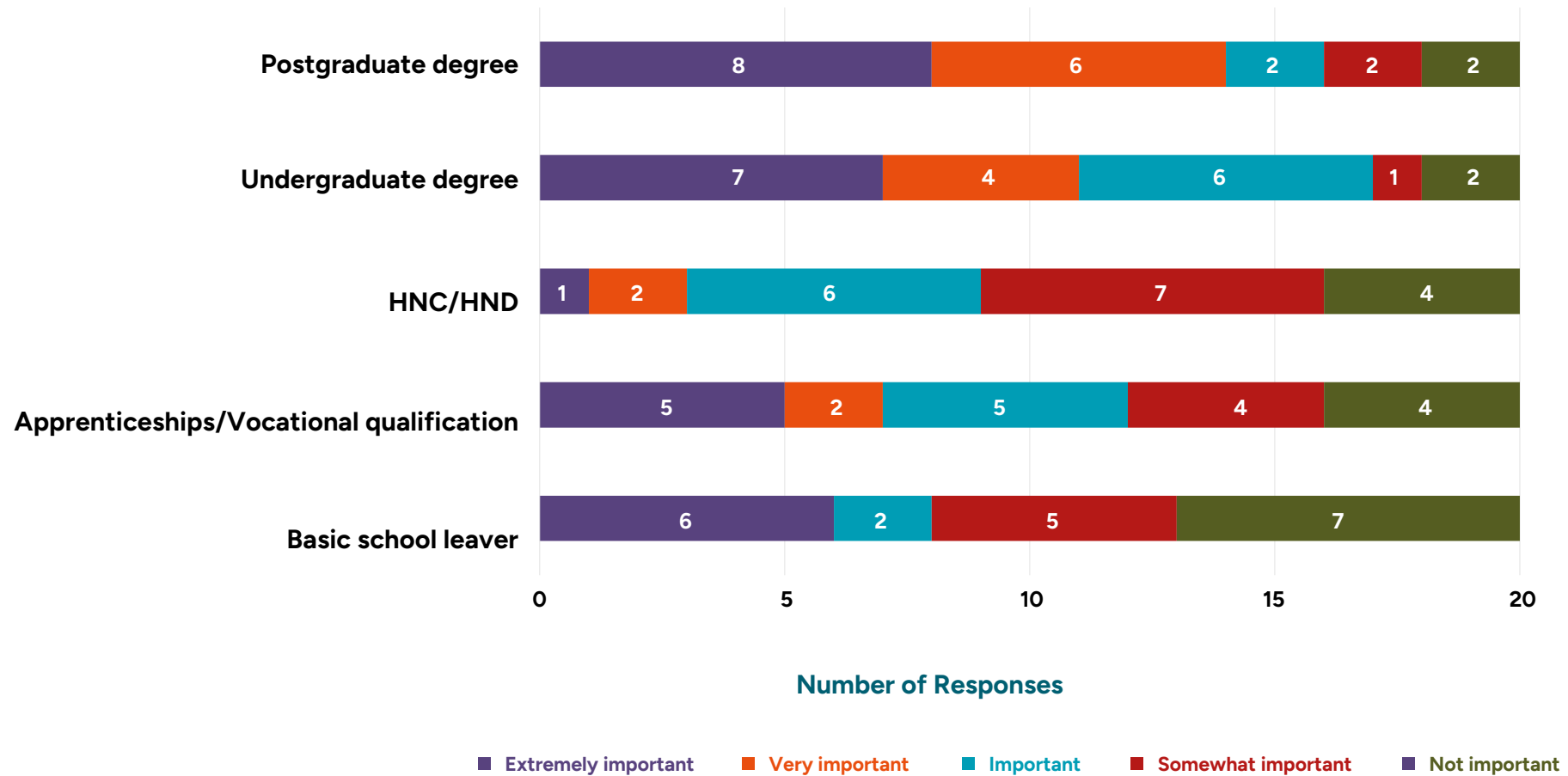
How important are the following to your recruitment?



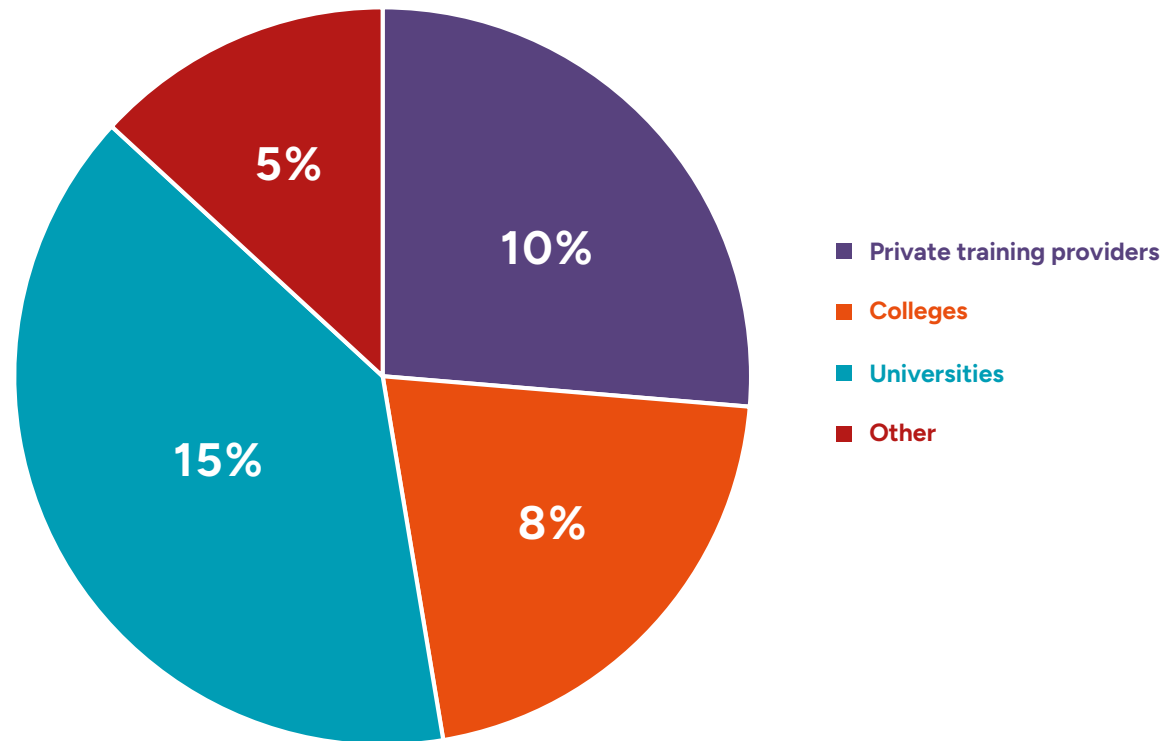
Have your workforce skills changed in the last 5 years?



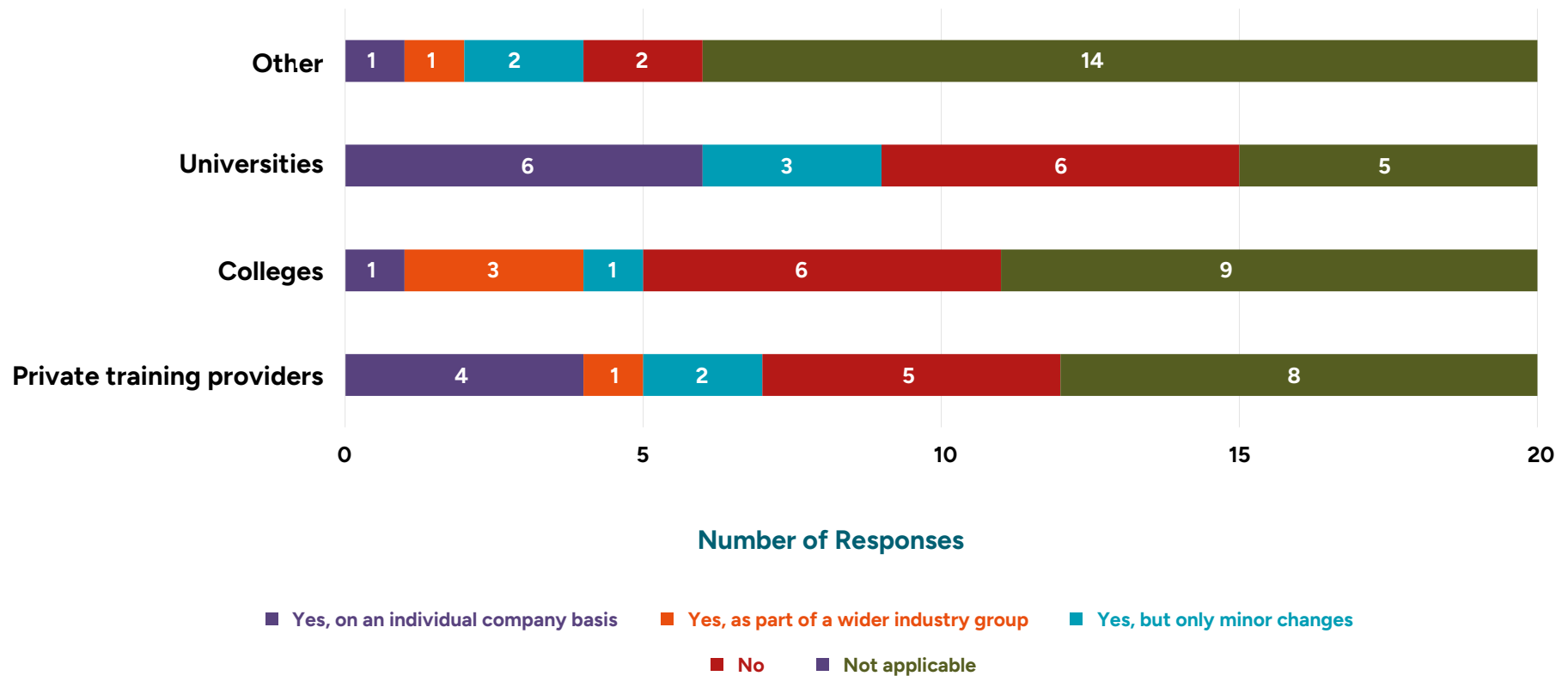
How important are the following qualification levels to your business?



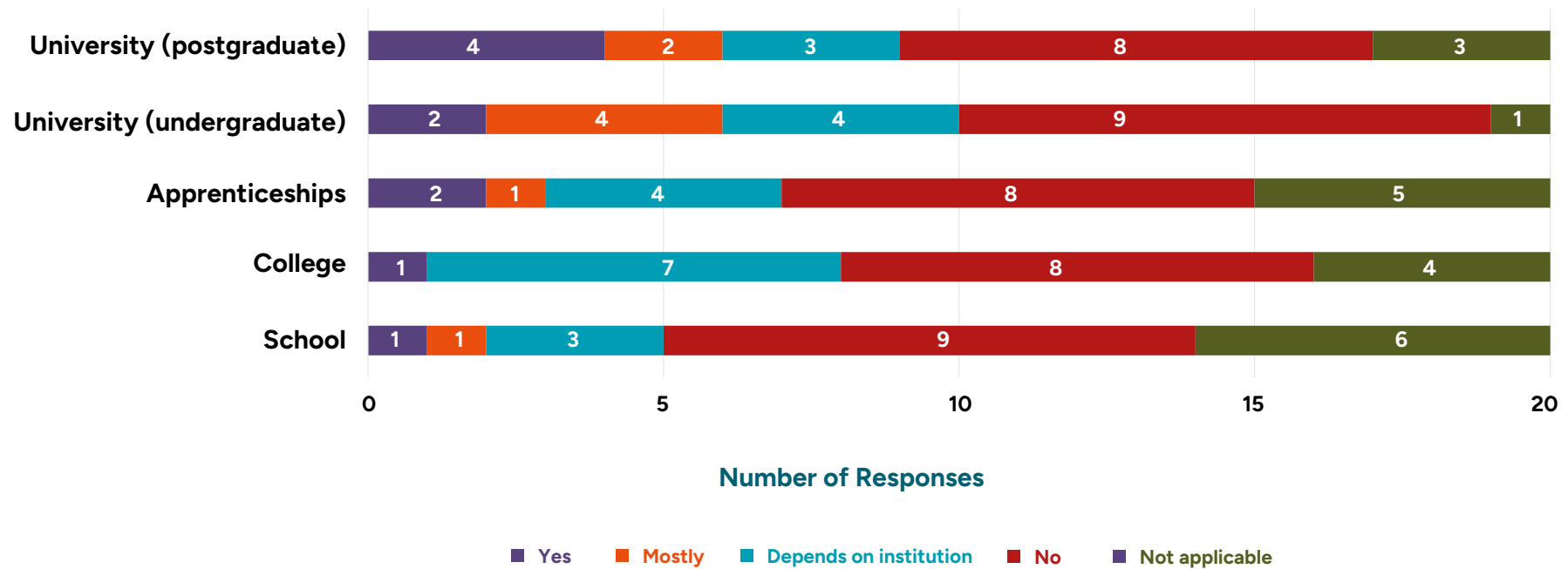
Which of the following skills and training providers do you engage with?



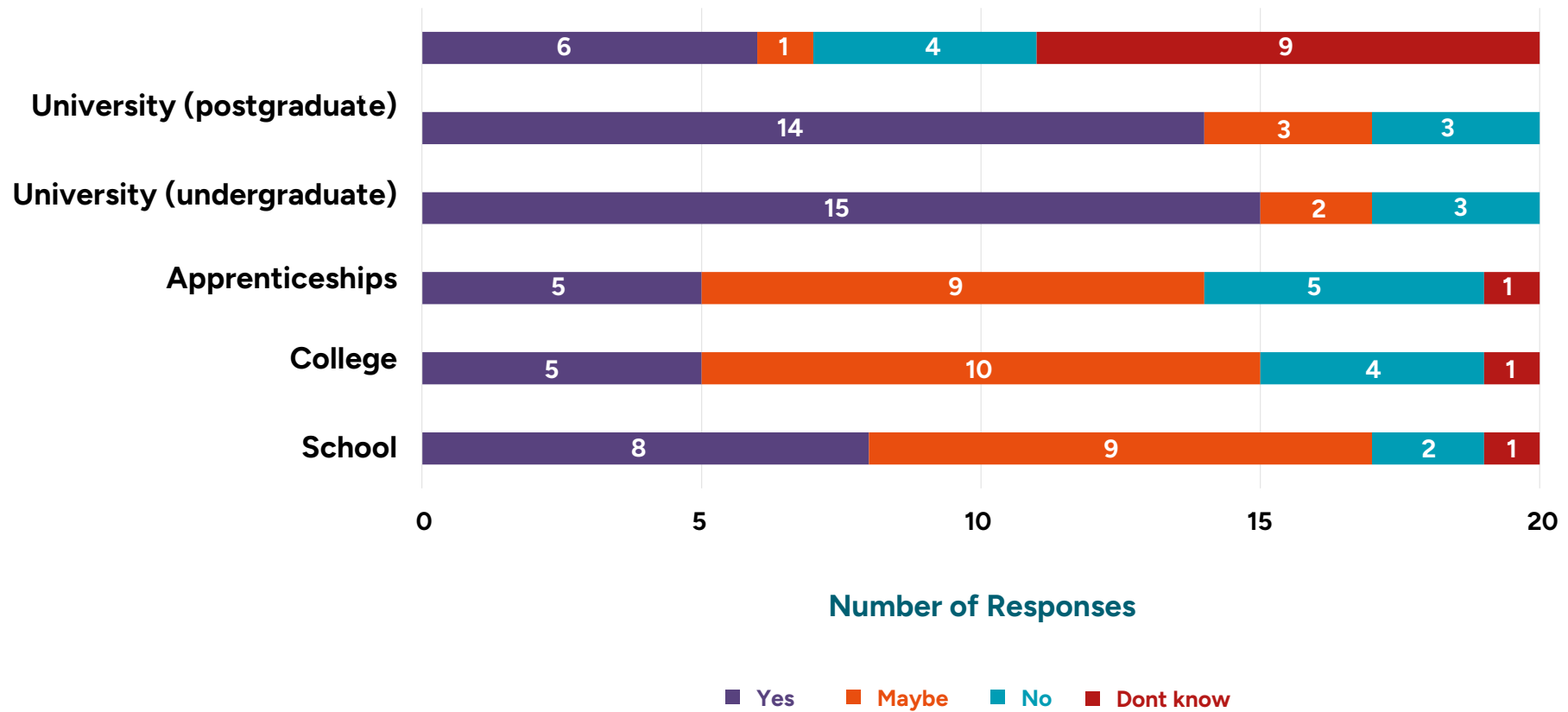
Has your engagement allowed you to influence course content and delivery to meet your needs?



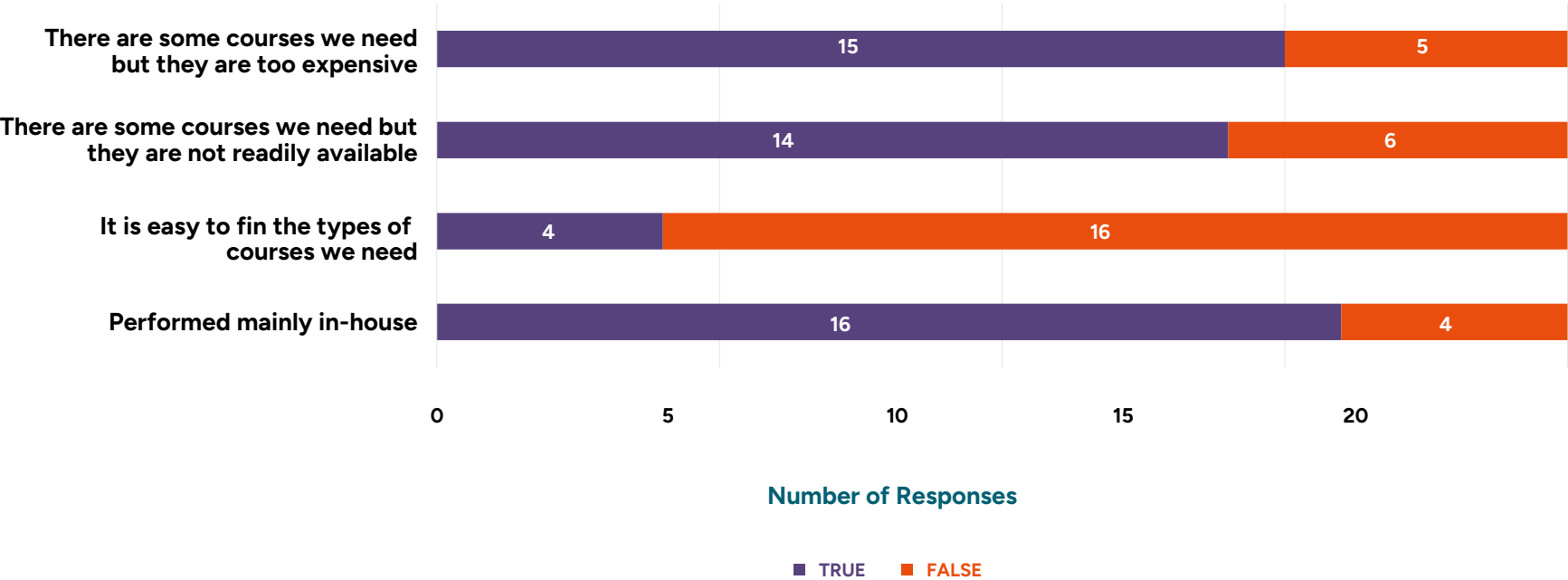
Are new entrants (from school, apprenticeships, college or university) equipped with the technical and workplace skills that you require?



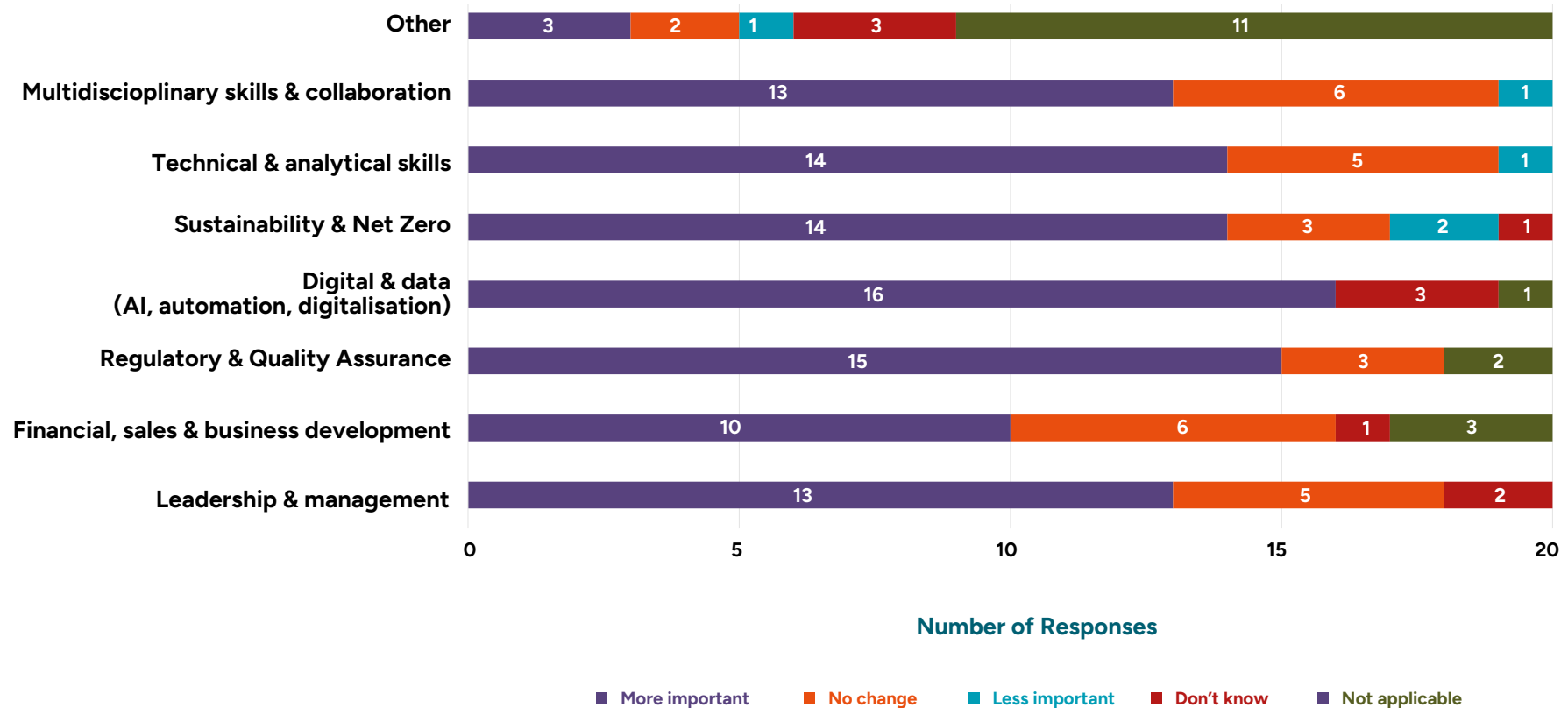
What changes would make it easier to access the skills your company needs?



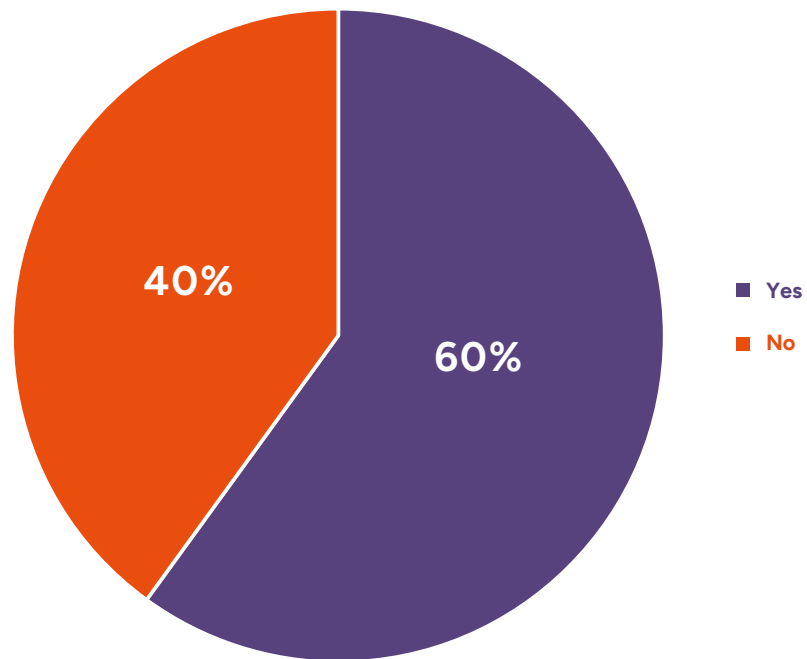
Considering up/reskilling of staff, which of the following statements are TRUE or FALSE?



How do you expect the following skills needs to change over the next 5 years?



Have you any concerns that you may not be able to satisfy your future skills need?



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