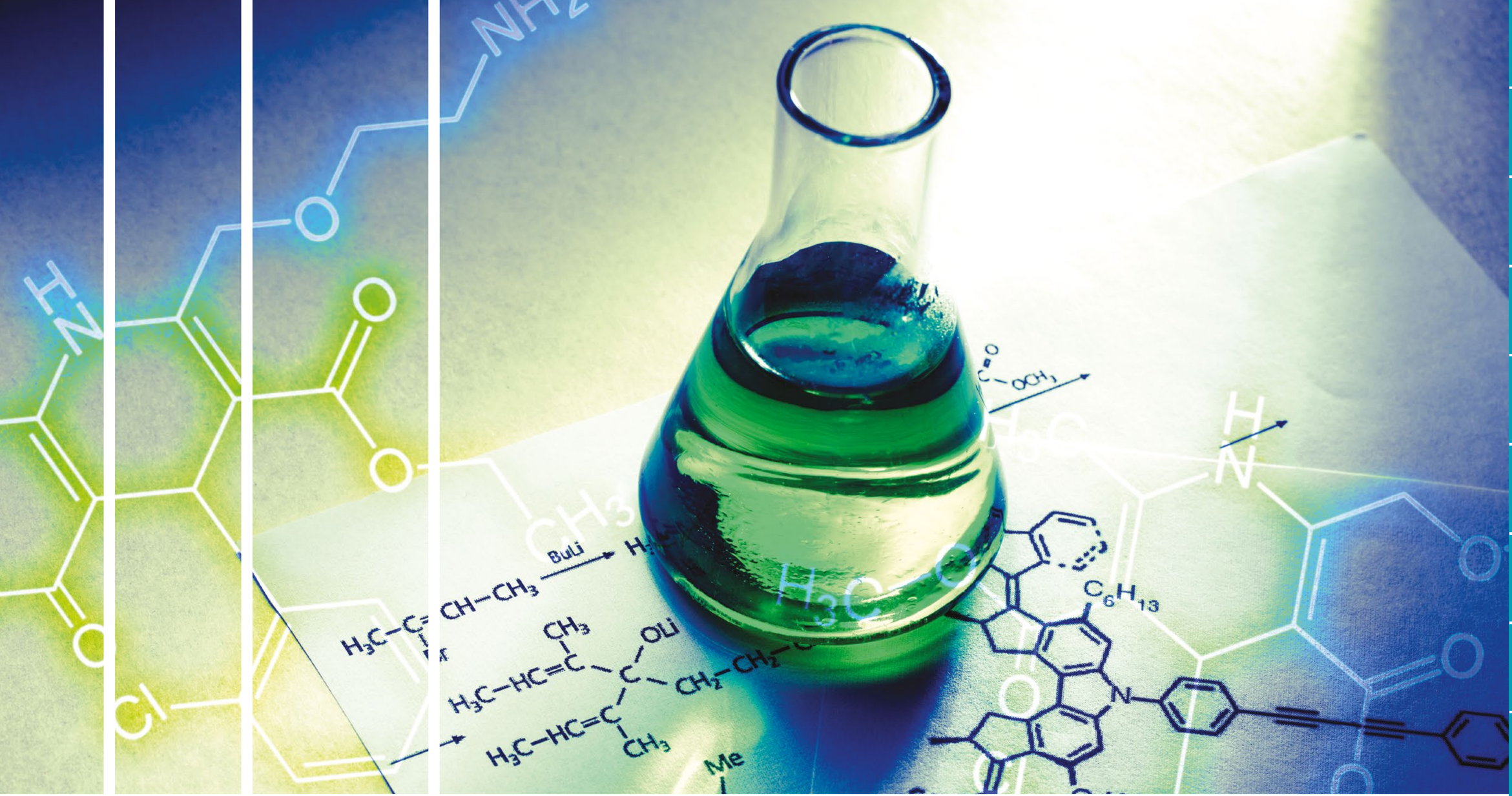


Skills Development Scotland

Skills Investment Plan

For Scotland's life and chemical sciences

Chemical Sciences SCOTLAND

Life Sciences in SCOTLAND

Scottish Government
Riaghaltas na h-Alba
gov.scot

Foreword

Alistair Cameron
Co-Chair
Life and Chemical Sciences Skills Working Group

Equipping our workforce with the correct skillset is crucial to ensuring the competitiveness of the Scottish Life and Chemical Sciences sectors. Skills has been, and continues to be, a key priority for the Life Sciences Scotland and Chemical Sciences Scotland Industry Leadership Groups.

The Life and Chemical Sciences sectors provide high quality jobs, and a vibrant environment which fosters opportunities for innovation and R&D. However, the emergence of Industry 4.0, advancement in technology, and the uncertainties of Brexit pose skills challenges for both sectors.

Recognising the many shared interests of our sectors, Chemical Sciences Scotland and Life Sciences Scotland agreed in early 2017 to merge their Skills Working Groups. Our first order of business has been to commission a combined Skills Investment Plan which looks at the likely skills requirements to sustain our industries over the next 10 - 15 years.

The Skills Investment Plan development has involved taking stock of existing capabilities and reviewing future skills requirements, to ensure the sector can respond. We must continually react to the skills challenges that exist by ensuring that we provide the right people with the right blend of skills and expertise at the right time for our industry.

Primarily there is a need to address specific skills shortages in areas such as Engineering, Digital and Regulatory/ Quality. We must ensure our skills system is fit for purpose by being flexible and adaptable to give national coverage of all geographic areas.

At the same time, however, we must develop pathways which will enable Life and Chemical Sciences companies to recruit and develop experienced people as well as new entrants.

We are all aware of the wide diversity of roles found within the sectors. The Skills Investment Plan will help identify gaps in current training provision (be that vocational, graduate or CPD level) and allow the Skills Working Group to embed systemic change to ensure that every entrant to our sectors has access to clear training progression pathways that can be easily accessed by employers.

The Skills Investment Plan outlines the need for new Graduate Apprenticeships relevant to our industries, and highlights the need for more technical skills within the sectors that could be delivered through work-based learning. As well as this, the evidence base allows us to engage with Scottish universities to ensure that their curricula are relevant to the needs of Scottish industry. We will also be engaging with local initiatives such as Developing the Young Workforce groups to actively promote the sectors to new entrants.

Increasing the exposure and understanding of industry and enhancing the practical experience of those entering the sectors is also a priority. Undergraduate level industry placements will play a key role in this. Enhanced career information and guidance across the entire education route should be available to allow individuals to make informed choices on the direction of travel for their career, whether that be a vocation or academic route into the sectors.

In all of these themes it is industry itself which will take the lead, with Skills Development Scotland acting as facilitator by working in partnership with employers, academia, training providers and other key stakeholders.

Delivering the goals in this Skills Investment Plan will create more jobs, more investment, and a stronger, more sustainable Scottish economy. We cannot stress enough how important it is that we in industry participate in the delivery to the fullest extent possible.

1 Background

The Life and Chemical Sciences (LCS) Skills Investment Plan (SIP) is an industry-led partnership document, facilitated by Skills Development Scotland (SDS) on behalf of the Scottish Government. SDS has worked closely with industry to develop this SIP and will continue to work with industry and public sector partners in its implementation.

Purpose of original SIPs

Separate SIPs for the Life Sciences and Chemical Sciences sectors were published in 2014 with the following broad objectives:

- **attracting more talent into both sectors through:**
  - increasing the flow of new entrants to the sector
  - building graduate work readiness
  - improving the attractiveness of the sectors to new entrants
  - supporting and encouraging those returning to the sector
- **broadening and securing the talent pool:**
  - attracting and anchoring key skills
  - upskilling the existing workforce
- **ensuring that skills and training provision meets employer demand:**
  - building an accessible and responsive skills system.

1 Background continued

Definition

Both the LCS sectors operate on a global platform: Chemical Sciences being the second biggest exporter for Scotland[1], whilst Life Sciences manufacture products and provide services to an international market. The sectors supply and manufacture a wide range of chemicals and healthcare equipment, including drugs, active ingredients, fine chemicals and diagnostics. Sector activities are broad, ranging from the development of medical devices requiring precision engineered components to a comprehensive integrated pharmaceutical service solution from bench to bedside across a breadth of therapy areas.

For continuity, the LCS sectors have been defined using the two previous SIP definitions[2]. Originally, Life Sciences was defined by the Scottish Government Growth Sector definition and Chemical Sciences was defined following consultation with SDS and Scottish Enterprise (see Appendix A for SIC Code definitions of both sectors). It is acknowledged, that at times, these definitions may over or underestimate one or both sectors. Where appropriate, different definitions have been outlined and used within this SIP.

Rationale for merging SIPs

The current SIPs have been in place for four years. It is therefore timely to review their progress and ensure that SDS continues to support the skills needs identified by industry.

Furthermore, there is an increasing overlap in skills needs between the LCS sectors, and it makes sense to consolidate the skills strategies to acknowledge this. However, this combined approach should continue to deliver on the specific skills needs of the different subsectors within LCS.

Finally, considering feedback concerning the existing SIPs, it is imperative that the combined SIP is built around measurable and achievable targets. This will require sufficient resource allocation and an action plan that ensures progress to be monitored and evaluated.

[1] www.chemicalsciencesscotland.com/scottish-chemicals-sector/
[2] The SIP focus is the LCS industry as such the public sector (including NHS scientific workers) and academic sector is not included.

Scottish Government strategy

The Scottish Government undertook an extensive review of the enterprise and skills system between May 2016 and June 2017 with the goal of improving Scotland's economic productivity and growth. A significant outcome was the creation of a Strategic Board to work with the enterprise agencies (Scottish Enterprise (SE) and Highland and Islands Enterprise (HIE), and the proposed South of Scotland Enterprise Agency) and skills agencies (SDS and Scottish Funding Council (SFC)) to develop shared goals and ensure coordination of activities and accountability for achieving these[3]. In addition, the skills agencies will work more closely together. The creation of a new post, Director of Skills Alignment, will report to the Chief Executives of both agencies and be responsible for aligning and coordinating national and regional skills planning and provision through a five-step process:

1. skills demand assessment
2. provision planning
3. coordination of commissioning of skills provision
4. performance monitoring of provision
5. review and evaluation of skills programmes.

These activities will be supported through the creation of an Analytical Unit, tasked with providing the evidence base for decision making to the Strategic Board and each of the agencies.

At the centre of the Scottish Government's strategy for skills and education is the objective of equitable access for all regardless of gender, ethnicity, geographic location, or other factors that might disadvantage individuals in their access to the education system. While there is a focus on young people, there are also many opportunities for later life learning and retraining.

Work-relevant learning is a prominent theme, for example ensuring that young people at all levels of primary and secondary education have the opportunity to learn relevant skills for the workplace (e.g. through placements). Developing the Young Workforce[4] (DYW) is the main strategy to increase youth employment and ensure Scotland's young people have access to the right support and opportunities. An important aspect of the DYW strategy is 'regional curriculum planning' which is informed by SIPs and Regional Skills Assessments (RSAs). A Scotland-wide network of 21 industry-led regional groups has been created to bridge the gap between education and employers.

[3] Enterprise and Skills Review: Report on Phase 2 (Scottish Government, June 2017)
[4] Developing the Young Workforce. Scotland's Youth Employment Strategy (Scottish Government, December 2014)

1 Background continued

DYW is seeking to encourage and support employers to engage directly with schools and colleges, and to challenge and support employers to recruit more young people into their workforce.

The Scottish Government recently undertook a review of Science, Technology, Engineering and Mathematics (STEM) skills and training provision and industry needs in Scotland[5]. This identified the important role that employers have in education and training – in particular, to take account of how quickly industrial technologies are developing, thereby ensuring a better 'fit' between skills and training provision and what industry needs. This in turn should lead to improved economic outcomes and impact. Clustering and collaboration between all levels of the education system and industry is also seen as vital to maximise impact. A more joined-up approach may reduce duplication, help address the lack of resources, and deliver effective schemes, including industry placements, to improve work-readiness of those coming through the education system.

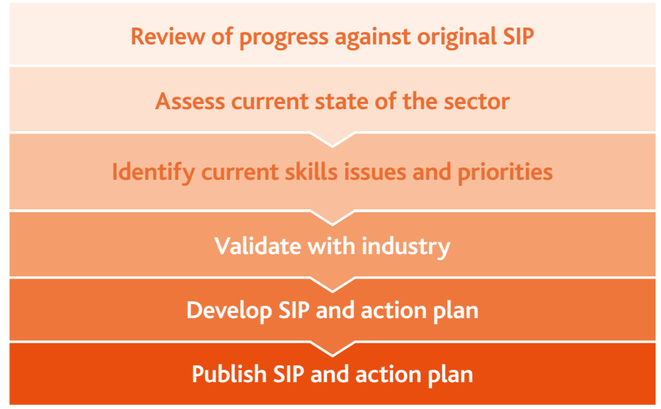
The Scottish Government are also using the Apprenticeship Levy to support skills, training and employment. The Flexible Workforce Development Fund (FWDF) is also available to organisations across the private, public and third sectors who are subject to the UK Government's Apprenticeship Levy[6].

Process undertaken in SIP development

The process of combining the Life and Chemical Sciences SIPs has been overseen by the joint LCS Skills Working Groups. It has been informed by the opinions of industry, representing different subsectors, company sizes and maturity, while also providing regional perspectives. It also incorporates input from stakeholders from public agencies and those representing the interests of different education providers and industry sectors.

Over 140 organisations were contacted, with input received from over 70 in the form of interviews, written statements and participation in workshops to discuss the initial findings of the review and development process. Figure 1.1 summarises this process.

Figure 1.1: SIP process



[5] Science, Technology, Engineering & Mathematics: Consultation on a Strategy for Education & Training (Scottish Government, March 2017)
[6] Scottish Government Response to the UK Government Apprenticeship Levy (December 2016)

2 Progress and achievements

Both the Life Sciences and Chemical Sciences SIPs provided a framework to address the skills issues within the respective sectors.

The SIPs:

- helped to simplify the skills landscape
- ensured a focused approach to address skills needs based on demand and supply side evidence base
- confirmed buy-in from industry, partners and key stakeholders with a strong governance structure.

To date, both the Life Sciences and Chemical Sciences SIPs have achieved many of their objectives against the three main themes:

- attracting more talent into both sectors
- broadening and securing the talent pool
- ensuring that skills and training provision meets employer demand.

There is an ongoing drive to enhance the scale and geographic reach of their impact and make these changes more sustainable in the long-term.

Examples of successful initiatives delivered through the SIPs to date are detailed in Table 1.

Four case studies are presented below to further evidence progress of both SIPs in more detail.

Table 1: Initiatives delivered from the Life Sciences and Chemical Science SIPs

Attracting more talent into both sectors	Broadening and securing the talent pool	Ensuring that skills and training provision meets employer demand
An industry designed laboratory and soft-skills course was developed. The course ran for three years for 40 underemployed/unemployed or newly employed students. Findings and recommendations fed into Royal Society of Biology accreditation programme.	Nine Chemical Sciences engineers were upskilled on the new industry-designed Automation and Control course. The one-day-per-week course lasted 28 weeks utilising SQA accredited units.	The Royal Society of Biology has developed accreditation to aid with embedding laboratory and soft skills into the university curriculum. Five Scottish universities have been awarded accreditation status.
Over 80 students have successfully completed placements through the Scottish Life Sciences Internship Programme. The Programme has seen almost 3,000 applications across 34 companies nationally. This is in addition to already existing work placement opportunities within both LCS sectors.	The Equate STEM Women Returners Programme supported 15 women through career clinics, site visits, networking and webinars. Resulting in two jobs secured to date. Equate has secured Scottish Government funding for a larger, Women Returners Programme working with 40 women and many more employers.	Industry has provided information appraising the demand for Modern Apprenticeships (MA) across the sectors. Demand for LCS related MAs has grown: the number of individuals In Training within LCS related MAs has increased by 82% since 2012/13.
A total of 936 S3 pupils from 21 different schools attended various science events throughout Scotland. These unique innovation and enterprise events combined industry-led practical activities to learn more about Life Sciences, Chemical Sciences, and Industrial Biotechnology careers. The activities have since been embedded back in the classroom.	A new Foundation Apprenticeship (FA) was developed in Scientific Technologies. There are over 200 places available on this new industry-led FA and over 400 Engineering places will be available from August 2018.	My World of Work (MyWoW) Life Sciences and Chemical Sciences pages were developed and improved. Both pages provide careers information for individuals entering the workforce.
Ten Life Sciences companies came together at the SECC Graduate Fair to showcase the diverse careers in Life Sciences. More than 4,000 students visited the SECC over the two days with 134 students captured on the registration tool. Many more students came to the stand for discussions with the companies.	A Chemical Sciences page was created on the Talent Scotland website to supplement other science areas and improve awareness and perception of careers in the area.	Research was undertaken to understand the landscape/current provision for LCS placements for undergraduate courses. Recommendations were incorporated into the Scottish Life Sciences Internship Programme.

Table 1: continued

Attracting more talent into both sectors	Broadening and securing the talent pool	Ensuring that skills and training provision meets employer demand
Industry driven Graduate Employability classes were developed and delivered at key universities across three regions in Scotland. A total of 22 organisations provided industry insight and career knowledge in areas not usually considered by students in the sector.	18 companies have benefited from leadership support through the Organisational Development aid provided through Scottish Enterprise. A further 14 organisations completed Leadership for Growth, whilst some 14 highly promising individuals took part in the industry-designed LCS Leadership Masterclass Programme to enhance the development of the leadership pipeline across the sectors.	The LCS Skills Working Groups has worked alongside the MyWoW Live team to develop and input into STEM activities.
Some 14 Life Sciences careers events were delivered at schools across the West, East and North East of Scotland, reaching 1,480 S2/3 pupils and 102 teachers.	TalentScotland provided immigration information and/or support to 11 Life Sciences companies (including four inward investors).	Research was carried out to understand the 'barriers to uptake' on the Life Sciences Modern Apprenticeship. Recommendations were used to develop bespoke marketing material resulting in several employers engaging in the apprenticeship programme for the first time.
Up to 15 industrial work placements were offered as a pilot programme to college students studying an HND in Chemical Process Technology.	Talent Scotland promoted Scotland as a global career location. 106 Life Sciences jobs advertised and a total of 250 Life Sciences companies profiled.	A Future Me career awareness campaign was aimed at S1-S3 pupils. Articles from LCS companies were provided (Marine Biopolymers and Cellucomp) to showcase the diverse careers.

Case Study: Scottish Life Sciences Internship Programme

The Scottish Life Sciences Internship Programme was developed in response to industry requests to enhance the work-readiness of graduates and help ensure graduates' CVs are of the standard expected by industry. The programme offers relevant, paid, work placements and exposes undergraduates to the diversity of roles within the Scottish Life Sciences sector. In turn, enabling individuals to make more informed career choices.

The programme is a true collaborative effort from SDS, AGCAS, ScotGrad[7] and industry, and has a strategic fit with the original Life Sciences SIP, aligning with several themes such as Building Graduate Work Readiness and Improving Attractiveness to New Entrants.

The programme is a national offering, with all Scottish universities that host a Life Sciences course invited to take part. It has been very attractive to students with almost 3,000 applications received and 81 places granted in the four years it has been running (Table 2). All applicants (successful and unsuccessful) received feedback about how to develop a CV.

The purpose being to ensure applicants are better aligned to the needs of industry in future. Some 34 companies have been involved to date. The programme is funded 50% by SDS and 50% from industry.

Employers have been very impressed with the quality of the students, with most employers offering recurring internships once they have participated in the scheme. The programme has allowed employers to complete specific project work, use the scheme as a recruitment tool and free up existing staff to do other essential work. Feedback from one company captured during the Evaluation of the Scottish Life Science Internship Programme[8] states:

"The interns got through a huge amount of work and freed up lab technicians to take on what they've been meaning to do for a while"

Table 2: Scottish Life Science Internship Programme - Student applications and places awarded (2014-17)

	2014	2015	2016	2017
Applications	Not recorded	759	1173	1042
Places	7	17	24	33

Source: Evaluation of Scottish Life Science Internship Programme (2018)

[7] A partnership organisation between AGCAS Scotland and Scottish Enterprise, HIE, Scottish Government, SDS and SFC.
[8] Scottish Life Science Internship Programme Evaluation (Ekosgen 2018)

Case Study: Scottish Life Sciences Internship Programme continued

Zara Puckerin, who conducted her placement at Reprocell, 2017 said:

"My time at Reprocell was invaluable. I learned so much about my strengths and weaknesses, gained real and relevant experience in the workplace, learned how important networking is, and made many new friends. I also realised that lab work isn't for me, but other aspects of the science work are, such as marketing."

Whilst the immediate output from this project has been a **higher calibre of CVs from students graduating with a Life Sciences qualification**, the overall outcomes for this programme have been much wider.

Findings from the Scottish Life Science Internship Programme Evaluation[9] found that:

- 77% of students agreed that the Programme provides the opportunity to gain an internship that is relevant to all students studying Life Sciences courses
- 82% of students had increased their awareness and understanding of the skills and capability needs of Life Sciences employers
- 78% of students had improved their understanding of jobs in the sector.

Life Sciences employers have also benefitted from the programme and reported to have:

- valued having bright, well-motivated young undergraduates working with them – employers stated the benefit of interns bringing new ideas and a fresh perspective to the workplace
- more confidence about employing locally – over a third of participant businesses have offered, or intend to offer, jobs to their intern and others have retained interns the following summer or for higher education research projects
- experienced an increase on business impacts/benefits. This has included commercial (increase in turnover, cost savings in recruitment) and wider benefits (an increase in productivity and the completion of research products)

The Scottish Life Sciences Internship Programme has grown exponentially since inception and is viewed by employers, students and partners as a valuable asset to the Life Sciences sector.

Source: scotgrad.co.uk, December 2017

[9] Scottish Life Science Internship Programme Evaluation (Ekosgen 2017)

Case study: The Royal Society of Biology: Accreditation for Skills and Outcomes

The Royal Society of Biology (RSB) developed an accreditation system which would address the needs of employers. Working with the ABPI, BIS, AstraZeneca and the academic community, RSB first developed a scheme for:

- advanced Accreditation - designed for graduates and employers looking for strong research skills (2012)
- accreditation - a more general, Bachelors-level accreditation which recognises expertise, skills and competencies in the Life Sciences sector (2015).

Both are outcome-based focusing on a skills-based approach rather than knowledge-based. In addition, the accreditation system employs a high level of flexibility, ensuring skills and competencies are properly addressed during a student's undergraduate career.

Since the launch in 2012 of Advanced Accreditation, and of Accreditation[10] in 2015, over 50 universities across the UK have successfully put themselves forward for the award.

The original Life Sciences SIP identified the need for the HE system in Scotland to better align with the current and future needs of employers. To that end, a short-term solution to address employer concerns around skills gaps in laboratory and soft skills was developed. The course (Laboratory Skills) was designed by industry with input from universities and the SFC and ran for three years at Edinburgh Napier University. The findings of the review of Laboratory Skills course were embedded into the RSB accreditation as part of ensuring a sustainable change to the skills system.

In total, five universities in Scotland have been granted accredited status[11]. All have demonstrated substantial changes in their teaching, focusing on laboratory and skills teaching to address employer concerns over the employability of graduates. Edinburgh Napier University's introduction of Good Laboratory Practice is now a core part of the curriculum and has had a major impact, not only on their programme, but in sharing their good practice with other Scottish universities.

[10] Royal Society of Biology Accreditation. www.rsb.org.uk/education/accreditation/Degree-Accreditation
[11] Glasgow Caledonian University; University of Aberdeen; University of Dundee; Edinburgh Napier University; and University of Strathclyde

Case study: Equate Scotland - Women Returners Programme

Women Returners Scotland aims to address the STEM skills shortage in Scotland by supporting professional women back into the workforce after a career break.

Delivered by Equate Scotland in partnership with Prospect and funded by Skills Development Scotland, the pilot supported 15 women to refresh their skills and knowledge and boost their confidence, resulting in Scottish Government funding for a larger programme in 2017, working with 40 women and more employers.

Support including workshops, one-to-one career clinics and webinars was boosted with additional online support from The Open University.

One employer to benefit from the programme was Eurofins Biopharma Services, a contract research organisation working with clients across the Life and Chemical Sciences.

A vacancy within the firm was advertised to the pool of female scientists supported through the programme, leading to Pinar Batat Buke beginning a placement with Eurofins in December 2017.

Pinar left behind an academic career after relocating from Turkey in 2013, and saw a placement as a start to her career in Scotland, with her chemistry background fitting well with career paths at Eurofins.

Managing Director Alison Clayton said: "I would recommend this approach to other employers as a way, not just to fill a role in the short term, but also attract some high calibre candidates and determine if there is a good fit for any longer-term opportunities."

Pinar added: "After years trying to find a job I am so happy. I have always enjoyed being a scientist. Wearing my lab coat, searching for answers is my life."

Case study: Work-Based Learning

With attracting new entrants to the sectors being a key theme of the previous Life Sciences and Chemical Sciences SIPs, Skills Development Scotland commissioned a study to better understand the barriers Life Sciences employers face in taking on an apprentice.[12]

The recommendations which emerged included improving awareness of Modern Apprenticeships, providing support to businesses, the importance of financial support and the need for improved communication between employers and training providers.

This resulted in a targeted marketing campaign to improve awareness of the apprenticeship pathway in the sciences. SDS produced bespoke marketing material, circulated to industries and used at key events throughout the sector.

This has increased awareness and understanding of the apprenticeship offering, with the Scottish Borders based Scotmas Group providing an example of the benefits.

Managing Director Alistair Cameron said: "Work-based learning is a crucial part of our training and development programme. It allows us to bring people on board quickly and immerse them in the culture and demands of an internationally focused organisation, whilst giving a structure and focus to their on-the-job training as they work to become a fully confirmed member of our team.

"We are now working with SDS and others within the industry to help develop new virtual learning tools that will allow our people to access the latest skills and safety training without the need to travel for expensive day release courses.

"Our investment in people through work-based learning has paid significant dividends and helped to allow our business to scale worldwide."

Foundation Apprenticeships are a new type of apprenticeship that helps senior school pupils in Scotland get qualified through work experience and work-based learning.

Providing qualifications which are at the same level of learning as a Higher (SCQF Level 6) and offering a range of positive post-school destinations and pathways to a future career. Foundation Apprenticeships widen the range of positive progression routes and post school destinations into employment including Modern Apprenticeships, Graduate Apprenticeships, FE and HE.

Modern Apprenticeships provide on the job experience while working towards a qualification, for example allowing people to train for a new job, or re-train for a new role. There are over 80 frameworks available with 'Engineering', 'Industrial Applications', 'Life Sciences', and 'Process Manufacturing' probably the most relevant to the LCS sectors.

Graduate Apprenticeships provide work-based learning opportunities for employees up to Master's level. There are currently 11 frameworks delivered in partnership with 12 university and college partners.

Rhona, Foundation Apprentice, Scientific Technologies

[12] Life Sciences Modern Apprenticeship Review (February 2015)

3 The contextual landscape

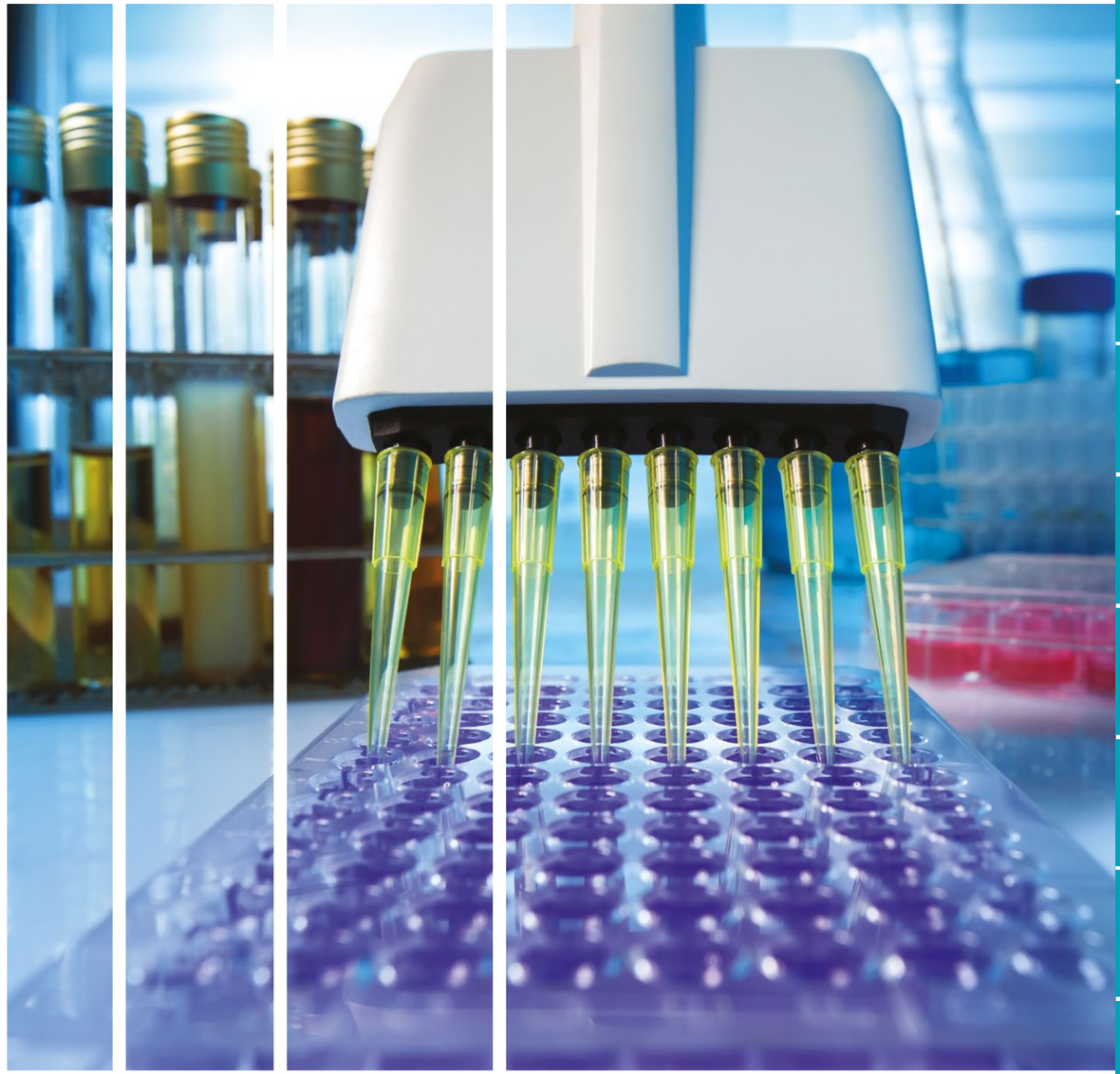
For the LCS sectors to remain competitive and productive they will require a highly skilled workforce.

Strategy and Policy Landscape

Skills is at the heart of the industrial strategy white paper (Industrial Strategy – building a Britain fit for the future) released in November 2017[13] and the Life Sciences Sector deal released in December 2017 (Industrial Strategy: Life Sciences Sector Deal)[14]. These emphasise the importance of technology education and investment needed in STEM skills.

This SIP considers the various industrial strategies developed at Scottish and UK level and their implementation plans. These include:

- Life Sciences Strategy for Scotland: 2025 Vision (February 2017)[15]
- Platform for Growth: A strategic plan for the Chemical Sciences in Scotland (2012)[16]
- Life and Chemical Sciences Manufacturing Strategy for Scotland (2015) and the subsequent action plan[17]
- Future Grangemouth Vision 2025 Evaluation of Economic Effects[18]
- The National Plan for Industrial Biotechnology 2015-2025 Building on Success[19]
- A manufacturing future for Scotland[20]
- Scottish Energy Strategy: The Future of Energy in Scotland[21]
- Making Things Last - A Circular Economy Strategy for Scotland[22].



[13] www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future
[14] www.gov.uk/government/publications/life-sciences-sector-deal
[15] www.scottish-enterprise.com/knowledge-hub/articles/publication/life-sciences-strategy-for-scotland-2025-vision
[16] www.scottish-enterprise.com/~/media/se/resources/documents/sectors/chemical%20sciences/platform%20for%20growth.pdf (Note opens as a PDF download in a new window.)
[17] www.scottish-enterprise.com/knowledge-hub/articles/comment/2015-manufacturing-strategy-for-life-and-chem-sciences
[18] www.chemicalsciencesscotland.com/content/uploads/2017/11/Future-Grangemouth-Vision-2025.pdf
[19] www.scottish-enterprise.com/knowledge-hub/articles/publication/scotlands-industrial-biotechnology-progress-report-2015-2025
[20] www.scottish-enterprise.com/knowledge-hub/articles/insight/scotlands-manufacturing-action-plan
[21] www.gov.scot/Publications/2017/12/5661
[22] www.gov.scot/Publications/2016/02/1761

3 The contextual landscape continued

Synthesising the above strategies identifies key implementation priorities for the Chemical Sciences sector which include:

- skills
- manufacturing
- industrial biotechnology
- development of the Grangemouth site.

Similarly, key implementation priorities for the Life Sciences sector include:

- innovation and commercialisation
- sustainable production
- internationalisation
- business environment.

All these priorities are supported by industry workstreams.

For the skills priority, a joint Chemical Sciences Scotland (CSS) and Life Sciences Scotland (LSS) group brings together members of the Chemical Sciences Skills workstream and members of the Life Sciences Business Environment workstream.

Drivers of change

Global and domestic drivers of growth are impacting on skills demand in terms of quantity, quality, and diversity of skills and the sectors' workforce. This includes the general challenge of achieving innovation whilst maintaining operational excellence and delivering on the specific skills required for both. Table 3 provides an overview of potential key drivers of change and skills implications which may impact the LCS sectors.

Table 3: Key drivers of change and skills implications which may impact the LCS sectors

Key driver of change	Skills implications
Regulation	The Industry Leadership Group (ILG) for Life Sciences has recommended that the UK Life Sciences regulation should not diverge from EU regulation post Brexit and should continue to see cooperation with the European Medicines Agency (EMA). Stringent quality compliance and regulatory demands, primarily from the US Food and Drug Administration (FDA), EMA and the Medicines and Healthcare Products Regulatory Agency (MHRA) continues to have implications for quality assurance/control/validation/qualified person skillsets.
Brexit	Employers require a diverse workforce to be creative and innovative. However, there is uncertainty over Brexit - changes or removal of free movement could have an impact on the pool of appropriate and available EU migrant labour in Scotland, and the UK. Any changes could create/exacerbate unmet demand for STEM skills and a reduced ability to recruit. Companies require experts and managers from the EU and overseas to be able to enter the UK at least as easily as at present. Any restrictions would have an impact on companies accessing highly-skilled talent entering Scotland.
Apprenticeship Levy	To meet key skills gaps and shortages the UK government introduced the Apprenticeship Levy. The purpose of the Levy is to encourage employers to invest in apprenticeship programmes and to raise additional funds to improve the quality and quantity of apprenticeships. Practical and technical skills are essential to the understanding of, and participation in, science, particularly for employment. Practical work improves the scientific knowledge and understanding of students, as well as providing opportunities for working scientifically and developing hands-on skills. Effective vocational training is integral to ensuring the technician workforce has up-to-date technical skills required by employers. The quality of practical and technical skill development depends on adequate resourcing, confident and competent teaching and appropriate pathways of training.
Industry 4.0	Job skills are changing rapidly as automation advances across almost every area of the LCS sectors. Training – or retraining – the workforce will be a huge challenge in the fourth industrial revolution. Simple tasks will be taken over by robots as factories and supply chains become ever more digitised; people will need to oversee these tasks, and must be multi-disciplined and able to adapt to changing roles.
Personalised medicine	The trend towards personalised healthcare is leading a shift from blockbuster products, applicable to large patient populations, towards niche products for more targeted patient populations. This is to provide the right treatment for the right patient. This development will generate a large volume of data that will require seamless and secure medical records and data recording systems. Increased IT and data recording including analysis of complex datasets, clinical informatics, patient administration and health records are likely to be in demand[23]. Developments in personalised and stratified medicine present an opportunity to deliver the required skillsets in health informatics and bioinformatics[24].

[23] Life Sciences and Pharmaceuticals: A Future Skills Review with Future Recommendations to Sustain Growth in Emerging Technologies (Cogent 2010), www.cogent-ssc.com/research/Publications/LSPReport.pdf
[24] Scottish Enterprise Insight: Personalised and Stratified Medicine: An Overview. www.scottish-enterprise.com/~/media/SE/Resources/Documents/STUV/Stratified%20and%20Personalised%20Medicine.pdf

Table 3: continued

Key driver of change	Skills implications
Digital health	Digital health is already accelerating the sector and putting the patient at the centre of treatment. Large data analytics is changing the value proposition of healthcare allowing real-time analysis about the effectiveness of certain medications in entire patient populations. This consumer-led digitisation of healthcare is already enormously powerful and empowering, allowing patients to search and self-diagnose. This is resulting in new tools for physicians and consumers to communicate with each other outside of doctors' surgeries. New technology is already impacting health. Understanding how to use digital techniques to be more efficient is an essential skill for a modern workforce. Individual health professionals and teams require training and support to develop their technical skills and confidence and to adapt their practice.
Data	The growth of more advanced data capture from patients (diagnostics, medical imaging and patient monitoring) and production plant processes is driving the need for information-based medicine, innovative monitoring and delivery mechanisms and prompting improved optimisation in manufacturing processes. This is resulting in a growing demand for bioinformatics and advanced data analytics skillsets at the interface of therapeutic manufacturing and medical devices.
Bioeconomy	A drive to reduce pressure on natural resources is likely to create opportunities for subsectors such as Industrial Biotechnology, and will require cross-disciplinary expertise[25]. Possible future growth of Industrial Biotechnology has the potential to develop a set of powerful tools for exploiting and optimising the efficiency of bioprocesses and the specific characteristics of biologically derived products (bioproducts). This increase in efficiency and specificity has great potential for moving industry along the path to sustainability and greater use of renewable resources. This will require new skills entering the labour market.
Energy	Publication of the 2050 Industrial Decarbonisation & Energy Efficiency Roadmap Action Plan[26] is an important landmark for UK Government and industry collaboration on decarbonisation and energy efficiency. The Scottish Energy Strategy[27] aims for Scotland is to be a world leader in renewable and low carbon technologies and services, with carbon capture and storage operational at a large scale. There is a clear role for the LCS sectors in supporting the achievement of this vision, particularly as providers of the enabling technologies which will facilitate the transition to a low carbon energy system.

[25] Sustainability – Global challenges, local opportunities (Scottish Enterprise, October 2011)
[26] www.gov.uk/government/publications/industrial-decarbonisation-and-energy-efficiency-action-plans
[27] www.gov.scot/Resource/0052/00529523.pdf

Table 3: continued

Key driver of change	Skills implications
Advanced Manufacturing	The Scottish Government published a paper on reindustrialising Scotland[28] that will increase innovation, tackle inequality, support internationalisation and create high-value, well-paid jobs. LCS manufacturing will see rapid advances in areas such as medicines manufacture, medical technologies, advanced therapy medicinal products (ATMP) and speciality chemicals. New technologies such as process analytical technology (PAT), a move from batch to continuous manufacturing, additive manufacturing (3D printing), robotics and automated systems will all impact on skills. A highly skilled workforce will need continuous development with a solid basis in IT supplemented with specialist knowledge of computer-aided design (CAD) and computer aided manufacturing (CAM) principles. Furthermore, with the onset of personalised medicine in the pharmaceutical industry "small molecule" production is moving towards lower volume, high value product runs. This will require redesign of future factories to be more flexible allowing them to be modular and movable across the globe.
Circular economy	A circular economy will look to Chemical Sciences to provide the basis of innovative products, made from renewable feedstocks e.g. agricultural and distillery by-products that have the potential to be reused or recycled. The substances that products are made from will increasingly be treated as a resource equal to the raw materials, and not disposed of. The ambition is to embed the development of new circular economy skills and thinking in the next generation of business leaders, designers and innovators. This SIP has the ambition to make sure Scotland's workforce has the right skills to take advantage of opportunities from a more circular economy, to ensure our businesses can innovate and prosper, now and in the future.
New technology	The LCS industries will continue to see disruption as technology makes innovation more affordable. Therefore, there will be a continuous need for workforce development in the face of rapid technological change. The blurring between the lines of these technologies and industries will see a need for interdisciplinary workers, generally at a higher skills level. Key areas of advances that will impact LCS will be: informatics, advanced robotics, automation, artificial intelligence, machine learning, advanced materials, biotechnology, synthetic biology, genomics, advanced therapies, material science and formulation.

[28] Reindustrialising Scotland for the 21st Century: A Sustainable Industrial Strategy for a Modern, Independent Nation (Scottish Government, June 2014)

3 The contextual landscape continued

Opportunities

When considering future demand for employees, it is important to remember that the nature of the LCS sectors is changing.

Within both LCS companies there is a move to adopt advanced manufacturing methods that are leaner and more versatile than traditional methods. Furthermore, companies, particularly in Life Sciences, are progressing from an exclusive focus on R&D and process development, towards full-scale commercial manufacturing. As they do, their requirements for specific skills are also changing. Many of the young companies in the sector will require employees that understand, and can implement, established methods of production that comply with Standard Operating Procedures (SOPs) and Good Manufacturing Practice (GMP). Individuals will be required to combine these with practical knowledge of the specific subsector the companies are operating in.

While knowledge of sector-specific SOPs and experience of GMP and/or Good Laboratory Practice (GLP) are seen as must-haves by industry, there is also the need for employees to have more multi-disciplinary skill sets.

Effective support for the development of advanced manufacturing has been highlighted by several reports and is an aspect that arose in many of the interviews in this study.

Manufacturing offers a wide range of career opportunities from unskilled work to highly skilled technical and managerial positions. To attract and retain the brightest young people (including from underrepresented groups) into manufacturing means promoting the reality of 21st century manufacturing opportunities which offer highly technical and well-paid careers, often in modern, progressive working environments. With a highly respected academic infrastructure serving manufacturing businesses, Scotland is ideally placed to build on this capability.

The SFC has funded the development of eight Innovation Centres in Scotland. The aim of the Innovation Centres is to foster collaboration between industry and academia as well as developing a highly skilled workforce at the cutting edge of technology, creating economic value. Six of the Innovation Centres are aligned to the LCS sectors:

- Stratified Medicine Scotland Innovation Centre (SMS-IC)
- Industrial Biotechnology Innovation Centre (IBioIC)
- Digital Health and Care Institute (DHI)
- The Data Lab
- Centre for Sensor and Imaging Systems (CENSIS)
- Scottish Aquaculture Innovation Centre (SAIC).

In this context, the IBioIC is beginning to provide relevant support to Scottish companies through its skills and training programme at PhD, MSc and HND levels. SAIC also have several skills related initiatives including championing the 'next generation of aquaculture leaders'. Since 2015, the skills programme has included undergraduate summer internships, MScs, a new PhD programme, and the graduate Junior Executive Development Programme.[29]

Other centres that will be relevant for the training of a future workforce in advanced manufacturing include the recently launched National Manufacturing Institute for Scotland (NMIS), and the proposed Medicines Manufacturing Innovation Centre (MMIC). Industry is further supported in this area by the Advanced Forming Research Centre (AFRC), part of the High Value Manufacturing (HVM) Catapult, which is running the new Lightweight Manufacturing Centre. These world-class hubs are also underpinned with the research and training provided by Scottish Manufacturing Advisory Service (SMAS), Centre for Continuous Manufacturing and Crystallisation (CMAC) and Edinburgh Complex Fluids (ECF) that will transform current manufacturing processes and provide the knowledge and training for a highly skilled workforce.

Out-sourcing, particularly in the pharmaceutical services environment, will present opportunities for Scotland's Life Sciences sector. Contract Research Organisations (CRO) will have the ability to impact on drug development across the whole drug discovery value chain, from early drug discovery to clinical research, manufacture and formulation. This is again underpinned by a highly skilled workforce that can take advantage of the need to submit complex data packages in a highly regulated environment. The 'Team Scotland' approach that has a strong collaboration across NHS, academia, Government and industry maximises the impact of the highly valued skills sets Scotland has at its disposal in this area.

Scotland also has the edge when it comes to Medical Technology (MedTech) opportunities. The subsector has a highly talented workforce with expertise in everything from non-imaging diagnostics and surgical instruments to ophthalmic surgery and cardiovascular therapies. This highly skilled and flexible workforce is also underpinned by a dedicated Medical Devices Doctoral Training Centre at the University of Strathclyde.

[29] issuu.com/fishfarmermagazine/docs/fish_farmer_magazine_march_2018

3 The contextual landscape continued

Worldwide, Scotland ranks among the top three for research productivity and impact, home to 19 universities and 12 further education institutions, and world leading research centres that attract some of the brightest international scientists. This powerhouse of talent generation should not be underestimated and aligning industry need with Scotland's high-quality research base can translate academic successes into tangible benefits for both individual businesses and the entire industry.

The university education system tends to provide the vast majority of new entrants to the sector however, larger employers tended to report that such individuals can be better sourced via work-based learning e.g. apprenticeships. Broadening entry routes to the sectors can support the development of a diverse workforce which in turn will improve the overall productivity of the sectors. In that regard, we should exploit the extensive and often under-utilised college network in Scotland. Despite recent policy initiatives to promote more vocational and technical routes into the sciences, the recruitment culture of university graduates persists. In terms of typical routes into LCS careers, there is a perception that university education generates operational managers, whilst college education (HNC, HND and MAs) generates operational 'doers'.

However, because of historic trends in young people pursuing university education, there is a big gap at the operational technician level in LCS. Some employers suggest that the supply pipeline that drives students towards academic degrees is therefore generating wasted talent.

4 Sector characteristics

The LCS sectors in Scotland are a major contributor to the economy.

Overview of Life and Chemical Sciences sectors

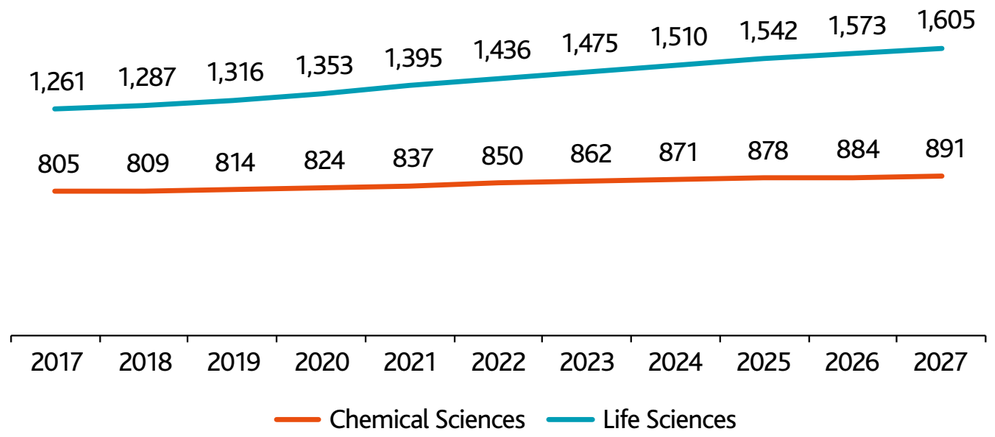
According to Scottish Government statistics[30], Gross Value Added (GVA) in the combined LCS sectors was just over £1.7 billion and turnover was almost £3.8 billion in 2014. There are ambitious plans to extend both sectors substantially in the next five to ten years, for example, increasing turnover in the Life Sciences sector to £8 billion by 2025[31] and increasing exports in the Chemical Sciences sector by 50% by 2020[32].

Furthermore, there is an ambitious goal to increase manufacturing turnover in the combined LCS sectors from £9.5 billion to £15.2 billion by 2020[33], to be achieved through:

- supporting leadership in the sector
- commercialisation of research activities
- supporting scale-up
- developing the supply chain
- securing new and inward investment.

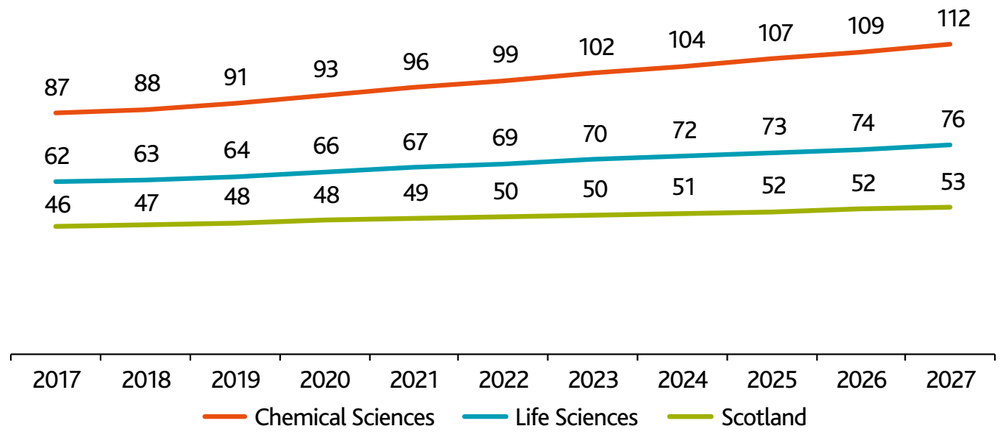
[30] Scottish Annual Business Statistics (2014)
[31] Life Sciences Strategy for Scotland 2025 Vision (Scottish Enterprise, January 2017)
[32] Life and Chemical Sciences Manufacturing Strategy for Scotland (Scottish Enterprise, September 2015)
[33] Life and Chemical Sciences Manufacturing Strategy for Scotland (Scottish Enterprise, September 2015)

Figure 4.1: GVA by LCS sectors (2017-2027) - £ million



Source: Oxford Economics Forecast Database. Constant 2013 prices

Figure 4.2: GVA per job (2017-2027) - £ thousands



Source: Oxford Economics Forecast Database (2017). Constant 2013 prices.

4 Sector characteristics continued

Altogether, the LCS sectors are expected to contribute an additional £5.6 billion of turnover per annum to the Scottish economy (2015-2020)[34]. However, the LCS sectors are highly diverse, in terms of technology, application and company size, and realising this growth will require a workforce with an equally diverse and high level of technical and soft skills.

Oxford Economics Forecast Database (2017) further evidences the ambitious growth targets[35]. Life Sciences sector GVA is forecast to grow by 27% over the period 2017 to 2027 (inclusive). This is substantially higher than the national GVA growth rate of 18%. Chemical Sciences sector GVA is also predicted to increase, although to a lesser extent by 11% (Figure 4.1).

Although the Chemical Sciences and Life Sciences sectors are relatively small in employment terms (see Chapter 5), both sectors are highly productive, and generate above average GVA per job (Figure 4.2). Chemical Sciences and Life Sciences are the second and third most productive sectors, behind that of Energy (2017)[36].

Similar to GVA per sector, productivity is also forecast to increase over the period 2017 to 2027 (inclusive). Chemical Sciences is forecast to experience an increase in productivity of 29%, whilst Life Sciences is anticipated to improve by 22%, both outperforming the national rate of 14%[37].

Direct and indirect businesses - narrow definition

The above definitions are based on Scottish Government key sector definition and SIC codes. It is relatively easy to characterise the Chemical Sciences sector using SIC codes 20.1 to 20.5, for the Manufacture of various chemicals and materials, and 21, for the Manufacture of pharmaceuticals and their preparations. However, the Life Sciences sector represents a broad range of activities that do not align well with SIC codes. For example, most analyses use the following SIC codes to classify the Life Sciences sector:

- 21: Manufacture of basic pharmaceutical production and pharmaceutical preparations
- 26.6: Manufacture of irradiation, electromedical and electrotherapeutic
- 32.5: Manufacture of medical and dental instruments and supplies
- 72.11: Research and experimental development of biotechnology
- 72.19: Other research and experimental development on natural sciences and engineering.

However, many Life Sciences companies are classed under different SIC codes including 62.09 (Other information technology service activities), 74.90/9 (Other professional, scientific and technical activities not elsewhere classified) and 86.90 (Other human health activities). What this means is that official statistics may be under-representing the scale of the Life Sciences sector.

To address this issue, a more empirical approach was adopted here to characterise the business base within the Scottish LCS sectors. A number of sources, including Scottish Enterprise's databases of companies in the LCS sectors and trade association member lists, have been used to identify the complement of companies.

Business characteristics

A total of 877 companies have been identified in the LCS sectors within Scotland. Of these, there are **476 companies** undertaking research and technology development (RTD), manufacturing, or delivering clinical research, diagnostic or testing services. **These are the companies whose skills needs are the focus of this SIP.**

The remaining companies include legal, financial, business consultancy and related services, university research centres and enterprise services, and companies which sell or distribute LCS products. These companies are not the focus of this SIP.

Some **60% of companies operate in the Life Sciences sector** exclusively, **30% in Chemical Sciences** and the remaining **10% operate in both sectors**.

Figure 4.3 provides an overview of the **476 companies across the subsectors** (further details of these subsectors are provided in Appendix B). Some 153 companies operate across two or more subsectors.

Over one in five companies operate in Pharma, Pharma Services and Contract Research (21%) followed by 19% in MedTech.

In terms of size, the majority of companies are micro/SMEs similar to the wider Scottish business base composition.

LCS companies are spread across Scotland with concentrations in Edinburgh and in Glasgow (see Appendix C).

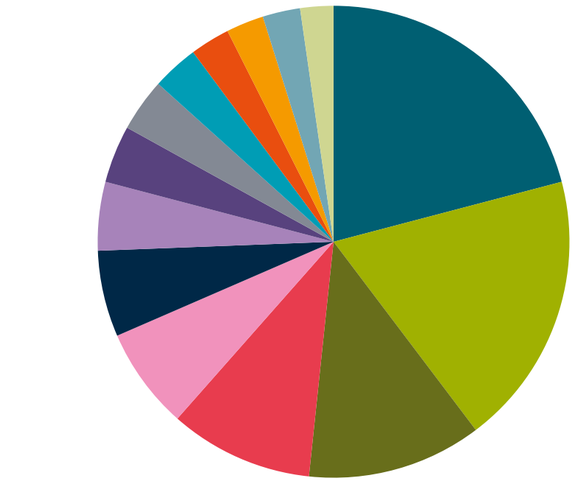
More specifically:

- the vast majority of Pharma, Pharma Services and Contract Research companies (73%, or 101 of 138) are located around Edinburgh, Glasgow, Lanarkshire or Tayside
- MedTech, Speciality Chemicals and Consumer Chemicals companies are more evenly spread across Scotland
- over 60% of Bio and Health Informatics companies are located around Edinburgh and Glasgow
- the majority of Digital Health companies are located around Edinburgh, Glasgow or in the Highlands and Islands
- Edinburgh has the highest number of Industrial Biotechnology companies (33%, or 7 of 21), followed by Highlands and Islands (14%, or 3 of 21).

[34] Life and Chemical Sciences Manufacturing Strategy for Scotland (Scottish Enterprise, September 2015)
[35] It should be noted the Oxford Economics Forecast data is likely to be a conservative forecast
[36] Oxford Economics Forecast Database (2017)
[37] Oxford Economics Forecast Database (2017.

4 Sector characteristics continued

Figure 4.3: Distribution of businesses in the Life and Chemical Sciences Subsectors



- Pharma, Pharma Services and Contract Research 138, 21%
- MedTech 124, 19%
- Speciality Chemicals 79, 12%
- Consumer Chemicals 65, 10%
- AgriTech 46, 7%
- Therapeutics 39, 6%
- Other 31, 5%
- Professional Services 26, 4%
- Digital Health 24, 4%
- Industrial Biotech 21, 3%
- Commodity Chemicals 18, 3%
- Stem Cell and Regenerative 17, 2%
- Bioinformatics and Health Informatics 17, 2%
- Materials 15, 2%

Note: 153 companies operate across two or more sub-groups, as such the base figure is 660 data points. Source: Internal Scottish Enterprise Database for Life and Chemical Sciences

Business research and development
The Life Sciences sector, as a whole, has seen substantial investment in research and development; although the level of investment decreased to 66% of 2001 levels by 2012. Nevertheless, Pharmaceuticals still accounted for £126 million business expenditure on R&D[38] in 2012, while business expenditure in Scientific Research and Development services (SIC code 72) increased by 283% from £20 million in 2001 to £57 million in 2015.

Combining available data for the LCS sectors ('Pharmaceuticals', 'Chemicals and Chemical Products', 'Research and Development Services') details LCS to have the largest business expenditure on R&D across Scotland: 23.2% of total in 2012[39].

Spin-out companies
The number of Life Sciences spin-out companies from universities in the UK has risen from circa 290 to circa 330 over the period 2006-10 to 2012-16[40]. Over 40 Life Sciences companies have started from 2012 to 2016, accounting for 13% of all start-ups in the UK. Nearly three quarters of Life Sciences start-ups in Scotland are university spin-outs, this is larger than other regions in the rest of the UK.

Three universities: Glasgow, Edinburgh and Strathclyde lead the way in Scotland is terms of Life Sciences spin-out companies from universities.

Information relating to the number of Chemical Sciences spin-out companies is not readily available.

[38] Business Enterprise Research and Development in Scotland (2016)
[39] Business Enterprise Research and Development in Scotland (2016)
[40] UK Life Science Start-up Report 2017

5 Skills demand

According to BIS[41] there are almost 222,000 people employed in over 5,600 Life Sciences companies in the UK.

Current and future employment in the UK

The **biopharmaceutical service and supply**, and **core medical technologies** are substantial subsectors in Scotland with **159 and 146 companies operating respectively** in each and with **turnovers of over £1 billion**. Respectively, these subsectors account for 10% and 7% of the total UK employment in the LCS sectors.

In terms of the future, the Life Sciences sector is growing considerably, whereas Chemical Sciences is in a period of consolidation or, at best, modest growth. The Life Sciences sector is relatively young and there are many different products and services being developed such as novel medical technologies, new medicines and diagnostics. The Chemical Sciences sector, in contrast, is mature. Both will continue to have a substantial impact on the Scottish economy and there will be a continued demand for skilled workers in the sector.

MedTech and Industrial Biotechnology are predicted to be the fastest growing subsectors over the period to 2025[42] although Digital Health saw the fastest growth rate, of 23%, from 2010 to 2015.

[41] Strength and Opportunity 2015. The landscape of the medical technology and biopharmaceutical sectors in the UK (BIS, 2015)
[42] The Demand for Skills in the UK Science Economy, Science Industry Partnership (Cogent, March 2016)

5 Skills demand continued

In terms of the skill issues facing these sectors, demand from UK industry for technical-level staff will be 'between 4,000 and 6,000 per year over the next 10 years' and at the graduate and post-graduate level around '10,000 per year over the next 10 years'[43]. Although there will be sufficient numbers of graduates to meet this demand, there is predicted to be a lack of technicians. This study identifies the Pharmaceuticals and Biotechnology industries as the largest recruiters of graduate and post-graduate students.

What this means in practice is that technical positions will be filled by graduates that are over-qualified for the role and lack relevant practical experience. Many of these individuals are likely to become dissatisfied with the work and pay associated with these positions and, as a result, they will only stay in post for a short period to gain the necessary experience to take on a role more suited to their qualifications. This will effectively exacerbate the shortage of skilled technician-level individuals in industry.

Current employment in Scotland[44]
Data from Oxford Economics[45] indicates that there were over **20,300 jobs in the Life Sciences sector** and over **9,200 in the Chemical Sciences sector** in Scotland in 2017[46]. For the Life Sciences sector, this should be taken as a conservative estimate as other sources place the Scottish Life Sciences sector workforce at over 30,000[47].

At present, 40% of those employed in the Chemical Sciences sector are employed in higher level occupations (SOC Code 1-3[48]), 29% are in middle level roles (SOC 4-6) and 31% are lower level roles (SOC 7-9). The Life Sciences sector has a greater proportion of individuals in higher level roles: 61%, 24% in middle level roles, and 15% in lower level roles (Figure 5.1).

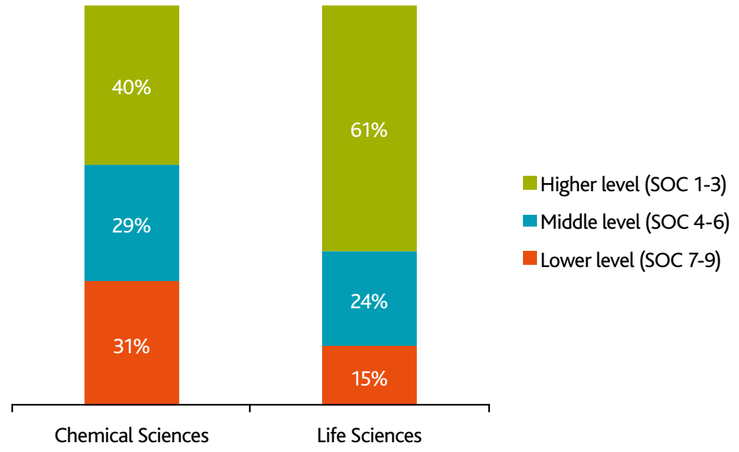
Past employment in Scotland
Both sectors experienced employment losses in 2008 resulting from the recession (Figure 5.2). Employment within the Life Sciences sector bounced back and has been above pre-recession figures since 2016. Employment in the Chemical Sciences sector, however, remains around 2,300 jobs below pre-recession figures.

Future employment in Scotland
Data from Oxford Economics reveals that, over the forecast period (2017-2027 inclusive), employment within the Life Sciences sector is expected to grow by 5% (equivalent to 1,100 new jobs).

In contrast, the Chemical Sciences sector is expected to contract by 14% (equivalent to -1,300 jobs, Figure 5.3). However, with the emergence of Industrial Biotechnology, the Industrial Biotechnology National Plan[49] forecasts growth of 1,400 new jobs in this area by 2025.

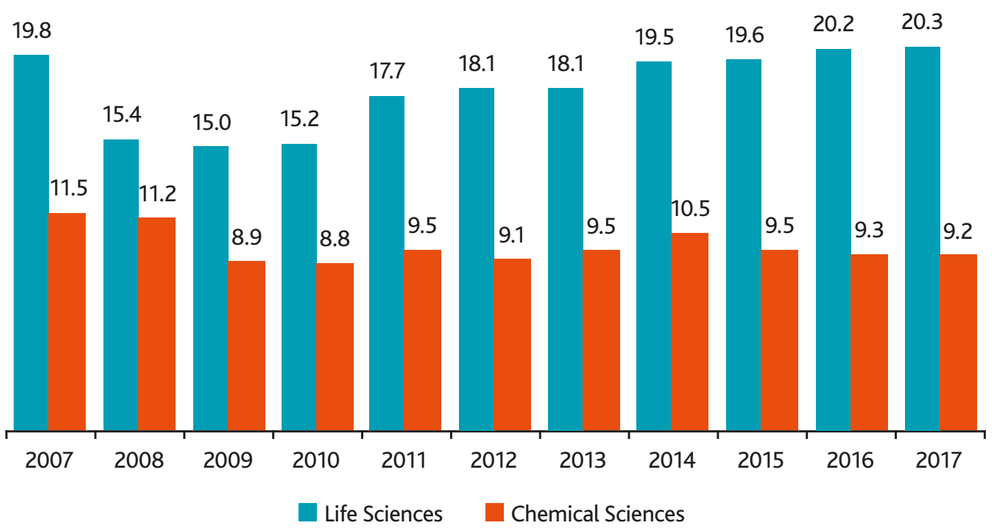
[43] The Demand for Skills in the UK Science Economy, Science Industry Partnership (Cogent, March 2016)
[44] Based on wider definition – See Appendix A
[45] Oxford Economics Forecast Database (2017).
[46] Note: 2017 is forecast data
[47] For example, Scottish Enterprise estimates that over 37,000 people are employed in the LS sector (Scottish Economic Facts, February 2017), however this data includes Higher Education Institutions, and companies providing services to the LS sector (as described later in this section).
[48] Standard Occupational Classification (SOC) codes – see Appendix D for further details
[49] www.scottish-enterprise.com/knowledge-hub/articles/publication/scotlands-industrial-biotechnology-progress-report-2015-2025

Figure 5.1: Occupational SOC level profile in Chemical Sciences and Life Sciences (2017)



Source: Oxford Economics Database (2017)

Figure 5.2: Employment (000's, jobs) in LCS in Scotland, 2007-2017



Source: Oxford Economics Database (2017)

5 Skills demand continued

Chemical Sciences
The Chemical Sciences sector is mature and as such it is expected that the majority of the total requirement for new employees will come from the need to replace workers leaving the sector (due to retirement and other factors) rather than through expansion (growth). This is supported by feedback from companies suggesting the age profile in the Chemical Sciences sector is weighted towards those in their late forties and fifties, meaning that replacement requirement in Scotland will be significant over the next 10 to 15 years.

Data from Oxford Economics[50] confirms this, suggesting 2,200 workers will leave the sector over the forecast period (2017-2027 inclusive) and will need to be replaced. This is also in line with UK figures quoted by the Science Industry Partnership stating that, based on employment in 2017, 24% of the sector's workforce will need to be replaced by 2027. Due to overall employment decline however, the sector's net requirement for workers up to 2027 will be **900 employees**.

The occupational profile of the sector is forecast to remain the same as the 2017 profile, with 41% of the sector employed in higher level occupations, 29% in middle level, and 31% in lower level.

Life Sciences
In contrast, feedback from Life Sciences companies suggests a broader workforce age demographic including a greater proportion of younger people. This is reflected in the large number of relatively young companies that are experiencing significant growth, particularly in the Pharma, Pharma Services and Contract Research industries.

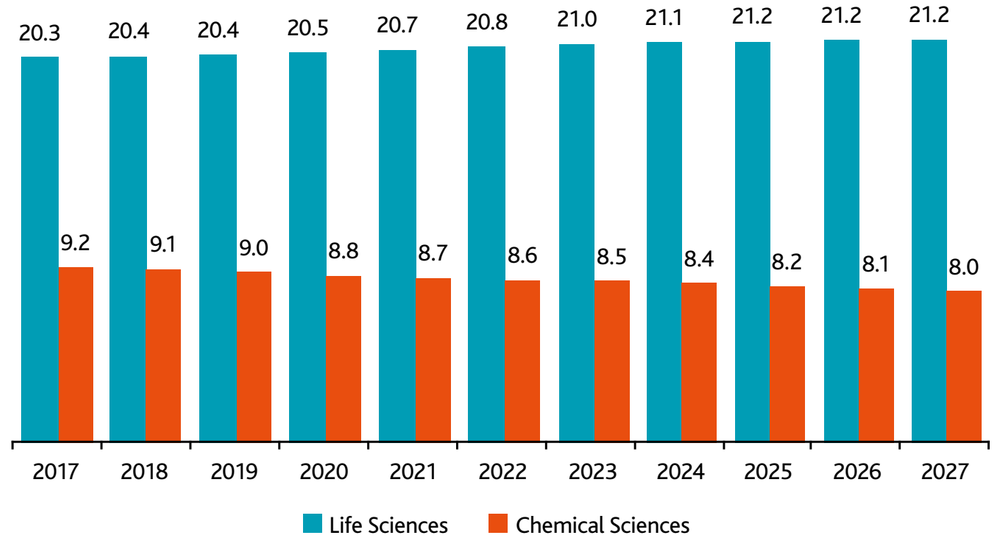
As such there is expected to be high demand for both new employees and replacement employees over the next 10 years (2017-2027 inclusive). This will equate to around 1,100 new employees and 1,800 replacement employees over the forecast period resulting in a net requirement of **2,900 people**[51].

Life Sciences occupational profile is forecast to become even more skilled. By 2027, 63% of individuals employed in the Life Sciences sector will be in higher level roles (2% increase from 2017); the proportion of middle level roles will remain constant (24%) whilst lower level roles will contract by 2%, settling at 13%.

If we extrapolate from the Science Industry Partnership at a UK level[52], and assume that the Scottish workforce accounts for between 7% and 10% of the total UK LCS sectors[53] demand is forecast to be closer to **between 700 and 1,000 graduates and between 280 and 600 technicians in the combined LCS sectors every year for the next ten years**[54].

[50] Oxford Economic Forecast Database (2017)
[51] Oxford Economic Forecast Database (2017)
[52] The Demand for Skills in the UK Science Economy, Science Industry Partnership (Cogent, March 2016)
[53] Based on BIS estimates
[54] Note: forecast figures are based on extrapolated data

Figure 5.3: Forecast employment (000's, jobs) in LCS in Scotland, 2017-2027



Source: Oxford Economics Database (2017)

5 Skills demand continued

Recruitment
In terms of evidence of the demand for skilled employees in the LCS sectors, Talent Scotland[55] posted 1,459 relevant job adverts in the period 2011 to 2016, of which:

- most of these adverts were for positions in Pharma, Pharma Services and Contract Research (44%), and MedTech (24%), both of which are forecast to be significant employers over the next ten years
- the majority of the positions that were advertised were entry-level (mainly technician and scientist posts) or mid-level (a mix of senior scientific and technical roles, management and quality assurance/ regulatory), which fits well with the skills demands identified within this SIP study
- regionally, many of the jobs offered are concentrated in the central belt, in particular around Edinburgh and up towards Stirling, which mirrors the main business locations.

Skills shortages
Companies that participated in the SIP development process identified a number of skill shortages including informaticians, computer scientists, technicians, production and process operators, and individuals with regulatory, quality control and assurance expertise (Table 4).
This is mirrored by the research of the Science Industry Partnership[56] and ABPI[57].

There are also skills gaps where employees are required to combine one or more of these specific skills with knowledge of the Life Sciences and/or Chemical Sciences sectors. Individuals with these combined skills-sets will be needed to deliver: the industrialisation and scale-up of biotechnology; embed informatics and computational science knowledge (which will be essential to digital health applications, and digitalisation and automation of industrial processes, or Industry 4.0); and deliver efficiency gains in the manufacture of chemicals and biologics.

However, in some cases companies reported finding it difficult to recruit the right candidates, even from outside Scotland, suggesting that the skills required are hard to find and likely to be sought-after across the globe. In addition to technical skills, 'general business or commercial skills' are those most sought after. These findings are echoed in the interviews carried out to perform the update of this research.

These studies support the conclusion that Life Sciences, and Chemical Sciences, where there is the opportunity to adopt biotechnology processes (e.g. in the manufacture of pharmaceuticals), are global growth areas, and areas that will require a new approach to the provision of skills and training in the future.

Table 4: Skills shortages reported by employers

Skill	Reason
Engineering skills	Most commonly needed across both LCS manufacturing companies and those that are developing or upscaling process technologies. Applies to all skill levels and includes plant operatives, maintenance, mechanical, electrical, electronic, process control and software technicians and engineers.
Digital skills (data, software and informatics)	The increase in automation and digitalisation of manufacturing processes and research, technology and development (RTD) has led to an increase in demand for digital skills. In most cases these skills are required in conjunction with a Life Sciences and/or Chemical Sciences knowledge base.
Regulatory, compliance, quality management, quality assurance, quality control, GMP, GLP and the ability to follow SOPs	Companies believe that this is an area that is not given sufficient prominence within the education system, both to make individuals aware of the opportunities at an early stage in their career, and also to provide the necessary training to become proficient in such a role. In most cases, such individuals must have a strong technical background in the industry before developing the regulatory understanding. As a consequence, individuals with these skills sets are difficult to source externally and most companies have developed their own in-house training and make internal appointments.
Advanced manufacturing (cell therapy and regenerative medicine which require specific aseptic techniques to use within a clean-room environment)	Companies believe there is insufficient curriculum and career awareness in this area. This is further exacerbated by the lack of facilities to upskill existing staff.
Individuals that combine business, commercial, entrepreneurial and leadership skills with sector knowledge	The perception is that business and commercial skills are not being taught in universities and are considered a poor career choice by both students and their lecturers. These are viewed by most companies as the most important non-technical skills, together with communication and team working.

[55] www.talentscotland.com
[56] The Demand for Skills in the UK Science Economy, Science Industry Partnership (Cogent, March 2016)
[57] The skills gap in the biopharmaceutical industry: Maintaining the UK's leading position in life sciences (ABPI, November 2015).

6 Current provision

Interventions at secondary school level (or earlier) are essential to ensure sufficiently interested and suitably qualified individuals enter the FE and HE systems and ultimately the LCS workforce.

The school population has been decreasing over several years (the number of 12-18 year olds in Scotland declined by almost 14,000 between 2010 and 2016[58]). These decreases, combined with students taking fewer subjects on average through the Curriculum for Excellence, have resulted in entries to National Level STEM subjects decreasing by 9% between 2010 and 2016 (see Appendix E for more detail).

Entries in Advanced Higher STEM subjects (and, to a lesser extent, Highers) have bucked the trend, and have increased over the same timescale.

The number of STEM passes fluctuated by level and by STEM subject. Overall, the number of National STEM passes has declined by 19% (2010 to 2016), Higher passes remained constant, and the number of Advanced Higher passes increased by 17%.

In terms of gender balance there are still fewer females than males taking STEM related subjects: 44.3% at National level, 45.5% at Higher level, and 42.1% at Advanced Higher level in 2016.

In total 95.4% of school leavers in Scotland in 2016 had a National STEM qualification, 35.4% at Higher and 8.5% at Advanced Higher[59].

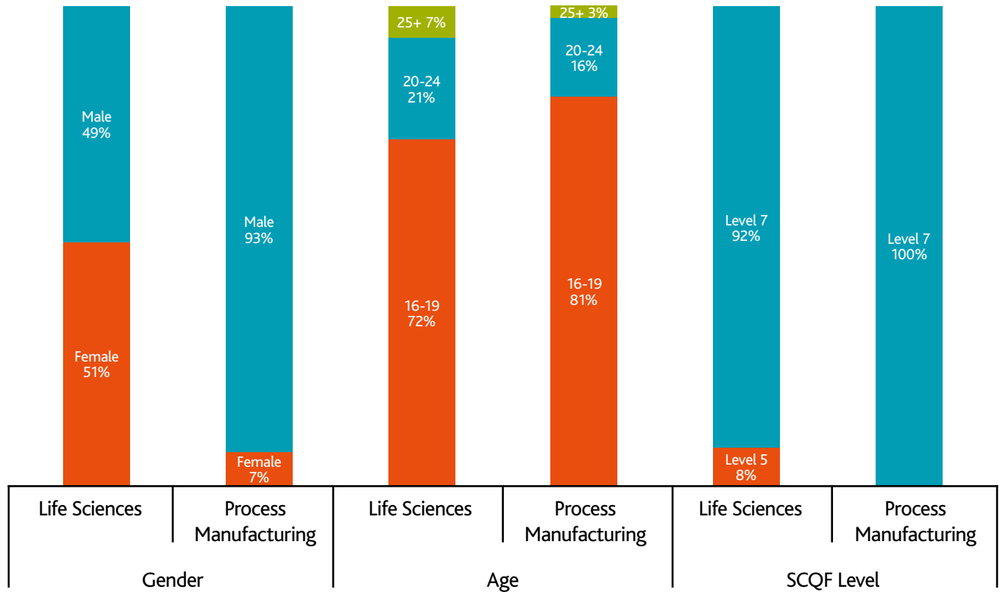
[58] www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-estimates/mid-year-population-estimates/population-estimates-time-series-data
[59] Developing a Scottish STEM Evidence Base (Ekosgen, 2017)

Table 5: LCS related Modern Apprenticeships (2012/13 and 2016/17)

	2012/13					2016/17				
	Starts	Leavers	Achievement	Achievement Rate	In Training	Starts	Leavers	Achievement	Achievement Rate	In Training
Life Science and Related Activities	21	16	13	81%	36	19	31	23	74%	61
Process Manufacturing	37	4	3	75%	61	24	43	41	95%	116
Total	58	20	16	80%	97	43	73	64	88%	177

Source: Skills Development Scotland

Figure 6.1: In-training characteristics for Modern Apprenticeships: Life Sciences and Related Activity and Modern Apprenticeships: Process Manufacturing (2016/17)



Source: Skills Development Scotland

6 Current provision continued

Work-based learning

One of the key recommendations of Sir Ian Wood's review on developing the young workforce was to "develop better connectivity and co-operation between education and the world of work to ensure young people at all levels of education understand the expectations of employers, and that employers are properly engaged"[60]. The Scottish Government set ambitious targets to ensure this connectivity is delivered through a partnership of schools, colleges/ training providers and employers.

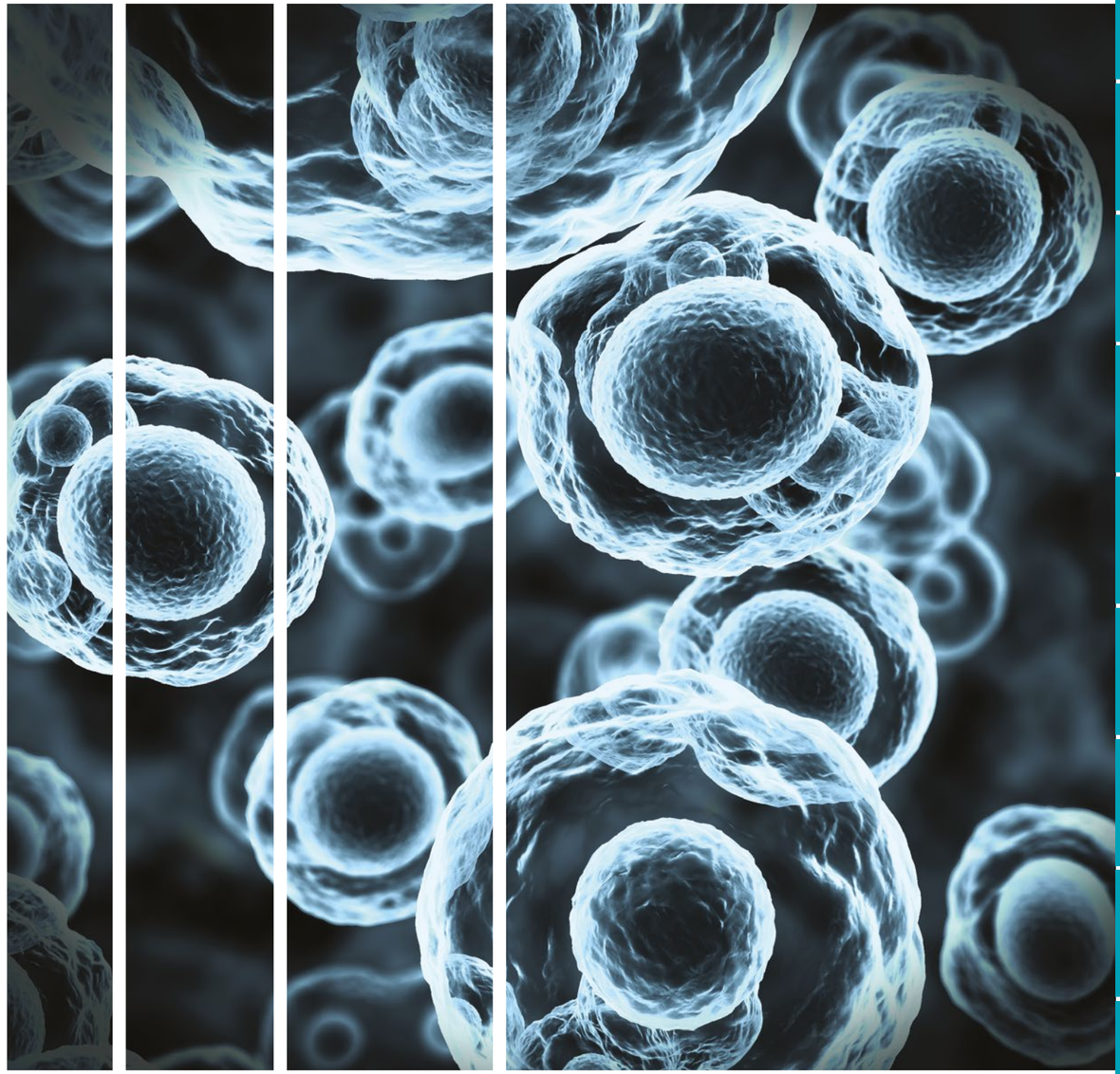
Foundation Apprenticeships

The Foundation Apprenticeship programme was first piloted in 2014, when there were over 70 learners on the Engineering framework. Since the pilot years of 2014 and 2015, the programme has grown in terms of the number of young people starting a Foundation Apprenticeship, the number of colleges and schools involved and the breadth of frameworks and geographic coverage. A total of 12 Foundation Apprenticeship frameworks will be available in 2018.

In the 2016-18 cohort, over 70 young people started a Foundation Apprenticeship in Engineering.

A Foundation Apprenticeship in Scientific Technologies is now available, having been developed through industry engagement. The Foundation Apprenticeship aims to give pupils in S5 and S6 the opportunity to develop the skills and knowledge to work towards an SVQ at SCQF Level 6 and enter a career in the science-based industries.

From August 2018, there will be over 200 Scientific Technologies Foundation Apprenticeship places and over 400 Engineering Foundation Apprenticeship places available across the country.



[60] Developing the Young Workforce. Scotland's Youth Employment Strategy (Scottish Government, December 2014)

6 Current provision continued

Modern Apprenticeships
There are two main Modern Apprenticeships frameworks utilised by the LCS sectors:

- Life Sciences and Related Science Industries available at:
  - Level 2 (SCQF Level 5)
  - Level 3 (SCQF Level 7)
- Process Manufacturing at Level 3 (SCQF Level 7).

In 2016/17:

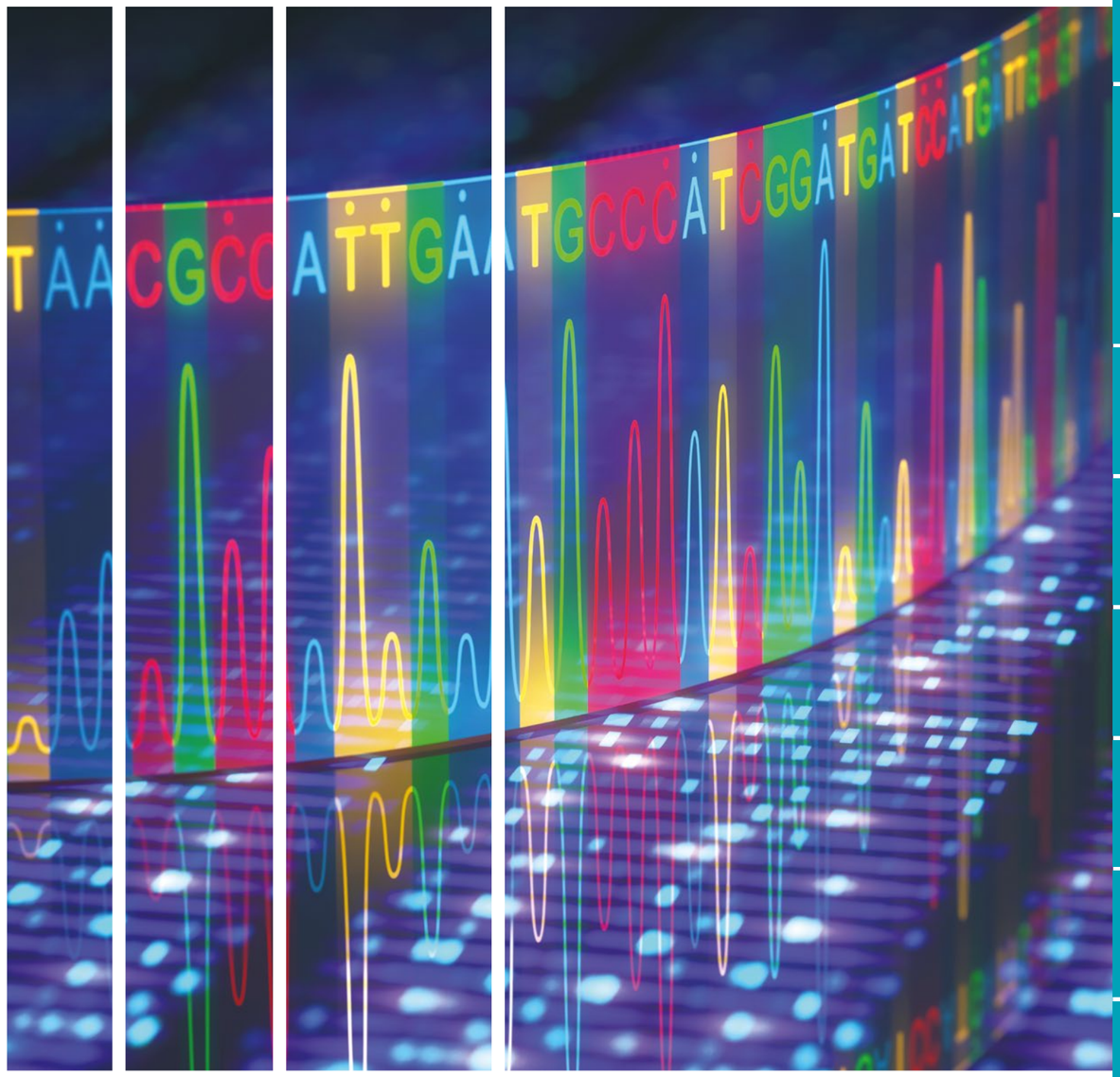
- 43 individuals began a Modern Apprenticeship relating to LCS
- 64 individuals completed their apprenticeship
- 177 individuals were undertaking their training.

Table 5 provides an overview of Modern Apprenticeship activity between 2012/13 and 2016/17.

Figure 6.1 summarises the characteristics of In Training Modern Apprenticeships relating to LCS in 2016/17.

Looking in more detail at individuals in training:

- there has been an increase in the number of individuals undertaking both frameworks between 2012/13 and 2016/17
  - Life Sciences has increased by 69% (25 individuals)
  - Process Manufacturing has increased by 90% (55 individuals)
- there is an equal gender balance within Life Sciences, however Process Manufacturing is heavily dominated by males (in 2016/17 93% of those in training were male)
- both frameworks have a slightly younger age range than total Modern Apprenticeship data
  - Life Sciences – 84% are 16-19 years old
  - Process Manufacturing – 85% are 16-19 years old
  - all Modern Apprenticeships – 62% are 16-19 years old
- the majority of individuals within the Life Sciences framework are undertaking a SCQF Level 7 qualification (92%). Process Manufacturing is only available at SCQF Level 7.



6 Current provision continued

A Technical Apprenticeship is available at SCQF Level 8 for Life Sciences and Related Science Industries, however there was no uptake in this framework in 2017/18[61].

Graduate Apprenticeships
Graduate Apprenticeships are the most recent addition to the Apprenticeship Family. Graduate Apprenticeships were first offered in 2016/17 across four frameworks at SCQF levels 8 and 10. Over 300 Graduate Apprenticeships were available during the first contractual year. The Graduate Apprenticeship offering has expanded and now covers 11 frameworks across SCQF levels 8, 10 and 11. Twelve university and college partners are involved in delivery for the contractual period 2017/18. By 2020, circa 4,000 Graduate Apprenticeship places will have been delivered.

This year, 2018, will see the newly developed Graduate Apprenticeship: Instrumentation, Measurement and Control (SCQF level 10) being delivered. This Graduate Apprenticeship is of interest to manufacturing across LCS.

In addition, the LCS Skills Working Group is reviewing demand for other Life Sciences and/or Chemical Sciences related Graduate Apprenticeships. Evidence based demand has been captured for Chemical and Process Engineering Graduate Apprenticeship and developed with industry commitment.

College sector[62]

Scotland has 26 FE colleges which are organised to operate as regional collectives to deliver vocational education and training more effectively. In addition to degree, diploma and certificate qualifications, colleges, in partnership with local education authorities, Higher Education Institutes (HEI) and industry, offer a number of apprenticeships.

Data provided by the SFC provides an overview of student qualifiers[63] at Advanced Higher/HNC level and above (SCQF level 7+), in subjects related to Life and Chemical Sciences. These learners have all achieved complete success at the end of their course.

By subject
In 2015/16, there were a total of 1,050 qualifiers from Life and Chemical Sciences subjects from colleges across Scotland, the majority (526, 50%) of whom were in Science & Technology subjects: Life Sciences and Chemistry both accounted for a significant number (202, 19% each) of qualifiers in 2015/16. Chemical-Material Engineering accounted for 10% (100) of all qualifiers in 2015/16, with just 2% (20) in Medical Technology/Pharmacology.

The number of qualifiers in Life and Chemical Science subjects collectively has increased by 469 since 2010/11, a percentage increase of 81%. Qualifiers from Chemistry subjects have shown the greatest increase, increasing from 37 in 2010/11 to 202 in 2015/16, representing a percentage increase of 446%.

Figure 6.2 summarises key indicators for student qualifiers in 2015/16.

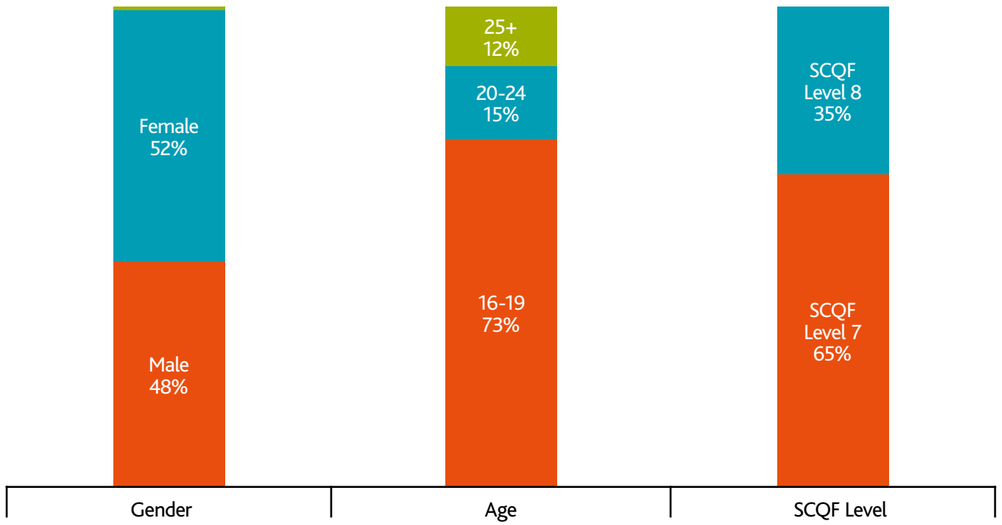
[61] SDS (February 2018)
[62] Data from SFC relates to college qualifiers in Life & Chemical Science subjects, at Advanced Higher/HNC level and above
[63] Student qualifiers are defined as those who had achieved complete success, and at SCQF level 7 or above

Table 6: Scottish qualifiers by subject (2010/11 and 2015/16)

	2010/11	2015/16	Change	% Change
Chemical - Material Engineering	51	100	49	96%
Chemistry	37	202	165	446%
Life Sciences	204	202	-2	-1%
Medical Technology/Pharmacology	27	20	-7	-26%
Science & Technology	262	526	264	101%
Total	**581**	**1,050**	**469**	**81%**

Source: SFC; Courses are subject superclasses

Figure 6.2: Student qualifier key characteristics (2015/2016)



Source: SFC N=1,050

6 Current provision continued

Further analysis of 2015/16 qualifier data revealed that in absolute terms:

- Forth Valley and Glasgow colleges had the greatest number of qualifiers in 2015/16:
  - 34% of qualifiers were from Forth Valley college; Chemistry and Material Engineering accounting for the greatest share of qualifiers from the region, at 46% and 28% respectively
  - almost all the qualifiers in Chemical - Material Engineering across Scotland were from Forth Valley College, which is unsurprising given the presence of CS at the Grangemouth site in the Forth Valley
  - 17% of all Life and Chemical Science qualifiers came from either Glasgow Clyde or Glasgow Kelvin college, equating to a total of 177 qualifiers, 82% (145) of whom were in Science and Technology subject
  - Glasgow Kelvin was responsible for the majority of the qualifiers in Science and Technology - 83% (121).
- approximately half (52%) of all qualifiers in Life and Chemical Science were female. This varies across the subjects:
  - Chemical - Material Engineering; females account for 16% of all qualifiers
  - in Chemistry, the gender balance is equal
  - Life Science subjects have a greater share of female qualifiers (58%), as does Science and Technology (57%)
- the majority (73%) of qualifiers across all Life and Chemical Sciences subjects are between the ages of 16 and 19; 20 to 24 year olds account for 15% and those aged 25+ account for 12%. Again, this varies across the different subject areas
  - Chemistry qualifiers have the youngest age profile, with 100% in the 16-19 age group
  - Science & technology, has an older age profile, with 65% of qualifiers aged 16-19, 19% aged 20-24 and 16% over the age of 25
- 35% of qualifiers completed a qualification at SCQF level 8 (i.e. HND, first degree), and 65% at SCQF level 7 (i.e. advanced Higher, HNC).

Table 7: Qualifiers from Life and Chemical Sciences courses across Scottish HEIs (2010/11 and 2015/16)

	2010/11	2015/16	Change	% Change
Total Life Sciences	**2,105**	**2,605**	**500**	**24%**
Biology	630	760	130	21%
Anatomy, physiology & pathology	260	305	45	17%
Pharmacology, toxicology & pharmacy	575	605	30	5%
Medical Technology	195	255	60	31%
Bioengineering, biomedical engineering & clinical engineering	0	35	35	-
Health Informatics	0	5	5	-
Genetics	65	115	50	77%
Microbiology	245	270	25	10%
Molecular biology, biophysics & biochemistry	135	255	120	89%
Total Chemical Sciences	**940**	**1,125**	**185**	**20%**
Chemistry	515	495	-20	-4%
Chemical, process & energy engineering	260	380	120	46%
Biotechnology	55	45	-10	-18%
Forensic Science	105	195	90	86%
Materials science	5	10	5	100%
Total	**3,045**	**3,730**	**685**	**22%**

Source: Higher Education Statistics Agency (HESA) (2017)

6 Current provision continued

University sector

Qualifiers (2011/12-2015/16)

Scotland's 19 HEIs are producing around **1,000 Chemical Sciences graduates**[64] and **2,400 relevant Life Sciences graduates**[65] each year[66] (of which the largest numbers are studying Biology, Table 7).

Looking in more detail at the graduates in 2015/16:

- around 60% of these graduates were from Scotland, and the remainder were fairly evenly split between elsewhere in the UK, elsewhere in the EU and from the rest of the world (RoW);
- there were small numbers of part-time and sandwich students (each less than 5% of the total)
- in terms of gender, around **66% of Life Sciences graduates are female** and **72% of Chemical Engineering graduates are male**. Other Chemical Sciences subjects are evenly balanced regarding student gender
- most students are studying at the Edinburgh and Glasgow universities, with significant numbers in universities in the Aberdeenshire, Tayside, Fife and Forth Valley regions[67].

Destinations

Looking specifically at those graduating with LCS qualifications between 2011 and 2016, on average 63% enter the workplace directly after graduating. Of the remainder, on average 26.7% pursue further full-time studies (Figure 6.3).

Analysis of 2011/12 to 2015/16 graduate data reveals, on average[68] individuals leaving the following courses with a qualification are:

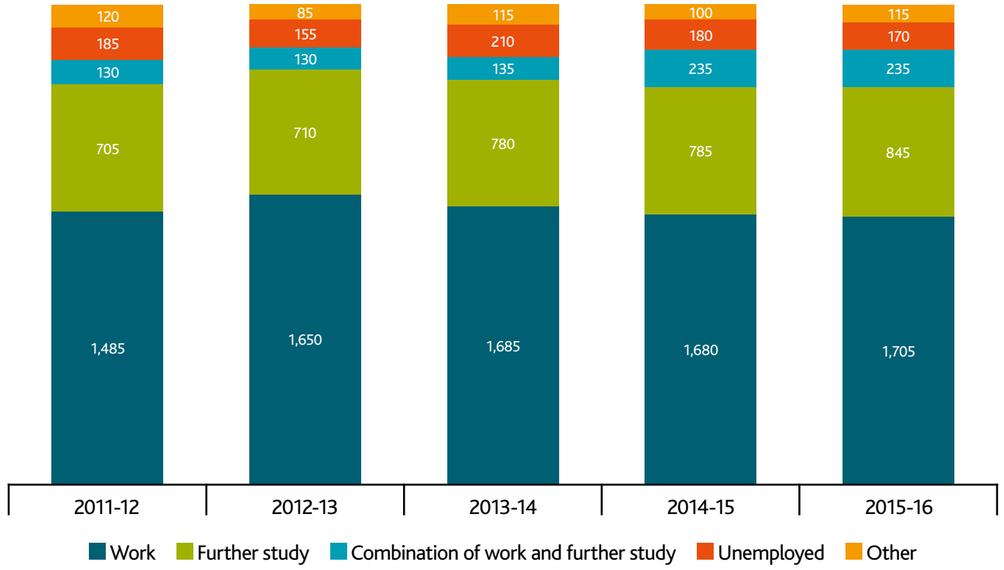
Most likely to enter the workplace directly:
- MedTech
- Pharmacology, toxicology & pharmacy
- Chemical, process & energy engineering

Most likely to enter a professional level position (SOC 1-3)[69]:
- MedTech
- Pharmacology, toxicology & pharmacy
- Chemical, process & energy engineering

Most likely to undertake further studies:
- Genetics
- Anatomy, physiology & pathology
- Molecular biology, biophysics & biochemistry

In contrast to those most likely to enter the workforce at a professional level, around **40% of Biology, Genetics and Anatomy, Physiology & Pathology graduate leavers who enter the workforce, do so at non-professional level i.e. SOC 4-9** (Appendix D). This is further evidenced by the Wakenham Review of STEM Degree Provision and Graduation Employability[70] which details 43% of Biological Science graduates in the UK gain employment in non-graduate positions six months after graduating, compared with 32% of all HE graduates. The Wakenham Review identifies a lack of positive outcomes for graduates from Biological Sciences courses as a cause for concern and an area where greater focus is required.

Figure 6.3: Graduate destination of those qualifying from undergraduate LCS courses in higher education (2011/12 to 2015/16)



Source: HESA (2017)

[64] These include: chemistry; chemical, process & energy engineering; biotechnology; forensic science; and materials science
[65] These include: biology; pharmacology, toxicology & pharmacy; anatomy, physiology & pathology; microbiology; molecular biology, biophysics & biochemistry; genetics; medical technology; bioengineering, biomedical engineering & clinical engineering; health informatics. Note Psychology graduates have not been included in the Life Sciences definition.
[66] On average between 2010/11 and 2015/16
[67] SDS RSA Data Matrix
[68] Average based on 2011/12-2015/16
[69] Based on those going directly into employment upon graduating
[70] www.gov.uk/government/publications/stem-degree-provision-and-graduate-employability-wakeham-review

6 Current provision continued

This is interesting as the vast majority of those studying MedTech; Pharmacology, Toxicology & Pharmacy; or Chemical, Process & Energy Engineering enter the work place directly, rather than undertaking further study.

There is an evident demand for such individuals at a professional level. Although within each subject area there have been increases in the proportion undertaking further studies over the last five years (e.g. MedTech was 3.4% in 2011/12, and 8.1% in 2015/16). This suggests that those who have studied other courses may be finding it more difficult to obtain professional-level employment directly and so undertake additional studies.

However, it should be noted that over the five-year period the percentage of Anatomy, Physiology & Pathology leavers who have taken up professional-level positions has increased from 57.1% to 66.7%, while overall numbers of those entering work directly have not changed substantially. In contrast, for those studying Forensic Science the percentage has dropped from 76.9% to 52.4% and for Chemical, Process & Energy Engineering from 92.5% to 83.8% (this perhaps reflects the downturn in the Oil and Gas sector).

Table 8 details the mean salary, and upper and lower salary quartiles for LCS graduates from Scottish Universities gaining employment within the UK immediately post graduation, in comparison to all Scottish graduates in 2015/16.

Chemistry and Chemical, Process & Energy Engineering students obtained salaries above the Scottish average upon graduating. In contrast, Life Sciences graduates obtained salaries below the national average.

The Delivering STEM Skills for the Economy report[71] supports this data and identifies large volumes of biological science graduates in the UK. A greater proportion of biological students enter non-graduate roles compared to the STEM average, earning below average salaries in comparison to STEM and all subjects 40 months after graduation.

Table 8: Salary quartiles for UK domiciled, full-time graduate leavers from Scottish HEIs who obtained first degree qualifications in LCS and entered full-time, paid work in the UK (2015/16)

	Mean salary (£)	Lower quartile (£)	Upper quartile (£)
Scotland	**22,500**	**18,000**	**25,000**
Total - Science subject areas*	23,500	20,000	26,500
Anatomy, physiology & pathology	21,117	20,000	22,218
Pharmacology, toxicology & pharmacy	21,003	19,250	22,200
Medical technology	22,941	22,000	22,500
Biology	18,933	15,724	21,000
Genetics	19,540	16,000	23,000
Microbiology	19,718	18,000	21,605
Molecular biology, biophysics & biochemistry	20,043	18,000	22,600
Chemistry	22,656	19,000	25,500
Forensic science	17,540	14,430	20,000
Chemical, process & energy engineering	26,583	23,000	29,000
Materials science	–	–	–
Bioengineering, biomedical engineering & clinical engineering	–	–	–
Biotechnology	–	–	–

* Total science subjects also include subjects not relating to LCS.
Note, suppressions are applied to salary data where the base total is 7 or fewer for mean and median and 14 or fewer for quartiles represented by - in the table above. Source: HESA Student Record 2015/16 and HESA Destinations of Leavers Survey 2015/16

[71] www.nao.org.uk/wp-content/uploads/2018/01/Delivering-STEM-Science-technology-engineering-and-mathematics-skills-for-the-economy.pdf

7 Key skills challenges and priorities

The Life and Chemical Sciences SIPs, both published in 2014, highlighted several priorities which industry reported as vital to address.

These included: building the work-readiness of graduates, improving the attractiveness of the sectors and increasing the flow of new entrants (both new graduates and more experienced people) into them, and working to anchor those people and skills in the sectors. While much has been done over the past few years to address these priorities (Section 2) industry is still reporting the following themes as priority areas:

1. Address specific skill shortages
2. Ensure national coverage of skills and training provision
3. Increase exposure to and understanding of industry
4. Enhance practical experience of those entering the sectors.

7 Key skills challenges and priorities continued

Objective 1: Address specific skill shortages

The combined LCS sectors represent a broad range of companies with some common and diverse skills requirements, covering Life Sciences, engineering, digital, and soft skills. Most companies that were engaged in the SIP development process confirmed a requirement for occupations at both graduates and non-graduates, skilled levels; the exceptions to this were non-manufacturing companies focused on delivering a service or RTD activities, where the requirement was focussed at a higher level of graduate and post-graduate skills.

The skill sets most often raised by companies as being in short supply were:

- engineering skills
- digital skills, including data, software and informatics
- regulatory, compliance, quality management/assurance/control, GMP, GLP and the ability to follow SOPs
- biomanufacturing, particularly cell therapy and regenerative medicine, both of which require specific, aseptic techniques to use within a clean room environment
- individuals that combine business, commercial, entrepreneurial and leadership skills with sector knowledge.

This highlights the increasing need within LCS sectors for cross-disciplinary skill sets. In addition to those mentioned, there is a growing need for chemical and process engineers that understand biosciences and vice versa, to support the development of new industrial biotechnology processes within manufacturing industries.

It is clear that we need a flexible and responsive education system that can:

- produce larger numbers of skilled workers and graduates in specific disciplines to satisfy demand for STEM skills within the LCS but also from other industry sectors
- combine different courses to provide cross-disciplinary training
- offer new approaches to deliver skills and training, including providing courses to existing employees to enable them to take on new responsibilities.

In order to address these issues, the following priority actions have been identified by industry:

- produce a database of existing modules and short courses across HE/FE/training providers that highlights gaps in provision. This also addresses feedback from industry that they would benefit from a central resource that provides information on available skills and training provision
- promote existing work-based learning pathways both to industry, education and individuals as a route into the sectors that encourages diversity
- review evidence in relation to the diversity of LCS sectors and act to attract and retain under-represented groups
- where there is evidence of demand and industry commitment develop, and promote, new Graduate Apprenticeships which will address the shortage of both technical and graduate-level skills
- revise and update relevant Scottish Vocational Qualifications (SVQs) to address technical skill shortages, ensuring that these meet National Occupational Standards (NOS)
- develop new cross-discipline Modern Apprenticeship structures to reflect the cross-disciplinary requirements of many jobs
- increase student intake on relevant courses to address shortages of skilled workers
- increase and/or enhance provision of current courses to include different competencies
- develop enhanced CPD provision to ensure that the existing workforce can respond to new opportunities and requirements
- extend access to the Leadership Masterclass to support the next generation of LCS industry leaders
- develop entrepreneurial, leadership and business skills so students and academics have the confidence to set up spin-out companies.

Objective 2: Ensure national coverage of skills and training provision

The review of skills and training clearly identifies the Central Belt, and Forth Valley College in particular, as providing most of the country's vocational skills and FE relevant to the LCS sectors. Most HEIs providing relevant training are also located in the Central Belt and the East Coast of Scotland. This geographic distribution of provision has been reported as an issue for companies located outside these regions, with the result that many have to send staff further to access training - something not all companies have capacity to do.

In order to address these issues, the following priority actions have been formulated:

- further develop the existing shared resources between FE colleges to better meet skills and training needs across the country
- produce online and flexible-learning courses that address skills shortages and can be accessed regardless of geographical location, and further develop these to address gaps in skills provision
- develop a shared assessor model to allow FE colleges and training providers to share the costs of training and assessment of apprentices and those undertaking other SVQs (which may be few in number at different sites).

7 Key skills challenges and priorities continued

Objective 3: Increase exposure to, and understanding of, industry

A consistent message from industry is that they do not expect graduates, or any new employee for that matter, to be fully productive from day one. However, the general perception is that graduates lack basic work skills including work ethic, the ability to work in teams, initiative and a basic knowledge of the company and industry.

While this is not the remit of the education system to resolve, it would be beneficial if the opportunity to gain relevant work experience were incorporated into the education programme. This would ensure that those undergoing training have a better understanding of what will be expected of them when they qualify. It is also important to promote a better understanding of the variety of role and skills required within the sectors to attract a more diverse range of talent to LCS.

To address these issues, the following priority actions have been developed:

- enhanced industry engagement with schools and FE/HE to provide opportunities for regular contact between industry and students throughout their education. This should be through existing resources including:
  - DYW are supporting Marketplace, where case studies can be posted to illustrate what industry does, and connections between industry and education signposted
  - My World of Work where there are opportunities to enhance industry participation
  - career information, advice and guidance from SDS staff
- extend the provision of Graduate Employability classes for HE students to provide insights into specific job requirements and career opportunities
- extend the availability of work placements during university courses to provide relevant, practical industrial experience for students.

Objective 4: Enhance practical experience

In addition to a lack of industry knowledge, many companies were of the opinion that Life Sciences graduates in particular lack practical laboratory experience and the ability to perform basic laboratory tasks. This is largely due to a reduction in the provision of practical classes in HEI, which are costly and require dedicated infrastructure, in favour of an approach that is more theoretical and can be delivered to larger numbers of students. In contrast, most Chemical Sciences and Engineering degrees are accredited, requiring a minimum level of practical lab experience to be included in the degree programme.

In order to address these issues, the following priority actions have been developed:

- establish a database of institutions that provide practical lab courses, such as Edinburgh Napier University, that students, companies or other education providers can access to supplement practical training
- establish additional courses where demand exceeds availability or where this training is not currently available outside integrated courses
- revise and update relevant SVQs to ensure that these meet NOS and accreditation requirements of the sector
- adapt HEI provision to include practical classes that address specific industry needs, and where possible secure accreditation of additional degrees.

8 Action plan

The action plan has been developed by the LCS Skills Working Group in partnership with industry and other stakeholders to address the key skills challenges facing the sector.

The action plan addresses the four key objectives:

- address specific skill shortages
- ensure national coverage of skills and training provision
- increase exposure to, and understanding of, industry
- enhance practical experience.

The action plan identifies the specific activities, outputs, and partners' engagement that will be required to achieve these objectives and the expected interim outcomes and longer-term impacts anticipated for the sector.

The actions are presented in terms of those that should be achievable in the short-term (1-2 years) and those that will take relatively longer to realise (over 2 years). There are a number of actions that will help deliver more than one objective, shown Table 9.

Each action has been prioritised based on industry need on a scale of one to five; where one is immediate need and five is a longer term commitment.

Table 9: Overview of objectives, action areas and outcomes

Provision		Industry Exposure	
4 Priority Themes			
Address specific skill shortages	Ensure national coverage of skills and training provision	Increase exposure to, and understanding of, industry	Enhance practical experience
Action Areas			
• Revise and update relevant SVQs • Promote work-based learning pathways e.g. Foundation Apprenticeships • Develop Graduate Apprenticeships offering • Ensure commitment to cross-discipline Modern Apprenticeship structures • Develop enhanced CPD provision • Address student intake for specific courses • Develop course and provider database • FE collaboration and shared resources • Develop distance/online learning tools • Shared assessor model		• Increase/enhance work placements for undergraduates • Enhanced industry engagement • Increase availability of industry-led Graduate Employability classes • Challenge university curricula • Develop supplementary practical courses	
Expected Outcomes			
• Students are aware of what industry need and what working for a company entails • More pupils consider LCS industry careers and are aware of the variety of career pathways available • Companies able to address skills deficits • There is a stronger pipeline of young people across the various parts of the education system that are industry ready • Industry achieves a more highly skilled, diverse and competent workforce • There is a larger pool of skilled individuals available to drive growth and development, particularly for spin-out companies • Employees utilise the opportunity to qualify from accredited courses across Scotland • Employees have more career options available to them • More LCS companies succeed in Scotland because they have access to appropriate workforce including senior leaders • More LCS companies able to grow and respond to changing skills needs no matter their location • Industry builds connections with future employees via the education system.			

Objective 1: Address specific skill shortages
Short-term actions

Action	Activities	Interim Outcomes	Longer Term Impact	Partners	Lead	Priority Level
Develop a database of relevant modules and short courses	1. Review all courses relevant to LCS sectors to identify available modules that address specific skill needs 2. Contact course coordinators to identify what modules are accessible as stand-alone content 3. Create online database, available through SE and ESP and signposted from other sources	Employers/ individuals can access up-to-date information about LCS courses to up-skill/reskill	Companies can source employees with the appropriate skills (including new entrants) Employees develop and maintain required skills for the sector	SDS, SE, ScotChem	ESP	1
Promotion of WBL pathways	1. Industry to support the Foundation Apprenticeship in Scientific Technologies through work-based placements 2. Develop case studies of companies and individuals utilising WBL pathways 3. Industry to support the wider WBL pathways outwith the sciences 4. Support for underrepresented groups onto WBL programmes	Employers/ individuals have increased awareness of work-based learning Increased uptake of WBL opportunities Increased diversity within work-based learning programmes	Companies can address technical skills gaps with new entrants and existing staff members Increased diversity of LCS workforce	DYW, SSC, Colleges, Training providers, Schools	SDS	2
Review evidence in relation to the diversity of LCS sectors	1. Undertake a scoping exercise to determine what data is available for underrepresented groups in the LCS sectors 2. Collate available data 3. Determine if targeted approaches are required to increase diversity amongst LCS sectors	Stakeholders have increased access to relevant sectoral data Increased awareness of LCS opportunities within under-represented groups	Increased diversity of LCS workforce	DYW, SSC, Colleges, Training providers, Schools	SDS	2

Longer-term actions

Action	Activities	Interim Outcomes	Longer Term Impact	Partners	Lead	Priority Level
Develop and promote new Graduate Apprenticeships	1. Promote new Graduate Apprenticeships in Instrumentation, Measurement and Control at SCQF Level 10 launching 2018 2. Industry to aid in the development of Graduate Apprenticeships in Chemical and Process Engineering and Opthalmic dispensing (proposed for 2019) 3. Industry commitment to develop evidenced demand for future Graduate Apprenticeships	Increased number of companies engaged in developing and utilising Graduate Apprenticeships Increased numbers of graduates with technical skills required by industry First entrants on Graduate Apprenticeship in Instrumentation, Measurement and Control at SCQF Level 10 associated with LCS sector	Increased number of companies able to recruit graduates with technical skills	LCS Skills Working Group, CS/LS ILGs, FE, HE	SDS	1
Revise and update relevant Scottish Vocational Qualifications (SVQ)	1. Review the content of current and lapsed SVQs, to determine whether these meet identified industry needs 2. Develop and incorporate new NOS if required 3. Align SVQs with formal accreditation e.g. Engineering Technician/ Registered Science Technician 4. Ensure continuation pathway from SVQ to degree level if required 5. Secure support for implementing and promoting new SVQs	All relevant SVQs are fully aligned with identified industry needs Relevant courses will qualify as part of the Engineering Technician/ Registered Science Technician registration Increased number of technicians with industry relevant accreditation	Employees develop and maintain required skills and standards for the sector Employees have access to a wider career pathway Companies can recruit a more highly skilled workforce	LCS Skills Working Group, Science Council, Engineering Council, FE, CS/LS ILGs, SDS	SSC	1
Ensure commitment to cross-discipline Modern Apprenticeship structures	1. Secure industry commitment for proposed Formulation Technician & Engineering for LCS Modern Apprenticeships 2. Engage with wider industry to identify further needs and secure commitment 3. Work with other SDS Key Sector Managers and industry sectoral skills groups to inform cross-discipline Modern Apprenticeship structures	Increased number of companies engaged in developing and utilising cross-discipline Modern Apprenticeships Increased number of individuals undertaking a Modern Apprenticeship Increased number of individuals with cross-disciplinary skills Wider geographic spread of Modern Apprenticeships	Companies can source employees with a range of skills Employees have access to a wider career pathway	SDS, FE, Training Providers, LCS Skills Working Group	SSC	3

Longer-term actions continued

Action	Activities	Interim Outcomes	Longer Term Impact	Partners	Lead	Priority Level
Increase student intake into relevant subjects for the sectors	1. Illustrate specific skills, training and career opportunities through case studies in MyWoW and DYW material going out to schools 2. Identify individual companies through the LCS Skills Working Group, ILGs and DYW to engage with schools 3. Develop a programme and support companies to engage with schools on skills and career opportunities 4. Implement school engagement programme	Increased number of pupils enrolling in LCS courses that address skill shortages Increased number of companies engaging with schools to promote the sectors/ career opportunities Increased awareness in school pupils (particularly underrepresented groups) of career opportunities in both sectors	Companies can source employees with the appropriate skills Integration of activities within current MyWoW and DYW strategies	LCS Skills Working Group, SDS, SULSA, ScotCHEM, ACGAS, STEM ambassadors, MyWoW	DYW	5
Increase / enhance provision of current FE/HE courses	1. Identification of key courses across Scotland which can satisfy skills shortages and the deficit in graduate numbers 2. Formulate proposal to increase/ enhance provision e.g. through increasing enrolment on these courses or adapting others to include relevant course modules 3. Launch enhanced programme	Increased number of FE/HE places available aligned to industry need Increased number of HE/FE students undertaking courses aligned with industry need	Companies can source employees with the appropriate skills (including new entrants) Employees develop and maintain required skills and standards for the sector	CS/LS ILGs, SDS	SFC, HE, FE	3
Develop an enhanced CPD provision	1. Identify skills needs for which there are gaps in current provision, e.g. QA, QC, regulatory 2. Establish industry-led working groups with academic partners to create course content and/or adapt existing course modules to satisfy this need 3. Industry-led working groups define content of different courses and which partners will be responsible for their delivery 4. Begin pilots in different regions and for different skills issues	Increased number of courses available that directly address skill shortages within the current workforce Uptake in CPD courses.	Reduced number of companies reporting skills gaps in existing workforce Employees develop and maintain required skills for the sector Employees have access to a wider career pathway.	LCS Skills Working Group, SULSA, ScotCHEM	SFC, HE, FE	2

Longer-term actions continued

Action	Activities	Interim Outcomes	Longer Term Impact	Partners	Lead	Priority Level
Maintain access to the LCS Leadership Masterclass	1. Identify numbers of potential candidates for the Leadership Masterclasses, their location and subsector of activity – based on applications to the existing Masterclass, and feedback from ILGs 2. Identify suitable mentors (business leaders, investors, etc) for additional Leadership Masterclasses 3. Identify additional venues around the country and develop programmes	Increased number of LCS employees undertaking Leadership Masterclasses	Companies employ employees with the appropriate skills Scotland has access to a larger pool of talent for senior leadership roles	CS/LS ILGs	SE	3
Develop entrepreneurial, leadership and business skills	1. Extend the provision of modules on entrepreneurship, leadership and business skills to a greater number of LCS courses 2. Consider how such courses and concepts could be introduced into the secondary and FE curricula to offer the opportunity to the largest number of people	Increased number of LCS undergraduates undertaking entrepreneurship, leadership and business skills courses Increased number of LCS FE students undertaking entrepreneurship, leadership and business skills courses Increased number of secondary school pupils undertaking entrepreneurship, leadership and business skills courses	Increase in the number of LCS spin-out companies Employees develop and maintain required skills for the sector	CS/LS ILGs, SFC	SE	3

Objective 2: Ensure national coverage of skills and training provision
Short-term actions

Action	Activities	Interim Outcomes	Longer Term Impact	Partners	Lead	Priority Level
Further develop shared resources between FE	1.Identify geographical gaps in FE provision 2. Identify and develop a partnership approach to FE provision to allow lecturers to travel to other FE sites or training provided to lecturers at other sites 3. Development of a mobile teaching resource	Increased number of LCS FE courses delivered throughout Scotland Increased number of FE students undertaking LCS courses	Companies can grow and respond to changing skills needs, no matter their location Employees develop and maintain required skills for the sector	SFC, FE, LCS Skills Working Group, SDS, Grangemouth Vision Group	ESP	4
Develop distance/ online learning resources	1.Develop online material and schedule residential courses out of FE term-time. 2. Identification of suitable and practical online and residential course provision	Increased number of FE students undertaking LCS courses Increased access to LCS FE courses	Companies can grow and respond to changing skills needs, no matter their location Employees develop and maintain required skills for the sector	SFC, FE, LCS Skills Working Group, SDS, Grangemouth vision group	ESP	2

Longer-term actions

Action	Activities	Interim Outcomes	Longer Term Impact	Partners	Lead	Priority Level
Ensure buy-in to a shared Assessor Model	1. Identify which FE colleges would benefit from shared access to assessors for Modern Apprenticeships 2. Develop a model and plan for shared assessors 3. Work with FE, Engineering Training Associations and commercial providers to ensure that Modern Apprenticeship assessors are available across Scotland 4. Consider similar approach towards Foundation Apprenticeships	Increased number of colleges delivering accredited courses across the whole of Scotland Increased number of individuals undertaking LCS related Modern Apprenticeships	Companies can source employees with the appropriate skills (including new entrants) Companies can grow and respond to changing skills needs, no matter their location Employees develop and maintain required skills for the sector	SDS, FE, ESP, SFC, Training Providers	SSC	5

Objective 3: Increase exposure to, and understanding of, industry
Short-term actions

Action	Activities	Interim Outcomes	Longer Term Impact	Partners	Lead	Priority Level
Increase and improve industry engagement with schools/ FE/HE	1. Develop enhanced LCS engagement plan that builds on MyWoW and DYW 2. Produce case studies that highlight the variety of LCS career opportunities through LCS Skills Working Group and ILGs 3. Support materials prepared, including case studies and success stories in traditional and social media to encourage interest from young people 4. Support greater involvement of local LCS industry with the education system 5. Develop additional modules describing industry needs for FE/HE 6. Implement additional training for FE/HE lecturers	Increased number of companies engaging with schools to promote the sectors/ career opportunities Increased number of companies engaging with FE to promote the sectors/career opportunities Increased number of companies engaging with HE to promote the sectors/career opportunities	Increased number of new entrants into both sectors Integration of activities within current MyWoW and DYW strategies.	SDS, ESP, FE/HE CS/LS ILGs AGCAS	DYW MyWoW	5
Expand delivery of Graduate Employability classes for HE students	1. Engage with HEIs to deliver relevant Graduate Employability classes, and identify student cohort and appropriate content and timing 2. Engage with relevant companies to contribute to the delivery of the Graduate Employability classes 3. Develop plan for successive engagement with HEIs	Increased number of HE students undertaking a masterclass Increased awareness in HE students of career opportunities in both sectors Increased number of LCS companies engaging with HEIs	Industry builds valuable connections with future employees, and builds stronger links between HEIs Increased number of new entrants into both sectors	SDS, LCS Skills Working Group, LS/CS ILGs	Universities	4
Increase awareness of work placements during university courses	1.Signpost existing opportunities more widely 2. Collate information on all industry placement opportunities, including integrated within degree courses, public (e.g. ScotGrad), and private (e.g. Santander) funded 3. Develop a model for expanded internships, in terms of numbers of placements and HEIs involved 4. Secure commitment from partners and develop a business plan for delivery of expanded internships	Increased number of placements within companies Increased number of companies providing placements Increased number of students receiving work placements	Students are more aware of what industry needs Companies can source employees with the appropriate skills (including new entrants)	SULSA, ScotCHEM, SDS AGCAS	SFC	3

Longer-term actions

Action	Activities	Interim Outcomes	Longer Term Impact	Partners	Lead	Priority Level
Enhanced industry engagement with schools/ FE/HE	1. Develop modules describing industry needs for FE/HE lecturers 2. Industry exposure/training for secondary school teachers, FE and HE lecturers	Students have greater awareness of industry needs and career opportunities Increased understanding of LCS sectors skills needs in teachers and lecturers Increased alignment of academic teaching and industry needs	There is a stronger pipeline of young people in different parts of the education system that are industry-ready across a range of disciplines and practical skill sets	SDS, Education Scotland, LCS Skills Working Group, STEM ambassadors	DYW	5
Work placements during university courses	1. Explore options to expand provision for internships (e.g. LS internships and ScotGrad) and ensure their sustainability 2. Assess the feasibility of a central hub/broker for managing placements. 3. Develop mentoring framework for industry and interns	Increased number of internships available Increased number of students that are placed into industry Wider representation of regions and sectors within internship offering.	There is a stronger pipeline of graduates that are industry-ready across a range of disciplines and practical skill sets	SULSA, ScotCHEM, SDS	SFC	3

Objective 4: Enhance practical experience
Short-term actions

Action	Activities	Interim Outcomes	Longer Term Impact	Partners	Lead	Priority Level
Develop a database of relevant providers	1. Review all practical courses and providers relevant to LCS sector to identify those that address specific skill needs 2. Create and market online database, available through SDS and signposted from other sources	Employers/ individuals can access up-to-date information about LCS courses to up-skill/reskill	Companies can source employees with the appropriate skills (including new entrants) Employees develop and maintain required skills for the sector.	SDS, SE	ESP	2

Longer-term actions

Action	Activities	Interim Outcomes	Longer Term Impact	Partners	Lead	Priority Level
Establish supplementary practical courses	1. Identify which practical courses can be expanded or shared between institutions, and identify where gaps remain 2. Develop plan for extending practical course provision based on the above analysis and prioritising key competencies and geographic delivery 3. Explore need for new NOS to be incorporated into SQA accredited course modules	Increased number of LCS students graduating with practical skills	Companies can source employees with the appropriate skills (including new entrants) There is a stronger pipeline of graduates that are industry-ready across a range of disciplines and practical skill sets	LCS Skills Working Group, SFC, FE, HE, SDS	ScotChem	2
Adapt HE provision to address specific industry needs	1.Expansion of HEI Life Sciences courses accredited by the Royal Society of Biology (RSB) in Scotland 2. Produce and present evidence from professional bodies and industry associations on expected standards of practical skills to HEIs	Increased number of HEIs accredited by Royal Society of Biology	There is a stronger pipeline of graduates that are industry-ready across a range of disciplines and practical skill sets. Companies can source employees with the appropriate skills (including new entrants)	RSB, SLA LS/CS ILGs, ScotCHEM, SULSA	SFC	4

9 Monitoring and implementation

The action plan will inform the development of the monitoring and implementation process.

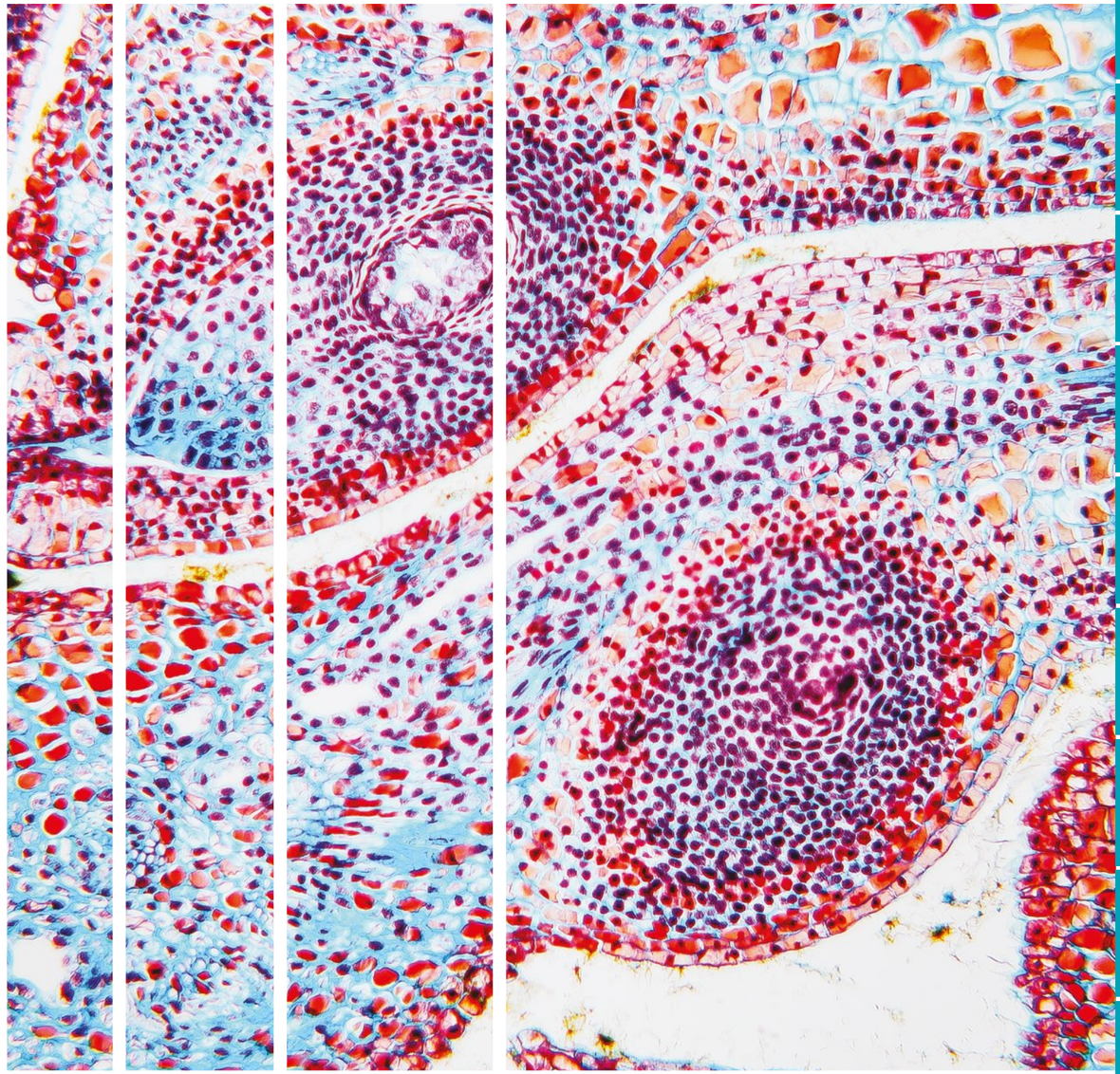
Following publication of the Life and Chemical Sciences SIP, the LCS Skills Working Group will facilitate a session with key partners, stakeholders and industry in which a detailed monitoring and implementation plan will be developed and agreed.
The monitoring and implementation plan will:

- identify step-by-step tasks for each action to be achieved
- name lead/support organisations within each action/task
- identify quantifiable SMART targets against the actions.

It is recognised that resources to deliver the action plan are constrained. As such, lead partners will be required to identify and unlock the potential resources to support each of the actions. This is likely to include in-kind contributions, building on existing activities and structures and the identification of additional resource.

The lead partners will report action plan progress on a quarterly basis to the LCS Skills Working Group for review.

To ensure the LCS SIP remains current and responsive to industry needs, the LCS Skills Working Group will review the Monitoring and Implementation Plan on an annual basis.



Appendix A: Life and Chemical Sciences SIC Code Definition

Table A.1: Life Sciences

SIC 2007 code	Description
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
26.6	Manufacture of irradiation, electromedical and electrotherapeutic equipment
32.5	Manufacture of medical and dental instruments and supplies
72.11	Research and experimental development on biotechnology
72.19	Other research and experimental development on natural sciences and engineering

Table A.2: Chemical Sciences

SIC 2007 code	Description
20.11	Manufacture of industrial gases
20.12	Manufacture of dyes and pigments
20.13	Manufacture of other inorganic basic chemicals
20.14	Manufacture of other organic basic chemicals
20.15	Manufacture of fertilisers and nitrogen compounds
20.16	Manufacture of plastics in primary forms
20.17	Manufacture of synthetic rubber in primary forms
20.20	Manufacture of pesticides and other agrochemical products
20.30/1	Manufacture of paints, varnishes and similar coatings, mastics and sealants
20.30/2	Manufacture of printing ink
20.41/1	Manufacture of soap and detergents
20.41/2	Manufacture of cleaning and polishing preparations
20.51	Manufacture of explosives
20.52	Manufacture of glues
20.53	Manufacture of essential oils
20.59	Manufacture of other chemical products n.e.c.
21.1	Manufacture of basic pharmaceutical products
21.2	Manufacture of pharmaceutical preparations

Appendix B: Sector segmentations

Life Sciences

- **MedTech** - imaging, non-imaging diagnostics, in vitro diagnostics, surgical instruments and other clinical equipment, research equipment, active/drug delivery therapeutic devices, passive therapeutic devices, personal care / assisted living, specialist consumables & equipment
- **Digital Health** – home/workplace health monitoring, home care monitoring, products for personal management, field working information systems, community connectivity, informatics and data handling
- **Stem cell and regenerative** – therapeutics, drug development tools and services, enabling technologies, contract research and manufacturing services, other
- **Pharma, Pharma services and contract research** – drug discovery, R&D, pre-clinical research, manufacturing, clinical research, laboratory services, regulatory, statistical, quality & logistics, consultancy
- **Therapeutics** – drug and cell-based therapeutics
- **Bioinformatics and Health Informatics** – health informatics, health and care data analytics, bioinformatics, other
- **Agritech** – agricultural biotech (green biotech), marine biotech (blue biotech), animal health, other
- **Professional Services** – consultants, investors, legal and IP, design
- **Supply chain** – supply of materials and/or devices
- **Non-commercial Organisations** – universities, charitable organisations
- **Other** – organisations that operate across several different sectors

Chemical Sciences

- **Commodity** – plastics, biofuels, rubbers, solvents, industrial gases
- **Speciality** – fine chemicals, water treatment, additives & fillers, dyes & pigments, surfactants, cleaning chemicals, corrosion inhibitors, speciality fibres & polymers, explosives, lubricants, food / agri-food additives, adhesives & sealants, cell culture reagents, agrochemicals
- **Consumer** – basic pharmaceuticals, pharmaceutical preparations, soap & detergents, personal care products, paints, inks, coatings
- **Industrial Biotechnology** – chemicals, food, feed, bioenergy
- **Materials** – textiles, manufacturing, life sciences, polymer processors / composites
- **Other** – monitoring, testing, manufacturing equipment

Appendix C: Life and Chemical Sciences Company Map

Figure C.1: Life Sciences Companies in Scotland

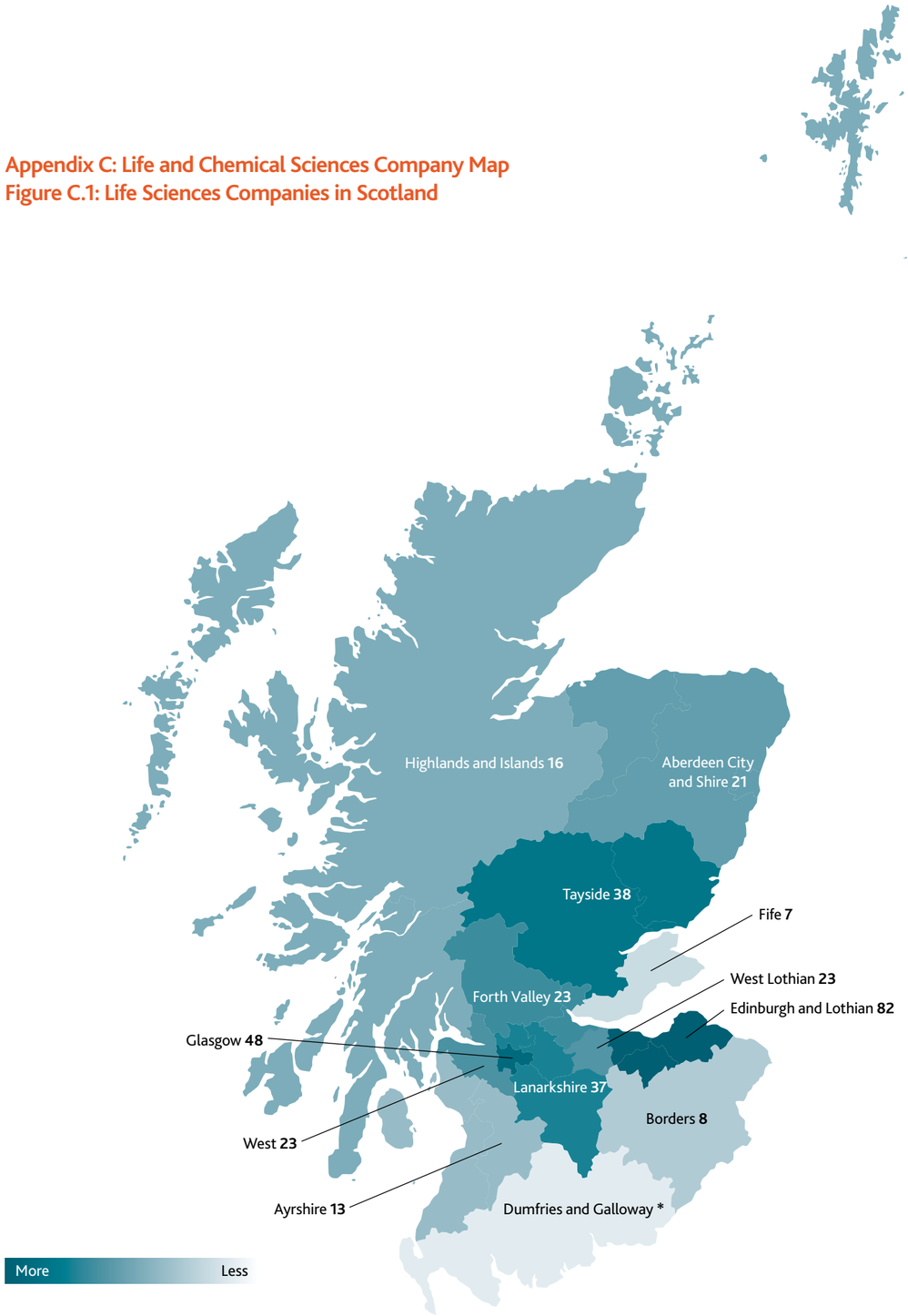
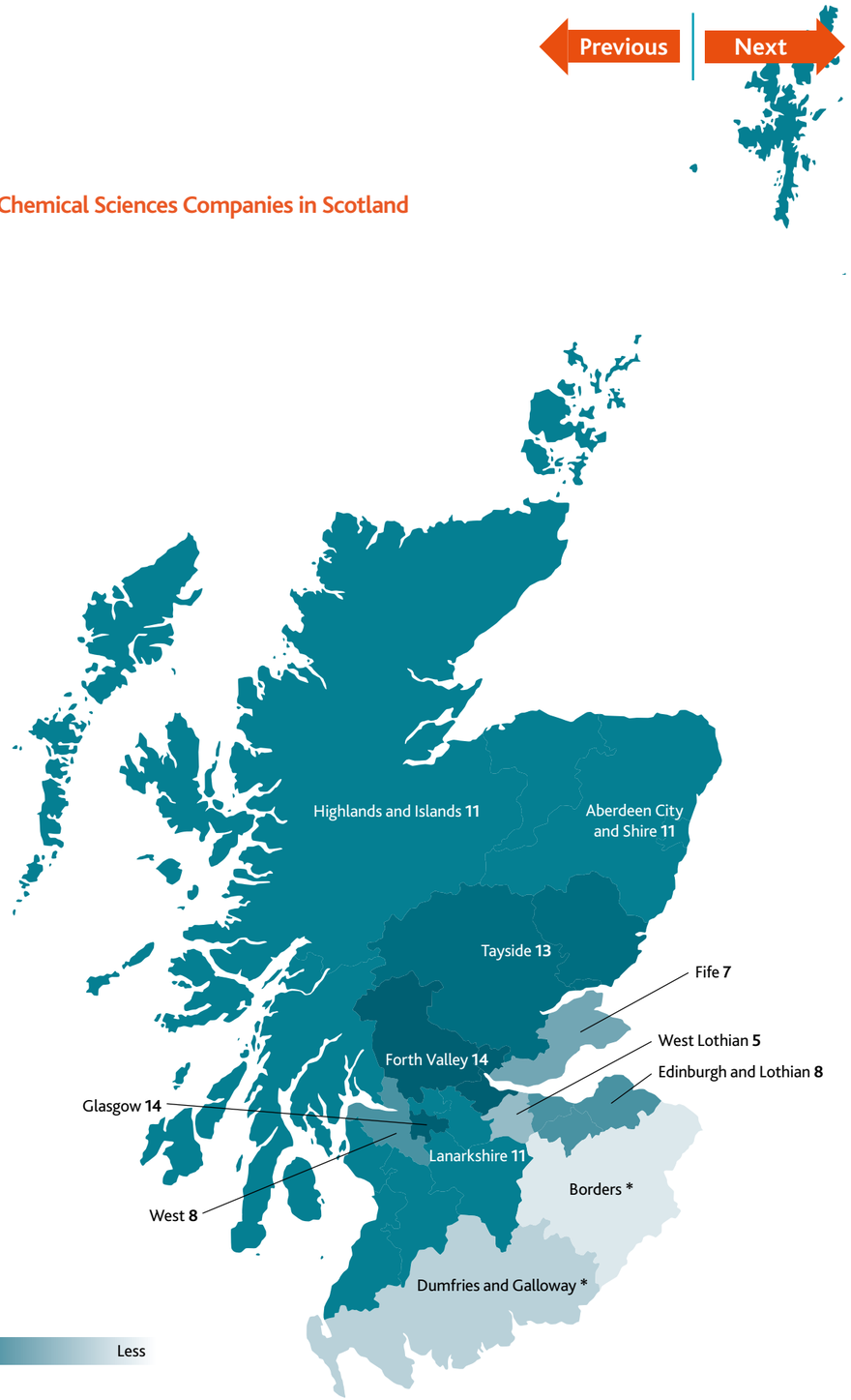


Figure C.2: Chemical Sciences Companies in Scotland



* This data is non-disclosive as there are less than five companies operating in this region.
N= 476, Source Internal Scottish Enterprise Database for Life and Chemical Sciences

Appendix D: SOC Codes

Table D.1: SOC Codes

	SOC Code
Higher level occupations	1 Managers, directors & senior officials
	2 Professional occupations
	3 Associate professional & technical occupations
Middle level occupations	4 Administrative & secretarial occupations
	5 Skilled trades occupations
	6 Caring, leisure & other service occupations
Lower level occupations	7 Sales & customer service occupations
	8 Process, plant & machine operatives
	9 Elementary occupations

Appendix E: School provision in STEM subjects

Table E.1: STEM subjects entries and passes (2010 and 2016)

		Entries			Passes		
		2010	2016	% Change (2010-16)	2010	2016	% Change (2010-16)
National	Biology	36,125	31,858	-12%	32,022	25,612	-20%
	Biotechnology	110	0	-100%	69	0	-100%
	Chemistry	27,904	23,873	-14%	26,002	19,453	-25%
	Environmental Science	0	642	-	0	491	-
	Mathematics	90,325	70,083	-22%	77,230	53,092	-31%
	Physics	22,183	20,775	-6%	20,093	16,641	-17%
	Science	2,607	728	-72%	2,457	690	-72%
	STEM	**223,423**	**202,797**	**-9%**	**199,152**	**162,026**	**-19%**
Highers	Biology	9,308	7,492	-20%	6,496	5,167	-20%
	Biotechnology	27	0	-100%	19	0	-100%
	Chemistry	10,179	10,077	-1%	7,834	7,710	-2%
	Environmental Science	0	392	-	0	238	-
	Mathematics	20,657	18,871	-9%	14,955	13,906	-7%
	Physics	9,018	9,129	1%	7,059	6,788	-4%
	STEM	**65,652**	**67,363**	**3%**	**48,554**	**48,741**	**0%**
Advanced Highers	Biology	2,177	2,362	8%	1,607	1,898	18%
	Chemistry	2,226	2,614	17%	1,735	2,171	25%
	Mathematics	2,936	3,358	14%	1,978	2,479	25%
	Physics	1,736	1,923	11%	1,371	1,519	11%
	STEM	**10,410**	**11,805**	**13%**	**7,829**	**9,145**	**17%**

Source: Ekosgen Note: the STEM total rows combines wider STEM subjects than just those relevant to LCS detailed above therefore the total sum of the individual subjects does not sum to the STEM total.

Appendix F: Abbreviations

AGCAS	Association of Graduate Careers Advisory Services	LS	Life Sciences
CPD	Continuing Professional Development	MA	Modern Apprenticeship
CS	Chemical Sciences	MyWoW	My World of Work
DYW	Developing the Young Workforce	NPA	National Progression Award
ES	Education Scotland	NOS	National Occupational Standards
ESP	Energy Skills Partnership	RSA	Regional Skills Assessment
FA	Foundation Apprenticeship	RSocBiol	Royal Society of Biology
FE	Further Education	RTD	Research and Technology Development
GA	Graduate Apprenticeship	ScotCHEM	Alliance of Scottish Universities Chemistry departments
GMP	Good Manufacturing Practice	SCQF	Scottish Credit and Qualifications Framework
GLP	Good Laboratory Practice	SDS	Skills Development Scotland
GVA	Gross Value Added	SE	Scottish Enterprise
HE	Higher Education	SFC	Scottish Funding Council
HEI	Higher Education Institution	SIP	Skills Investment Plan
HIE	Highlands and Islands Enterprise	SLA	Scottish Lifesciences Association
HNC	Higher National Certificate	SOP	Standard Operating Procedure
HND	Higher National Diploma	STEM	Science, Technology, Engineering and Mathematics
IBioIC	Industrial Biotechnology Innovation Centre	SULSA	Scottish Universities' Life Sciences Alliance
ILG	Industrial Leadership Group	SVQ	Scottish Vocational Qualification

Contributing organisations

The following organisations contributed to the development of this SIP:

Almac Sciences (Scotland)
Aubin
BBI (Solutions)
BDD Pharma
Biogelx
BioReliance
Biz Therapies
Calachem
Cellucomp
Celtic Renewables
Charles River Laboratories
Chemco International
City Deals
Collagen Solutions
Cyclacel Ltd
DC Bioscience
Devro
DSM Nutritional Products
DuPont Teijin Film
Developing the Young Workforce
Education Scotland
ESP
Ferring Controlled Therapeutics
Fios Genomics
FMC Health and Nutrition
Glycomar
GSK Irvine
GSK Montrose
HIE
Highland Biosciences
Highland Innovation Centre
IBioIC
Ineos
Ingenza
Interface
Johnson Matthey
LifeScan (J&J Company)
Marine Biopolymers Ltd
Mentholatum
Nandi Proteins
Neogen
NovaBiotics
Petroineos
Pharmatics
PPD
Rathburn Chemicals
Reprocell Europe Ltd
R-Biopharm Rhone Ltd
Sartorius Stedim
Sasol
SB Drug Discovery
ScotCHEM
Scotmas
Scottish Government
SDS
SE
SFC
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