ROYAL SOCIETY OF CHEMISTRY

The Future Chemistry Workforce and Educational Pathways

Examining the data behind the changing nature of jobs and skills in chemistry

An interim report produced by Lightcast
for the Royal Society of Chemistry

Lightcast

About the Royal Society of Chemistry

With around 50,000 members and a knowledge business that spans the globe, the Royal Society of Chemistry is the UK's professional body for chemical scientists, supporting and representing our members and bringing together chemical scientists from all over the world. Our members include those working in large multinational companies and small and medium enterprises, researchers and students in universities, teachers, and regulators. Our Royal Charter aims include: "to establish, uphold and advance the standards of qualification, competence and conduct of those who practise chemistry as a profession".

As a Professional Body and Learned Society, we also have an important role to play in ensuring the UK has the people and skills needed in STEM, for example through supporting members' continuous professional development of STEM and other skills and knowledge, supporting chemistry teachers, bringing chemical scientists together, disseminating knowledge and researching and campaigning on key issues for our science, such as inclusion and diversity in the chemical sciences.

About Lightcast

Lightcast (formerly Emsi Burning Glass) is the world's leading authority on job, skills, workforce talent, and labour market dynamics.

With engineers and data specialists collecting and analysing data from thousands of job boards, company websites, online resumes, employee profiles, and traditional government sources, the company produces the most comprehensive and up-to-date picture of the labour market available. Organisations across the globe use Lightcast market research, analytical software, and data expertise to better understand their own workforce and identify skilled and diverse talent for future growth.

Headquartered in Boston, Massachusetts, and Moscow, Idaho, Lightcast is active in more than 30 countries and has offices in the United Kingdom, Italy, New Zealand, and India.

This report was produced by Lightcast for the Royal Society of Chemistry by Jeff Dwan-O'Reilly and Elena Magrini, who would like to thank Duncan Brown from Lightcast, as well as Tanya Sheridan, Henry Lovett, Barney Slater and the wider Royal Society of Chemistry stakeholder group, for their input.

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Forewords

Sarah Robertson, Director of Education and Professional Practice
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Project Sponsors

As the professional body for chemistry in the UK, the Royal Society of Chemistry (RSC) supports the chemical science community in making the world a better place. To deliver on that aspiration, it is critical for the RSC to have a detailed understanding of the people making up the chemical sciences workforce, the skills they employ in their work and, crucially, understanding how these may change in the future. This means we can offer the most effective support and benefit to chemical scientists, ensuring it is relevant to the modern world they are working to build, empowering the sector to fulfil its potential as a force for good. That is why our 2021-25 strategy set out the Future Workforce and Educational Pathways project: to give us that vision of what the future may bring for the chemical sciences and inform our offer to our members, while shaping and driving our wider work advocating for the discipline.

We now have outputs from the first stage of the project, so are pleased to welcome this detailed data report from our project partners, Lightcast. Their analysis of official and proprietary data has given us an in-depth view of the work being done by people using chemistry. It builds on our Chemistry's Contribution research from 2020, this time focusing in on the skills these workers possess and employers seek, giving us a rich picture of the industries chemical scientists are working in and the roles they occupy. From these, we have been able to make projections of the growth and change that could be coming in the next decade based on current trends. To further build on these foundations, we will be engaging closely with the chemical sciences community to validate and expand on the picture given by the data. This additional research and contextualisation will be key to picking up emerging signals that projections alone cannot give us, enabling us to develop a rounded evidence base to provide professional development support and advocacy for our members and our discipline going forward.

Chemistry will continue to be of central importance to the challenges our society faces, in the UK and on a global scale. Chemical scientists develop solutions to these in many fields, including health, environment, energy and net zero, education and manufacturing. This work on Future Workforce and Educational Pathways will push us forward to be the best catalyst we can in delivering on that potential.

Tanya Sheridan, Head of Policy and Evidence

Project Lead

From cutting edge research on batteries and future fuels, to keeping our water clean and developing new pharmaceuticals, chemical research is critical to our future. Chemists provide scientific advice and services, oversee safety, inform the decisions of governments and educate the next generation. The chemical sciences workforce plays many, varied and vital roles across the economy and society. Lightcast's work in this report has given us the most detailed picture yet of the roles where chemical science is making an impact in the UK, either directly or through providing advice and understanding, and informs our understanding of how that may develop in future.

The key headline is that chemistry as a sector is projected to grow ahead of the average for the UK economy. Core chemistry occupations will need more workers in the coming years. This makes a chemistry degree the passport to a range of exciting jobs in the lab, the field or the office. Additionally, the data show these jobs pay significantly above the UK median salary. Chemistry skills are needed within the economy and employers are willing to pay for them. These data support the conclusions from other RSC work including our Pay and Reward Survey of members, and from national graduate destinations and earnings data.

The research also highlights potential risks to this future growth. There may not be the supply of skilled chemists we need to achieve the growth potential the projections indicate. We see fewer apprenticeships in the chemical sciences compared to the economy as a whole, and the literature review identifies current and future skills shortages. With the ageing workforce meaning experience is being lost as workers retire, and with new technologies changing the way we work, training is critical for new and current workers. In 2019, 80% of the 2030 workforce had already started their careers (McKinsey, 2019). Continuous professional development, as well as education, will be key to us all developing the skills we need to thrive in the future.

It is also important to note that these are the right skills for the future. The analysis shows green skills are much more in demand in chemistry jobs than in the wider economy, as chemistry is central to so many challenges around sustainability. However, we do not see this translate to the skills requirements for science teachers. There are key implications here for school chemistry education, building on the RSC's Green Shoots report, which showed that employers, learners and teachers all want to see more sustainability content in the curriculum. The analysis also shows that digital skills are in demand and early conversations with our community suggests this is a key trend for chemistry, in line with the RSC's Digital Futures report.

Our next step will be to take Lightcast's rich and excellent analysis to conversations with our community in early 2024 to add the colour that data can't give us, and understand where people working in chemistry see skills and knowledge needs developing in the future. We will discuss with a broad range of stakeholders how the information we have uncovered can best inform curricula, careers advice, and other RSC offers. We will be sharing findings with, and advocating to, decision-makers about the most effective changes to guarantee the health and impact of the chemical sciences. I hope you find this work as interesting as we do, and are keen to help us in meeting our goal of chemistry making the world a better place. To get involved with our work expanding and enriching this evidence base, please contact policy@rsc.org by the end of March 2024.

Executive summary

In a rapidly evolving world of work characterised by technological leaps, economic shifts and a green revolution, adaptability and continuous learning are now essential for success. Recognising the universality of these shifts, the Royal Society of Chemistry (RSC), as the representative body for chemistry in the UK, commissioned Lightcast to build a comprehensive evidence base to explore how these trends impact the UK chemistry workforce.

This report zooms in on the next decade, offering quantitative insights on future trends, challenges and educational needs of the chemistry sector in the UK. While it is impossible to predict the future, this report provides an indication of the direction of travel for chemistry. It does so by combining data from official statistics with Lightcast projections based on past labour market trends, and big data analytics from job postings data – a unique, granular and almost real time source of information on employers' skill needs. This combined approach helps overcome some of the challenges presented by using official statistics only – both in terms of defining the chemistry workforce, as official statistics do not offer a granular enough view of different chemistry jobs, and in terms of understanding how the chemistry workforce is changing over time. Indeed, while projections are based on past trends only, they offer a starting point to discuss how things may continue to change going forward. The quantitative findings presented in this report were then further contextualised by carrying out a comprehensive literature review, to identify fast growing trends not captured by projections, and will serve as the centrepiece for a conversation the RSC will hold with key stakeholder groups to build on the research.

Based on the latest official statistics, this report finds that the UK chemistry workforce comprises a core of at least 70,000 jobs in core chemistry occupations. This includes all jobs associated with chemical scientists, biochemists & biomedical scientists[1], quality assurance technicians and laboratory technicians working within chemistry-centred industries, as well as higher education chemistry professionals.

Depending on the definition used to quantify the chemistry workforce, there are, however, considerably more jobs associated with chemistry. In addition to this core, there are over 120,000 other jobs within chemistry-centred industries that require some knowledge of chemistry, an additional 1.4 million non-chemistry jobs in support activities and activities adjacent to chemistry, and an extra 184,000 jobs in core chemistry occupations outside the chemistry sector. Chemistry manufacturing and professional activities are the most popular industries for chemistry jobs, but large shares of chemistry jobs are also found in the education sector, particularly higher education, and in healthcare.

Assuming historical patterns will persist into the future, initial projections suggest that the chemistry workforce will grow by 6% over the next decade, outpacing the broader economy's 4% growth. Lightcast's projection model estimates this expansion will apply to all parts of the chemistry workforce, resulting in at least 12,000 new jobs in core chemistry occupations, with the swiftest growth anticipated for biochemists & biomedical scientists. From an industry perspective, food manufacturing and scientific research are projected to be the two sectors with the largest growth in job numbers – adding approximately 20,000 jobs each respectively.

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[1] As part of the Office for National Statistics 4-digit Standard Occupation Taxonomy (SOC), 'Biochemists' and 'Biomedical scientists' are treated as one unique occupation called 'Biochemists & biomedical scientists'. For this reason, it is not possible to split the two when using official statistics.

While chemistry jobs are projected to grow overall, the composition of the sector is likely to change, and this is further corroborated by findings from the wider literature. A comprehensive literature review of 33 policy and research papers on current labour market trends in the UK economy, and for the chemistry sector specifically, points to a notable shift in job composition towards professional services and green chemistry, against a decline in manufacturing chemistry roles.[2] This is due to a combination of macroeconomic changes, technological advancements and the current policy and investment landscape.

The literature review, however, also suggests that the biggest challenge for the chemistry sector over the next decade is not job creation, but arguably access to skills and talent to fill these new jobs. Chemistry businesses are currently facing significant recruitment challenges and are struggling to find workers with the right skills. The most acute skill shortages highlighted in the literature concern a lack of transferable skills, STEM knowledge and skills, as well as digital and green skills and knowledge gaps. An ageing population, lack of coordination between businesses and education providers, limited availability of technical and vocational routes, and lack of continuous professional development opportunities suggest the potential for growth of the chemistry sector over the next decade is at risk.

In an effort to further understand these changes, and shed light on some of the key education and skill needs in the sector, job postings data were used to capture the most comprehensive view of employers' needs in chemistry roles available to date. This dataset, which is based on over 80 million job postings collected in the UK since 2012, complements official statistics by providing a more granular and up-to-date picture of the labour market, identifying the specific roles employers are currently recruiting for, and the specific skills, knowledge and abilities associated with them.

Looking at trends in recruitment activity shows that chemistry currently has a particularly active labour market, witnessing a 50% increase in online job postings compared to 2018/19. This surge is particularly notable for nuclear engineers, pharmacists, and law, regulatory & policy chemistry professionals, once again highlighting that the composition of chemistry jobs is changing. Furthermore, the median advertised salary for chemistry roles stands at £38,600, approximately £7,600 (25%) above the UK median average, reflecting employers' willingness to offer a premium for chemistry jobs. The notable exception to this is for operations and support roles in manufacturing and laboratory settings. Recruitment activity is up in all parts of the country, and while in terms of volumes it is highest in London and the South East of England, in relative concentration terms it is particularly high in the North East, East of England and the North West, with the North West in particular seeing strong growth in recent years.

From a skills perspective, chemistry jobs are on average more likely to require technical skills, knowledge and abilities than other occupations, and these technical skills, knowledge and abilities vary significantly from one occupation to another, reflecting the high level of specialisation in the sector. To reflect the uniqueness of different chemistry occupations, the specific skills, knowledge and abilities required in 12 different career paths in chemistry are presented in detail in 12 individual factsheets.[3]

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[2] The full list of papers reviewed as part of the literature review is available in Appendix 1 at the end of the report.

[3] Factsheets are available at the end of the report.

Despite these differences, job postings data show five cross-cutting trends in relation to skills and training that apply right across chemistry occupations:

1. Central importance of transferable skills, which has further increased in recent years. Alongside technical skills, transferable skills, in particular in relation to business, professional skills, and communication, are pivotal to chemistry jobs. Among the top 20 skills, knowledge and abilities most mentioned in chemistry job postings, 12 are transferable, with communication and management standing out. This suggests employers explicitly focus on recruiting candidates with transferable skills, while the emphasis on chemistry-specific technical skills is more implicitly linked to role titles and educational requirements needed to apply for these roles. Demand for transferable skills has also increased significantly in recent years, indicating that chemistry employers increasingly value candidates with both sector-specific knowledge and the ability to collaborate, communicate effectively, and take initiative in today's dynamic work environment.

2. Chemistry jobs are in the midst of a digital transformation. Over the past five years, the frequency with which digital skills have been mentioned in chemistry job postings grew by 5.7 percentage points, outpacing the overall UK labour market's 1.9 percentage point increase. Approximately four in 10 skills, knowledge and abilities mentioned in chemistry job postings are digital. Chemistry job postings require high basic computer literacy and knowledge of the Microsoft Office Suite, but also more advanced digital skills, knowledge and abilities, in particular in relation to data, automation, and computer science. This shift suggests a need for continuous learning and adaptability, highlighting the critical role of lifelong learning. It also poses pressing questions for education providers and policymakers to align curricula with evolving digital demands and equipping students with the right skills to navigate a rapidly evolving technological landscape.

3. Critical role of green skills, knowledge and abilities. Using a list of approximately 450 skills, knowledge and abilities related to the green economy, this paper found that approximately one in five skills mentioned in chemistry job postings is 'green', compared to 2.5% in the wider UK labour market.[4] The most cited skills, knowledge and abilities are directly linked to knowledge of environmental laws and regulations, renewable energy and net zero. While most chemistry occupations show a significant demand for these green skills, knowledge and abilities, they are barely mentioned in job postings for chemistry related education roles, posing a potential challenge. Having identified green skills, knowledge and abilities needed from employers, the focus now needs to shift to determining the necessary investment levels, course specifics, curricula adjustments and formats to address these evolving skill and knowledge needs in the green space.

4. While science and research skills, knowledge and abilities are critical to chemistry jobs, there is declining emphasis on them in job postings, with the exception of chemistry skills related to safety and regulations. Of the 15 chemistry skills clusters analysed as part of the research, 11 saw no or negative change in job posting frequency over the past five years, with chemistry-general skills declining on average the most (-2.7 percentage points). This applies across all chemistry occupations with the only exception appearing to be for the frequency of specific chemistry safety and regulation knowledge and skills. However, this is not a reflection of a declining importance of these skills in chemistry jobs; rather, it highlights employers may be more explicitly recruiting for other skills, which they find harder to fill, while implicitly assuming candidates continue to have the core specialist skillset to carry out these jobs.

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[4] The full list of the 450 green skills, knowledge and abilities used in this report can be found in Appendix 2 of the report.

5. Key role of education qualifications, particularly higher level qualifications. While the UK's businesses are increasingly moving towards skill-based hiring, this does not appear to be the case for chemistry. Approximately 37% of chemistry job postings between August 2022 and July 2023 specified a minimum education level, almost twice the UK economy's average. Notably, 65% of these postings required at least a bachelor's degree, and over 5% sought a PhD. This emphasis on high-level qualifications, pervasive across chemistry occupations, highlights the specialised nature of these roles, but also raises potential challenges for employers in accessing a wider and more diverse talent pool.

The last chapter of the research focused on the demographics of the current chemistry workforce, using the Office for National Statistics Labour Force Survey microdata. The gender distribution of chemistry professions is particularly varied, with chemical scientists and quality assurance technicians being highly male-dominated occupations, while biochemists and laboratory technicians having an above-average female representation. On all other dimensions, chemistry professions tend to share similar trends. On average, chemistry workers tend to be younger, particularly chemical scientists, and to be less likely to self-identify as disabled compared to the wider workforce (13% v 15% respectively). In terms of ethnicity, chemistry jobs have an above-average representation of Asian workers and a lower representation of Black workers. Approximately 70% of chemistry workers hold a degree, compared to 40% in the UK wide workforce, and, because of their occupational status, are for the majority associated with managerial or professional socioeconomic status.

These findings paint a dynamic picture of the current and future landscape of the chemistry sector, providing a comprehensive overview of business demand. This will continue to evolve and come into shape in coming years. To secure the success of the sector, education and policymakers now need to ensure chemistry businesses can access the talent they need to continue to thrive in the future.

Chapter 1: Introduction

1.1 Research overview

The world of work is changing at an unprecedented pace. Rapid advancements in technology, shifting economic trends, an ageing population and the transition to a greener economy are bringing profound changes to the labour market. The traditional notions of careers and job security are giving way to a new reality where adaptability and continuous learning are the cornerstones of success. As industries and professions undergo unparalleled transformations, the ability to navigate and thrive within this fast-changing environment has become essential.

As the UK's professional body for chemistry, the Royal Society of Chemistry (RSC) commissioned Lightcast to develop a comprehensive quantitative evidence base of how these trends are affecting the UK's chemistry sector. In particular, this report focuses on providing insights into future trends, challenges and educational requirements that will shape the chemistry workforce over the next decade, with a special attention to the impact of the digital transformation and the green transition on the chemistry workforce.

By building upon previous work conducted by the RSC, such as the 2020 Chemistry's Contribution report[5] and the 2019 Science Horizons report[6], as well as work from other key stakeholders in the sector, including work by the UK Research and Innovation (UKRI) and the Engineering and Physical Sciences Research Council (EPSRC), this report aims to inform a wide range of RSC work to support the chemical sciences community. This includes professional development, educational offer and training, and raising awareness of the chemistry profession in the current policy landscape, with the report serving as the centrepiece for a conversation the RSC will hold with key stakeholder groups to build on the research.

1.2 Report structure

The insights presented in this report are organised in four different chapters, each answering a different research question related to the future of the chemistry workforce over the next decade. Chapter 2 focuses on quantifying the current size of the chemistry-using workforce in the UK and how this may change between now and 2032, as well as reviewing key trends likely to affect the chemistry labour market in coming years. To complement these findings, Chapter 3 looks at the latest trends in recruitment activity for the chemistry-using workforce, providing almost real-time insights on the latest employers needs. Chapter 4 further delves into recruitment activity trends to understand the specific skills and educational requirements of employers recruiting for chemistry-using roles, while Chapter 5 focuses on providing a snapshot of the current demographics of the chemistry-using workforce. The report then closes with conclusions in Chapter 6 and will be followed by a second paper focusing on international comparisons about the chemistry-using workforce in a number of different countries across the world.

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[5] Cambridge Econometrics (2020) 'Chemistry's Contributions'
https://www.camecon.com/what/our-work/chemistrys-contribution-workforce-trends-and-economic-impact/

[6] Royal Society of Chemistry (2019) 'Science Horizons'
https://www.rsc.org/globalassets/04-campaigning-outreach/campaigning/science-horizons/science-horizons-report.pdf

1.3 Data sources

The research presented in this report was produced by combining data from official statistics with Lightcast proprietary data on job postings. Among the official statistics used in this report, there are a variety of large-scale official surveys conducted regularly by the Office for National Statistics (ONS) combined with Lightcast empirical enrichment models that better integrate and enhance these different official datasets. Alongside these core labour market statistics, Lightcast used its own proprietary online job postings library – a library containing over 80 million job postings collected in the UK since 2012. A detailed description of the data sources and methodology used to answer each research question is available at the beginning of each chapter.

1.4 Defining the chemistry-using workforce

For each of the datasets used in the research, a tailored definition of the chemistry workforce was created based on data granularity, consistency of definitions across different datasets, and feedback from the Royal Society of Chemistry and its stakeholders. Each definition is described in detail at the beginning of each chapter, the first time it is introduced. All definitions share the same starting point as they were all built from the research presented in the 2020 Chemistry's Contributions report produced by Cambridge Econometrics for the RSC.[7]

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[7] Cambridge Econometrics (2020) 'Chemistry's Contributions'
https://www.camecon.com/what/our-work/chemistrys-contribution-workforce-trends-and-economic-impact/

Chapter 2: Overview of future trends for the chemistry-using workforce

Summary and key findings

- This chapter provides an overview of the chemistry-using workforce today and how this may evolve over the next decade. The insights presented in this chapter were produced by combining quantitative insights from official statistics on jobs numbers with Lightcast's empirical enrichment models, and a comprehensive literature review. All definitions of chemistry used in this chapter are based on the ONS official classifications for occupations (SOC2020) and industries (SIC 2007).
- Depending on the criteria chosen to define the chemistry workforce, its size changes considerably:
  - As a lower bound, the chemistry workforce accounts for at least 70,000 jobs in core chemistry occupations within chemistry-centred industries. These core chemistry occupations are: chemical scientists, biochemists & biomedical scientists, quality assurance technicians and laboratory technicians, as well as chemistry higher education professionals, and they are predominantly found within manufacturing and professional services – particularly research – chemistry-centred industries.
  - In addition to these 70,000 jobs, there are also:
    - An extra 121,000 jobs in other chemistry occupations within chemistry-centred industries;
    - A further 1.4 million non-chemistry jobs in chemistry-centred industries such as in support roles and supply chain;
    - Approximately 184,000 jobs in core chemistry occupations working in other, non-chemistry-centred, industries. This is particularly the case for biochemists & biomedical scientists, as well as laboratory technicians, which are often found in the healthcare sector and in the education sector.
- The chemistry workforce is projected to grow by 6% over the next decade. This is considerably faster than the wider economy (4%), and translates into at least 12,000 new jobs in core chemistry occupations and approximately 100,000 new jobs in chemistry-centred industries. All parts of the chemistry workforce are projected to grow by 2032, with the fastest growth projected for biochemists & biomedical scientists.
- These projections are to be interpreted alongside the findings from a comprehensive literature review. This exercise suggests that, from a demand-side, job creation perspective, the chemistry sector is likely to see a shift in composition in coming years, with growth in professional service and green chemistry jobs and a decline in manufacturing chemistry jobs. However, the biggest challenge for the chemistry sector appears to be on the supply side – both in terms of access to workers and to skills.

The aim of this chapter is to provide an overview of the chemistry-using workforce today and how this may evolve from an occupational perspective over the next decade, setting a 10-year horizon to 2032. In particular, this chapter focuses on quantifying the size of the chemistry workforce today, its occupational and industrial breakdown, alongside providing quantitative and qualitative insights on how the size and composition of the chemistry workforce may change over the next 10 years.

Understanding the job dynamics of the chemistry workforce today and in the future is important for several reasons. Firstly, it helps the RSC and its members understand how best to inform work on professional development. It also helps ensure current and future educational offer and training provision are aligned with labour market needs. And, thirdly, the insights presented in this chapter can help shape policy investments and decisions to maximise the contribution of the chemistry's workforce to the UK's economy.

2.0 Methodology and definitions

The insights presented in this chapter were produced by combining quantitative insights from official statistics on jobs numbers with Lightcast's empirical enrichment models, and a qualitative literature review of trends affecting the chemistry labour market.

To provide a granular analysis of the labour market, Lightcast brought together eight different official government data sources. These eight sources are:

- ONS Annual Business Inquiry
- DEFRA Statistics
- ONS Annual Population Survey (APS)
- UKCES Working Futures
- ONS Labour Force Survey (LFS)
- ONS Workforce Job Series
- ONS Business Register and Employment Survey (BRES)
- ONS Annual Survey of Hours and Earnings (ASHE)

Each of these sources describes a different aspect of the labour market and, in isolation, only tells part of the story or contains weaknesses. Modelled together, these datasets provide a more holistic and robust view of the labour market.

Starting from this data, Lightcast then used its staffing pattern matrix and projection models to extrapolate insights by chemistry-centred industries and occupations and how these may change over time (more details on the models are set out in the relevant sections, 2.1 and 2.4 respectively). These projections offer a starting point for understanding how the chemistry workforce may evolve in the future and have then been complemented with qualitative insights from 33 policy and research papers identified by the RSC to provide a more holistic view of how the sector may evolve over time.[8]

For this chapter, the chemistry-using workforce has been defined both from an occupational and industrial point of view, and a combination of the two. All the definitions of chemistry used in this chapter are based on the ONS official classifications for occupations (SOC2020) and industries (SIC2007) and were built starting from the 2020 Chemistry's Contributions report,[9] with feedback from the RSC and its stakeholders.

Depending on the selection criteria chosen from a definitional perspective, the size of the chemistry workforce changes considerably. This is true both from an occupational and industrial point of view.

These differences are explored in more detail in the next section, alongside their strengths and limitations and a full list of what they include.

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[8] The full list of papers reviewed as part of the research is available in Appendix 1.

[9] Cambridge Econometrics (2020) 'Chemistry's Contributions'
https://www.camecon.com/what/our-work/chemistrys-contribution-workforce-trends-and-economic-impact/

2.1 The chemistry workforce and its components

From an industry perspective, the 2020 Chemistry's Contribution report identified a number of industries with a key chemistry component. These have been reviewed and, with feedback from the RSC, a list of chemistry-relevant industries has been compiled as the starting point for this research:

Table 1: Chemistry-relevant industries

SIC2007 code	Industry name (SIC2007)
10xx	Manufacture of beverages – all four-digit codes
11xx	Manufacture of food products – all four-digit codes
12xx	Manufacture of tobacco products – all four-digit codes
19xx	Manufacture of coke and refined petroleum products – all four-digit codes
20xx	Manufacture of chemicals – all four-digit codes
21xx	Manufacture of pharmaceuticals – all four-digit codes
22xx	Manufacture of rubber plastic products – all four-digit codes
23xx	Manufacture of non-metallic mineral products – all four-digit codes
24xx	Manufacture of basic metals – all four-digit codes
2720	Manufacture of batteries and accumulators
3522	Distribution of gaseous fuels through mains
36xx	Water collection, treatment and supply – all four-digit codes
38xx	Waste Collection, Treatment and Disposal Activities; Materials Recovery – all four-digit codes
46 subset	Wholesale trade of chemical-related activities: 4612 – Agents involved in the sale of fuels, ores, metals and industrial chemicals 4618 – Agents specialised in the sale of other particular products 4619 – Agents involved in the sale of a variety of goods 4621 – Wholesale of grain, unmanufactured tobacco, seeds and animal feeds 4645 – Wholesale of perfume and cosmetics 4646 – Wholesale of pharmaceutical goods 4675 – Wholesale of chemical products
7120	Technical testing and analysis
72xx	Scientific research and development – all four-digit codes

In addition to these industries, education also plays a key role in employing chemistry professionals. However, due to limitations in the ONS industrial and occupational classifications, teaching professionals are treated separately throughout the report as further explained below.

Broadly speaking, the jobs associated with these chemistry-centred industries can then be split into three categories, based on the amount of chemistry knowledge and skills the occupation they are associated with requires:

1. **Core chemistry jobs**: these are jobs that are linked to occupations requiring a great deal of chemistry knowledge and skills. In this paper, this category includes four SOC2020 occupations plus chemistry-related Higher Education professionals (see **Table 2**).

Table 2: Core chemistry occupations

SOC2020 code	Occupation name (SOC2020)
2111	Chemical scientists
2113	Biochemists & biomedical scientists
3111	Laboratory technicians
3115	Quality assurance technicians
-	Chemistry Higher Education professionals (treated separately – HESA data)

It is important to remember that these core chemistry occupations are not only employed within chemistry-relevant industries, but jobs associated with them can also be found in other parts of the labour market. This crossover is further explored in the next section.

2. **Other chemistry jobs**: these are other jobs within chemistry-relevant industries that are linked to 15 occupations requiring some level of chemistry knowledge and skills. Due to limitations in the ONS classification, these occupations appear, on average, to require chemistry knowledge and skills to a smaller extent compared to core chemistry occupations. However, in reality, in each of these occupations, there are specific roles requiring high chemistry knowledge and skills. These 15 occupations are listed in **Table 3**.

Table 3: Other chemistry occupations

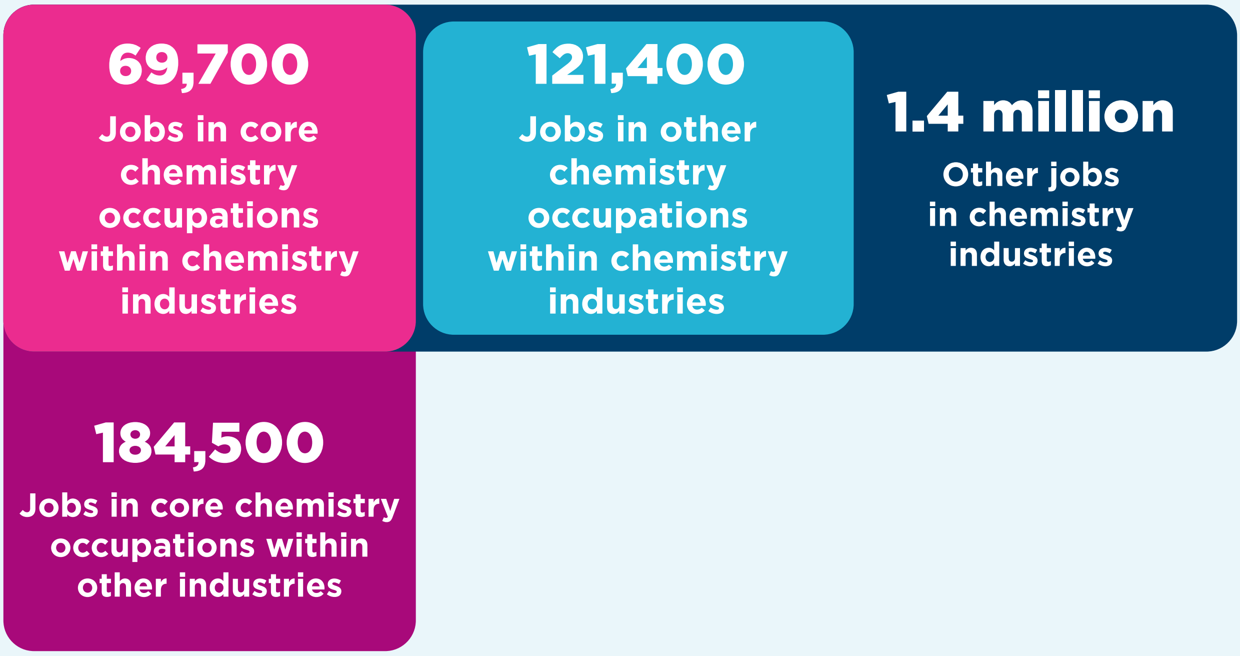
SIC2007 code	Industry name (SIC2007)
2129	Engineering professionals n.e.c.
2482	Quality assurance and regulatory professionals
8139	Plant and machine operatives n.e.c.
8113	Chemical and related process operatives
2483	Environmental health professionals
2152	Environment professionals
2125	Production and process engineers
-	Further education teaching professionals (treated separately – Government data)
-	Secondary education teaching professionals (treated separately – Government data)
3119	Science, engineering and production technicians n.e.c.
3582	Health and safety managers and officers
8133	Energy plant operatives
1254	Waste disposal and environmental science managers
2119	Natural and social science professional n.e.c.
2162	Other research, unspecified discipline

3. Other related jobs: these are jobs in occupations that do not require on average any particular chemistry knowledge and skills, but operate within chemistry-related industries. These are jobs related to business support activities to support the functioning of the chemistry sector, such as jobs in finance, HR and marketing, as well as other jobs adjacent to chemistry or linked to chemistry via supply chain.

Figure 1 provides a visual representation of these different components and the number of jobs associated with each of them. The number of jobs in each of the components has been estimated using Lightcast's staffing pattern matrix. This matrix helps connect occupations to industries, by breaking down the number of jobs in an industry by different occupations and, vice versa, by breaking down the number of jobs in each occupation by the industry people work in.

Overall, as of 2022, the chemistry-using workforce was made of a core of at least 69,700 jobs in chemistry occupations within chemistry-relevant industries. On top of these 69,700 jobs, there were an additional 121,400 jobs within chemistry-relevant industries, requiring at least some chemistry knowledge and skills, and a further 1.4 million other jobs related to chemistry via supply chain, business support or industry adjacency. Lastly, alongside these jobs within chemistry-relevant industries, there were a further 184,500 jobs associated with core chemistry occupations but operating outside the defined parameters of the chemistry-centred industry. Each of these components are explored in more detail in the next two sections.

Figure 1: The chemistry workforce and its components



Source: Job data 2022, Lightcast data version 2023.2

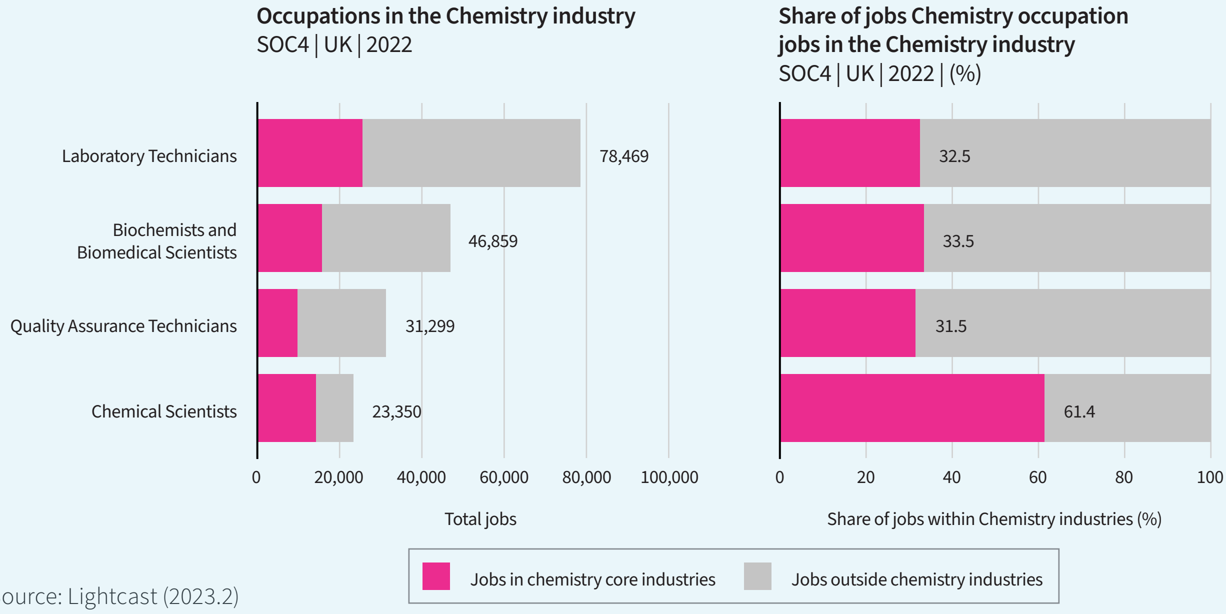
2.2 Job numbers today in core chemistry occupations

From an occupation perspective, as of 2022, there were approximately 180,000 jobs associated with the four core-chemistry SOC2020 occupations of chemical scientists, biochemists & biomedical scientists, lab technicians and quality assurance technicians.

Of these, approximately 65,400 (36%) were directly linked to chemistry-relevant industries. From a concentration perspective, *chemical scientists* was the occupation with the highest concentration of jobs within chemistry-centred industries (61%), compared with a concentration between 31% and 34% for the other three core-chemistry occupations.

While *chemical scientists* is the most ‘chemistry’ occupation from a concentration perspective, lab technicians are the largest occupation for jobs in chemistry-centred industries in terms of volume. Of the 78,500 lab technician jobs in the UK economy, just over 25,500 were directly linked to chemistry-centred industries. Biochemists and biomedical scientists accounted for approximately 15,700 jobs within chemistry-centred industries, closely followed by chemical scientists (14,300). In contrast, with just shy of 10,000 jobs, quality assurance technicians was the core chemistry occupation accounting for the smallest number of core chemistry jobs within chemistry-centred industries.

Figure 2: Core chemistry occupations – volumes and shares



Source: Lightcast (2023.2)

In addition to these 65,400 key core-chemistry jobs, separate analysis on education data reveals a further 4,300 jobs directly related to chemistry higher education staff roles. These jobs sit alongside just over 70,000 broader science and chemistry-related teaching professional jobs across higher and secondary education, **as further discussed in Box 1**. These are considered core chemistry professionals sitting outside chemistry-centred industries.

Box 1: Chemistry jobs in higher and secondary education

Teachers and lecturers play a key role in the chemistry workforce, however, due to the way official occupations are classified, it is not possible to isolate education staff working specifically on chemistry in official statistics. To overcome this challenge, the chemistry teaching workforce was analysed using other datasets, namely data from the Higher Education Statistics Agency (HESA) for higher education, and data from relevant government education departments in each UK nation for secondary education. Chemistry-related education staff also works in the Further Education sector, but due to data availability, it was not possible to isolate them in the data.

From a higher education perspective, estimates from HESA data show at least 4,300 jobs specifically linked with UK chemistry department staff in 2022. This is out of a total of 27,700 higher education staff more broadly linked to science with a significant chemistry content such as biosciences, pharmacy, environmental studies, chemical engineering and materials engineering.

The role of chemistry in secondary education is more difficult to quantify and isolate. Secondary education statistics are compiled by each individual UK nation and are reported using slightly different methodologies. In England and Wales chemistry teachers are often coded as ‘general science’ teachers and therefore, just the number of chemistry teachers alone is an underrepresentation. For Scotland, the breakdown is typically more accurate, but presenting data for chemistry-only teachers would not allow for a consistent comparison with the English and Welsh data. In addition to that, teacher numbers are typically reported by headcount in England and Wales, while the Scottish figures are presented as Full Time Equivalent. Lastly, teaching data by subject is not available for Northern Ireland.

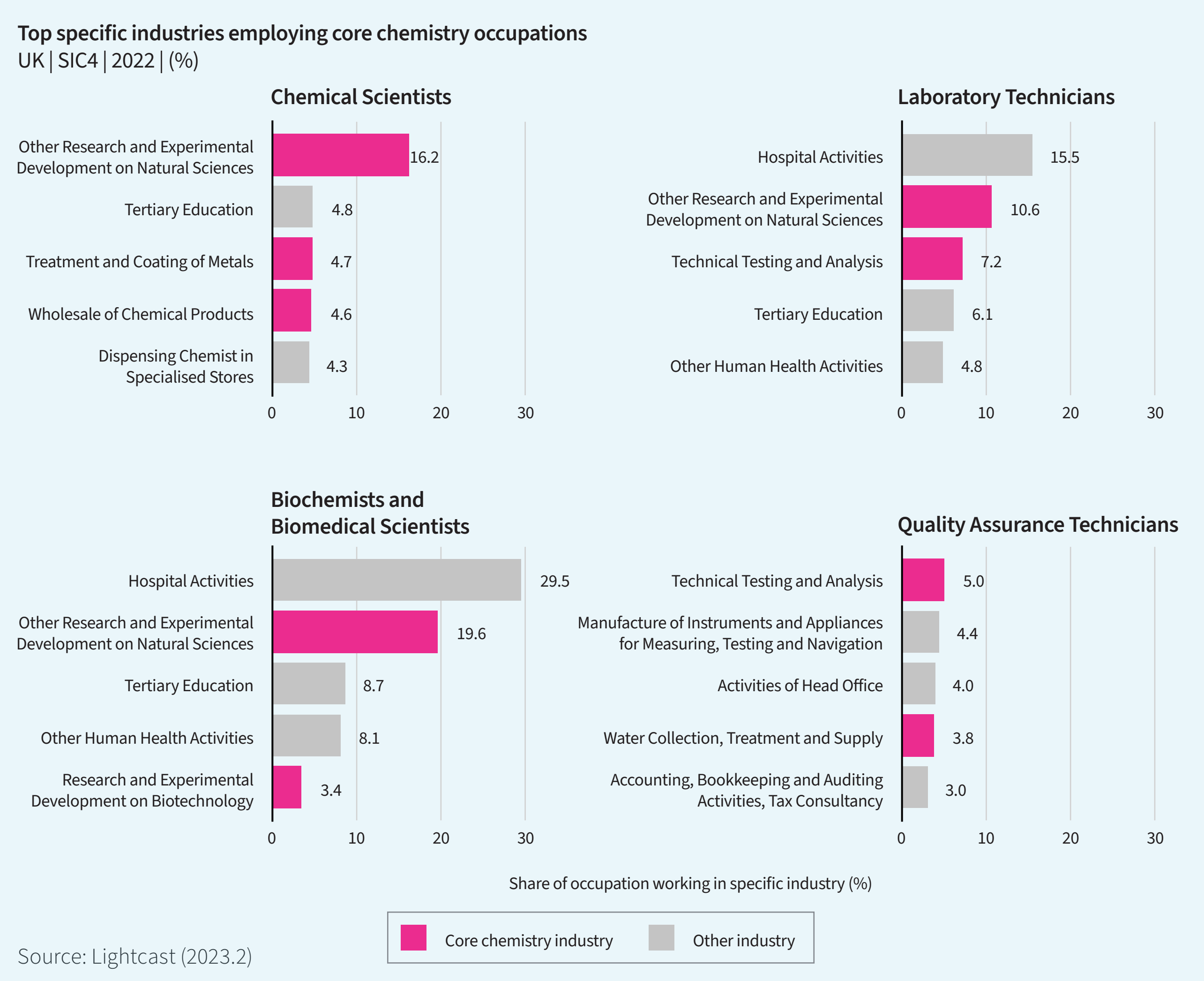
With these caveats in mind, an estimated 47,700 teachers were associated with chemistry or general sciences across Great Britain in 2022. In Scotland, where the breakdown between chemistry and general science tends to be more accurate, 42% of teachers were directly associated with chemistry. In comparison, only 17% of general science and chemistry teachers in England and 20% in Wales were directly associated with chemistry.

Bringing the focus back to the four core chemistry occupations, the next paragraph delves deeper into the industries they are most often associated with.

Manufacturing and professional services – particularly research – are the key industries for core chemistry occupations, but they are not the only ones. While the top industries for chemical scientists and quality assurance technicians are chemical-relevant industries – namely research & development, and technical testing & analysis respectively – the top industry for biochemists & biomedical scientists, and for lab technicians is hospital activities. Education, and in particular tertiary education, as highlighted in Box 1, is also a key sector for chemistry jobs, accounting respectively for 9% of all biochemists & biomedical sciences, 6% of lab technicians and 5% of chemical scientists jobs in the UK.

This has two implications for the RSC and its members. Firstly, it suggests that the importance of chemistry knowledge and skills goes beyond the boundaries of chemistry-centred industries, meaning the economic contribution of chemistry is varied and not exclusive to chemistry-centred industries. Secondly, it highlights how businesses beyond the chemistry sector are also competing for chemistry talent and, conversely, how chemistry businesses facing recruitment challenges may look to address their talent shortages by tapping into chemistry professionals working outside the chemistry sector boundaries, such as in the healthcare sector.

Figure 3: Top 5 industries employing core chemistry occupations



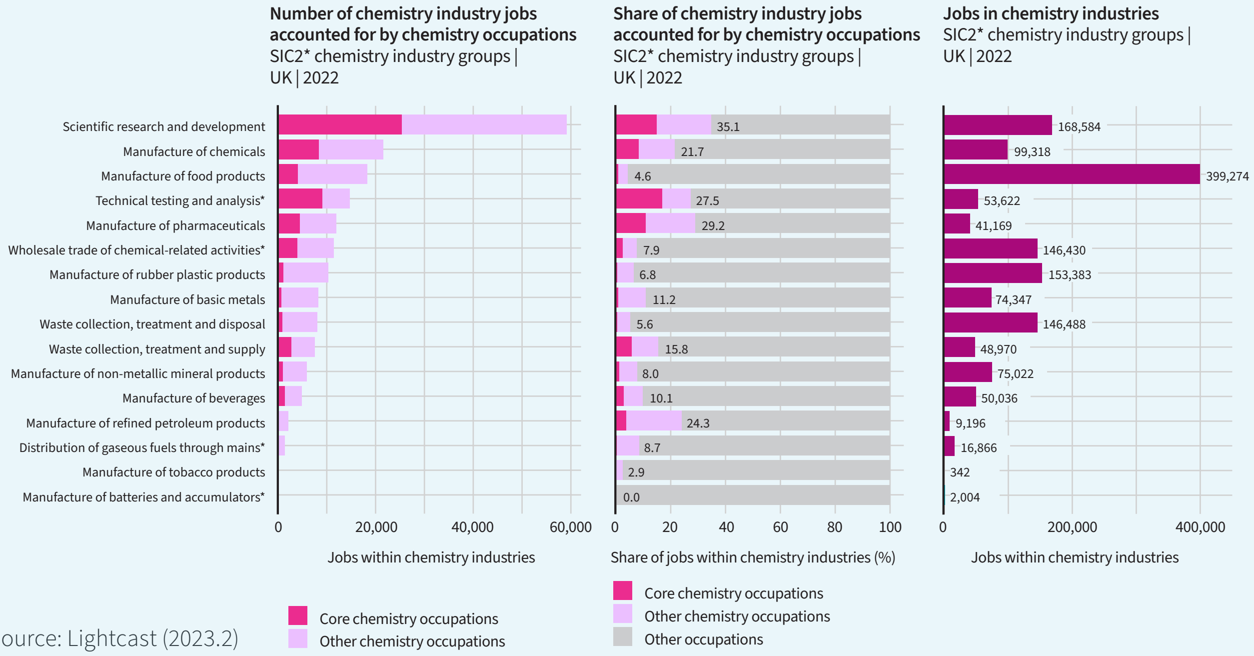
Source: Lightcast (2023.2)

2.3 Job numbers today in core chemistry industries

As mentioned in section 2.1, in addition to the 69,700 jobs in core chemistry occupations, chemistry-centred industries also include approximately 121,400 other chemistry jobs and a further 1.4 million other jobs across business support, supply chain and roles adjacent to chemistry. The focus of this section is to break down these job numbers by different industry and occupation components.

While chemistry occupations only account for a small minority of jobs in chemistry-centred industries – approximately 4% – there is a great deal of variation across chemistry sub-sectors. Over a third of all jobs within the scientific research & development sector – approximately 60,000 jobs – are either core or other chemistry jobs, followed by 29% of jobs in manufacture of pharmaceuticals and 28% of jobs in chemistry-related technical testing and analysis activities. In contrast, chemistry occupations (core and other) account for less than 5% of jobs in the manufacture of food products sector, which, overall is by far the biggest sub-sector included in the chemistry-centred industry definition, with approximately 400,000 jobs. This means that, in practice, only 19,200 jobs in the manufacturing of food products sub-sector are in reality directly linked to chemistry occupations (core or other), making it the third chemistry-relevant sector in terms of chemistry jobs by volumes, after scientific research & development, and the manufacture of chemicals sector (22,000 chemistry jobs, either core or other).

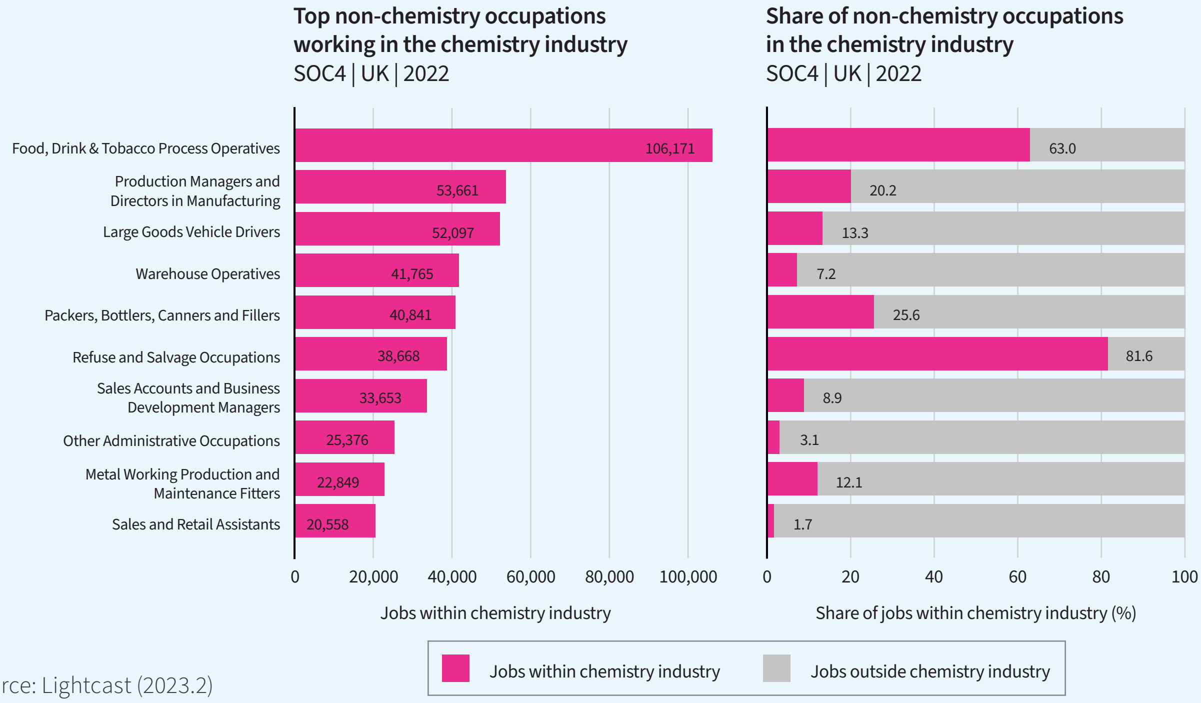
Figure 4: Chemistry relevant industries, volumes and shares and chemistry v other occupations breakdown



Source: Lightcast (2023.2)

In terms of the other occupations accounting for the largest shares of jobs in the chemistry-centred industry, these are mostly operatives, elementary and business support roles. Over 100,000 jobs within the chemistry-centred industry are food operatives, and a further 42,000 warehouse operatives. On top of that, production managers in manufacturing, and large vehicle drivers account for over 50,000 jobs each, and packers account for over 40,000 jobs. This reflects the manufacturing focus of some of the largest chemistry sub-industries, in particular food manufacturing and rubber and plastic products.

Figure 5: Top 10 other occupations in chemistry relevant industries, volumes and shares



Source: Lightcast (2023.2)

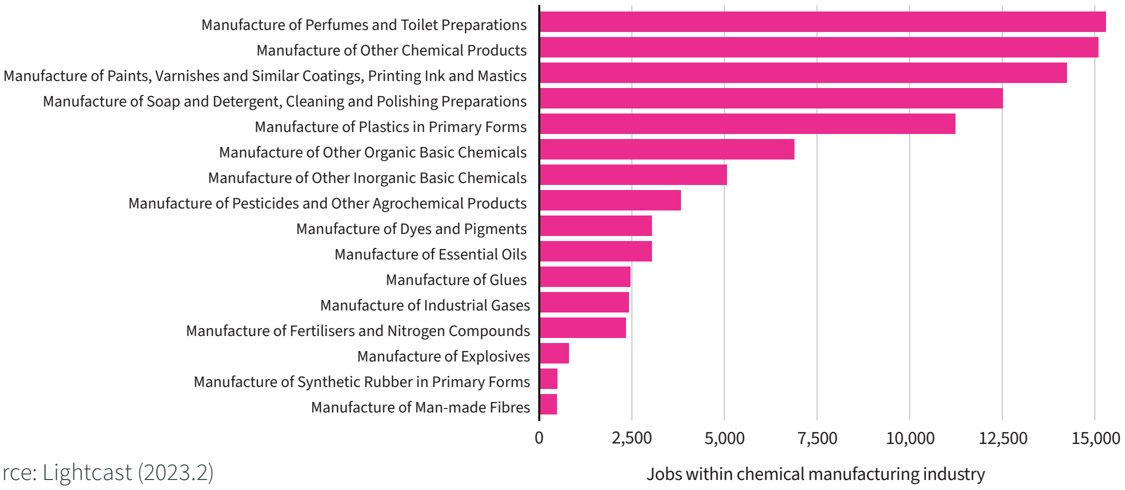
Box 2: Deep dive on chemical manufacturing

Chemical manufacturing is undoubtedly a key chemistry sector. Accounting for almost 100,000 jobs in 2022, the chemical manufacturing industry produces many of the essential chemical-based materials needed in other industries as well as core household products.

Within chemical manufacturing, the manufacture of perfumes and toilet preparations is the biggest subsector, accounting for 15% of all jobs, followed by the manufacture of paints, varnishes and similar coatings, as well as soap and detergents.

Figure 6: The composition of chemical manufacturing jobs by sub-industries

Composition of Chemical Manufacturing Jobs SIC4 | UK | Jobs | 2022

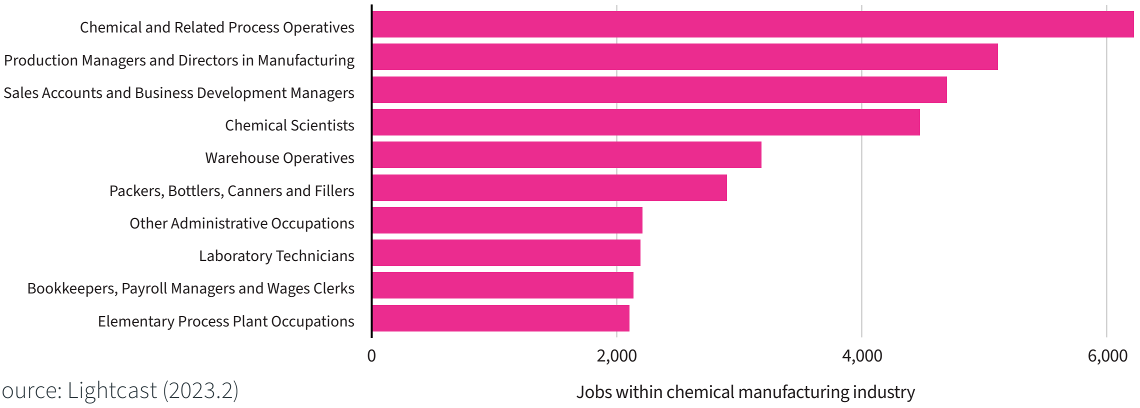


Source: Lightcast (2023.2)

While each sub-industry requires its own mix of occupations, depending on the activities involved, the chemical manufacturing sector requires a large number of chemical and related process operatives – over 6,000 jobs, or approximately 6% of all the jobs in the industry. Two business support occupations – production managers and sales managers are the second and third most important occupations in the sector in terms of volumes – while the first core-chemistry occupation, chemical scientists, is fourth in terms of job volumes, accounting for approximately 4,500 jobs within chemical manufacturing.

Figure 7: Top 10 occupations in chemical manufacturing

Top occupations working in chemical manufacturing SIC20 | SOC4 | UK | 2022



Source: Lightcast (2023.2)

2.4 Growth projections for the chemistry workforce

After having analysed the chemistry workforce today, this section starts looking at how the chemistry workforce may evolve over the next decade. It does so by starting from the Lightcast's projection model, which helps imagine what the future could look like if recent growth trends continue over the next decade.

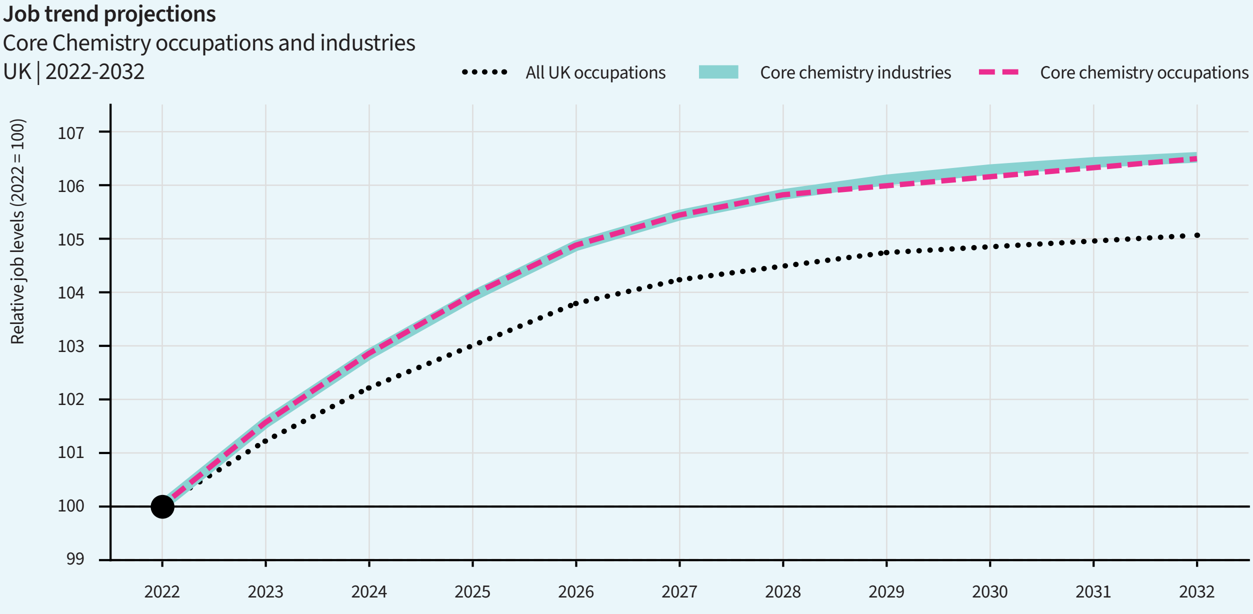
Lightcast projections offer insights about how the number of jobs in an industry or occupation might change in the future, based on past trends, and are built using the following methodology:

- Creating simple short-, mid-, and long-term trend lines for every industry, occupation and local authority based on historical data;
- Removing unrealistic extreme changes through averaging;
- Incorporating national industry projections (Working Futures national employment projections) as well as regional projections provided by the UK Government.

These projections offer a starting point for understanding how the chemistry workforce may evolve in the future. It is important to note these are projections, not forecasts, meaning they look at the future based on past trends only. Like with all projections and forecasts produced by different organisations, Lightcast's projections are subject to substantial disruption in practice and should therefore be taken as a baseline to frame the discussion, not the 'definitive' word.

Overall, the chemistry workforce is projected to grow at a faster rate than the average rate across all industries between now and 2032. On the assumption that the labour market will continue on the same growth trajectory of the past few years, both core chemistry occupations and chemistry-centred industries are projected to grow by 6% over the next decade, compared with 4% for the UK-wide economy. This translates into almost 12,000 new jobs in chemistry related core occupations and approximately 97,000 jobs in chemistry-centred industries.

Figure 8: Job trend projections for chemistry occupations and industries[10]



Source: Lightcast (2023.2)

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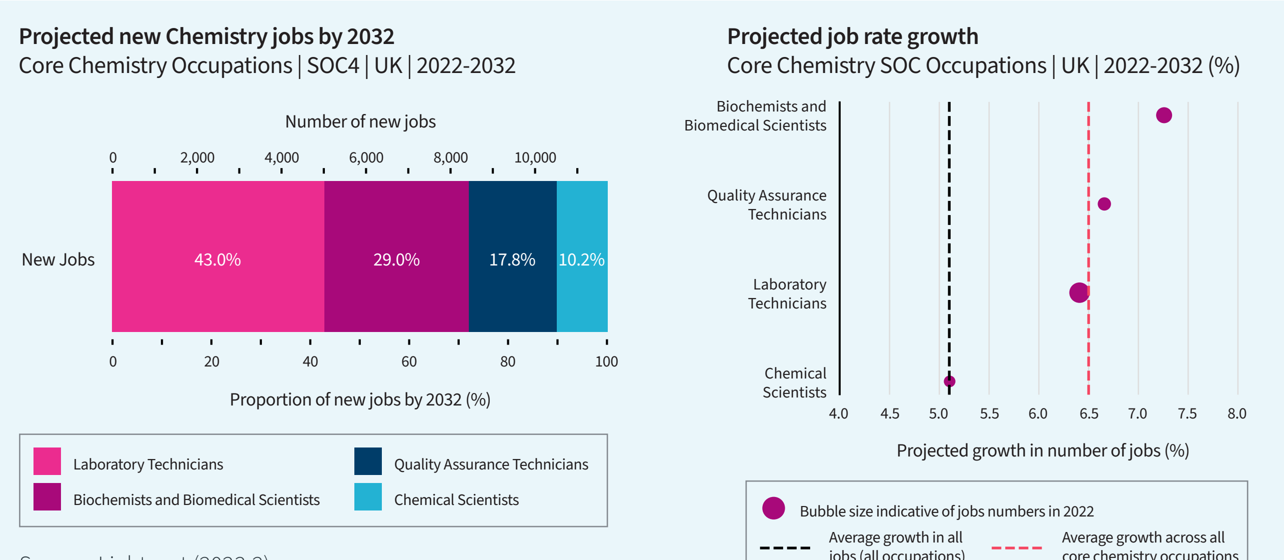
[10] **Note:** the way the projection model is built means the growth trend line flattens after the first few years. This is a construct of the model and applies to every part of the labour market, as visible in the UK – all occupations line.

Breaking down these overarching trends by specific occupations and industries shows that all parts of the chemistry sector are projected to grow over the next decade, though there is variation in the pace of growth.

From an occupational perspective, all chemistry occupations are projected to grow faster than the UK-wide economy. Biochemists & biomedical scientists in particular are the core chemistry occupation projected to grow the fastest between now and 2032 (7%), while chemical scientists are projected to grow somewhat slower in comparison (5%). In contrast, from a volume perspective, laboratory technicians are projected to account for the largest proportion of new jobs in core chemistry occupations (43%, or approximately 5,000 jobs).

This above-average growth in jobs for chemistry occupations may be reflective of the increased need of chemistry knowledge and expertise in the UK economy in recent years.

Figure 9: Projected job growth in core chemistry occupations



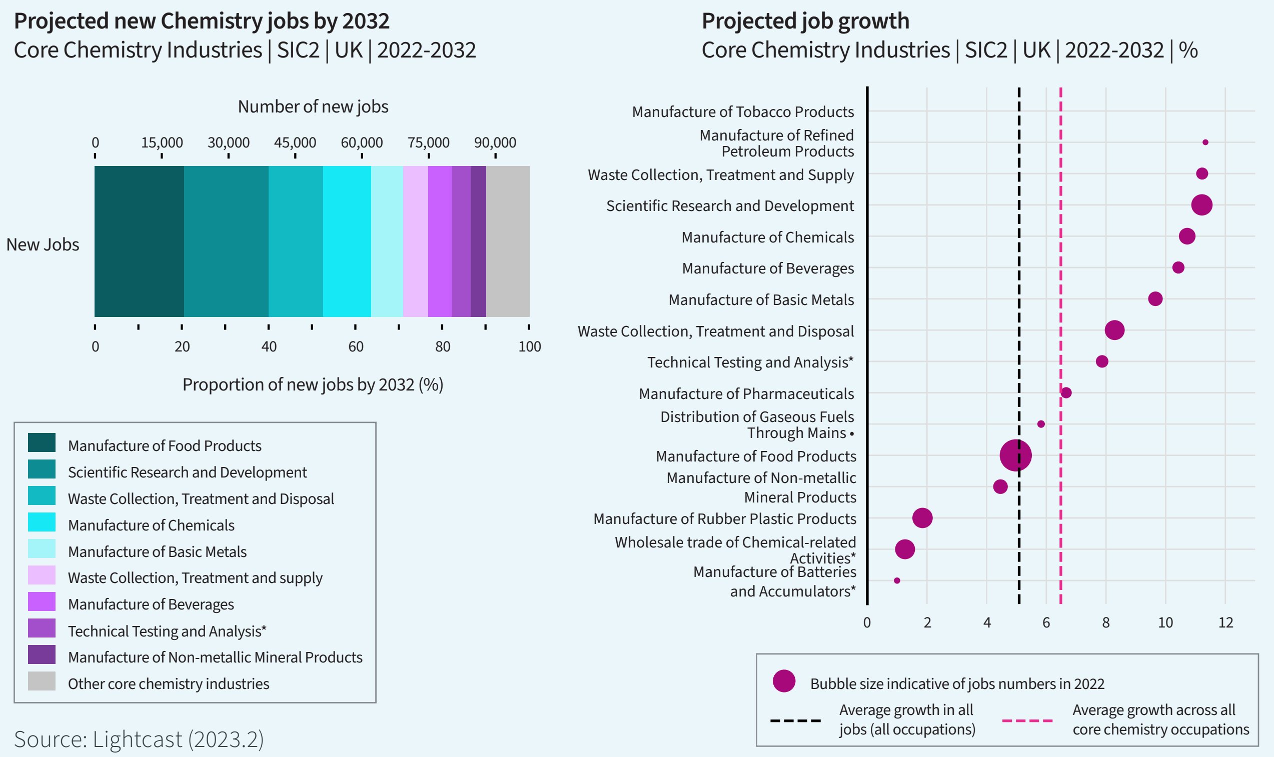
Source: Lightcast (2023.2)

Industry-wise, all chemistry-centred industries are projected to grow, but with greater variation than chemistry occupations. Overall, chemistry-centred industries are projected to see an increase of approximately 100,000 jobs – chemistry or otherwise. In particular, scientific research and development activities are projected to grow at a much faster rate than the UK's average (at a rate of approximately 11%), accounting for approximately 20,000 or 20% of all these additional jobs projected to be created in chemistry-centred industries by 2032 – be them in core chemistry occupations or other occupations.

In contrast, chemistry-related manufacturing sub-sectors present a more diverse picture. On one hand, the manufacture of food products, the biggest sub-sector in terms of jobs in 2022, is projected to grow at the same pace of the UK-wide economy. However, due to its initial size, it is projected to account for the largest share of new jobs in chemistry-centred industries over the next decade (21%).

On the other hand, some of the smallest chemistry manufacturing sub-sectors from a job number perspective, due to their initial smaller numbers, are presenting a more polarised picture.

Figure 10: Projected job growth in chemistry sub-sectors



Source: Lightcast (2023.2)

While these insights offer a picture of how the chemistry workforce could look like if past trends continue into the future, a number of current and future factors are also likely to come into play. Macroeconomic shifts such as technological advancements and the transition to a greener economy, as well as sector specific policy developments, such as investment decisions and education reforms, are already affecting the chemistry sector and will continue to do so in coming years. Some of these caveats are discussed in more detail in the note below.

A note from the RSC on data caveats around industries

The picture given here of the projections for different chemistry-using industries may at first seem surprising to some readers. Fast growth of petroleum products and slow growth of batteries seem to belie the sustainable transition we are undergoing. It is critical to understand limitations of the data to explain this. Projections based on historic trends may not pick up changes we are just starting to see. Further, new technologies are less likely to be captured in manufacturing roles and will be included in the chemistry research sector instead. Short-term changes can skew the data, such as the massive rise in the use of vapes and e-cigarettes in recent years that could explain the huge growth projection of tobacco manufacture. Various sectors will, in the coming years, be affected by political decisions that are being taken now. Examples include the support for particular new technologies (e.g. Engineering Biology) in the government's Science and Technology Framework, and the plan to increase age restrictions on tobacco to phase out smoking. Further external factors are explored in the literature review section of this work to help contextualise the results of this analysis around wider trends affecting the whole sector. This contextualisation is important when analysing and using the data presented here. The RSC will be adding detail to our contextual understanding through engagement with the chemical sciences community on the data generated in this project.

Understanding these factors is as critically important as understanding past trends – but there are still significant challenges. For a start, there is a lag between recent policy initiatives and investment and the impact they will have on the labour market, meaning it is harder to put an exact figure on the number of jobs they are likely to affect. On top of that, some factors will be missed out altogether as they are yet to become apparent.

2.5 Horizon scanning: putting projections into context

To help interpret the findings presented in section 2.4, this section complements the quantitative analysis with a literature review of 33 policy and research papers identified by the RSC.[11] These papers identify a number of key trends likely to affect the chemistry workforce over the coming decade, adding colour to the mere projections. Trends have been split into two categories – demand-side and supply-side – and organised using a traffic-light system based on their likely impact on jobs in the chemistry profession. This approach provides a holistic view of the trends likely to affect the chemistry-using workforce, without being too prescriptive about the exact number of jobs that will be created over the next decade, which is instead highly volatile and hard to predict.

From a job creation, demand-side, perspective, the trends identified suggest different future outcomes for different chemistry sectors, pointing towards a change in the composition of chemistry jobs. On one hand, the ongoing macroeconomic transition of the UK's economy towards high value service activities, growing policy support for, and investment in R&D, and the green transition suggest chemistry-related professional service jobs, and green chemistry jobs in particular, are likely to grow in the future. To secure this growth, however, the sector would need to overcome bureaucratic challenges related to access to investment, and provide adequate support to small and medium size businesses operating in the chemistry sector. In contrast, the UK's shift away from manufacturing, exacerbated by logistical barriers created by the UK's departure from the European Union, and rapid advancements in technology may pose challenges to the growth in chemistry-related manufacturing industries.

Table 5: Demand-side factors likely to affect the chemistry workforce over the next decade

Theme	Factor(s)	Sources [12]	Impact
UK macro-economic shifts	Continued **growth in importance of high-value service industries**, with STEM industries and related professional occupations among those projected to grow strongest by 2035. According to one study, the number of full-time roles requiring specialist chemistry knowledge are projected to grow by 10% by 2030. Similarly, the Department for Business, Energy and Industrial Strategy estimated the R&D sector will need at least an additional 150,000 researchers and technicians by 2030 to sustain the forecasted increase in research and development intensity (see UK Government R&D strategies).	4, 5, 11, 14	**Positive**
	Declining importance of some manufacturing (including chemical) due to increased adoption of automation practices for routine roles as well as increased competitiveness from manufacturers overseas.	4, 5	**Negative**

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[11] The full list of papers reviewed as part of the research is available in Appendix 1.

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Theme	Factor(s)	Sources [12]	Impact
R&D policy landscape	**Growing government policy support for, and investment in, R&D innovation activities**. Scientific and technological R&D is considered to be a central lever for fueling the UK's long-term economic growth strategy. In addition to committing to investing £20 billion in R&D over 2024-2025, the UK government has also founded the 'Advanced Research & Invention Agency' to fund high-risk, high-reward research. While not specific to the chemical science sector, given the cross-cutting interdisciplinary nature and applications of many of the science and technology fields, these initiatives and funding channels are likely to be beneficial in growing the chemistry using workforce.	21, 31, 33	**Positive**
	A recent review found UK R&D is in danger due to **underinvestment** from successive governments. While total UK investment is approximately 2.7% of UK GDP on R&D (around the 2019 OECD average), relative to EU and global R&D leaders (such as Germany 3.1%, South Korea 4.6% and the USA 3.2%), this lags well behind. Moreover, funding of R&D directly performed by UK government entities was found to be very low, considerably less than the OECD average. Funding mechanisms and **bureaucracy** around the funding process will also need to be simplified to encourage greater engagement.	31	**Negative**
	Insufficient support systems for innovative R&D SMEs are a key constraint on the growth of these emergent industries. SMEs need improved access to early stage funding and specialist equipment, as well as greater proliferation of regional R&D ecosystems to improve research collaboration and access to investment.	27	**Negative**
Brexit	Additional **administrative burdens, barriers to shared learning/collaboration, logistical challenges** in importing critical materials, **research talent bottlenecks**, and **lower EU-UK trade volumes** as a result of being outside the EU single market, are all factors that may make the chemical science sector **less attractive to foreign direct investment (FDI)**. However, the long-term impacts of Brexit on the UK economy, including the **opportunities** it may present, **remain unclear**.	1, 2, 13, 16, 21	**Neutral**
Green transition	Increased demand for skilled workers (incl. chemistry roles) and the innovative solutions they provide to **drive the green industrial and technological revolution** necessary to meet 2050 Net-Zero decarbonisation commitments. The UK Government aims to provide £12 billion of funding for green projects and support almost half a million new green jobs by 2030, some of which will likely be focused on chemical science related roles. The net zero agenda will be a major priority of the science and research community in the years ahead, driving investment, growth and job creation opportunities, globally including in green chemistry.	22, 5, 9, 25	**Positive**
Digitalisation	Increased adoption of more **digital tools and emergent technologies, such as artificial intelligence (AI)**, has the potential to revolutionise chemistry-using sectors. For R&D alone, it can help deliver faster, cheaper, safer, and more efficient **innovation breakthroughs**. **While the impact of digitalisation on increasing productivity is clear, its effect on overall job numbers is less certain**. Over time, more advanced digital or automated technologies **may replace some of the more routine tasks** of the chemistry workforce, although human input and supervision is expected to remain essential. In contrast, roles with **increased technological expertise are expected to grow** as the sector seeks to harness the full potential offered by new technologies.	5, 6, 7, 8, 25	**Neutral**

The growth of the chemistry sector does not only depend on the creation of new jobs, but also by the availability of workers able to fill these roles. This appears to be one of the biggest challenges for the sector in the coming decade, as highlighted by the supply-side findings from the literature review. While recent policy developments aimed at better linking education with employers' needs may have a positive impact on the chemistry sector, it appears the sector faces major challenges both in terms of access to workers and to skills. At the UK level, an ageing population and changes to the international movement of people suggest it will be harder to find workers to fill any jobs, chemistry jobs included. On top of that, the chemistry sector appears to be facing a number of sector-specific challenges, with businesses facing acute skills shortages in terms of STEM (including chemistry) skills, interpersonal and transferable skills, and green skills and knowledge. Furthermore, while technological advancements may present opportunities for the sector, the only way to reap these opportunities is by ensuring people have the right skills to work with new technologies.

This means that, in practice, it is ever more critical for the RSC and its members to understand the specific skills needs of chemistry businesses and work with policymakers and education providers to ensure these skills needs are met by the education system.

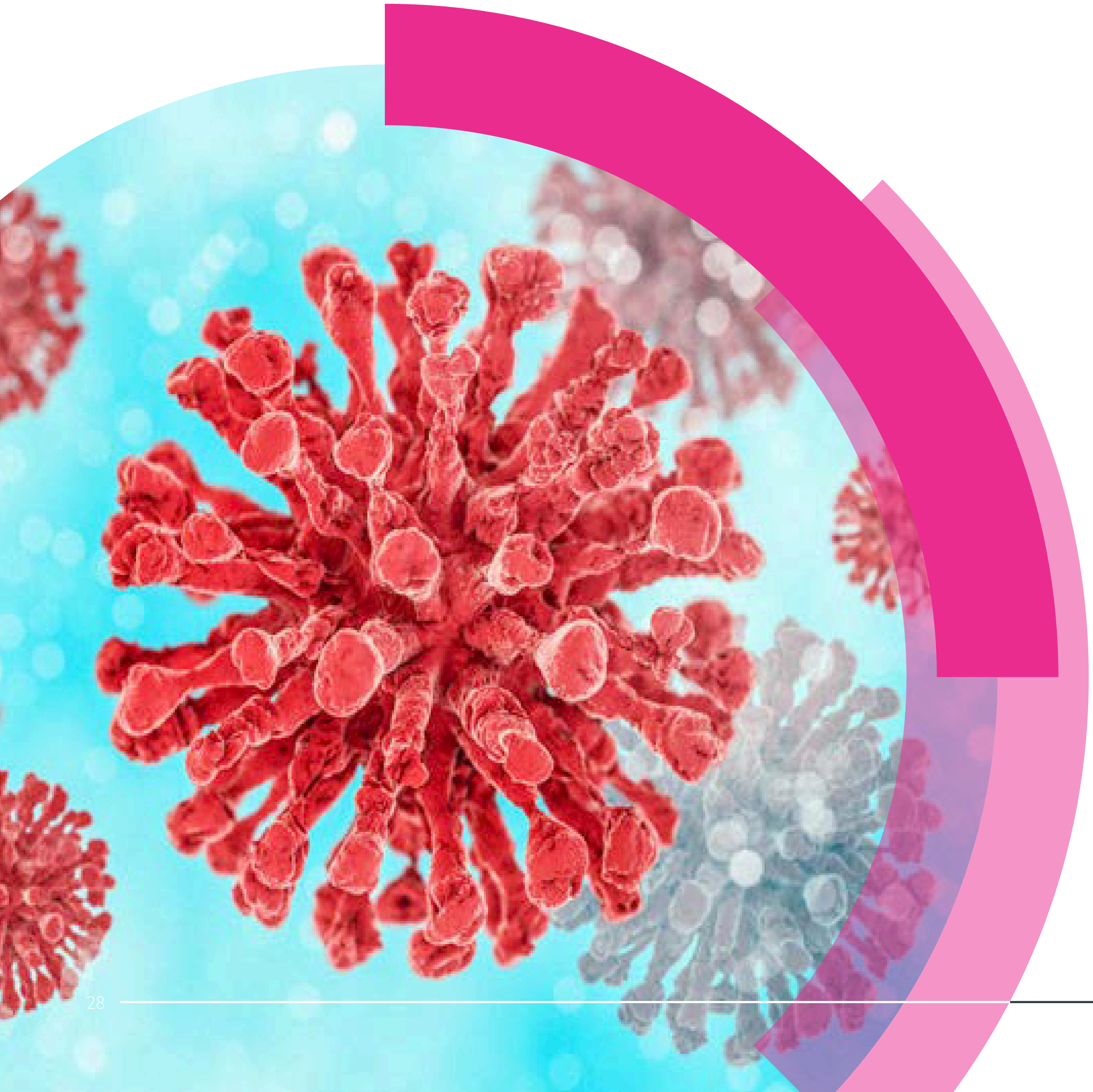

Table 6: Supply-side factors likely to affect the chemistry workforce over the next decade

Theme	Factor(s)	Sources [13]	Impact
Ageing population	Projections suggest that job openings created by workers leaving for reasons such as retirement, etc., are going to be larger than new additional jobs. For chemistry, ensuring there are **enough workers to meet this replacement demand**, in addition to new jobs being created, will be critical.	4, 5	**Negative**
Skills gaps	Research suggests that there is already a **shortage of STEM (including chemistry) skills and subject expertise** in the UK. This shortage is forecast to grow further by 2030, in part driven by increased demand for relevant STEM occupations. The most acute skill shortages for STEM roles are anticipated to be in **STEM practical** and **knowledge expertise** as well as **interpersonal** skill areas, representing a significant constraint to the sector's growth.	4, 6, 11, 13, 21, 24	**Negative**
	Employers report difficulties in hiring suitable candidates owing to **green skills and knowledge gaps**. This impacts their ability to compete in a sustainable economy and attract investment in green industries. Literature suggests a **lack of understanding as to what green skills** (both generally and chemistry specific) need to be developed in the **education system** in order to drive the net-zero transition.	4, 9 , 12, 24	**Negative**
	The future of STEM roles (including chemistry) will rely heavily on the **integration of digital skills and the adoption of new technologies**. To realise the full benefits of digital and avoid falling behind, workers across career stages in the chemical sciences will need to continuously develop and update their digital and analytical skills, with 'basic fundamental IT' skills anticipated to become increasingly advanced relative to today's level.	4, 6, 8 11, 17, 25	**Neutral**
Brexit (Talent attraction)	To help fill crucial STEM and research skill gaps in the short-term, the UK needs to **maintain a competitive immigration offer that attracts international talent**. In this regard, Brexit represents both an opportunity and threat, with it allowing for more flexible, streamlined visa routes but also making the UK somewhat less attractive owing to reduced cross-pollination with EU research counterparts. This reduced cross-pollination may now be somewhat improved thanks to the UK association to Horizon Europe but the net effect on talent attraction still remains unclear.	13, 15, 16, 17	**Neutral**
Education system: challenges and reform	**Technical and vocational education shortfall** challenges post-16 education contributing to skill critical gaps (incl. STEM), with concerns about the low skill levels and work-readiness of young people entering the workforce. Need to increase employer buy-in and that technical routes become more accessible.	24, 26	**Negative**
	Literature suggests **insufficient opportunity** (dedicated time) and/or funding for workers to up- or re-skills. A lack of **continuous professional development (CPD)** in terms of both technical and transferable skills can slow career progress, stagnate productivity and/or adversely impact employee retention rates. A **shortage of sufficiently skilled mentors** or teachers across industries was also cited as a concern to re-skilling efforts.	1, 4, 6, 11, 13, 17, 20	**Negative**
	Technical education policy reform: The Institute for Apprenticeships and Technical Education's development of centralised, **employer-led occupation specific standards** for the UK's technical education system. These new simplified standards will ensure that students leave education with the knowledge and critical skills that their industry (including STEM) needs. These reforms are also reflective of a **wider pivot among government and education providers (including higher education) to a more employer-led curriculum development** approach where the skills and competencies taught are responsive to the changing regional skills requirements of employers.	3, 29, 20, 21.	**Positive**

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[13] The full list of papers reviewed as part of the research is available in Appendix 1.

Chapter 3: Recruitment activity for the chemistry-using workforce

Summary and key findings

- To further understand the future trends of the chemistry-using workforce, this chapter looks at the latest trends in recruitment activity in the profession, by using Lightcast's proprietary data on job postings.
- These insights provide the most up-to-date picture of employers' needs, with insights up to July 2023. Furthermore, the granularity of job postings data allows for a deeper investigation of the chemistry workforce, which was split into 12 groups.
- Overall, chemistry has a very active recruitment market, with the number of online job postings up by approximately 50% compared to pre-pandemic. This is particularly the case for nuclear engineers, pharmacists, and law, regulatory & policy chemistry professionals.
- The median advertised salary for chemistry job postings is £38,600. This is approximately £7,600 (25%) higher than the UK median average for job postings across all sectors, suggesting employers are ready to pay a premium to fill these roles. This applies to most chemistry occupations, with the exception of chemistry professionals working in manufacturing or lab operations and support roles, whose median advertised salary is below the UK average.
- Geographically, volumes of recruitment activity for chemistry jobs are higher in the South East and London. This is in line with population trends. However, when looking at concentration, chemistry job postings currently play an above-average role in the North East, East of England and North West labour markets. The North West in particular has seen the largest positive increase in job postings in chemistry occupations across the country.

To further understand current and future factors shaping the chemistry-using workforce, this chapter looks at the latest trends in the UK's chemistry recruitment market. These insights, which are drawn from online job postings data, complement the insights presented in Chapter 2 by offering the most up-to-date picture of employers' needs. This further helps contextualise the projections presented in Chapter 2 by offering the most timely and granular employer-led perspective of current and future trends in the chemistry sector.

The findings presented in this chapter help the RSC and its members better understand job trends in the chemistry workforce. Firstly, by focusing on recruitment activity, these insights help identify the parts of the chemistry workforce that are currently more active – i.e. where more job opportunities are currently available, be it because of labour market churn or genuine growth. This, in turn, provides an indication of how the chemistry labour market is evolving over time. Secondly, thanks to the use of job postings data, the insights presented in this chapter fill the gap of lagged official statistics, and present a more up to date picture of the chemistry profession using data up to July 2023. In addition to that, job postings data allow for a more granular analysis of chemistry jobs as it was possible to identify and isolate 12 different groups of chemistry roles.

3.0 Methodology and definitions

All the insights presented in this chapter and the following one are based on Lightcast's proprietary data on job postings.

Lightcast's job postings library is made of over 80 million job postings collected in the UK since 2012. These job postings are scraped on a daily basis from thousands of job boards, newspapers and employers sites. They are then cleaned and deduplicated to ensure only one posting is counted for each opening, regardless of how many places it is advertised in. The job postings are then classified by location, industry, occupation, skills required, and any other type of relevant information that can be extracted from the ad, using a combination of official and proprietary taxonomies.

The advantage of using this data is that, unlike official statistics, it presents a unique opportunity to get insights from a large amount of almost real-time data on employers' needs. This helps quickly capture emerging trends, even before they appear in official statistics, and the granularity of the data helps understand more nuances of a sector labour market.

The downside of using job postings data is that the quality of the insights is dependent on employers posting their job ads online and the type of information they include in these postings. Online recruitment is, for example, normally more popular among employers looking to recruit for professional based jobs rather than more manual or casual jobs. In addition to that, the content of job postings may vary, with employers sometimes deciding not to mention specific skills they may need because they consider them implicit to a job – for example, a job postings for a plumber may not mention plumbing knowledge and skills as the employer may assume them to be implicit to the role.

It is also important to note that job postings data and jobs data are complementary, not substitutes. While all job postings are jobs, not all jobs are currently being advertised for – and advertised online. Job postings data only show the parts of a labour market that currently have an active recruitment market online. This can either be due to labour market churn in the sector (i.e. due to people exiting the labour market or changing jobs) or to genuine job creation (i.e. more jobs being created in a sector).

From a definitional point of view, job postings data allows for a more in depth analysis of the chemistry profession presented in Chapter 2. This is due to the use of the Lightcast Occupation Taxonomy (LOT) – a taxonomy consisting of over 780 occupations and 1,900 sub-occupations, and therefore offering a richer and more granular view of the labour market than the ONS official SOC2020 classification and its less than 400 occupations. Each US O*NET occupation identified as part of the chemistry workforce in the 2020 Chemistry's Contributions report was matched to its closest Lightcast sub-occupations and by doing so it was possible to isolate 150 specific occupations related to chemistry. With feedback from the RSC, these occupations were then grouped into 12 categories:

1. Research chemist
2. Process chemist/chemical engineer
3. Analytical chemist
4. Data scientist/computational chemist
5. Manufacturing operations & support
6. Laboratory operations & support
7. Research, management and administration
8. Legal, regulatory & policy
9. Education (science & chemistry)
10. Biochemist
11. Pharmacist
12. Nuclear engineer

The details of which occupations are included in each of the 12 categories are set out in **Table 7**.

Table 7: The 12 chemistry occupation groups and their components

Chemistry occupation group	Lightcast specific occupations included in each group
Research chemist	Inorganic Chemist, Polymer Chemist, Organic Chemist, Research and Development Chemist, Chemist (General), Infectious Disease Scientist, Drug Formulation Scientist, Water Resource Specialist, Geologist, Geophysicist
Process chemist/chemical engineer	Chemical Engineer (General), Process Engineer (General), Pharmaceutical Manufacturing Process Engineer, Process Development Engineer, Moulding Process Engineer, Machining Process Engineer, Chemical Engineering Manager, Environmental Engineer, Hazardous Materials Worker, Materials Research Engineer, Corrosion Engineer, Plastics Engineer, Materials Engineer (General), Metallurgical Engineer, Ceramic Engineer, Materials Development Engineer, Welding Engineer, Water/Wastewater Engineer, Fuel Cell Engineer
Analytical chemist	Analytical Chemist, Assay Development Scientist, Quality Control Chemist, Environmental Field Chemist, Forensic Chemist, Environmental Planner/Scientist, Laboratory Analyst, Drug Safety Scientist, Quality Control Analyst, Crime Scene/Forensic Science Technician
Data scientist/computational chemist	Bioinformatics Engineer, Computational Chemist
Manufacturing operations and support	Chemical Operator, Manufacturing Chemist, Environmental Engineering Technician, Environmental Technician, Food/Agricultural Technician, Food and Agricultural Scientist/Technologist, Manufacturing Quality Manager, Industrial Hygiene Specialist, Sanitation Specialist, Water Treatment Specialist/Waste Water Operator, Weatherisation Installer
Laboratory operations and support	Chemical Technician, Chemistry Laboratory Supervisor, Laboratory Manager, Quality Control Laboratory Technician, Biology Laboratory Technician, Research Laboratory Technician, Pathology Laboratory Technician, Laboratory Technician (General), Laboratory Specimen Processor, Materials Laboratory Technician, Microbiology Laboratory Assistant, Medical Laboratory Technician, Clinical Laboratory Technician, Sleep Laboratory Technician, Plasma Processor, Director of Laboratory Services, Optical/Laser Engineer, Photonics Technician, Physical/Geoscience Technician, MRI/CT Technician/Technologist
Research management and administration	Medical Science Liaison, Natural Science Research Director, Natural Science Research Manager (General), Research and Development Director, Research and Development Manager
Legal, regulatory & policy	Any job postings linked with the occupations listed below AND having at least one skill related to science and research, environment or engineering, to exclude any other non-chemistry relevant role. Environmental Compliance Specialist, Site Remediation Specialist/Manager Quality Manager (General), Quality Assurance Supervisor, Food/Beverage Quality Manager, Patient Safety Director, Safety Director, Patient Safety Manager, Environmental Health and Safety (EHS) Manager, Occupational Health and Safety (OHS) Manager, Safety Manager (General), Environmental Health and Safety (EHS) Director, Food Safety Manager, Fire Safety Manager, Site Safety Manager, Transportation Safety Manager, Construction Safety Manager, Drug Safety Manager, Occupational Health and Safety (OHS) Director, Safety Compliance Manager, Safety Specialist (General), Environmental Health and Safety (EHS) Coordinator, Safety Coordinator (General), Occupational Health and Safety (OHS) Specialist, Fire Safety Specialist, Construction Safety Specialist, Consumer Safety Specialist, Drug Safety Specialist, Transportation Safety Specialist, Food Safety Specialist, Patient Safety Specialist, Site Safety Specialist, Waste/Recycling Coordinator, Clinical Quality Manager, Director of Quality Assurance, Quality Control Manager, Quality Assurance Manager

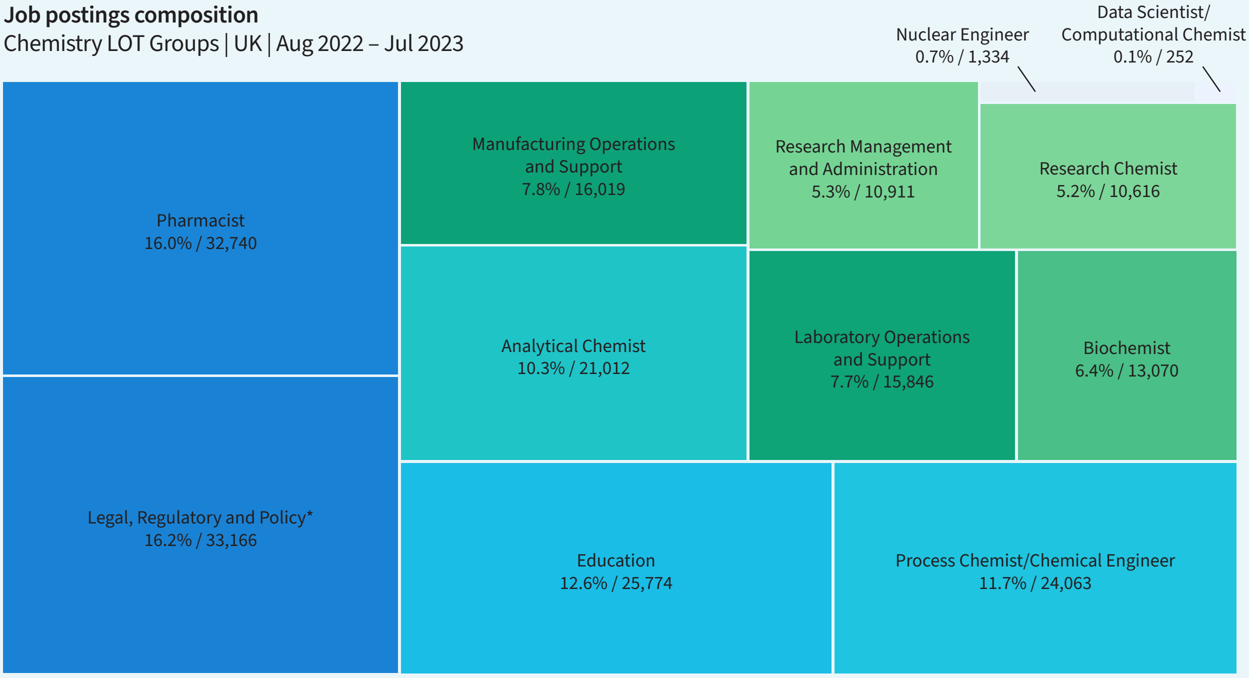
Chemistry occupation group	Lightcast specific occupations included in each group
Education	Chemistry Lecturer, Chemical Engineering Lecturer, Science Teacher
Biochemist	Biochemist, Biophysicist, Biological Technician, Biomedical Engineer (General), Bioinstrumentation Engineer, Biomechanical Engineer, Biomedical Imaging Scientist, Clinical Biomedical Engineer, Biomedical Systems Engineer, Systems Physiologist, Toxicologist, Pharmacology Research Scientist, Biomedical Scientist, Medical Laboratory Scientist, Medical Research Scientist, Soil/Plant Scientist
Pharmacist	Clinical Pharmacist, Clinical Pharmacy Manager, Compounding Pharmacist, Hospital Pharmacist, Informatics Pharmacist, Infusion Pharmacist, Long-Term Care Pharmacist, Nuclear Pharmacist, Oncology Pharmacist, Pharmacist (General), Pharmacy Director, Pharmacy Practice Resident, Retail Pharmacist, Retail Pharmacy Manager
Nuclear engineer	Nuclear Engineer, Nuclear Safety Engineer

To interpret the results presented in this chapter and the next one, particularly when talking about chemistry occupations in general, it is important to understand the composition of the job postings sample used for the analysis.

Between August 2022 and July 2023, there were just shy of 205,000 unique postings linked to any of the 12 chemistry occupational groups selected for the analysis. Of these postings, approximately 33,200 (16%) belonged to the legal, regulatory & policy chemistry group, a further 32,700 (16%) to the pharmacists chemistry group and 25,800 (13%) to chemistry and science education. More specialised chemistry occupation groups accounted instead for smaller shares of postings: 0.7% (1,330) postings for nuclear engineers and 0.1% (250) postings for data scientists/computational chemists.

Figure 11: Job postings composition across the 12 occupational groups

Job postings composition
Chemistry LOT Groups | UK | Aug 2022 – Jul 2023



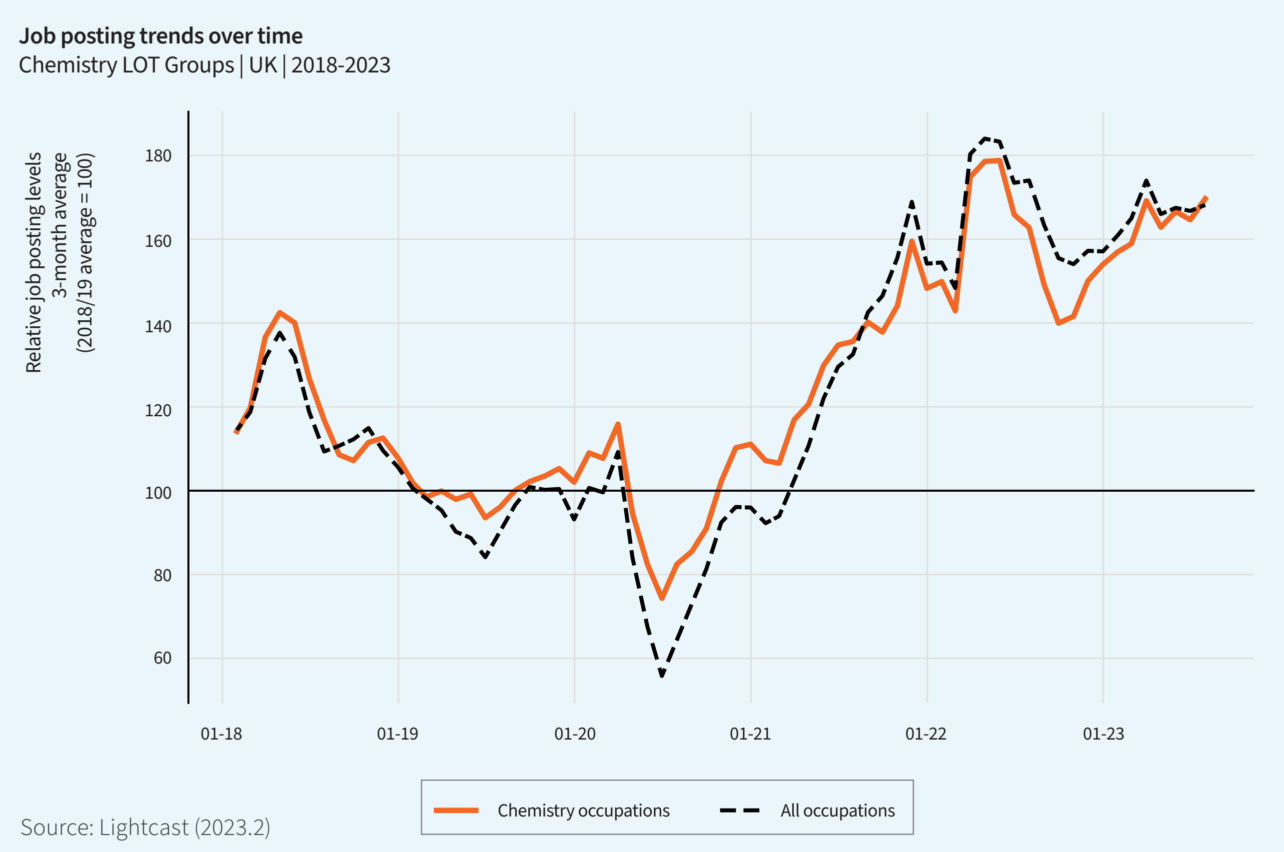
Source: Lightcast, Job Postings

3.1 Overview of chemistry job postings trends over time

Comparing job postings volumes between August 2022 and July 2023 to the same period between 2018 and 2019 shows that the chemistry sector has seen strong growth in recruitment activity over the past five years and particularly post-pandemic. Broadly speaking, recruitment activity for chemistry using occupations is up by over 60% compared to 2018/19. This is in line with wider labour market trends as the UK's economy experienced a strong period of sustained growth in the aftermath of the Covid-19 pandemic and a particularly tight labour market.

Trends over time also show that recruitment activity for chemistry-using occupations was less affected by the Covid-19 pandemic. At its worst, recruitment activity for chemistry-using occupations dropped by just over 20% in 2020, compared to an average drop of over 40% in recruitment activity overall in the UK. Furthermore, the sector returned to pre-pandemic levels of recruitment activity faster than other parts of the economy. This resilience in recruitment activity for chemistry jobs throughout the pandemic may be partly explained by their essential nature and their work settings.

Figure 12: Trends in recruitment activity over time



Job posting trends over time
Chemistry LOT Groups | UK | 2018-2023

Source: Lightcast (2023.2)

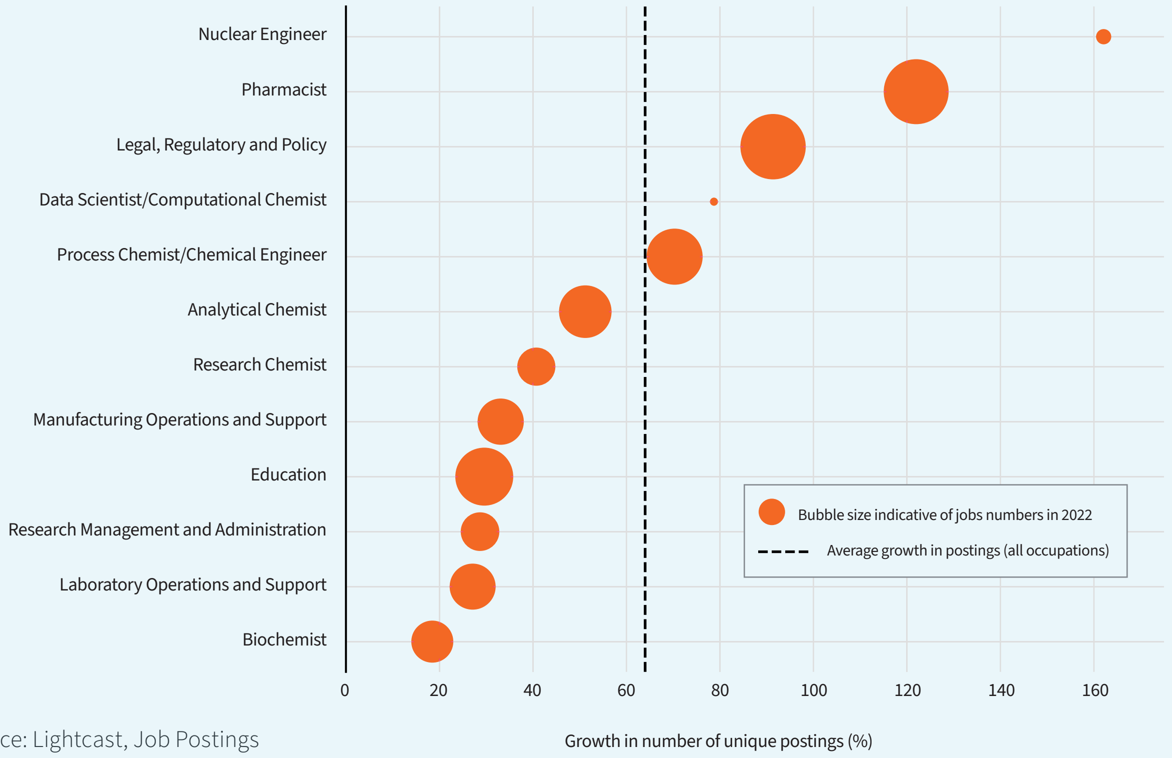
3.2 Occupational insights on recruitment for chemistry occupations

While all chemistry occupation groups have seen growth in job postings compared to 2018/19, five of the 12 chemistry groups have seen above-average growth compared to the UK wide labour market. These are: nuclear engineers (+163%), pharmacists (+122%), legal, regulatory & policy chemistry occupations (+91%), data scientists/computational chemists (+79%) and process chemists/chemical engineers (+70%). In contrast, biochemists, laboratory operations & support and research management and administration roles saw somewhat slower growth rates in job postings (+18%, +27% and +29% respectively).

These different growth rates appear to reinforce the point that the composition of chemistry jobs is changing. This is particularly important in terms of understanding how employers' needs towards chemistry roles and skills are changing over time and may be continuing to change in the future. While job postings data only show a partial picture of the labour market for chemistry jobs, it zooms in specifically on the areas which are seeing the biggest changes. This means these insights and the ones in the next chapter provide an early indication of how employers' needs are changing and therefore how policy and education provision need to respond to ensure continued growth in the future.

Figure 13: Growth in recruitment activity for the 12 chemistry occupation groups

Growing demand for chemistry occupations
Chemistry LOT Groups | UK | Jul 2018-Aug 2019 vs Jul 2022-Aug 2023



Source: Lightcast, Job Postings

In addition to volumes, job postings data also provide key information about the advertised salary businesses currently offer for open positions. These insights are particularly important as they help assess the value and premium employers are willing to offer for different types of jobs.

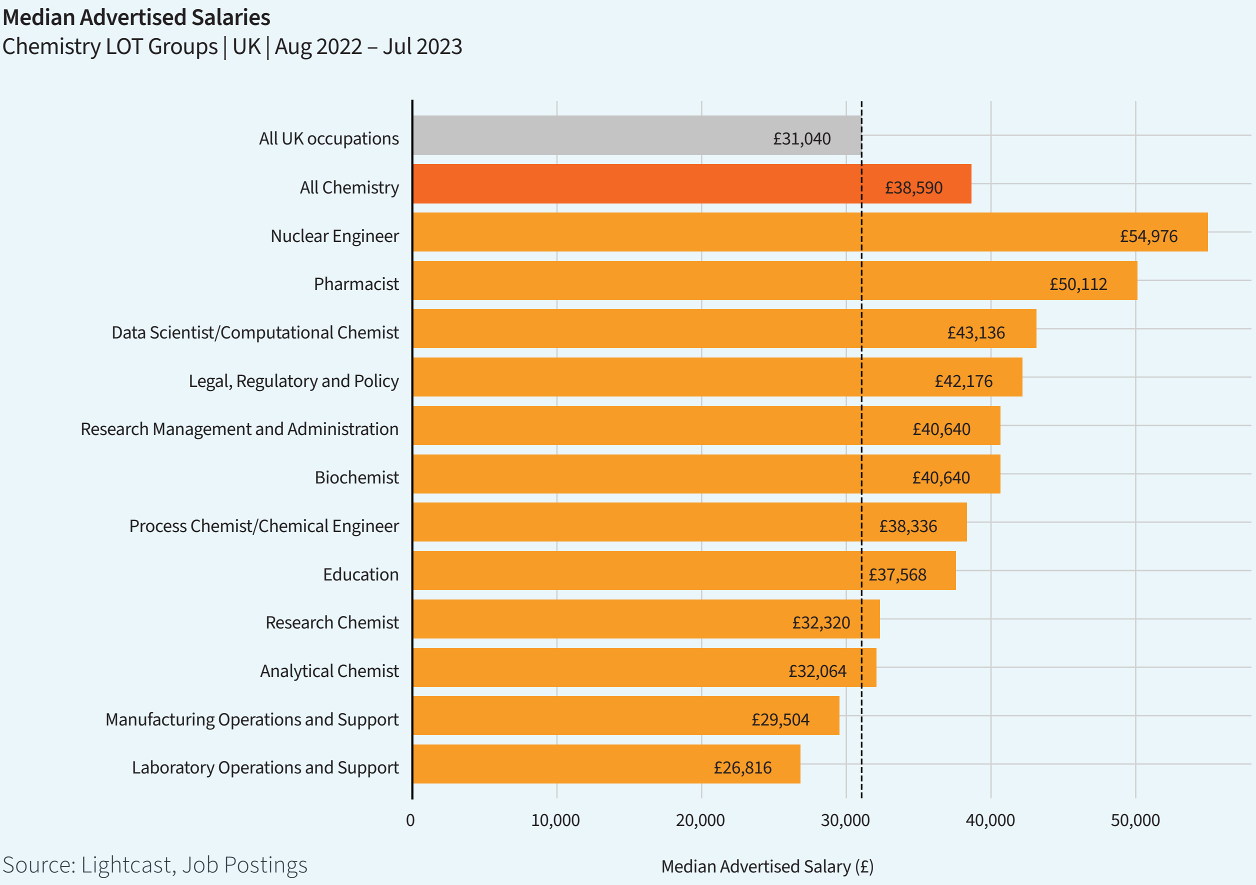
Overall, businesses recruiting for chemistry roles offer above-average median advertised salaries. The median advertised salary for all chemistry related job postings between August 2022 and July 2023 was £38,590, almost £7,500 – or 24% – more than the median advertised salary for all occupations in the UK (£31,040).

Most chemistry occupation groups offer above-average median advertised salaries, with nuclear engineering, pharmacists and data scientists/computational chemistry roles offering the highest median advertised salaries among chemistry occupation groups. These occupations are also the chemistry occupations which have seen the fastest growth in recruitment activity in the past five years, suggesting they are particularly in demand among employers, so much so that they are willing to pay a premium for them.

It is important to note, however, that chemistry roles in laboratory and manufacturing operations and support currently offer below average median advertised salaries. Between August 2022 and July 2023, the median advertised salary for chemistry manufacturing operations & support roles was £29,500 – £1,500 or 5% below the UK average for all occupations. The gap was even wider for laboratory operations and support chemistry roles: their median advertised salary was £26,800 – £4,200 or 14% below the UK average for all occupations. These findings are in line with the latest findings from the RSC Pay and Reward Survey, despite the Survey using a different data source, namely self-reported data from RSC members, and focusing on all workers, not just new positions.[14]

Although the actual numbers are slightly higher in the Pay and Reward Survey, the survey also finds technicians and operative roles to command the lowest salaries within the chemistry workforce. This may make these roles less attractive to current and prospective workers and could lead to recruitment and retention challenges that could affect the growth potential of these activities in the future.

Figure 14: Median advertised salaries for the 12 chemistry occupation groups



Source: Lightcast, Job Postings

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[14] https://www.rsc.org/careers/whatchemistsearn/

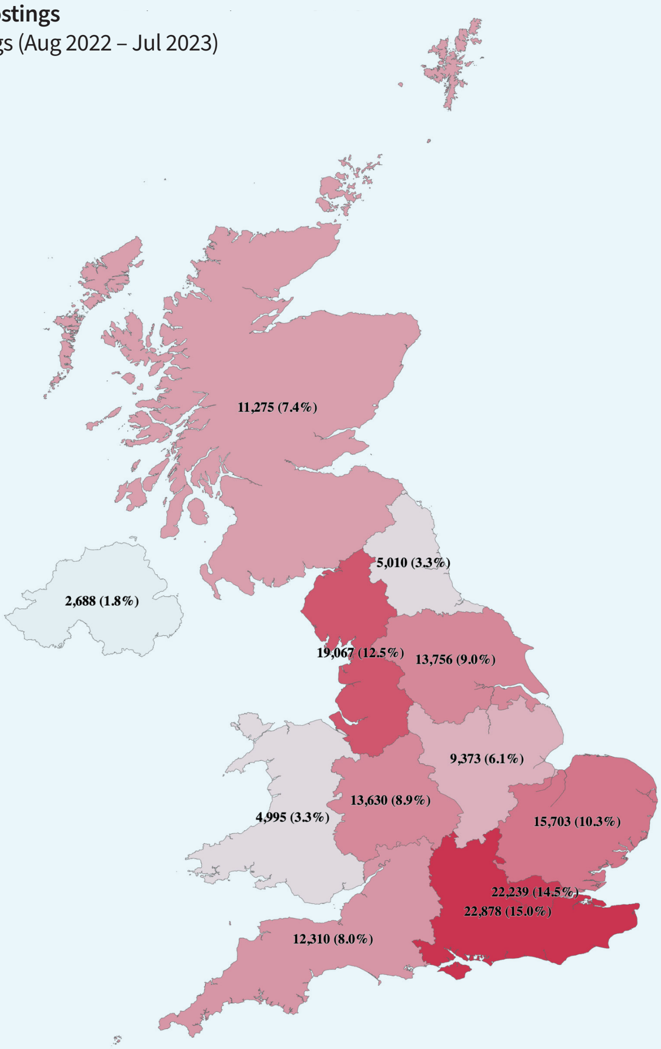
3.3 Regional analysis of chemistry job postings

To understand whether these trends are consistent across the country, this section breaks down job posting volumes by nations and English regions (using the first level of the Nomenclature of Territorial Units for Statistics – NUTS1), and looks at them from three different perspectives: volumes, relative concentration and change in distribution over time.

In absolute terms, the South East of England and London accounted for approximately 30% of all chemistry job postings between August 2022 and July 2023. This is in line with wider workforce and population trends, however there are some variations within specific occupation groups, which are reflective of different regional strengths. The South East of England, for example, is the top region for recruitment volumes for most chemistry occupations groups, and in particular for research chemists, chemical engineers and lab operations and support roles. Research management and administration job postings are instead particularly concentrated in the capital, which alone accounts for 30% of all the job postings in this group – a key reflection of the central role that London plays in terms of research, policy and business headquarters activities. London also accounts for approximately 20% of all job postings for computational chemists, biochemists and education roles related to science and chemistry. In contrast, the North West and the South West of England together account for over 50% of all chemistry job postings related to nuclear engineering.

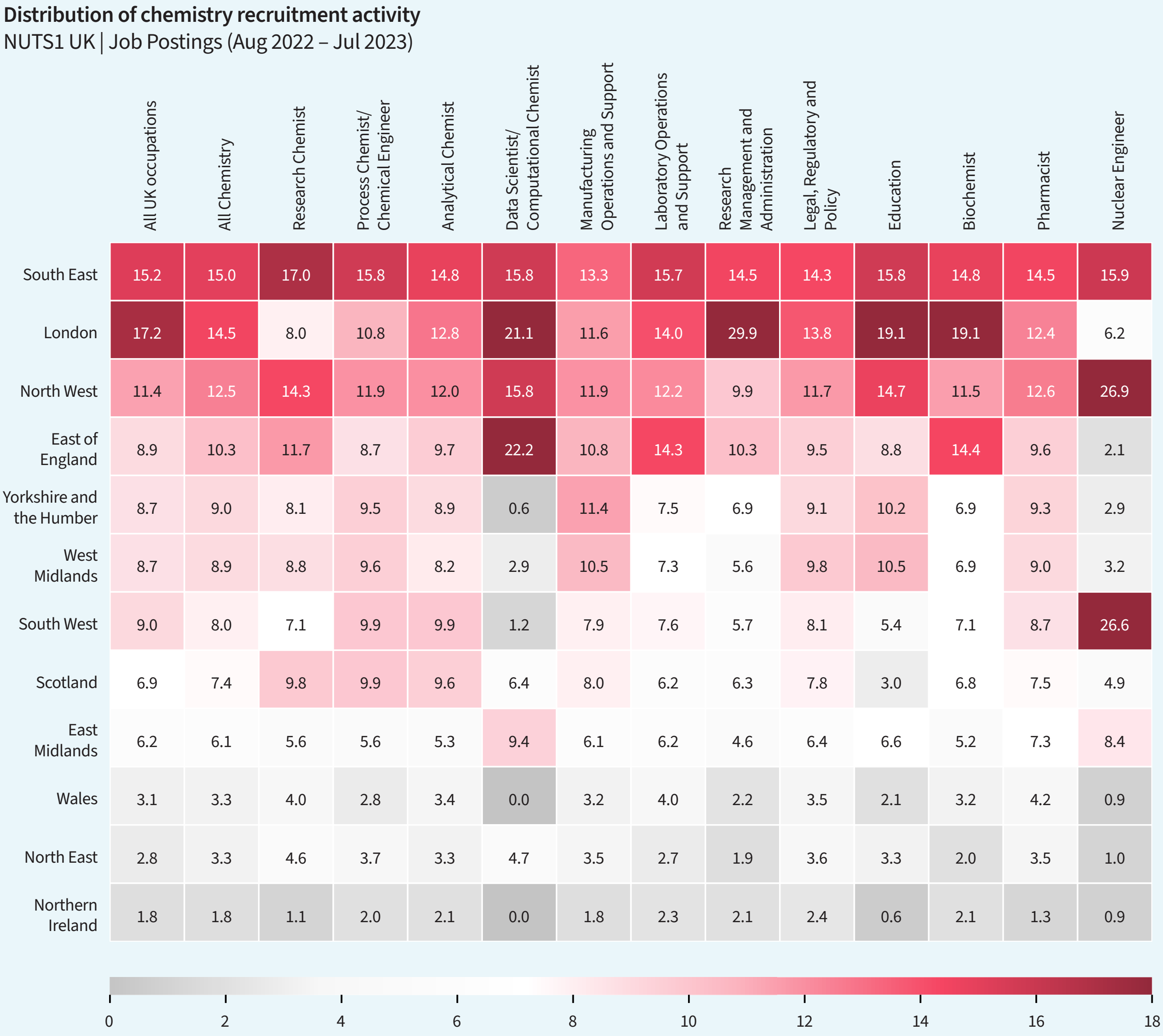
Figure 15: Regional distribution of total chemistry job postings

Regional distribution of total chemistry job postings
Chemistry LOT Groups | NUTS1 UK | Job Postings (Aug 2022 – Jul 2023)



Source: Lightcast, Job Postings

Figure 16: Regional distribution of chemistry job postings by the 12 occupational groups


Distribution of chemistry recruitment activity
NUTS1 UK | Job Postings (Aug 2022 – Jul 2023)

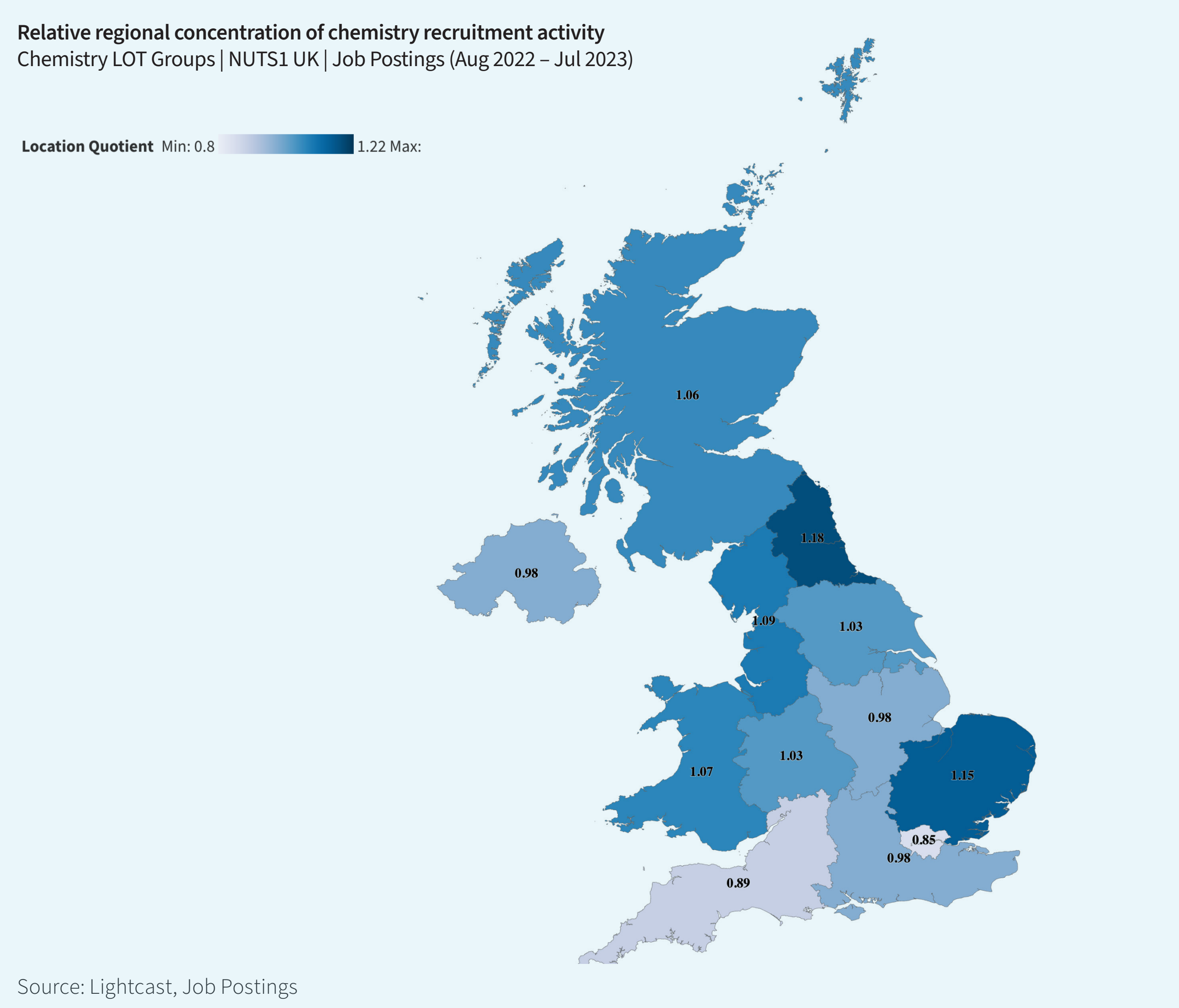
	All UK occupations	All Chemistry	Research Chemist	Process Chemist/ Chemical Engineer	Analytical Chemist	Data Scientist/ Computational Chemist	Manufacturing Operations and Support	Laboratory Operations and Support	Research Management and Administration	Legal, Regulatory and Policy	Education	Biochemist	Pharmacist	Nuclear Engineer
South East	15.2	15.0	17.0	15.8	14.8	15.8	13.3	15.7	14.5	14.3	15.8	14.8	14.5	15.9
London	17.2	14.5	8.0	10.8	12.8	21.1	11.6	14.0	29.9	13.8	19.1	19.1	12.4	6.2
North West	11.4	12.5	14.3	11.9	12.0	15.8	11.9	12.2	9.9	11.7	14.7	11.5	12.6	26.9
East of England	8.9	10.3	11.7	8.7	9.7	22.2	10.8	14.3	10.3	9.5	8.8	14.4	9.6	2.1
Yorkshire and the Humber	8.7	9.0	8.1	9.5	8.9	0.6	11.4	7.5	6.9	9.1	10.2	6.9	9.3	2.9
West Midlands	8.7	8.9	8.8	9.6	8.2	2.9	10.5	7.3	5.6	9.8	10.5	6.9	9.0	3.2
South West	9.0	8.0	7.1	9.9	9.9	1.2	7.9	7.6	5.7	8.1	5.4	7.1	8.7	26.6
Scotland	6.9	7.4	9.8	9.9	9.6	6.4	8.0	6.2	6.3	7.8	3.0	6.8	7.5	4.9
East Midlands	6.2	6.1	5.6	5.6	5.3	9.4	6.1	6.2	4.6	6.4	6.6	5.2	7.3	8.4
Wales	3.1	3.3	4.0	2.8	3.4	0.0	3.2	4.0	2.2	3.5	2.1	3.2	4.2	0.9
North East	2.8	3.3	4.6	3.7	3.3	4.7	3.5	2.7	1.9	3.6	3.3	2.0	3.5	1.0
Northern Ireland	1.8	1.8	1.1	2.0	2.1	0.0	1.8	2.3	2.1	2.4	0.6	2.1	1.3	0.9

Source: Lightcast, Job Postings

Share of occupational group recruited for in each NUTS1 region (%)

If volumes provide an understanding of where chemistry jobs are more in demand, relative concentration provides insights into the areas of the country where chemistry jobs play an above-average role in recruitment activity in the local economy. In this respect, the North East of England is the area of the UK where the concentration of chemistry job postings relative to all job postings is the highest. This is particularly the case for job postings related to research chemists and data scientists/computational chemists: for both these groups, the North East had 70% more chemist job postings than expected based on the size of its overall recruitment market. The East of England, North West, Wales and Scotland also had a slightly above-average relative concentration of chemistry job postings, each for different reasons. For the East of England region for example, this is due to an above-average concentration of data scientists/computational chemists, laboratory operations and support roles, biochemists and research chemists. This is reflective of the relative strength in research activities of the region, with Cambridge University strength in life sciences resulting in the creation of a cluster of related activities in the region. In contrast, despite accounting for the second largest number of chemistry job postings, London's recruitment market is actually underrepresented when it comes to these types of postings. This is reflective of the capital's unique labour market composition, focused mostly on professional activities carried out in office settings.

Figure 17: Relative regional concentration of total chemistry job postings



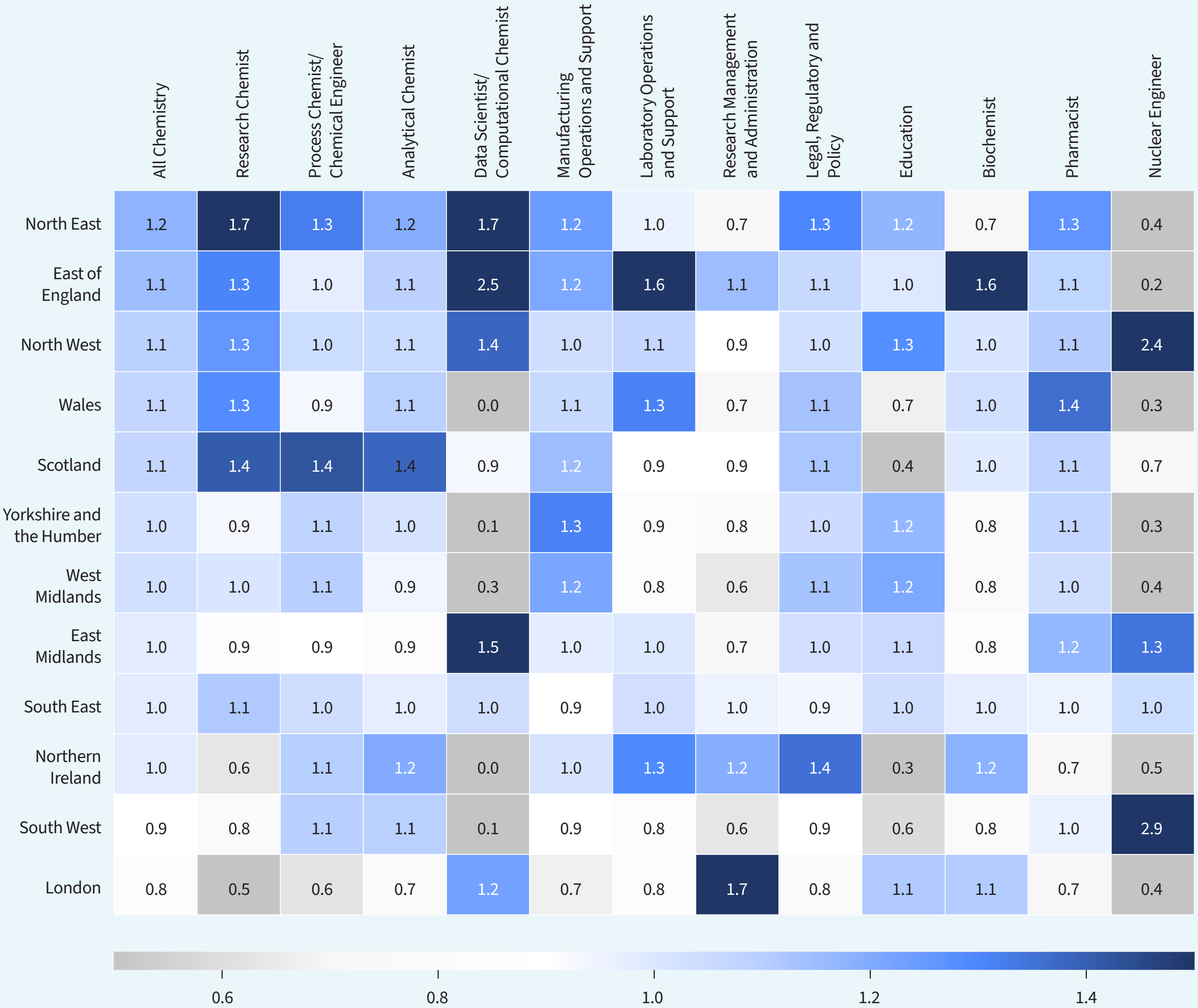
Relative regional concentration of chemistry recruitment activity

Chemistry LOT Groups | NUTS1 UK | Job Postings (Aug 2022 – Jul 2023)

Source: Lightcast, Job Postings

Figure 18: Relative regional concentration of chemistry job postings by the 12 occupational groups

Location Quotient of chemistry job postings
NUTS1 UK | Job Postings (Aug 2022 – Jul 2023)



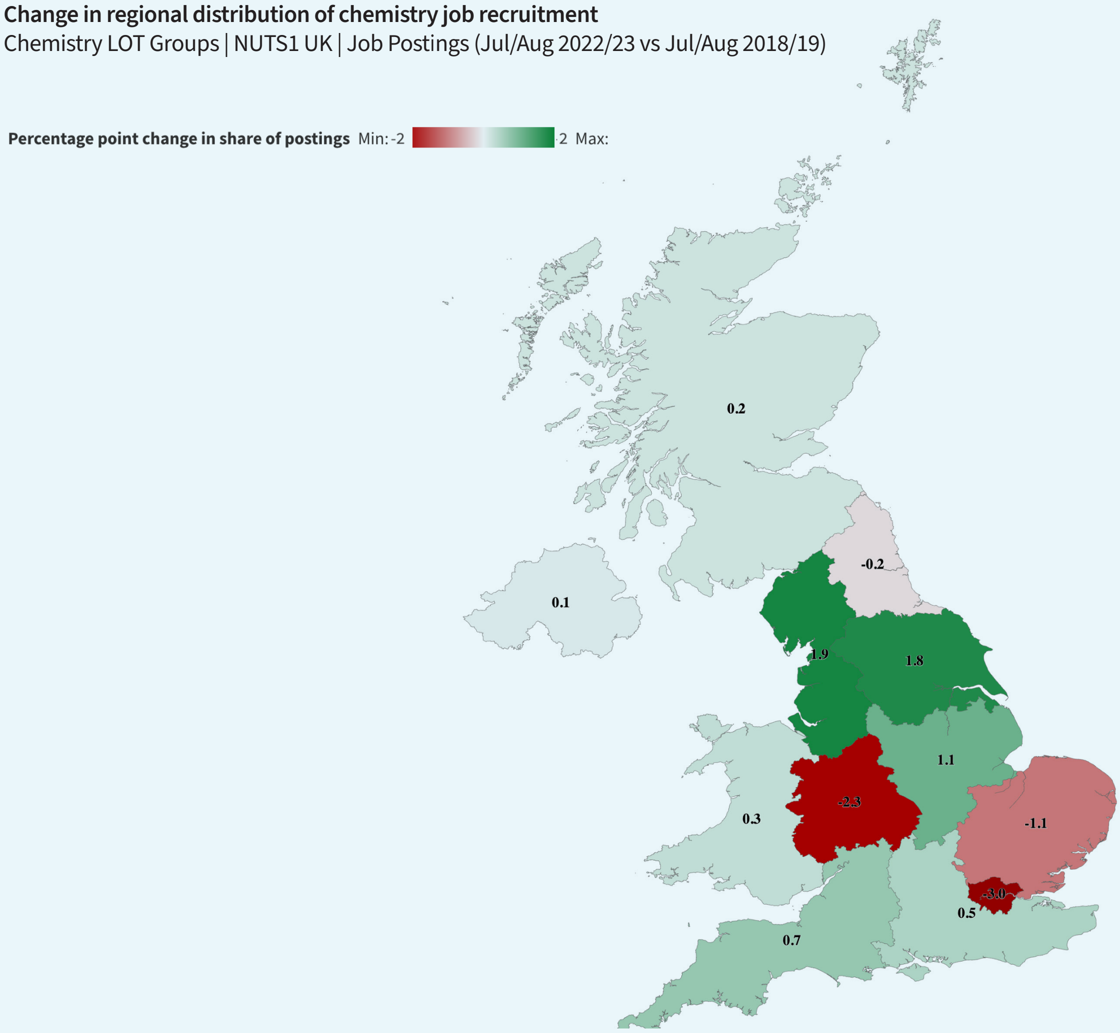
	All Chemistry	Research Chemist	Process Chemist/ Chemical Engineer	Analytical Chemist	Data Scientist/ Computational Chemist	Manufacturing Operations and Support	Laboratory Operations and Support	Research Management and Administration	Legal, Regulatory and Policy	Education	Biochemist	Pharmacist	Nuclear Engineer
North East	1.2	1.7	1.3	1.2	1.7	1.2	1.0	0.7	1.3	1.2	0.7	1.3	0.4
East of England	1.1	1.3	1.0	1.1	2.5	1.2	1.6	1.1	1.1	1.0	1.6	1.1	0.2
North West	1.1	1.3	1.0	1.1	1.4	1.0	1.1	0.9	1.0	1.3	1.0	1.1	2.4
Wales	1.1	1.3	0.9	1.1	0.0	1.1	1.3	0.7	1.1	0.7	1.0	1.4	0.3
Scotland	1.1	1.4	1.4	1.4	0.9	1.2	0.9	0.9	1.1	0.4	1.0	1.1	0.7
Yorkshire and the Humber	1.0	0.9	1.1	1.0	0.1	1.3	0.9	0.8	1.0	1.2	0.8	1.1	0.3
West Midlands	1.0	1.0	1.1	0.9	0.3	1.2	0.8	0.6	1.1	1.2	0.8	1.0	0.4
East Midlands	1.0	0.9	0.9	0.9	1.5	1.0	1.0	0.7	1.0	1.1	0.8	1.2	1.3
South East	1.0	1.1	1.0	1.0	1.0	0.9	1.0	1.0	0.9	1.0	1.0	1.0	1.0
Northern Ireland	1.0	0.6	1.1	1.2	0.0	1.0	1.3	1.2	1.4	0.3	1.2	0.7	0.5
South West	0.9	0.8	1.1	1.1	0.1	0.9	0.8	0.6	0.9	0.6	0.8	1.0	2.9
London	0.8	0.5	0.6	0.7	1.2	0.7	0.8	1.7	0.8	1.1	1.1	0.7	0.4

Source: Lightcast, Job Postings

Job posting location quotient, LQ (LQ > 1 = regional specialisation relative to national average concentration)

While London and the South East of England continue to account for the largest share of chemistry job postings, this may be slowly changing. This is because, over the past five years, recruitment activity overall, including for chemistry jobs, has been growing faster in other parts of the country. The North West of England in particular has seen its share of chemistry job postings growing the fastest over this time period, right across all 12 chemistry occupation groups, even faster than its overall recruitment market share. Yorkshire and the Humber and the East Midlands also saw particularly large positive changes in the distribution of chemistry job postings. London was the biggest net loser of this transition, with its share of chemistry job postings compared to other parts of the country decreasing by three percentage points over the same period. While this is less than what London lost in terms of overall recruitment market shares, it applies to different extents to most chemistry occupational groups and in particular to research management and administration. Alongside London, the East of England also saw a decline in the country's share of chemistry job postings, suggesting that the distribution of chemistry activities may be slowly becoming less concentrated in a selected few parts of the country.

Figure 19: Change in the regional distribution of total chemistry job postings

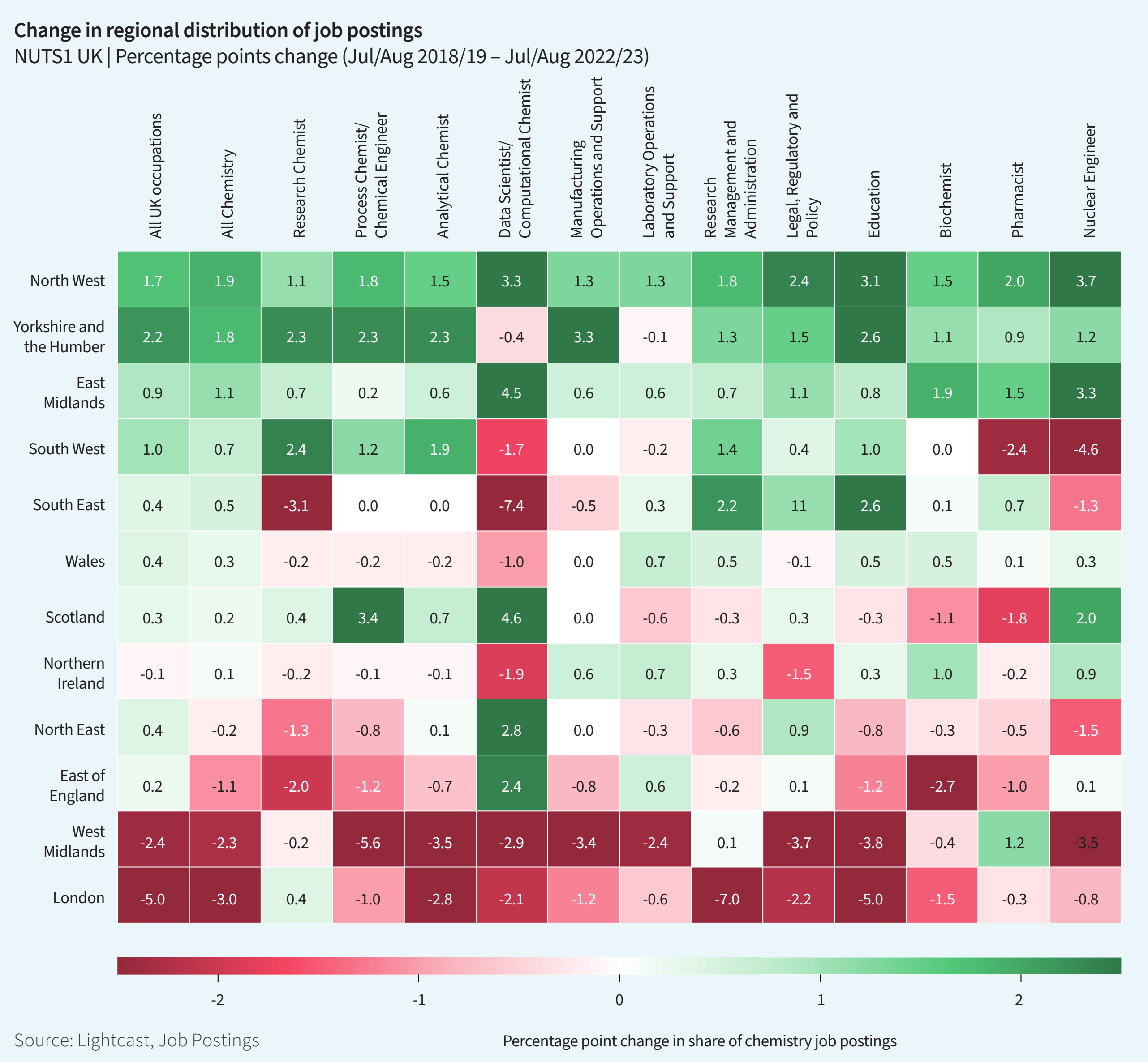


Change in regional distribution of chemistry job recruitment

Chemistry LOT Groups | NUTS1 UK | Job Postings (Jul/Aug 2022/23 vs Jul/Aug 2018/19)

Source: Lightcast, Job Postings

Figure 20: Change in the regional distribution of chemistry job postings by the 12 occupational groups



Change in regional distribution of job postings

NUTS1 UK | Percentage points change (Jul/Aug 2018/19 – Jul/Aug 2022/23)

	All UK occupations	All Chemistry	Research Chemist	Process Chemist/ Chemical Engineer	Analytical Chemist	Data Scientist/ Computational Chemist	Manufacturing Operations and Support	Laboratory Operations and Support	Research Management and Administration	Legal, Regulatory and Policy	Education	Biochemist	Pharmacist	Nuclear Engineer
North West	1.7	1.9	1.1	1.8	1.5	3.3	1.3	1.3	1.8	2.4	3.1	1.5	2.0	3.7
Yorkshire and the Humber	2.2	1.8	2.3	2.3	2.3	-0.4	3.3	-0.1	1.3	1.5	2.6	1.1	0.9	1.2
East Midlands	0.9	1.1	0.7	0.2	0.6	4.5	0.6	0.6	0.7	1.1	0.8	1.9	1.5	3.3
South West	1.0	0.7	2.4	1.2	1.9	-1.7	0.0	-0.2	1.4	0.4	1.0	0.0	-2.4	-4.6
South East	0.4	0.5	-3.1	0.0	0.0	-7.4	-0.5	0.3	2.2	11	2.6	0.1	0.7	-1.3
Wales	0.4	0.3	-0.2	-0.2	-0.2	-1.0	0.0	0.7	0.5	-0.1	0.5	0.5	0.1	0.3
Scotland	0.3	0.2	0.4	3.4	0.7	4.6	0.0	-0.6	-0.3	0.3	-0.3	-1.1	-1.8	2.0
Northern Ireland	-0.1	0.1	-0..2	-0.1	-0.1	-1.9	0.6	0.7	0.3	-1.5	0.3	1.0	-0.2	0.9
North East	0.4	-0.2	-1.3	-0.8	0.1	2.8	0.0	-0.3	-0.6	0.9	-0.8	-0.3	-0.5	-1.5
East of England	0.2	-1.1	-2.0	-1.2	-0.7	2.4	-0.8	0.6	-0.2	0.1	-1.2	-2.7	-1.0	0.1
West Midlands	-2.4	-2.3	-0.2	-5.6	-3.5	-2.9	-3.4	-2.4	0.1	-3.7	-3.8	-0.4	1.2	-3.5
London	-5.0	-3.0	0.4	-1.0	-2.8	-2.1	-1.2	-0.6	-7.0	-2.2	-5.0	-1.5	-0.3	-0.8

Source: Lightcast, Job Postings

Chapter 4: Skills and education insights

Summary and key findings

- This chapter focuses on understanding the skills and educational requirements of the chemistry-using workforce and how these are changing over time.
- The analysis presented in this chapter is primarily based on Lightcast job postings data and the chemistry-using workforce continues to be split into 12 groups as in Chapter 3. To identify skills needs, Lightcast used its Open Skills Taxonomy, a taxonomy containing over 32,000 skills organised in 32 categories and 400 subcategories.
- Chemistry jobs are on average more likely to require technical skills, knowledge and abilities than other occupations, and these technical skills, knowledge and abilities vary significantly from one occupation to another, reflecting the high level of specialisation in the sector.
- Despite that, there are a number of overarching trends encompassing all chemistry occupations, first of which is the growing significance of transferable skills. Of the top 20 skills most mentioned in chemistry job postings, 12 are transferable, with management and communication particularly standing out.
- Chemistry roles are undergoing a digital transformation. Over the past five years, the share of chemistry job postings mentioning digital skills, knowledge and abilities grew faster than the labour market average, by 5.7 percentage points. Around 40% of chemistry job postings now require digital skills, ranging from basic computer literacy to more advanced digital competencies related to data, automation and computer science.
- Green skills, knowledge and abilities are core to chemistry jobs. They constitute one in five of the skills mentioned in chemistry job postings, with knowledge of environmental laws and regulations, skills and knowledge related to renewable energy and net zero particularly in high demand. This applies to all chemistry occupations, with the notable exception of education, posing challenges to the sector.
- While science and research skills, knowledge and abilities are critical to chemistry jobs, there is declining emphasis on them in job postings, with the exception of chemistry skills related to safety and regulations. This shift signals potential changes in recruitment priorities.
- While businesses are increasingly moving towards skill-based hiring, chemistry employers continue to prioritise education qualifications. Minimum education requirements are specified in 35% of chemistry job postings, twice the UK average. A substantial 65% of these postings require a bachelor’s degree, and over 5% a PhD. In contrast, chemistry job postings are half as likely to mention apprenticeships. These trends are reflective of the highly specialised nature of the sector and raise challenges in terms of access and diversity of talent.

Building on the findings from Chapter 3, this chapter delves deeper into job postings data to gather insights on the specific skills needs of the chemistry profession and how they are changing over time. Job postings data are the richest dataset available in terms of skill needs and, given its very timely nature, it provides a unique snapshot on specific employers needs, with the opportunity to spot new emerging trends even before they translate into specific jobs and occupations.

The findings from this chapter provide key insights on how education provision and policymaking need to adapt to the changing labour market landscape for chemistry jobs. They help translate what macroeconomic trends like the green and digital transition mean for chemistry roles, better align education curricula to business needs, and identify training pathways and qualification requirements most in demand for chemistry-using occupations.

4.0 Methodology and definitions

The analysis presented in this chapter is primarily based on Lightcast job postings data, building on the data and methodology set out in Chapter 3. The same 12 occupational chemistry groups continue to be used in this chapter, with the approximately 205,000 chemistry job postings being analysed from a skills and education perspective. These insights are then complemented, where necessary, with insights from existing literature.

To identify skills needs, this report uses Lightcast Skills Taxonomy, a taxonomy comprising over 32,000 skills, knowledge and abilities.[15] These skills, knowledge and abilities are gathered from hundreds of millions of online job postings and workers profiles across the world and the taxonomy is updated every two weeks to capture new, emerging skills. Lightcast Skills Taxonomy is organised hierarchically in 32 thematic categories and 400 subcategories. Skills are tagged across Lightcast's entire data ecosystem to allow for an in-depth analysis on how they relate to one another as well as identify the top requirements for specific job titles, occupations, industries, companies, regions and keywords.

Within Lightcast Skills Taxonomy, the skills, knowledge and abilities are then also classified by type:

- **Common skills** – also referred to as transferable or soft skills, these are typically skills prevalent across many different industries and occupations and include personal attributes, behaviours, competencies and learned skills.
- **Specialised skills** – these are skills unique to a task or skills primarily sought after within a specific subset of industries or occupations.
- **Software skills** – a subset of specialised skills, these include specific computer programs, tools and programming skills.

The insights presented in this chapter are then the result of overlaying this skills taxonomy with the 12 chemistry occupational groups, to identify key trends for the chemistry-using workforce overall and across each group.
For the sake of brevity, throughout the rest of this report, 'skills, knowledge and abilities' are sometimes simply referred to as 'skills'.

4.1 Skills framework for chemistry occupations

This first section provides an overview of the current skills, knowledge and abilities most commonly asked for among employers recruiting for chemistry jobs – focusing on overarching trends, and similarities and differences among specific chemistry occupation groups.

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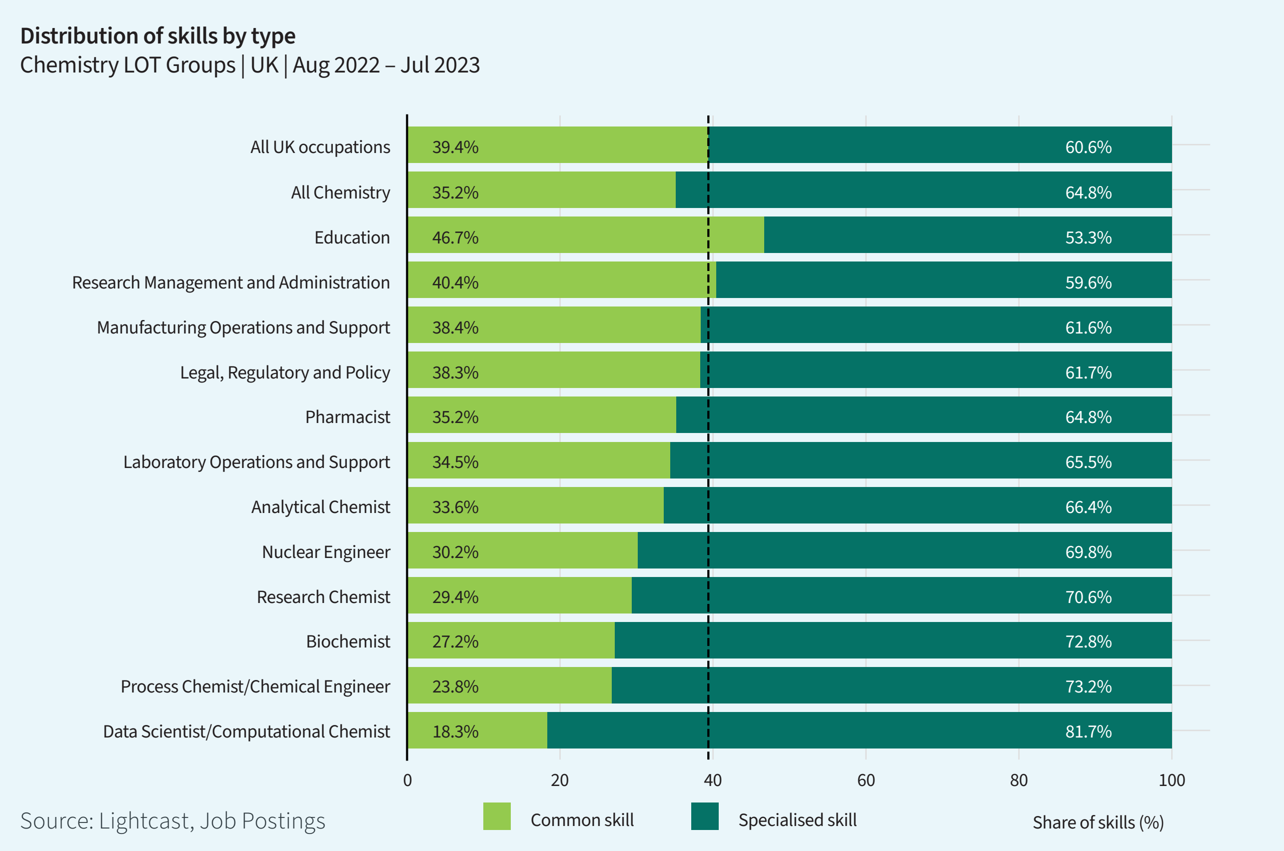
[15] Lightcast Open Skills Taxonomy is available at this link: https://lightcast.io/open-skills

On average, chemistry jobs are more likely to require a specialised, technical skill set than the wider labour market. Approximately 65% of all skills, knowledge and abilities mentioned in chemistry related job postings between August 2022 and July 2023 was specialised, compared to 61% for all occupations. This is reflective of the more technical nature of chemistry jobs and applies to most chemistry occupational groups, with the exception of education, and research management and administration chemistry roles. For these roles, transferable, common skills play a bigger role than in the wider labour market as they are mentioned in 47% and 40% of job postings respectively, against an average of 39% in the UK labour market overall.

Figure 21: Distribution of skills, knowledge and abilities by type

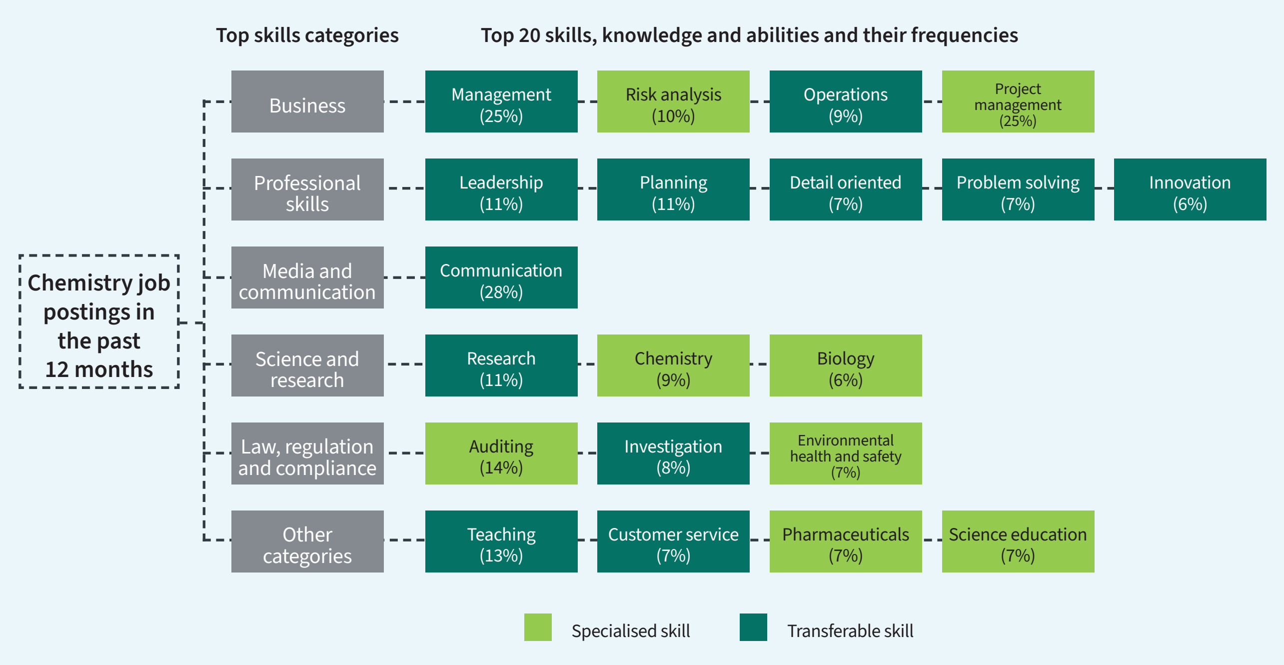


Source: Lightcast, Job Postings

While most of the skills mentioned in chemistry job postings are specialised, the ones most frequently cited overall, right across chemistry jobs, are instead transferable, common skills. In line with wider labour market trends, the top three skills categories most mentioned in chemistry job postings are business, professional skills and communication. Digging deeper into specific skills, of the top 20 most frequently mentioned skills, knowledge and abilities in chemistry job postings, 12 are transferable skills. Communication and management skills in particular are the two skills most frequently cited in chemistry job postings overall (28% and 25% of all chemistry job postings respectively). These two transferable skills, alongside research, leadership and innovation skills also appear among the most frequently cited skills for each specific chemistry occupational group, highlighting the key role they play right across chemistry occupations.

Specialised skills are in contrast, by definition, more unique to individual career areas and therefore their frequency appears to be lower when looking at chemistry job postings overall. On average, the specialised skills most frequently mentioned in chemistry job postings relate to science and research and law, regulation and compliance, with auditing (14%), risk analysis (10%) and chemistry knowledge (9%) the most frequently mentioned specialised skills in chemistry job postings overall.

Figure 22: Skill framework – the top 20 skills, knowledge and abilities most in demand in chemistry job postings



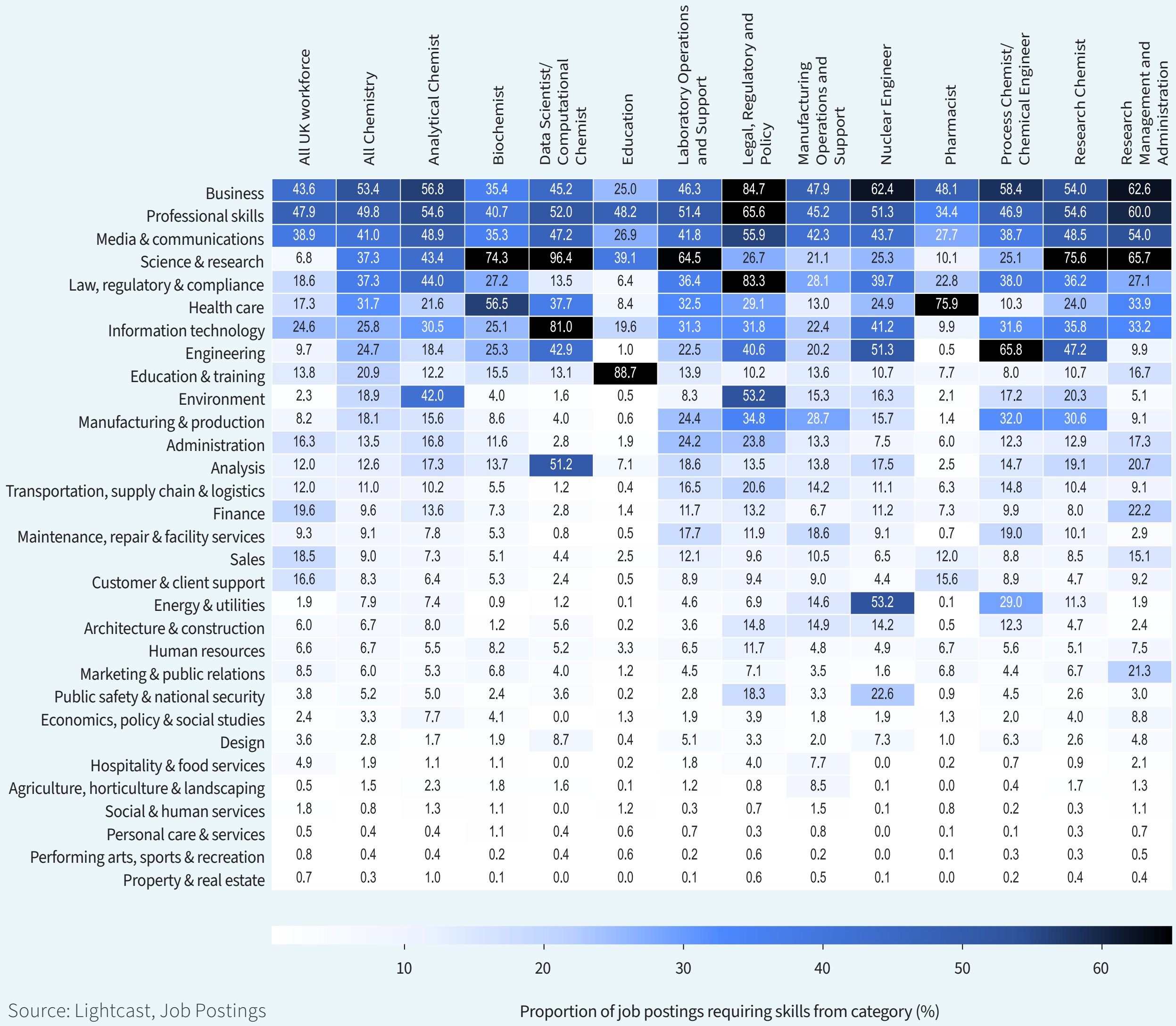
That said, the higher prevalence of science and research skills applies to most chemistry job postings – a reflection of their own very nature. Chemistry job postings are four times more likely to mention science and research skills, knowledge and abilities than the UK average. On average, only 7% of UK job postings mention any science and research skill, knowledge or ability, but four in 10 chemistry job postings do. In particular, science and research related skills are mentioned in most job postings for data scientist/computational chemist roles, and in approximately three quarters of job postings for research chemists and biochemists. It is also plausible to believe that some of these skills are being considered implicit by chemistry employers and that the actual number of jobs requiring skills, knowledge and abilities related to science and research is higher right across the 12 occupational groups.

Beyond science and research skills, there is considerable variation in the other specific specialised skills mentioned in chemistry job postings. On average, chemistry job postings are more than twice as likely to mention law, regulation and policy related skills, healthcare skills, and engineering related skills, knowledge and abilities. This is however where nuances between different chemistry occupational groups start to emerge. For chemists who work in legal, regulatory & policy related roles for example, law and regulation skills are particularly important and mentioned in eight in 10 job postings, compared to less than one in 10 for chemistry education roles. Healthcare-related skills, knowledge and abilities are high in demand for pharmacists and biochemists, while process and nuclear engineers have a particularly high demand for engineering-related skills, which is practically absent in chemistry education and pharmacist roles.

To fully capture nuances across the chemistry workforce, the specific skill requirements of each of the 12 occupations are further explored in the accompanying factsheets to this report (also available at the end of the report).

Figure 23: Top skill categories across chemistry occupation groups

Top skills categories across the chemistry occupational groups
Aug 2022 – Jul 2023



	All UK workforce	All Chemistry	Analytical Chemist	Biochemist	Data Scientist/ Computational Chemist	Education	Laboratory Operations and Support	Legal, Regulatory and Policy	Manufacturing Operations and Support	Nuclear Engineer	Pharmacist	Process Chemist/ Chemical Engineer	Research Chemist	Research Management and Administration
Business	43.6	53.4	56.8	35.4	45.2	25.0	46.3	84.7	47.9	62.4	48.1	58.4	54.0	62.6
Professional skills	47.9	49.8	54.6	40.7	52.0	48.2	51.4	65.6	45.2	51.3	34.4	46.9	54.6	60.0
Media & communications	38.9	41.0	48.9	35.3	47.2	26.9	41.8	55.9	42.3	43.7	27.7	38.7	48.5	54.0
Science & research	6.8	37.3	43.4	74.3	96.4	39.1	64.5	26.7	21.1	25.3	10.1	25.1	75.6	65.7
Law, regulatory & compliance	18.6	37.3	44.0	27.2	13.5	6.4	36.4	83.3	28.1	39.7	22.8	38.0	36.2	27.1
Health care	17.3	31.7	21.6	56.5	37.7	8.4	32.5	29.1	13.0	24.9	75.9	10.3	24.0	33.9
Information technology	24.6	25.8	30.5	25.1	81.0	19.6	31.3	31.8	22.4	41.2	9.9	31.6	35.8	33.2
Engineering	9.7	24.7	18.4	25.3	42.9	1.0	22.5	40.6	20.2	51.3	0.5	65.8	47.2	9.9
Education & training	13.8	20.9	12.2	15.5	13.1	88.7	13.9	10.2	13.6	10.7	7.7	8.0	10.7	16.7
Environment	2.3	18.9	42.0	4.0	1.6	0.5	8.3	53.2	15.3	16.3	2.1	17.2	20.3	5.1
Manufacturing & production	8.2	18.1	15.6	8.6	4.0	0.6	24.4	34.8	28.7	15.7	1.4	32.0	30.6	9.1
Administration	16.3	13.5	16.8	11.6	2.8	1.9	24.2	23.8	13.3	7.5	6.0	12.3	12.9	17.3
Analysis	12.0	12.6	17.3	13.7	51.2	7.1	18.6	13.5	13.8	17.5	2.5	14.7	19.1	20.7
Transportation, supply chain & logistics	12.0	11.0	10.2	5.5	1.2	0.4	16.5	20.6	14.2	11.1	6.3	14.8	10.4	9.1
Finance	19.6	9.6	13.6	7.3	2.8	1.4	11.7	13.2	6.7	11.2	7.3	9.9	8.0	22.2
Maintenance, repair & facility services	9.3	9.1	7.8	5.3	0.8	0.5	17.7	11.9	18.6	9.1	0.7	19.0	10.1	2.9
Sales	18.5	9.0	7.3	5.1	4.4	2.5	12.1	9.6	10.5	6.5	12.0	8.8	8.5	15.1
Customer & client support	16.6	8.3	6.4	5.3	2.4	0.5	8.9	9.4	9.0	4.4	15.6	8.9	4.7	9.2
Energy & utilities	1.9	7.9	7.4	0.9	1.2	0.1	4.6	6.9	14.6	53.2	0.1	29.0	11.3	1.9
Architecture & construction	6.0	6.7	8.0	1.2	5.6	0.2	3.6	14.8	14.9	14.2	0.5	12.3	4.7	2.4
Human resources	6.6	6.7	5.5	8.2	5.2	3.3	6.5	11.7	4.8	4.9	6.7	5.6	5.1	7.5
Marketing & public relations	8.5	6.0	5.3	6.8	4.0	1.2	4.5	7.1	3.5	1.6	6.8	4.4	6.7	21.3
Public safety & national security	3.8	5.2	5.0	2.4	3.6	0.2	2.8	18.3	3.3	22.6	0.9	4.5	2.6	3.0
Economics, policy & social studies	2.4	3.3	7.7	4.1	0.0	1.3	1.9	3.9	1.8	1.9	1.3	2.0	4.0	8.8
Design	3.6	2.8	1.7	1.9	8.7	0.4	5.1	3.3	2.0	7.3	1.0	6.3	2.6	4.8
Hospitality & food services	4.9	1.9	1.1	1.1	0.0	0.2	1.8	4.0	7.7	0.0	0.2	0.7	0.9	2.1
Agriculture, horticulture & landscaping	0.5	1.5	2.3	1.8	1.6	0.1	1.2	0.8	8.5	0.1	0.0	0.4	1.7	1.3
Social & human services	1.8	0.8	1.3	1.1	0.0	1.2	0.3	0.7	1.5	0.1	0.8	0.2	0.3	1.1
Personal care & services	0.5	0.4	0.4	1.1	0.4	0.6	0.7	0.3	0.8	0.0	0.1	0.1	0.3	0.7
Performing arts, sports & recreation	0.8	0.4	0.4	0.2	0.4	0.6	0.2	0.6	0.2	0.0	0.1	0.3	0.3	0.5
Property & real estate	0.7	0.3	1.0	0.1	0.0	0.0	0.1	0.6	0.5	0.1	0.0	0.2	0.4	0.4

Source: Lightcast, Job Postings

4.2 Changing demand for skills in chemistry-using roles

To understand how demand for skills is changing for chemistry-using roles, this section compares skills demand in chemistry job postings today (August 2022 – July 2023) with that of five years ago (August 2018 – July 2019).

The analysis reveals three emerging trends and a declining one, which are broadly consistent across chemistry occupations.

First, chemistry job postings across all groups have seen a sharp rise in demand for transferable, common skills. Compared to 2018, job postings today are, on average, more likely to mention transferable skills, particularly in relation to inherent abilities and business, but also communication. This shift is even more pronounced in chemistry job postings, which have, on average, seen demand for professional skills, business and media and communication skills grow by 6.3, 6.2 and 2.6 percentage points respectively, compared to the wide labour market average of 4.2, 2.6 and 1.3 percentage points. This shift may suggest chemistry employers are increasingly valuing workers who not only have sector-specific knowledge, but also the skills and abilities to work in teams, communicate clearly, manage workload, and take initiative.

Secondly, chemistry job postings across all groups have seen an above-average growth in demand for information technology related skills. Compared to 2018/2019 the share of chemistry job postings requiring these skills has grown by 5.7 percentage points – the third skill category for growth over the time period. This is compared to a 1.9 percentage point increase in the UK labour market overall. The growth in demand for information technology skills applies right across chemistry occupations, with data scientists/computational chemists, research management & administration, laboratory operations and support and education roles seeing growth in demand of 10 percentage points or above. This indicates that the digital transition is having a more pronounced impact on chemistry jobs than the wider labour market and this is further explored in section 4.4.

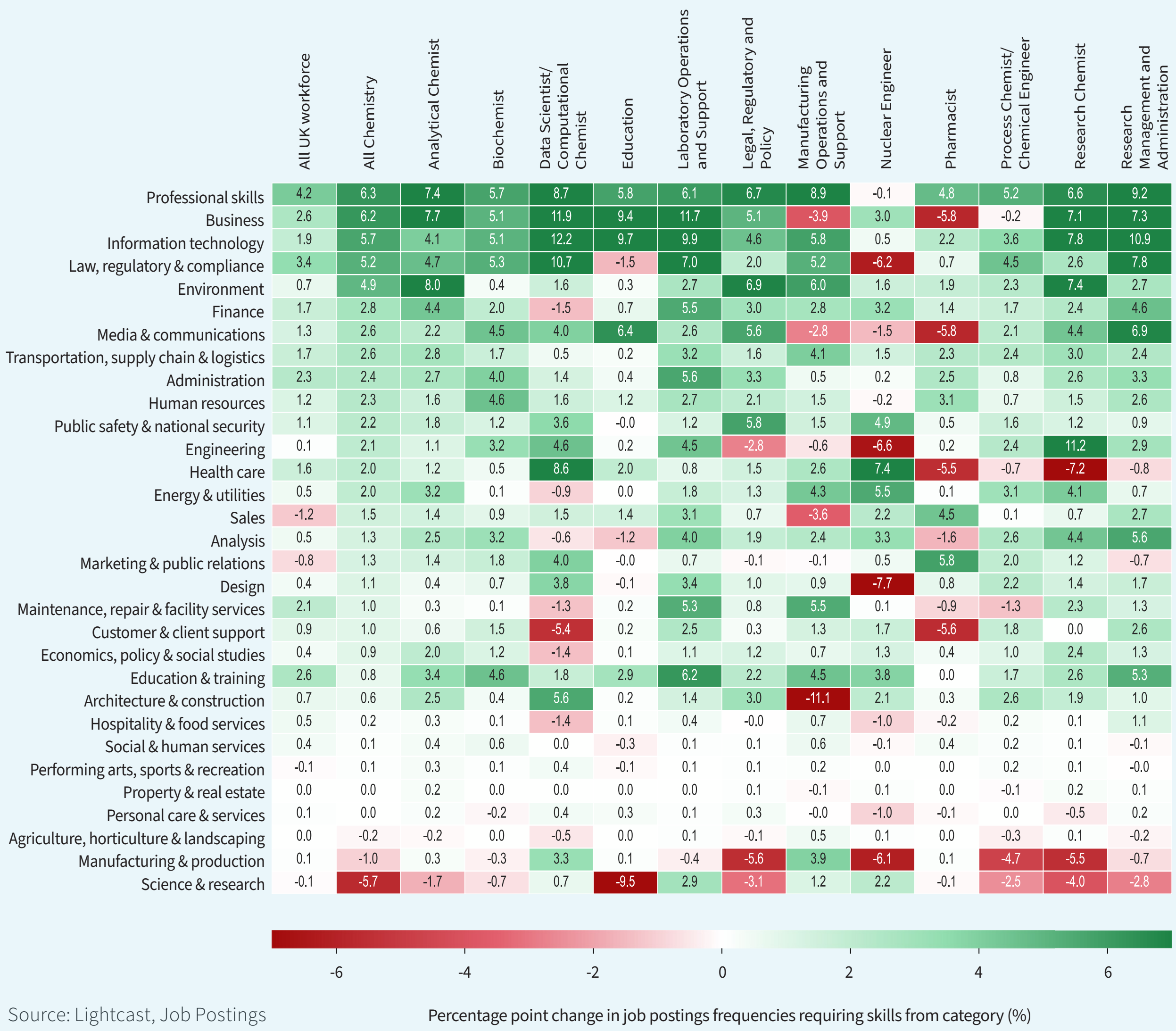
The third key positive trend in chemistry job postings over the past five years is the fast growth in demand for green related skills, knowledge and abilities. The share of chemistry job postings requiring environment-related skills has grown by 4.9 percentage points compared to the 0.7 percentage points average of the UK labour market overall. Once again, this is an overarching trend affecting chemistry job postings right across the 12 occupation groups, with analytical chemists, research chemists and legal, regulatory & policy related roles particularly affected. Digging deeper within categories to look at specific skills, it is a green skill, namely carbon footprint reduction, which is the skill that has seen the largest growth in frequency over the past five years in chemistry job postings overall. In addition to that, skills related to water quality and remedial action are also among the fastest growing skills for chemistry roles. These findings suggest chemistry jobs will be playing a key role in the transition to a green economy, and therefore this aspect has been further explored in section 4.5.

In contrast, science and research skills, knowledge and abilities are now less frequently mentioned in chemistry job postings than they were in 2018/19. On average, the share of chemistry job postings mentioning these types of skills has declined by 5.7 percentage points over the time period, despite remaining pretty much unchanged in the UK labour market overall. The decline in science and research skills has been particularly pronounced in education-related chemistry roles (-9.5 percentage points), but it also applies to a number of other chemistry occupation groups, including research chemists (-4.0), legal, regulatory & policy-related chemistry roles (-3.1) and research management and administration roles (-2.8). This is also visible when looking at the specific skills, knowledge and abilities declining the fastest in chemistry job postings: these tend to be associated with chemistry knowledge (such as agrochemicals and medical chemistry) and lab operations (such as cell culture, toxicology and good lab operations).

The decline in science and research skills is most likely explained by employers now implicitly assuming chemistry roles require these skills, rather than a decline in their importance. Employers may choose to focus their online postings on new, emerging skills – such as green and digital – as their new nature means they may be harder to find in the labour market. Similarly, they may decide to explicitly mention transferable skills as they may appear less obviously related to chemistry jobs than specific science and research skills.

To further understand these dynamics, and their specific link to chemistry knowledge, skills and abilities, section 4.3 provides a deep dive into chemistry-specific skills.

Figure 24: Change in demand for skill, knowledge and abilities categories across chemistry occupation groups



Change in demand for skill categories across the chemistry occupational groups

2018/19 vs 2022/23 | UK | (% change)

	All UK workforce	All Chemistry	Analytical Chemist	Biochemist	Data Scientist/ Computational Chemist	Education	Laboratory Operations and Support	Legal, Regulatory and Policy	Manufacturing Operations and Support	Nuclear Engineer	Pharmacist	Process Chemist/ Chemical Engineer	Research Chemist	Research Management and Administration
Professional skills	4.2	6.3	7.4	5.7	8.7	5.8	6.1	6.7	8.9	-0.1	4.8	5.2	6.6	9.2
Business	2.6	6.2	7.7	5.1	11.9	9.4	11.7	5.1	-3.9	3.0	-5.8	-0.2	7.1	7.3
Information technology	1.9	5.7	4.1	5.1	12.2	9.7	9.9	4.6	5.8	0.5	2.2	3.6	7.8	10.9
Law, regulatory & compliance	3.4	5.2	4.7	5.3	10.7	-1.5	7.0	2.0	5.2	-6.2	0.7	4.5	2.6	7.8
Environment	0.7	4.9	8.0	0.4	1.6	0.3	2.7	6.9	6.0	1.6	1.9	2.3	7.4	2.7
Finance	1.7	2.8	4.4	2.0	-1.5	0.7	5.5	3.0	2.8	3.2	1.4	1.7	2.4	4.6
Media & communications	1.3	2.6	2.2	4.5	4.0	6.4	2.6	5.6	-2.8	-1.5	-5.8	2.1	4.4	6.9
Transportation, supply chain & logistics	1.7	2.6	2.8	1.7	0.5	0.2	3.2	1.6	4.1	1.5	2.3	2.4	3.0	2.4
Administration	2.3	2.4	2.7	4.0	1.4	0.4	5.6	3.3	0.5	0.2	2.5	0.8	2.6	3.3
Human resources	1.2	2.3	1.6	4.6	1.6	1.2	2.7	2.1	1.5	-0.2	3.1	0.7	1.5	2.6
Public safety & national security	1.1	2.2	1.8	1.2	3.6	-0.0	1.2	5.8	1.5	4.9	0.5	1.6	1.2	0.9
Engineering	0.1	2.1	1.1	3.2	4.6	0.2	4.5	-2.8	-0.6	-6.6	0.2	2.4	11.2	2.9
Health care	1.6	2.0	1.2	0.5	8.6	2.0	0.8	1.5	2.6	7.4	-5.5	-0.7	-7.2	-0.8
Energy & utilities	0.5	2.0	3.2	0.1	-0.9	0.0	1.8	1.3	4.3	5.5	0.1	3.1	4.1	0.7
Sales	-1.2	1.5	1.4	0.9	1.5	1.4	3.1	0.7	-3.6	2.2	4.5	0.1	0.7	2.7
Analysis	0.5	1.3	2.5	3.2	-0.6	-1.2	4.0	1.9	2.4	3.3	-1.6	2.6	4.4	5.6
Marketing & public relations	-0.8	1.3	1.4	1.8	4.0	-0.0	0.7	-0.1	-0.1	0.5	5.8	2.0	1.2	-0.7
Design	0.4	1.1	0.4	0.7	3.8	-0.1	3.4	1.0	0.9	-7.7	0.8	2.2	1.4	1.7
Maintenance, repair & facility services	2.1	1.0	0.3	0.1	-1.3	0.2	5.3	0.8	5.5	0.1	-0.9	-1.3	2.3	1.3
Customer & client support	0.9	1.0	0.6	1.5	-5.4	0.2	2.5	0.3	1.3	1.7	-5.6	1.8	0.0	2.6
Economics, policy & social studies	0.4	0.9	2.0	1.2	-1.4	0.1	1.1	1.2	0.7	1.3	0.4	1.0	2.4	1.3
Education & training	2.6	0.8	3.4	4.6	1.8	2.9	6.2	2.2	4.5	3.8	0.0	1.7	2.6	5.3
Architecture & construction	0.7	0.6	2.5	0.4	5.6	0.2	1.4	3.0	-11.1	2.1	0.3	2.6	1.9	1.0
Hospitality & food services	0.5	0.2	0.3	0.1	-1.4	0.1	0.4	-0.0	0.7	-1.0	-0.2	0.2	0.1	1.1
Social & human services	0.4	0.1	0.4	0.6	0.0	-0.3	0.1	0.1	0.6	-0.1	0.4	0.2	0.1	-0.1
Performing arts, sports & recreation	-0.1	0.1	0.3	0.1	0.4	-0.1	0.1	0.1	0.2	0.0	0.0	0.2	0.1	-0.0
Property & real estate	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	-0.1	0.2	0.1
Personal care & services	0.1	0.0	0.2	-0.2	0.4	0.3	0.1	0.3	-0.0	-1.0	-0.1	0.0	-0.5	0.2
Agriculture, horticulture & landscaping	0.0	-0.2	-0.2	0.0	-0.5	0.0	0.1	-0.1	0.5	0.1	0.0	-0.3	0.1	-0.2
Manufacturing & production	0.1	-1.0	0.3	-0.3	3.3	0.1	-0.4	-5.6	3.9	-6.1	0.1	-4.7	-5.5	-0.7
Science & research	-0.1	-5.7	-1.7	-0.7	0.7	-9.5	2.9	-3.1	1.2	2.2	-0.1	-2.5	-4.0	-2.8

Source: Lightcast, Job Postings

Percentage point change in job postings frequencies requiring skills from category (%)

Table 8: Fastest changing skills, knowledge and abilities in chemistry job postings

Top 10 fastest growing skills, knowledge and abilities (change in frequency)[16]	Top 10 fastest growing skills, knowledge and abilities (percentage point change)	Top 10 fastest declining skills, knowledge and abilities (frequency)
Carbon footprint reduction (+463%)	Control of substances hazardous to health (COSHH) (0.85)	Enzyme-linked immunosorbent (ELISA) assay (-46%)
Drug interaction (+457%)	Chemical engineering (0.46)	Agrochemicals (-42%)
Water quality (+200%)	Remedial action (0.33)	Gas chromatography mass spectrometry (-38%)
Electron microprobe (+100%)	Laboratory equipment (0.24)	Cell cultures (-38%)
Embedding (+99%)	Water quality (0.22)	Medicinal chemistry (-34%)
Polypharmacy (+87%)	Drug interaction (0.21)	Composite materials (-32%)
Laboratory safety (+83%)	Chemical process (0.19)	Toxicology (-31%)
Control of substances hazardous to health (COSHH) (+61%)	Histology (0.18)	Mass spectrometry (-30%)
Remedial action (+59%)	Laboratory information management systems (0.17)	Good laboratory practice (GLP) (-30%)
Computational chemistry (48%)	Carbon footprint reduction (0.16)	Immunohistochemistry (-29%)

4.3 Deep dive on chemistry skills, knowledge and abilities

This section zooms in on employers' needs specifically related to chemistry skills, knowledge and abilities.

Starting from Lightcast Skills Taxonomy, Lightcast and the RSC worked together to identify a set of chemistry-specific skills. For the purpose of this research, approximately 250 skills, knowledge and abilities were identified as directly related to chemistry.

It is important to note that, because of their very specialised nature, the frequency with which each of these skills individually appears in chemistry job postings overall is on average relatively low. For context, "Chemistry" – the most frequently mentioned chemistry skill, was mentioned in just 9% of chemistry job postings between August 2022 and September 2023, "Pharmaceuticals" in 7% and "Control of substances hazardous to health (COSHH)" – the third most frequent chemistry skill – in only 2% of chemistry postings. Their individual frequency increases somewhat, however, when focusing on specific chemistry occupations, as illustrated in the accompanying factsheets (also available at the end of the report).

These 250 chemistry skills, knowledge and abilities were then organised in 15 clusters. Table 9 illustrates these clusters and the most frequently mentioned chemistry skills, knowledge and abilities included in each of them.

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[16] The analysis excludes skills that appeared in less than 0.15% of chemistry job postings in 2022/23 to avoid small sample biases.

Table 9: The 15 chemistry skills clusters and their associated chemistry skills, knowledge and abilities

Chemistry skill cluster	Examples of the most frequently mentioned chemistry skills, knowledge and abilities included in each cluster
General chemistry	Chemistry, reagent, scientific instruments etc.
Analytical techniques	High-performance liquid chromatography, analytical chemistry, chromatography etc.
Biochemical/medical chemistry	Biochemistry, biochemical assays, biopharmaceuticals, pharmaceuticals, etc.
Data science/computational techniques	Laboratory information management systems, computational chemistry, cheminformatics etc.
Physical chemistry	Physical chemistry, chemical kinetics, mass transfer etc.
Organic chemistry	Organic chemistry, wet chemistry, chemical synthesis etc.
Inorganic chemistry	Inorganic chemistry, ligand, ion exchange etc.
Materials sciences	Polymer chemistry, composite materials, plastic materials, etc.
Environmental chemistry, water & sustainability	Water treatment, agrochemicals, soil science, etc.
Electrochemistry	Electrochemistry
Clinical techniques	Clinical chemistry, osmolality
General lab techniques	Good laboratory practices (GLP), laboratory experience, laboratory equipment, etc.
Safety and regulations	ISO/IEC 17025, Control Of Substances Hazardous To Health (COSHH), re-medial action, etc.
Chemical engineering	Chemical engineering, chemical process, process chemistry, etc.
Biotechnology	Biotechnology, biological engineering, etc.

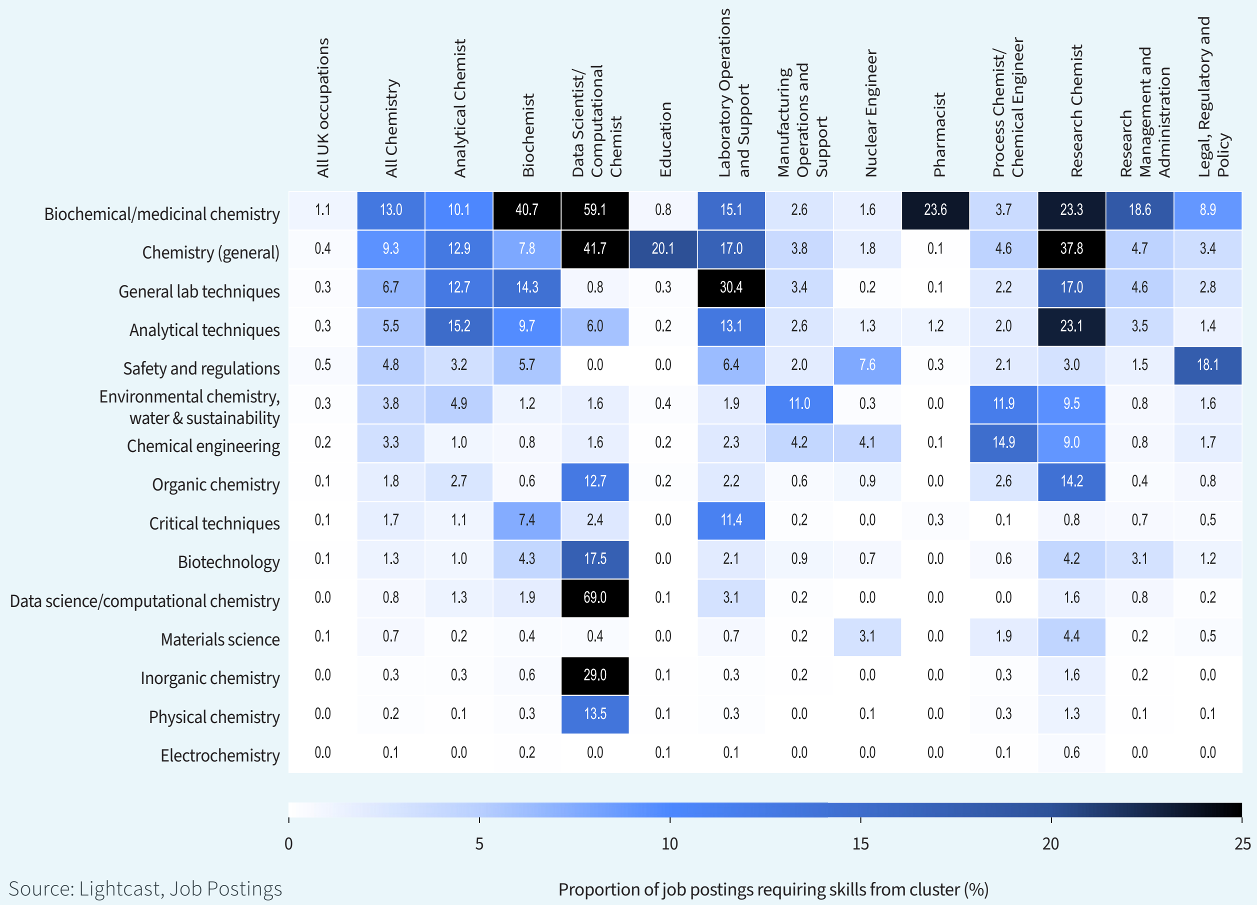
In line with trends for specific skills, explicit reference to each chemistry cluster also tends to be relatively low when looking at chemistry job postings overall. Biochemical/medical chemistry knowledge, skills and abilities were the chemistry skills most often cited in chemistry job postings between August 2022 and July 2023 (13% of postings), followed by general chemistry skills (9%), and general lab techniques (7%).

However, these numbers are considerably higher than the UK average for all occupations and each individual chemistry group tends to see a spike for the specific chemistry skill clusters associated with their roles. Six in 10 job postings for data scientists/computational chemists and 41% of job postings for biochemists, for example, mention at least one skill related to biochemical/medicinal chemistry, while 30% of laboratory operations & support roles mention skills related to general lab techniques.

This once again highlights the high level of skills specialisation required in chemistry jobs and the great diversity of jobs included within the chemistry sector.

Figure 25: Demand for chemistry skill clusters across the 12 chemistry occupation groups

Chemistry skill clusters across the chemistry occupational groups
Aug 2022 – Jul 2023 | UK | (%)



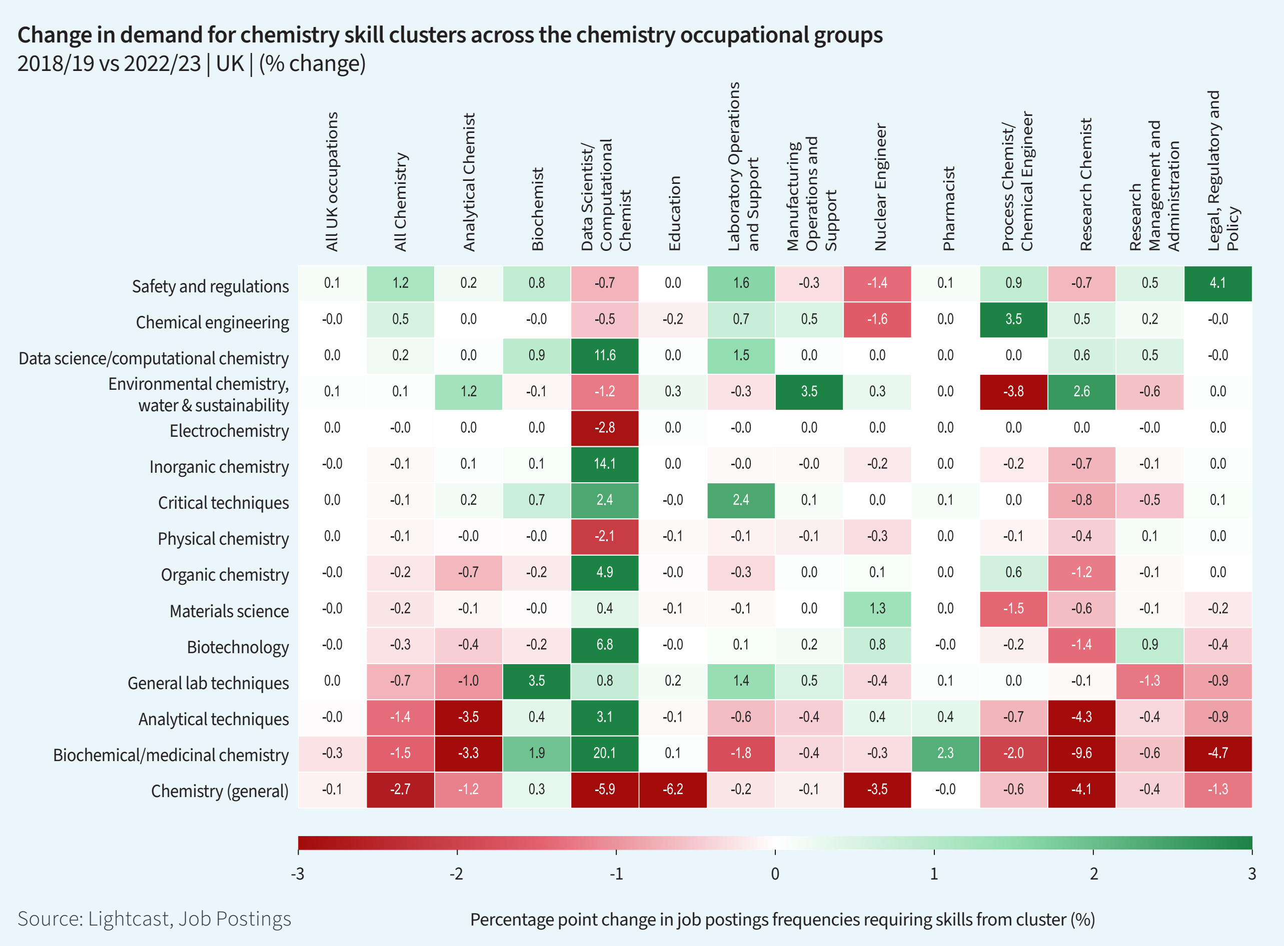
	All UK occupations	All Chemistry	Analytical Chemist	Biochemist	Data Scientist/ Computational Chemist	Education	Laboratory Operations and Support	Manufacturing Operations and Support	Nuclear Engineer	Pharmacist	Process Chemist/ Chemical Engineer	Research Chemist	Research Management and Administration	Legal, Regulatory and Policy
Biochemical/medicinal chemistry	1.1	13.0	10.1	40.7	59.1	0.8	15.1	2.6	1.6	23.6	3.7	23.3	18.6	8.9
Chemistry (general)	0.4	9.3	12.9	7.8	41.7	20.1	17.0	3.8	1.8	0.1	4.6	37.8	4.7	3.4
General lab techniques	0.3	6.7	12.7	14.3	0.8	0.3	30.4	3.4	0.2	0.1	2.2	17.0	4.6	2.8
Analytical techniques	0.3	5.5	15.2	9.7	6.0	0.2	13.1	2.6	1.3	1.2	2.0	23.1	3.5	1.4
Safety and regulations	0.5	4.8	3.2	5.7	0.0	0.0	6.4	2.0	7.6	0.3	2.1	3.0	1.5	18.1
Environmental chemistry, water & sustainability	0.3	3.8	4.9	1.2	1.6	0.4	1.9	11.0	0.3	0.0	11.9	9.5	0.8	1.6
Chemical engineering	0.2	3.3	1.0	0.8	1.6	0.2	2.3	4.2	4.1	0.1	14.9	9.0	0.8	1.7
Organic chemistry	0.1	1.8	2.7	0.6	12.7	0.2	2.2	0.6	0.9	0.0	2.6	14.2	0.4	0.8
Critical techniques	0.1	1.7	1.1	7.4	2.4	0.0	11.4	0.2	0.0	0.3	0.1	0.8	0.7	0.5
Biotechnology	0.1	1.3	1.0	4.3	17.5	0.0	2.1	0.9	0.7	0.0	0.6	4.2	3.1	1.2
Data science/computational chemistry	0.0	0.8	1.3	1.9	69.0	0.1	3.1	0.2	0.0	0.0	0.0	1.6	0.8	0.2
Materials science	0.1	0.7	0.2	0.4	0.4	0.0	0.7	0.2	3.1	0.0	1.9	4.4	0.2	0.5
Inorganic chemistry	0.0	0.3	0.3	0.6	29.0	0.1	0.3	0.2	0.0	0.0	0.3	1.6	0.2	0.0
Physical chemistry	0.0	0.2	0.1	0.3	13.5	0.1	0.3	0.0	0.1	0.0	0.3	1.3	0.1	0.1
Electrochemistry	0.0	0.1	0.0	0.2	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.6	0.0	0.0

Source: Lightcast, Job Postings

Looking at change over time shows that skills related to chemistry clusters followed a similar declining pattern in chemistry job postings to the one highlighted for wider science and research skills in the previous section, albeit to a smaller extent. Of the 15 chemistry skills clusters, 11 saw no or negative change, with chemistry-general skills declining on average the most (-2.7 percentage points). This applies to most chemistry individual occupational groups too.

The exception to this is chemistry skills related to safety and regulation, which instead have risen in demand. The share of chemistry job postings mentioning these skills grew by 1.2 percentage points between 2018/19 and 2022/23, with the largest growth associated with legal, regulation & policy chemistry roles (+4.1 percentage points).

Figure 26: Change in demand for chemistry skill clusters across the 12 chemistry occupation groups



Change in demand for chemistry skill clusters across the chemistry occupational groups
2018/19 vs 2022/23 | UK | (% change)

	All UK occupations	All Chemistry	Analytical Chemist	Biochemist	Data Scientist/ Computational Chemist	Education	Laboratory Operations and Support	Manufacturing Operations and Support	Nuclear Engineer	Pharmacist	Process Chemist/ Chemical Engineer	Research Chemist	Research Management and Administration	Legal, Regulatory and Policy
Safety and regulations	0.1	1.2	0.2	0.8	-0.7	0.0	1.6	-0.3	-1.4	0.1	0.9	-0.7	0.5	4.1
Chemical engineering	-0.0	0.5	0.0	-0.0	-0.5	-0.2	0.7	0.5	-1.6	0.0	3.5	0.5	0.2	-0.0
Data science/computational chemistry	0.0	0.2	0.0	0.9	11.6	0.0	1.5	0.0	0.0	0.0	0.0	0.6	0.5	-0.0
Environmental chemistry, water & sustainability	0.1	0.1	1.2	-0.1	-1.2	0.3	-0.3	3.5	0.3	0.0	-3.8	2.6	-0.6	0.0
Electrochemistry	0.0	-0.0	0.0	0.0	-2.8	0.0	-0.0	0.0	0.0	0.0	0.0	0.0	-0.0	0.0
Inorganic chemistry	-0.0	-0.1	0.1	0.1	14.1	0.0	-0.0	-0.0	-0.2	0.0	-0.2	-0.7	-0.1	0.0
Critical techniques	0.0	-0.1	0.2	0.7	2.4	-0.0	2.4	0.1	0.0	0.1	0.0	-0.8	-0.5	0.1
Physical chemistry	0.0	-0.1	-0.0	-0.0	-2.1	-0.1	-0.1	-0.1	-0.3	0.0	-0.1	-0.4	0.1	0.0
Organic chemistry	-0.0	-0.2	-0.7	-0.2	4.9	-0.0	-0.3	0.0	0.1	0.0	0.6	-1.2	-0.1	0.0
Materials science	-0.0	-0.2	-0.1	-0.0	0.4	-0.1	-0.1	0.0	1.3	0.0	-1.5	-0.6	-0.1	-0.2
Biotechnology	-0.0	-0.3	-0.4	-0.2	6.8	-0.0	0.1	0.2	0.8	-0.0	-0.2	-1.4	0.9	-0.4
General lab techniques	0.0	-0.7	-1.0	3.5	0.8	0.2	1.4	0.5	-0.4	0.1	0.0	-0.1	-1.3	-0.9
Analytical techniques	-0.0	-1.4	-3.5	0.4	3.1	-0.1	-0.6	-0.4	0.4	0.4	-0.7	-4.3	-0.4	-0.9
Biochemical/medicinal chemistry	-0.3	-1.5	-3.3	1.9	20.1	0.1	-1.8	-0.4	-0.3	2.3	-2.0	-9.6	-0.6	-4.7
Chemistry (general)	-0.1	-2.7	-1.2	0.3	-5.9	-6.2	-0.2	-0.1	-3.5	-0.0	-0.6	-4.1	-0.4	-1.3

Source: Lightcast, Job Postings

Percentage point change in job postings frequencies requiring skills from cluster (%)

4.4 Digital skills, knowledge and abilities analysis in chemistry occupations

As highlighted in section 4.2, the digital transition is affecting employers' skill needs in the UK wide labour market, and even more so for chemistry-related roles.

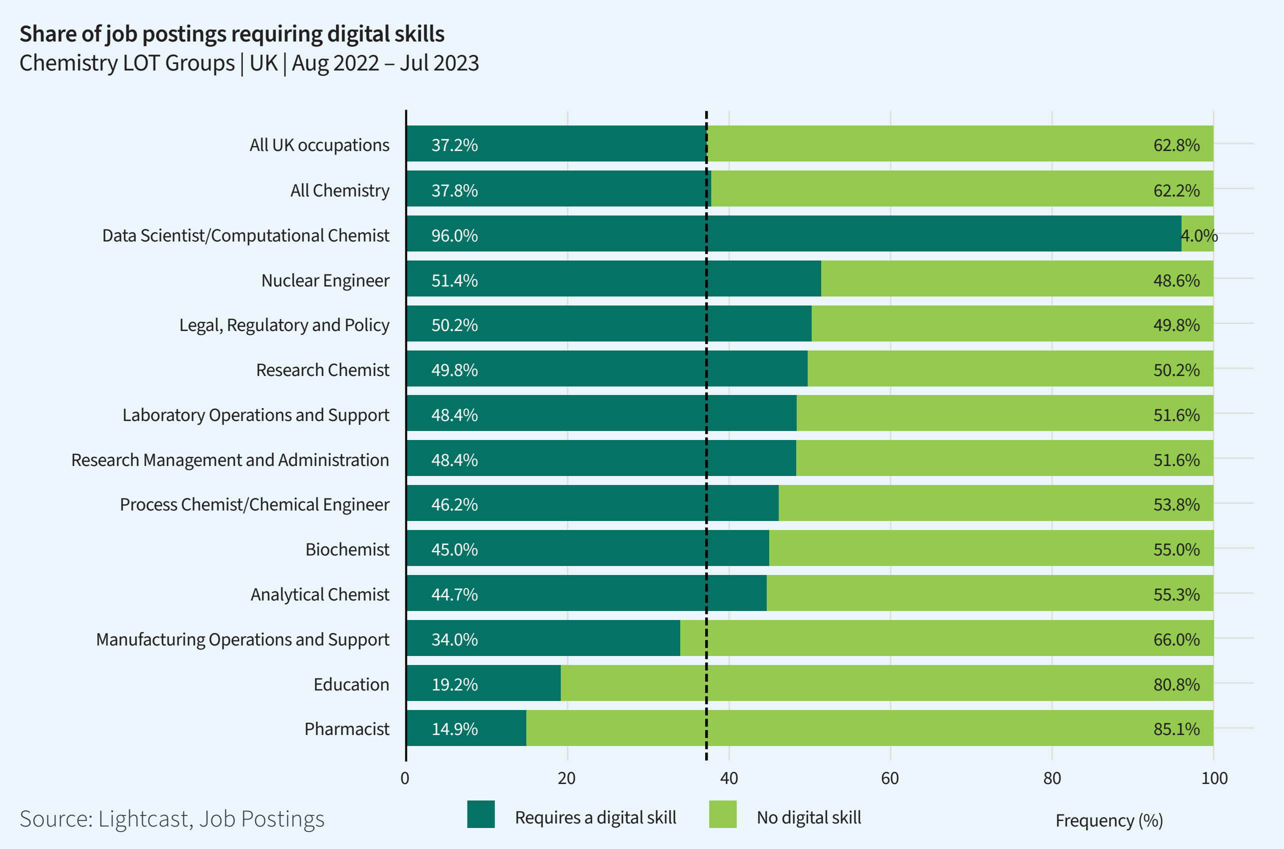
To further understand the impact of this transition on chemistry-using jobs, this section delves into the specific digital skill requirements of the chemistry profession. It does so by zooming in on approximately 12,000 of the skills, knowledge and abilities from the Lightcast Skills Taxonomy, which are directly – or indirectly – related to digital. These skills encompass a wide range of skill clusters, from basic office and digital tools like the Microsoft Office suite and Zoom, to more advanced digital skills, knowledge and abilities, such as the ability to use specific programming languages and other IT-specific skills like 'Amazon Web Services'. In addition to these skills, this definition also includes general skills, knowledge and abilities needed to use digital tools – such as 'computer literacy' – as well as skills that need digital competencies to be carried out, such as 'automation', 'forecasting modelling' and 'data analysis'.

Using this approach, it appears that overall, chemistry using jobs have an average demand for digital skills – but this hides significant variation between specific chemistry using occupations. Approximately four in 10 skills mentioned in chemistry job postings are digital, however the share goes down to two in 10 or less for education roles and pharmacists, reflecting the higher importance of people-oriented skills for these roles. That said, for all other chemistry occupation groups, digital skills account for an average or above-average share of skills, with the share going up to above 50% for legal, regulation & policy chemistry roles and nuclear engineers, and to above 95% for data scientists/computational chemists.

Furthermore, with the exception of nuclear engineers and data scientists/computational chemists, all other chemistry occupations have seen an above-average growth in demand for digital skills compared to 2018/19. This applies to both occupation groups which have a high share of these digital skills and those that comparatively have less, with education roles related to chemistry exhibiting the largest growth in demand for digital skills over the time period (+70%).

This suggests that chemistry-using roles are currently at the centre of a digital transformation. Unlike other parts of the labour market, chemistry jobs are currently seeing a big shift towards digital skill requirements and, with the pace of innovation currently accelerating, it is likely these trends will continue over the next few years.

Figure 27a: Demand for digital skills, knowledge and abilities in chemistry job postings and change over time

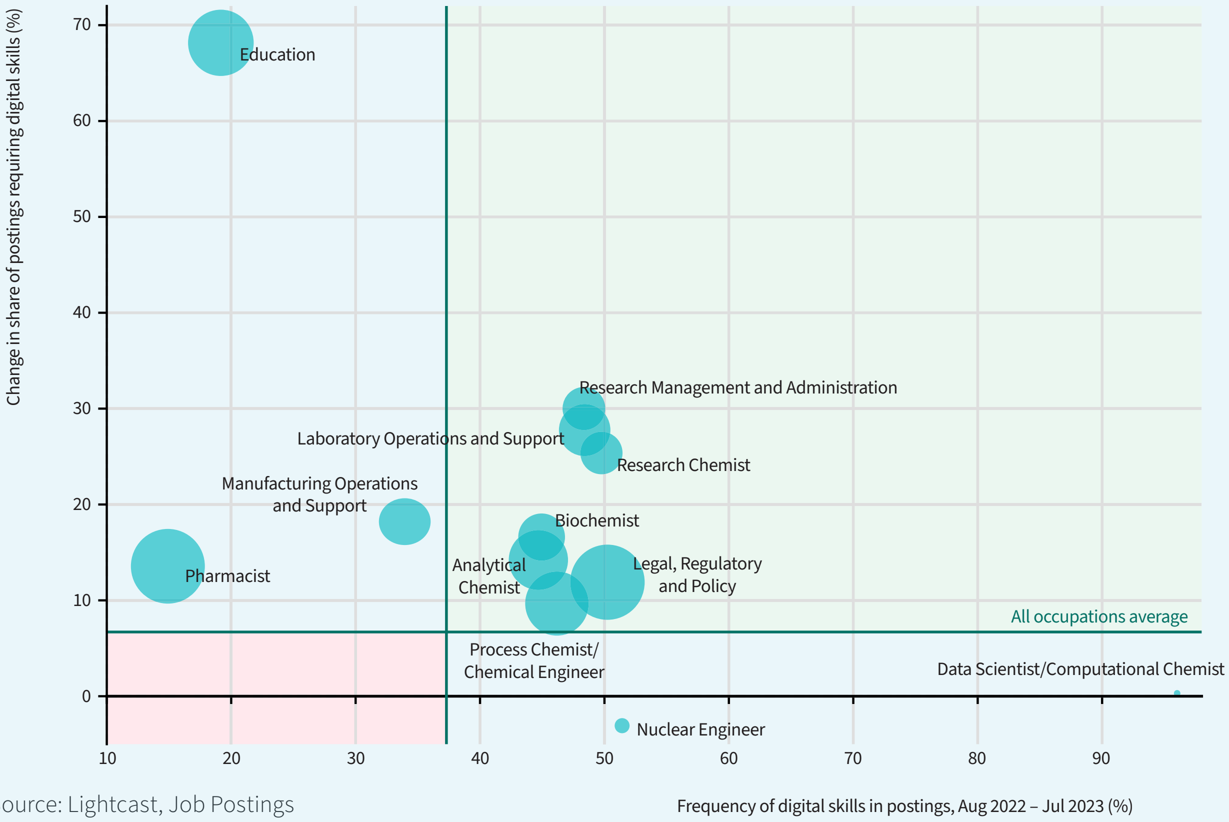


Source: Lightcast, Job Postings

Figure 27b: Demand for digital skills, knowledge and abilities in chemistry job postings and change over time

Changing prevalence of digital skills

Chemistry LOT Groups | UK | Jul 2018-Aug 2019 vs Jul 2022-Aug 2023



Source: Lightcast, Job Postings

This is further reinforced by the fact that chemistry job postings are transitioning towards more complex and advanced digital skill needs. Looking at the digital skills currently most in demand in chemistry-using roles shows that alongside knowledge of the Microsoft Office Suite and basic computer literacy, chemistry jobs require more advanced digital skills related to data analysis, automation and computer science. On top of that, the fastest growing digital skills in chemistry job postings are mostly advanced skills related to artificial intelligence, computer science, data management, data science, analysis and visualisation.

In practice, these findings have a number of key implications for education providers and policymakers working in the chemistry sector. Firstly, they highlight that both basic digital skills and more advanced ones are critical to businesses recruiting for chemistry roles. Secondly, with the continued introduction of new technologies, the specific digital skills learnt by students may have already been replaced by the time they enter the labour market. This, in turn, suggests that developing skills around the ability to learn and quickly adapt to change are equally, if not more, important than the specific digital skills. On top of that, this also suggests that workers will continue to need to update their skills throughout their careers, highlighting the critical role of lifelong learning, and that, when it comes to digital skills, shorter, bite-size courses may help workers stay up to date with the latest technological developments.

Table 10: Most in demand and fastest growing digital skills, knowledge and abilities in chemistry job postings overall

Top 10 digital skills, knowledge and abilities (frequency)	Top 10 fastest growing digital skills, knowledge and abilities (change in frequency)	Top 10 fastest growing digital skills, knowledge and abilities (percentage point change)
Microsoft Office (3.8%)	eClinicalWorks (ECW) (44,800%)	Microsoft Excel (0.96)
Microsoft Excel (3.6%)	Software systems (888%)	Data analysis (0.95)
Data analysis (3.4%)	Digital transformation (778%)	Microsoft PowerPoint (0.68)
Computer literacy (3.0%)	Power BI (487%)	Software systems (0.68)
Computer science (2.1%)	Artificial intelligence (221%)	Microsoft Office (0.61)
Microsoft PowerPoint (2.1%)	Aspen HYSYS (210%)	Computer Science (0.46)
Automation (1.5%)	Data science (188%)	Python (programming language) (0.35)
Building automation (1.5%)	Scalability (169%)	Microsoft Outlook (0.32)
Microsoft Outlook (1.5%)	Dashboard (144%)	Artificial intelligence (0.31)
Microsoft Word (1.1%)	Systems engineering (140%)	Systems engineering (0.29)

4.5 Green skills, knowledge and abilities analysis in chemistry occupations

Alongside the digital transition, the transition to a greener economy is undoubtedly another key macroeconomic trend that is currently reshaping the UK's labour market.

As mentioned in section 2.5 and 4.2, this is one of the areas of biggest potential for the chemistry sector. As such, the aim of this section is to further unpack this topic to identify the specific areas of the chemistry workforce that are likely going to be affected by these changes, and the specific skill requirements they need to unlock these opportunities.

The findings presented in this section were built using Lightcast green jobs definition. Despite the consensus around the importance of the green transition, there is currently no officially agreed definition of what counts as a 'green job' in the UK. To help overcome this challenge and get the conversation started, Lightcast developed its own definition of green jobs by using Lightcast job postings data and skills taxonomy. Starting from Lightcast Skills Taxonomy, approximately 450 skills, knowledge and abilities were identified as green. These skills, knowledge and abilities encompass 21 different green clusters, from green architecture and construction, to environmental regulations, renewable energy and conservation. The full list of green skills, knowledge and abilities and their associated green clusters are available in Appendix 2. Job postings that included at least one of these skills were then classified as green job postings.

Based on this approach, approximately one in five of the skills, knowledge and abilities mentioned in chemistry job postings is 'green' – compared to only 2.5% in the UK-wide labour market. Green skills play a significantly more important role in chemistry occupations and this applies right across most chemistry occupation groups. More than 50% of all the skills mentioned for nuclear engineer roles are green, and four in 10 are for analytical chemists and legal, regulation and policy related chemistry roles.

For some chemistry occupation groups, this above-average demand for green skills, knowledge and abilities is also coupled with above-average growth in demand over time, suggesting they are currently undergoing major changes. These groups are: research management and administration roles, data scientists/computational scientists, research chemists, and roles related to manufacturing operations and support. Unlike other chemistry occupation groups – such as nuclear engineering and analytical chemists – where demand for green skills was already high five years ago, these groups are currently in the midst of a transition towards a skillset requiring an increased amount of green skills, knowledge and abilities.

A notable exception to these trends is education. Unlike other chemistry jobs, only 0.9% of the skills, knowledge and abilities mentioned in chemistry-related education job postings are currently 'green'. This is despite a very sharp rise in demand over the past five years in the wider chemistry workforce.

This is in line with findings from the literature review, highlighting potentially one of the biggest challenges facing the chemistry sector in the years to come. While chemistry jobs increasingly require green skills, knowledge and abilities, businesses are finding it hard to fill these positions with candidates with the required skills. This is partly due to a lack of evidence and clear understanding of what green skills, knowledge and abilities needed to be taught, and at which level of the education system. This confusion is seen in all parts of the ecosystem, with education providers, policymakers and young people all lacking a clear view of the green skills needs of employers. Businesses too lack understanding and knowledge, in particular in relation to how and who within the education system, can help them fill these green skill shortages.[17]

Thanks to its granularity, job postings data can help provide clarity in this context, by offering clear insights on the specific green skills currently most sought after in chemistry roles and how these are changing over time. Furthermore, the richness of the sample size of job postings data means these insights offer a more holistic picture of green skills, knowledge and abilities than what would otherwise be possible to get from surveys and focus groups.

The green skills, knowledge and abilities most in demand in chemistry job postings include the knowledge of environmental regulations, such as the ISO 14000 series, and knowledge, skills and abilities related to water treatment, waste management, renewable energy and net zero. Once again, each chemistry occupation group has its own specific needs and these are further explored in the accompanying factsheets (also available at the end of the report).

These insights offer the unique opportunity to education providers and policymakers to draw clarity in the green space and start shaping training provision in a way that aligns with employers needs. The question then is no longer about 'what green skills' but rather becomes about the level of investment required, as well as the type of courses, length, level and format best suited to address these skill needs.

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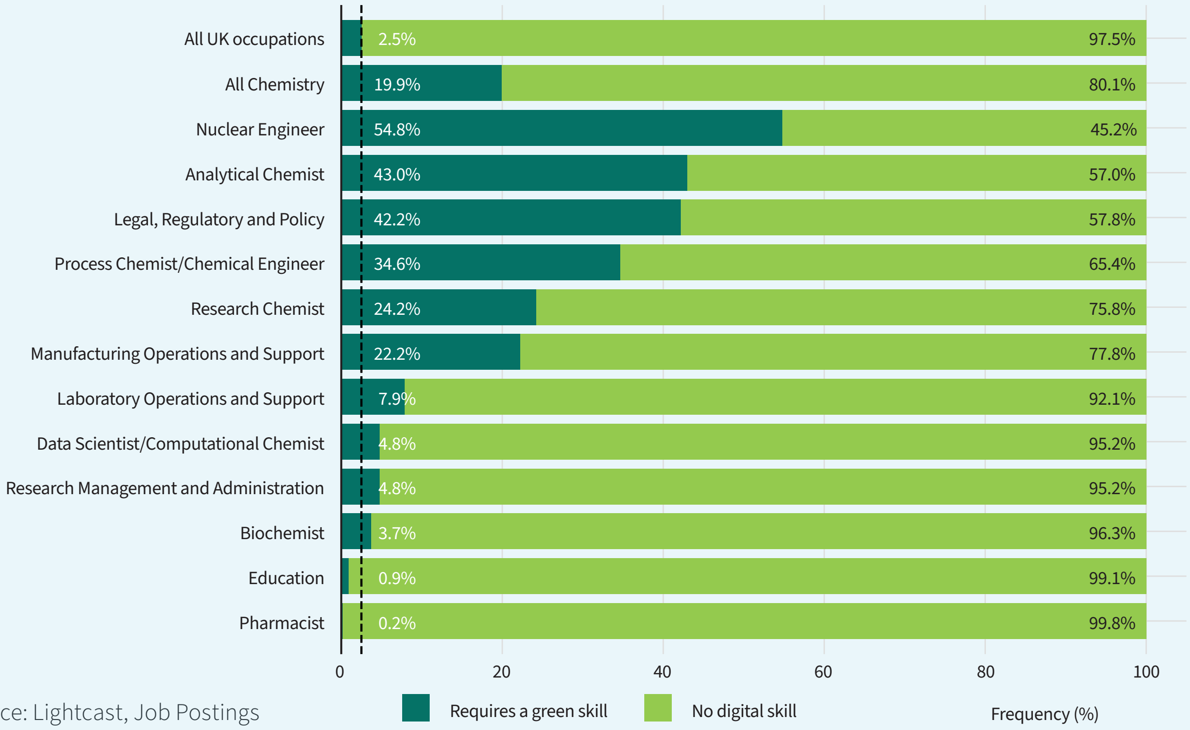
[17] Skills Shortages in the UK Economy (Edge Foundation, 2023), Green shoots part 2 – Sustainability and the chemistry curriculum (RSC, 2022), Skills for a net-zero economy: Insights from employers and young people (WorldSkillsUK, 2022) and Science Horizons: Leading-edge science for sustainable prosperity over the next 10-15 years (RSC, 2019)

Figure 28: Demand for green skills in chemistry job postings and change over time



Share of job postings requiring green skills
Chemistry LOT Groups | UK | Aug 2022 – Jul 2023

Source: Lightcast, Job Postings

Changing prevalence of green skills
Chemistry LOT Groups | UK | Jul 2018-Aug 2019 vs Jul 2022-Aug 2023

Source: Lightcast, Job Postings

Table 12: Most in demand and fastest growing green skills, knowledge and abilities in chemistry job postings overall

Top 10 green skills, knowledge and abilities (frequency)	Top 10 fastest growing green skills, knowledge and abilities (change in frequency)	Top 10 fastest growing green skills, knowledge and abilities (percentage point change)
ISO 14000 Series (3.5%)	Net zero (49,400%)	Environmental resource management (0.87)
Environmental resource management (2.3%)	Electric vehicles (8,950%)	ISO 14000 Series (0.86)
Water treatment (1.9%)	Carbon footprint reduction (421%)	Wastewater (0.61)
Waste management (1.8%)	Water resources (273%)	Environmental laws (0.55)
Environmental laws (1.7%)	Renewable energy (238%)	Net zero (0.55)
Environmental science (1.7%)	Water quality (177%)	Environmental management systems (0.49)
Ecology (1.5%)	Smart meter systems (172%)	Environmental permitting (0.45)
Wastewater (1.3%)	Environmental planning (160%)	Waste management (0.45)
Environmental consulting (1.3%)	Water resource management (120%)	Renewable energy (0.38)
Environmental management systems (1.3%)	Surface water (105%)	Environmental science (0.36)

4.6 Education insights analysis in chemistry occupations

After having looked at the specific skills, knowledge and ability requirements for chemistry jobs, this last section of Chapter 4 focuses on educational requirements and how often they are mentioned by employers in job postings.

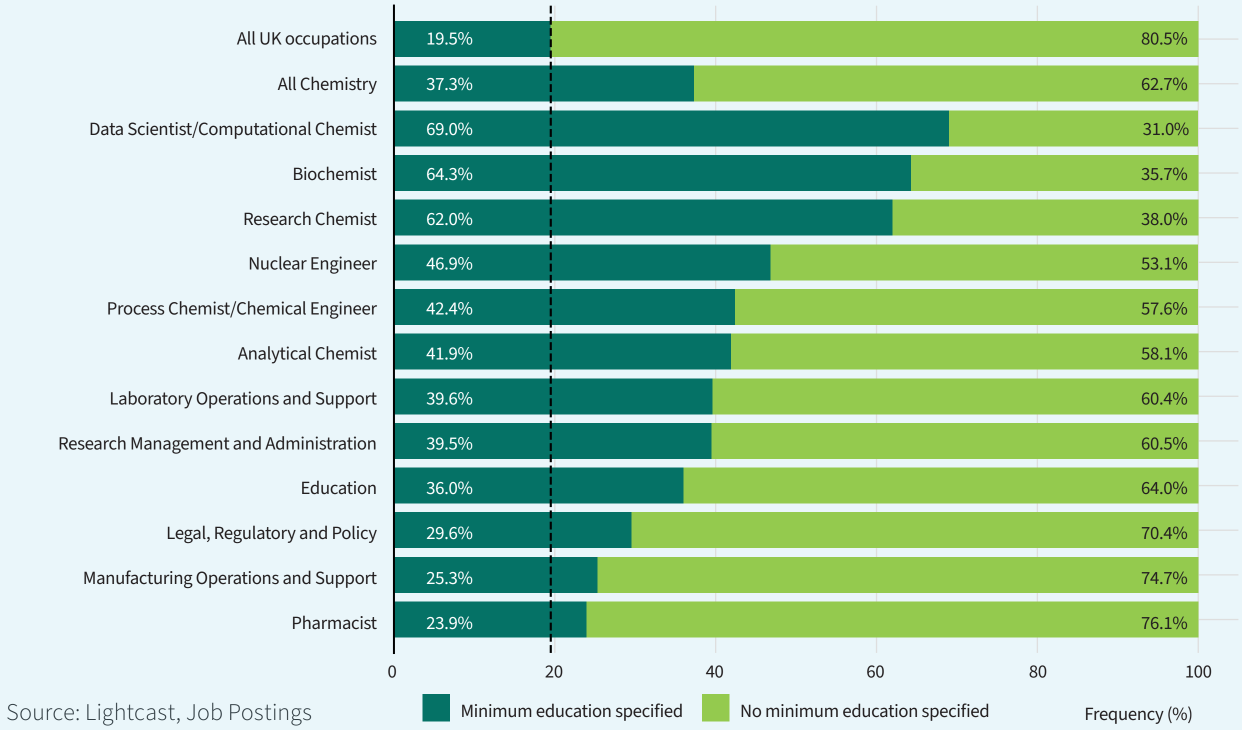
While businesses are increasingly moving towards skill-based hiring, chemistry employers continue to prioritise education qualifications. On average, approximately 37% of chemistry-related job postings between August 2022 and July 2023 required a minimum level of education – almost twice as many as the average for all job postings in the UK's economy (19.5%). This applies to all chemistry occupational groups and in particular to data scientists/computation chemists (70%), research chemists (62%) and biochemists (64%).

On top of that, chemistry job postings are considerably more likely to require high-level qualifications. Of the chemistry job postings specifying a minimum educational requirement, 65% required at least a bachelor's degree or equivalent qualification, and more than 5% required a PhD. With the exception of manufacturing operations and support-related roles, this applies to all chemistry occupation groups. The share of postings requiring at least a bachelor's degree or equivalent qualification increases to over 80% for data scientists/computational chemists, biochemists, research chemists and research management and administration roles.

This is reflective of the highly specialised and knowledge intensive nature of many of these chemistry roles and presents high barriers to entry for those not holding the desired qualification. This, in turn, may present a challenge to recruiting employers as it limits the talent pool to which they have access.

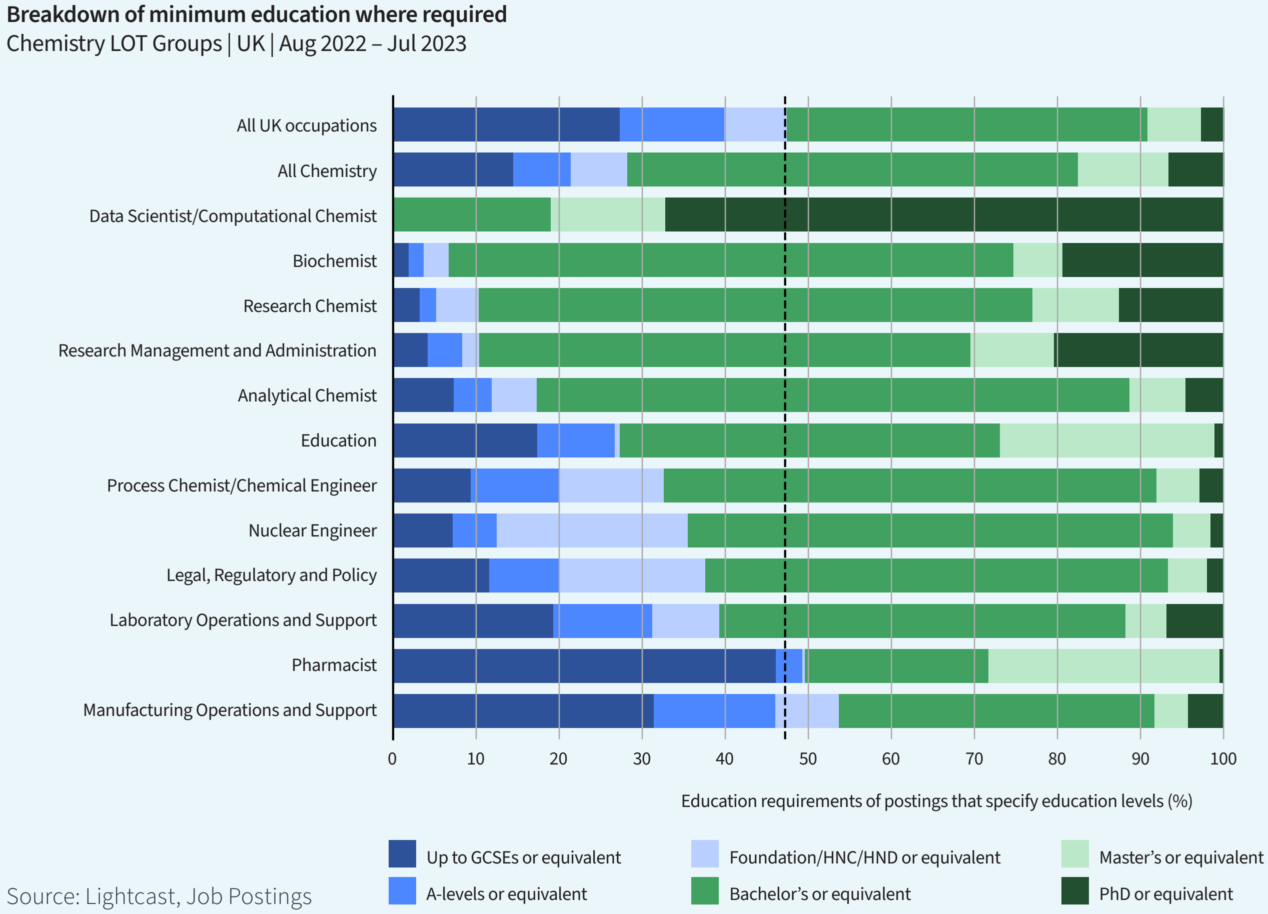
Figure 29a: Education requirements in chemistry job postings

Share of job postings specifying minimum education
Chemistry LOT Groups | UK | Aug 2022 – Jul 2023



Source: Lightcast, Job Postings

Figure 29b: Education requirements in chemistry job postings



Source: Lightcast, Job Postings

Box 3: Chemistry job postings and apprenticeship offerings

Beyond traditional higher education routes, there are some, but limited, vocational pathways to chemistry jobs, such as apprenticeships. Job postings data provide an initial indication of that, as it is possible to isolate job postings specifically advertising for apprenticeship positions. It is important to note however, that apprenticeship positions directly recruited for through education institutes and/or without explicit mention of 'apprenticeships' in the online job ad, would not be captured by this analysis. As such, the findings presented in this box are likely to present a conservative picture of the overall number of apprenticeships offered in the chemistry sector and in the UK economy overall.

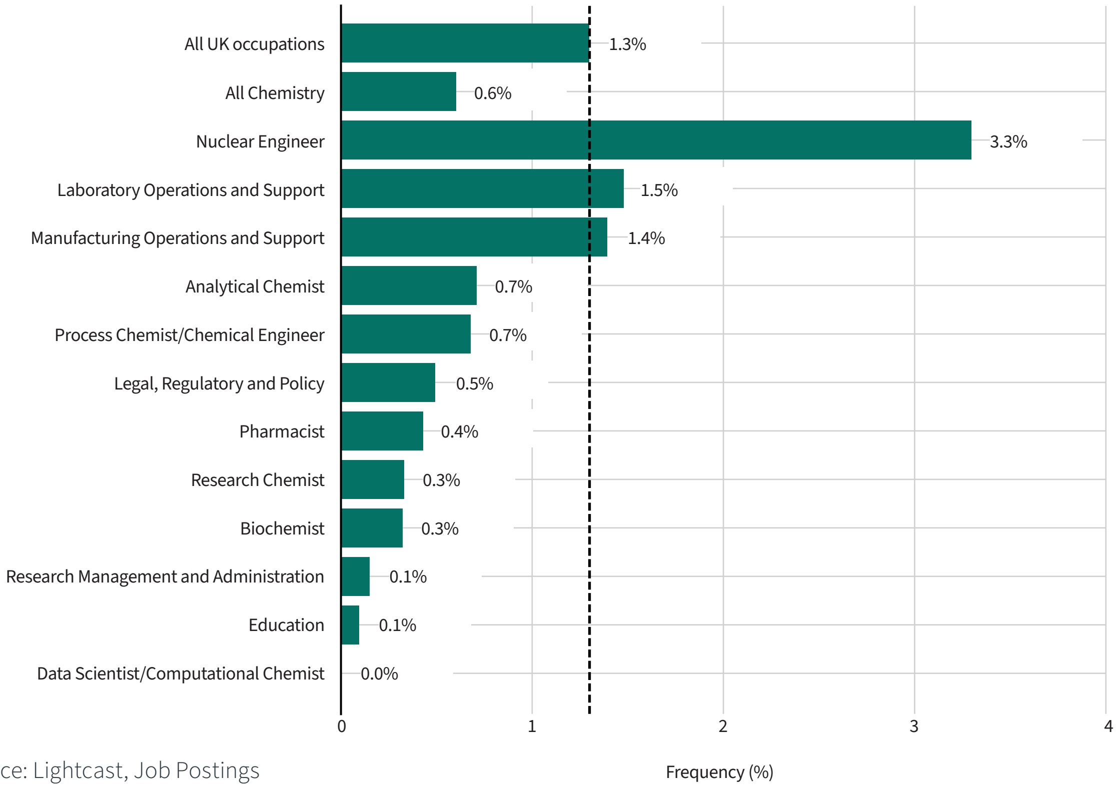
Based on that, approximately 0.6% of all chemistry-related job postings between August 2022 and July 2023 were for apprenticeships, compared to 1.3% in the labour market overall.

The prevalence of apprenticeships, however, varies significantly across chemistry's occupational groups. Nuclear engineering, manufacturing and laboratory operations all have an above-average share of apprenticeship job postings (3.3%, 1.5% and 1.5% respectively).

This highlights the key role that apprenticeships can play, particularly for technicians roles, but also the limited scope they currently play in other parts of the chemistry sector. This is further highlighted by a search specifically carried out for 'degree apprenticeships', which returned less than 60 chemistry-related job postings.

Figure 30: Share of job postings advertised as apprenticeships

Share of postings that are apprenticeships
Chemistry LOT Groups | UK | Aug 2022 – Jul 2023



Source: Lightcast, Job Postings

Chapter 5: Workforce demographics

Summary and key findings

- This chapter investigates the demographics composition of the current chemistry workforce, benchmarked against the wider workforce.
- The insights presented in this chapter are based on the ONS microdata from the Labour Force Survey. To ensure robustness of the sample, the analysis was conducted by combining 12 quarters of data (approximately three years). Because the analysis is based on ONS data, the definition used for chemistry in this chapter focuses on four key chemistry occupations as identified in the SOC2010 classification.
- **Age**: Overall, chemistry occupations tend to have a slightly younger workforce than the average and this is particularly the case for chemical scientists.
- **Sex**: There is great variation in sex representation in chemistry occupations, with chemical scientists and quality assurance technicians being particularly male-dominated.
- **Disability**: Chemistry occupations have a lower share of workers reporting to have a disability compared to the wider workforce (13% compared to 15%).
- **Socio-economic status**: Chemistry occupations are mostly associated with a higher socio-economic status, be that a higher or lower managerial economic status.
- **Ethnicity**: There is great variation in the ethnic composition of different chemistry occupations – ranging from 83% of the workforce being White for biological scientists and biochemists to 90% for quality assurance technicians, against an average for the wider workforce of 86%. One common theme throughout chemistry occupations, however, is the higher representation of Asian workers compared to the wider workforce (10% v 7%) and a lower representation of Black workers (1% v 3%).
- **Education**: Chemistry workers are considerably more likely to hold a degree or equivalent qualification compared to the wider workforce (70% v 40%).

This chapter focuses on the demographic composition of the chemistry-using workforce, benchmarked against the wider UK workforce. The purpose of this analysis is to understand how inclusive the chemistry workforce is on a number of different dimensions, namely age, gender, disability, socio-economic status, ethnicity and educational background.

These insights are essential to help the RSC and its member organisations understand how to recruit and retain a diverse and inclusive workforce. As highlighted in Chapter 2, one of the key challenges for the chemistry sector over the next decade is that of talent shortages. Being able to tap into a diverse and inclusive workforce can help mitigate this challenge as it widens the talent pool. Furthermore, there is growing evidence on the positive impact of diversity on business productivity,[18] and recent findings from the latest Pay and Reward Survey suggests that feeling that an organisation is diverse and inclusive promotes employee retention.[19]

5.0 Methodology and definitions

Despite the critical importance of diversity and inclusion in the workplace, there are significant limitations in data availability on the demographics profile of different occupations.

The key source for demographics insights by occupation in the UK is the Office for National Statistics Labour Force Survey (LFS) microdata. However, its survey nature means the quality of its insights are not granular enough to conduct this type of analysis at a quarterly level. To overcome this challenge and ensure the robustness of the sample, the insights presented in this chapter were therefore produced by combining 12 quarters of data, three years, from 2020 to 2022. This ensures reliability of findings but comes at the cost of being able to track meaningful changes over time.

Another limitation of the Labour Force Survey (LFS) is related to the way questions are set out and variables derived. This particularly affects the analysis presented in this research in relation to sex, disability and socio-economic status as set out in more detail in the relevant sections of this chapter.

Throughout the chapter, results are presented at a chemistry-wide occupational level, benchmarked to the UK-wide workforce, and, where sample size allows, broken down by individual chemistry-using occupations. The chemistry-using occupations selected for this part of the analysis are the SOC2010 best match to the core chemistry SOC2020 occupations identified in Chapter 2, namely:

- Chemical scientists (SOC2010 code 2111)
- Biological scientists & biochemists (SOC2010 code 2112)
- Laboratory technicians (SOC2010 code 3111)
- Quality assurance technicians (SOC2010 code 3115).

The use of SOC2010 occupations for this part of the analysis rather than SOC2020 occupations was necessary due to the ONS only starting to report findings from the LFS with SOC2020 from 2022.

Demographics data in relation to chemistry higher education workers is also presented in this chapter. This comes from the Higher Education Statistics Agency (HESA) dataset and it is presented in a separate box as findings are not comparable across the two different data sources.

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[18] Saxena A. (2014) 'Workforce Diversity: a key to improved productivity', Procedia Economics and Finance, Volume 11 https://doi.org/10.1016/S2212-5671(14)00178-6

[19] https://www.rsc.org/careers/whatchemistsearn/

5.1 Sex and age

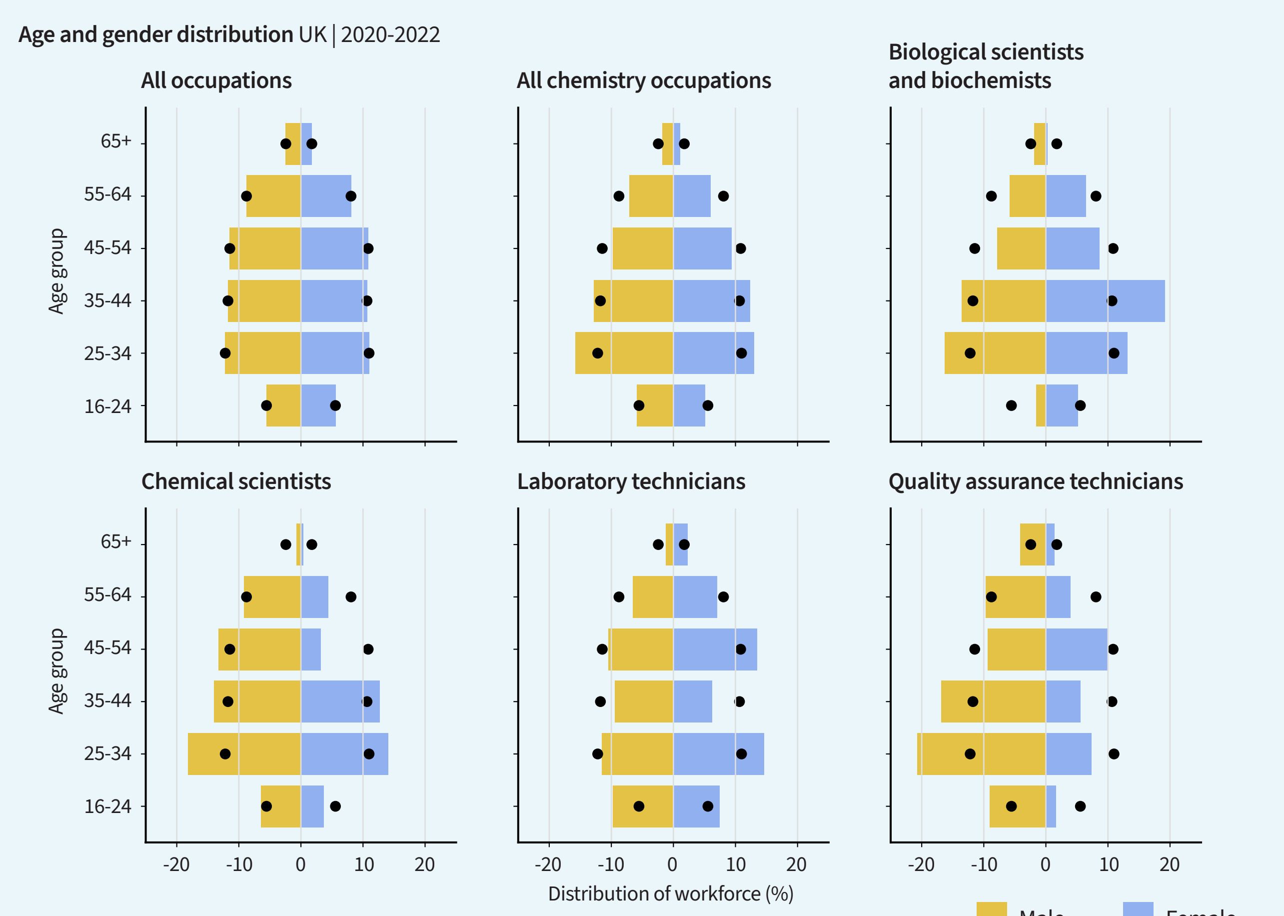
Two specific questions from the LFS survey were used for analysing the sex and age of the chemistry using profession. In terms of sex, the question asked focuses on the current sex of the respondent and only offers a binary choice between 'male' and 'female'. This is a significant limitation of the dataset, as it means it is not possible to isolate non-binary workers. In terms of age, respondents are asked to provide their age and responses have been aggregated into six groups: 16-24 years old, 25-34, 35-44, 45-54, 55-64 and 65+. The data have then been presented using a population pyramid style of analysis, combining age and gender. Each pyramid represents a different occupation or group of occupations, with the dots showing levels for the UK wide workforce as benchmark.

Overall, chemistry occupations tend to have a slightly younger workforce profile than the average, both in the 16-24 and the 25-34 years old age groups. This is particularly the case for chemical scientists.

In contrast, in terms of sex, there is great variation across the specific chemistry-using occupations. In aggregate, the sex profile of the chemistry using workforce is only slightly more male-dominated than the UK-wide workforce (53% v 52%). However, this hides significant variations: on one hand, quality assurance technicians and chemical scientists are particularly male-dominated occupations (70% and 62% respectively), while biological scientists & biochemists and laboratory technicians actually have a higher proportion of female workers than male workers (53% and 51% respectively).

Combining age and sex reveals further peculiarities of different chemistry occupations. Biological scientists & biochemists for example have an above-average representation of female workers aged 35-44 years old. In contrast, chemical scientists and quality assurance technicians are skewed towards 25-34 years old male workers.

Figure 31: Age and Sex distribution



Source: ONS, Labour Force Survey, 12 quarters and Lightcast calculations

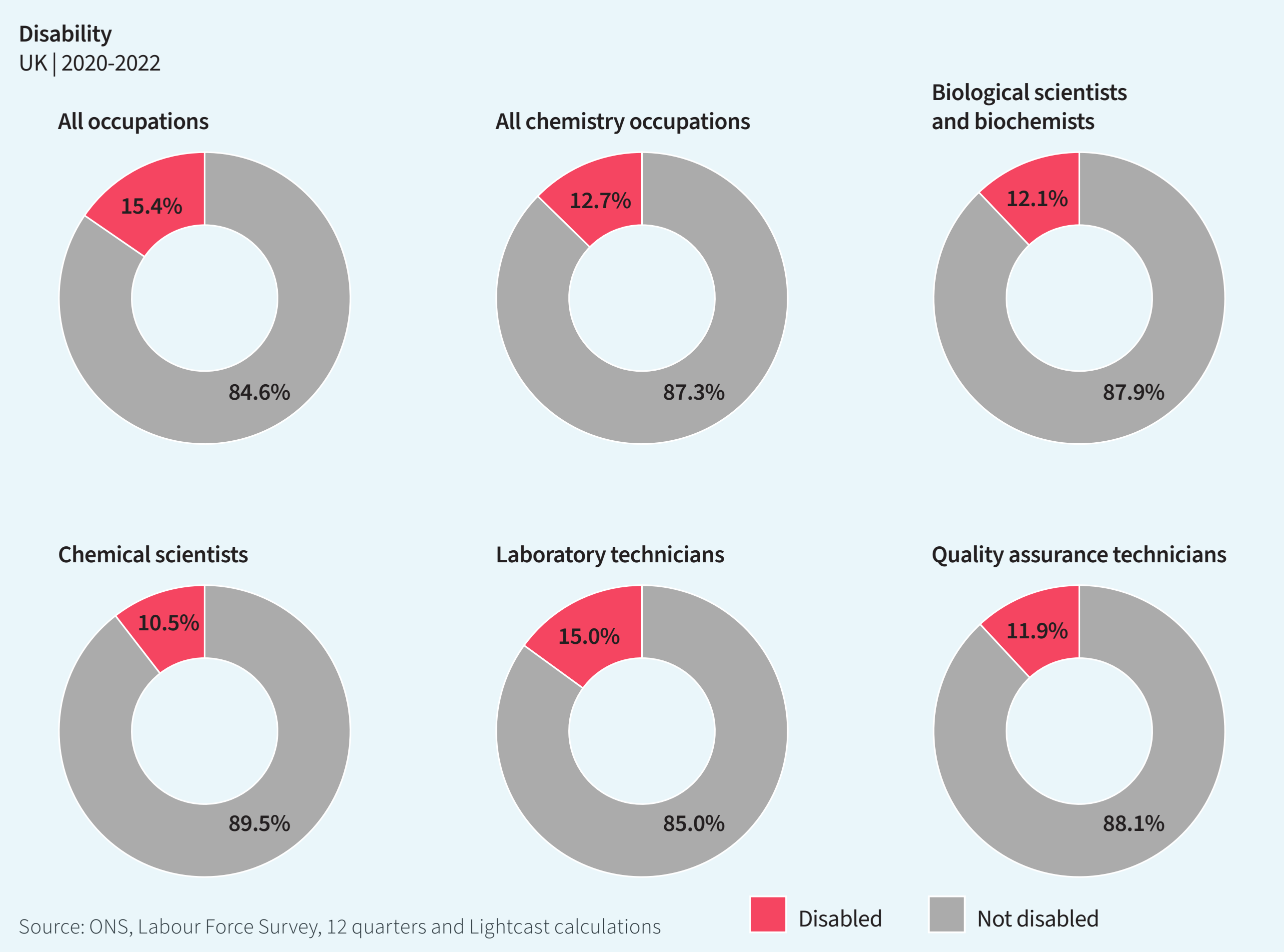
5.2 Disability

The data on disability presented in this section is based on the LFS question which records whether the respondent considers themselves to have a disability under the Equality Act definition.

On average, workers in chemistry occupations are 18% less likely to report having a disability compared to the wider workforce (13% compared to 15%). All chemistry occupations have below average representation of people with disabilities, with chemical scientists having the lowest share of all (10.5%).

When interpreting these results however, it is worth noting that the definition of disability used in the LFS is both broad and subjective. Furthermore, the RSC Member Survey shows that language makes a great difference to disability disclosure, with respondents more likely to disclose a disability when asked whether they experience barriers or limitations in their daily activities because of any form of disability, long-term health condition or impairment.[20]

Figure 32: Share of workers having a disability



Source: ONS, Labour Force Survey, 12 quarters and Lightcast calculations

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[20] https://www.rsc.org/globalassets/02-about-us/corporate-information/our-diversity-data/rsc-diversity-data-report-2022.pdf

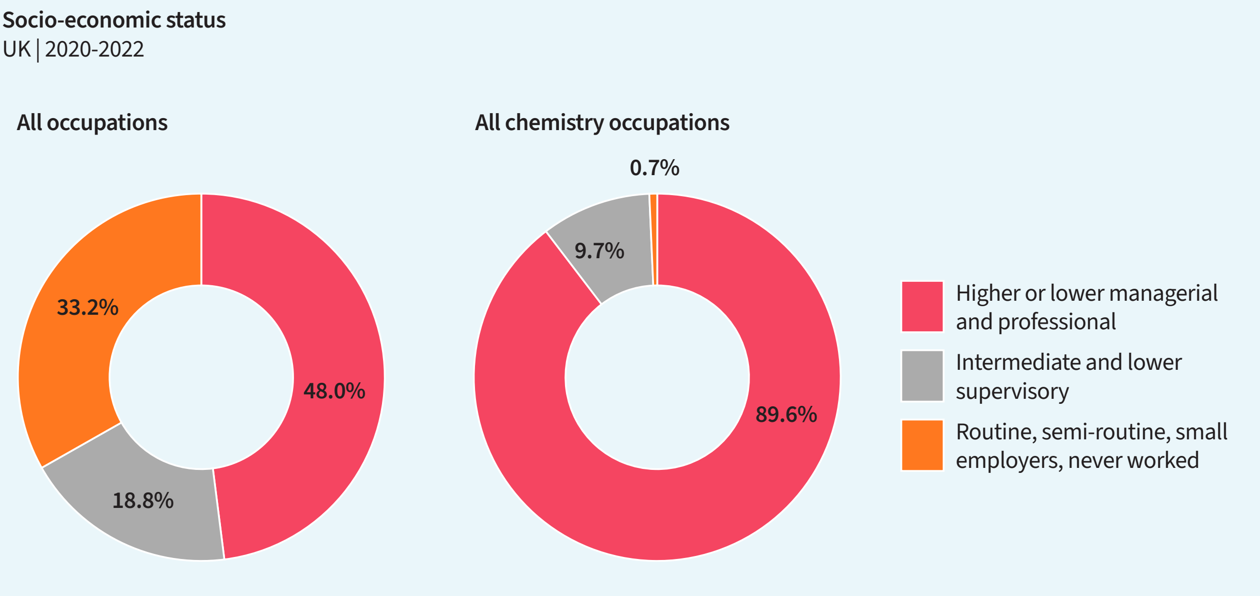
5.3 Socio-economic status

The National Statistics Socio-Economic Classification (NS-SEC) is a derived variable in the Labour Force Survey, built on a combination of information on the occupation of the respondent (SOC2010 code), their employment status (employed, self-employed, business owner) and the size of the organisation they work for. Eight different categories are available in the original version of the NS-SEC variable, namely: higher managerial & professional, lower managerial & professional, intermediate occupations, small employers and own account workers, lower supervisory & technical, semi-routine occupations, routine occupations, and students, people who have never worked or are long-term unemployed. For the purpose of this analysis, these have then been further merged into three broader categories, namely: (1) higher or lower managerial and professional, (2) intermediate and lower supervisory, and (3) routine, semi-routine, small employers and never worked, students and unemployed, to overcome data disclosure challenges in relation to chemistry occupations.

The reason behind this aggregation is that, because of the way the data are built, workers in chemistry occupations are predominantly (90%) by default associated with a higher or lower managerial and professional socio-economic status. This compares to an average of 48% for the UK-wide workforce. Albeit to different extents, this applies to all chemistry occupations and, to avoid disclosure challenges, the data were therefore only presented at an aggregated level with all chemistry occupations grouped together.

While these insights point towards people working in chemistry occupations predominantly being associated with a higher socio-economic status, this tells little about the family background of the people working in the chemistry workforce. This is a significant limitation of the data as it does not help answer questions about social mobility and/or diversity in backgrounds of the chemistry workforce.

Figure 33: Breakdown by socio-economic status



Source: ONS, Labour Force Survey, 12 quarters and Lightcast calculations

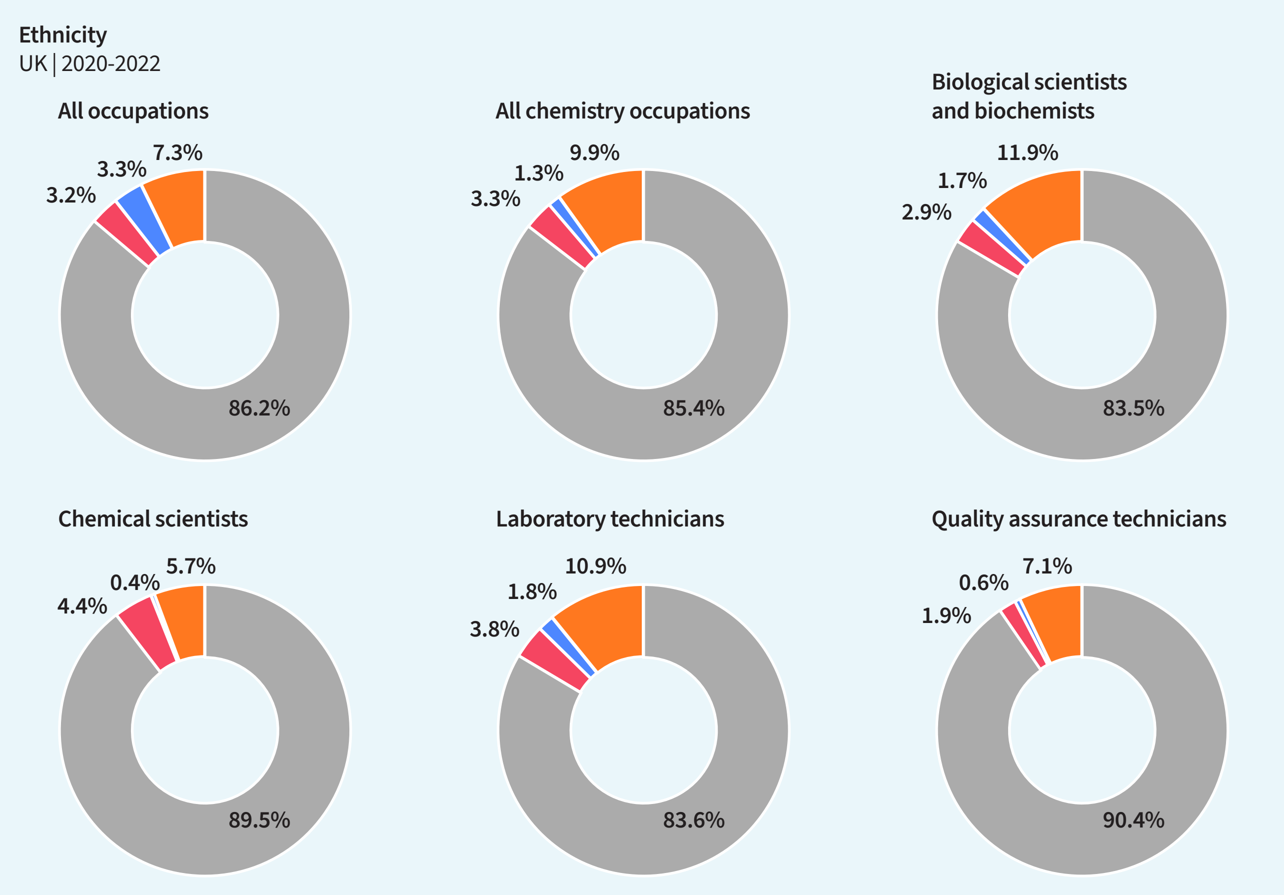
5.4 Ethnicity

The ethnicity variable of the LFS classifies respondents into nine groups: White, Mixed/Multiple ethnic groups, Indian, Pakistani, Bangladeshi, Chinese, any other Asian background, Black/African/Caribbean/Black British, and any other ethnic group. Due to low numbers, these categories have been merged into three broad categories to draw meaningful conclusions from the data. Therefore, for the chemistry workforce overall and for each individual chemistry occupation, results are presented using four ethnic groups: White, Asian (which includes Indian, Pakistani, Bangladeshi, Chinese and any other Asian background), Black (shortened name for Black/African/Caribbean/Black British), and Mixed & Other.

On average, chemistry occupations appear to have a similar share of workers who are White as the wider workforce (85% v 86%), however, this hides considerable variations across individual occupations. For example, while 84% of biological scientists & biochemists, and laboratory technicians are White, 90% for chemical scientists and quality assurance technicians are.

In terms of workers from minority ethnic backgrounds, all chemistry occupations have a below average representation of Black workers and most have an above-average representation of Asian workers. While 3% of the UK wide workforce is Black, Black workers only account for 1% of the chemistry workforce and for only 0.4% and 0.6% of the chemical scientists and quality assurance technicians workforce. In contrast, Asian workers are more likely to be represented in the chemistry workforce than the UK-wide workforce (10% v 7%) and this is particularly the case for biological scientists & biochemists as well as laboratory technicians, where Asian workers account respectively for 12% and 11% of the workforce.

Figure 34: Ethnicity distribution of the chemistry workforce



Source: ONS, Labour Force Survey, 12 quarters and Lightcast calculations

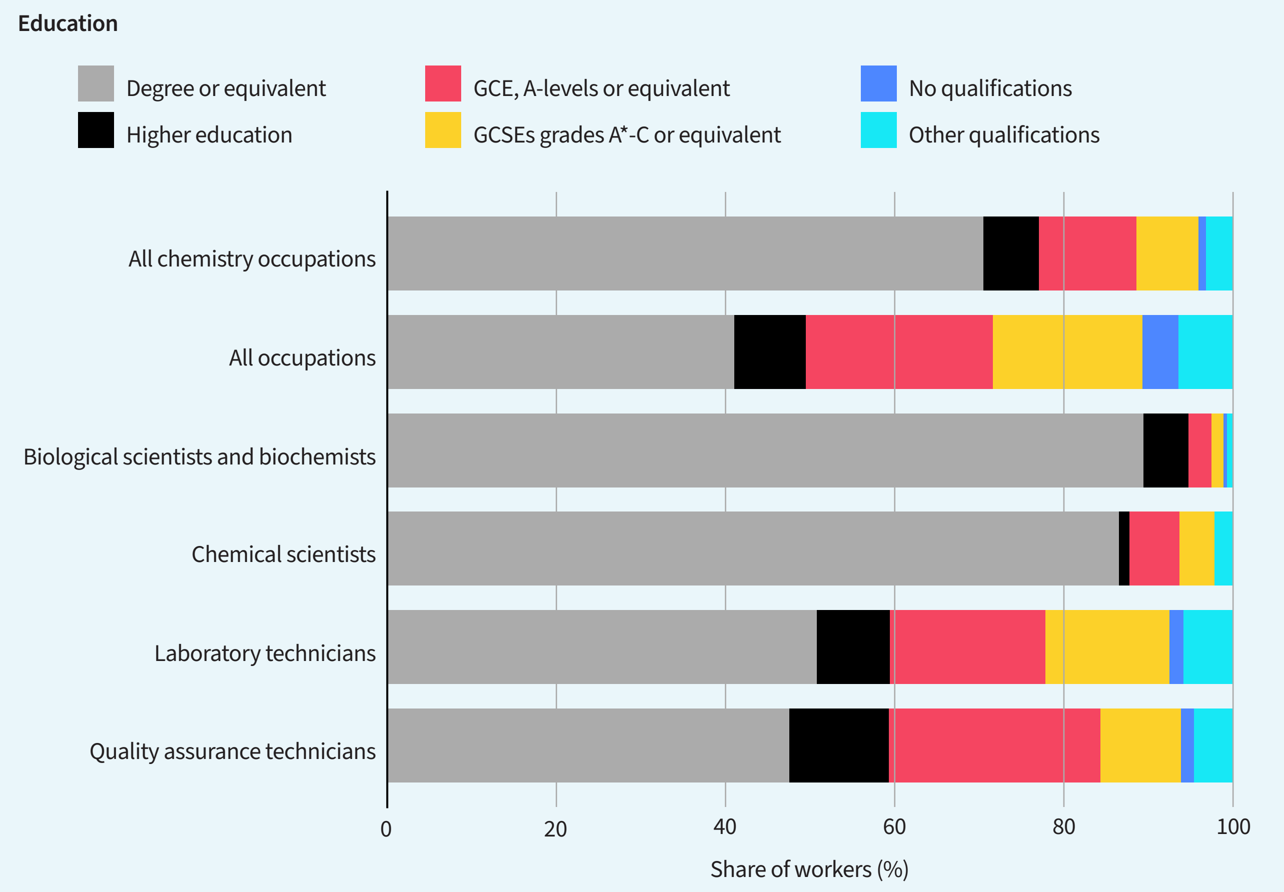
5.5 Education qualifications

The Labour Force Survey also collects information about the educational qualifications held by respondents. Respondents are grouped into six categories: not holding any qualifications, having a GCSEs grades A*-C or equivalent, holding GCE, A-levels or equivalent qualifications, holding a higher education qualification, a degree or equivalent qualification and above, or other qualifications.

On average, chemistry workers are 75% more likely to hold a degree or equivalent qualification than the wider workforce. Approximately 70% of the chemistry workforce holds a degree or equivalent qualification. This is compared to a 40% average for the UK workforce. Biological scientists & biochemists, as well as chemical scientists have a particularly high share of workers with a degree or equivalent qualification (90% and 87% respectively). In contrast, quality assurance technicians are the chemistry-related occupation with the lowest share of workers holding a degree or equivalent qualification – though this is still above the UK-wide workforce average.

These findings present an even more pronounced inclination towards educational requirements than those shown in Chapter 4 based on employers requirements mentioned in job postings. This once again stresses the key role that higher education plays in the chemistry world and the barrier to entry it presents for those without these levels of qualifications.

Figure 35: Education profile of the chemistry workforce



Source: ONS, Labour Force Survey, 12 quarters and Lightcast calculations

Box 4: Higher education demographics

This box focuses on the demographics profile of chemistry higher education workers by using data from the Higher Education Statistics Agency (HESA). The use of this dataset rather than the LFS was made necessary by the fact that the LFS reports insights by SOC occupations only and therefore it was not possible to isolate chemistry-specific higher education workers.

While the HESA data allow for the split of workers by subject (cost-centre) area, it is also important to note that the findings from this box are not comparable with the other results presented in this chapter.

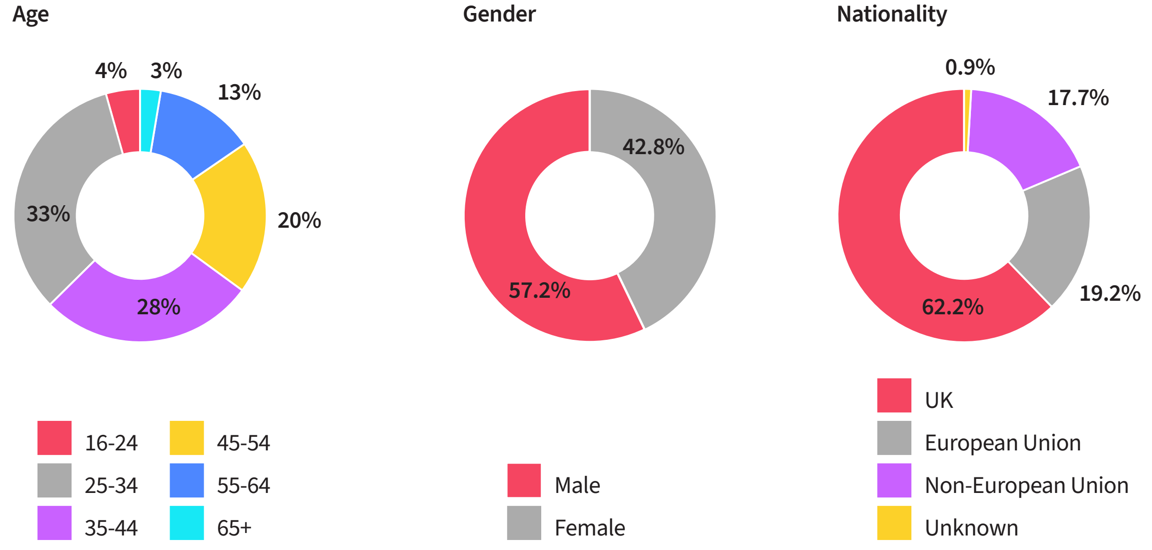
Overall, chemistry workers in higher education tend to be male, younger and of UK nationality. This is particularly the case for the core specialist chemistry higher education roles, where 69% of the workforce is male – compared to 57% in subjects more widely related to science and chemistry – and their age profile is even younger. While these trends may partly reflect wider trends across the academic world, these findings may also possibly be a reflection of a mismatch with the labour market, with the number of students completing PhD and postdoc studies being higher than the numbers of available jobs for this cohort.

In terms of nationality, while chemistry-related higher education professionals are predominantly UK nationals (62%), chemistry has an above-average representation of overseas workers than the wider higher education workforce (38% v 33%).

These findings complement findings from previous research by the RSC on the ethnicity breakdown of the chemistry-related higher education workforce and on disability.[21]

Figure 36: Demographics of all chemistry-related higher education workers

All chemistry-related higher education jobs
UK | 27,700 jobs | 2022



Source: HESA staff count

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[21] https://www.rsc.org/globalassets/22-new-perspectives/talent/racial-and-ethnic-inequalities-in-the-chemical-sciences/missing-elements-report.pdf and https://www.rsc.org/policy-evidence-campaigns/inclusion-diversity/surveys-reports-campaigns/disability-in-the-chemical-sciences/#who-identifies

Chapter 6: Conclusions

As the world of work continues to undergo unprecedented changes, from shifts in the macroeconomy and technological advancements, to new policy investments and the green transition, it is essential the chemistry profession stay abreast of these changes.

By combining data from official statistics with big data from online job postings, this report provides a mostly quantitative starting point of view for a comprehensive examination of the present state and future trajectories of the chemistry sector in the UK.

The authors found that there are significant data gaps in official statistics required to allow for a complete analysis of the changing nature of the chemistry sector. Data lags and lack of granularity mean official statistics provide only a partial picture of how the chemistry workforce is evolving. For example, using official statistics, the number of jobs counted for as part of the chemistry workforce varies significantly depending on the definition adopted – from a core of 70,000 chemistry jobs in core chemistry occupations in chemistry-centred industries to over 1.9 million jobs when accounting for other jobs within chemistry-centred industries and other core chemistry jobs outside chemistry-centred industries.

Despite these limitations, by combining these official statistics with the Lightcast projections model and a detailed literature review, it is possible to identify emerging trends that are likely to affect the chemistry workforce over the next decade. In particular, this analysis, which serves as the starting point for future discussions, finds that the chemistry workforce is projected to grow in coming years, but it is likely the type of chemistry jobs will change. The exact extent of these changes may vary and it is being shaped by current and future policy developments and investment decisions. Furthermore, while the analysis points towards growth for the chemistry workforce, the literature review highlights access to talent and skills as potential barriers to this growth. These too are being shaped by current decisions, meaning the findings from this research now need to be further contextualised within recent and future policy developments.

To further understand the changing nature of the chemistry workforce, this paper complemented these insights from official statistics with big data from online job postings. This is a dataset of over 80 million job postings collected in the UK since 2012, offering the richest and most granular dataset to date on employers' needs. With this dataset, it was possible to identify the specific chemistry roles employers are currently recruiting for, trends over time, location of recruitment, advertised salary and specific skills and education needs. Through this analysis, it was possible to identify five key trends in skills and education requirements for the chemistry workforce, including providing an experimental analysis on green chemistry jobs while the sector awaits for an official definition on green jobs from the UK Government. The findings from this analysis serve as the starting point to inform discussions around policy development and adjust current education and training provision to align to employers' needs.

While the analysis of job postings data presents an improvement to current research to date, offering clear insights on current and emerging skills needs, it is worth highlighting that the quality of the data presented in this research is as good as the information employers explicitly provide in online job postings. This means that implicit skills, knowledge and abilities, such as those inherently linked to a specific occupation, may be overlooked. This suggests that the findings presented in this research present a clear picture of employers' most pressing skill and education needs, but need to be complemented with insights on the implicit skills, knowledge and abilities employers require for specific jobs.

Lastly, this report provides an initial analysis on the demographics of the chemistry workforce by using the Labour Force Survey microdata. The Labour Force Survey is the main official data source for this type of analysis, and offers the opportunity to provide an initial picture of the demographics of the sector by focusing on groups of occupations and/or major demographic categories, and providing a current snapshot of the workforce. However, due to its sample size and the way the data is collected, the data currently available on demographics does not allow for in depth analysis nor for tracking changes over time – significant limitations the ONS should be looking to overcome with future reiterations of the Survey.

The findings from this report serve as the starting point for conversations among key stakeholders of the Royal Society of Chemistry of what these changes mean in practice in terms of education and policy decisions. A discussion of the data with stakeholders across the chemical sciences community will allow for the identification of the key policy implications from the research, bringing together educators, policymakers and industry leaders to collaboratively shape a future where the chemistry sector continues to innovate, thrive, and contribute significantly to societal progress.

Annex 1: Skills factsheets for each of the 12 chemistry occupation groups

ROYAL SOCIETY OF CHEMISTRY

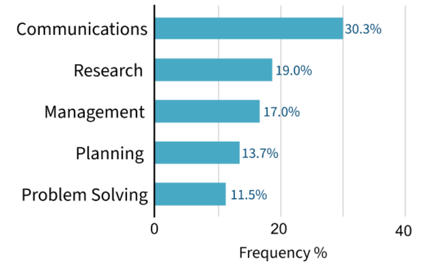
Skills Snapshot:

Research Chemist

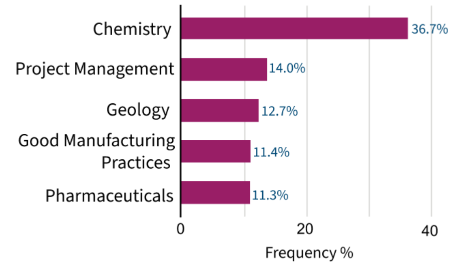
This factsheet provides a snapshot of the current skills, knowledge and abilities most frequently mentioned in job postings related to chemistry jobs in the Research Chemist group between August 2022 and July 2023 in the UK. Skills, knowledge and abilities are organised in six key themes: common or transferable, specialised, digital, green, general chemistry, and field-specific chemistry.

The Lightcast Skills Taxonomy was used for the production of this factsheet. All the details on the methodology can be found in the accompanying data report for the RSC's Future Workforce and Educational Pathways project.

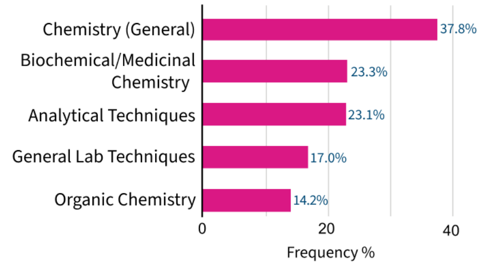
Common Skills



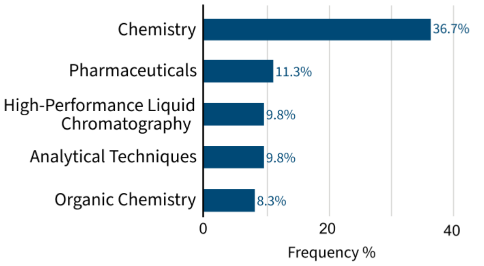
Specialised Skills



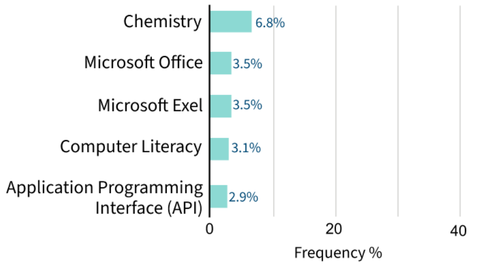
Chemistry Skill Clusters



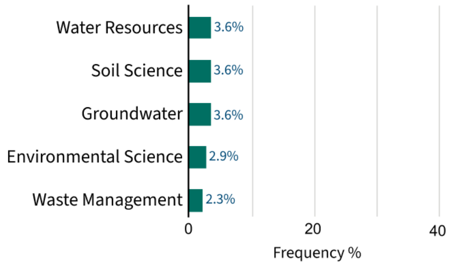
Core Chemistry Skills



Digital Skills



Green Skills



Source: Lightcast Job Postings

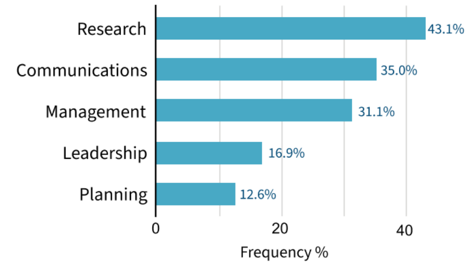
ROYAL SOCIETY OF **CHEMISTRY**

Skills Snapshot: Research Administration and Management

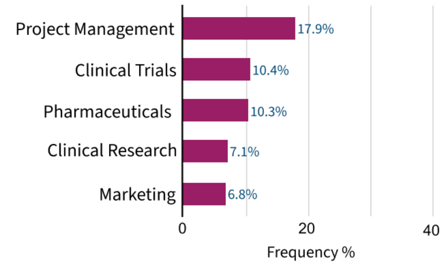
This factsheet provides a snapshot of the current skills, knowledge and abilities most frequently mentioned in job postings related to chemistry jobs in the Research Administration and Management group between August 2022 and July 2023 in the UK. Skills, knowledge and abilities are organised in six key themes: common or transferable, specialised, digital, green, general chemistry, and field-specific chemistry.

The Lightcast Skills Taxonomy was used for the production of this factsheet. All the details on the methodology can be found in the accompanying data report for the RSC's Future Workforce and Educational Pathways project.

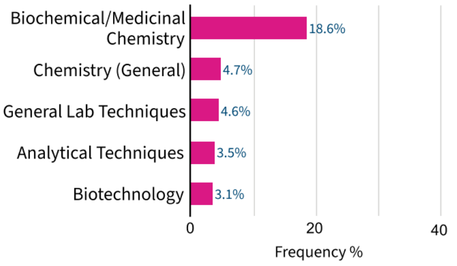
Common Skills



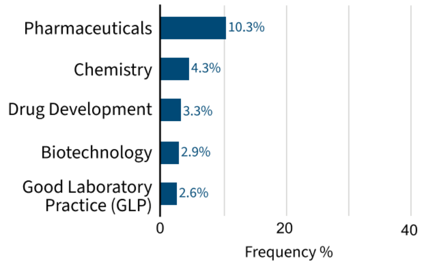
Specialised Skills



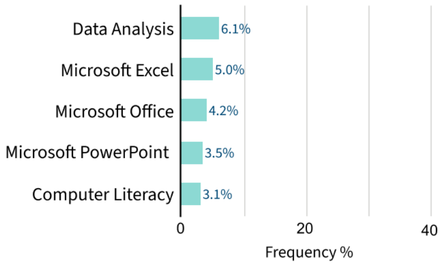
Chemistry Skill Clusters



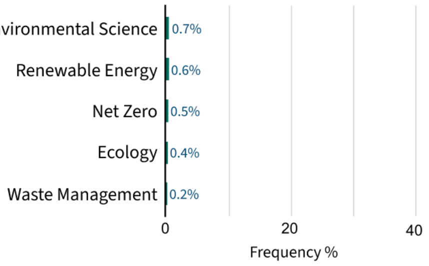
Core Chemistry Skills



Digital Skills



Green Skills



Source: Lightcast Job Postings

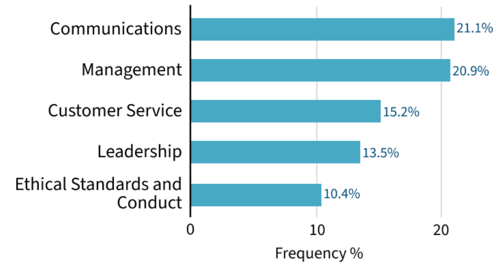
ROYAL SOCIETY
OF **CHEMISTRY**

Skills Snapshot:
Pharmacist

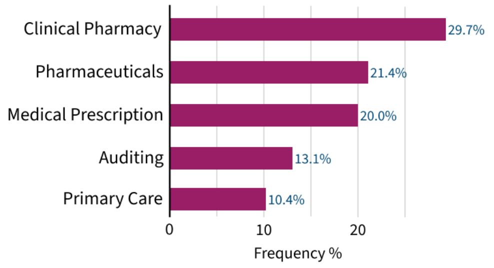
This factsheet provides a snapshot of the current skills, knowledge and abilities most frequently mentioned in job postings related to chemistry jobs in the Pharmacist group between August 2022 and July 2023 in the UK. Skills, knowledge and abilities are organised in six key themes: common or transferable, specialised, digital, green, general chemistry, and field-specific chemistry.

The Lightcast Skills Taxonomy was used for the production of this factsheet. All the details on the methodology can be found in the accompanying data report for the RSC's Future Workforce and Educational Pathways project.

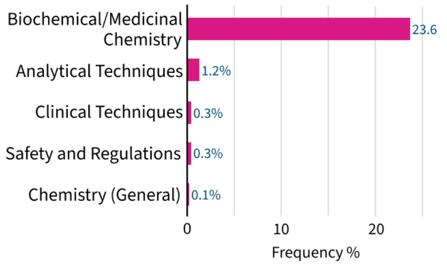
Common Skills



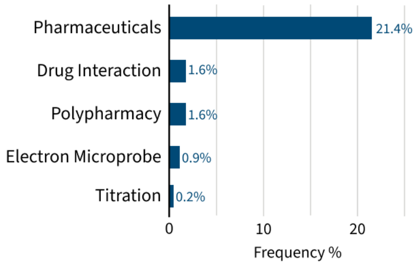
Specialised Skills



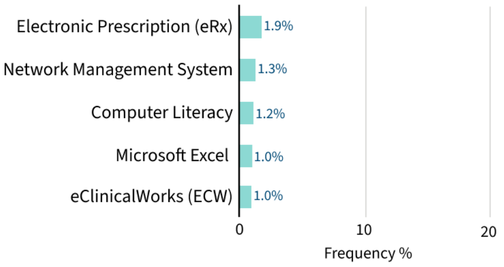
Chemistry Skill Clusters



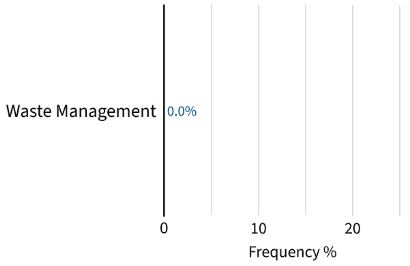
Core Chemistry Skills



Digital Skills



Green Skills



Source: Lightcast Job Postings

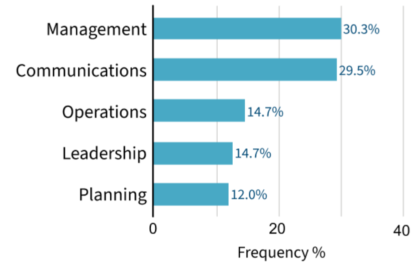
ROYAL SOCIETY
OF **CHEMISTRY**

Skills Snapshot:
Nuclear Engineer

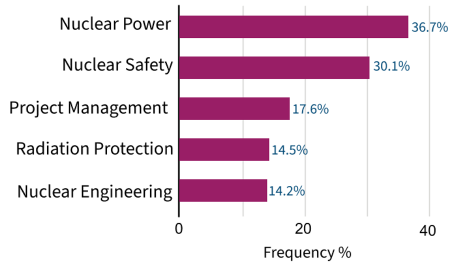
This factsheet provides a snapshot of the current skills, knowledge and abilities most frequently mentioned in job postings related to chemistry jobs in the Nuclear Engineer group between August 2022 and July 2023 in the UK. Skills, knowledge and abilities are organised in six key themes: common or transferable, specialised, digital, green, general chemistry, and field-specific chemistry.

The Lightcast Skills Taxonomy was used for the production of this factsheet. All the details on the methodology can be found in the accompanying data report for the RSC's Future Workforce and Educational Pathways project.

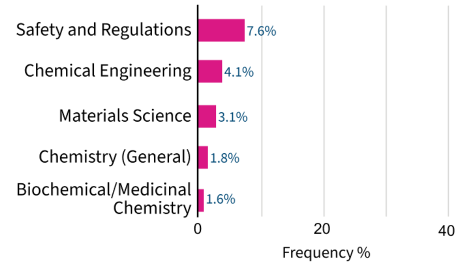
Common Skills



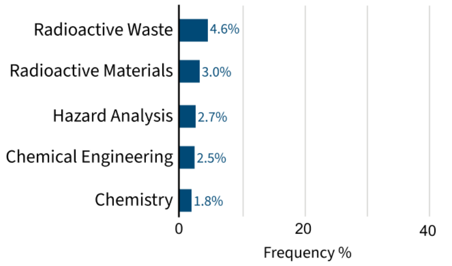
Specialised Skills



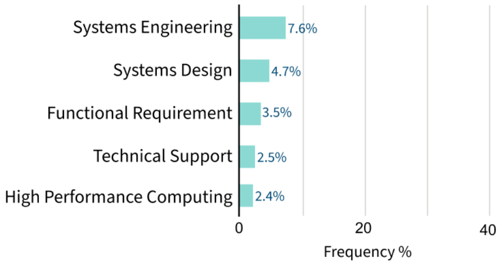
Chemistry Skill Clusters



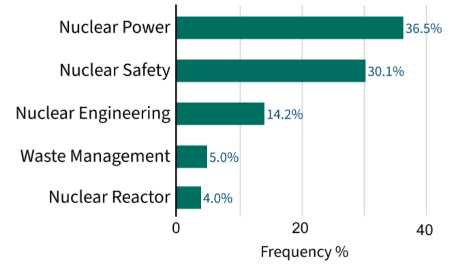
Core Chemistry Skills



Digital Skills



Green Skills



Source: Lightcast Job Postings

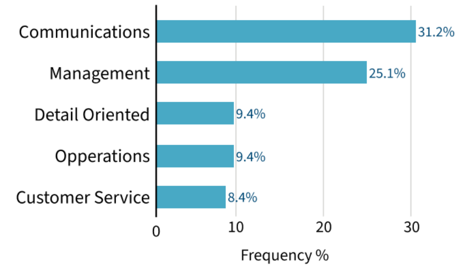
ROYAL SOCIETY
OF **CHEMISTRY**

Skills Snapshot: Manufacturing Operations and Support

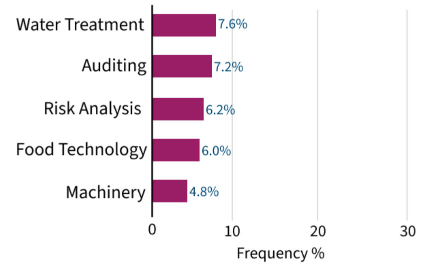
This factsheet provides a snapshot of the current skills, knowledge and abilities most frequently mentioned in job postings related to chemistry jobs in the Manufacturing Operations and Support group between August 2022 and July 2023 in the UK. Skills, knowledge and abilities are organised in six key themes: common or transferable, specialised, digital, green, general chemistry, and field-specific chemistry.

The Lightcast Skills Taxonomy was used for the production of this factsheet. All the details on the methodology can be found in the accompanying data report for the RSC's Future Workforce and Educational Pathways project.

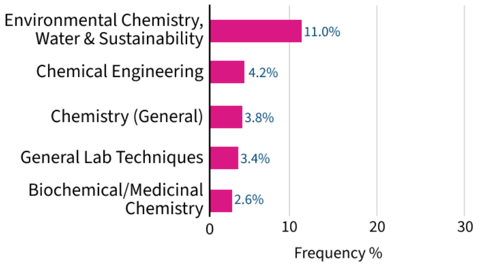
Common Skills



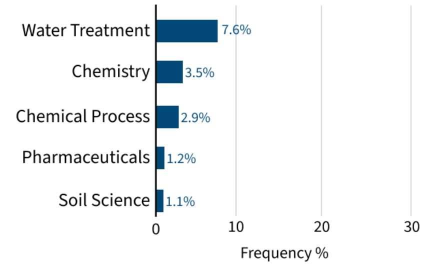
Specialised Skills



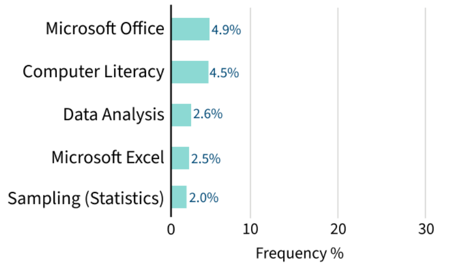
Chemistry Skill Clusters



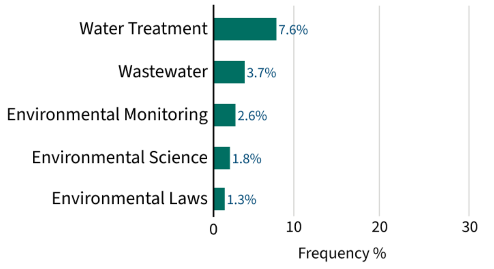
Core Chemistry Skills



Digital Skills



Green Skills



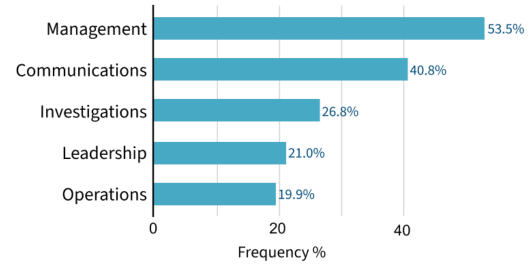
Source: Lightcast Job Postings

Skills Snapshot:
Legal Regulatory and Policy

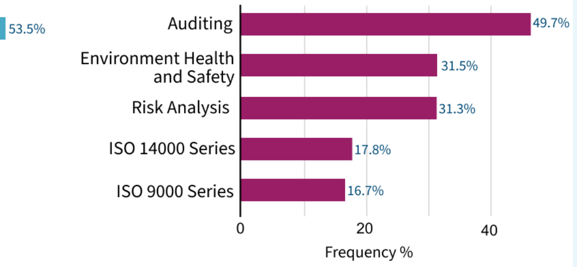
This factsheet provides a snapshot of the current skills, knowledge and abilities most frequently mentioned in job postings related to chemistry jobs in the Legal Regulatory and Policy and Support group between August 2022 and July 2023 in the UK. Skills, knowledge and abilities are organised in six key themes: common or transferable, specialised, digital, green, general chemistry, and field-specific chemistry.

The Lightcast Skills Taxonomy was used for the production of this factsheet. All the details on the methodology can be found in the accompanying data report for the RSC's Future Workforce and Educational Pathways project.

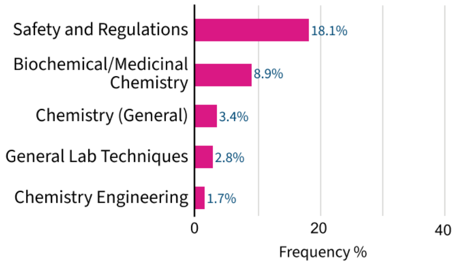
Common Skills



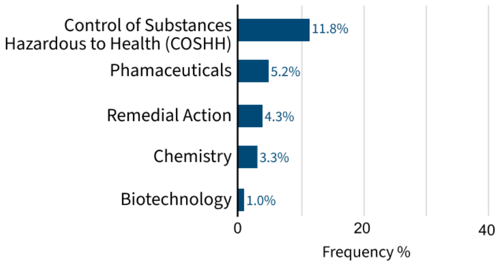
Specialised Skills



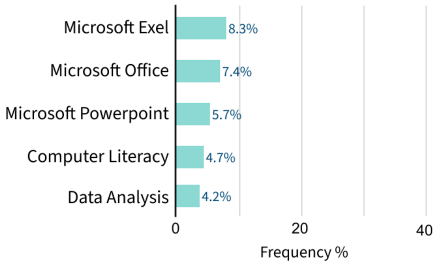
Chemistry Skill Clusters



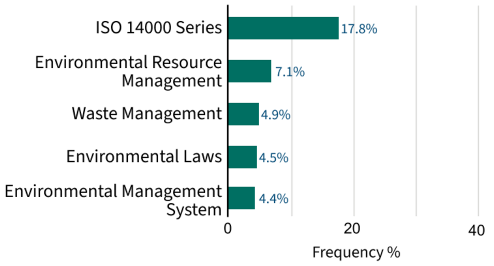
Core Chemistry Skills



Digital Skills



Green Skills



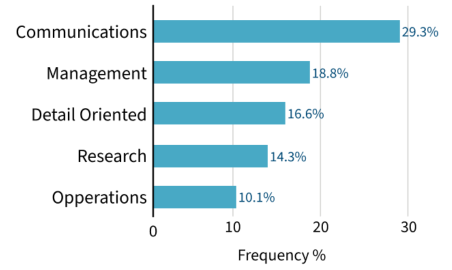
Source: Lightcast Job Postings

Skills Snapshot:
Laboratory Operations and Support

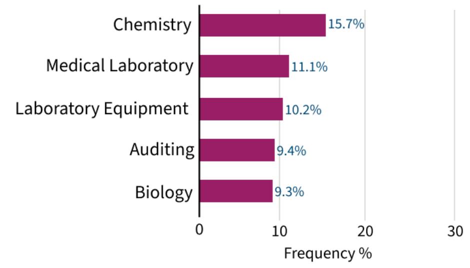
This factsheet provides a snapshot of the current skills, knowledge and abilities most frequently mentioned in job postings related to chemistry jobs in the Laboratory Operations and Support group between August 2022 and July 2023 in the UK. Skills, knowledge and abilities are organised in six key themes: common or transferable, specialised, digital, green, general chemistry, and field-specific chemistry.

The Lightcast Skills Taxonomy was used for the production of this factsheet. All the details on the methodology can be found in the accompanying data report for the RSC's Future Workforce and Educational Pathways project. .

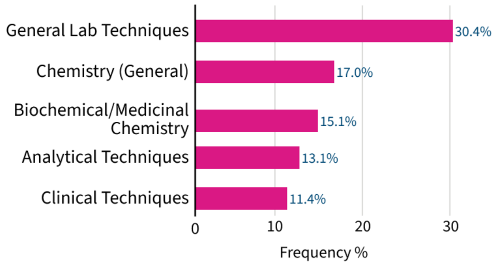
Common Skills



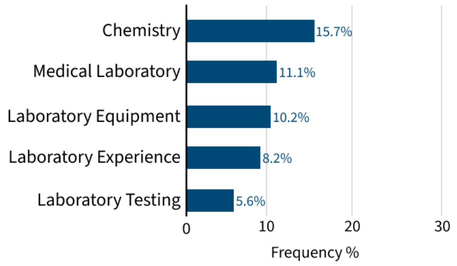
Specialised Skills



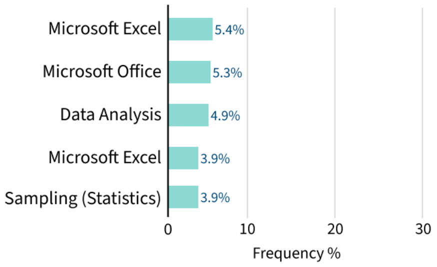
Chemistry Skill Clusters



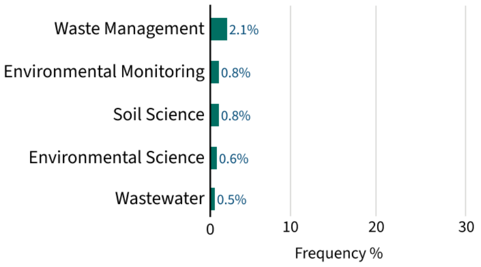
Core Chemistry Skills



Digital Skills



Green Skills



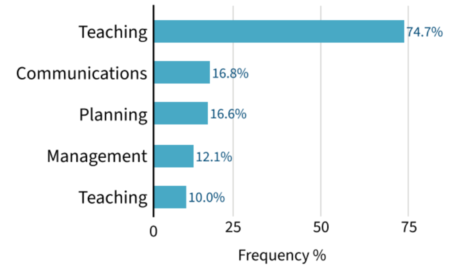
Source: Lightcast Job Postings

Skills Snapshot:
Education

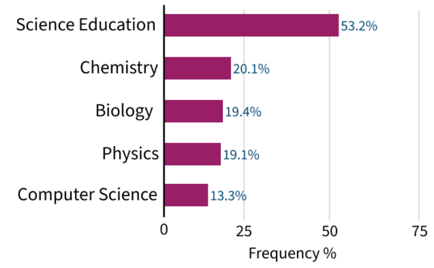
This factsheet provides a snapshot of the current skills, knowledge and abilities most frequently mentioned in job postings related to chemistry jobs in the Education group between August 2022 and July 2023 in the UK. Skills, knowledge and abilities are organised in six key themes: common or transferable, specialised, digital, green, general chemistry, and field-specific chemistry.

The Lightcast Skills Taxonomy was used for the production of this factsheet. All the details on the methodology can be found in the accompanying data report for the RSC's Future Workforce and Educational Pathways project.

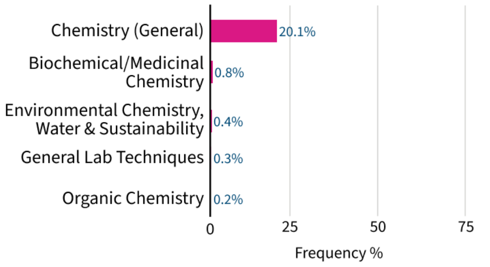
Common Skills



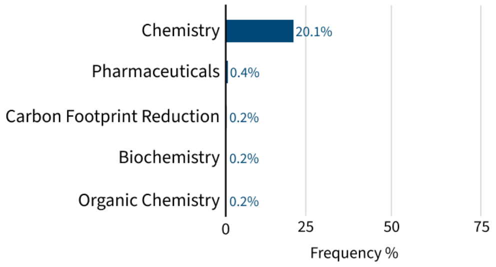
Specialised Skills



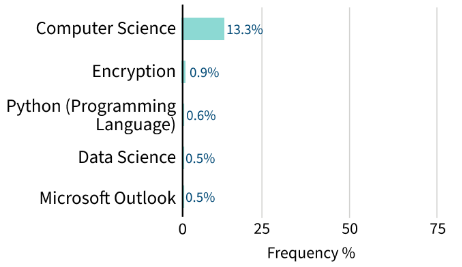
Chemistry Skill Clusters



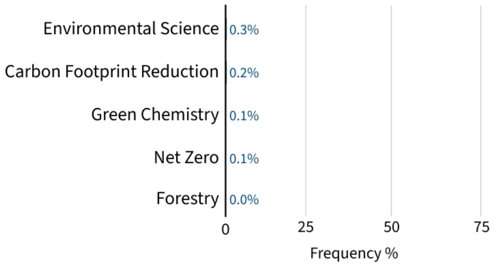
Core Chemistry Skills



Digital Skills



Green Skills



Source: Lightcast Job Postings

ROYAL SOCIETY OF CHEMISTRY

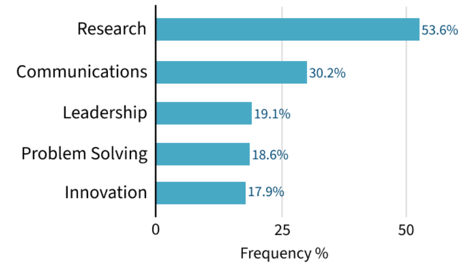
Skills Snapshot:

Data Scientist/Computational Chemist

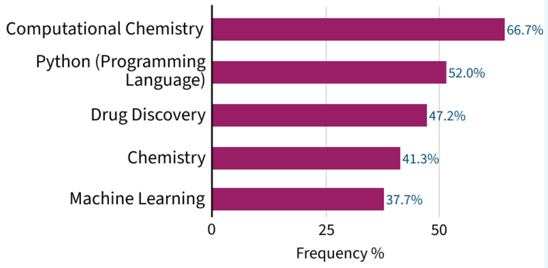
This factsheet provides a snapshot of the current skills, knowledge and abilities most frequently mentioned in job postings related to chemistry jobs in the Data Scientist/Computational Chemist group between August 2022 and July 2023 in the UK. Skills, knowledge and abilities are organised in six key themes: common or transferable, specialised, digital, green, general chemistry, and field-specific chemistry.

The Lightcast Skills Taxonomy was used for the production of this factsheet. All the details on the methodology can be found in the accompanying data report for the RSC's Future Workforce and Educational Pathways project.

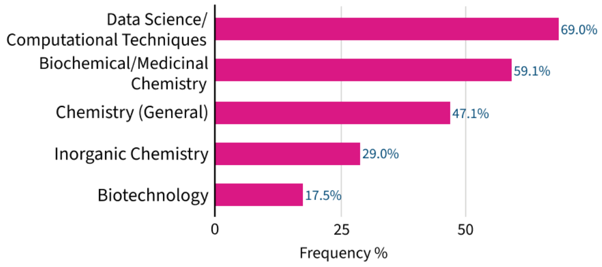
Common Skills



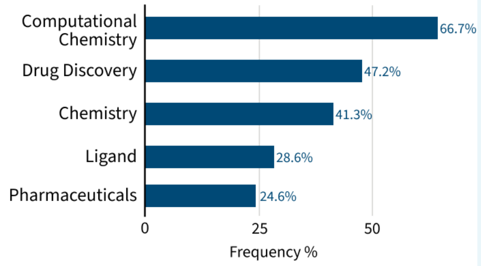
Specialised Skills



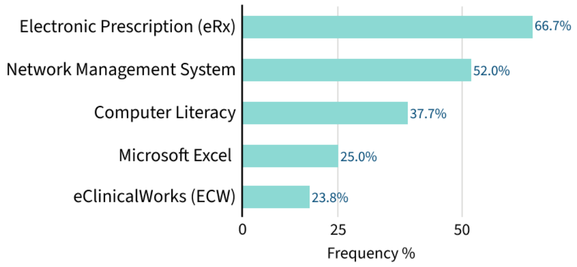
Chemistry Skill Clusters



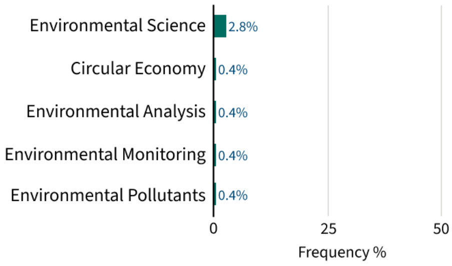
Core Chemistry Skills



Digital Skills



Green Skills



Source: Lightcast Job Postings

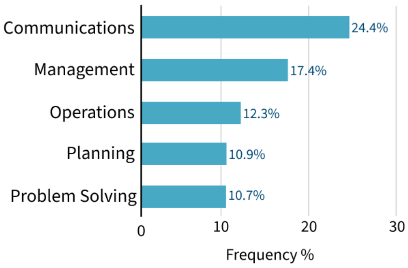
ROYAL SOCIETY
OF **CHEMISTRY**

Skills Snapshot:
Chemical Engineer/Process Chemist

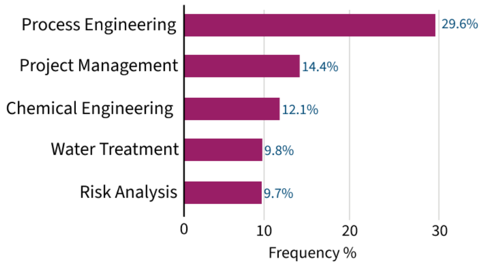
This factsheet provides a snapshot of the current skills, knowledge and abilities most frequently mentioned in job postings related to chemistry jobs in the Chemical Engineer/Process Chemist group between August 2022 and July 2023 in the UK. Skills, knowledge and abilities are organised in six key themes: common or transferable, specialised, digital, green, general chemistry, and field-specific chemistry.

The Lightcast Skills Taxonomy was used for the production of this factsheet. All the details on the methodology can be found in the accompanying data report for the RSC's Future Workforce and Educational Pathways project.

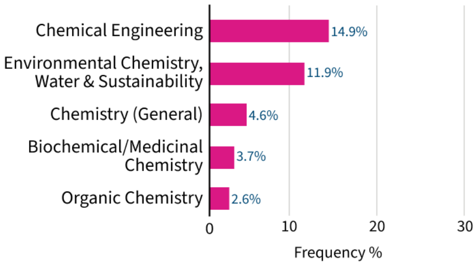
Common Skills



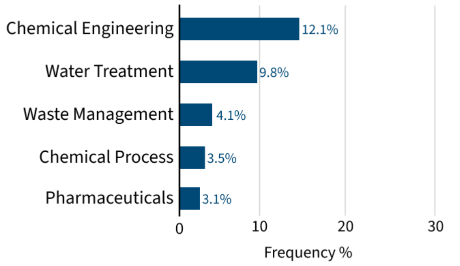
Specialised Skills



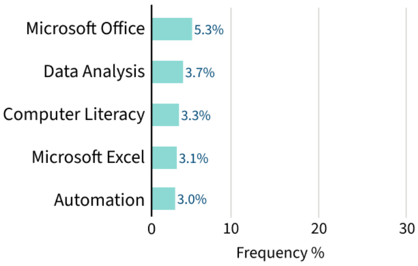
Chemistry Skill Clusters



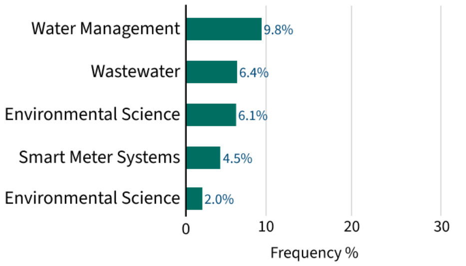
Core Chemistry Skills



Digital Skills



Green Skills



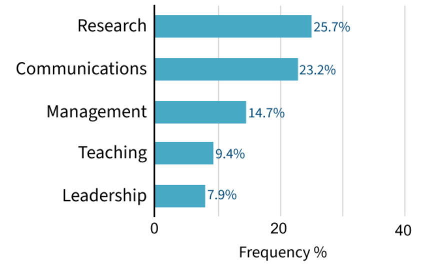
Source: Lightcast Job Postings

Skills Snapshot:
Biochemist

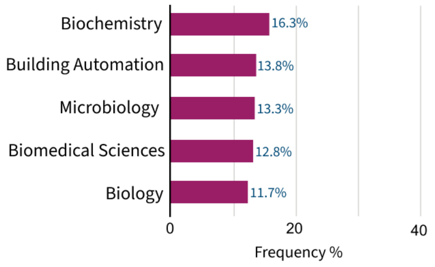
This factsheet provides a snapshot of the current skills, knowledge and abilities most frequently mentioned in job postings related to chemistry jobs in the Biochemist group between August 2022 and July 2023 in the UK. Skills, knowledge and abilities are organised in six key themes: common or transferable, specialised, digital, green, general chemistry, and field-specific chemistry.

The Lightcast Skills Taxonomy was used for the production of this factsheet. All the details on the methodology can be found in the accompanying data report for the RSC's Future Workforce and Educational Pathways project.

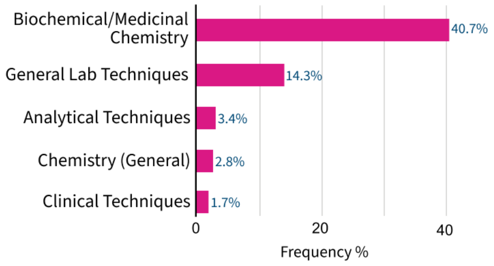
Common Skills



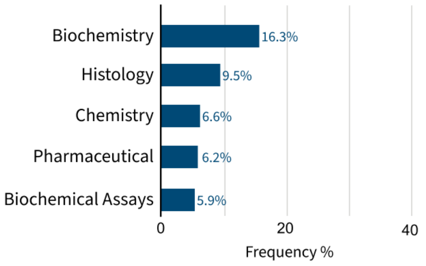
Specialised Skills



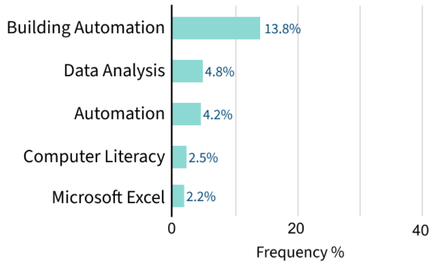
Chemistry Skill Clusters



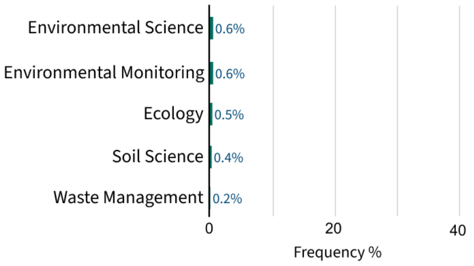
Core Chemistry Skills



Digital Skills



Green Skills



Source: Lightcast Job Postings

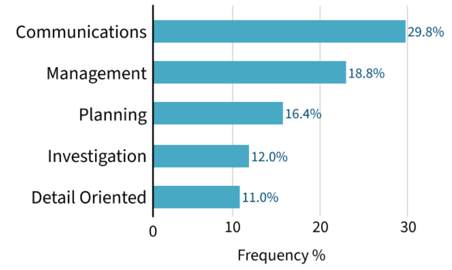
ROYAL SOCIETY OF **CHEMISTRY**

Skills Snapshot:
Analytical Chemist

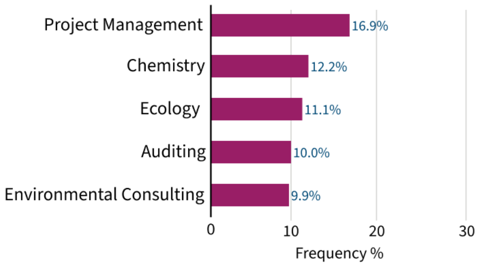
This factsheet provides a snapshot of the current skills, knowledge and abilities most frequently mentioned in job postings related to chemistry jobs in the Analytical Chemist group between August 2022 and July 2023 in the UK. Skills, knowledge and abilities are organised in six key themes: common or transferable, specialised, digital, green, general chemistry, and field-specific chemistry.

The Lightcast Skills Taxonomy was used for the production of this factsheet. All the details on the methodology can be found in the accompanying data report for the RSC's Future Workforce and Educational Pathways project.

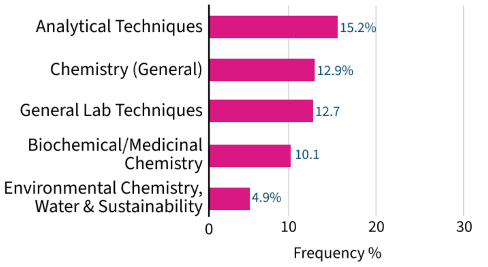
Common Skills



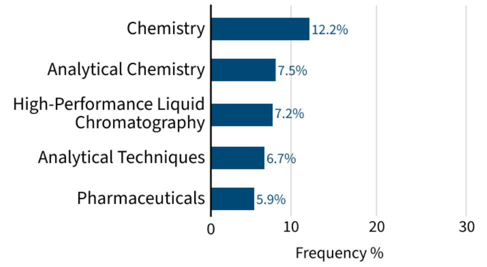
Specialised Skills



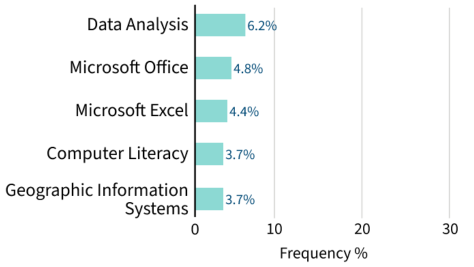
Chemistry Skill Clusters



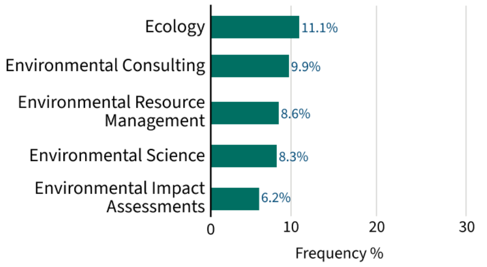
Core Chemistry Skills



Digital Skills



Green Skills



Source: Lightcast Job Postings

Appendix 1: List of papers reviewed as part of the research

As part of the literature review conducted for this research project, Lightcast reviewed 33 policy and research papers identified by the Royal Society of Chemistry as key papers for understanding which trends are going to affect the chemistry labour market over the next decade and how. A full list of the these papers is presented below:

1 Pay and Reward Report. (RSC, 2021)
2 Chemistry's Contribution (RSC & Cambridge Econometrics, 2020)
3 Institute for Apprenticeships and Technical Education – Occupational Maps and Standards. (IfATE)
4 Skills Shortages in the UK Economy (Edge Foundation, 2023)
5 The Skills Imperative 2035: An analysis of the demand for skills in the labour market (NFER, 2022)
6 Skills needs in selected occupations over the next 5-10 years (DfE, 2022)
7 Which occupations are at highest risk of being automated? (ONS, 2019)
8 Digital futures: A new frontier for science exploration and invention (RSC, 2020)
9 Green shoots part 2 – Sustainability and the chemistry curriculum (RSC, 2022)
10 UK Government press releases here and here
11 UK Skills Mismatch in 2030 (Industrial Strategy Council, 2019)
12 Skills for a net-zero economy: Insights from employers and young people (WorldSkillsUK, 2022)
13 The Skills Opportunity: Building a more innovative UK (Campaign for Science and Engineering, 2023)
14 R&D People and Culture Strategy (DBEIS, 2021)
15 Summary of visa costs analysis (The Royal Society, 2021)
16 Global Mobility of Research Personnel (UKRI, 2022)
17 Bridging the skills gap in the biopharmaceutical industry (ABPI, 2022)
18 Review of EPSRC-funded Doctoral Education (UKRI, 2021)
19 The research and technical workforce in the UK (The Royal Society, 2021)
20 Business of Science 2022 Survey Report (Business of Science Conference, 2022)
21 Build Back Better strategy: Our Plan for Growth (UK Government, 2021)
22 Net Zero Strategy: Build Back Greener (UK Government, 2021)
23 Inquiry into Equity in the STEM Workforce (All Party Parliamentary Group, 2021)
24 The future of post-16 qualifications (House of Common Education Committee, 2023)
25 Science Horizons: Leading-edge science for sustainable prosperity over the next 10-15 years (RSC, 2019)
26 Employer Skills Survey 2019: Summary report (Department for Education, 2020)
27 What works for innovation: supporting R&D and innovation in deep tech chemistry SMEs (RSC, 2021)
28 Missing Elements: Racial and ethnic inequalities in the chemical sciences (RSC, 2022)
29 A Simpler Skills System (IfATE, 2023)
30 A sense of belonging in the chemical sciences (RSC, 2021)
31 Independent Review of the UK's Research, Development and Innovation Organisational Landscape (Nurse, 2023)
32 How Should Chemistry Educators Respond to the Next Generation of Technology Change? (Pense, 2020)
33 The UK Science and Technology Framework (DfSIT, 2023)

Appendix 2: Green skills, knowledge and abilities used in the research

Despite the consensus around the importance of the green transition, there is currently no officially agreed definition of what counts as a 'green job' in the UK. To help overcome this challenge and get the conversation started, Lightcast developed its own definition of green jobs by using Lightcast job postings data and skills taxonomy. Starting from Lightcast Skills Taxonomy, approximately 450 skills, knowledge and abilities were identified as green. These skills, knowledge and abilities encompass 21 different green clusters, from green architecture and construction, to environmental regulations, renewable energy and conservation. The full list of green skills, knowledge and abilities and their associated green clusters are available in the table below. Job postings that included at least one of these skills were then classified as green job postings.

Green cluster	Green skills, knowledge and abilities
Air quality and emissions	Air Permitting, Air Pollution Control, Air Quality, Air Quality Control, Air Sampling, Atmospheric Dispersion Modelling, Carbon Accounting, Carbon Footprint Reduction, Carbon Management, Carbon Monoxide Detectors, Continuous Emissions Monitoring Systems, Emission Calculations, Emission Reduction Projects, Emission Standards, Emission Testing, Emissions Controls, Emissions Inventory, Fugitive Emissions, Greenhouse Gas, Low Carbon Solutions, MACT Standards, National Emissions Standards For Hazardous Air Pollutants, Stack Emission Measurements, Vapour Recovery, Carbon Capture And Storage, Net Zero
Agriculture, horticulture and landscaping	Regenerative Agriculture, Sustainable Agriculture, Green Walls, Sustainable Gardening, Sustainable Horticulture, Sustainable Landscaping
Clean energy	Alternative Energy, Alternative Fuels, Biodiesel, Biodiesel Production, Bio-fuel Production, Biofuels, Biomass, Clean Technology, Geothermal Energy, Geothermal Heating, Renewable Energy, Renewable Energy Development, Renewable Energy Markets, Renewable Energy Systems, Renewable Fuels
Climate change	Climate Analysis, Climate Change Adaptation, Climate Change Mitigation Climate Change Programs, Climate Information Climate Policy, Climate Resilience, Climate Variability And Change, Carbon Offsets, Climate Modelling
Conservation	Environmental Impact Statements, Environmental Literacy, Environmental Protection, Environmental Risk Assessment, Environmentalism, Low Impact Development, Sustainability Planning, Conservation Biology, Conservation Planning, Fish Conservation, Forest Conservation, Habitat Conservation, Habitat Conservation Plan, Marine Conservation, Rainwater Harvesting, Soil Conservation, Soil Genesis, Threatened And Endangered Species Surveys, Water Conservation, Watershed Management, Wetland Conservation, Wetland Delineation, Wildlife Conservation, Wildlife Monitoring, Conservation Science

Green cluster	Green skills, knowledge and abilities
Ecology and Environmental ecology	Economic Geology, Environmental Geology, Glaciology, Groundwater, Groundwater Assessment, Groundwater Monitoring, Groundwater Remediation, Sediment, Sediment Sampling, Seismic Data, Sequence Stratigraphy, Soil Boring, Soil Chemistry, Soil Management, Soil Science, Soil Vapour Extraction, Surface Water, Applied Ecology, Aquatic Ecology, Avian Ecology, Biological Oceanography, Chemical Ecology, Coastal Ecology, Community Ecology, Ecological Economics, Ecological Restoration, Ecological Services, Ecological Studies, Ecological Systems, Ecology, Ecosystem Ecology, Ecosystem Science, Freshwater Ecology, Habitat Assessment, Habitat Improvement, Harmful Algal Blooms, Human Ecology, Invasive Plants, Invasive Species Management, Landscape Ecology, Limnology, Marine Ecology, Marine Habitats, Microbial Ecology, Natural Channel Design, Nutrient Cycling, Plant Ecology, Plant Identification, Political Ecology, Riparian Ecology, Soil Ecology, Terrestrial Ecology, Urban Ecology, Vegetation Surveys, Watershed Improvement, Wetland Assessment, Wetland Ecology, Wetland Science, Wildlife Habitats, Wildlife Management
Energy management	Automatic Meter Reading, Energy Analysis System, Energy Audits, Energy Consumption, Energy Conversion, Energy Demand Management, Energy Forecasting, Energy Management, Energy Management Planning, Energy Management Systems, Energy Market, Energy Policy, Energy Production, Energy Project Management, Energy Supply, Energy Transformation, Energy Transport, Flow Assurance, Fuel Metering, Gas Meter Systems, Hydraulic Accumulators, Load Shedding, Resource Distribution, Smart Meter Installation, Smart Meter Systems, Transmission System Operator
Energy efficiency	Cooling Efficiency, Energy Analysis, Energy Conservation, Energy Conservation Measures, Energy Efficiency Analysis Energy Efficiency Assessment, Energy Efficiency Improvement, Energy Efficiency Research, Energy Efficiency Services, Energy Efficiency Technologies, Energy Efficient Lighting, Energy Efficient Operations, Energy Modelling, Energy Saving Products, Energy-Efficient Buildings, Heat Recovery Steam Generators, Home Energy Assessment, LED Lamps, Renewable Portfolio Standard, Residential Energy Conservation, Residential Energy Efficiency
Environmental engineering & restoration	Environmental Analysis, Environmental Contamination Environmental Economics, Environmental Emergency, Environmental Problem Solving, Environmental Program Management, Environmental Remediation, Environmental Technology, Underground Storage Tanks (UST), Water Pollution, Biological Systems Engineering, Bioremediation, Ecological Engineering, Environmental Field Services, Environmental Pollutants, Environmental Toxicology, Geotextile, Land Reclamation, Landfill Design, Oil Containment Booms, Oil Skimmer, Oil Spill Contingency Plans, Pollution Control Systems, Reforestation, Remediation Systems, Restoration Ecology, Sanitary Engineering, Sediment Controls, Soil Contamination, Stream Restoration, Wetland Restoration, Air Stripping, Climate Engineering Environmental Biotechnology, Environmental Engineering
Environmental regulations	Best Available Control Technology, California Environmental Quality Act (CEQA), Categorical Exclusions, Clean Water Act, Comprehensive Environmental Response Compensation and Liability Act (CERCLA), Emergency Planning And Community Right-To-Know Act, Endangered Species Act, Environmental Auditing, Environmental Compliance, Environmental Compliance Assessment, Environmental Due Diligence, Environmental Laws, Environmental Permitting, Environmental Protocols, EPA Regulations, Federal Insecticide Fungicide And Rodenticide Act, ISO 14000 Series, ISO 14064, Marine Mammal Protection Act, Massachusetts Environmental Policy Act, National Environmental Policy Act, Natural Resources Law, Pollution Regulations, Resource Conservation And Recovery Act (RCRA), Safe Drinking Water Act, Spill Prevention Control And Countermeasure (SPCC), Total Maximum Daily Load, Water Law, Water Regulations Advisory Scheme, Clean Air Act, Environmental Governance, Environmental Reporting, Environmental Claims, Environmental Policy Analysis, Environmental Policy Development

Green cluster	Green skills, knowledge and abilities
Environment and resource management	Biodiversity, Circular Economy, Coastal Management, Ecosystem Management, Environmental Consulting, Environmental Data Analysis, Environmental Data Management, Environmental Degradation, Environmental Design, Environmental Education, Environmental Ethics, Environmental Impact Assessments, Environmental Interpretation, Environmental Issue, Environmental Management Systems, Environmental Mitigation, Environmental Modelling, Environmental Monitoring, Environmental Planning, Environmental Policy, Environmental Quality, Environmental Resource Management, Environmental Stewardship, Green Infrastructure, Natural Resource Management, Phase I Environmental Site Assessment, Pollution Prevention, Water Resource Development, Water Resource Management, Water Resources, Wetland Management, Biomass Conversion, Sustainability Procedures, Leadership in Energy and Environmental Design (LEED) Rating System, Biorefinery, Turbines
Green architecture and construction	Biophilic Design, Retrofitting, Electric Vehicle (EV) Installation, Adaptive Reuse, Building Energy Codes, Building Performance, Green Building, Regenerative Design, Sustainable Design, Sustainable Infrastructure
Green engineering	Alternative Fuel Vehicles, Electric Vehicles, Emissions Analysers, Fuel Cell Vehicles, Hybrid Vehicles, Battery Management, Battery Pack, Battery Testing, Battery Technology
Green science and research	Biosafety, Environmental Biology, Plant Biotechnology, Environmental Chemistry, Environmental Research, Environmental Science, Environmental Studies
Forestry	Agroforestry, Forest Ecology, Forest Engineering, Forest Entomology, Forest Genetics, Forest Management, Forest Mensuration, Forest Pathology, Forest Planning, Forest Protection, Forest Science, Forest Technology, Forestry, Rangefinder, Silvics, Silviculture, Timber Harvesting, Timber Management, Tree Inventory, Tree Surveying, Urban Forestry, Forest Restoration
Nuclear energy	ANSI/ANS Standards, Monte Carlo N-Particle Transport Codes, Nuclear Core Design, Nuclear Criticality Safety, Nuclear Design Nuclear Fuel, Nuclear Fuel Cycle, Nuclear Instrumentation Module, Nuclear Navy, Nuclear Plant Design Nuclear Power, Nuclear Reactor Nuclear Safety, Nuclear Technology, RELAP5-3D, Roentgen, Scintillator, Nuclear Engineering
Solar energy	Commercial Solar Projects, Concentrix Solar, Passive Solar Building Design, Photodetector, Photovoltaic Systems, Photovoltaics, PVsyst, Solar Application, Solar Cell Manufacturing, Solar Cells, Solar Consulting, Solar Design, Solar Development, Solar Energy, Solar Energy Systems Installation, Solar Engineering, Solar Equipment, Solar Inverter, Solar Manufacturing, Solar Panel Assembly, Solar Panels, Solar Photovoltaic Design, Solar Products, Solar Roofs, Solar Systems, Solar Thermal Installation, Solar Thermal Systems, Solar Water Heating, Solar Collectors
Water energy	Dam Construction, Hydroelectricity, Hydropower, WaterCAD
Wind energy	Wind Engineering, Wind Farm Construction, Wind Farm Design, Wind Farm Development, Wind Farming, Wind Power, Wind Turbine Maintenance, Wind Turbine Technology, Wind Turbines
Water supply, testing and treatment	Purified Water, Wastewater, Water Purification, Water Quality, Water Quality Modelling, Water Quality Studies, Water Reclamation, Water Testing, Water Treatment,Water Treatments Operation, Water Wells, Wastewater Treatment Plant Design
Waste management	E-Waste, Electrocoagulation Landfill, Landfill Gas Collection, Leachate Management, Municipal Waste Management, Plastic Recycling, Recycling, Sludge, Sludge Disposal, Solid Waste Management, Tire Recycling, Transfer Station, Waste Characterization, Waste Collection, Waste Disposal Systems, Waste Management, Waste Packaging, Waste Removal, Waste Sorting, Waste Tracking System, Waste Transport, Waste Treatment, API Oil-Water Separator

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