IChemE

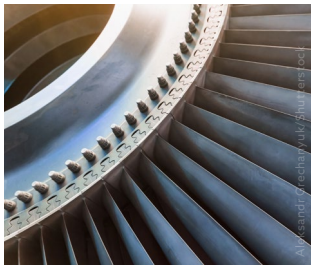
I·M3 Institute of Materials, Minerals & Mining

ROYAL SOCIETY OF CHEMISTRY

Published October 2025

Jobs and skills for a circular economy:

a cross-sector perspective from the chemical and materials science and engineering communities



Foreword

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Foreword

We are pleased to present this collaborative report on the jobs and skills needed for the circular economy, which has been produced by the Institution of Chemical Engineers (IChemE), the Institute of Materials, Minerals and Mining (IOM3), and the Royal Society of Chemistry (RSC). In this report we draw on the breadth of expertise of our respective communities and highlight both the challenges and opportunities presented by the move to a circular economy. The interest in this report from across our communities is a testament to the widespread recognition of the importance of this move.

This report makes clear that chemical and materials science and engineering are at the heart of the shift to a circular economy, providing essential skills and innovative solutions needed to unlock all the benefits that the circular economy can bring – green growth, improved sustainability and greater supply chain security. The report also sets out the stark challenges we face if we want to unlock these benefits. There are significant skills gaps across several key professional groups that are vital to delivering the circular economy - such as materials engineers, chemical engineers, regulatory and compliance specialists, and Research & Development professionals. And we heard very clearly from our communities about how financial pressures on chemical and materials science and engineering departments in our universities threaten the UK's ability to draw on sufficient skilled workers in this area in the future.

As the report spells out, policymakers have a crucial role in providing the right environment for the circular economy to flourish and making sure that there are a wide range of attractive and effective routes for people to gain the skills they need to participate in it. But ultimately this is a challenge that requires collaborative action across industry, government, education and professional bodies. As representatives of three key professional bodies, we will be continuing to work individually and in partnership to drive forward the circular economy.

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Executive summary

This report by the Institution of Chemical Engineers (IChemE), the Institute of Materials, Minerals and Mining (IOM3) and the Royal Society of Chemistry (RSC) provides a current perspective from the chemical and materials science and engineering communities on the opportunities and challenges related to jobs and skills in the transition to a circular economy. It provides cross-sectoral insights that build on previous work focused on individual sectors or material streams. It applies a circular economy lens to the skills and employment landscape in the UK and brings out discipline-specific evidence.

Context for this report

The UK's material consumption far exceeds the global average, contributing to climate change, biodiversity loss, and pollution. With only 7.5% of materials currently recirculated, the economic and environmental costs are significant. A circular economy in which materials are retained at their highest value for as long as possible offers a pathway to sustainable growth, improved resource security, and reduced environmental harm. This transition is especially urgent given the global demand for critical materials essential to sectors like energy, healthcare, and defence. Chemical and materials science and engineering are central to enabling circularity including through better material choices, sustainable design, and end-of-life recovery technologies.

There is existing research that highlights growing skills gaps in critical areas such as metallurgy, mineral extraction, and sustainable manufacturing. The demand for skills spans multiple sectors, creating competition and additional pressure on talent pipelines. There is strong potential for job growth, but this is threatened by university course and department closures and regional disparities in education access, with 'cold spots' in undergraduate provision risking undermining diversity and regional workforce development. However, a major knowledge gap remains in understanding how the skills and job landscape in these disciplines will evolve. To address this gap, IChemE, IOM3, and the RSC brought together stakeholders from their communities in two workshops, complemented by an online survey, to gather cross-sectoral insights and inform future action.

Relevance of this work

The UK's Industrial Strategy and forthcoming policies on circular economy, decarbonisation, clean energy, and critical minerals underscore the urgency of building a robust skills pipeline, with regional industrial clusters, reskilling from declining sectors, and the creation of good jobs as important levers.

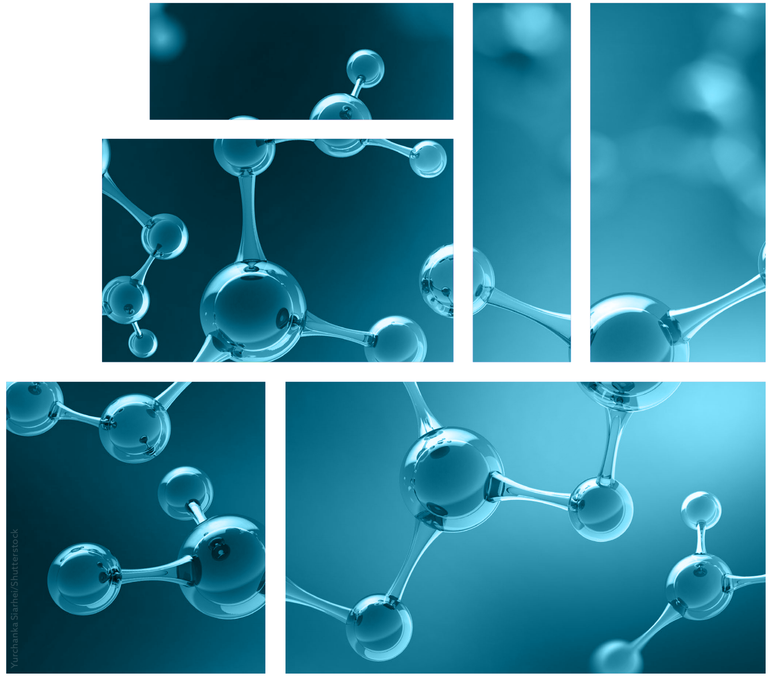
The collaborative effort summarised in this report advances the conversation on jobs and skills by offering cross-sectoral perspectives, applying a circular economy lens to the UK's skills landscape, and highlighting discipline-specific evidence. It builds on previous reports while introducing new questions and insights, helping to shape a more informed and inclusive approach to workforce development in support of the circular economy.

Methodology

Two online workshops brought together stakeholders from across the chemical and materials science and engineering sectors, along with representatives from the Department for Business and Trade (DBT), the Department for Environment, Food and Rural Affairs (Defra) and the Department for Energy Security and Net Zero (DESNZ). In each workshop, participants were asked questions grouped into the following thematic areas:

1. The skills horizon
2. Educational pathways
3. Sourcing circular economy skills
4. Avenues to reskilling
5. Policy priorities

A survey was shared with workshop participants and our wider networks, offering additional individual perspectives to complement and enrich the workshop discussions.



Key Findings

1. The skills horizon

The transition to a circular economy will reshape industrial practices and drive demand for new skills, particularly in chemical and materials science and engineering. These disciplines are essential for sustainable materials management, including recycling, reuse, and lifecycle analysis. Our stakeholders highlighted that key roles such as materials engineers, chemical engineers, and Research & Development professionals are both critical and in short supply. Skills shortages are most acute in areas like metallurgical techniques, regulatory compliance, and chemical process engineering. There is a growing need for interdisciplinary expertise, systems thinking, and hybrid roles that combine technical, regulatory, and commercial knowledge. Without targeted action, the UK risks falling short of the workforce needed to deliver a sustainable circular economy.

2. Educational pathways

A mix of academic, vocational, and alternative educational routes is essential to meet evolving industry needs. Vocational pathways, although vital for hands-on roles, remain undervalued and underutilised. Stakeholders stressed the importance of elevating technician-level careers, expanding apprenticeships, and embedding circular economy principles into mainstream education. Industrial experience and collaboration between academia and industry are key to preparing graduates effectively. However, financial pressures and closures of chemistry and materials courses and departments threatens graduate numbers as well as regional access and diversity. This risks long-term damage to the UK's talent pipeline and global competitiveness.

3. Sourcing circular economy skills

There was agreement among stakeholders that recruiting skilled workers for the circular economy is challenging across local, national, and international levels. Rural areas face transport and relocation barriers, while visa regulations and post-Brexit constraints affect international hiring, especially for small- and medium-sized enterprises (SMEs). The ageing workforce adds urgency, with fears of losing specialist knowledge. Training remains difficult to access, particularly for smaller firms, and industrial placements are resource-intensive. Graduate training schemes and regional clusters offer promising models for strengthening the skills pipeline.

4. Avenues to reskilling

Reskilling is crucial to meet circular economy workforce demands, especially as new jobs emerge and other industries decline. Stakeholders emphasised that many skills from sectors like oil and gas are transferable, but awareness of this is low among employers and jobseekers. Pay disparities and the cost of continued professional development (CPD) and training are major barriers. Modular and affordable training, and national frameworks for recognising transferable skills are needed. Coordinated efforts across government, industry, and education are essential to ensure training is relevant, accessible, and well-funded.

5. Policy priorities

Stakeholders felt that there is an urgent need for government to recognise chemical and materials science and engineering as strategically important and support skills development accordingly. Policy alignment, long-term stability, and robust targets are needed to foster confidence and investment. Education should

embed circular economy principles meaningfully, not superficially. Improving awareness of career opportunities, removing barriers to vocational education, and supporting SMEs are key priorities. A well-resourced regulatory environment, streamlined permitting, and public mapping of industry skills needs will be vital to enabling innovation and mobility across sectors.

Conclusions

The transition to a low-carbon, circular economy is critically dependent on chemical and materials science and engineering. A robust and resilient workforce with a strong skills pipeline and clear, accessible education and training pathways into the circular economy is of strategic importance. However, as this report highlights, the current system is not adequately aligned to meet this need. Planning and coordinated action are urgently needed to address critical skills shortages, challenge outdated perceptions, support reskilling efforts and promote rewarding career pathways. All actors, including industry, education and training providers, regulators and policymakers, have a role to play in delivering a future-facing, inclusive and responsive skills system.

From exploring the above themes with the contributors, this report draws the following 8 overarching conclusions:

1. An enabling policy and regulatory environment is integral to a circular economy
2. Strategic, data-driven skills mapping and planning are urgently required to address current and future jobs and skills gaps
3. Skills needs and applications are evolving, and these must be considered to unlock a future-proofed workforce
4. Delivering circular economy priorities depends on modernised curricula and a combination of educational pathways
5. Financial pressures on chemical and materials science and engineering university departments pose significant risks
6. Recruitment locally, nationally and internationally is challenging
7. Addressing negative perceptions and lack of awareness about circular economy opportunities will help attract more talent
8. Effective collaboration and partnerships will be crucial to meet the skills and workforce needs of the circular economy

Recommendations

Strategic, coordinated action is urgently needed across government, industry, education and training providers, and professional bodies to build and maintain a resilient, future-ready workforce. **Table 3 in Part 3 of this report compiles a detailed set of recommendations** for these different stakeholder groups. The following is a high-level summary of these priority actions:

Government

- Recognise the strategic role of chemical and materials science and engineering in the transition to a circular economy
- Lead strategic skills and workforce planning across sectors and regions
- Address strategic skills shortages through targeted interventions
- Support high-quality, inclusive education and training provision across academic, vocational, and technical routes including ensuring the long-term viability of key courses
- Modernise curricula and support educator readiness
- Reduce burdens and facilitate partnerships to increase industrial experience
- Enable more extensive and inclusive opportunities for reskilling and promote skills transferability across sectors
- Address international recruitment barriers
- Align government strategies, provide long-term policy certainty, and set measurable targets for skills progress
- Resource and empower national bodies such as Skills England and devolved counterparts to drive coordination
- Ensure the planning, permitting and regulatory environment is appropriately skilled and resourced

Industry/employers

- Champion the strategic role of chemical and materials science and engineering in enabling the circular economy
- Contribute insights to strategic workforce planning
- Collaborate with educators, professional bodies and policymakers to shape future skills provision
- Strengthen workforce planning and retention strategies
- Engage in collaborative dialogue to support development of education and training provision that responds to industry needs
- Expand outreach and visibility of circular economy careers and skills
- Enable accessible industrial experiences
- Recognise and promote flexible training and career pathways and skills transferability
- Work with government to inform the development of ambitious, measurable skills targets

Education and training providers

- Embed circular economy principles into learning outcomes at all levels
- Raise awareness of circular economy careers and the role of chemical and materials science and engineering
- Contribute insights to workforce planning
- Collaborate with employers, professional bodies and policymakers to shape future skills provision
- Align education and training provision with circular economy skills priorities
- Work with government to ensure long-term viability of key courses
- Engage in collaborative dialogue to support development of relevant and responsive education and training provision
- Promote flexible, modular and interdisciplinary learning pathways
- Integrate industrial experiences into education programmes
- Expand provision of training to support career transitions
- Work with government to inform the development of ambitious, measurable skills targets

Professional bodies

- Champion the strategic role of chemical and materials science and engineering in enabling the circular economy
- Facilitate cross-sector collaboration and convene stakeholders to promote insight sharing
- Collaborate with employers, education and training providers and policymakers to shape future skills provision
- Identify and promote opportunities in the current curricula to support the skills required for a circular economy
- Engage in collaborative dialogue to support development of relevant and responsive education and training provision
- Equip educators to inspire future talent
- Promote awareness of diverse career and educational pathways into circular economy roles
- Support visibility of skills transferability and career transition routes
- Provide opportunities to help professionals enhance their understanding of circular economy policy
- Support regulatory and policy engagement acting as a bridge between stakeholders and policymakers

A coordinated, collaborative approach is vital to build the skills base for a circular economy. Stakeholders must work together to recognise and value diverse educational pathways, improve visibility of careers and the transferability of skills, and promote the opportunities presented by a circular economy. Only through collective action can the UK secure the workforce required for a sustainable, resilient future.

Acknowledgements

IChemE, IOM3 and the RSC would like to thank all stakeholders – including employers, education and training providers, policymakers, professional bodies and students – for their time, insight and cross-sectoral perspectives that were invaluable in informing this report.

We'd also like to thank our wider communities who engaged with our survey, offering diverse viewpoints that added breadth and depth of understanding.

We are grateful to policymakers from the Department for Business and Trade (DBT), the Department for Environment, Food and Rural Affairs (Defra) and the Department for Energy Security and Net Zero (DESNZ) for their continued engagement and support throughout the process – from its development to their active participation in the workshops.

Special thanks go to the team members from IChemE, IOM3 and the RSC for their skilled facilitation of the workshops, assistance with notetaking and valuable contributions to writing, reviewing and editing this report.

Our organisations

The **Institution of Chemical Engineers (IChemE)** is the qualifying body and learned society for chemical, biochemical, and process engineers in the UK and worldwide, with over 30 thousand members. Its mission is to champion the input of chemical engineers to create a sustainable future.

The **Institute of Materials, Minerals and Mining (IOM3)** is a professional engineering, environmental and scientific institution, a registered charity and governed by a Royal Charter. IOM3 supports professionals in materials, minerals, mining and associated technical disciplines to be champions of the transition to a low-carbon, resilient and resource efficient society. With around 13,000 members, IOM3 brings together expertise across the full materials cycle.

The **Royal Society of Chemistry (RSC)** is the UK's professional body for the chemical sciences, with over 60,000 members in over 100 countries and a knowledge business that spans the globe. Its members include those working in large multinational companies, small to medium enterprises, researchers, students in universities, teachers and regulators. The RSC works at the heart of the chemical sciences community to create a future that is more open, more green, and more equal.

[1] The term 'chemical and materials science and engineering' is used to refer to the broad range of disciplines within our communities and the wide range of professional backgrounds of those who fed into the report.

Overview

This report provides a current perspective from the chemical and materials science and engineering[1] communities on the skills the UK will need to transition to a circular economy. It has been produced as part of a collaboration between the Institution of Chemical Engineers (IChemE), the Institute of Materials, Minerals and Mining (IOM3) and the Royal Society of Chemistry (RSC).

In **Part 1** of this report, we provide a brief overview of the context in which the work described here has arisen, we outline the role of our communities in the transition to a circular economy, we summarise what we know about the current skills and jobs landscape, and we delineate why we think a deeper and more nuanced understanding of this is important if the UK wants to realise its circular economy and economic growth ambitions.

Part 2 of this report is a deep dive into the five themes we explored with our communities in two separate workshops and a wider survey (see Annex for the methodology). This section covers the evolving skills landscape, the educational pathways to circular economy skills and roles, current practice and hurdles in skills sourcing, avenues to reskilling, and finally thoughts from workshop participants and survey respondents on how policymakers can support the transition to a circular economy.

In **Part 3,** we outline our conclusions from this work and put these findings into the wider context of the current debate on skills and the circular economy. We conclude this section with recommendations to government, employers in industry, education and training providers and professional bodies.

The annex to this report gives an overview of the workshop and survey methodology on which this evidence exploration was based.

Contents

1. The circular economy and skills context

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Part 1: The circular economy and skills context

A circular economy of materials

Unsustainable resource use is the main driver of the triple planetary crisis of climate change, biodiversity loss, and waste and pollution, and there is the need for urgent global transformation towards the sustainable use of resources. The UK's population consumes 15.3 tonnes of materials per person per year, which is well above the global average. Not only does this mean we are contributing disproportionately to the problem of unsustainable materials use, but also the economic value that these materials have is lost from the UK economy if they end up in landfill and incineration or are exported abroad, with some estimates suggesting that at present as little as 7.5% of materials are circled back into the UK economy.[2]

Many of the materials that are vital to meet the UK's net zero commitments are also essential in a range of other sectors, including healthcare, defence and electronics, and there is significant global demand for these materials. Some of these materials are designated as 'critical' because of their importance to our economy and supply chain risks. Unresolved imbalances between supply and demand pose risks to UK economic growth and national and energy security.

In a circular economy, materials are kept circulating for as long as possible, at their highest value. The UK is committed to transition to a circular economy[3], which will provide opportunities for economic growth and job creation, help to diversify supply chains and increase resource security, and reduce the environmental and human impacts of unsustainable resource management.

The role of chemical and materials science and engineering

Chemical and materials science and engineering will play a pivotal role in enabling the circular economy by driving better material choice and substitution decisions, making processes and products more resource-efficient and sustainable, and developing the technologies for recovery of materials at the end-of-life. Understanding how the skills and jobs needs of these disciplines will change as the UK transitions to a circular economy is crucial yet there is a significant knowledge gap.

To address this gap, IChemE, IOM3 and the RSC have brought together our communities of engineers and chemical and materials scientists, allowing us to gain cross-sectoral insights and perspectives. This report presents the findings from two workshops and a wider online survey in July and August 2025 and outlines our recommendations for next steps. The methodology underpinning this report is detailed in the Annex.

What do we know about the skills and jobs landscape?

The IOM3 Talent Gap: Critical Skills for Critical Materials report[4] published in 2023 identified a serious and growing skills gap which poses a significant risk for the critical materials value chain and the UK economy. The report highlighted some of the specific skills and job roles that are needed but are facing a shortage, for

[2] The UK Circularity Gap Report. Circle Economy & Deloitte, 2023.

[3] Terms of Reference: Circular Economy Taskforce. HM Government, 2024.

[4] Talent Gap: Critical Skills for Critical Materials. IOM3, 2023.

example metallurgical skills. Skills for the circular economy were identified as a key gap ranging from design, to research for new manufacturing processes, and the application of mineral extraction techniques and technologies to end of life products. This highlighted that as we shift to a more circular economy, there will be both new skillsets required as well as additional pressures on current pipelines that are already facing stresses on supply. It also emphasised that skills needed in the critical materials value chain may be in demand in other sectors. For example, electrochemists are in demand in midstream processing, but many are choosing to work in battery chemistry. This underscores the need to consider the skills question on a cross-sectoral and discipline basis.

A study by the Critical Minerals Association UK (CMA UK) looking at the skills needs of the UK's critical mineral midstream and recycling sector, highlighted the need for transferable skills in a resilient workforce, the importance of retaining UK talent, and lack of awareness and negative perceptions about some jobs and sectors[5]. The general theme of shifting industrial demand is echoed by recent work by Lightcast for Engineering UK which found that demand for 'green skills' and postings of 'green jobs' within engineering had grown steadily over time[6].

Work has also been carried out by the RSC to examine the UK chemicals sciences workforce in the UK, which totals around 314,000 people, with a further 1.4 million jobs supported by chemistry-using industries[7]. The Future Workforce and Educational Pathways report established that the sector's potential for job creation over the next decade is greater than that of the wider UK labour force, building on existing sectoral strengths. Particularly strong growth was projected in the waste sector, scientific research and chemical manufacturing, all of which will be important in a circular economy. However, these growth projections – and the innovation potential of the chemical sciences – are unlikely to be realised without the skilled individuals to fill these new jobs.

Ensuring that there is a steady and diverse talent pipeline of chemical and material science and engineering graduates entering the workforce will be a key aspect of realising this potential. However, there has been growing concern about the impact of closures, and potential closures of Higher Education departments and courses. Cuts and closures will affect the absolute numbers of graduates entering the workforce, but there is an additional concern around regional disparity in terms of the availability of provision.

The RSC has been monitoring the health of chemistry provision in Higher Education to understand where students can study and whether there are any barriers emerging. In recent years the financial pressure on universities has led to cuts and closures of chemistry courses and departments in the UK, resulting in 'cold spots' where no provision of chemistry is available within a reasonable travel time[8]. Nearly half of UK undergraduates choose to study less than 55 miles from home and commute[9],

[5] Skills Development for UK Critical Minerals and Recycling: Workshop Report. Critical Minerals Association, 2025.

[6] Engineering skills needs – now and into the future: A report produced by Lightcast for EngineeringUK. EngineeringUK, 2023.

[7] Future Workforce and Educational Pathways. Royal Society of Chemistry, 2024.

[8] Chemistry 'cold spots' emerging across the UK with recent department and course closures, RSC warns. Chemistry World, 2025.

[9] Commission on Students in Higher Education. APPG for Students, 2025.

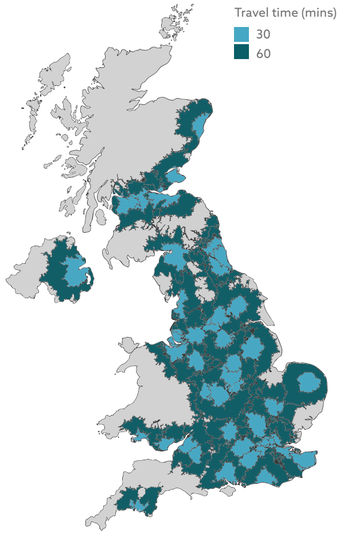

Figure 1: Accessibility to Chemistry undergraduate provision. This map indicates the travel times by car to an active chemistry undergraduate course in the UK based on HESA data. 30- and 60-minute driving ranges are indicated in blue and green respectively. Grey indicates where the driving range is over one hour. Note: This map provides a good picture of accessibility to chemistry courses, but has some limitations, notably it does not take into account other factors which impact access in any given geography such as departmental capacity in terms of courses and staff, public transport links and accessibility, and entry tariffs. The Open University was excluded from this analysis because it offers distance learning. Data source: Open Route Service.

with students from disadvantaged groups three times more likely to commute from home[10]. Cold spots limit student choice and access, and these limitations could result in lost progress towards improving the diversity of the chemical sciences.

Cold spots are emerging in East Yorkshire and the Humber with the closure of the University of Hull's chemistry department, and in North Wales with the closure of Bangor University's department (see Figure 1)[11]. Some of the institutions that have already announced cuts and closures to chemistry courses or are believed to be at risk of doing so, have strong track records in supporting underrepresented groups to achieve degrees. Cuts and closures to chemistry and materials provision therefore restricts choice and will affect some groups of students more than others.

Why is this work relevant now?

The recent Industrial Strategy White Paper highlights the critical role of a strong skills pipeline into the Industrial Strategy growth-driving sectors (the IS-8) and frontier industries[12]. With a strong focus also on the importance of city regions and industrial clusters in delivering the strategy, ensuring there is regional provision of degrees and apprenticeships may be of increasing importance. Chemical and materials science and engineering roles will be required across the IS-8 but particularly in Advanced Manufacturing, Clean Energy, and the Life Sciences, and are also crucial in the foundational industries and inputs that are the building blocks for these sectors. The Industrial Strategy recognises the opportunities presented by reskilling from sectors such as oil and gas, and the importance of creating 'good jobs'.

In addition, England's Circular Economy Strategy, the Industrial Decarbonisation Strategy, the Clean Energy Workforce Strategy and the Critical Minerals Strategy (all forthcoming at the time of publication of this report) are all important in this rapidly evolving policy landscape, and all will form a part of the puzzle in the transition to a circular economy.

[10] Home and Away: social, ethnic and spatial inequalities in student mobility. Sutton Trust, 2018.

[11] Chemistry higher education data and messaging pack. Royal Society of Chemistry, 2025.

[12] The UK's Modern Industrial Strategy. HM Government, 2025.

The importance of these strategic developments is echoed by sector stakeholders who responded to the survey described in this report, with over three quarters of them rating the strategies we asked about as 'very relevant' or 'somewhat relevant' (Figure 2).

How does this report contribute to the evidence base?

With this backdrop of prior work and strategy development, this collaborative work between IChemE, IOM3 and the RSC drives forward the understanding of skills and jobs in the circular economy in the following ways:

- It provides **cross-sectoral insights and perspectives,** building on work that has focused on single sectors or material streams
- It applies **a circular economy lens** to the skills and jobs landscape in the UK
- It brings out **discipline-specific evidence,** recognising the vital role our disciplines have in a circular economy

By approaching the research in this way, we have tested findings from previous reports and asked new questions to add depth and nuance to the debate on skills for the circular economy.

This is an exciting and pertinent time for this work, and we greatly appreciate the time that participants gave us in sharing their views.

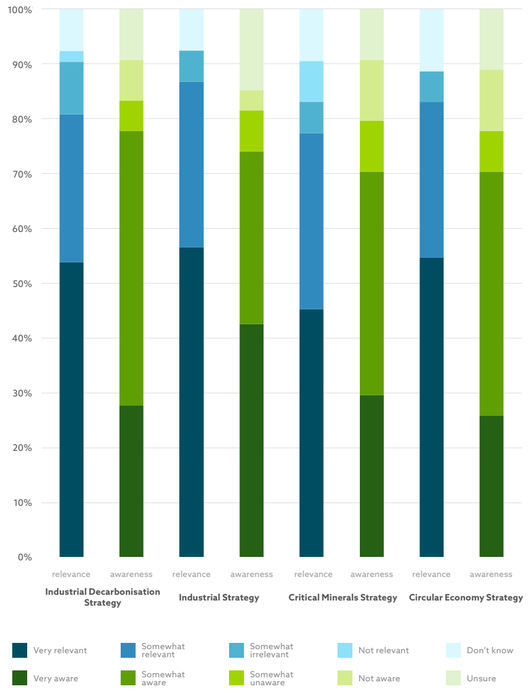

Figure 2: Awareness and perceived relevance of current and upcoming government strategies.

2.

Thematic exploration of skills in a circular economy

Part 2: Thematic exploration of skills in a circular economy

1. The skills horizon

1.1 Why is this theme important?

The transition to a circular economy requires a major overhaul of industrial norms and practices, and with that a rapidly evolving skills landscape. A successful transition cannot be achieved without a clear vision of skills needs and proactive action to address forecast shortages and bottlenecks.

1.2 What did we ask?

To gain insights into the challenges and opportunities associated with skills for a circular economy, we asked the contributors to this work to share how they envision their sector or discipline changing over the coming decade, what implications these changes will have for jobs and skills, and what they foresee as the most important jobs and skills for a circular economy.

1.3 What did we learn?

Forthcoming industrial shifts

The transition to a circular economy will require the emergence of new business models, norms and priorities, ultimately shaping the evolution of job roles and skills applications in practice.

There was broad consensus among all contributors that **chemical and materials science and engineering are vital in a circular economy.** Specifically, these disciplines will be integral to the recovery, reuse and recycling of materials in a circular economy, including in materials processing, characterisation, and the evaluation of performance and safety of secondary materials. This point is highlighted through survey responses such as these:

"By shifting towards such... processes, we can improve traceability, increase recovery efficiency, and foster a genuinely circular system where valuable materials are continuously reused rather than lost. Chemical science is not just contributing to the circular economy, it's transforming how we envision and execute sustainable materials management."

Survey respondent, chemical sector

"Understanding the condition of materials [at] end of life and the requirements for materials as repaired, repurposed or manufactured components or as feedstock for new manufacturing processes is critical for circular economy and baseline skills for a materials engineer"

Survey respondent, manufacturing sector

Several respondents also highlighted the value creation that this circulation of materials can unlock, for example:

"Recycling and reformulating waste products into re-usable materials (diversion from landfill and generation of income)."

Survey respondent, academic

Another key theme was the role of chemicals and materials science and engineering in designing, innovating and optimising processes, products and materials to, for example, improve efficiency, increase lifespans, substitute critical materials, reduce greenhouse gases and quantify environmental impacts as illustrated by the following responses:

"Chemical engineers help to assess "preloved" materials to replace both virgin raw materials and fossil fuels within the process, without compromising on either product quality, process emissions or plant & personnel safety"

Survey respondent, foundation industries

"Development of new materials that last longer and can be more easily recycled. Quantification of environmental impacts using life cycle analysis. Development of opportunities and processes for industrial symbiosis"

Survey respondent, academic

Several survey respondents commented that chemical and materials science and engineering offers scientific understanding and knowledge that underpins a circular economy, for example:

"[The] chemical sciences contribute to a circular economy by embedding sustainable practices into laboratory training and curriculum design. Learners are taught to consider the life cycle of materials, minimise waste, and adopt greener alternatives, such as using microscale experiments, solvent recovery, and non-toxic reagents. By instilling these principles early, we help shape a technically skilled workforce that understands not only how to carry out chemical processes, but how to do so responsibly and sustainably"

Survey respondent, academic

> *"By shifting towards such... processes, we can improve traceability, increase recovery efficiency, and foster a genuinely circular system where valuable materials are continuously reused rather than lost. Chemical science is not just contributing to the circular economy, it's transforming how we envision and execute sustainable materials management."*
>
> *Survey respondent, chemical sector*

> *Understanding the condition of materials [at] end of life and the requirements for materials as repaired, repurposed or manufactured components or as feedstock for new manufacturing processes is critical for circular economy and baseline skills for a materials engineer"*
>
> *Survey respondent, manufacturing sector*

Key roles and skills

Survey respondents were asked to select the most important jobs and skills in a circular economy from a list of 24 roles and 28 skills (identified from the IOM3 skills report and additional research), as well as which ones would face the greatest shortage. Table 1 shows the top 10 most important job roles and the top 10 roles identified as facing the greatest shortage. Materials engineer and research and development roles were identified as both important and facing supply shortages. The full lists of important roles and shortage roles as identified by respondents are shown in Figures 3 and 4, respectively.

Rank	Most important job roles	Rank	Job roles facing the greatest shortages
1	**Materials engineer**	1	**Materials engineer**
2	**Chemical engineer**	2	**Research and development**
3	**Research and development**	3	**Regulatory compliance specialist**
4	Environmental engineer/consultant	=4	Hydrometallurgist
5	Energy efficient specialist	=4	Metallurgical engineer
6	Supply chain manager	=5	Analytical chemist
7	**Process Engineer**	=5	**Chemical engineer**
8	**Regulatory compliance specialist**	=5	**Environmental engineer/consultant**
9	**Product development engineer**	=5	**Process engineer**
10	Safety and environmental compliance officer	=5	**Product development engineer**

Table 1: Top circular economy job roles and greatest job shortages. Roles in bold were identified as both important and facing shortages. '=' signifies tied ranks.

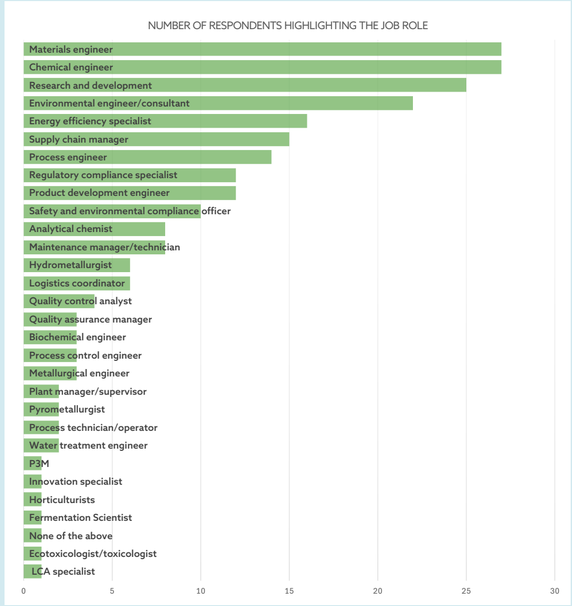

Figure 3: Top circular economy job roles, as identified by survey respondents.

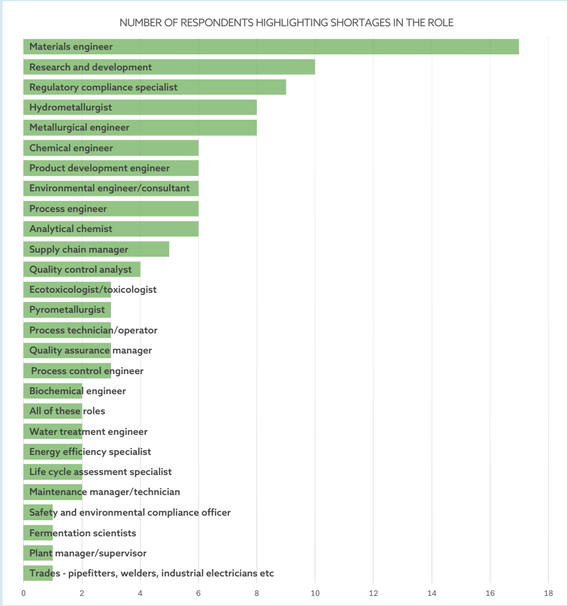

Figure 4: Job roles facing the greatest shortages in supply, as identified by survey respondents.

In a free text question, survey respondents also identified the following **job roles and role clusters** as important for their sector in a circular economy (listed here according to how frequently they appeared in the responses):

- Business, commercial, economics, marketing, procurement, project management and quality control roles, and those that are needed to scale up
- Lifecycle assessment specialists and material flow analysts
- Material recovery, recycling and waste management roles
- Sustainability specialists
- Supply chain and logistics roles
- Material scientists and design specialists
- Extraction and processing roles
- Policy specialists
- Roles in environmental monitoring, health monitoring, impact mitigation, environmental fate analysis
- Intellectual Property, legal and compliance roles
- Biotechnologists
- Electrochemists

Survey participants were also asked about **the most important skills,** and about which ones would face **the greatest skills shortages.** Table 2 shows the top-rated most important skills and those identified as facing the greatest shortage. Figures 5 and 6 show the full lists of important and shortage skills as identified by respondents.

Rank	Most important skills	Rank	Skills facing the greatest shortages
1	**Research and development**	1	**Research and development**
2	**Chemical separation processes**	2	**Metallurgical processes and techniques**
3	Process operation and control	3	**Materials analysis**
4	**Metallurgical processes and techniques**	=4	**Environmental management and compliance**
=5	**Materials analysis**	=4	**Chemical process engineering**
=5	**Chemical process engineering**	=5	**Science and engineering**
=6	**Environmental management and compliance**	=5	**Regulatory compliance and permitting**
=6	**Science and engineering**	6	**Chemical separation processes**
=6	**Product development and optimisation**	=7	Energy efficiency
7	**Regulatory compliance and permitting**	=7	Disassembly
		=7	Hydrometallurgy
		=7	**Product development and optimisation**

Table 2: Top circular economy skills and greatest skills shortages. Skills in bold were identified as both important and facing shortages. '=' signifies tied ranks.

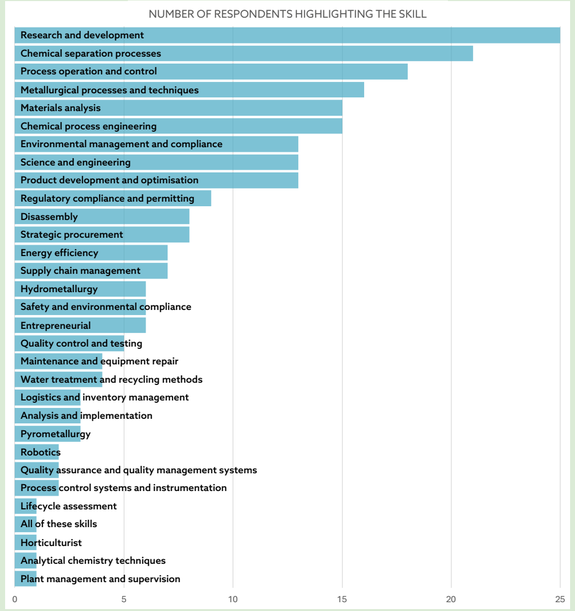

Figure 5: Top circular economy skills, as identified by survey respondents.

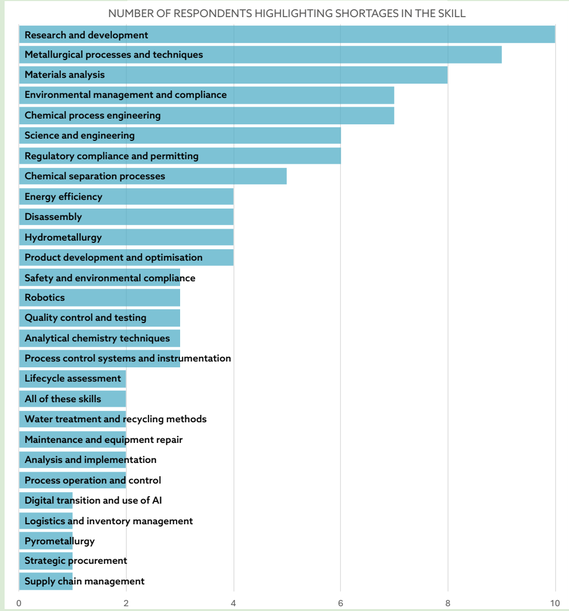

Figure 6: Skills facing the greatest shortages, as identified by survey respondents.

In a free text question, survey respondents also identified the following skills and skill clusters as important in addition to those already listed above:

- Strategy, planning, business, project management, lifecycle thinking, and techno-economic analysis skills
- Design (for recycling) skills; skills in recovery, reuse and recycling
- Systems thinking skills
- Policy skills
- Digital skills, data science, AI, and modelling skills
- Supply chain management skills
- Process control, process optimisation, scale-up, quality control, analysis, testing, and certification skills
- General skills, including problem solving and critical thinking

Workshop participants were asked how they saw their sector changing over the next decade. A point echoed by multiple workshop participants was that core chemical and materials science and engineering skills are likely to remain important; however, there will be *"an evolution"* in their application and demand.

Workshop participants outlined the various ways in which an increasing focus on sustainability and circularity was influencing the trajectory of their sectors, with changes spanning the full lifecycle, from sustainable design to value retention at end-of-first-life. One participant from the chemicals sector highlighted that the sector is *"re-evaluating everything they make",* from material selection to manufacturing processes and resource.

In a similar vein to the survey respondents, workshop participants highlighted that **far more engagement with and understanding of the broader supply chain is needed to facilitate the transition.** For example, the traceability of raw and processed materials across their full lifecycle is increasingly essential both for waste management and secondary supply. The growing importance of lifecycle analysis and the introduction of materials passports are both reflective of this trend.

Another particularly strong theme that arose from workshop participants was the **need for greater interdisciplinarity,** again echoing the survey findings. For example, a participant from the chemical sector highlighted that there is now a need for chemists to have knowledge and skills in microbiology. One workshop participant emphasised the need for *"skilled generalists":* professional staff who can assimilate diverse sources of information and use technical knowledge to unpick a problem. Systems thinking was another skill identified by both the survey respondents and workshop participants as key in a circular economy. This need for overarching was summarised as follows by one participant:

"Balancing inter/trans disciplinarity and systems thinking to solve problems, with deep enough domain knowledge AND critical thinking around limitations (understanding error in tools used for decision making, unintended consequences etc) [is important]"

Workshop participant

Workshop participants also identified **research and development skills and roles as increasingly vital** in a circular economy, again matching the survey findings. For example, a participant from the chemical sector highlighted that their industry is seeing a growing number of trials for new products which includes testing and development in research laboratories to study areas such as corrosion, quality control, and mechanical integrity in the context of circularity.

Alongside this, **scale-up skills** were identified as crucial by a number of workshop participants while broader business development and entrepreneurial skills were viewed as important by some participants, in particular by those working in SMEs. Workshop participants also highlighted the increased importance of **communications skills,** both in the context of communicating between industries to facilitate greater collaboration and raising awareness of the circular economy to the general public. Other non-technical skills identified by workshop participants were **economics and financial modelling, policy engagement specialists, commercial roles and entrepreneurial skills.**

Workshop participants highlighted that **digital skills** including digital twinning, digital technology, robotics, data analysis and management, materials 4.0 and AI were in growing demand, again matching the need for digital skills identified in the survey.

Ecotoxicology was another skill which was identified by workshop participants as important, with some suggestion that every chemist needs some understanding of this:

"As we reassess the type of chemicals we make, we need people that learn about chemistry to have an understanding of what's going to be harmful or toxic in the environment."

Workshop participant

> *"Balancing inter/trans disciplinarity and systems thinking to solve problems, with deep enough domain knowledge AND critical thinking around limitations (understanding error in tools used for decision making, unintended consequences etc) [is important]"*
>
> *Workshop participant*

> *As we reassess the type of chemicals we make, we need people that learn about chemistry to have an understanding of what's going to be harmful or toxic in the environment."*
>
> *Workshop participant*

> *"There isn't the attraction to technical roles in science and engineering due to many factors - assumptions that the training is hard, the pay is not great, and there are not great career prospects"*
>
> *Survey respondent, manufacturing sector*

Reasons for job and skills shortages

Survey respondents were asked to explain in their own words why they had identified a job role or skill as in particularly short supply. This was either interpreted as meaning a shortage of workers and certain skills, or in some cases, that the shortage of skills may be preventing certain jobs from being created in the first place as employers are unable to find people with the right capabilities.

A number of respondents identified a lack of training opportunities or courses as a key barrier. This includes a lack of coverage of these skills or knowledge in undergraduate degree courses, or the need for these skills to be learnt on the job, for example:

"Hydrometallurgy is not regularly covered at undergraduate level, there is a shortage of skilled process engineers as there are in demand across many sectors and regulatory compliance is increasingly complex and only really learnt on the job"

Survey respondent, waste and recycling sector

Several respondents identified that university department or course closures and cuts would exacerbate this problem, for example:

"We have education, especially HE, distracted by layered crises which put people off engagement and ultimately may risk closure of the very departments that can fill innovation, R&D and skills gaps"

Survey respondent, academic

"The reduction in degree courses offering this training has starved the supply chain of Materials Engineers/Scientists"

Survey respondent, defence sector

Another theme identified from the responses was the challenge of negative perceptions about some roles within circular economy, as well as lack of awareness among graduates and those in early career about the type of roles available. This also extended to HR personnel and careers advisors.

"Usually these roles are drawn to primary manufacturing with recycling and circular economy seen as a 'dirty' industry"

Survey respondent, energy sector

"There isn't the attraction to technical roles in science and engineering due to many factors - assumptions that the training is hard, the pay is not great, and there are not great career prospects"

Survey respondent, manufacturing sector

Several respondents also identified that finding people with the right combination of skillsets or level of experience is a challenge:

"Limited ability to find someone who simultaneously understands the process and has sufficient skills to work in the sector with the same crossover as someone who understands the regulatory environment significantly"

Survey respondent, manufacturing sector

Some roles or skills are very new so this can also create a barrier, as described by this respondent:

"Robotics is still too new to have created a large pool of high calibre graduates"

Survey respondent, materials sector

Other barriers highlighted included competition between sectors for some skills, a lack of UK career opportunities, uncertainty about future opportunities, the need to scale to match sector growth, poor salaries in some roles or sectors (potentially also adding to negative perceptions), and the length of time it takes to develop some skills. Several of these barriers are exemplified by this survey response:

"Finding quality analytical and hydrometallurgical specialists in the UK has been challenging. This is likely to be due to talent not gravitating towards these subjects as there are limited career opportunities within the UK. It may also be due to how courses are run in academia.

Supply chain specialists for raw materials such as E-waste exist but again, it is hard to find quality ones. Given the fractured nature of the E-waste recycling industry, building that knowledge base of the market and growing the network is challenging"

Survey respondent, chemical sector

The reasons for job and skills shortages were also discussed by workshop participants. Overall, the growth in demand for circular economy skills was seen as a challenge for employers, particularly when it comes to recruitment. One participant from academia highlighted that circular economy job posts have often gone unfilled. As a result, employers have taken to capturing these roles under a general sustainability banner and then training appointees on the job.

However, other workshop participants noted that employers can have an unrealistic expectation of the skills that graduates have, and this can be exacerbated by challenges in delivering on the job training as this is seen as time consuming, expensive and resource intensive. Several workshop participants highlighted that greater collaboration between those delivering education and those working in the sector would help to address this skills disconnect.

The skills gap in critical minerals was also flagged as particularly challenging by some workshop participants, with one participant noting that the UK is at risk of brain drain in this field. Workshop participants also identified a pressing need for companies to

collaborate across the supply chain, including the integration between upstream and recyclers and greater coordination between industry and academia.

The **need for regulatory skills** was a theme that arose from both workshop participants and survey respondents. Workshop participants highlighted that regulatory skills are generally not covered in courses and that these skills depend on on-the-job learning. One participant shared that they were *"not sure where the next generation of regulatory experts will come from".*

In addition to the industrial workforce, government bodies and regulators must have access to the skills needed to ensure effective enforcement. This means ensuring regulators have the expertise to take a whole system approach to circularity, rather than focusing only on the finer details of regulations. One participant argued that regulations need to be interpreted and enforced across the supply chain in such a way that benefits the transition to a circular economy.

The specialist nature of regulatory skills, in conjunction with their application in often highly specialised sectors, was seen as another reason for their shortage by a survey respondent:

"[Regulatory compliance specialist] is a niche area within a niche area, the people fulfilling this role need a high level of competence and experience which cannot be achieved without sustained investment in maintaining the skillsets"

Survey respondent, materials sector

Depth of specialism was also seen as a barrier in recruiting operators and technicians. For example, a participant from the magnet recycling industry shared that because their technology is highly specialised, finding workers with the practical skills to operate machinery can be a challenge. Multiple participants from other industries also highlighted that sourcing operators and technicians with sufficient experience was a concern.

Workshop participants highlighted that upskilling has become an increasingly important avenue for meeting skills demand. With the dynamic environment of transition, employers will also often need workers to be able to upskill and move into, or incorporate new areas as needs change. For instance, it was highlighted that chemical engineers increasingly have to upskill to integrate digital tools needed for process design for recycling. Moreover, it was noted that upskilling will be important for transitioning workers from declining, linear industries such as fossil fuels.

Finally, the nature of circular business practices means that **a regional outlook on skills** will be necessary. As cross-industry collaboration is fostered to achieve closed loop supply chains (i.e. where 'waste' materials are cycled back into production processes), regional clusters are likely to play an increasingly important role. As such, questions of labour supply and skills shortages will need to be assessed more on a local and regional level than might be seen under a linear economy model.

1.4 Key findings

The transition to a circular economy is reshaping industrial practices and driving demand for new skills and job roles, particularly in chemical and materials science and engineering. These disciplines are central to enabling sustainable materials management, from recycling and reuse to the design of longer-lasting, more efficient products. Chemical scientists, materials scientists, materials engineers, chemical engineers, and R&D professionals are both critical and in short supply – with these shortages set to become more pronounced over time. Key skills such as research and development, metallurgical techniques, materials analysis, and chemical process engineering are essential but lacking. There is a growing need for interdisciplinary expertise, systems thinking, and hybrid roles that combine technical, regulatory, and commercial knowledge. Embedding sustainability principles into education and training is essential, and collaboration across sectors and supply chains has to be fostered to support innovation and scale-up.

Significant barriers include a lack of training opportunities, course closures, and negative perceptions which deter talent from entering the field. The shortage of regulatory expertise and the challenge of finding workers with the right combination of skills and experience were also noted. Employers can have unrealistic expectations of graduates, while on-the-job training is seen as costly and time-consuming. Upskilling and cross-sector mobility are increasingly important, especially for transitioning workers from declining industries, and a regional approach to skills development, aligned with emerging industrial clusters and circular supply chains, is needed. Without targeted action, the UK risks falling short of the workforce needed to deliver a sustainable, circular economy.

2. Educational pathways to circular economy skills and roles

2.1 Why is this theme important?

Educational pathways are the foundation of the skills system. They are central to attracting and retaining talent and play a vital role in meeting the needs of industry and the economy.

Job roles and skills needs are changing with the transition to a low-carbon, circular economy, from the development and deployment of new technologies and processes to embedding new business models.

As set out in Skills England's assessment of priority skills to 2030, 'in a time of rapid technological change and shifting economic priorities, it's vital to equip our workforce with the right skills'[13].

Now is therefore a key moment to reflect on the current educational pathways – what is working well, what could be better – and to explore how well the current system is likely to meet evolving needs and deliver a workforce that is diverse, technically competent, interdisciplinary and practically experienced.

2.2 What did we ask?

We explored with stakeholders where the balance is of skills required from different educational pathways, how this will change over time and with business development, how well current educational pathways support progression into the circular economy, and how chemistry and materials university programme closures might impact this all.

[13] Assessment of Priority Skills to 2030. Skills England, 2025.

2.3 What did we learn?

A balance of skills and pathways is essential

The circular economy requires a workforce equipped with a diverse and evolving set of skills. As industries change – for example in how they manufacture products or how they adapt processes to use less or different materials, reduce energy, water consumption and waste – so do the skills that are required.

There was a clear consensus that a mix of educational and training pathways is necessary to meet these evolving and diverse demands for the variety of roles and skills needed for a circular economy. This includes academic, vocational and alternative pathways such as degrees, apprenticeships, reskilling and vocational training.

High proportions of workers in sectors reliant on chemical and materials science and engineering possess or require a degree level qualification. This will remain an important avenue to build the talent pipeline with contributors stressing the value of degree level understanding including as a foundation for non-technical commercial roles.

Alongside academic routes, technical and vocational pathways play a vital role in meeting the evolving needs, ensuring greater inclusivity and in bringing in new talent.

"[We] need more of all AND need to look at how we attract holistically, show the opportunities for comms, marketing, business management, finance/accounting"

Workshop participant

"Each pathway encourages a different perspective on what is actually happening in industry - all are needed"

Workshop participant

However, participants flagged that the current system typically favours academic routes, and vocational pathways are often undervalued by actors from across the skills ecosystem. It was highlighted that this is no longer sustainable or well-aligned with the skills required for a circular economy. It was emphasised that greater awareness, recognition and promotion of alternatives routes and the options and opportunities they provide is also necessary to meet the evolving needs, ensure greater inclusivity and to bring in new talent. Participants also noted that a persistent perception that vocational pathways are less valuable and that this stigma undermines recruitment, particularly among young people.

"The UK chemical sciences sector is likely to face the greatest supply shortages in roles that require hands-on technical expertise and practical application, particularly process technicians/ operators, maintenance technicians, chemical engineers, environmental engineers, and quality control analysts.

These positions are critical to ensuring safe, sustainable, and efficient chemical production, yet they are often underrepresented in education pathways and undervalued in career guidance. While FE and vocational routes such as T Levels and apprenticeships are beginning to address these gaps, uptake is uneven and infrastructure limited, particularly for real-world training. In higher education, many science and engineering degrees still fall short in preparing graduates for site-based or regulatory intensive roles."

Survey respondent, energy sector

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>
> *Survey respondent, energy sector*

Without action, roles identified by contributors as essential that are typically filled through vocational pathways (such as maintenance specialists, research technicians and operators) will remain in short supply. This bottleneck risks threatening the viability of industry and practical implementation of innovation. **Elevating technician-level careers**, providing **accredited training**, and offering **clear career progression pathways** were suggested to unlock a more inclusive and comprehensive workforce.

Apprenticeships, in particular degree apprenticeships, were highlighted as an important and successful route that equips individuals well and requires greater emphasis. Suggestions of areas that could benefit from more apprenticeship programmes included dealing with end-of-life lithium-ion batteries and diagnosis of problems for remanufacture / reuse and triage for recycling, where both technical knowledge and practical familiarity with safety procedures are important. Barriers persist, however, including the high cost of placements, the limited number of host companies and funding cuts – including the defunding of Level 7 apprenticeships – all restricting access.

Participants highlighted that the **balance of skills from different educational pathways changes throughout the different stages of technology maturity.** At early development stages there is a need for workers from highly specialised academic backgrounds, while at later phases there is a greater need for workers from vocational pathways including operators, technicians, and equipment maintenance roles.

"There is a need to move new critical materials recycling technologies up the TRLs, initially high-level skills will be needed to develop the technologies, but in time will shift to lower-level jobs to run and maintain plant in this sector"

Workshop participant

In addition, it was noted that, as technologies move through technology readiness levels (TRLs), there is an increasing need for hybrid roles that work across disciplines and combine technical knowledge with commercial, regulatory and systems thinking.

"Technologies can only move through TRLs if we have mobility of ideas, experience and people across sectors at all career stages"

Workshop participant

Negative perceptions and lack of awareness must be overcome

Improving negative perceptions and raising awareness of the opportunities available are seen as key steps to encourage individuals to pursue chemical and materials science and engineering educational pathways and career routes. Contributors expressed concern about the negative perception of working in industry, with it being seen as dirty, involving long hours, and not offering a secure or valuable career path.

All stakeholders (including teachers, industry, government and professional bodies) have an important role to play in sharing and showcasing modern industry, updating perceptions and raising awareness of the diverse and exciting opportunities available in a circular economy. This concern about negative perceptions and lack of awareness was also raised by survey respondents in the context of jobs and skills shortages.

Greater awareness among educational providers about the potential careers available and interventions such as a STEM ambassador in schools can help to support the pipeline of interest.

Opportunity to align educational pathways with the circular economy should be seized

The transition to a circular economy is becoming increasingly important; however, integration into educational pathways remains fragmented. Participants suggested circular economy principles should be embedded throughout education and into core modules and mainstream programmes, not just electives or in specialised courses.

A broader issue was highlighted in the need for systems thinking, with current education typically being siloed and providing little industrial context.

Integration of industrial context and experience

Throughout the workshops, the importance of relating education to real-world context was stressed as being essential to developing a fit and resilient workforce. This includes both industrial context embedded throughout the educational journey, and practical, hands-on industry experience at all career stages. Throughout education there is substantial benefit in relating concepts to modern technology and real-world examples. Not only does this help with learning but also in opening up career possibilities and building awareness of different industries. with contributors stressing the benefit of direct collaboration with industry to ensure up-to-date industrial perspectives are built into learning such that graduates are more prepared for the workforce.

This was noted for example in the context of higher education programmes:

"Industrial experience as part of degree programmes will be important to allow graduates to switch into the industrial mindset more easily"

Workshop participant

There was extensive agreement among contributors that meaningful, supported industrial placements are vital across all career stages. As well as providing industrial experience and practical insights, placements (including internationally) can encourage collaboration and enhance the domestic skills base.

However, a range of challenges was identified both for industry and education providers. Companies cited resource challenges, lack of capacity and incentives. Education providers outlined regional challenges relating to the location of large industry.

As one attendee shared, *"It's quite difficult to allow those or to enable those short placements".*

High numbers of graduates are struggling to find suitable work after their studies, while at the same time many companies struggle to fill graduate roles with the right people due to lack of relevant skills in the recruitment pool.

"We often hear from employers that graduates don't have the skills on graduating for the roles they need to fill, and similarly, we hear from graduates that they struggle to find entry level roles upon graduating"

Workshop participant

Bridging this divide is a crucial task in which both industry and educational institutes have a role to play. One delegate suggested that incentives for businesses to lean into work experience programmes might be advantageous in this regard. It was also suggested that policy incentives could be put in place to promote placement programmes and the inclusion of graduates in industry projects. For example, one participant suggested that grant funding for low-TRL projects to encourage graduate and involvement could be of benefit.

Closure of chemical and materials science and engineering departments pose a major threat

Chemical and materials science and engineering programmes are expensive to run and are increasingly facing financial challenges. Issues range from staff cuts and course mergers to programmes ending and department closures.

Participants were clear that the this poses a major threat to industry, to delivering the UK government's ambitions and to the UK's global competitiveness.

"The closure of Chemistry departments in academia will be detrimental and further worsen the skills gap in relation to circular economy"

Survey respondent, academic

> *As an industry, we are very concerned about the state of UK academia and the increasing difficulty for people to stay in relevant further education long enough to become sufficiently skilled for recruitment into high-tech industries. For a long time, the UK has depended on the excellence of its academic institutions; this is being undermined by uncertainty and underfunding. And if this is not rectified soon, it will no longer be a UK strength"*
>
> *Survey respondent, chemistry sector*

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Survey respondent, chemical sector

Chemistry and materials science and engineering underpin modern society and are integral to many key sectors from aerospace, automotive and construction to healthcare, manufacturing and transport. If chemistry and materials education contracts, so too will the pipeline of professionals capable of delivering the circular economy, including to drive critical minerals security, sustainable manufacturing and clean energy systems.

As put by one workshop participant, *"Everything is made of materials so if there is a reduction in the understanding of chemistry and material qualities progress will be lost".*

Course closures also result in sparser provision and the loss of regional access. This was highlighted as a concern for both employers and employees, affecting regional industrial clusters, limiting local workforce development and recruitment, and disproportionately impacting students from minority or low-income backgrounds who may not be able to relocate.

"Moving far from home is not an option for many - [there are] implications for equity of provision"

Workshop participant

One delegate suggested that prioritising educational programmes that coincide with the regional industrial base and employment opportunities may be beneficial in this regard.

"As students are increasingly studying in areas where they are from and it follows they are likely to remain in area (strong contrast to 1990s when most left home for uni), then could argue priority should be given to supporting where the relevant education programmes coincide with the industrial base and employers"

Workshop participant

Another significant concern is that the impacts of closures are not easily reversed and the current cohort of skilled staff to train the next generation is lost. Attempts therefore to 'turn back on the tap' with new funding or course provision in the future may meet delays and complications due to challenges attracting, training and supporting new talent.

"Loss of teaching, technical and research staff [is] also a concern - once courses close and staff relocate, there is a lag between 'turning back on the tap' with funding or course provision and ability to attract, train and support future workforce"

Workshop participant

2.4 Key findings

The transition to a circular economy demands a workforce with diverse, evolving skills supported by a balanced mix of academic, vocational, and alternative routes into the circular economy such as apprenticeships and reskilling programmes – however the current educational and training landscape does not provide this. We heard that vocational pathways remain undervalued, despite being critical for roles requiring hands-on expertise. Participants saw a need to elevate technician-level careers, improve access to accredited training across the circular economy, embed circular economy principles and systems thinking across education curricula, and connect learning to real-world industrial applications to better prepare graduates for the workforce.

Negative perceptions of industry careers and limited awareness of opportunities in chemical and materials science were seen to be barriers to recruitment, and the closure of chemistry and materials departments was seen to pose a major threat to the UK's industrial capability and global competitiveness, limiting the accessibility of these courses and opportunities for people living in areas without a nearby department, and leading to the long-term loss of skilled educators. Alignment of educational provision and regional industrial needs, as well as policy incentives to support industrial placements are needed urgently. Without action, the UK risks undermining its ability to deliver the workforce needed for a sustainable, circular economy.

3. Sourcing circular economy skills

3.1 Why is this theme important?

External recruitment is a routine way for companies to meet their immediate workforce needs, and organisations working in the circular economy are no different. If companies have difficulty sourcing the skills they need through this route, then this has the potential to impose additional costs, to constrain their plans and activity, and increase the need for reskilling and training of their existing workforce.

3.2 What did we ask?

We asked workshop participants whether they were able to source the skills they need locally, from the UK, or in the international market. Participants were also asked about any challenges they

have encountered in doing this, and their experience of the regional profile of skills availability and demand.

3.3 What did we learn?

Before discussing specific challenges associated with the circular economy, participants noted that they felt that the general hiring environment in the UK was difficult (for instance with recent Employer National Insurance Contributions increases). Considering the circular economy specifically, participants identified deep challenges in sourcing skills from local, UK-wide and international markets.

"Employers report struggling to fill positions with enough grads both locally and regionally - reliance on international skills doesn't conflate well with existing immigration policy"

Workshop participant

Locally, participants saw a shortage of workers for the circular economy. Particular challenges were noted for rural areas which often lacked transport networks. Recruitment across the UK saw challenges including a reluctance to relocate on the part of individuals, particularly to rural areas or areas that were seen as undesirable.

"[I]t can be easier to get someone to relocate from Europe to the Northeast, compared to getting someone to relocate from South to North in the UK"

Workshop participant

"Regionality often goes hand in hand with salary benchmarking, which we know is important to emerging graduates due to the rising cost of a degree and living - many are attracted to places based on their potential earning as much as their potential life and working environment"

Workshop participant

Place branding and local engagement were seen as crucial tools to address this issue, with Future Humber being cited as an example of good practice in improving perceptions. Socio-economic barriers were also identified as restricting access, with individuals from lower socioeconomic backgrounds being less likely to relocate in pursuit of opportunities.

Participants also reported a lack of specific skills and experience, and competition for expertise across different sectors. International recruitment challenges included visas, post-Brexit barriers, and competition for more specialised/highly specialised skills that are only available internationally:

"Recruiting abroad has become more difficult with visa regulations and the specific nature of the skills we needs compared to that on the visa applications. Recent challenges…include the pay bands required to stay compliant with the visa and we are still unsure how the new immigration rules…will impact. It also takes longer to relocate someone to the UK."

Workshop participant

Some participants reported seeing preferred candidates dropping out part way through recruitment processes once they had come to appreciate the costs of relocating to the UK. One participant highlighted that international recruitment is a particular challenge for smaller companies.

"Smaller companies [are] less able to recruit from wider geographical pools - and don't have facilities to support international worker visas"

Workshop participant

Beyond challenges in sourcing skills, there were clear areas of agreement regarding demographic challenges, the evolving nature of skills needed in the circular economy, and the importance of training. These are explored in turn below.

Concerns were expressed that **many experienced people in the current circular-economy related workforce are reaching retirement age** and that, as they leave the industry, their specialist skills and know-how would be lost. Relatedly, there was a concern that many of these skills would not be passed on to the next generation, which would represent a significant reduction in organisational know-how across the sector within the next decade

Workshop participants from the private sector were clear that they wanted to recruit graduates who were able to quickly upskill and move into different areas as needs changed. As the circular economy develops and evolves, participants agreed that the work that people would need to do would also shift, along with the skills needed to accomplish it. **Flexibility and ability to learn new skills** were therefore seen as key attributes for the circular economy workforce.

Training was recognised as being important for the circular economy, but participants found it hard to deliver or access in practice. On-the-job and in-post training were seen to be challenging for smaller companies to provide, given the associated costs and demands on staff time (e.g. to back-fill someone who is on a training course). Even representatives from larger companies reported finding it difficult to support industrial placements due to the resource demands involved. There was agreement that graduate training schemes and Innovate UK Catapult Centres had a key role to play in supporting companies in sourcing the skills they needed.

A number of specific regional clusters of circular economy activity were discussed in the workshops which were felt to provide examples of strong academic and industry partnerships. These included: the Aerospace sector in Bristol; Rolls-Royce University Technology Centres; Future Humber (promoting the area and its opportunities); battery recycling clusters in Coventry, Birmingham, Warwick; and electric vehicle and battery specialisations in the Midlands.

3.4 Key findings

The central takeaway from the exploration of this theme was that **skills shortages are seen to be a real threat** by those close to the circular economy and there are significant challenges in addressing these through external recruitment, either locally, nationally or internationally.

Sourcing skills for the circular economy presents significant challenges across local, national, and international recruitment. There are difficulties in hiring graduates with the right expertise, especially in rural areas where transport and relocation barriers are more pronounced. Socioeconomic factors and regional salary disparities further complicate recruitment, with many candidates prioritising earning potential and lifestyle. International hiring is hindered by visa regulations, post-Brexit constraints, and the high cost and complexity of relocation – particularly for smaller companies lacking the infrastructure to support overseas hires. Place branding and local engagement to improve perceptions and attract talent will play an important role in skills sourcing more locally.

Beyond recruitment, the ageing workforce and the risk of losing specialist knowledge as experienced professionals retire are major challenges. The evolving nature of circular economy roles demands flexibility and the ability to upskill quickly, yet training opportunities remain limited. On-the-job training is resource-intensive and often inaccessible for smaller firms, while even larger companies struggle to support industrial placements. Graduate training schemes and Innovate UK Catapult Centres can be key enablers for bridging these gaps, and regional clusters – such as those in aerospace, battery recycling, and electric vehicles – can serve as models of academic-industry collaboration that could be replicated to strengthen the circular economy skills pipeline.

> *"Supporting people to know their potential or possible application of skills elsewhere would support movement and inter-industry-mobility"*
>
> *Workshop participant*

4. Avenues to reskilling

4.1 Why is this theme important?

At present, circular economy skills exist only in small pockets of the economy, and sources of talent – such as the pipeline of new university graduates – simply cannot provide the numbers of workers needed to fill the roles required. Given this, reskilling the existing workforce has a crucial role to play in providing the skilled workers needed for the circular economy. Existing workers will need to be supported to transition into the circular economy and develop the new skills and competencies they will need to do so.

As the economy changes, new jobs are created in some industries and lost in others – for instance, many areas of the circular economy are growing as some long-established industries are declining. For individuals, for companies and for the country more broadly, this represents an opportunity to ensure that the best use is made of the skills of workers leaving these industries, and this can include reskilling to work in the circular economy.

4.2 What did we ask?

Workshop participants were asked about the opportunities presented by reskilling into the circular economy from other sectors, what support was needed for this, what training opportunities were available at present, and what the challenges were. They were also asked about their experiences filling temporary skills gaps and how they went about doing this.

4.3 What did we learn?

Participants strongly agreed that reskilling has a crucial role to play in providing the circular economy workforce, particularly given the limited and ageing workforce in many industries relying on STEM skills. Particular opportunities were highlighted for reskilling with regards to the transitions from oil and gas, and from primary plastics feedstock to plastics production from secondary feedstock.

"Oil and gas project skills are transferable to H2 and decarbonation. Plastics recycling can take skills from Formulation and waste sorting sectors. Minerals processing has solids handling which can take in skills learnt in the Pharma Sector"

Workshop participant

Despite consensus on the importance of reskilling, several issues were identified with achieving it in practice, and a range of factors threatened to undermine the contribution of reskilling to the circular economy. These include awareness, pay disparities, and concerns about the price, availability and accessibility of Continuing Professional Development (CPD) and reskilling.

Awareness was identified as a key barrier to reskilling. It was seen as crucial for employers to better **recognise less conventional sources of expertise and progression routes**, and the transferability of skills. Often, both employers and jobseekers were unaware of how certain skills can be applied in new contexts and new industries (e.g. many skills from the oil and gas sector can be applied in green energy industries).

"Supporting people to know their potential or possible application of skills elsewhere would support movement and inter-industry-mobility"

Workshop participant

"Awareness of skills to transfer - plastics (biobased or fossil based) needs polymer chemistry skills, for example"

Workshop participant

This lack of awareness means that individuals are less likely to think that these new industries could be appropriate places for them to work, and companies often overlook these transferable skills and set overly prescriptive requirements for new recruits which could exclude individuals who could in fact be good candidates for upskilling/reskilling, building on their existing knowledge and expertise. There was some discussion about the role that a national framework for recognising transferrable skills could play in allowing individuals and companies to better understand how skills could be transferred between different roles.

Another challenge for reskilling was **pay disparities between industries.** For some individuals, circular economy-aligned roles offer lower salaries than roles in their previous industry, providing a clear disincentive for them to reskill and shift roles.

Concerns were also expressed around the **price, availability and accessibility of CPD** and reskilling. The costs of CPD and reskilling were seen to dissuade some individuals and companies from making what could be a substantial up-front investment. In addition to costs or lack of awareness preventing people from reskilling, there were also challenges noted in the accessibility of training such as gaps in provision in certain geographical or topic areas, and challenges in ensuring that training keeps pace with the constantly evolving needs of industry. Government financial support, modular training and secondments were seen as having an important role to play in addressing these challenges.

The dynamic and evolving nature of the circular economy means that **all companies can expect to face temporary skills gaps.** Attendees spoke about responses to such gaps that ranged from hiring new staff, to redistributing activity across the existing workforce, to scaling back activity. Such skills gaps were seen as being easier for larger companies to fill because, due to their size, they possess greater flexibility in their workforce.

There was a range of good practice in reskilling that was identified in the discussion, including Innovate UK Knowledge Transfer Partnerships whereby a graduate can access university facilities and knowledge, and transfer these to the company (and often find permanent employment there); the Innovate UK Catapult Network which was seen to be in a strong position to offer applied training; and the Environmental Biotechnology Network, University of Southampton.

Survey respondents were also asked about whether training opportunities exist to reskill or upskill workers to mitigate skills supply gaps. Significant numbers of respondents said opportunities either do not exist or are limited in their availability. Echoing the workshop participants, survey respondents highlighted lack of funding, lack of awareness or advertising of training opportunities, and varying availability depending on sector as reasons for their answer.

"Often, some training opportunities do exist, but the extent to which these are well advertised or funded is limited. In skills supply gaps for areas of cutting-edge technology, reskilling and upskilling opportunities are limited as training is always a few steps behind industry"

Survey respondent, manufacturing sector

"Yes, there are opportunities but (a) are there enough, (b) are they well known and (c) do people understand what they can lead to?"

Survey respondent, defence sector

In contrast to the challenges noted above, some respondents reported that training opportunities are available, although some people went on to qualify that these might be internal only.

Some respondents suggested that greater co-ordination between government, industry and education providers would support the reskilling and upskilling ecosystem, with one identifying this as particularly important in the green transition.

"To support the existing workforce, the government could implement upskilling and reskilling programmes that enable workers from traditional industries to transition into green jobs. By collaborating with industry bodies and employers, the government can tailor these programmes to meet specific skill shortages and ensure that workers are equipped with the necessary competencies to thrive in the green economy"

Survey respondent, waste and recycling sector

"To support the existing workforce, the government could implement upskilling and reskilling programmes that enable workers from traditional industries to transition into green jobs. By collaborating with industry bodies and employers, the government can tailor these programmes to meet specific skill shortages and ensure that workers are equipped with the necessary competencies to thrive in the green economy"

Survey respondent, waste and recycling sector

Collaboration was also seen as important to ensure opportunities from different providers do not remain siloed, and all actors within the skills ecosystem have a role to play.

Given the concerns about the expensive or resource intensive nature of training courses, support with funding was also identified as a way to support the availability of opportunities. Finally, technology and innovation centres such as the Innovate UK Catapult Network were also identified by one survey respondent as a key opportunity in supporting the bridge between academia and industry, something that was also discussed during the workshop.

"Catapults are in a prime position to offer the applied training needed to build on strong university R&D foundations as a bridge to industry. Catapults are increasingly filling the gap left by the historic large industry employers who would have nurtured the development of R&D professionals"

Survey respondent, other

4.4 Key findings

Reskilling is a key source of talent for the circular economy, especially given the limited supply of new graduates and the ageing STEM workforce, but it is hampered by a range of issues ranging from lack of awareness to funding and cost challenges. There are opportunities to transition workers from long-established industries – such as oil and gas, and 'traditional' plastics production from primary feedstocks – into emerging circular economy roles, with many skills being transferable across sectors. However, several barriers hinder effective reskilling, including low awareness

of transferable skills, pay disparities between sectors, and the cost and accessibility of CPD. Non-traditional expertise needs to be recognised more, and national frameworks for skill transfer, and more modular, affordable training options are necessary. Government support, secondments, and collaboration between industry and education providers will be key enablers.

Temporary skills gaps are common in the evolving circular economy landscape, and while larger companies can often adapt more easily, smaller firms face greater challenges. Training opportunities were often limited in their availability, or not as well known about by those who would be interested in them – particularly in fast-moving technology areas. Coordinated efforts across government, industry, and education were seen to be vital to ensure training is relevant, accessible, and well-funded, and collaboration was seen to be essential to build long-term, attractive career pathways that support retention and growth in the circular economy workforce. Good-practice examples include Innovate UK's Knowledge Transfer Partnerships and Catapult Centres, which help bridge academia and industry.

5. Views from our communities on policy priorities

5.1 Why is this theme important?

The circular economy poses a range of opportunities and challenges for UK policymakers, promising to support government agendas in numerous ways. However, a circular economy cannot be developed in isolation, and it links with a wide range of government departments and policy objectives – from promoting innovation and economic growth through to achieving environmental goals and keeping citizens and consumers safe. Policymakers and regulators will need to adapt to both help bring about and respond to the circular economy – for instance, as new chemicals, materials, processes and products are developed.

5.2 What did we ask?

Participants were asked about their top priorities for policymakers in connection to the circular economy and what they felt success would look like.

5.3 What did we learn?

An overriding message from workshop participants was that government should recognise that **chemical and materials science and engineering are fundamental to the circular economy,** and that government action to promote the development of skills in these areas was essential. Some felt that courses on these topics should be seen as being of *"national strategic importance"* and supported by the government to ensure they can contribute to the economy and circular economy.

Participants highlighted several fundamental requirements for a successful policy regime for the circular economy. These included **alignment and mutual reinforcement between government strategies,** robust targets and measures for progress on the circular economy, as well as long-term policy certainty and stability.

As one workshop participant put it, policy needs to *"offer certainty and security for the materials and minerals sector to make roles more attractive during uncertain times"*.

There was also a desire for government to promote the circular economy, for example by encouraging repair and remanufacturing rather than replacement (as seen in initiatives like the EU's right-to-repair legislation).

Long-term stability was seen to be fundamental for giving industry the confidence to make investment decisions, and in giving individuals the certainty they needed to make decisions about their careers, such as relocating, changing industry or investing in training. It was seen to be particularly important given that this is a new area that is developing and requires investment of companies, and of individuals to decide to move into these new roles.

Education and skills were seen as a priority policy area by workshop attendees. It was felt that circular economy principles needed to be embedded into educational pathways at all levels. Contributors felt that, at present, the circular economy could sometimes appear as a "tick box exercise" in certain courses, without actually inculcating a circular economy mindset.

Participants saw a clear role for government in addressing perceptions and awareness of the opportunities associated with the circular economy – both with the existing workforce and the next generations.

"Employers are struggling to hire young people because they see mining, manufacturing and recycling processes as 'dirty' and possibly negatively impacting on the environment"

Survey respondent, other

There was a strong desire to see government remove barriers to education, including vocational pathways such as apprenticeships, and to provide greater support as part of this – particularly for smaller and medium-sized businesses, and especially in relation to apprenticeships. It was noted that addressing these barriers would widen the talent pool available for the circular economy and improve diversity within the field.

"Employers are struggling to hire young people because they see mining, manufacturing and recycling processes as 'dirty' and possibly negatively impacting on the environment"

Survey respondent, other

Reflecting on recent policy developments, participants viewed the **growth and skills levy as a key opportunity** for encouraging more people to get involved in the circular economy, there was concern about the uncertainty around the Apprenticeship Levy, and while the creation of Skills England was welcomed, it will need support from industry and government departments to deliver at the pace demanded.

Participants highlighted the need for an **adequately resourced and skilled regulatory environment** to enable and support the circular economy. Without this in place, they felt that consumers would not be able to have confidence in new products, and companies would not have the necessary certainty about the frameworks they need to operate within to allow them to make

> *In some sectors (i.e. Environmental Agency) compliance and policy to regulate sustainable practices is well developed, but not necessarily in all industries with innovative technologies and there needs to more thinking about waste and life cycle assessment of new products. Analysis of products in expensive and industries need investment to be able to use the best technologies"*
>
> *Survey respondent, academic*

effective long-term decisions. This need for skills in the circular economy was seen to extend to policymakers more generally, to ensure that they were able to make effective decisions in this emerging field.

"It is not realised that people in my job role can go into industries like that. We just think of scientific lab-based roles, not policy or regulation"

Survey respondent, academic

"In some sectors (i.e. Environmental Agency) compliance and policy to regulate sustainable practices is well developed, but not necessarily in all industries with innovative technologies and there needs to more thinking about waste and life cycle assessment of new products. Analysis of products in expensive and industries need investment to be able to use the best technologies"

Survey respondent, academic

Planning and permitting were mentioned in the workshops as areas for particular attention, with a call for streamlined, consistent permitting processes and better integration of the circular economy into policy frameworks to ensure that regulation was not a bottleneck for innovation.

On the theme of supporting individuals and companies potentially involved in the circular economy in their decision-making, workshop participants saw a role for government in **mapping industries and their skills needs,** and making this information public, as well as encouraging recognition of cross-sector relevant training and certification to help individuals move between sectors more easily.

5.4 Key findings

Key findings from the discussions included a strong consensus that chemical and materials science and engineering are foundational to the circular economy and should be recognised as areas of national strategic importance. Participants saw the need for a **long-term, ambitious and systematic policy regime for the circular economy,** as well as appropriate level of knowledge of the circular economy on the part of policymakers and regulators to be able to make a success of it. A well-resourced and skilled regulatory environment was seen as essential for enabling innovation and consumer confidence, complemented by streamlined planning and permitting processes. There was a clear role for government to play in **raising awareness of the circular economy and the opportunities** it presented, as well as in reshaping the educational system to ensure that people had the knowledge, skills, and awareness needed to participate. Participants identified mapping of industry skills needs and better recognition of cross-sector training as two important ways to supporting people in pursuing careers in the circular economy. In the world of education, the circular economy had been seen to be growing in prominence, although it was felt that at present, many approaches treated it as a superficial add-on, rather than fostering a genuine mindset shift. Relatedly, the circular economy was seen as being held back by barriers to vocational education (especially apprenticeships), and challenges for SMEs in accessing training.

Part 3: The way ahead

Introduction

The transition to a low-carbon, circular economy relies on chemical and materials science and engineering. From developing longer-lasting materials and technologies to the recovery and reuse of valuable resources, these disciplines provide the essential skills needed to reduce reliance on raw materials and build resilience into UK supply chains.

To achieve this transition, it is vital that industry, education and training providers, regulators and policymakers can access professionals equipped with the right expertise, supported by appropriate education and training. However, the current talent supply is struggling to meet this growing need, and it is forecast to become an even greater challenge as the demand and competition for chemical and materials science and engineering skills increases.

A robust and resilient workforce with a strong skills pipeline, and clear and accessible education and training pathways into the circular economy, is therefore of strategic importance. However, the current system is not adequately aligned to meet this growing demand. In addition, while core skills remain vital, their applications are changing – requiring more interdisciplinary, digital, and systems thinking capacities from all actors.

Strategic planning and coordinated action are urgently needed to address critical skills shortages, challenge outdated perceptions, support reskilling efforts, and promote rewarding career pathways that support the UK government's ambitions.

All actors - including industry, education and training providers, regulators and policymakers - have an important role to play to deliver a skills system that is future facing, inclusive and responsive to the evolving needs of a low carbon, circular economy. This means investing in lifelong learning and upskilling opportunities, strengthening collaboration between sectors, and ensuring that pathways into chemical and materials science and engineering careers are in the circular economy are visible, accessible, and appealing to diverse talent.

Only through coordinated, strategic action can the UK build the workforce necessary to accelerate the transition to a low-carbon, circular economy and secure long-term economic and environmental resilience.

The next section draws together conclusions from across the workshops and survey, synthesising them under a number of cross-cutting themes identified by the research team. It also considers how these align with the existing literature as well as the policy landscape.

Key conclusions

1. An enabling policy and regulatory environment is integral to a circular economy

A skilled workforce capable of driving the transition to a circular economy requires a robust, coordinated enabling environment that aligns policy, regulation, industry action and education and training provision. This is essential to unlock the full potential of chemical and materials science and engineering in driving the transition. Stakeholders across the workshops and survey consistently highlighted the need for ambitious, aligned, and

stable policy frameworks supported by well-informed and adequately resourced regulatory systems. The increasing complexity of regulatory compliance and need for cross-sectoral training was also highlighted in the RSC's 'Future workforce and educational pathways report'[7]. This aligns with the Industrial Strategy's emphasis on reducing regulatory burdens.

2. Skills mapping and planning are urgently required

A successful transition to the circular economy depends on the availability of the right skills in the right places at the right time. However, understanding of the circular economy workforce is fragmented, with significant gaps in both strategic planning and skills intelligence.

There are critical shortages in strategically important roles – including materials engineering, R&D professionals, metallurgists and regulatory specialists – that pose a direct risk to the UK's ability to deliver circular economy goals. These shortages are identified both in this report and elsewhere – metallurgical engineers, hydrometallurgists and chemical engineers as top shortages in the CMA UK's recent 'Skills development for UK critical minerals and recycling' report[5], and metallurgical skills in the IOM3 report 'The talent gap: critical skills for critical materials'[4]. Contributors to this work identified that these challenges were compounded by limited reskilling and workforce mobility, due in part to a lack of awareness around the transferability of skills across sectors.

To address these challenges, a coherent, data-driven approach to skills mapping and forecasting is urgently needed. Strategic planning must be informed by industry, education and training providers, and policymakers working in partnership. This will enable better alignment of educational pathways and training provision with emerging demand, more effective deployment of talent, and the development of a more resilient and responsive skills system.

3. Skills needs and applications are evolving as the circular economy develops

The transition to a circular economy is reshaping industrial practice and with it, the skills required. To deliver on the UK's circular economy ambitions there is not only a need for a greater number of skilled professionals, but also for a workforce that reflects these changing demands. While core chemical and materials science and engineering skills remain essential, their applications are evolving. Increasingly there is a need for professionals to complement technical expertise with skills such as systems thinking, regulatory awareness, policy skills data literacy, supply chain insight and the ability to work across disciplines. This is supported by IOM3's report[4], which notes growing demand for automation, robotics, and data analytics, while the CMA UK study[5] identifies a potential regional aspect for some skills shortages while others are national. The general theme of shifting industrial demand is echoed by recent work by Lightcast for Engineering UK which found that demand for 'green skills' and postings of 'green jobs' within engineering had grown steadily over time[14].

[14] Engineering skills needs – now and into the future: A report produced by Lightcast for EngineeringUK. EngineeringUK, 2023.

Critical job roles such as materials, chemical, process and environmental engineers, and R&D professionals were identified in our research as both vital and in short supply. At the same time, emerging roles in regulatory compliance, supply chain awareness and life cycle analysis are gaining strategic importance but are often poorly understood, underdeveloped in training pathways or lacking visibility in career pipelines.

New business models demand flexibility and adaptability, yet current training pathways and awareness are not keeping pace. A proactive, strategic approach is required to future-proof the workforce, scale innovation and meet circular economy goals.

4. The circular economy requires modernised curricula and a combination of educational pathways

Contributors from industry, academia and the public sector agreed that the UK's chemical and materials science and engineering education system is poorly aligned with the needs of a low-carbon, circular economy. Academic pathways, while important, dominate the system and are often siloed, lacking practical, interdisciplinary and systems-based skills.

There is deep concern over the closure of chemistry and materials higher education courses and departments, warning that this further weakens the UK's ability to meet its goals and compounds insufficiencies in the education system; this is discussed in more detail in the next section.

Vocational and technical routes - crucial for technician and operator roles - are consistently undervalued, underfunded and poorly understood by actors across the skills ecosystem. The RSC's 'Future workforce and educational pathways' report[7] shows that a degree remains the most in demand pathway to the chemical sciences workforce, but also highlights the low availability of apprenticeships in chemistry-related fields, 'the 2022/23 academic year saw 408 level 3-5 apprenticeships started in the Laboratory Technician and Technician Scientist pathways – compared to 4,900 students accepted onto a chemistry degree course'.

The imbalance between academic and alternative pathways is viewed as driving critical skills and jobs shortages in areas vital to a circular economy, including process operations, regulatory compliance and materials recovery. Contributors identified key priorities: embedding circular economy principles and systems thinking into all levels of education, integrating these into core curricula, and elevating vocational and technical routes through better funding, career guidance and recognition.

Industrial placements and collaboration between education providers and employers are essential to bridge the gap between learning and employment. Contributors stressed that hands-on experience is vital at all career stages, but access is uneven due to cost, location and limited capacity. The CMA UK study[5] reinforces this, calling for stronger partnerships between universities and industry to embed specialist skills and provide real-world learning opportunities.

Skills needs also shift as technologies mature, affecting the balance between academic and vocational pathways. There was clear and urgent agreement across sectors that reform is needed to build a workforce with the technical, regulatory and interdisciplinary skills required for a successful circular economy transition.

5. Financial pressures on university departments pose significant risks

Chemical and materials science and engineering departments and courses at UK universities are under significant and increasing financial pressure. This is likely to be a key factor in decisions to close departments (such as the Chemistry Departments at the University of Hull, Bradford, Aston and others). It is also leading others to make cuts to staffing or provision, with longer-term risks for research and teaching.

Course closures threaten the overall numbers of circular economy workers that the UK is able to train in its universities, but financial pressures on courses can have negative effects beyond outright closures: for instance, cuts to staffing and provision in university courses can undermine the quality of teaching that can be offered (resulting in a less highly skilled workforce and potentially undermining the quality of research produced), and were seen to weaken courses and potentially make them more susceptible to closure in the future. In addition, closure of departments can create 'cold spots' which create regional inequalities in access to STEM education and undermines national capacity to train future chemists and materials scientists.

Threats to the sustainability of provision of these university courses poses significant risks to the ability of the UK to produce the next generation of skilled workers to contribute to the circular economy, which threatens the pursuit of a number of government priorities ranging from delivery of growth through the Industrial Strategy, or the forthcoming Circular Economy Strategy, Industrial Decarbonisation Strategy, Clean Energy Workforce Strategy and Critical Minerals Strategies.

6. Recruitment locally, nationally and internationally is challenging

Despite the growing importance of the circular economy, major challenges affect the future supply of skilled workers. These include difficulties in recruiting qualified candidates locally, nationally and internationally, limited access to affordable and relevant training, low awareness of transferable skills, and an ageing workforce in many STEM disciplines leading to loss of valuable expertise and the ability to pass this on. IOM3's 'The talent gap' report[4] also highlights the challenges presented by an aging workforce.

7. Addressing negative perceptions and low awareness supports talent attraction

Roles essential to the circular economy suffer from low visibility, negative perceptions and poor understanding of career opportunities. To attract talent, the sector must be seen as offering rewarding careers. Currently, many roles are viewed as undesirable or overlooked entirely. This is reinforced by findings in the IOM3 report[4], which identifies negative perceptions of roles in the critical minerals value chain as a barrier.

This lack of awareness and poor perception restricts the potential workforce and threatens the UK's ability to meet its strategic goals.

8. Collaboration and partnerships are vital to meet the skills and workforce needs of the circular economy

Contributors to this report were clear that collaboration is essential to building the chemical and materials science and engineering skills base required for a circular economy. The scale and complexity of the challenge cannot be met by any single sector or institution alone. Achieving meaningful progress will require long-term, co-ordinated partnerships across academia, industry, government and regulators.

Cross-sector collaboration is key to unlocking innovation, scaling technologies and ensuring skills development keeps pace with industrial change. Better integration across supply chains – from recyclers to manufacturers – is needed. Successful regional clusters, such as battery recycling in the Midlands and aerospace in Bristol, show what can be achieved when collaboration is prioritised.

Academic-industry partnerships are especially urgent. Without them, graduates lack the practical experience and industrial context needed to succeed. Contributors called for more placements and joint training programmes, embedded into education and training design rather than added later. The RSC's 'Future workforce and educational pathways' report[7] also identified the importance of work experience and placements, recommending that employers engage more actively with education providers.

Innovate UK's Catapult Centres and Knowledge Transfer Partnerships are vital mechanisms, but must be scaled up and better resourced to meet growing demand. Government support is crucial – through policy alignment, funding incentives and help for SMEs – to overcome barriers and build a connected skills ecosystem.

Place branding and regional engagement were also seen as powerful tools to attract talent and improve perceptions of industrial centres. Contributors urged stakeholders to work together to promote circular economy careers, improve sector perceptions and ensure equal value across all educational pathways.

Recommendations

The UK's transition to a circular economy presents significant opportunities for economic growth, job creation, and enhanced resource resilience. This is a monumental transformation and chemical and materials science and engineering will be pivotal in enabling this shift.

As we look ahead, it is apparent that we urgently need strategic, coordinated action across the UK skills ecosystem to drive this transition. In the table below, we set out **a suite of recommendations for key actors** that are grounded in the perspectives that emerged from our communities in this work (Table 3).

Government and employers in industry need to work alongside education and training providers and professional bodies to build and maintain a resilient, future-ready workforce that realises the potential of the circular economy. We need an inclusive approach, and stakeholders must work together to align education and training with circular economy skills, improve visibility of career pathways, and ensure strategic alignment across policy and practice. Only through this kind of collective, coordinated action can the UK secure the workforce required for a sustainable, resilient future.

Table 3 (overleaf): Detailed actions for stakeholders. These are grouped so that related actions read across columns to highlight that meaningful change in the skills ecosystem can only occur if actors coordinate and collaborate. For the recommendations for government, the relevant and lead stakeholders are indicated in brackets.





Government	Industry/employers	Education & training providers	Professional bodies	Everyone
(A1) Recognise the strategic role of chemical and materials science and engineering: Acknowledge these disciplines as foundational to government priorities related to the circular economy, and embed these disciplines into national skills strategies, workforce and educational pathway planning. (Cross-government)	**(B1) Champion the strategic role of chemical and materials science and engineering:** Promote recognition of chemical and materials science and engineering as core enabling disciplines for the circular economy and raise awareness of the importance and potential of circular economy careers, including with teachers, students, parents and broader public.	**(C1) Embed circular economy approaches:** Integrate circular economy principles including systems thinking, digital literacy, and supply chain awareness into core learning outcomes across all levels of education. **(C2) Embed career awareness:** Raise awareness of the importance and potential of circular economy careers, including with students, parents, and the broader public as well as integrating into chemical and materials science and engineering education.	**(D1) Champion the strategic role of chemical and materials science and engineering:** Promote recognition of chemical and materials science and engineering as core enabling disciplines for the circular economy and raise awareness of the importance and potential of circular economy careers, including with industry, teachers, students, parents and broader public.	**(E1) Promote the opportunities of the circular economy:** Promote the opportunities presented by the circular economy including the diverse careers involved. This should include public awareness, working with parents and other key influencers of young people. This is particularly important in areas that suffer from negative perceptions, for instance through place-based branding and local engagement, learning from examples such as Future Humber.
(A2) Lead skills data and evidence gathering: Develop a UK-wide approach to circular economy skills data and evidence gathering, with Skills England and devolved counterparts convening the relevant stakeholders. (Skills England, devolved counterparts, DfE, DWP, local and mayoral strategic authorities, HMT)	**(B2) Support strategic workforce planning:** Contribute to national and regional skills planning by sharing insights on current and emerging roles, participating in strategic workforce initiatives, and helping to define evolving job profiles, especially those not yet reflected in occupational standards.	**(C3) Support strategic workforce planning:** Contribute to national and regional skills planning by sharing insights on education and training provision.	**(D2) Facilitate cross-sector collaboration and insight gathering:** Convene and support dialogue between industry, government, employer-led sector skills bodies and education and training providers to share emerging good practice (including of collaborations), identify challenges, gather insights on evolving skills needs and opportunities in the circular economy, and connect potential partners.	
(A3) Lead strategic skills and workforce planning: With Skills England and devolved counterparts as the convenors, perform strategic skills planning including (i) regular national and regional mapping of current and future skills needs, (ii) cross-sector demand, (iii) replacement demand and (iv) the implications of industrial transitions. This could be facilitated by establishing UK-wide coordination mechanisms (e.g. cross-sector working groups) to align circular economy skills planning across sectors and devolved administrations, and providing funding and guidance to enable industry, education provider and professional body involvement. Consideration should be given to areas most affected by industrial transition or with the greatest potential for growth in circular economy industries. (Skills England, devolved counterparts, DfE, DWP, Defra, DBT, DESNZ, local and mayoral strategic authorities)	**(B3) Collaborate across the wider skills ecosystem:** Work with other sectors, education providers, professional bodies, and policymakers to shape future skills needs. This includes contributing to strategic skills planning through engaging in industrial advisory boards, informing skills gap analyses, and ensuring educators have access to up-to-date information about employers' needs. **(B4) Partner regionally and across the sector:** Build long-term, active, regional and sector-wide skills partnerships by engaging with local authorities, and education and training providers.	**(C4) Collaborate across the wider skills ecosystem:** Work with industry, professional bodies, and policymakers to shape future skills needs. This includes contributing to strategic skills planning, informing skills gap analyses, and working with employers to gain up-to-date insight about employers' needs.	**(D3) Collaborate across the wider skills ecosystem:** Work with industry, education and training providers, and policymakers to shape future skills needs. This includes contributing to strategic skills planning, informing skills gap analyses, and working with employers to gain up-to-date insight about employers' needs.	
(A4) Address strategic skills shortages: With Skills England and devolved counterparts as the convenor, develop and implement targeted strategies for critical skills that are identified as in short supply and strategically important to the circular economy. (Skills England, devolved counterparts, DfE, DWP Defra, DBT, DESNZ, local and mayoral strategic authorities)	**(B5) Strengthen and maintain workforces:** Plan for workforce needs by identifying critical roles, aligning recruitment criteria with job requirements, and ensuring accessibility across qualification levels. Improve retention through professional development, career progression, and recognition.	**(C5) Align provision with circular economy needs:** Adapt curricula and training programmes to reflect national and regional circular economy skills mapping. In the more immediate term, identify and emphasise aspects of the existing curricula that support the skills required for the circular economy.	**(D4) Identify opportunities in current curricula:** Help identify aspects of existing curricula that should be highlighted as supporting the skills required for a circular economy.	





Government	Industry/employers	Education & training providers	Professional bodies	Everyone
(A5) Ensure long-term course viability: Work with education and training providers to ensure that decisions on course viability reflect the long-term strategic value of programmes aligned with circular economy skills. (DfE, Skills England, devolved counterparts, HMT)		**(C6) Ensure long-term course viability:** Work with government and funding bodies to ensure that decisions on course viability reflect the long-term strategic value of programmes aligned with circular economy skills.		
(A6) Support high-quality education and training provision: Support the provision of high-quality chemical and materials science and engineering education and training for a circular economy, including, academic, vocational and technical routes that are accessible for all. (DfE, Skills England, devolved counterparts, DSIT, UKRI, OfS, HMT)	**(B6) Collaborate to develop responsive provision:** Engage in ongoing dialogue and work with education and training providers, professional bodies, students and other institutions to support design and delivery of training that is relevant and aligned to current and future workforce needs to help close skills gaps.	**(C7) Collaborate to develop responsive provision:** Engage in ongoing dialogue and co-design and deliver education and training that is relevant and aligned to current and future workforce needs by working closely with employers, students, professional bodies and other institutions.	**(D5) Collaborate to develop responsive provision:** Engage in ongoing dialogue and work with education and training providers, industry, students and other institutions to support design and delivery of training that is relevant and aligned to current and future workforce needs. **(D6) Equip educators to inspire future talent:** Facilitate school ambassador programmes and outreach activities, and support teacher CPD to ensure educators have the resources and knowledge needed to guide students toward careers in the circular economy.	
(A7) Ensure curricula and educator readiness: Ensure that school, technical and vocational curricula equip learners with the technical, transferable, and digital skills needed to participate in the circular economy. Enable access to high-quality CPD for educators to support delivery of circular economy content across relevant subjects. (DfE, Skills England, devolved counterparts)	**(B7) Expand outreach and awareness:** Increase involvement in public outreach to raise awareness of circular economy careers and skills including through working with professional bodies and other non-governmental organisations. For example, supporting school visits, careers events, and work experience programmes across all educational levels.	**(C8) Promote interdisciplinary and flexible learning pathways:** Collaborate across institutions and disciplines to develop broad interdisciplinary pathways that cultivate both deep technical expertise and 'skilled generalists'. Offer flexible, modular training options to support diverse learner needs and evolving industry demands.	**(D7) Promote career awareness and educational pathways:** Collaborate with members and stakeholders to raise awareness of circular economy job opportunities and promote the diverse range of educational pathways into these roles, including vocational and interdisciplinary routes.	**(E2) Promote skills pathways into the circular economy:** Recognise, value and promote vocational and technical educational pathways into the circular economy, and ensure academic and vocational routes awarded at the same level are held in parity of esteem. Careers advisers, teachers, professional bodies, employers, industry, employer-led sector skills bodies and policymakers all have a role to play in achieving this.
(A8) Reduce burdens to providing industrial experience: Provide support for employers to offer placements and work-based learning, and for education and training providers and individuals to access them for example by providing guidance and templates to make partnerships easier and more attractive. Ensure equity by identifying and addressing regional access challenges and financial barriers for participants and providers. (DBT, Defra, DESNZ, DSIT, HMT) **(A9) Facilitate industrial placement partnerships:** Drawing on existing good practice, local and mayoral strategic authorities should convene and broker partnerships to make these appealing and more accessible. (Local and mayoral strategic authorities)	**(B8) Enable industrial experiences:** Provide meaningful work-based learning experiences by hosting student placements, apprenticeships and industrial experience programmes, and collaborate with education and training providers, and professional bodies to ensure these opportunities are accessible and aligned with career pathways.	**(C9) Integrate industrial experiences:** Incorporate practical, hands-on experience into further and higher education programmes to prepare students for professional roles in the circular economy. This includes placements and industrial experience, and exposure to industry technologies and practices.		





Government	Industry/employers	Education & training providers	Professional bodies	Everyone
(A10) Enable more extensive and inclusive opportunities for reskilling: Skills England and devolved counterparts to convene stakeholders to support expanding the provision, affordability and accessibility of upskilling and re-training opportunities to support career transitions. This could include reviewing and modelling options for providing additional financial support for training connected to the circular economy, modular or flexible options, and the opportunities presented by the lifelong learning entitlement. (DfE, DWP, Skills England, devolved nation counterparts, HMT) **(A11) Support recognition of skills transferability and pathways:** Explore the viability of a UK-wide framework for recognising transferable skills or cross-sector training/certification. (Skills England and devolved counterparts) **(A12) Promote opportunities and skills transferability:** Increase the visibility of pathways to transition into circular economy roles and the transferability of existing skills. Promote these opportunities with targeted awareness or promotion campaigns for particular sectors, geographies or demographics. (Defra and cross-government)	**(B9) Champion flexible training and career pathways and skills transferability:** Recognise and encourage diverse sources of expertise and progression routes into the circular economy and the transferability of skills from other roles and sectors. This could be by offering secondment opportunities, supporting CPD and training provision and working with government and other stakeholders to facilitate and promote opportunities.	**(C10) Expand provision of training to support career transitions:** Training providers should engage with the opportunities presented by the circular economy and the demand it creates for training in the circular economy skills by expanding and refreshing training offers and developing new provision.	**(D8) Support awareness of skills transferability:** Support the visibility of pathways and opportunities to transition into circular economy roles and the transferability of existing skills.	**(E3) Raise awareness of transferability of skills into the circular economy:** Government, education and training providers, professional bodies, industry and employer-led sector skills bodies should collaborate to raise awareness of how skills can be applied in new contexts and new industries, e.g. through ensuring students encounter it early as a career option. **(E4) Develop new pathways into the circular economy:** Government, professional bodies, industry and employer-led sector skills bodies should collaborate to develop recognised career pathways and CPD credentials in circular economy skills, so professionals can clearly see how to enter and progress in the sector.
(A13) Address barriers to international recruitment: Address barriers and costs associated with international recruitment ensuring policies on visas and fees for international recruits reflect the needs of the circular economy alongside other government objectives. (Home Office, HMT)				
(A14) Align and coordinate strategies: Ensure strategic alignment and mutual reinforcement between government strategies, workforce plans, and industrial policy in support of the circular economy and its associated skills needs. (Defra and cross-government)				





Government	Industry/employers	Education & training providers	Professional bodies	Everyone
(A15) Build policy confidence: Deliver long-term policy certainty and stability to give industry, education and training providers, and individuals the confidence to invest in circular economy skills and career pathways, including through policy frameworks with a longer time horizon. (Defra, DBT, DESNZ, DSIT, HMT)			**(D9) Support policy literacy:** Provide guidance and opportunities to help professionals integrate emerging circular economy skills into their practice, including enhancing understanding of relevant policy and regulatory frameworks.	
(A16) Set targets and measure progress: Set clear and robust targets and measures, developed in collaboration with industry and education and training providers, for circular economy progress, including specific indicators related to skills development and workforce capacity in strategically important areas. (Defra, DfE, DBT DESNZ, DSIT)	**(B10) Collaborate to develop ambitious and practical targets and measures:** Work with government and other stakeholders to support the development of measurable and impactful targets.	**(C11) Collaborate to develop ambitious and practical targets and measures:** Work with government and other stakeholders to support the development of measurable and impactful targets.		
(A17) Resource national bodies: Ensure that national bodies such as Skills England and devolved counterparts are empowered and resourced to drive coordination between skills policy and industrial strategy. (DfE, devolved counterparts, HMT)				
(A18) Support an effective planning, permitting and regulatory environment: Ensure the UK's planning processes are streamlined and consistent, and the regulatory environment is adequately resourced, skilled and able to keep pace with and enable innovation and investment in the circular economy in a proportionate and responsive way. (Cross-government)			**(D10) Support regulatory and policy engagement:** Act as a bridge between policymakers, industry and education providers to ensure provision reflects current and future requirements of the circular economy.	

Annex – Workshop and survey methodology

The evidence exploration described in this report is based around findings from two workshops and a wider online survey held in July and August 2025.

Workshops

The workshops were convened online by IChemE, IOM3 and the RSC, bringing together 47 participants from the chemical and materials science and engineering communities including the Department for Business and Trade (DBT), the Department for Energy Security and Net Zero (DESNZ), and the Department for Environment, Food and Rural Affairs (Defra). Participants included individuals with experience in large multinational companies, small- and medium-sized enterprises, trade associations, professional bodies, consulting, research services, university teaching and research.

The workshops were structured into a scene-setting introductory session, two sets of breakout discussions in smaller groups, and short plenary sessions to report areas of convergence and note to all participants. The breakout discussions were facilitated by IChemE, IOM3 and RSC representatives who took participants through 12 questions clustered into five thematic areas as | per Table A1. The questions were co-developed with representatives from DBT and DESNZ ahead of the first workshop.

Theme	Questions
Skills horizon for individual sectors	How do you envisage your sector or discipline will change over the next decade? What are the implications for jobs and skills? What are going to be the most important jobs and skills?
Educational pathways to circular economy skills and roles	What balance of skills from different pathways are needed – academic, vocational/technical routes? How will this change over the next 5 years, 10 years, and as technologies move through TRLs and are commercialised? How well do current educational pathways support progression into roles within a circular economy? Are there any good/useful examples of these pathways? How would closures of chemistry or materials courses or departments in universities affect your sector or discipline?
Skills sourcing	Can you source the skills and knowledge you need locally, from elsewhere in the UK, or do you recruit from abroad? Any challenges with that? How does regionality affect skills demand? Can you identify any regional clusters of specialisms? In your experience, are companies looking to local universities for skilled graduates?
Reskilling	What opportunity is presented by reskilling from other sectors? What is needed to support this transition and what are the key challenges? To what extend do appropriate training opportunities exist to upskill or reskill workers?
Priorities and success criteria	What would be your top priorities or recommendations to policy makers? What would success look like over the next 5 to 10 years?

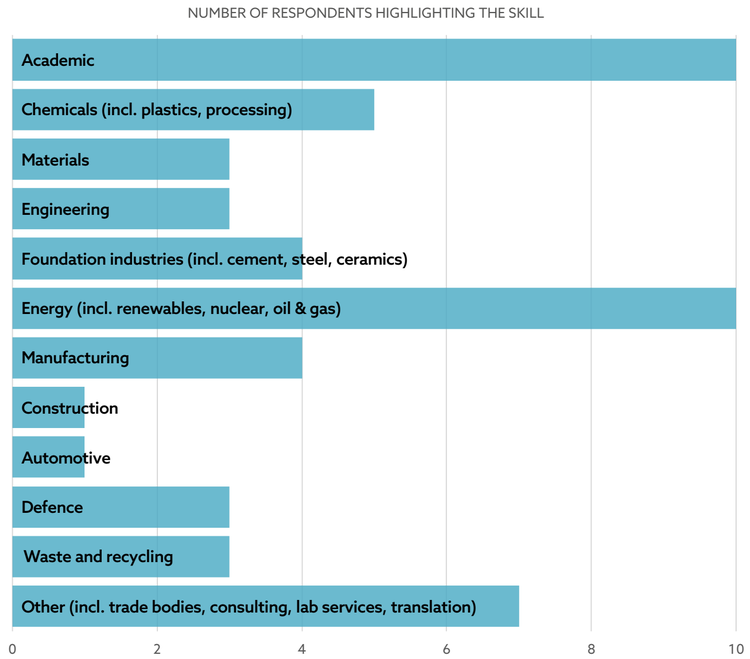
Left: Table A1: Workshop themes and questions discussed in the breakout groups.

An online whiteboard was used to allow participants and facilitators to capture perspectives and quotes. The plenaries and breakout discussions were recorded to complement the note taking and the information compiled on the online white board.

Survey

The online survey was designed to complement group discussions and was sent to workshop participants as well as our organisations' wider network to provide respondents with the opportunity to expand on their individual perspectives.

The survey was completed by 54 respondents from our communities. Figure A1 gives a breakdown of survey respondents by sector.



Right: Figure A1: Breakdown of online survey respondents by sector.

The questions administered in the survey build on those used for the workshop breakout discussions and answers were a mixture of multiple-choice and free text, providing opportunity for respondents to expand on specific points and to indicate whether they would be willing to be contacted about their responses. Table A2 gives an overview of the questions.

Analysis

The quantitative and qualitative data gathered in the workshops and the online survey were compiled and analysed by the IChemE, IOM3 and RSC policy teams. Free text answers to survey questions were coded to identify recurring themes and trends.

This quantitative and sentiment analysis was then positioned in the current policy context and existing literature to surface granular insights and new learning relevant to the circular economy transition and skills debate.

Questions	Answer type
What sector or discipline do you work in?	Free text
What is your job title?	Free text
Do you think your current role contributes to a circular economy?	Multiple choice
With which of these do you most closely identify?	Multiple choice
How do the chemical sciences / material sciences / material engineering / chemical engineering contribute to a circular economy in your sector or discipline?	Free text
Are you a member of any of the following organisations?	Multiple choice
Out of the following which job roles do you think will be most important for your sector in a circular economy?	Multiple choice
What other chemistry or materials using roles will be important for a circular economy in your sector? This could include non-specialist roles that need a chemical/material science or engineering background.	Free text
From the job roles you have identified, which do you think will face the greatest supply shortage?	Multiple choice
Why?	Free text
From this list, what are the key chemical/materials science or engineering skills that are needed in a circular economy in your sector?	Multiple choice
What other skills can chemical/materials scientists/engineers offer that are needed for a circular economy?	Free text
From the skills you have identified, which do you think will face the greatest supply shortage?	Multiple choice
Why?	Free text
Where you have identified a skills supply gap, do training opportunities exist to reskill or upskill workers to mitigate this?	Free text
What is your awareness of the following government strategies that are under development or have recently been published?	Multiple choice with 5-point scale
How relevant to your work are the following government strategies that are under development or have recently been published?	Multiple choice with 5-point scale
Is there anything else you would like to share about skills or jobs in a circular economy?	Free text

Table A2: Online survey questions.

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