

CIA

CHEMICAL
INDUSTRIES
ASSOCIATION

Cogent skills

for science industries

FUTURE SKILLS FOR THE CHEMICAL INDUSTRIES



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The Chemical Industries Association is the organisation representing and advising chemical and pharmaceutical companies located across the UK. Our core membership is a diverse mix of chemical and pharmaceutical companies operating within the UK.

Our representation includes lobbying legislators, policy-makers and stakeholders on the issues that affect our member companies the most. We do this at UK, European and international level.

We provide advice and guidance to our member companies by:

- Reporting on policy developments
- Providing business support
- Technical application of legal requirements
- Sharing good practice

We cover nine policy areas:

- Climate change
- Energy
- Health & safety
- Employment
- Trade
- Environment
- Security
- Chemicals management
- Economic affairs

Our member companies decide on our policy and approach through our committees, led by our President Tom Crotty (Director of INEOS) and our Board.

Our staff members are based in Westminster, with some working remotely in different parts of the UK. Our Chief Executive is Steve Elliott.

ABOUT COGENT SKILLS

Cogent Skills is the UK's strategic body for skills in the science industries. Our purpose is entirely focused on skills and supporting the skills needs and ambitions of individual employers and their employees. We are sector-based, working with companies from across the science industries embracing Life Sciences, Industrial Sciences and Nuclear.

We have particular expertise in STEM vocational education and industry regulation with respect to skills and competence. Cogent Skills also supports and facilitates the Science Industry Partnership (SIP) and the Nuclear Skills Strategy Group (NSSG).

Cogent Skills has a long history of producing skills research publications that provide clarity and strategic direction on the issues that matter most to UK science employers. Recent publications include:

- SIP Life Sciences 2030 Skills Strategy
- SIP Apprenticeship Survey 2020
- Life Sciences: Equality, Diversity and Inclusion
- Future Skills for the Downstream Sector

FOREWORD

The UK chemicals sector is a key enabler for achieving Net-Zero. The sector provides many of the technologies needed to transition to a low carbon economy, and our highly-skilled, technically advanced workforce can play a leading role in the charge for industrial decarbonisation.

As a major contributor to the UK economy, adding more than £18bn every year, the sector is also making substantial progress on its operations, continuously working to reduce its carbon footprint whilst remaining competitive on the global stage. However, the industry also understands societal expectations and recognises the need to do more.

The insight in this report highlights the influence of Net-Zero and the introduction of new digital technologies as two significant and emerging trends expected to fundamentally alter the day-to-day operations and working practices of chemical businesses in the coming years.

There is a clear need to advance these agendas to maintain and grow the sector's competitive position in global markets. However, the rapidly evolving nature of these trends means that there is still so much unknown, and companies will need time and support to adjust and prepare for the world ahead. This is especially true given the hugely disruptive impacts of Brexit, COVID-19, the cost of living squeeze and Russia's invasion of Ukraine.

At its core, this is a skills issue with some employers lacking the relevant experience and understanding to capitalise on advancements in technology. With that in mind, collaboration between sector companies is key to creating a shared understanding of critical issues and sharing best practice and examples of best use cases.

Although these trends present a significant challenge, they also represent an opportunity to reinvent the sector and engage with the next generation of highly skilled workers.

We know that the proportion of workers in the sector qualified to a degree level has risen significantly over the past decade. Employers predict the demand for higher-level skills will increase further and be particularly acute in the short to medium term. The demand for innovation, R&D and engineering skills will be extensive throughout the economy and competing for them is already a challenge. The best and the brightest want to work in innovative companies using cutting edge technology and making a difference.

Therefore, we must recognise the move toward Net-Zero and Industry 4.0 as an attraction and perception opportunity. Now more than ever, it is important that chemical companies live up to the standards and expectations of the modern workforce. This also means a solid commitment to ED&I and a proactive approach to promoting the breadth of rewarding career pathways available in the sector. It is also increasingly important to promote a culture of lifelong learning and provide genuine opportunities for career development among existing employees to minimise the impact of an ageing workforce.

Apprenticeships have traditionally provided a reliable entry point into the sector and must be protected and enhanced to keep up with the evolving needs of the industry. They are also a valuable tool as companies look to find innovative ways of upskilling and reskilling workers into future-ready roles.

This report makes an important contribution to our understanding of the sector's current position on skills at a critical time. We look forward to working together to address the challenges outlined in this report.



Steve Elliott
Chief Executive
Chemical Industries Association

1

BACKGROUND AND METHODOLOGY

The concept of sustainability is already well-established in a chemicals sector that is largely built upon the principles of continuous improvement. Even so, the legal commitment by the UK government to reduce national greenhouse gas emissions to 'Net-Zero' by 2050 has brought renewed emphasis and growing urgency to the challenge. There are a variety of potential strategies that organisations can pursue to achieve and maintain Net-Zero emissions, and many companies will need to adopt a multipronged approach that considers the full range of their activities.

At the same time, the growth of industrial digital technologies has the potential to take the sector's manufacturing capability to the next level. Industry 4.0 is the ongoing automation of traditional manufacturing and industrial practices using modern smart technology. There is a wide range of advanced technologies relevant to the chemicals sector, promising everything from efficiency and productivity gains to improved health & safety performance.

Net-Zero and Industry 4.0 are thus expected to fundamentally alter the day-to-day operations and working practices of sector companies over the coming decades. Although this presents a significant challenge, it is also an opportunity to transform the sector as forward-looking and uniquely placed to help society achieve its decarbonisation targets. This will only be possible if employers have access to the skills they need as the sector evolves, and yet there is currently limited insight into the future skills landscape.

Cogent Skills hosted two roundtable events with 14 chemical industry leaders to explore these emerging trends in detail and understand their impact on the skills needs of sector companies. The attendees were predominately senior management staff from Human Resources and Learning & Development, such as HR Directors and Chief People Officers. Equally, several senior technical staff were in attendance, such as Manufacturing Managers and Technical Training Managers.

To help guide the discussions, attendees were also asked to complete two short surveys before the events. Due to the relatively low sample size, the surveys do not provide a robust source of quantitative data. The data is not strong enough to confidently represent the feelings of the wider chemicals sector. Therefore the results from the survey in terms of percentages and figures will not be reproduced in this report. However, the report will refer to the survey throughout to provide context to the conversation around the general feeling of participants.

This research should not necessarily be considered exhaustive, but it is intended to be an honest, reflective, non-judgmental report that will help the sector understand its current position and inform the action plan moving forward.

2

SETTING A PATH TO NET-ZERO

One issue that soon became evident was the challenge of confidently developing a precise strategic direction around sustainability and the target of Net-Zero carbon emissions. To start with, some participants found it difficult to comprehend the size and scale of the potential undertaking. One employer commented, *"The whole scale of it is so huge that the whole world is only just waking up to it."* Another suggested that one challenge is how to *"focus minds"* on the challenge ahead because *"2050 feels like a million miles away."*

There are, in fact, a wide range of potential pathways that organisations can take to help them achieve their sustainability goals. Part of the problem lies in differentiating between the possibilities and having confidence that the chosen strategy is appropriate and works practically, in line with the overarching business needs.

"We're trying to set a direction without fully understanding what direction we **need** to go in."

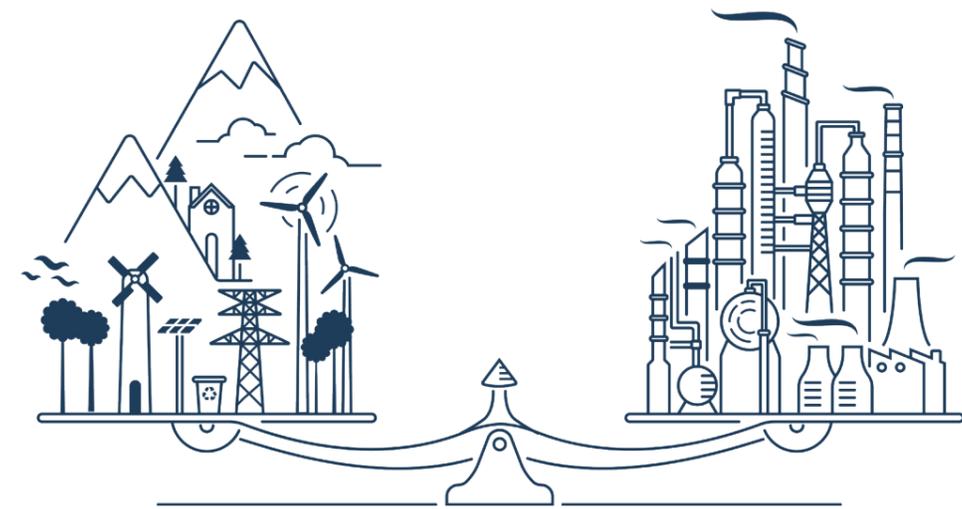
The accompanying survey presented five potential strategies asking respondents to rate them in terms of how important they are to their organisation's transition towards Net-Zero. The results below are ranked in order of importance, with 1 as the most important:

1. Low Carbon/ Renewable Energy usage
2. Resource Efficiency, e.g. reducing waste/ maximising productivity
3. Environmentally friendly procurement practices
4. Carbon capture, usage & storage (CCUS) technologies
5. Development of 'green' products/ services

Interestingly, more than three-quarters of respondents gave all five potential strategies a rating of between 'High' and 'Critical' importance. This suggests that many organisations expect to have a multipronged or 'portfolio' approach to sustainability. However, the scope of this issue goes beyond even the suggested strategies. One employer pointed out, *"It's not just what you're doing on-site. How is your product getting to your customers? How are your raw materials getting to you? It's massive."*

"In terms of developing 'green' products and services, when you've got an established business, that is a really difficult challenge to take on. I would say that the majority of our focus will be on resource efficiency, reduction of waste, and maximising the productivity of our manufacturing remit."

“You don’t want to invest however many millions of pounds to do something and then find out you’ve gone in the wrong direction.”



2.1 Measuring carbon footprint

A prerequisite to forming a cohesive strategy around sustainability begins with understanding the organisation’s current carbon footprint. There was a general recognition that this is a particularly challenging undertaking, with a potential lack of consistency between approaches. This raised the possibility that different companies could be calculating their carbon emissions in entirely different ways and that a ‘standardised’ approach may be needed.

This difficulty means that some organisations are unsure of their current position and consequently are uncertain about which actions they must take in order to achieve Net-Zero.

“We don’t understand the size of the issue. We don’t understand what the problem is or where we are trying to get to. We don’t know where we are at now in carbon, and if we don’t understand where we are now, it’s hard to imagine how we are going to get to zero.”

This uncertainty and lack of clarity is also a significant barrier to financial investment in new technologies and processes. As one employer observed, *“We recently completed a beta study that came out with numerous different options, ranging from spending £5-10 million to spending £40-50 million. But until you actually know what answer you’re trying to achieve, it’s really difficult to then say, ‘this is the way that we think we should go’.”*

“It’s a bit of a ‘caught in the headlights’ moment at this point, and we need to figure this out.”

This is perhaps particularly concerning for small companies, with one SME commenting, *“We’ve got a modest capital budget at the main site, and a lot of that is already allocated to the*

things that need to be done to the site. So the financial cost would be huge for us, and we might not be here in 2050 because of that.”

Companies must be supported as they continue to develop their understanding of sustainability and set out their plans for the future. One such project is the ‘Department for Business, Energy & Industrial Strategy’ Industry of the Future Programme (IFP). The IFP aims to work with industry to understand what is required to make sites ‘retrofit-ready’ by assessing the feasibility of new equipment. Successful applicants will have access to a contractor that will help them evaluate their options for implementing technologies that could reduce the site’s carbon emissions and develop a deep decarbonisation road map.¹

Unfortunately, the application deadline for the IFP has already passed. The level of support available should be deepened and expanded, especially considering the urgency of the problem and the wide variety of processes and technologies used in the sector.

1. BEIS Industry of Future Programme, Scoping Study Competition: Application Guidance Notes, 2021

2.2 Skills for sustainability

Despite the overarching uncertainty, participants did have a good overall sense of the skill areas that will be important on their sustainability journeys. The employers were given a list of 21 potential skills and asked to rate their likely importance regarding their organisation’s transition towards Net-Zero. In descending order, the top six skills were:

1. Innovation
2. Data analysis & modelling skills
3. Health & safety
4. Management & leadership
5. Managing change
6. Research & development

The skills highlighted above indicate that parts of the sector are still working through a transition period that will involve new ways of thinking and will require strong leadership to deliver.

One employer commented, *“We’ve got a mature business, so we know what we do, and our people know what we do. We have high-level thinkers, and they can offer some innovation, but it’s not a ‘step out’. When I think of the chemical engineers in our business, they are improving what we’ve already got, but the scale of this is just massive. We need people who are not constrained by what we’re currently doing.”*

Another participant observed that *“Management & leadership, and managing change, are almost as critical as innovation because it’s about how you engage and influence stakeholders and senior leaders.”*

Another remarked that *“Our biggest challenge is going to be more around the commerciality of what we do. Our commercial team will potentially have to interact with an entirely different sector, with entirely different demands around our products. How they negotiate the commercial contracts and engage with a different customer base is a big challenge.”*

“We need people who are not constrained by what we’re currently doing.”

“It’ll be more about tweaking current skill sets. The biggest changes will probably come in terms of the equipment that is being used.”

2.3 Demand for higher qualifications

There was a consensus that green/sustainability will increase the demand for highly skilled workers who are qualified at a degree or equivalent level (levels 6 and 7). However, this discussion also raised a couple of important considerations.

Firstly, the demand for certain skills will depend on timescale and specifically how far through the transformation process the organisation is. One employer remarked, *“I would imagine that over the next five years, innovation, creative thinking, and R&D will be right up there. And then perhaps they become less important as we start to understand our commerciality and what our strategy is. And then you’re very much back to process operations, attention to detail, and engineering becoming the key skills”.*

Equally, the demand for certain skills will be concentrated around specific roles and functions within the sector. *“There are a handful of people in the scientific and engineering fields who we need to be innovative and look at different ways of doing things. For everybody else, it’s things like critical thinking, compliance, and being able to go along with what’s required within the role. They’re equally important because if we get them wrong and people aren’t operating the plant properly, then we’re going to be inefficient with resources and potentially have bigger environmental consequences from not doing things properly.”*

It is worth noting that the proportion of workers in the sector who hold a degree or equivalent level qualification has increased from 22.5% in 2010 to 37.8% in 2020.² This suggests that the industry already necessitates consistent increases in demand for higher-level qualifications. For context, it is also true that there has just generally been a rise in the

overall number of workers across the economy who now hold a degree, with record levels of young people now being accepted onto university courses.³



2. Office for National Statistics, Annual Population Survey. Trend data - 2010:2020
3. <https://www.ucas.com/corporate/news-and-key-documents/news/record-levels-young-people-accepted-university>

2.4 Updated skill sets

Employers were asked to consider if a significant number of roles within their organisation will need to be completely rethought in order to achieve Net-Zero. Although participants agreed that most workers will need some understanding of the issues, they generally don’t believe it will require a complete overhaul of existing roles. One employer commented, *“The roles that are operating the plant, and the support roles all around that, will use different equipment or software, but actually I don’t see a fundamental difference in the required skill sets.”*

An example given was that it will be just like introducing new operations and processes to existing operator staff. There may be different skills that need to be learnt within that for each new bit of equipment, but overall it is ‘doable’ and something most organisations will already have some experience of.

Despite the aforementioned, there was broad agreement that most employees will still need an understanding of how their role impacts the organisation’s sustainability journey. This drew comparisons to the intensity and seriousness of approach usually associated with health & safety or compliance.

One employer stated, *“This will become second nature to any of us, just as understanding our responsibilities under safety. On an individual level, you will probably have an understanding of your own carbon footprint because I can’t see how you can hit zero without that understanding. Everybody will need to know what their impact is. And to sustain it at zero – that’s massive. ‘How much effort do we all put into safety?’ And I’m guessing that all of us would say that we could still improve our safety performance. And we do that every day and have been doing that every day for decades.”*

Another observed that *“It’ll certainly be beneficial for everyone within the organisation to have some understanding on how their role interacts with sustainability because then people will be able to make the right decisions. It’s about understanding the consequences of their actions.”*

However, participants were again eager to point out that the more pressing concern around sustainability is the question of overarching strategic direction. As one employer stated, *“It’s about how do you even get to that point where you know what equipment you’re going to install, that it’s going to be flexible enough, and it gives you that value. It’s quite a painful understanding to know what that is, and that is a challenge.”*

One employer described how their organisation has started to create specific sustainability roles, people whose core responsibility is to look at the business from the perspective of sustainability. These are *“New roles within the business that are multi-functional. They’re not just engineers; it goes right through from procurement to logistics.”* The idea is that these new roles will help inform and influence the overall strategic decision-making.

This discussion again supports the notion that the increased demand for new/ higher-level skills will be felt most acutely in the short term as organisations work through their options and set out their plans. Once new technologies have been established and existing processes adapted, most employees should only require minor tweaks and updates to their current understanding and skill sets.

“With all the change brought through sustainability and Net-Zero, this feels like a really good time to get out there and rebrand ourselves in a better position.”

2.5 An attraction and perception opportunity

Research shows that more than three-quarters of UK adults (78%) think it's important to play a part in the UK's journey to reaching Net-Zero emissions.⁴ More than half (57%) are interested in working for an organisation that specifically contributes to reaching Net-Zero.

As noted earlier, the concept of sustainability is already deeply ingrained throughout much of the chemicals industry. Recent analysis shows an 82% reduction in direct emissions across the wider UK chemicals sector between 1990 and 2018, while at the same time, production increased by 40%.⁵ Having said that, a significant proportion of this progress was achieved prior to 2010, and most abatement and efficiency measures that are currently available and affordable have now been exhausted. For this reason, achieving and maintaining Net-Zero remains a formidable undertaking for many companies.

Still, it is not surprising then that a majority of participants agreed that their organisation has already made substantial progress against its sustainability targets. The same analysis referenced above also shows that for every one tonne of CO2 emitted directly, the products and solutions produced deliver a saving of at least two tonnes in the sector's customer industries. With this in mind, there was a consensus among participants that sustainability and Net-Zero may actually present an opportunity to reinvent the sector as forward-looking and a vital contributor to tackling climate change.

“The raw materials that go into what we manufacture are actually from waste material/waste products. And what we produce is then used across a number of key sectors in the economy. In terms of sustainability, it is a really

good and engaging story. And that has to be shared, and they would be missing a trick by not sharing it.”

One participant described the potential benefits *“At a corporate level the company has done huge advertising campaigns, media work, and links with other external organisations all-around green and sustainability, and it has made it easier from a recruitment perspective because we've got something to point to and say 'here is the overarching strategy, we take this seriously'. We're also quite visible on LinkedIn and other forums, where we talk extensively about our overarching company targets, the importance of those and why we're committed to them. And part of that is to demystify what we do and position ourselves successfully in a competitive market.”*

Another stated, *“Ours is a product that is required, so when I'm talking to candidates about what we do and what they will be doing, there is a sense of pride and a sense that it (our product) is something that is needed. I can then talk to them about what we are doing to become more sustainable and being on that journey.”*



4. National Grid: Building the net zero energy workforce, 2020
5. Chemical Industries Association: Accelerating Britain's Net-Zero Economy, 2020

3

INDUSTRY 4.0

Industry 4.0 (also known as the Fourth Industrial Revolution) is the ongoing automation of traditional manufacturing and industrial practices using modern smart technology. There are a wide variety of advanced and digital technologies that are relevant to the chemicals sector, including (but not limited to): Artificial Intelligence; Virtual/Augmented Reality; Digital Twin; Cyber-Physical Systems; Big Data/Smart Algorithms; Internet of Things; Advanced Robotics & Cobotics; Cloud Technology; 3D Printing/Additive Manufacturing; Cyber-Security.⁶ And while some businesses already have well-developed digital transformation plans in place, others are struggling to understand the potential benefits that a long list of digital technologies could bring to their business.

The 2017 Made Smarter review describes a lack of skills as “the greatest barrier to industrial digital technology adoption”.⁷ When asked, only a third of our participants agreed that their current workforce is already equipped with the skills needed to support their transition to digitalisation and smart technology. Equally, two-thirds reported that they find it difficult to recruit people with the necessary skill set to fully identify and adopt digital technologies. Part of the problem appears to be the difficulty in “separating out the things that are going to give real business value”.

Research from the wider manufacturing sector describes a number of key challenges to the digital transformation process. These challenges include the need for high financial investment, unclear economic benefit, and a lack of business cases.⁸ The rapid evolution of industrial digital technologies, combined with the wide variety of potential applications and uses, means that (by definition) some companies lack the necessary experience and understanding to confidently justify significant investment.⁹

One employer commented, *“There are a lot of things out there that are offered to be industry 4.0, but they are just toys. They are not going to give productivity gains, and they are not going to give safety increases.”*

Another stated, *“The CapEx (capital expenditure) outlay that is required, especially in legacy plants going from manual to automated processes, unless that noticeably increases productivity it gets very hard to justify the cost. And those machines aren't cheap.”*

The discussion around digitalisation and smart technology thus provided many parallels to the issues around sustainability. There is a wide range of potential strategies and technologies for organisations to consider, and many of the options are emerging and largely untested. Therefore, despite broad agreement among participants that progressing with Industry 4.0 intuitively feels like the right thing to do, some companies are finding it difficult to formulate a clear digital transformation strategy with so much unknown.

“If you haven't got the right skills, you're not going to be able to define what the project is and what is needed.”

6. Chemical Industries Association: Digitisation in the chemical industry, 2021
7. Made Smarter Review 2017
8. Cranfield University/ Vendigital: Digital transformation: A Smarter Way Back To Growth, 2021
9. Accenture: Industry X.0: Unlocking the Power of Digital in Plant Operations

“If we become more intelligent in our own capacity because of what the analytics tell us, that might influence that we need to have a greater workforce to further push productivity.”

3.1 Size of workforce

Participants were asked whether introducing new technologies will impact the overall number of people employed across their organisation (over the next ten years). The responses suggest that, generally, employers expect the overall size of their workforce to ‘stay about the same’.

One employer commented, *“If you can invest in new technologies that should be more efficient from a people point of view. But if you’re doing it incrementally, it’s unlikely that you’re going to cut many people out of your organisation.”*

This supports the notion that Industry 4.0 will augment human effort in the chemicals sector rather than replace it. That said, there is no one-size-fits-all approach to introducing new industrial digital technologies. The impact on the workforce will depend on the approach of each individual company, the specific technology and how it’s applied. As such, the survey responses were mixed, with some participants anticipating they could see an overall decrease, with others predicting it could, in fact, help grow the size of their workforce.

One employer provided the example, *“We have been utilising digital technologies at customer sites to do monitoring that was previously done by applications specialists. This used to be ‘feet on the ground’, going out and doing the testing in person. So we have certainly seen some reductions already in those types of positions because of the digitalisation we can do.”*

In contrast, another participant commented, *“The technology will potentially allow us to take on more people. The data science behind the smart manufacturing element will tell us how we can influence productivity better. If we can become more intelligent in our own capacity*

because of what the analytics tell us, that might influence that we need to have a greater workforce to further push productivity.”

3.2 Skills gaps

The employers were then given a list of 18 relevant skills and asked to consider whether they had any specific skills shortages in relation to Industry 4.0. In descending order, the six most commonly reported skills gaps were:

1. Engineering skills
2. Critical thinking/ problem solving
3. Digital manufacturing
4. Technology identification and application
5. Creative thinking
6. Innovation

There is longstanding recognition of a need for more engineers right across the UK economy. Recent estimates suggest an annual shortfall of between 37,000 and 59,000 in meeting the national demand for core engineering roles requiring level 3+ skills.¹⁰ It is not surprising then that engineering skills stood out here as well, with the vast majority of participants reporting that they currently have either a moderate or severe skills shortage in engineering. However, this also served as a good example of the discussion around the sector’s niche or bespoke skills requirements, with one employer clarifying that their issues are actually with a lack of specialist engineers.

¹⁰ Engineering UK: Excel Resource 2019

“Our issue is with specialist engineers like rotating equipment or site electrical where they are standalone skills. They’re normally at the latter end of their career and asking for a lot of money because there’s not many of them.”

With ever-increasing importance placed on sustainability and digitalisation, the demand for relevant skills will be extensive throughout much of the economy. Sectors as varied as construction, energy, automotive, and manufacturing will be competing with chemical companies for workers who can deliver high-level innovation, R&D, engineering and leadership skills. Competing for these skills will require the sector’s narrative to be compelling.

One employer explained, *“We’re often up against the oil and gas industry. And if somebody has got a job offer from both sectors, oil and gas is inevitably higher (salary). So we find that people start off interested, but then we might lose them as we go through the recruitment process. It’s either they’re not fitting what we need, or something more attractive comes along at the last minute.”*

3.3 Recruitment challenges

Participants were then asked about the challenges they face in recruiting the right skills for their organisation. In descending order, the three most commonly reported issues were:

1. Low numbers of applicants with the required level of skills and/ or qualifications
2. Low numbers of applicants with job-specific knowledge and/or industry experience
3. Competition from other employers/ sectors

There was a general sense among participants that recruiting people with the right skill set has become increasingly challenging in recent years. This suggests a couple of potential possibilities. Either there is a genuine lack of appropriately qualified and experienced candidates, or the sector must do more to attract potential recruits in an increasingly competitive environment. The reality may be somewhere in the middle.

One employer commented, *“We used to be able to put out an advert and get over 100-200 applications guaranteed and get at least 20-30 people who had worked in our local area, in similar industries. And now that’s very much dwindling to a small handful of people. So we’re having to look at bringing people in at a much lower level and training them up for longer because there’s not such easy access to experienced chemicals manufacturing skills in the marketplace right now.”*

“Once people come in and see what a great industry it is to work in, we’ve kind of got them then. But actually it’s about how do we get people through the door in the first place.”

However, this admission also raised an important point about recruitment and the time it takes to train someone to a sufficient level of competence in a new role. One employer commented, *“It takes a long time to train people. Even if somebody comes with experience, it’s potentially 2/3/4 years before we would class them as being fully validated. So a huge challenge for us is how can we make that happen faster.”*

Part of the issue for some employers is the unique nature of their businesses. The chemicals industry has a diverse mix of companies producing an immense variety of products. This often requires custom-built equipment and bespoke processes, so finding people with relevant knowledge or experience can be challenging. This means that some organisations need to recruit people at a lower level of skill or experience than is desired and spend more time developing them up to the required competence.

“To be able to manufacture what we need and to operate the machinery that we have, we just can’t find the skills anywhere. We are a niche market, so we can’t buy ‘off-the-shelf’. We have to take someone with a certain level of understanding, and we have to teach them on site. But it’s hard to get the right people at the right level even to begin that training process.”

Companies must be proactive in their approach and take a long-term view of recruitment, helping open up and enhance entry routes into working in the sector. For example, skills partnerships with academic institutions could help ensure that courses continue to meet the requirements of modern industry and keep up with technological advancements. Equally, the current apprenticeship system is employer-led, meaning employers design the standards

and subsequently create the demand for apprentices. Chemical employers need to be active in this process to develop and maintain a broad range of industry-specific apprenticeship standards that are fit for purpose.

More generally, the sector must promote itself as an attractive career option, working with young people and their influencers to inspire future generations and ensure a sustainable talent pipeline.

“The anxiety could be that I’m working on a piece of technology and a process that will substantively change my role going forward.”

3.4 Changing perceptions

Research by Deloitte proposes that younger professionals might not view chemical companies as their most attractive option and that one potential solution lies in changing their perceptions of the industry.¹¹ It recommends that this can (at least in part) be achieved by emphasising that jobs in chemicals are high-tech and cutting-edge.

This report describes how some companies cite a lack of appropriate skills and understanding as a barrier to greater investment on both issues of sustainability and digitalisation. However, Deloitte’s research suggests that this lack of investment will lower the sector’s attractiveness and, therefore, result in less interest from quality candidates, especially among the younger generations. In short, skills shortages are making companies less willing or able to invest in new technologies, thus limiting the sector’s ability to make progress against its goals. In turn, a lack of investment may be exacerbating skills shortages by making it harder to attract and recruit workers in an increasingly competitive environment.

Beyond the possible impact on recruitment, it was also recognised that a lack of clear strategic direction on both issues has the potential to create a certain level of angst within the current workforce too. One participant commented, *“We haven’t got clarity around what the end game is. And people do need that in order to focus on their day jobs”*.

Another remarked, *“It’s got the potential to create a bit of uncertainty within the workforce because they’re going to ask you questions that you can’t answer. Such as ‘am I going to have a job in 15 years’ time?’”*

A recent study of employers in the wider manufacturing sector describes how some businesses are struggling to make digital transformation an empowering experience for their employees.¹² It suggests that some workers may feel that their jobs are being undermined by digital technologies under trial, rather than viewing their introduction as an opportunity for skills development. To address this, business leaders must have a clear understanding of the company’s digital transformation plans and what success will look like, and then share this vision openly with the entire workforce. Employees should be encouraged to take an active part in the digital transformation process and must be provided with opportunities and support to upskill and reskill appropriately.

11. Deloitte: The future of work in chemicals, 2021

12. Cranfield University/ Vendigital: Digital transformation: A Smarter Way Back To Growth, 2021

4

DEVELOPING THE FUTURE

Office for National Statistics data show that the proportion of workers in the sector who are aged 50+ has grown over the past decade, from 33.6% in 2010 to 36.2% in 2020.¹³ This presents an acute challenge for some companies as retiring workers often take with them essential knowledge that cannot be easily replaced, and can only be developed internally over a long period of time. When asked, the vast majority of participants agreed that their organisation now finds it increasingly difficult to replace the experience and knowledge lost by older workers retiring.

Succession planning is the process of identifying and developing existing employees with the potential to become future leaders, as well as individuals to fill business-critical roles. The aim is to be able to fill key positions effectively if a current post holder leaves the organisation. The nurturing of internal talent in this way has many potential benefits, creating leaders with relevant operational experience who already understand the organisation's cultural nuances.¹⁴

One employer commented, "We've had more of a focus on succession planning over the past couple of years. Now we are getting smarter. Proactively finding a replacement, buddying them up with people who are nearing retirement and taking on more trainees to be able to bridge the gap that they are going to leave."

Beyond the more immediate challenge of replacing knowledge lost by retirees, research shows 'opportunities for career progression' is the most important factor in making an organisation an attractive place to work. Similarly, 'a lack of opportunities for career progression' is cited as the number one reason why an employee decided to leave their previous job.¹⁵ Loyalty to an employer is thus

often driven by an understanding and support of career ambitions, as well as providing realistic and fair opportunities to progress and become leaders. Therefore, active career progression planning not only helps keep existing employees motivated and committed, but it also supports recruitment by attracting people to the business.

"Ultimately, the people who are already in your workforce who are ageing, you can't do anything about it. They are going to leave. Therefore, our focus is on when we bring people into the business, how do we make sure we keep them? And structured career development, internal training and CPD are what employees want to see. That's one of the things that's going to keep them aligned with your business as you move forward. So then you are only handling retirement and a low turnover, not trying to handle retirement and a high turnover."

Participants were then asked more broadly about the type of programmes and initiatives they intend to expand and increase in order to meet future skills requirements. The top three responses were:

- Structured career development programmes
- Recruitment of apprentices
- Internal training/ CPD

It suggests companies will increasingly offer a mixture of upskilling and reskilling opportunities to their existing employees and develop the next generation through apprenticeship-based training.

13. Office for National Statistics, Annual Population Survey, Trend data - 2010:2020
14. CIPD: Succession planning, 2020
15. PWC: Winning the fight for female talent, 2017

"Unless you have the correct training to go with the technology then you're on to a loser. It's not going to give the benefit that you're intending."

Upskilling is the process in which employees gain new skills to help in their current roles. Reskilling is where staff need the capabilities to take on different or entirely new roles. The reskilling challenge is expected to be particularly acute in operationally intensive sectors.¹⁶

4.1 Internal training

Research shows less than half (49%) of employers in the wider manufacturing sector are confident that the current education and training market can deliver the skills they need to transition to a digital and green future.¹⁷ Moreover, an estimated 80% of the UK's 2030 workforce have already left formal education.¹⁸ As such, companies cannot rely solely on the education system to satisfy the demand for digital skills in the short to medium term. As the sector evolves existing employees will need to develop new capabilities and embrace new tools and digital methods. Therefore, there is a need to develop and sustain a culture of upskilling, reskilling and lifelong learning.

As one employer commented, "Businesses flex in and out around some of the 'non-technical' training elements, depending on how much they are a priority. But the thing that does not change is the rigour around regulatory requirements, compliance, health & safety. I think that will just evolve. So as a new process gets invented that, for instance, has a bearing on health & safety across the site and the sustainability of what we do, we will just replicate that in some form of training package so that everybody has an appreciation and an awareness of that change in requirement. And this is just going to be part and parcel of the sustainability journey."

Another provided an example of how it's already working, "We are doing a generic digitalisation technologies training as e-learning for a number of roles in commercial and manufacturing organisations to raise awareness and knowledge in those areas. So that's something that has already been identified as a core training need for a number of positions."



16. McKinsey & Company: Building the vital skills for the future of work in operations, 2020
17. Make UK: Unlocking the skills needed for a digital and green future
18. CBI: Learning for life – Funding a world-class adult education system, 2020

4.2 Apprenticeships

Since the introduction of the apprenticeship levy system in April 2017 the total number of apprenticeship starts has fallen across the economy, including in the chemicals sector, and have not recovered. The data also show that large organisations (250+ employees) now account for a much higher proportion of all apprenticeship starts, suggesting that the levy system has disproportionately impacted SMEs. One participant spoke of their confusion around the current apprenticeship system, citing that constant change and a lack of consistency in policy is creating unnecessary complexity. Another spoke of not having the “*infrastructure in place to support apprentices*”.

Despite this, there was a clear sense that the businesses that are engaged with apprenticeships are increasingly seeing the value in them. As organisations become more comfortable with the administration and processes involved, they become more engaged and look to see what other areas of the business apprentices can be utilised.

One participant commented, “*I like the concept of putting weight behind apprenticeship programmes because you get some talented young people that come through and get integrated into your business, and then they’ve got the ability to stretch off and get additional technical skills through apprenticeship programmes and then they become your engineers of the future.*”

Another stated, “*We are doing a mix of apprenticeships now, we’ve got new recruits coming in at around level three, but this year we’ve also started moving into some of the advanced apprenticeships for current staff.*”

Research shows that employers across the UK science sector are increasingly turning to apprenticeships as a vehicle through which to upskill and reskill their existing workforce. Approximately 60% of all Industrial Sciences apprentices are existing employees using apprenticeship based training to upskill and retrain.¹⁹ As such, many companies are now using apprenticeships in a variety of ways across different areas of the business, including leadership & management, marketing, sales, and in their supply chains.

One known obstacle which was raised during the discussion is that apprenticeships require 20% time for ‘off-the-job’ training. As one employer observed, “*What we have on-site at the moment is a number of people who are extremely stretched in their current roles. I don’t think we have the current excess facility to be able to make that happen.*”

Participants were also asked whether they are likely to need a range of new apprenticeship standards in ‘green’ industry specialisms in order to achieve Net-Zero. The responses were consistent with two overarching points from earlier in the discussion. First, the true extent of the required changes will become clearer once organisations have more clarity around their overarching strategy for sustainability.

One participant stated, “*Once we have a firm view of the direction we are headed in, and can confidently say it’s this technology, it may be that we need to formally upskill people to a higher degree level and fund them through the apprenticeship system.*”

19. Science Industry Partnership: Apprenticeship Survey 2020

“Apprenticeships are a much more efficient route by which you develop your degree qualified people of the future. In line with the requirements of your business at the time that you need them to learn those additional top-up skills.”

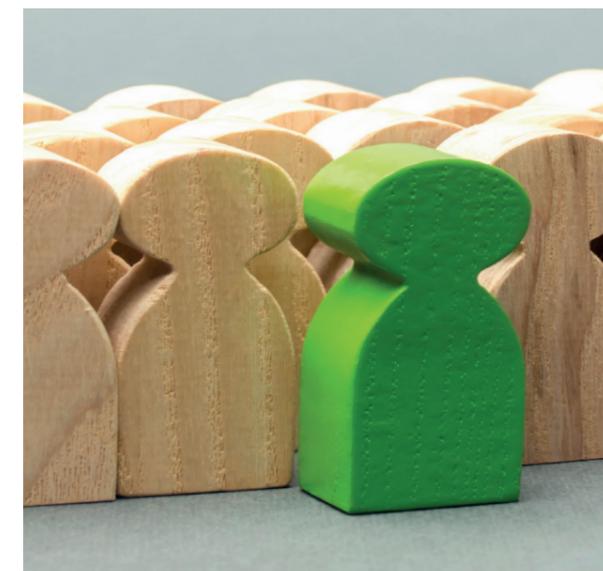
Academic year	Number of apprenticeship starts ²⁰					
	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
SIC Code 20: Manufacture of chemicals and chemical products	940	930	600	780	760	520

“I think the route to success is through the apprenticeship programme. You’re not going to get a degree programme that is going to satisfy all your requirements. You will get an individual who will come from university and has got the ability to learn new skills, but I think apprenticeships are a much more efficient route by which you develop your degree qualified people of the future. In line with the requirements of your business at the time that you need them to learn those additional top-up skills. I see that as being a point at which it becomes ever so important to upgrade higher apprenticeship programmes, so they are specific around green specialisms.”

Again there was a general sense that most employees will probably only need a ‘tweak’ or an update to their current roles and skill sets.

One employer commented, “*I don’t think it’s necessarily a need to have new apprenticeship standards because the existing standards are regularly reviewed. But I do think they will have to adapt as we move towards Net-Zero.*”. Another agreed by saying, “*I do think there will be a nod towards green specialisms, but it will just be a nod.*”

It remains critically important to maintain the continuous development and improvement of employer-led apprenticeship standards to keep up with changes in technology and industry needs.



20. Department for Education: Apprenticeships in England by industry characteristics, Academic Year 2019/20

“What we need to do as an industry is think through how we work collaboratively, as a cluster of businesses, to define what our strategy looks like.”



4.3 Industry ready graduates

Official statistics show that approximately 780 graduates from the academic year 2018/19 entered the chemicals sector within 15 months of completing their course.²¹ Perhaps unsurprisingly, the two most commonly studied subject areas within this population were ‘chemistry’ and ‘chemical, process and energy engineering’.

Participants were asked whether they believed that recent graduates come equipped with sufficient competency and skills as to be considered ‘industry ready’. The employers have had mixed experiences engaging with the graduate market. One participant stated, “We have always taken on graduates with a realisation that we know they are not going to stay with us. We use it as a platform for them to learn and to gain really valuable experience.”

Approximately 780 graduates from the academic year 2018/19 entered the chemicals sector within 15 months of completing their course.

Another commented, “In terms of graduates going into the process engineering side of our business, I find those very hard to fill our needs. They have high expectations but not enough skills and knowledge to be able to get us where we need them to be. They are the people you’re counting on to fill you’re (skills) gaps, and it’s just not there.”

“We’ve been turning down people with first-class honours degrees because they haven’t quite got what we’re looking for.”

When asked specifically about graduates preparedness for Net-Zero and Industry 4.0, one participant commented, “My sense is that universities are going along the same journey that we have described. They are saying... what is your strategy? What will that mean? What will they have to do in their day jobs? What skills can we help them have by the time they reach you? And they’ve not mapped that out yet either because they’re getting the same answers. There are just still too many question marks.”

Another employer stated, “I don’t think there’s enough communication between the industries and the learning institutes around what skills are now required to take us forward. I think something is missing there.”

“What we need to do as an industry is think through how we work collaboratively, as a cluster of businesses, to define what our strategy looks like. Once we begin to understand what that strategy looks like, we will need to work ‘upstream’ with schools, colleges, and universities to define what the skills are, so they can be ready to provide them when we are ready to draw down on them.”

21. HESA Graduate Outcomes Survey Results Record 2018/19

4.4 Equality, Diversity & Inclusion

Encouragingly, the majority of participants stated that their organisation does have an Equality, Diversity & Inclusion (ED&I) strategy for its workforce. Indeed, there was broad recognition that the sector must continue to live up to the standards and expectations of the modern workforce in order to ensure a sustainable and diverse talent pipeline.

One participant commented, “People who are keen to join our organisation and have choices as to which organisation they choose are particularly keen to understand what our ED&I strategy is.”

“The new generation of workers want different things – they want a work-life balance. It is a different world, and if we want to engage with the younger generations, we have to speak a different language.”

“We need to think about the way that we engage with groups of people and how we present our jobs. For example, if we present jobs as ‘jobs in industry’, it is not likely to land well. So it is thinking about how we can present these jobs that will engage with that next generation.”

One employer stated that “ED&I is quite a new thing to us. But what we are recognising is that it’s more than a ‘target’; it’s got to be a cultural thing.”

Participants then described a wide range of ED&I related initiatives that their organisations have instilled.

“Things like volunteering days, being able to give back to your local community, encouraging suggestions of things to improve, being able to do voluntary work experience in local schools. It’s about your sense of belonging of where you work, and why you go and work somewhere. And people really do care about all those things.”

“You work for a company because you believe in what they do, and this should be part of the company values.”

Another important talking point was the potential role that chemicals employers can play in helping to advance social mobility. As one participant pointed out, “Many chemicals employers in the UK are in areas with high levels of deprivation. So in terms of salary, we’re not just offering better than the national average; we are offering significantly better than you could get in other areas of the local economy.”

“The jobs in our area for some people are life-changing for them and their families.”

Another employer commented, “We forget that for some jobs that we have in our industry, a level 2 (qualification) is appropriate. And for some individuals, a level 2 qualification is the equivalent of another family getting a first-class honours degree. Because they could be the first person in their family who has achieved any formal qualifications.”

A strong commitment to ED&I will be essential both now and in the future in an increasingly competitive marketplace for skills.

5

CONCLUSIONS AND RECOMMENDATIONS

4.5 Careers Outreach

Evidence suggests that career aspirations are set early, as the top four sectoral preferences for students aged 7-8 are also three of the top four for 17-18-year-olds.²² The Department for Education (DfE) Careers Strategy (2017) recommends that pupils spend more time with employers from an early age. It concluded that employers play an integral role in careers advice by providing inspiring encounters and opportunities to learn about what work is like and what it takes to be successful in the workforce.²³

Careers Outreach programmes thus serve an essential function by informing and enthusing future generations about the range of opportunities available in the sector. They broaden young people's aspirations about potential jobs, foster confidence and ambition, and can help to challenge stereotypes. It is encouraging then that there was strong support for Careers Outreach initiatives. The vast majority of participants reported that their organisation already engages with them either in primary or secondary schools.

One employer commented, *"Our factory is within a very big housing estate. If they see steam coming out of a chimney, they just think it's all the wrong things. So you have to educate people. And if you start in the schools, the kids can filter that down."*

Another spoke more broadly about being visible in the local community, *"It's only in recent years we've really started to recognise the value in being a little bit better known in the local area, so that people might want to come and work for you because of who you are and where you are. Not necessarily just because they've found a job on the internet. So that's changed our philosophy a little bit in terms of what we do."*

"You've got to put yourself out there and be part of the community. Let them know who you are, where you are and what it is that you do."

22. Education and Employers: Disconnected - Career aspirations and jobs in the UK, 2020

23. Department for Education: Careers strategy: making the most of everyone's skills and talents, 2017

Connecting Up

There are a wide range of potential strategies and technologies for organisations to consider regarding both Net-Zero and Industry 4.0. Many of the options are emerging and largely untested, and some companies are finding it difficult to develop a precise strategy with so much unknown. This acts as a barrier to investment, limits progress against sustainability goals, and negatively impacts the sector's ability to recruit and retain talented workers.

There is a need for greater collaboration between sector companies to come together and create a shared understanding of critical issues. Some smaller companies may also benefit from access to generic planning tools to help them decipher complex issues more effectively.

- Promote collaboration between sector stakeholders around common issues. Where possible, utilising existing groups and bodies with skills in their remit. e.g. calculating the carbon footprint, digital/smart technologies in application, carbon capture processes for industry, etc.
- Develop shared resources or generic planning tools to help companies advance their understanding of critical issues and formulate a clear skills strategy. e.g. an Industry 4.0 sector framework, sharing of best practice and business case examples, business mentoring programmes, etc.

Apprenticeships

The UK apprenticeship system is employer-led, meaning employers design the standards and subsequently create the demand for apprentices. Apprenticeships have a long history of providing reliable entry routes into the sector. Moreover, they have the potential to play an important role in helping companies to address their upskilling and reskilling needs. Yet the number of apprenticeship starts in the sector has fallen since the introduction of the apprenticeship levy system in April 2017. This comes at a time when Net-Zero and Industry 4.0 promise to introduce new technologies and new working practices into many sector companies. It is thus vital that employers are proactive and engage with trailblazer groups to develop and maintain apprenticeship standards that can meet the evolving needs of industry.

- Inform the development of a broad range of industry specific apprenticeship standards that are fit for purpose and reflect modern technological needs.
- Conduct research into apprenticeship utilisation in the sector and consider how changes to the system may stimulate engagement and remove barriers to adoption.
- Consider how apprenticeships could be used to meet the sector's upskilling and reskilling demands.

Upskilling, reskilling and lifelong learning

An estimated 80% of the 2030 workforce has already left formal education. As such, companies cannot rely solely on the education system to satisfy the demand for digital and green skills in the short to medium term. As the sector evolves, existing employees will need to develop new capabilities and embrace new tools and digital methods.

Equally, providing genuine opportunities for career progression and professional development will help companies to recruit and retain ambitious employees. Keeping the workforce aligned to the company's needs, fostering loyalty and creating future leaders with relevant operational experience.

- Promote a culture of lifelong learning and Continuing Professional Development (CPD).
- Proactive succession planning and career development programmes to minimise the impact of an ageing workforce.

Future pipeline

The demand for relevant skills will be extensive throughout much of the economy. Therefore, competing for these skills will require the sector's narrative to be compelling. Chemical companies must continue to live up to the standards and expectations of the modern workforce with a recognisable commitment to sustainability and ED&I. Equally, it is important to be proactive and take a long-term view on recruitment, helping to open up and enhance entry routes into working in the sector. The sector must promote itself as an attractive career option, working with young people and their influencers to inspire future generations and ensure a sustainable talent pipeline.

- Build upon the work undertaken by CIA that recognises Net-Zero and Industry 4.0 as an attraction and perception opportunity. Reinventing the sector as forward-looking and a strong contributor to tackling climate change.
- Partner with SIP to develop an ED&I strategy for the chemicals industry, in order to attract and retain a diverse future workforce.
- Engage with Careers Outreach programmes (e.g. SIP/ STEM Ambassadors) to inform and enthuse young people and their career influencers to enter the sector.

Higher-level skills

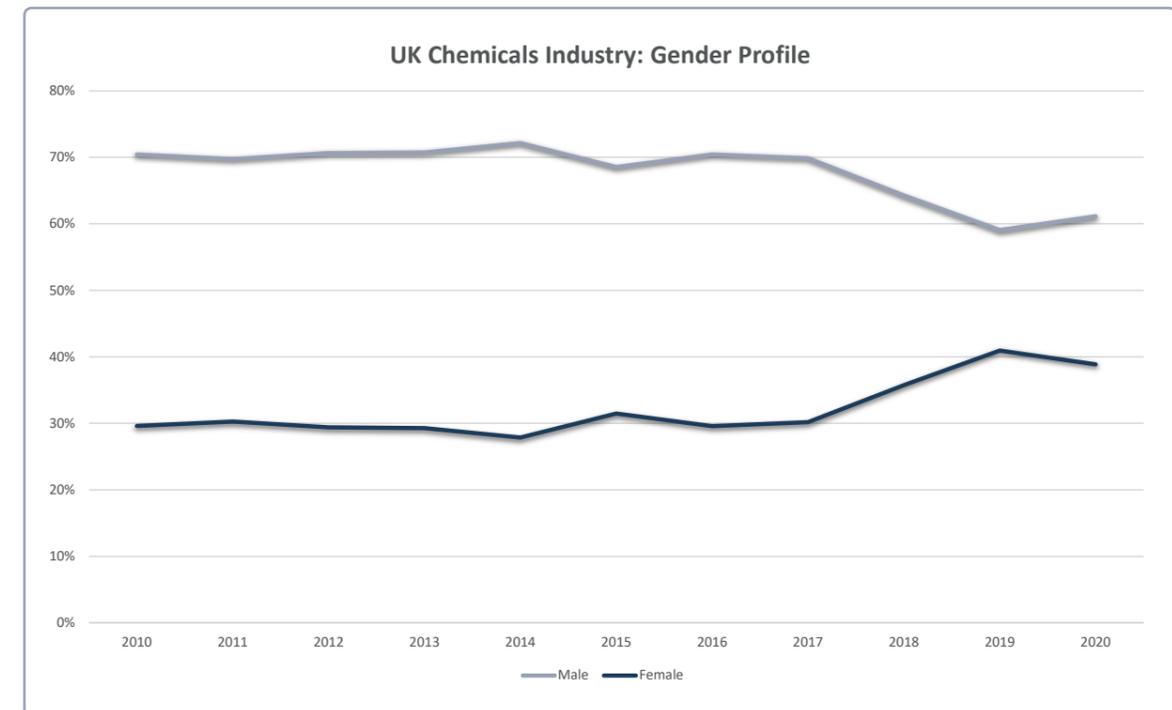
Our research suggests that the move towards Net-Zero will increase the demand for highly skilled workers who are qualified to a degree or equivalent level. This is likely to be particularly acute in the short to medium term as companies work through their transformation. Evidence suggests that Innovation, Research & Development, Leadership & Management skills will be in high demand, with many already experiencing skills shortages in a variety of Engineering disciplines.

- Strengthen links with academic institutions and join up with learned societies to ensure that courses continue to meet the requirements of modern industry and keep up with technological advancements, particularly in Engineering.

6

NATIONAL STATISTICS ²⁴

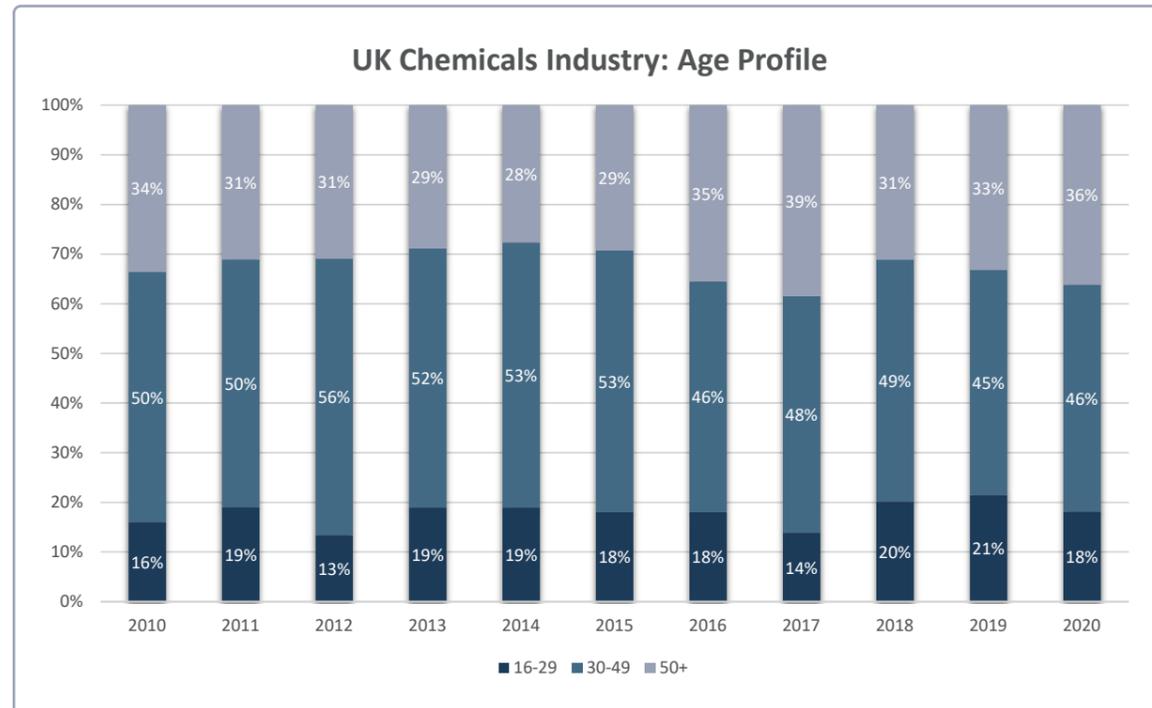
6.1 Gender profile



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Male	70.4%	69.7%	70.6%	70.7%	72.1%	68.5%	70.4%	69.8%	64.3%	59.1%	61.1%
Female	29.6%	30.3%	29.4%	29.3%	27.9%	31.5%	29.6%	30.2%	35.7%	40.9%	38.9%

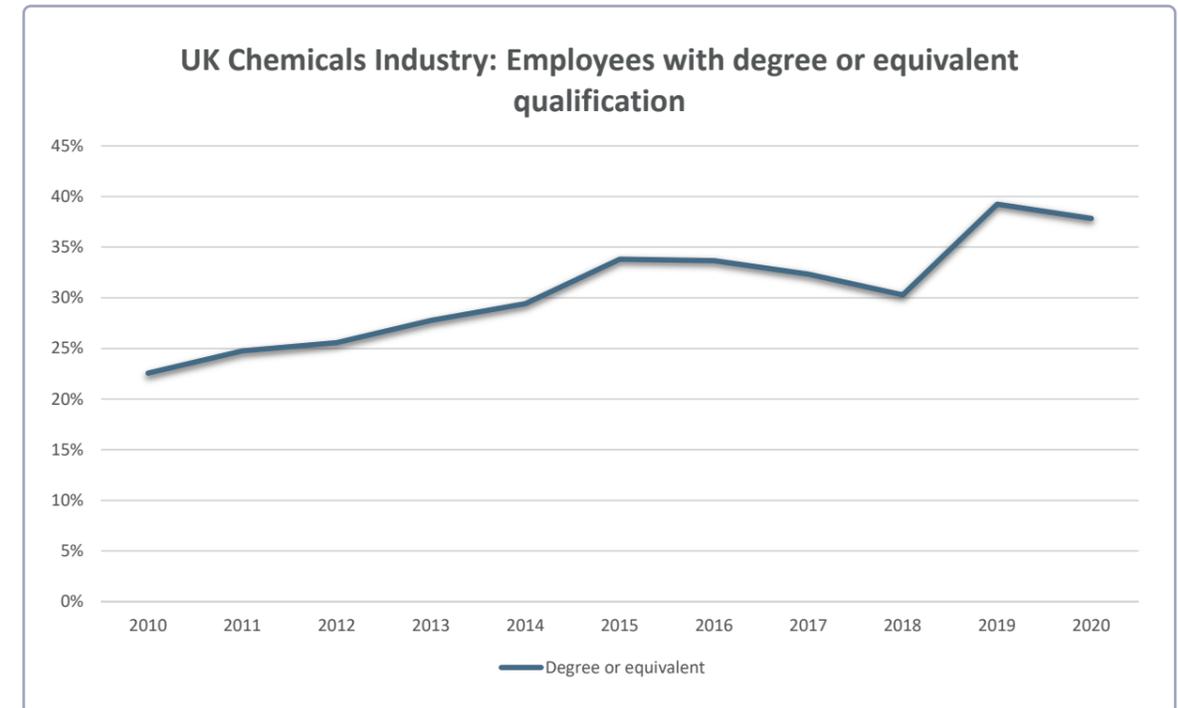
24. Office for National Statistics, Annual Population Survey. Trend data - 2010:2020

6.2 Age profile



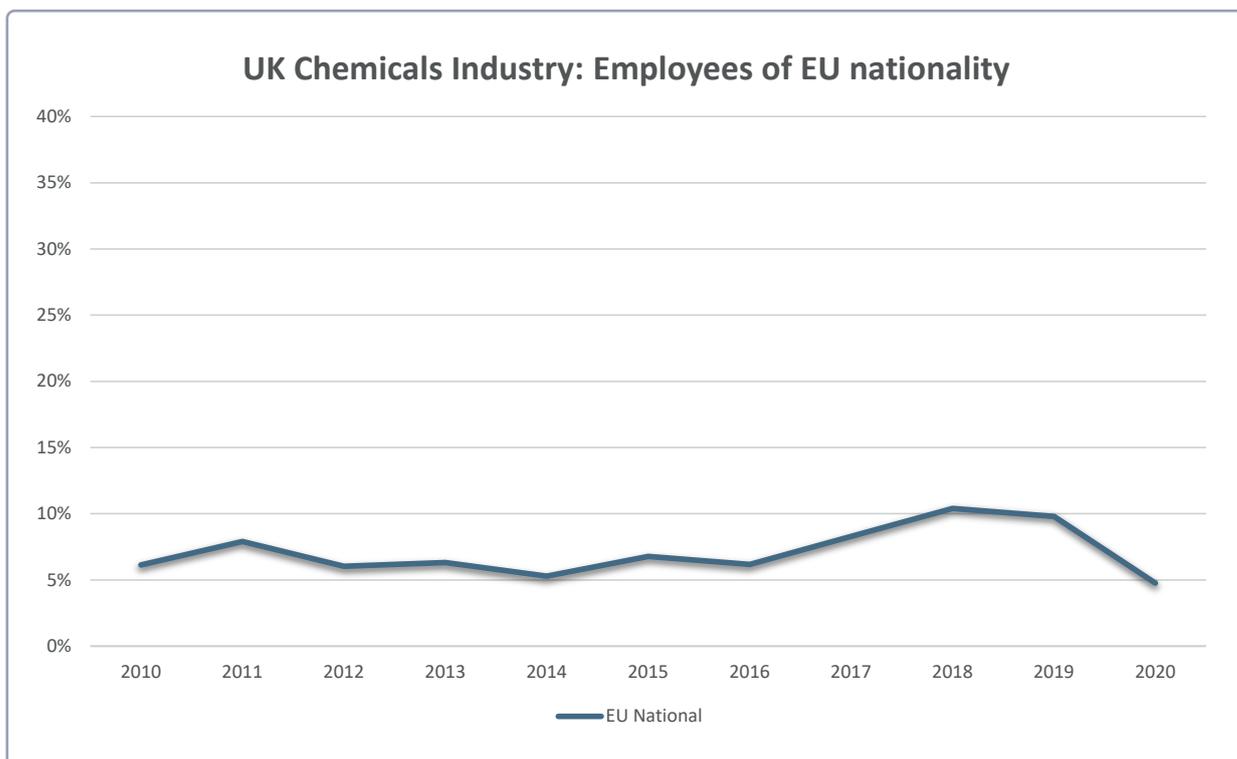
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
16-29	16.0%	19.0%	13.4%	18.9%	18.9%	18.0%	18.0%	13.8%	20.2%	21.5%	18.1%
30-49	50.4%	49.9%	55.7%	52.2%	53.5%	52.7%	46.5%	47.7%	48.7%	45.3%	45.7%
50+	33.6%	31.1%	30.9%	28.8%	27.6%	29.3%	35.5%	38.5%	31.1%	33.2%	36.2%

6.3 Qualifications



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Degree or equivalent	22.6%	24.8%	25.6%	27.8%	29.4%	33.8%	33.7%	32.3%	30.3%	39.2%	37.8%

6.4 Leaving the European Union



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EU	6.1%	7.9%	6.0%	6.3%	5.3%	6.8%	6.2%	8.3%	10.4%	9.8%	4.8%