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Strategy and solutions in a changing world



Low Carbon and the Circular Economy: An Assessment of Skills Supply and Demand

**Produced on behalf of York and North Yorkshire Local Enterprise
Partnership**

Report authors: *Les Newby and Nicky Denison*

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CONTENTS

[Executive Summary](#)

PART ONE: [Introduction and Context](#)

1. [Introduction to the Research, its Purpose and Methodology](#)
2. [Context](#)

PART TWO: Key Findings

3. [Importance of Low Carbon Transition and the Role of Education and Skills](#)
4. [Demand for Low Carbon Skills by Business](#)
 - 4.1 Overview of demand from business
 - 4.2 Construction and related trades
 - 4.3 Energy and engineering
 - 4.4 Automotive and electric vehicles
 - 4.5 Digital (as an enabling sector)
5. [Supply of Low Carbon Skills – Qualitative Analysis](#)
 - 5.1 Messages from suppliers and factors influencing supply
 - 5.2 Likely future provision
6. [Data and Analysis of Current Provision](#)
 - 6.1 Places and courses analysis
 - 6.2 Apprenticeships
 - 6.3 University courses
 - 6.4 Relevant exam entries and courses in sixth forms
7. [Conclusions and Recommendations](#)

[Annex 1: Provision of Courses and Places](#)

[Annex 2: Sixth Form Subject Analysis](#)

[Annex 3: Skills needs in the Bioeconomy sector. An assessment from BioYorkshire](#)

GLOSSARY

Table 1: Breakdown of stakeholder interviews and input

Table 2: Courses by sector and main providers and levels

Table 3: Apprenticeship framework starts by sector groupings and level (2018/19)

Table 4: Course enrolments by provider in main sector groupings (2018/19)

Table 5: Enrolment on courses by level and sector subject area (2018/19)

Table 6: Apprenticeship starts by provider in main sector groupings (2018/19)

Table 7: Main apprenticeship frameworks by sector groupings and level (2018/19)

Table 8: Numbers of relevant courses in universities in York and North Yorkshire (2017/18)

EXECUTIVE SUMMARY

York and North Yorkshire Local Enterprise Partnership (YNY LEP) has set an ambitious vision to become England's first carbon negative region. Delivering this ambition will require major transitions and depend on having the right type, level and volume of skills in place.

Les Newby Associates and Nicky Denison/Wordfern Ltd completed this research on behalf of YNY LEP to advance understanding of what skills businesses require to deliver a low carbon, circular economy; how far education and training providers are delivering these; and what barriers and solutions exist to enhancing future delivery. We completed the research in autumn 2020, using qualitative engagement with skills stakeholders and provider organisations and complemented by analysis of current provision.

While low carbon and circular economy transition are relevant to all sectors, we focused on four sectors where the speed and scale of transition will be critical to achieving net zero goals: energy and engineering; construction (and related roles/trades); automotive; and digital skills (as an enabler). In interpreting the conclusions reached, it is important to note that engagement for the research was completed before the Government announced its 'green industrial revolution' plan, which may influence awareness, planning and future action by businesses and skills providers. The Bio economy also represents one of the most significant opportunities for the region. In this respect, [BioYorkshire](#), led by University of York in partnership with FERA Science and Askham Bryan, is driving forward a bold new green agenda to create jobs, boost the regional economy - and develop sustainable solutions for some of the UK's most pressing environmental challenges. Whilst largely outside the scope of this research, the importance of the sector is such that the LEP has signalled its intention to explore with key stakeholders further research into its skills needs. Meanwhile, we are grateful for the insights BioYorkshire have shared with us from their own research and set out in **Annex 3**.

The **overall conclusions and recommendations** from the research are:

Businesses and demand for low carbon and circular economy skills

Conclusions

- Clearer definition and stronger communication of low carbon and circular economy concepts are needed to drive action and generate demand for related skills, especially within SMEs (who often do not see the scale of change required and the implications for their business and skills and are confused about what concepts like low carbon and circular economy mean in practice).
- There is opportunity for collaboration between businesses and interaction with SMEs to drive low carbon and circular economy solutions and related skills demands.
- Further partnership and engagement between businesses, providers and others is critical to improve the flow of information.

Recommendation 1: *Develop and deliver sector specific communication to businesses that explain in simple terms relevant to SMEs the current and future business opportunities linked to low carbon and the circular economy and any support available to exploit them.*

Recommendation 2: *Promote peer learning and sharing of resources and expertise by businesses and collaborative low carbon projects where participation itself builds skills and awareness.*

Recommendation 3: *Encourage further engagement between industry and providers with a focus on current and future workforce/skills demands related to a low carbon, circular economy. This should be framed around specific skills and technologies rather than in general terms.*

Supply of skills and training to support transition to a low carbon, circular economy

Conclusions

- Current low carbon skills provision is low. While further provision is emerging, there is a need to increase the scale and pace including integrating content into existing courses and new courses to meet specific needs.
- Suggested responses mostly focused on how existing courses and apprenticeships can have low carbon content embedded and integrated within them, for example as a context for application or through specialist units. They also stressed the value of building a combination of STEM skills and 'soft' skills in the workforce. These measures would provide a foundation from which specialist low carbon skills (e.g. technology specific) can be rapidly acquired and applied. However, some key gaps where specific skills are or will be needed were also identified.

Recommendation 4: *Make tools and training available to encourage employers to build carbon literacy across their entire workforce to grow a supportive culture and general awareness.*

Recommendation 5: *Continue to promote STEM subjects and encourage more people to enter engineering, construction and automotive careers. This will address skills/labour shortages overall and provide foundations on which specific low carbon expertise can be quickly built and applied.*

Recommendation 6: *Nurture the development of transferable skills through education - such as problem solving, communication, and leadership and management, which are important in designing and driving low carbon and circular economy solutions and making them work in practice.*

Recommendation 7: *Establish a task group to integrate and maximise low carbon content and options in existing courses and qualifications, bringing together businesses, training and education providers and awarding bodies, and prioritising courses that can most effectively address skills gaps.*

Recommendation 8: *Support rapid increase in delivery and uptake of short/top up courses in specific technologies and tasks where skills gaps are apparent and/or likely to grow. These courses should be developed in partnership, effectively promoted and be targeted at those who already have core skills (e.g. electrical, engineering, construction, plumbing) to build on. They are likely to include:*

- Air source and ground source heat pumps (where massive expansion is expected this decade)
- Whole house retrofit (and specific gap technologies/skills within this including around insulation)
- Solar energy and micro-renewables
- Electric Vehicle maintenance and installation of charging points
- Other technologies that may come to the fore (e.g. hydrogen related technologies)
- Specific bioeconomy skills not fully identified in this research (e.g. related to anaerobic digestion)

Barriers and solutions

Conclusions

- Recruitment, retention and ability to deploy suitably expert staff is a barrier to progress in designing and delivering low carbon courses, partly due to lower wages than in industry. Skills funding can also be a barrier as it encourages provision where student demand is high, within a limited list of funded qualifications, and where equipment needed for training can be costly.
- Young people's interest in sustainability is rarely translated into career choices and schools and careers advice can do more to support transition by promoting opportunities in the low carbon economy. Stakeholders called for continued work to promote STEM subjects, transferable skills and for communication of low carbon careers – which would help to increase future capacity and tackle issues to do with demand and funding.

Recommendation 9: Test the concept of and pilot a “train the trainer” approach in low carbon technologies where experts in industry and education pass on expertise in key areas that need embedding in courses to lecturers/trainers who can then teach them to students.

Recommendation 10: Invest targeted resources from devolved funding, partner contributions and other funding streams to deliver low carbon skills solutions (e.g. to accelerate and increase short/top up courses, provide necessary equipment/infrastructure, and to communicate to key audiences).

Recommendation 11: Create careers advice resources on hands-on careers that tackle the climate emergency and pathways into them to help young people translate their interest in this issue into their choices of courses and careers.

Wider opportunities

Conclusions

- Retraining can contribute to low carbon skills and to economic recovery, and there is opportunity for innovation, new businesses and scale ups to respond to low carbon challenges as gaps in skills and capacity are unlikely to be fully met by expansion of current businesses.
- There is much potential to collaborate with other areas and national industry bodies in developing solutions.

Recommendation 12: Explore and exploit opportunities to redeploy and retrain workers who are unemployed, underutilised or at risk of redundancy to equip them to move into and progress in low carbon job roles where there are labour and skills shortages.

Recommendation 13: Communicate opportunities for business creation and rapid growth (scale ups) where sizeable gaps exist and ensure that mainstream business support can assist these.

Recommendation 14: Engage with other LEPs, localities and national industry bodies in developing solutions.

[Back to Contents](#)

PART ONE: INTRODUCTION AND CONTEXT

1. Introduction to the Research, its Purpose and Methodology

York and North Yorkshire Local Enterprise Partnership (YNY LEP) has set an ambitious vision to become England's first carbon negative region, leading the way in the low carbon and circular economy sectors and supporting the Government's net zero objectives and clean growth agenda. Delivering this ambition will require major transitions, resolute focus and innovative solutions, and will depend on having the right type, level and volume of skills in place.

The LEP commissioned Les Newby Associates and Nicky Denison/Wordfern Ltd to complete this research to increase its understanding of:

- what skills businesses require linked to a low carbon, circular economy;
- how far education and training providers are delivering these; and
- what the barriers are to enhancing future delivery and how these might be overcome.

The research took as its starting point a recognition that there is no single definition of low carbon or circular economy skills. 'Low carbon' is not so much a sector itself, but a characteristic that can apply to businesses and practices within all sectors depending on how things are done. Hence, the skills in question can relate to the ability to develop and use new products and approaches, and to workplace behaviours that result in less waste, resource-use and carbon emissions, regardless of the sector.

There are however some sectors where the speed and scale of low carbon transition will be critical to achieving the LEP's net zero goals and to the survival and success of businesses across YNY. This research has focused on this group because it is here that the immediate opportunities, disruptions, impacts and skills required are most pronounced, often due to need for designing, manufacturing, installing, using and maintaining new products and technologies in the following sectors:

- Automotive and electric vehicles
- Construction (new/retrofit) and related roles and trades such as plumbing and electrical services
- Energy and engineering
- Digital skills as an enabler

The research took place between September and December 2020 and centred on qualitative engagement with 41 organisations (mostly stakeholders, plus some wider expert inputs – see Table 1). Interviews were typically conducted via Teams/Zoom or telephone and with one or more person from the relevant organisation. Two written inputs were also received and local authorities in YNY were engaged through a facilitated online focus group.

Stakeholder engagement was supplemented by high-level quantitative analysis of the provision of courses and apprenticeships looking at the types of provision relating to the sectors in question, and whether any of that was specifically low carbon or circular economy focused. We also analysed data sets on vocational course entries in York and in North Yorkshire, and the extent to which sixth forms in both areas covered potentially relevant subjects beyond the sciences and maths.

Table 1: Breakdown of stakeholder interviews and input

Type of Stakeholder	Number of organisations interviewed or otherwise inputting*
Business/Sector Representative Body	5
Further Education College	10
Independent Training Provider	6
Universities/ Higher Education	3
Business	5
Local Authorities	7
LEPs	2
Others (independent experts, VCS, etc.)	3
Total	41

*Two submission were via written input rather than an interview, six were via a focus group

This report draws out the main messages from the engagement, initially identifying the nature and level of demand for low carbon skills from businesses across the focus sectors, and then reflecting on the supply side perspective, both in terms of current and likely future provision. It goes on to outline a range of barriers perceived to exist around this agenda before proposing a set of potential solutions and recommendations for ways forward.

We would like to thank all the contributors for their support, time and insights. We have included quotes from interviews to demonstrate views without directly attributing them.

2. Context

Significant commentary and research back the case that achieving transition to a low carbon, circular economy will rely on having the right number of people with the right skills at the right time. Whilst the scope of this research did not include a literature review, it is helpful to point to some important headlines that provide context for delivering these skills in YNY.

National and International Policy

From a national perspective, two key recent government policy pieces sit front and centre. Firstly, the new **Green Jobs Taskforce** launched on 12 November 2020 to represent the voice of businesses, employees and skills sectors. It will support the UK Government's ambition to 'support 2 million green jobs by 2030'¹ and deliver skilled workers to enable the transition to net zero by 2050, including through:

- building immediate skills needed to build back greener, e.g. in offshore wind and home retrofit;
- developing a long-term plan that charts the skills needed to help deliver a net zero economy;
- ensuring good quality green jobs and a diverse workforce; and
- supporting workers in transitioning sectors, like gas, to retrain in green technologies.

Shortly after this, the government announced its **ten-point plan for a 'green industrial revolution'**, mobilising £12 billion of public investment to 'create and support up to 250,000 green jobs in the UK

¹ <https://www.gov.uk/government/news/uk-government-launches-taskforce-to-support-drive-for-2-million-green-jobs-by-2030>

by 2030.² Linked to the levelling up agenda, many of its goals and associated investment will be highly relevant to YNY including:

- quadrupling of offshore wind power generation;
- transforming electric vehicle infrastructure, ending the sale of new petrol and diesel cars and vans by 2030, and grants to incentivise purchase of zero/ultra-low emission vehicles;
- making buildings greener, warmer and more energy efficient, including extending the Green Homes Grant, phasing out fossil fuel boilers in new homes from 2023, and a target to install 600,000 heat pumps every year by 2028;
- driving the growth of low carbon hydrogen, and of carbon capture usage and storage;
- making cycling and walking more attractive and investing in zero-emission public transport; and
- protecting/restoring the natural environment, including 30,000 hectares of trees planted each year.

It is important to note that all stakeholder engagement took place *before* these announcements. It is probably fair – although not certain – to assume that had these announcements already happened, some views may have evolved, for example in respect to the pace of change in electric vehicles (EVs) or in sustainable construction. To maintain the integrity of the research, we have reported views as expressed in the absence of that policy context. Our concluding remarks and recommendations do however take new policy and associated investment into account in proposing ways forward given the extent to which they will drive support and accelerate change.

The UK will host the 26th UN Climate Change Conference of the Parties (COP26) in Glasgow in November 2021, bringing together heads of state, climate experts and campaigners to agree coordinated action to tackle climate change. This is likely to further stimulate significant action and build the profile of climate emergency issues in the run up to the event.

National studies and industry reports

Some recently published sector-based research studies articulate the role of skills in achieving low carbon transition, sometimes focused on specific sectors. For example, National Grid has reported³ that the UK energy sector will need to recruit for 400,000 jobs between 2020-50 (260,000 in new roles and 140,000 replacing those who have left the workforce), of which 117,000 will be needed by 2030. These jobs will require a diverse mix of skills, from scientists and engineers, to communications professionals and data specialists in roles focused on operation, generation, transmission, distribution and retail of energy - plus those in the associated supply chain linked to building, upgrading, maintaining or operating energy infrastructure. It recognises that the industry has much to do to attract people to these roles, badging them as ‘the jobs that can’t wait’.

A recent report from the Aldersgate Group⁴ also notes the scale of the opportunity in terms of low carbon, with the sector predicted to grow four times faster than the rest of the economy over this decade, with a global market for low carbon goods worth £1 trillion per year by 2030. It calls for a comprehensive focus on providing the right skills across key sectors, including via radically adapted curricula and apprenticeship standards; a leading role for FE and HE in working with business to develop local skills for green jobs; and a focus on diversity and a just transition. It makes clear that

²file:///C:/Users/lesne/Dropbox/YN%20LOW%20CARBON%20SKILLS/Background%20reading%20and%20reports/10_POINT_PLAN_BOO%20KLE%20-%20Green%20Industrial%20Revolution%20Nov%202020.pdf

³ Building the Net Zero Energy Workforce (2020) <https://www.nationalgrid.com/document/126256/download>

⁴ Upskilling the UK Workforce for the 21st Century (2020) <https://www.aldersgategroup.org.uk/latest#skills-deficit-needs-to-be-urgently-tackled-to-get-to-net-zero>

this should be backed by clear regulations, standards and fiscal incentives to accelerate decarbonisation in ‘low regret’ sectors.

In construction, the Construction Industry Training Board (CITB) is set to publish a major study on the skills needed to support the sector’s transition to net zero. It will provide detail of specific skills needs and roles and the technologies that they relate to, and its findings will be helpful in further framing needs in YNY. Key conclusions already emerging are presence of skills gaps in:

- energy efficiency, retrofit survey and design, heat pump design and installation, and low carbon new build, combined with low levels of knowledge of the transition needed;
- how to reduce errors and defects e.g. through quality management systems and links to the Get It Right initiative⁵;
- installers being aware of and fully understanding how their work fits in with low carbon measures to ensure their work is complimentary and not detrimental; and
- traditional buildings and retrofit given the majority of training is focussed on new build.

Other LEP areas and regional studies

YNY has impressive ambitions for a low carbon, circular economy, but it is not the only area interested in this agenda and active in researching it. This research, and relevant leads within the YNY LEP, are cognisant of a spread of wider work and intelligence that continues to be developed in support of local net zero or low carbon ambitions. Examples of other regional initiatives we connected to as part of this research include:

- Work by the North East LEP (NELEP) on construction, energy and greener buildings
- A study for Sheffield City Region LEP about to start on employment and skills implications of the transition to net zero
- Collaborative work by the universities of Teesside, Hull and York (the ‘THYME’ project) on higher education curriculum development and the bioeconomy

We also noted strong interest in this agenda in the Humber, the Tees Valley and in West Yorkshire LEP/Combined Authority areas. For example, this research builds on evidence jointly commissioned by the YNY LEP and the West Yorkshire Combined Authority to identify technically robust pathways from current regional emissions to net zero and beyond, looking at the five most carbon-intensive sectors in the region – buildings, transport, industry, power, and land use and agriculture.

[Back to Contents](#)

⁵ The Get It Right Initiative is a group of UK construction industry experts, organisations and businesses actively improving productivity and quality in the construction sector by eliminating error.

PART TWO: KEY FINDINGS

3. Importance of Low Carbon Transition and the Role of Education and Skills

There is clear consensus – across all types of organisations interviewed – that making the transition to a low carbon, circular economy is important to YNY. People noted Government’s advancing policy agenda in setting the national context for this and welcomed the ambition and strategic priority given through the LEP’s work on Local Industrial Strategy and the Greener, Fairer, Stronger⁶ post-Covid 19 economic reshaping plan.

The extent to which national and regional ambitions have been translated by organisations into corporate policy is covered in more detail in the sections that follow on business demand and provider supply. However, at a headline level, evidence suggests that implementation efforts are still very much in their early stages. A good number of stakeholders spoke about how they are starting (or looking) to make changes, but whilst still a positive move, current action was often about improving resource efficiency to drive cost savings rather than adapting or introducing new goods or services, including curriculum offers, to respond to low carbon transition and associated skills needs. Therefore, despite high-level recognition, application of low carbon in a transformative way is still at the emerging stage.

One reason cited for this position is - inevitably – the Covid-19 pandemic. This context has dominated people’s thinking and action before and during the period of this research and occupied the space that other forms of organisational innovation or progress might otherwise take. Advancement on the agenda by business (as a precursor to demand for skills) was seen to be further impeded by a low level of understanding of what low carbon actually means in the “*here and now*”, despite people having a good understanding in their non-work lives and changing behaviours accordingly.

Interviewees broadly agreed that skills would be an important part of achieving transition. Little reference was made to the scale of this challenge, with more focus devoted to the question of challenging how low carbon skills are defined. From a business perspective, the issue centred on how far they are willing or ready to adapt to respond to low carbon opportunities and hence to stimulate demand for skills. Communication and definition issues also extended to young people making choices in their education, skills and work journeys, and how far they understand what low carbon jobs are available, what skills are needed and what pathways exist. This is discussed further in section 5.1 on factors influencing the supply of low carbon skills.

[Back to Contents](#)

⁶ <https://www.businessinspiredgrowth.com/covid-19-economic-recovery/>

4. Demand for Low Carbon Skills by Business

4.1 Overview of demand from business

Overall, those with strategic awareness and insights about low carbon and circular economy transition know that it will create major challenges and opportunities for business – including on skills. This includes larger businesses and business/sector representative groups. However, most businesses, especially SMEs, are not in this position and do not yet appear to see low carbon issues as bringing about major challenges for themselves – at least in the short term. As one interviewee put it:

“Generally, it [low carbon] doesn’t come up that often. It’s still seen as something for the future by so many of the businesses we work with.” [Business representative organisation].

Others such as the FE sector, who regularly engage with business to gauge demand from them, also reported low carbon skills to be rarely mentioned, with this position partly due to ‘competing’ with more urgent business issues and threats such as Covid-19 now and Brexit in the future.

“We’re not seeing business demand – especially at the moment when the focus is on survival and there is no scope to ‘give something a go’.” [FE College].

“There’s very little demand from SMEs...we don’t get calls from employers wanting to discuss low carbon.” [FE College].

“Conversations with SMEs on low carbon are few and far between.” [Local authority].

At one level the lack of resonance of low carbon and circular economy issues with SMEs at the time of this research questions the premise behind the study. That is because if businesses are not looking to respond to these issues and opportunities, and are not looking for related skills, it is hard to say what low carbon skills they are looking for and whether they are available.

The limited attention SMEs pay to low carbon and the circular economy is a key issue, and the subdued demand it signals hampers the ability of FE colleges and training providers to expand related content and courses. It also points to the need for awareness raising, communication and intelligence sharing with SMEs to better prepare them for rapid changes in the future. However, other evidence reinforces the importance of low carbon skills issues for SMEs. Besides heightened national emphasis on the issue, four other factors are important in highlighting future demand:

- i) Businesses of all sizes see skills and workforce generally as a key issue (*“the number one priority for business”* as one interviewee put it). Responding to many existing skills gaps and shortages – such as in engineering and construction – is also likely to prepare SMEs to respond to low carbon and circular economy challenges.
- ii) A minority of SMEs are interested in, or otherwise working in a niche based upon, low carbon technologies. This number, and the workload of the firms within it, are likely to be growing.
- iii) Larger businesses do see transition to low carbon as a high priority and are responding to it. Accordingly, related skills demand from these businesses are growing, and as large businesses increasingly seek good environmental credentials from their suppliers, this will impact on SMEs too.

- iv) Business representative organisations for the sectors affected by low carbon transition covered in this report – notably automotive, construction and engineering – were all clear that there is major change ahead which will and is already beginning to impact on businesses in their sectors, and which will have implications for skills and labour. This is borne out by research at the national level.

Language also emerges as a key issue. Business representatives noted that talking in general concepts – for example about net zero carbon and circular economy – does not resonate with SMEs who are more likely to tune into issues that appear less conceptual in nature and are more obviously related to their business. Examples would be to couch threats and opportunities in terms of markets, innovation, supply chain pressures, costs and to specific changes and technologies and the benefits they will gain. As one stakeholder, who themselves saw low carbon transition as “*of massive importance*” put it:

“We need to get better at explaining what businesses need to do – ‘sustainability’ seems huge – and explain low carbon and circular economy in clear and consistent terms that work across sectors.” [Training provider].

Finally, many stakeholders said that the skills they were looking for in relation to low carbon were not simply technical ones, but also soft/transferable ones (e.g. problem solving, communication). Some also stressed the importance of leadership and management skills, and of the role of business and public sector leadership in shaping future demand for low carbon skills and ability to respond to this agenda. Businesses (and others) often said that what matters is the take up and application of STEM subjects combined with attitudinal and ‘soft’ skills that bring creativity, problem solving, agility and the ability to communicate solutions and influence decisions. This combination of core expertise and transferable skills allows businesses to identify, seize and manage new opportunities.

“Practical skills are the bread and butter of energy and carbon management. Education needs to support questioning skills and creative thinking...we need people who can challenge the ‘it can’t be done’ mentality and can adapt and develop practical solutions.” [Business].

“We need a focus on producing ‘flexible scientists’ from school age and through FE and HE – people who can take things from first principles and develop them – and who are prepared for a portfolio career as the [low carbon] sector grows and job opportunities evolve.” [Training provider].

This theme chimes with national commentary, including by the National Grid, stressing the huge competition across sectors for these aptitudes at all levels. It is not only low carbon sector businesses that are trying to recruit people with these skills, but other companies involved in energy and infrastructure and in financial services and wider sectors too. This presents a challenge to the skills system in developing a large enough talent pipeline, connected to the enduring challenge of how to drive take-up of STEM subjects. As one interviewee optimistically observed:

“The low carbon agenda could be the trigger that finally changes the game on STEM provision and take-up.” [Training provider].

The sub-sections that follow explore the position on demand and any specific skills needs and issues within key sectors.

4.2 Construction and related trades

Construction input came via the CITB, the North Yorkshire Construction Training Group, a number of construction and associated services businesses and the YNY LEP. All agreed that low carbon is critical to the sector, but that the response from the sector to date has been limited, certainly on any significant scale.

In terms of new house building, a lack of demand for low carbon housing from home buyers plus limited financial incentives or legal imperatives to build sustainably were seen to give little reason for major house builders, and consequently their supply chains, to do anything other than the norm. This was especially the case given their already full order books driven by demand for large-scale house building. As one interviewee noted, *“nothing will change until this changes.”*

The result is that business demand for skills remains focused on traditional construction practices – and even on that basis, there is a shortage of construction workers. Grants to stimulate domestic demand e.g. the Green Homes Grant, have provided limited impetus for training so far. In part this is due to their short timeframes preventing businesses seeing the value of or being able to fit in the necessary – and very specific – training required to become accredited. Meanwhile, homeowners are unable to find trades to do the work they require.

That said, one training provider reported demand for its Building Insulation Treatment courses, typically from sole traders or micro businesses. This is specifically linked to the government’s Green Homes Grant requirements that all installers must meet Publicly Available Specification Standards (PASS) to install energy efficiency measures including external wall, cavity wall, cold roof and floor insulation. The same provider is also seeing *“steady”* demand for its Introduction to Energy Level 1 qualification from domestic energy assessors wishing to offer EPC checks; and its non-regulated Level 2 on Minimum Energy Efficiency Standards, teaching up to date legislation on improving energy ratings. Demand is coming from private landlords, housing associations and councils who wish to improve the quality of private rented and social stock; and from charities wanting to offer energy advice as part of fuel poverty prevention.

“Demand for these accreditations is an upward curve and I have heard anecdotally that homeowner demand is outstripping supply of PASS qualified trades.” [Training provider].

The age-old issue of persuading business of the value in investing in skills was also raised as a barrier to change. Key points included the difficulty in releasing staff for training when there is *“pressure for all hands on deck in sole or micro businesses”*; and when the *“financial constraints of working to low profit margins makes it difficult to invest in training and new products”*. One business believed that it would take low carbon legislation around housing to justify the cost of training. Recent government legislation announcements may now stimulate an acceleration in business take-up of skills in these fields.

Stakeholders reported limited understanding in the sector about how to make more informed choices e.g. around the materials, building processes or energy used. Additionally, there is a lack of realisation that low carbon cuts across construction skill sets – from technical design, consultancy and procurement to everyone involved onsite – making it a collective responsibility across business, operational and technical roles. This in itself implies that greater awareness is required to instil an understanding of what low carbon means to the sector from a skills perspective, how relevant it can be across a range of roles, and what the jobs for the future might look like. This is widely perceived as a responsibility for the entire skills system – FE, HE and intermediary bodies like CITB. That

includes communicating what funding and support is available and making learning about low carbon construction integral to apprenticeships across the trades.

“The industry knows brick and block and will keep using it, especially when new products and skills are seen as high risk over accepted traditional build methods.” [FE College].

“Take air tightness - everyone needs to be aware of the notion that a house is being built in this way and all the trades need to be aligned on site...but the industry is not currently set up that way.” [Business].

Passivhaus⁷ standards including thermal efficiency and air tightness were noted as becoming more recognised, with some places adopting this as the way forward in planning policy, including in York where the Council has committed to building 600 new homes over the next five years.

“Local authorities are not typically ahead of the curve on this, but it is great that City of York have taken the stance.” [Business].

Heat pumps were the most commonly referred to technology requiring skill development – unsurprising given the Committee on Climate Change has advised that installations will need to increase to over 1 million per year by the mid-2030s, with a total of 19 million heat pumps deployed by 2050.⁸ As identified by BEIS in their Heat Network Skills Review (2020), this will take in the full range of vocational and professional roles and span design, installation and maintenance, as well as new and retrofit applications. There are few specialised qualifications for working in the heat network sector, and instead people will have recognised qualifications in a related trade combined with heat network specific knowledge developed through on-the-job training and supplemented by the short training course run by the Chartered Institution of Building Services Engineers (CIBSE).

Other current, growing or future skills needs identified through interviews included those relating to:

- Thermal modelling and skills linked to airtightness and other passivhaus requirements
- Quality control skills
- Home insulation beyond windows, cavity wall and loft
- Household EV charging point installation and maintenance
- Ground and air source heat pumps
- Hydrogen boiler installation and maintenance
- Retrofit across trades and whole house retrofit coordinators
- Resource efficiency in the business itself

Finally, one business interviewee was keen to point out that there is much best practice in sustainable construction and that this should be used to support a shift in behaviour, acceptance and therefore demand, resulting in a positive impact on demand for low carbon associated skills. The same interviewee noted the extent to which the social housing sector is currently driving demand, observing that *“there is a massive opportunity for social housing to be at the vanguard of sustainable construction techniques – they have the money, and they need the houses, and the long term impact is a win for people [who live in them] and the planet”*.

⁷ Passivhaus buildings provide a high level of occupant comfort while using very little energy for heating and cooling. They are built with meticulous attention to detail and rigorous design and construction according to principles developed by the Passivhaus Institute in Germany, and can be certified through an exacting quality assurance process.

⁸ Next steps for UK heat policy (2016) Committee on Climate Change <https://www.theccc.org.uk/wp-content/uploads/2016/10/Next-steps-for-UK-heat-policy-Committee-on-Climate-Change-October-2016.pdf>

4.3 Energy and engineering

Experts in the sector argue that the requirement is not for specialist ‘low carbon engineers’ – a role that arguably does not exist – but for engineers in existing disciplines with the mindset, soft skills and top up specialisms to apply their engineering skills to low carbon solutions and technologies.

“Quite often it is about an adaption of an existing course.” [University expert]

As with businesses generally, there is a gulf between larger companies and SMEs. Carbon reduction is a recognised business issue in most large companies, and a fundamental one for those that are energy intensive or involved in energy supply. However, sector representatives and others engaged with business in YNY reported that manufacturing and engineering-based SMEs typically see transition to low carbon as *“a nice to do, not something that is essential right now, especially with Covid-19 and Brexit”*. Nevertheless, there is evidence that attitudes are changing, and one specialist engineering training provider in the Humber, where low carbon energy is becoming well embedded and visible, described the issue as *“coming up more and more”*.

The link between specialist low carbon skills and general engineering skills is of key importance. Interviewees were clear that the national shortage of engineers applies locally and that recruiting and retaining skilled engineers is difficult. One sector representative described skills as *“the number one issue for the sector”*, and in a national survey⁹, 60% of employers reported recruitment of engineering and technical staff with the right skills as the biggest barrier to achieving their business objectives over the next three years. This is important for low carbon transition as there is consensus that the ‘low carbon skills’ needed in energy and engineering are dependent on these skills and typically involve a combination of:

- a) qualifications and expertise in an existing ‘traditional’ manufacturing disciplines (e.g. mechanical or electrical engineers in relation to renewable energy);
- b) ‘bolt on’ specialisms, in particular low carbon technologies e.g. wind energy and solar installation; and
- c) soft/transferable skills and a good attitude that support flexible application.

Training providers and university experts with industry experience highlighted the importance of a blended approach in this respect. This involved continuing to train more engineers through established core courses and apprenticeships, but also ensuring that these courses are ‘flavoured’ (as one expert put it) with low carbon throughout and include specialist units where relevant. The engineers trained through them would then have the core expertise that is needed and be well placed to upskill on specific technologies as they emerge and evolve through taking short courses. This approach has the benefit of meeting the core skills needs required for engineering generally and for low carbon application specifically, without restricting those trained to very specialist niches.

“You can’t tell exactly where you will be working and what you will be working on. The sector will grow, and jobs and opportunities will grow, and you should be prepared for a portfolio career in engineering.” [Training provider].

⁹ Skills and Demand in Industry Survey, Institution of Engineering and Technology (IET), November 2019

As with businesses generally, those in the energy and engineering sector also put great stress on a positive attitude and soft/transferable skills such as problem solving, initiative, collaboration and communication, with these needed on top of technical skills to be effective in a job in the sector.

Many of the same themes emerged about the skills required in energy and engineering whatever technology was involved, but there were some specific points and technologies noted in relation to different areas of renewable energy as identified below.

Biorenewables/bioeconomy sector

The bioeconomy comprises “*economic activity derived from bio-based products and processes which contributes to sustainable and resource-efficient solutions to the challenges we face in food, chemicals, materials, energy production, health and environmental protection*”.¹⁰ In 2017, there were over 16,000 companies in the North of England with bioeconomy innovation potential, and a total of around 415,000 employees. The BioYorkshire initiative will expand the region’s bioeconomy R&D base, help to move innovation ideas towards commercialisation and contribute to ‘green’ economic recovery.

The bioeconomy is of great importance to YNY and extends well beyond the focus sectors in this research. Hence our conclusions do not cover the majority of bioeconomy businesses and their skills needs, but do overlap in relation to engineering and energy, and specifically the biorenewables sector. Given this context, BioYorkshire have fed in information about the bioeconomy sector and its skills needs that is included in full in **Annex 3**. The following paragraph is taken from that submission in relation to the skills gaps they have identified:

“Although the bioeconomy represents a major opportunity for growth, skills shortages are a major barrier to its development. Higher-level technical skills development in the UK lags behind that of other countries, although there are measures to address this that will come into effect in the near future (such as the new T’ levels). A lack of STEM graduates will also have a negative impact on the development of the bioeconomy, given that the majority of graduate employees working in the bioeconomy have a STEM degree. Skills shortages in industrial biotechnology, an underpinning enabling technology with applications across many sectors of the bioeconomy, are documented by Cogent, who are taking steps to address this. The development of cross-sector, interdisciplinary and soft skills and the way in which these can help to develop awareness of the bioeconomy is also something that needs to be addressed.”

These findings mirror many of the key points about low carbon and circular economy skills that emerge throughout this report. These relate especially to the combination of STEM skills as a foundation; transferable skills; and in some instances specialist skills (such as in relation to anaerobic digestion within the bioeconomy sector, where the lack of a formal qualifications was identified as an issue).

Separate to the BioYorkshire input, wider (but limited) consultation in relation to biorenewable energy identified broad areas of skills needs rather than areas of specialist low carbon expertise. Noting assets such as the University of York and progress already made that can be built upon, an input from one large specialist organisation in the sector said that:

“...universities and colleges have already responded to these developments in their curriculums and the skills required represent a shift in emphasis for ecologists and such like rather than the establishment of a new academic discipline.”

¹⁰ <https://bbsrc.ukri.org/research/briefings/bioeconomy/>

Elsewhere, the 'THYME' project is a collaboration between the universities of Teesside, Hull and York on knowledge exchange in the bioeconomy, and is in the process of engaging sector stakeholders as part of research intended to inform curriculum development in higher education. Early findings suggest that firms in the sector tend to require something unique to their own business and may often address their own skills needs (especially in larger businesses who have their own graduate employment programmes that aid recruitment). The general view was that businesses are seeking a combination of base knowledge in a relevant topic (e.g. chemistry, biochemistry, biology, chemical engineering) and the right transferable skills. If a recruit has the core chemistry skills for lab work and a good attitude, then employers can train them up in specialist elements required in their business (or could potentially access external top-up training to do so should that be available).

Solar Energy

The research included input from a company who installed solar energy panels as part of what they do, and the solar technology was also raised in some wider responses. The key skills need for solar energy installation (depending on whether PV or thermal) was said to be for “*good electricians and plumbers*”, with commercial on-site (rather than solely domestic) experience needed for installation at scale. In this respect, general electrical and plumbing qualifications were accepted as the base (no specific low carbon or solar ones were noted), potentially combined with top-up training on specific solar energy technologies and installation. The ideal combination was to have core electrical and plumbing skills, on-site experience, and transferable skills such as initiative, communication and problem solving.

Wider sources¹¹ also point to the need for technician level electrical-related skills for small-scale solar PV installation projects, while in small-scale solar thermal projects, the main skills involved are related to plumbing. Some roofing skills can also be relevant for solar installation and maintenance. The same report identifies that jobs around solar energy identify a range of roles that typically demand technician level skills to perform tasks across the solar value chain from manufacturing and construction to installation, operation and maintenance. They also note potential for a shortage of solar installers. Mirroring findings in this research, a UNESCO report notes that “many of the skills needed in the transition to green-energy technologies can be covered by topping-up of existing job-related skills, together with the strengthening of generic competences, and additional skills for specific sectors or technologies can be acquired relatively quickly through training or on-the-job courses.”

(Offshore) Wind Energy

Offshore wind is relevant to YNY given its proximity to the Humber and the UK's largest offshore windfarms, with these set to expand. Insights into the sector for this research were gained mainly via interviews with the Aura Centre at the University of Hull and with HETA, an engineering specialist training provider based in Hull, as well as drawing from a virtual conference involving businesses in the sector.¹² Currently the UK's offshore wind electricity generation capacity is

¹¹ https://unevoc.unesco.org/pub/solar_energy_demands-discussion_paper1.pdf

¹² Upskilling the UK Workforce for the 21st Century (2020) <https://www.aldersgategroup.org.uk/latest#skills-deficit-needs-to-be-urgently-tackled-to-get-to-net-zero>

delivered by 11,000 skilled jobs, and this is expected to grow to 27,000 by 2030,¹³ supported by Government commitment to quadruple offshore wind capacity to 40GW by 2030.¹⁴

At one level, it can be argued that there is not a current skills shortage for many roles in the industry as some recruitment exercises by offshore wind energy companies in the Humber have been substantially oversubscribed with suitable applicants. However, companies are fearful of future skills shortages and wage inflation and project delays due to them, and of being impacted by the general shortage of engineers. In 2018, an Energy & Utility Skills report reported that 265,000 skilled entrants were needed each year to meet the demands from engineering companies through to 2024, with a potential shortfall of 20,000 engineering graduates per year across the UK.¹⁵

Generally, wind energy industry skills needs are for conventional engineering skills sets and are similar to those required by other sectors such as onshore electricity generation, transmission and distribution, general manufacturing and the offshore oil and gas sector. As such, the skills required are often based on the foundations provided by existing courses such as mechanical engineering, electrical installation or linked to control and instrumentation and related digital skills. Wind energy roles include scientists in environmental and physical sciences (e.g. marine biology), technicians (e.g. for blade and turbine maintenance), engineers (mechanical and electrical) and project and asset management and leadership positions. Transferable skills are also important. For example, Siemens Gamesa Renewable Energy's recruitment of 750 people for its blade factory was carried out on the basis of attitude and practical ability, rather than qualifications. The sector is also striving to overcome a deficit of BAME and female recruits/employees.

4.4 Automotive and electric vehicles

The Institute for the Motor Industry (IMI) in the region was a major contributor to the research and a number of other interviewees (e.g. from colleges) also referred to the automotive sector. Given that YNY does not have a major automotive manufacturing sector, it is likely that the main implications for skills will be around the installation of charging infrastructure and the maintenance of non-petrol and diesel vehicles, in particular electric vehicles (EVs).

EV charging point installation capability will be a key need in the future given the Government's intention to end the sale of new petrol and diesel cars and vans by 2030 and to invest £1.3 billion in charging infrastructure, including rapid charge points on motorways and major roads and more on-street charge points near homes and workplaces. Key skills needs are for electricians with the required top-up training (a matter of a few days or less) to install charging points. A current skills deficit did not emerge strongly in this respect but given likely future demand and other demands for electricians/electrical installers linked to renewable energy growth, there could be electrician skills shortages in the future and capacity bottlenecks around short course provision. Some colleges in YNY are integrating modules on EV charging into existing electrical courses, and short courses enabling electricians to gain certification in this area are available reasonably nearby (e.g. in Leeds).

The main challenge emerging in the automotive sector itself is the need for the 'aftermarket' (i.e. garages, repairs, servicing, etc.) to be able to service and maintain electric and hybrid vehicles. These require some different skill sets to petrol and diesel vehicles and currently most garages do

¹³<https://static1.squarespace.com/static/5faa9db24824a917c7e06a4c/t/5faac0f953e983236a938b9e/1605026053460/The+Humber+Offshore+Wind+Cluster+Prospectus.pdf>

¹⁴file:///C:/Users/lesne/Dropbox/YN%20LOW%20CARBON%20SKILLS/Background%20reading%20and%20reports/10_POI%20NT_PLAN_BOOKLET%20-%20Green%20Industrial%20Revolution%20Nov%202020.pdf

¹⁵ <https://aura-innovation.co.uk/wp-content/uploads/2020/04/Aura-EU-Skills-Study-Summary-Report-October-2018.pdf>

not have these capabilities. Moreover, the perception is that “*companies are doing the minimum they need to*”, are focused on the short-term, and that this is “*leading to a massive skills gap*” which is on top of a skills gap in technicians generally.

Specific skills gaps include the lack of suitable accreditation for EV/hybrid vehicle technicians. Typically, a garage will have one employee who can do basic electrics, but this will not be sufficient in the future, and there will be a need for more employees with Level 3 auto-electrics including diagnostics to systematically find faults. Currently, basic maintenance apprenticeships are only available at Level 2 and there is not a specific EV focused apprenticeship at Level 3. Short courses (3-4 days) are run for technicians who are already competent with electrics to upgrade their skills and there is a Level 4 Hybrid course for working on battery and charge systems, but overall there is a supply issue for level 2/3 EV/hybrid courses. The YNY LEP has recently allocated funding to York College and Scarborough TEC to enable investment in EV/hybrid training rigs which replicate the systems that are in use and enable training via courses or as part of apprenticeships and this will help to tackle skills issues in the area.

4.5 Digital (as an enabling sector)

Most stakeholders had little to feed in around digital skills and their low carbon/circular economy application. Reflecting this it was hard to identify *specific* digital skills that applied to low carbon and hence to assess the availability of these and any need for further provision. Instead, the prevailing view was that a general uplift in digital skills will tend to support low carbon application too.

“The key need is building digital skills in a general way, the application of which can benefit low carbon as a by-product.” [Local authority].

While a full review of digital skills provision was outside the scope of this research, a number of existing digital skills assets (not low carbon focused) and opportunities to enhance them were noted in discussions. These included digital skills courses provision at most FE colleges; the proposal for a Hambleton E-Campus; emerging Digital T Levels; and recycling of computing and IT equipment as part of a circular economy. Digital skills were also seen as a component of what one interviewee described as a ‘flexible scientist’ with a portfolio of knowledge and skills that can be applied to low carbon. Additionally, the Institute of Technology noted that while messages about digital from employers tend to be about issues like cyber security rather than low carbon, there may be potential to look at any needs around digital skills and low carbon goals.

One area that did emerge around a specific digital technology was control systems in renewable energy, especially offshore wind and tidal energy, where remote management of assets is important to companies to prevent the expense of journeys to, for example, offshore turbines. Digitally based asset management is likely to be a growth area given the rapid increase in wind energy off the East Coast. More widely, stakeholders noted the expanding role of digital and computing skills in engineering, manufacturing and automotive, and its application in lean manufacturing and automation – which could have low carbon benefits as a by-product.

[Back to Contents](#)

5. Supply of Low Carbon Skills – Qualitative Analysis

5.1 Messages from suppliers and factors influencing supply

The role of the skills system in building low carbon skills

People agreed that the skills system has an important role to play in building the low carbon and circular economy talent pipeline. This seems to take five dimensions:

- i) Many placed **importance on colleges themselves acting as exemplar anchor institutions** through their strategic priorities, estate and wider behaviours and in *“doing real things that people can see”*. All reported low carbon and sustainability more broadly either as embedded in strategic plans or on the way to being so, but with some being demonstrably further down the line. Harrogate College is a good case in point, with a strategy that aims for a net zero estate, partnering in Circular Yorkshire, and targeting a change in behaviour, culture and curriculum to become a centre of excellence on the green economy.
- ii) Interviewees talked about the curriculum offer. This is discussed in more detail in the sections that follow, but at a big picture level, **support for building low carbon skills provision is limited because the curriculum lags behind, is still very traditional and implementing change is complex**. The general view is that colleges *“need to embed low carbon across everything in the existing curriculum”* at the earliest opportunity, as a cross-cutting theme to raise awareness and make low carbon an intrinsic part of the world of skills and work (as digital skills has become) as opposed to being a niche area. This needs to sit alongside specific and specialist low carbon provision. Additionally, horizon scanning should be used to spot future low carbon needs that curricula in relevant subjects will need to respond to, e.g. around new renewable technologies.

“There is a level of tokenism in post-16 education about how to embed low carbon. We need to teach it in a less subtle way – content needs to be in your face at all qualification levels – with a ‘you don’t pass it until you have achieved it’ approach.” [Training provider].

- iii) Interviewees talked about the **important role colleges and specialist training providers can play in interfacing with business**, specifically helping them to understand what skills they need as well as supporting a localised flavour and more granular breakdown of low carbon skills provision. This includes, for example, colleges closer to the YNY coast developing specialisms in offshore wind; and Leeds College of Building’s work to support Northern Gas Networks in developing a green gas apprenticeship funded by the Leeds City Region’s ‘Let’s Talk Real Skills’ ESF programme.
- iv) **Independent training providers were seen as having an important role to play in building low carbon skills**, perhaps being more agile than large FE colleges and able to respond to specialist skills and localised sectoral or niche demand.
- v) **Awarding bodies have potential to bring the skills system together** to align provision with economic and skills intelligence and priorities to build a route map for skills and careers in low carbon.

The need for concurrent increases in demand and supply - a chicken and egg paradox

Several different stakeholders stressed the need for there to be a supply of low carbon training from providers and demand from industry *at the same time*. This is an overarching issue that was repeatedly described in terms of there being a chicken and egg situation at play. As long as SME demand for low carbon skills is subdued and/or not articulated (see section 4) provision to meet it will lag. This is partly because of previous experience. One college referred to there being a reticence borne of *“having had fingers burnt in the past”* in respect to making capital investments in resources needed to support new teaching only for funding to be subsequently withdrawn. Another stressed that FE is unable to *“speculatively put on provision and hope that it is taken up”*; and providers generally are unwilling to put on courses that are not linked to clearly identifiable employment opportunities or higher level learning at the end.

This is true too from an independent training provider perspective, with one saying that *“we have dipped our toe into low carbon but not gone all in.”* This was despite recognising that *“it is coming up more and more”* and the relevant training provider being *“close to the epicentre of offshore wind activity.”* Providers feel that they are able to develop their offer to deliver specialist training, but that these training needs and the demand for them need to be identified in advance based on clear intelligence. Definition about the *specific* skills and training that transition to a low carbon, circular economy requires in practice is needed as part of this intelligence – although this is not straightforward because (as we have found in this research) few businesses, providers or public bodies working on skills are able to easily articulate these details.

“It’s very difficult to get clear messages from industry about their needs for low carbon skills...we wouldn’t know what to provide without intelligence from employers to colleges.” [Training provider].

Across providers, the overall requirements that would need to be in place to give them the confidence to make major or expensive shifts towards greater low carbon skills provision were that:

- a) they can see demand;
- b) they fully understand what it means to them and so can take an informed view on what it offers in terms of growth;
- c) they are being measured on it by Ofsted; and
- d) there is funding to support transition.

This mix was seen to be especially important in the current climate where *“the focus is on safeguarding current business and recovery and not taking on new curriculum areas that require investment and bring risk.”*

Overall, it appears that at the time of this research, demand had not yet passed the tipping point around which widespread and dedicated provision is a priority and mainstream. Provision is further hindered by the absence of mandatory curriculum requirements, and by an Ofsted inspection regime that does not assess or make judgement based on such provision being in place.

Interest from young people and how far this translates into post-16 choices

A key factor that influences demand from young people and their choice of courses and careers is how far they (and their parents) see that there are good jobs and careers. Training providers/colleges and businesses see that while young people often have an interest in sustainability issues, they rarely make the connection between this and their career choices, partly because the idea of what a low carbon career actually is can be vague or invisible:

“It’s not a job, not something that young people see as a career. We need to turn all those words on low carbon into tangible occupations that young people can identify with and aspire to be.” [FE College].

“Student desire is coming through; the hard bit is cohesion of that around a relevant course and convincing parents that there is a career in it.” [University expert].

Part of the reason for this may be that there are not many clear and specific ‘low carbon careers’, and the greatest opportunities for tackling climate change through hands-on work are often about the way in which existing jobs are performed and the technology/products they use. For example, a glazier fitting a quadruple glazed window is still a glazier. This makes communication of opportunities more difficult, a problem that is compounded by what is perceived as a lack of good careers advice and information about low carbon careers, and the longstanding issue of schools being perceived to steer more able pupils towards A levels in their sixth forms rather than encouraging them to also consider alternative vocational routes.

Initial steps to embed and increase low carbon content in courses

Specific low carbon and circular economy skills provision is currently somewhat limited and is mainly contained within – but not the focus of – established core curriculum provision. However, there is some evidence of efforts to flex and tailor course content by building in specific low carbon modules or units. Examples noted of where this sort of embedding occurs include:

- Electric installation and motor vehicle courses in respect to electric and hybrid vehicles
- Modern methods of construction embedded within construction crafts courses
- Technical and higher level courses on civil and structural engineering
- Lean manufacturing to cut costs that may support low carbon via reduced energy or waste
- Engineering courses that cover energy sources, pollution and environmental impact

While positive, the extent of such provision and how much of a course it covers is however modest:

“The EV/Hybrid unit scratches the surface...it is one of 25 units” [FE College].

“From a house builder perspective, it is still the case that all they want is to build houses quickly and to do that they are demanding more bricklayers. Any demand for modular skills is because it is quicker to build, not because it is low carbon – that is just a happy coincidence!” [FE College].

There are some exceptions. For example, the University of Hull and Siemens have developed together a three-year graduate level engineering apprenticeship with an offshore wind focus (this is covered as a module in the first eight weeks). In its first year it will cater for 12 people based on Siemens demand, but there is flexibility for others to use the same provision in future years, or to apply the wind energy module or aspects of it in other courses. This sort of collaborative business and educational institution provision serves as a good model for designing and securing investment for new low carbon skills provision.

Curriculum, flexibility and provider capacity and expertise

Input was consistent – from skills providers and others – that it is often very hard to recruit suitably experienced tutors based on the stark reality that people can command far greater wages working in trades or in industry, particularly in STEM and technology fields. Solving this requires proper, well

facilitated, flexible partnership working between education and industry, with the Advanced Manufacturing Research Centre in South Yorkshire cited as an example of this. One interviewee summed up the solution as:

“Experts from industry need to be brought in a peripatetic way to support education design and delivery. This way, lecturers can be very good subject generalists supported by industry specialists who provide focus.” [Training provider].

Interviewees also identified the need for the continuous professional development teaching staff receive to keep them updated on low carbon, especially in areas such as EVs, where technology advancements are happening at pace. However, this adds to the cost of provision and can act as a disincentive. Again, stakeholders suggested better provider partnerships with business as a solution to this; alongside systematic updating of teaching standards, as 75% of teachers currently feel that they have not received adequate training to educate students about climate change.¹⁶

There was a view that the curriculum itself lags behind, is still very traditional and changing it is not easy. This has led to some colleges looking for ways to deliver low carbon in innovative ways, including via demonstrator projects and in partnership with business. One College for example is looking at skills for retrofitting heritage buildings and is considering how it can use a plastic free horticulture project to teach sustainable resource use. Curriculum issues are compounded by an awarding system that is still very traditional, with scope to be far better shaped by business and to be backed by apprenticeship standards that integrate climate and sustainability.

Funding and resources

The adult education funding model is an important barrier. This is on the basis that it encourages provision where current demand for places from students (and to a point businesses) is high and obvious, which is not yet the case for low carbon. The model also requires courses for 16-18 year olds and adult provision to be on a funded qualification list, which limits what courses are available and restricts the ability of colleges to put on specialist courses over a more generic list. Colleges feel that they simply cannot afford to invest in setting up a course if there is a chance of low take up, especially given the capital outlay required for specialist kit and equipment in a field where technologies are fast evolving, and equipment quickly becomes outdated and needs replacing.

“There are not a lot of bums on seats for low carbon yet, but it will grow, and providers need to align themselves to LEP priorities (as they are being directed to do by the Ofsted framework) if they want to tap into devolved adult education budgets.” [FE College].

“A hybrid vehicle training rig alone can be in the excess of £10,000 – and you need one rig for every two students – with 16 students in a class it is simply prohibitive!” [FE College].

“LEP and any devolved budgets should support more agile and apportioned risk towards developing and providing courses and kit.” [FE College].

The situation is similar for independent training providers. There is also work to do to raise awareness and to support them to understand and look ahead to what low carbon provision they could expand into. One interviewee observed that although demand is in its infancy currently, it

¹⁶ Upskilling the UK Workforce for the 21st Century (2020) <https://www.aldersgategroup.org.uk/latest#skills-deficit-needs-to-be-urgently-tackled-to-get-to-net-zero>

would serve providers well to prepare themselves now and in so doing develop a USP and long term curriculum security in an agenda *“that is not going to go away in the foreseeable future”*.

While this approach is clearly desirable, the challenge for the skills system will be how to gear itself up to provide an increased diversity and scale of low carbon provision set against an unsupportive funding backdrop and with uncertain and unproven demand (as already noted in this section).

5.2 Likely future provision

Colleges and other training providers were asked whether they expected to put on new training/courses, or to change existing provision in order to respond to low carbon and circular economy issues. The main overall points emerging in this respect are that:

- The level of specific planned new provision is currently modest. However, most providers are open to expanding or changing the nature of their provision to respond to low carbon issues.
- Translating this openness into new areas of provision depends on there being sufficient demand (from students and employers) and on overcoming a number of barriers – for example around qualifications design, funding and availability of expertise (see section 4).
- There is willingness (and already some plans in place) to frame and amend existing courses and apprenticeships in a low carbon way. This fits with the finding that influencing mainstream courses may have more power to equip the workforce to support low carbon transition than standalone new courses. For example, engineering focused providers are doubtful that there are roles or courses that are specifically about being a low carbon engineer, and that adapting existing courses and highlighting their relevance is more apt. Examples of this embedding, integrating approach to low carbon and ongoing or potential shifts in this direction include:
 - One college which intends to select elements related to low carbon to build into courses where options to do so are available and to embed low carbon into courses more widely.
 - One institution that said it was open to integrating low carbon content into courses, e.g. in engineering, and to *“modifying what we already do to give that a low carbon slant.”*
 - One college which recognises the need to *“embed low carbon so that it sits in all of the curriculum and how it is taught.”*
- Some institutions also have plans or potential to enhance specific areas of provision. Examples of these include:
 - Organisations responding to skills gaps around EV hybrid vehicles, sometimes supported by LEP investment. These include new provision at Scarborough TEC and at York College. Other bodies enhancing provision include a Humber based training provider who is looking at short course training on installing and maintaining EV charging points.
 - One institution said it was open to considering how digital courses could include content on low carbon application.
 - One Training Association is looking to extend their offer to include Leadership & Management training, with potential to use that to shape future awareness of the low carbon circular economy and business issues and opportunities around it.

- Leeds College of Building is developing a 'Green Gas Apprenticeship' in partnership with Northern Gas Networks.
- A 3-year degree level wind energy flavoured engineering apprenticeship developed by the University of Hull in partnership with Siemens, where the first eight weeks are based on an offshore wind module.
- A Wind Turbine Technician apprenticeship that highlights wind energy relevance whilst being based on many of the same skills as other engineering apprenticeships.

More widely, a significant number of providers think that using their buildings and campus to demonstrate sustainability credential and net zero ambitions and establishing a low carbon culture that involves students and staff also helps to build low carbon understanding and values. Examples of institutions with plans in this respect include Harrogate College, which is striving to become a centre of excellence on the green economy, with a net zero estate and encouragement of green behaviours and culture. Another institution is looking at a role as 'low carbon hub' and is considering potential to use its modern, high tech building as a visible demonstration of low carbon design and technologies in practice.

[Back to Contents](#)

6. Data and Analysis on Current Provision

We analysed data provided on starts on courses and apprenticeships in subjects relevant to the sectors of focus for this research, as well as provision of local university courses. We also reviewed subjects offered by sixth forms in YNY. The results are summarised in the sections below and provided in greater detail in Annex 1.

6.1 Places and courses analysis

We reviewed data on the number of starts by YNY residents on courses related to each key sector, and the providers and levels of these courses. Annex 1 shows this data in full and table 2 shows the numbers and main providers for each sector. We identified a total of around 9,000 enrolments in courses related to engineering, manufacturing technologies, electricians, plumbing, construction, transport and ICT.

Table 2: Courses by sector and main providers and levels

Sector	Number of enrolments	Main providers	Level of courses
Engineering	2,000	York College (300), British Army (220), Calderdale College (150), Selby College (130)	<ul style="list-style-type: none"> • Mostly Level 2 or 3 (91% combined) • 46% Level 3 or above
Building and Construction	2,490	York College (790), Leeds College of Building (280), Grimsby Institute of FE and HE (230), Selby College (140)	<ul style="list-style-type: none"> • Mostly Level 2 or below (72%) • 28% Level 3 or above
Electrician	430	York College (130), Grimsby Institute of FE and HE (70)	n/a
Plumbing	220	York College (90), Leeds College of Building (40)	n/a
Manufacturing Technologies	330	Calderdale College (70), York College (50)	<ul style="list-style-type: none"> • Mostly Level 2 (50%) • 32% Level 3 or above
Transportation Operations and Maintenance	950	York College (180), Grimsby Institute of FE and HE (130)	<ul style="list-style-type: none"> • Mostly Level 2 (68%) • 32% Level 3 or above
ICT	2,370	Darlington College (820), York College (290)	<ul style="list-style-type: none"> • ICT for Users mostly below level 2 (77%) • ICT for Practitioners mostly Level 3 (71%)
Total	8,930		<ul style="list-style-type: none"> • 34% Level 3+ overall

Key points in relation to provision and uptake of courses are that:

- Overall, most courses are at Level 2 (39%), while 34% are at Level 3 or above including 380 at Level 4 or above (5%).
- There is a very wide spread of course-provider combinations (over 1,500). This makes it hard to review how far individual courses and institutions include low carbon without deep dive studies into particular areas of provision.

- Many of the courses will build technical skills in engineering, construction, automotive and digital sectors that provide a foundation on which specific low carbon skills could be developed through top up courses. Some of them are also likely to have potential to incorporate greater low carbon content depending whether there is any choice of the modules and material they cover.
- However, we were only able to identify four courses that explicitly included a low carbon or sustainability focus, only two of which had significant uptake - a Level 2 Award in Industrial Environment Awareness provided by Calderdale College (120 enrolments) and an NVQ Diploma in Construction Management (Sustainability) at Leeds College of Building (30 enrolments).

6.2 Apprenticeships

We analysed data on apprenticeship programme starts by YNY residents in the 2018/19 academic year on specified framework sector subject areas (Construction, Engineering and Manufacturing, Digital). Key points are:

- Nine apprenticeship providers registered 50+ starts in frameworks or standards relevant to the focus sectors, these being York College (300 starts), the British Army (130), Leeds College of Building (100), Grimsby Institute of Further and Higher Education (90), Darlington College (80), JTL Training (80), Selby College (50), Craven College (50) and Derwent Training Association (50).
- The largest providers for starts in engineering were York College (60) and JTL (40) and in manufacturing technologies it was the British Army (130).
- The largest providers for construction were York College (120) and Leeds College of Building (60), while York College (40) and Leeds City College (30) were the most significant for plumbing and JTL (40) was for electrician courses/trades.
- York College (30), the Grimsby Institute of FE & HE (30) and Babcock Training Ltd (30) were the main providers for Transport, while British Telecommunications (40) and QA Ltd (30) were the most significant ones for ICT.

Table 3: Apprenticeship framework starts by sector groupings and level (2018/19)

Sector	Apprenticeship Level			
	Intermediate	Advanced	Higher	Total
Engineering, Electrical & Plumbing and Manufacturing Technologies	320	310	50	680
Building and Construction	270	130	60	460
Transportation Operations and Maintenance	90	140	0	230
ICT Practitioners	40	100	40	170

For Engineering, Manufacturing, Electrician and Plumbing, the Engineering framework had most starts overall (210); for Construction it was Construction Skills (230), for Transport it was Vehicle Maintenance and Repair (100), while for ICT, IT and Telecoms Professional and Digital Marketer both had 50 starts.

None of the twenty frameworks identified with a rounded total of 20 or more starts across all the focus sectors appeared to be slanted towards low carbon/circular economy content. This reinforces messages from stakeholder engagement, which pointed to a lack of specific low carbon focused apprenticeships and stressed the potential to build in low carbon and circular economy content into existing apprenticeships. This low carbon flavouring of the main courses that are already training the engineers, mechanics, builders, electricians and plumbers of the future is likely to have greater impact than creating standalone low carbon courses given the number of apprentices that could be reached, including a significant number at advanced and higher levels.

6.3 University courses

Annex 1 shows the number of 'HE qualifiers' (i.e., students who *gained qualifications*, not the total number of students, which will be higher) in relevant courses in the two universities within YNY in 2017/18. The subjects listed are potentially relevant to one or more of the key sectors in this research at a general level because they provide valuable foundational skills. Some of them may also contain low carbon specific content. The main groupings of courses analysed that are potentially relevant are:

Engineering related (190 qualifiers): the Electronic & Electrical engineering course at the University of York has a high number of students and is likely to develop skills that will be potentially valuable in renewable energy industries and potentially other sectors of interest.

Digital related (285 qualifiers): a significant number of students are graduating with skills in this area, mostly in Computer Science at the University of York, which will be relevant to the digital sector and could potentially be applied in ways that assist low carbon technologies and goals.

Bio-related (315 qualifiers): biological and biochemistry related subjects are a major strength at the University of York and are of value to the bioeconomy sector, including biorenewable energy.

Other STEM subjects (830 qualifiers): The University of York runs courses in maths and sciences such as Physics, Maths, Chemistry and Physical Geography. These will provide foundational skills that could be of value in the energy and engineering sector and other sectors too.

Management and business related (750 qualifiers): both York universities have sizeable courses in Management/Business Studies. While not directly relevant to the key sectors, they could provide a vehicle to influence business thinking and decision making on low carbon in the future.

Overall conclusions from analysis of HE provision are that:

- 'Bio' related provision is strong, and this fits with messages from stakeholders in highly specialised areas of the bioeconomy who reported satisfaction with the supply side. However, as the BioYorkshire report highlights in Annex 3, the picture is more complex.
- Other subjects with significant HE provision include electrical engineering, computing and STEM subjects. Whilst the extent of specific low carbon content in these courses is uncertain, they will provide foundational understanding that can be built upon (e.g. through short courses).
- Areas where there are gaps in YNY include other types of engineering, energy and automotive specialisms. However, there is strong provision in many of these areas in other universities close to YNY, which will be of benefit and may be further utilised. These include engineering, energy, climate change and circular economy strengths in universities in Hull, Teesside, Leeds and Bradford.

6.4 Relevant exam entries and courses in sixth forms

We reviewed the extent and spread of age 16-18 Tech Level and Tech Certificate exam entries¹⁷ in York and North Yorkshire in 2020 and the number of students in Level 2 and 3 apprenticeships in the same year. The data referred to here is for any topic or apprenticeship standard as the official data that it is based on is not subject specific and includes all sixth form (colleges) and FE colleges in York and North Yorkshire.

We also reviewed the number of sixth form colleges that offer more technically focused courses at age 16-18 outside of the standard science and maths options, based on analysis of all schools/sixth form colleges with provision at that age and using information available via their web sites (this was possible for 39 institutions). Data on both sets of analysis is in Annex B and show that:

- There were 561 Tech Level exam entries in YNY colleges and sixth forms in 2020, with most of these at Askham Bryan College (350) or York College. Eight schools with sixth forms had at least one Tech Level exam entry, but these accounted for only 59 entries in total.
- Additionally, there were 49 Tech Certificate exam entries, mostly at Selby College and Askham Bryan College (18 each). None of these were in schools with sixth forms.
- There were 650 apprenticeships in the same year, with all of these through four colleges – Askham Bryan (170), York (100), Craven (80) and Selby (60).
- The number of students with Tech Level/Certificate exam entries or completing apprenticeships is significant – 1,260 in total – but modest compared to the total number of students with an academic exam entry (4,244) of which most were A Levels (4,138).
- The main subject option that is commonly available in school sixth forms and has clear relevance beyond the core STEM subjects is Design Technology/Product Design A Level. This was available at most sixth form colleges, although a significant minority did not offer it. Two other options were occasionally available - Engineering/Design Engineering (5 establishments) and Electronics (1 establishment).

We did not identify any specific courses focused on low carbon. However, an interesting example of the blending of low carbon themes into a Design Engineering A Level was identified in Skipton Girls High School¹⁸ which is promoting itself as ‘an engineering academy’ with a “learning environment which is not constrained by gender stereotypes or a fixed mind-set”. It offers Engineering at GCSE and Design Engineering at A Level. The latter builds understanding of a range of materials and their properties, and how these can be manufactured into products using Computer Aided Design/Manufacture and is taught so as to place learning and projects in the context of a broader theme such as sustainability, energy conservation and new technologies. The School also involves Year 12 girls in mentoring and support programmes for younger girls, including as STEM and Engineering Ambassadors and Digital Leaders.

[Back to Contents](#)

¹⁷ Tech Levels are Level 3 qualifications for students wishing to specialise in a technical occupation, e.g. engineering, IT. Tech Certificates are a subset of level 2 vocational qualifications

¹⁸ <https://www.sghs.org.uk/>

7. Conclusions and Recommendations

We set out below ten main conclusions from our research, including barriers to progress and solutions to overcoming these, and recommendations for action where appropriate.

Conclusion 1: Clearer definition and stronger communication of low carbon and circular economy concepts are needed to drive action and generate demand for related skills, especially within SMEs.

Sector representative organisations and large businesses see the impact that transition to a low carbon and - over time - net zero economy will have on the key sectors, and change will be more rapid and intensive given new Government policy on 'Green Industrial Revolution' and associated policies in areas such as construction, energy and transport. However, most SMEs do not yet appreciate the scale of change that will be required and the implications for their business and skills.

Many SMEs are confused about concepts like 'low carbon' and 'circular economy' and what they mean for their business. This can prevent them from finding out about low carbon solutions and taking action, and hence from identifying any skills needed to do so. As a result, businesses rarely communicate skills needs linked to low carbon to providers, who are likely to conclude that there is a low level of business demand and related employment opportunities, and that running or adapting courses in response is not warranted. The solution to this will involve stronger, proactive communication of low carbon and circular economy issues and opportunities to SMEs in terms that are meaningful to them. We need to move beyond the generalities of asking for provision of 'low carbon skills', to defining the specific skills and training that are needed in particular sectors.

This research is hopefully a starting point for clarifying requirements and the need for both specific training linked to particular low carbon and circular economy approaches and technologies, and integration of these across existing courses. Further specification and ongoing review of low carbon skills will be needed to encourage and enable businesses and providers to respond as low carbon policy and technologies evolve.

Recommendation 1: *Develop and deliver sector specific communication to businesses that explain in simple terms relevant to SMEs the current and future business opportunities linked to low carbon and the circular economy and any support (including training) available to exploit them.*

Conclusion 2: There is opportunity for collaboration between businesses and interaction with SMEs to drive low carbon and circular economy solutions and related skills demands

Large businesses often have good understanding and intelligence, resources in place, workforce development plans and supportive CSR policies that assist low carbon progress. This is far less prevalent amongst SMEs who may be well intentioned but can often lack time to evolve practices, explore new avenues or attend training. Initiatives which connect SMEs to each other or with other partners can therefore be valuable in raising awareness and reducing the time and effort required.

Potential avenues in this respect include developing clusters of businesses (e.g. within a locality) that can work together and support each other with elements including business to business coaching, mentoring, networking and peer to peer learning to exchange good practice. There is also scope to link large businesses who are making good progress to SMEs who may emulate their example given access to their expertise. Other ideas suggested around business engagement that merit consideration include:

- using demonstrator projects and visits to showcase good practice;
- supporting businesses to upscale projects so they pass the tipping point needed to train staff;
- supporting clusters of SMEs to create shared resources/know-how (e.g. a joint Energy Manager);
- work experience placements (essential for T-Levels), and undergraduate placements and knowledge transfer programmes that can bring in low carbon interest and expertise; and
- looking at how procurement and supply chains can drive and embed low carbon practice.

Recommendation 2: *Promote peer learning and sharing of resources and expertise by businesses, and collaborative low carbon projects where participation itself builds skills and awareness.*

Conclusion 3: Further partnership and engagement between businesses, providers and others is critical to improve the flow of information

Although many providers do have good links to businesses, there appears to be insufficient exchange between businesses and the skills system as to what low carbon skills are in demand and what the supply side can offer. There is a need for stronger business engagement – across FE, HE and awarding bodies, and also involving the LEP and intermediaries – to provide a greater and clearer flow of messages focused on:

- raising low carbon and circular economy awareness to accelerate change and stimulate demand;
- developing robust business/education links that support continuous dialogue, share intelligence and help businesses to identify and articulate their skills needs;
- working together to map out supply and demand and to develop pathways, including progression from FE to HE to aid skills progression, skills retention and expansion of provision;
- bringing business influence to bear in shaping qualification and course content and design; and
- facilitating blended learning delivery to overcome issues of teacher/industry pay differentials.

Recommendation 3: *Encourage further engagement between industry and providers with a focus on current and future workforce/skills demands related to a low carbon, circular economy. This should be framed around specific skills and technologies rather than in general terms whenever possible.*

Conclusion 4: Current low carbon skills provision is low. While further provision is emerging, there is a need to increase the scale and pace including integrating low carbon and circular economy content into existing courses and to create and roll out new courses to meet specific needs

Overall, the extent of low carbon and circular economy skills and expertise within courses, careers and workplace training is very limited. This reflects multiple barriers, which are set out in other conclusions. It is also clear that delivering low carbon approaches in key sectors is critical to achieving the YNY LEP’s net zero ambitions, that national policy and targets around carbon and energy will accelerate future change, and that availability of a workforce with the required skills will be fundamental to progress.

Stakeholders identified five areas of action in response – as identified in the recommendations below. These reflect the fact that transition will largely be delivered by engineers, builders, mechanics, designers, planners, architects, leaders and managers, and a range of other specialists, rather than through new occupations yet to be conceived. Hence, with some exceptions around

specific technologies and tasks where there is or will be a clear skills gap, these are mostly focused on how existing courses and qualifications, and the whole workforce of today and tomorrow, can be part of building a low carbon, circular economy. That includes widespread carbon literacy, further building STEM skills and soft skills, and crucially, the ‘flavouring’ of all relevant existing courses and apprenticeships with low carbon context and specialist units.

Recommendation 4: *Make tools and training available to encourage employers to build carbon literacy across their entire workforce to raise general awareness and grow a supportive culture (much in the way that health and safety is applicable to all and building on existing best practice).*

Recommendation 5: *Continue to promote STEM subjects and encourage more people to enter engineering, construction and automotive careers. This will address skills/labour shortages overall and provide foundations on which specific low carbon expertise can be quickly built and applied.*

Recommendation 6: *Nurture the development of transferable skills through education - such as problem solving, communication, and leadership and management, which are important in designing and driving low carbon and circular economy solutions and making them work in practice.*

Recommendation 7: *Establish a task group to integrate and maximise low carbon content and options in existing courses and qualifications, bringing together businesses, training and education providers and awarding bodies, and prioritising courses that can most effectively address skills gaps.*

Recommendation 8: *Support rapid increase in delivery and uptake of short/top up courses in specific technologies and tasks where skills gaps are apparent and/or likely to grow. These courses should be developed in partnership, effectively promoted and be targeted at those who already have core skills to build on (e.g. electrical, engineering, construction, plumbing). They are likely to include:*

- Air source and ground source heat pumps (where considerable expansion is expected this decade)
- Whole house retrofit (and specific gap technologies/skills within this including around insulation)
- Solar energy and micro-renewables
- Electric Vehicle maintenance and installation of charging points
- Other technologies that may come to the fore (e.g. hydrogen boilers and technologies)
- Specific bioeconomy skills not fully identified in this research (e.g. related to anaerobic digestion)

Conclusion 5: Recruitment, retention and ability to deploy suitably expert staff (in training providers) is a barrier to progress in designing and delivering low carbon courses.

We recommend action to address challenges in recruiting and retaining experienced tutors, which are partly due to wage gaps compared to working in trades/industry. This is not straightforward as some of the solutions to this issue are macro ones about pay levels, the overall supply and demand for skills and expertise in key sectors, and collaboration in designing or adapting courses. These are by their nature national issues and/or are covered in other recommendations. However, there may be potential for innovative education/industry partnerships where training the trainer approaches allow for rapid upskilling of current lecturers and trainers with the specific, new expertise they require to deliver enhanced low carbon and circular content within existing courses or in new ones.

This can be supported by ensuring that awarding bodies are engaged in discussion and are prompted to produce and provide high quality learning resources as well as qualifications. Doing this well means that subject matter can be delivered by non-specialists, especially when delivered as units or modules rather than full courses. This can work well for lower level qualifications, but for fuller qualifications at higher levels there remains an essential need for specialist training. All approaches need to be underpinned by systematic updating of teaching standards to equip teachers with the skills they need to confidently educate students about climate change and the relevant response in terms of specific subjects and sectors.

Recommendation 9: *Test the concept of and pilot a “train the trainer” approach in low carbon technologies where experts in industry and education pass on expertise in key areas that need embedding in courses to lecturers/trainers who can then teach them to students.*

Conclusion 6: Funding can play an important role in preventing or enabling progress

The adult education funding model presents a significant barrier. It encourages provision where demand for places from students is high and obvious, which we know is not yet the case for low carbon and circular economy and is based on a funded qualification list that limits options and restricts the ability of colleges to put on specialist courses rather than more generic ones on the funded qualifications list. Constraints also come in the form of significant costs for investing in necessary training equipment and keeping it up to date in an environment of fast changing technologies. Independent training providers are similarly not seeing sufficient demand to push forward low carbon provision.

Ways forward are often intrinsically linked to other recommendations – better labour market information, stronger links between businesses and the skills system to identify and articulate need, and work to stimulate demand for skills from businesses by raising awareness, driving a cultural shift, and stimulating innovation and enterprise in low carbon sectors. New government policy and legislation will also be a key lever, making needs clearer and providing confidence for the supply and demand side to invest. There is work to do to raise awareness amongst independent training providers because they play an important complementary role to FE colleges – especially in specialist provision – supporting them to understand and look ahead to what low carbon provision they could expand into as part of their long term offer. Finally, there may be occasions when bodies such as the LEP, or industry partnerships are able to invest resources to tackle funding based barriers – such as for purchase of new equipment needed for low carbon related training.

Recommendation 10: *Invest targeted resources from devolved funding, partner contributions and other funding streams to deliver low carbon skills solutions (e.g. to accelerate and increase short/top up courses, provide necessary equipment/infrastructure, and to communicate to key audiences).*

Conclusion 7: Young people’s interest in sustainability is rarely translated into career choices and schools and careers advice can do more to support transition by promoting opportunities in the low carbon economy

To provide the right platform of skills for low carbon transition in the future workforce, stakeholders called for continued work to promote STEM subjects in schools and colleges (including a focus on girls and young women). They also wanted education to support low carbon awareness and to foster transferable skills (e.g. problem solving) through the way in which the curriculum is taught.

The role of schools and careers advice and guidance in shaping perceptions and career choices is important. Some stakeholders feel that schools with their own sixth forms tend to steer more academically able pupils away from vocational courses, which reduces the supply of skilled young people moving into key sectors. Parental perceptions about lower quality or pay can have the same effect. Better careers advice and engagement with schools to raise awareness and promote positive messages about the engineering, construction and automotive sectors would help to address skills shortages in these areas generally and to equip the future workforce to be able to deliver low carbon transition.

Demand from young people to take up courses in relevant subjects is also a big issue, especially in terms of the ability of colleges/training providers to offer courses and apprenticeships. While young people often have an interest in sustainability, they rarely make the connection between this and their career choices, partly because of the challenge in defining a low carbon career.

Recommendation 11: *Create careers advice resources in hands-on careers that tackle the climate emergency and pathways into them to help young people translate their interest in this issue into their choices of courses and careers.*

Conclusion 8: Retraining can contribute to meeting skills needs and to economic recovery

The need to support people in retraining has become a prominent skills policy issue in recent years, driven in good part by automation and technological change, and accelerated by Covid-19 and the ensuing economic shock. There is huge potential for job creation linked to low carbon transition across sectors, however, as noted by the Aldersgate Group, seizing these opportunities will involve retraining a significant proportion of the current workforce alongside developing the pipeline. The World Economic Forum¹⁹ has found that in the 'green economy' only three out of the top ten skills identified are industry specific (linked to wind energy, solar and landfill gas), whereas others relate to areas like digital and marketing skills, electrical, health and safety and project management – heightening potential for transferability.

Recommendation 12: *Explore and exploit opportunities to redeploy and retrain workers who are unemployed, underutilised or at risk of redundancy to equip them to move into and progress in low carbon job roles where there are labour and skills shortages.*

Conclusion 9: There is great opportunity for innovation, new businesses and scale ups to respond to low carbon challenges and bottlenecks linked to gaps in skills and capacity

There are some areas where action is needed but there is a pronounced lack of capacity to deliver – which already make it difficult or slow to get some types of work done (e.g. aspects of retrofitting homes) or will do in the future (e.g. installation of heat pumps) given anticipated growth. Expanding the skills of existing businesses to be able to do this work will be part of the solution to these bottlenecks. However, given likely demand, the relatively small number of businesses that can undertake some types of work, and that not all businesses will be minded to upskill or grow, new start businesses and others which pursue significant scale up should also be part of the solution. This provides a major opportunity for enterprise and innovation as well as a low carbon solution.

Recommendation 13: *Communicate opportunities for business creation and rapid growth (scale ups) where sizeable gaps exist and ensure that mainstream business support can assist these.*

¹⁹ http://www3.weforum.org/docs/WEF_Jobs_of_Tomorrow_2020.pdf

**Conclusion 10: Many areas outside of YNY are working on the same challenges.
Collaboration with them will assist progress and development of cost-effective solutions**

Although it is one of the most ambitious areas, the YNY LEP is clearly not alone in seeking to make progress on low carbon and circular economy issues, and neither is it alone in exploring skills issues in this respect. As part of this research we engaged with several LEPs, colleges, training providers and universities who were outside of YNY but reasonably close to it (e.g. in the North East and other parts of Yorkshire), as well as engaging with or looking at research by national industry bodies. Many of these are conducting work – either research or practical initiatives – which it would be useful to link into in developing low carbon and circular economy skills solutions.

Recommendation 14: Engage with other LEPs, localities and national industry bodies in developing solutions.

[Back to Contents](#)

ANNEX 1: Provision of courses and places

A) Enrolments on courses offered by colleges and other training providers

Table 4 shows the number of starts by YNY residents on courses in each sector subject grouped by provider for all providers with a rounded total of 100 or more starts in total. Hence it points to key institutions to engage with to influence skills development within young people in YNY, including those residing outside of the area itself.

Table 4: Course enrolments by provider²⁰ in main sector groupings (2018/19)

Provider	Engineering	Electrician	Plumbing	Manufacturing Technologies	Building & Construction	Transportation Operations & Maintenance	ICT	Total
York College	300	130	90	50	790	180	290	1,830
Darlington College	60	10	20		110	80	820	1,110
Grimsby Institute of FE & HE	100	70	20		230	130	60	620
Selby College	130	10	10	10	140		120	410
Calderdale College	150			70	70	40	50	370
Leeds College of Building	20	20	40		280			350
Hull College	40	40		10	120	70	20	310
Middlesbrough College	100	30	10		80	20	20	270
British Army	220							220
North Yorkshire County Council							190	190
Craven College	30	10		30	70	30	30	190
Leeds City College	60	10	10	10	20	10	30	160
Askham Bryan College	50				20	60		120
EXG Ltd							120	120
Tyne Coast College	30					80		120
YH Training Services Ltd	20			20	60		10	120
The Education Training Collective	0	10		20	80			120
City of York Council							100	100
Scarborough Sixth Form College	40						60	100
Derwent Training Association	100							100
All providers Total*	2,000	430	220	330	2,490	950	2,370	8,930

Notes: All data is rounded to the nearest 10 and hence rows of data may not add exactly to the corresponding total. Figures for ICT are combined totals for ICT users and practitioners.

Starts by level of course and sector

Table 5 shows the total number of enrolments by YNY residents in the 2018/19 academic year (starts) on courses with learning aims/subject areas that fit with the target sectors. It also shows the

²⁰ Harrogate College was part of the Hull College Group at the time and data for it will be included within that total, while Scarborough TEC is part of the Grimsby Institute Group and will be included within its data.

level of the qualifications for each sector subject area. ICT skills data distinguishes between ‘users’ and ‘practitioners’ courses, and as shown below, these have quite different skills level profiles.

Table 5: Enrolments on courses by level and sector subject area (2018/19)

Learning Aim Sector Subject Area Tier 2	Below Level 2	Level 2	Level 3	Level 4 Plus	Grand Total	% Level 3 or above
Building and Construction	830	990	590	110	2,530	28%
Engineering	110	1,020	790	160	2,080	46%
Manufacturing Technologies	10	250	110	10	370	32%
Transportation Operations and Maintenance	170	520	300	20	1,010	32%
ICT for Users	1,210	310	40	10	1,570	3%
ICT Practitioners	-	190	620	60	870	78%
Total	2,330	3,280	2,450	380	8,420	34%

Examples of the courses with the largest number of students and any others that are specifically low carbon and sustainability related are noted below.

Engineering and Manufacturing Technologies

- We identified over 500 combinations of course type and provider, of which six had 50 or more enrolments (through the British Army, York College, Calderdale College and Blackpool and Fylde College).
- Calderdale College provided a Level 2 Award in Industrial Environment Awareness that attracted 120 enrolments. We also identified small scale enrolment (around ten or less participants) onto an Award in Understanding Carbon Awareness and Energy Management (12 students) and a Diploma in Sustainable Recycling.

Building and Construction

- Over 530 combinations of course type and provider were identified. York College provided six of the nine of these with over 50 enrolments
- The range of courses was wide, covering areas such as construction management, electrical installation and plumbing that can be relevant to low carbon skills
- One course with 10+ students was identified as explicitly relevant to low carbon - an NVQ Diploma in Construction Management (Sustainability) at Leeds College of Building, with 30 enrolments

Transport and Automotive

- All over 50 Transportation Operations and Maintenance courses identified had less than ten enrolments. None of them had an explicit low carbon focus (e.g. on electric vehicles).

ICT

- The five largest courses were all ‘ICT Users’ courses below Level 2 – these had a combined total of around 900 enrolments, mostly at Darlington College. It is reasonable to assume that these are of limited relevance to low carbon.
- There was a wide range ICT practitioner courses, nearly all of which had low numbers of students. The largest identified was a BTEC National Extended Certificate in Information Technology at York College with around 70 enrolments.

- No significantly sized ICT courses directly related to low carbon were identified, but the Level 3 and above ICT practitioner courses are likely to provide valuable foundational skills.

B) Apprenticeship Starts by Framework, Provider and Level

We analysed data on apprenticeship programme starts by YNY residents in the 2018/19 academic year on specified framework sector subject areas (Construction, Engineering and Manufacturing, Digital). The two tables that follow show the main apprenticeship providers for each subject grouping (showing only those with a rounded total of 20+ starts) and the main frameworks taken up under each subject heading and the level of the apprenticeships concerned. Although the terminology relates to ‘frameworks’, the analysis still contains standards-based apprenticeships. Hence it provides a full picture and should be instructive in indicating the volume of apprenticeships under broad headings and the main institutions involved.

Table 6: Apprenticeship starts by provider in main sector groupings (2018/19)

Provider	Engineering	Electrician	Plumbing	Manufacturing Technologies	Building & Construction	Transportation Operations & Maintenance	ICT Practitioner	Total
York College	60	20	40	10	120	30	10	300
British Army	0	0		130	0	0	0	130
Leeds College of Building	20	0	20	0	60	0	0	100
Darlington College	20	0	10	10	20	20	0	80
JTL	40	40	0	0	0	0	0	80
Grimsby Institute of FE & HE	20	10	10	10	10	30	0	90
Selby College	10	0	0	10	40	0	0	50
Craven College	0	0	0	10	40	10	0	50
Derwent Training Association	30	0	0	20	0	0	0	50
Leeds City College	10	0	0	30	0	0	0	40
British Telecommunications	0	0	0	0	0	0	40	40
Maritime + Engineering College North West	20	0	0	20	0	0	0	40
Hull College	10	10	0	0	10	20	0	50
Babcock Training Ltd	0	0	0	0	0	30	0	30
Middlesbrough College	10	0	0	10	10	0	0	30
QA Ltd	0	0	0	0	0	0	30	30
Remit Group Ltd	0	0	0	10	0	20	0	30
YH Training Services Ltd	0	0	0	20	0	0	0	30
Barnsley College	0	0	0	0	20	0	0	30
CITB	0	0	0	0	20	0	0	20
Leeds Beckett University	0	0	0	0	20	0	0	20
Estio Training Ltd	0	0	0	0	0	0	20	20
Wakefield College	0	0	0	10	10	0	0	20
North Lancs Training Group	0	0	0	20	0	0	0	20
All Providers Total*	270	100	80	380	430	210	150	1690

*The All Providers subject totals include providers not listed in the table with less than 20 apprenticeship starts. Provider subject totals do not always add to the grand total due to rounding.

Table 7: Main apprenticeship frameworks by sector groupings and level (2018/19)

Frameworks with most starts by sector (20 or more rounded)	Apprenticeship Level			Grand Total
	Intermediate	Advanced	Higher	
Engineering, Electrical & Plumbing and Manufacturing Technologies	320	310	50	680
Engineering Technician	0	50	0	50
Installation Electrician / Maintenance Electrician	0	90	0	90
MES Plumbing	50	30	0	80
Engineering	150	60	0	210
Industrial Applications	70	0	0	70
Glass Industry Occupations	20	10	0	20
Building and Construction	270	130	60	460
Construction Skills	150	90	0	230
Maintenance and Operations Engineering Technician	0	30	0	30
Construction Management	0	0	30	30
Civil Engineer (degree)	0	0	20	20
Property Maintenance Operative	20	0	0	20
Bricklayer	20	0	0	20
Transportation Operations and Maintenance	90	140	0	230
Vehicle Maintenance and Repair	50	40	0	100
Light Vehicle Service & Maintenance Technician	0	50	0	50
Heavy Vehicle Service and Maintenance Technician	0	20	0	20
Vehicle Body and Paint Operations	10	10	0	20
ICT Practitioners	40	100	40	170
IT and Telecoms Professionals	40	10	0	50
Digital Marketer	0	50	0	50
Infrastructure Technician	0	30	0	30
Digital & Technology Solutions Professional	0	0	20	20

C) Universities

Table 8: 'HE Qualifiers' – numbers gaining qualifications from relevant courses in universities in YNY in a given year (2017/18)

Course (and 4 Digit ref)	University of York	York St John University	Total
Engineering related – total	190		190
Electronic & electrical engineering	175	0	175
Avionics	5	0	5
General engineering	5	0	5
(H671) Robotics	5	0	5
Digital related - total	265	20	285
(I100) Computer science	205	20	225
(I200) Information systems	15	0	15
(I400) Artificial intelligence	15	0	15
(I140) Human-computer interaction	10	0	10
(I300) Software engineering	10	0	10
(H650) Systems engineering	10	0	10
Bio-related - total	300	15	315
(C100) Biology	145	0	145
(C700) Molecular biology, biophysics & biochemistry	75	0	75
(C521) Medical microbiology	15	0	15
(C130) Cell biology	15	0	15
(C431) Medical genetics	15	0	15
(C500) Microbiology	15	0	15
(C400) Genetics	15	0	15
(C900) Others in biological sciences	0	15	15
(J700) Biotechnology	5	0	5
Marine related - total	10	0	10
(C161) Marine biology	10	0	10
Other STEM subjects	830	0	830
(F100) Chemistry	255	0	255
(G100) Mathematics	215	0	215
(F300) Physics	175	0	175
(F800) Physical geographical sciences	155	0	155
(F510) Astrophysics	15	0	15
(G350) Mathematical statistics	10	0	10
(F600) Geology	5	0	5
Management and business related	490	260	750
(N200) Management studies	330	260	590
(N100) Business studies	125	0	125
(N211) Strategic management	35	0	35

The table shows the number of 'HE qualifiers' – students who *gained qualifications* for relevant courses in the two universities within York and North Yorkshire in the given year (2017). The total number of students on courses will be considerably higher. Courses are grouped under broad

subject areas, and we consider these to have potential relevance to one or more of the key sectors in this research at a general level because they provide valuable foundational skills. However, it is not possible to assess whether they contain any specific low carbon content from the information available. Key points on each grouping are as follows:

Engineering related (190 qualifiers)

The Electronic & Electrical engineering course at the University of York has a high number of students and is likely to develop skills that will be valuable in renewable energy industries such as solar and offshore wind and may also have relevance to automotive (electric vehicles) and construction (e.g. energy in domestic/commercial premises). How far it does will depend on the specific content, but even if this is not included, those graduating will be well positioned to undertake top-up courses in relevant specialisms.

Digital Related (285 qualifiers)

A significant number of students are graduating with skills in this area, mostly in Computer Science at the University of York, which will be relevant to the digital sector and could potentially be applied in ways which assist low carbon technologies and goals.

Bio-related (315 qualifiers)

This group of biological and biochemistry related subjects is a major strength at the University of York and is of value to the bioeconomy sector, including biorenewable energy.

Other STEM subjects (830 qualifiers)

There are significant numbers of graduates from University of York science courses in subjects such as Physics, Maths, Chemistry and Physical Geographical Sciences. These will provide foundational skills that could be of value in the energy and engineering sector and potentially in aspects of automotive and construction if further specific training is undertaken on top of these skills.

Management and business related (750 qualifiers)

Both York St John University and the University of York have sizeable courses in this field, including Management Studies and Business Studies. While not directly relevant to the key sectors in this research, they are included because they provide a potential vehicle to influence business thinking and decision making in the future and could hence support transition to a low carbon, circular economy.

Overall conclusions from analysis of HE provision:

- 'Bio' related provision is strong, and this fits with messages from stakeholders in highly specialised areas of the bioeconomy who reported satisfaction with the supply side. However, as the BioYorkshire report highlights in Annex 3, the picture is more complex.
- Other relevant areas where there is at least reasonable strength in university provision include electrical engineering, computing and STEM subjects. Whilst any specific low carbon content in these courses is not clearly identifiable, they will provide foundational understanding which could quickly be built upon through short top courses or on the job training.
- Areas where there appear to be gaps in the YNY area include other types of engineering, energy, automotive. However, there is strong provision in many of these areas in other universities close to YNY, which could potentially be further utilised. These include engineering, energy, climate change and circular economy strengths in universities in Hull, Teesside, Leeds and Bradford.

Annex 2: Sixth Form Subject Analysis

This analysis examines how many sixth forms/sixth form colleges in YNY offer vocational course options that could be relevant to the sectors identified in this research as key ones for transition to a low carbon, circular economy. It does this in two ways:

- Analysis of the number of 6th form / college provision of tech qualifications / apprenticeships.
- Analysis of 6th forms that offer A Level or options that could be considered vocationally relevant to the relevant sectors (excluding Maths and Science).

a) Overview of Sixth Form/College Provision of Tech Qualifications and Apprenticeships

The summary table is based on data for age 16-18 Tech Level and Tech Certificate exam entries²¹ in York²² and North Yorkshire²³ in 2020 and the number of students in Level 2 and 3 apprenticeships in the same year. This data is for any topic or apprenticeship standard as the data is provided at general level and not subject specific. It includes all sixth form (colleges) and FE colleges in York and North Yorkshire but only shows those where at least one exam start or apprenticeship has been registered in the fields considered.

Establishment	Number of students with		Apprenticeships	
	Tech Level Exam Entry	Tech Certificate Exam Entry	Level 3	Level 2
York				
Archbishop Holgate School	5			
York College	90	7	70	100
Askham Bryan College	350	18	50	170
North Yorkshire				
St Aidans & St John Fisher Sixth Form	7			
Northallerton School & Sixth Form College	7			
South Craven School	8			
Richmond School	18			
Norton College	5			
Outwood Academy Ripon	8			
Sherburn High School	1			
Scarborough Sixth Form College	10	5		
Scarborough UTC	12			
Craven College	28	1	80	80
Selby College	12	18	40	60
Total	561	49	240	410

²¹ Tech Levels are Level 3 qualifications for students wishing to specialise in a technical occupation, e.g. engineering, IT. Tech Certificates are a subset of level 2 vocational qualifications (see glossary)

²² <https://www.compare-school-performance.service.gov.uk/schools-by-type?step=default&table=schools®ion=816&la-name=york&geographic=la&for=16to18&basedon=Level%20%20apprenticeships&show=All%20students>

²³ <https://www.compare-school-performance.service.gov.uk/schools-by-type?step=default&table=schools®ion=815&la-name=north-yorkshire&geographic=la&for=16to18&basedon=Level%20%20apprenticeships>

b) Technically focused A level options offered at 6th form

We reviewed the number of sixth form colleges that offer more technically focused courses at age 16-18 outside of the standard science and maths options, based on analysis of all schools/sixth form colleges with provision at that age and using information available from their web sites (this was possible for 39 institutions). The main findings from this review are that:

- The main subject option that is commonly available and has clear relevance beyond the core STEM subjects is Design Technology/Product Design A Level. This was available at around two thirds of the sixth form colleges where information on courses was identified (excluding special schools).
- Two other options were occasionally available - Engineering/Design Engineering (5 establishments) and Electronics (1 establishment).
- We did not identify any specific courses focused on low carbon. However, an interesting example of the blending of low carbon themes into a Design Engineering A Level was identified, at Skipton Girls High School.

[Back to Contents](#)

Annex 3: Skills needs in the Bioeconomy sector. An assessment from BioYorkshire

The following text is input BioYorkshire contributed to the study, in full and unedited by the authors.

The Bioeconomy

The bioeconomy is defined as, “*All economic activity derived from bio-based products and processes which contributes to sustainable and resource-efficient solutions to the challenges we face in food, chemicals, materials, energy production, health and environmental protection*”.²⁴

In 2017, there were over 16,000 companies in the North of England with bioeconomy innovation potential, a combined annual turnover of over £91 billion and a total of around 415,000 employees. The industrial sectors represented by these companies include: agriculture, forestry and fishing; production and manufacturing; construction; and professional, scientific and technical. A wide range of businesses are contained within these sectors. In terms of contribution to the UK economy, the most significant regional businesses are the chemical and chemical products industry, and food and drink manufacturing.²⁵

Expansion of the UK Bioeconomy Sector and BioYorkshire

The 2018 UK Bioeconomy Strategy²⁶ describes an ambition to double the size of the UK bioeconomy sector by 2030 to generate £440 billion in gross value added. Based upon this level of ambition, it is important not to limit the York and North Yorkshire (YNY) region’s bioeconomy skills needs to the gaps that can be identified within the existing 2021 bioeconomy. A doubling of the region’s bioeconomy by 2030 can be achieved through the ambitious plans that have been developed within the BioYorkshire initiative - a key component of the YNY devolution deal.

BioYorkshire will expand the region’s outstanding research and development base and provide mechanisms where research and innovation ideas can be taken forward towards commercialisation. The importance of BioYorkshire to our regional resilience, growth and prosperity is amplified in the context of COVID-19, as it will meet the demands for a ‘green’ economic recovery. Further development of BioYorkshire plans should enable more granular detail of the types of jobs that will be generated and, in turn, the skills needed for this workforce. We will also need to significantly increase the entrepreneurial culture across the region with specific training. Overall, a regional bioeconomy skills strategy combined with a communications programme will be needed in order to realise our bioeconomy growth ambitions. Furthermore, training across the bioeconomy sector is a product that we can sell to the rest of the world. The BioYorkshire Bioeconomy Skills Academy will co-ordinate and help deliver the various elements of the region’s bioeconomy skills needs.

Skill Shortages

The scale of the bioeconomy skills shortage will be influenced by the level of ambition and the degree of expansion of the sector in the UK. Although the bioeconomy represents a major opportunity for growth in the region, skills shortages represent a major barrier to its development. Higher Level Technical Skills development in the UK lags behind that of other countries, although there are measures in place to address this that will come into effect in the near future (such as the new T’ levels). A lack of STEM graduates will undoubtedly also have a negative impact on the development of the bioeconomy, given that the majority of graduate employees working in the bioeconomy have a STEM degree. Skills shortages in industrial biotechnology, an underpinning enabling technology with

²⁴ <https://bbsrc.ukri.org/research/briefings/bioeconomy/>

²⁵ The Bioeconomy in the North of England (2017) 27

²⁶ <https://www.gov.uk/government/publications/bioeconomy-strategy-2018-to-2030/growing-the-bioeconomy-a-national-bioeconomy-strategy-to-2030>

applications across many sectors of the bioeconomy, are documented by Cogent, who are taking steps to address this²⁷. The development of cross-sector, interdisciplinary and soft skills and the way in which these can help to develop awareness of the bioeconomy is also something that needs to be addressed.

The need for skills training for SMEs and start-ups

One way to identify skills training needs is to examine the take-up of opportunities offered. For example, BioVale has developed training in response to feedback from companies about the skills and knowledge gaps they have to support their bioeconomy business, including:

- Entrepreneurship training for over 45 bioeconomy start-ups between 2017-20, including commercialisation skills, communications and intellectual property.
- CPD technical training via its Anaerobic Digestion Special Interest Group.

The Biorenewables Development Centre provides support for companies in the region wishing to develop, scale-up and commercialise bio-based products and processes. To date they have helped almost 300 businesses explore bio-based opportunities by providing technical data and specialist advice and training to inform business decisions. At the University of York, the Product and Process Innovation project delivers innovation workshops to companies across many industrial sectors, including those that are bio-based (particularly the food and drink sector). These workshops provide advice and training to senior company staff and cover all aspects of new product development, such as change management, marketing and financial planning etc. The result of the workshop is bespoke innovation plan that gives the company a clear roadmap to develop their company and staff.

The requirement for these services demonstrates the skills gaps within the region. In addition, many companies who identify as being part of the bioeconomy point to wide-ranging skills gaps from technical to soft skills.

View from the food manufacturing industry: A food manufacturer interviewed mentioned that they are always recruiting to fill technical roles and that graduates also require training, for example in basic microbiology and hygiene, to cover the needs of the role. Another aspect of skills shortages highlighted was the lack of commercial skills new graduates have and the inability to convey why their research is important to industry.

View from the Anaerobic Digestion (AD) industry: An AD operator highlighted the lack of formal qualifications relevant to AD sector workers to assist the smooth running of an AD site. Sales and marketing training was also raised as something that would benefit the AD sector, to enable them to market their products (digestate), alongside business planning and leadership skills. Basic science skills, such as the ability to operate an onsite laboratory to perform rudimentary analysis on feedstocks delivered to the AD site would also be beneficial.

View from the agricultural employer: A local farmer from a mixed pig and arable farm in Yorkshire with an onsite AD unit interviewed and agreed that it is very difficult to recruit people to work on the farm with the right skills. A recent vacancy was filled with a worker recruited from Ireland.

View from bio-based chemical company (SME with 9 employees): This company said that it was exceptionally difficult finding the right people to work with them. Many candidates lack the ability to think of solutions to challenging novel problems and lack initiative. Consequently, they hire inexperienced candidates to train in-house.

²⁷ See, for example, Industrial Biotechnology Leadership Forum (IBLF), Growing the UK Industrial Biotechnology Base. Enabling Technologies for a Sustainable Circular Bioeconomy: A National Industrial Biotechnology Strategy to 2030 (2018)

BioYorkshire will enable York and North Yorkshire to become the epicentre of the UK's bioeconomy. However, to support this ambition we need to develop a skills and training offer which provides academic and technical courses, enhances existing qualifications and delivers entrepreneurship and business skills in a bio-based context.

[Back to Contents](#)

Glossary

CE – Circular Economy

CITB – Construction Industry Training Board

EV – Electric Vehicle

FE – Further Education

HE – Higher Education

LEP – Local Enterprise Partnership

SME – Small and Medium Enterprise(s)

STEM – Science, Technology, Engineering and Maths

YNY – York and North Yorkshire

Passivhaus – These buildings provide a high level of occupant comfort while using very little energy for heating and cooling. They are built with meticulous attention to detail and rigorous design and construction according to principles developed by the Passivhaus Institute in Germany and can be certified through an exacting quality assurance process.

'Providers' – is used as a collective term to refer to all bodies who provide training and courses – including colleges, universities and independent training providers

Tech Certificates - are a subset of level 2 vocational qualifications. To be included in the technical certificate performance cohort, the student must have entered for at least one such qualification as listed in the performance tables which can be found at :

<https://www.gov.uk/government/publications/2019-performance-tables-technicaland-vocational-qualifications>

Tech Levels – Level 3 (advanced) qualifications for students wishing to specialise in a technical occupation or occupational group for example engineering, IT or accounting

YNY – York and North Yorkshire