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Green skills in education and employment

Overview

- Green skills can be defined as "the knowledge, abilities, values and attitudes needed to live in, develop and support a society which reduces the impact of human activity on the environment".
- Green skills are often associated with sectors that will play a major role in reaching net zero greenhouse gas emissions by 2050, such as power, home heating, waste and resources.
- Upskilling workers will be necessary to address green skills shortages, as well as increasing the workforce in key sectors.
- Stakeholders suggest that the quality and uptake of vocational education and training (such as apprenticeships) are important factors for developing green skills in the workforce.
- There is regional variation in demand for, and access to, green skills. Stakeholders have identified opportunities to align skills policy with the levelling up agenda to reduce regional disparities.
- Policy certainty is seen as a key lever to promote upskilling. Commentators suggest that frequent changes to government policies and targets can inhibit investment in skills. The UK Government's Green Jobs Delivery Group plans to publish a Net Zero and Nature Workforce Action Plan in the first half of 2024.
- There is low public awareness of green skills and the available training options, which has been attributed to inconsistent definitions for green skills.

Background

The European Centre for the Development of Vocational Training (CEDEFOP) defines green skills as "the knowledge, abilities, values and attitudes needed to live in, develop and support a society which reduces the impact of human activity on the environment".[1] However, green skills can be defined in different ways (Box 1).[2]

Green skills are often associated with 'green jobs', defined by the UK's Green Jobs Taskforce* as "employment in an activity that directly contributes to - or indirectly supports - the achievement of the UK's net zero emissions target and other environmental goals".[3] The Green Jobs Delivery Group† plans to publish a Net Zero and Nature Workforce Action Plan in the first half of 2024.[4]

As the UK economy targets net zero by 2050,[5] there will be greater demand for green skills in the workforce, which will vary over time. There will also be a risk of skills gaps (when workers lack necessary skills to complete their role) and skills shortages (when vacancies go unfilled due to a lack of skills in the workforce).[6]

Green skills can apply to everyone in society and all forms of work (Figure 1).[3,7,8] Some sectors will face greater changes as they decarbonise, such as power supply, vehicle and battery manufacturing, construction and heating, heavy manufacturing, land-based sectors, and waste and resources.

This POSTnote primarily focuses on green skills for net zero, although green skills are also needed to achieve wider environmental goals. Initiatives such as Green Jobs for Nature seek to raise public awareness of jobs and skills relating to conservation and biodiversity.[9]

Some of the policy in this area is devolved. This briefing mainly focuses on policy in England and refers to devolved executives in other nations of the UK where appropriate.

* The Green Jobs Taskforce was convened by Ministers from BEIS and DfE between November 2020 and July 2021, to set the job-market direction for a "high-skill, low carbon economy".

† The Green Jobs Delivery Group was convened in response to recommendations from the Green Jobs Taskforce.

Figure 1. Examples of green skills and different applications

Source: Adapted from Kwauk and Casey (2022), who suggest that there are different understandings of green skills ranging from transformative (on the left) to instrumental (on the right). They propose that the scale of societal change needed to achieve net zero will require a range of interpersonal and learning skills to mobilise communities and solve complex problems.[10]

Defining green skills

The lack of a standard definition makes it difficult to compare statistics on green skills and jobs.[11–13] Stakeholders have suggested that a consistent definition for green skills could improve data on skills supply and demand to help forecast future needs.

Commentators suggest that the concept of green skills can be a powerful communication tool to raise awareness and enthusiasm among the public and employers, if language is consistent.[14] However, the term 'green skills' is a term more frequently used by policy makers, compared with industry stakeholders who are less involved in policy engagement.[15]

There are also challenges in defining green skills as different people consider different sectors to be 'green'. Some people use 'green' to describe sectors that are already low-carbon. However, green skills are often associated with high-carbon sectors that are actively decarbonising,[3] such as electricity generation, home heating, construction and steelmaking. Other sectors, such as education, play an enabling role by teaching green skills and promoting routes into green jobs.[2]

Whether a specific skill is considered green also depends on the technology used and the context it is used in. For example, welding may be applied in an oil refinery or in generating renewable energy.

Examples of types of green skills:

- **Practical:** heat pump installation, domestic recycling, energy grid engineering, peatland restoration.[15,16]
- **Enabling:** project management, collaboration, public engagement, digital skills.[10,17,18]
- **Understanding/attitudes:** scientific (including carbon and climate) literacy,[17] systems thinking,[19,20] environmental stewardship.[10]

Some stakeholders prefer a broad definition to increase awareness that green skills are needed in every sector and to account for workforce mobility and resilience.[21] However, others suggest that broader definitions may reduce clarity on the skills required to drive change.[11,22]

Academics also suggest expanding the definition to better account for issues such as humans' interconnection with nature (PN 701), the necessity of a just transition (PN 706), and the role of sectors beyond science, technology, engineering, and mathematics (STEM) (Figure 1).[10]

Occupational classifications

Combining skills classifications with data sources, such as the UK Employer Skills Survey and online job vacancy data, could help to monitor skills shortages.[23] The UK may have its own skills classification in future.[24]

International classifications include:

- **O*NET:** The Occupational Information Network is a database of employment information maintained by the U.S. Department of Labor.[25] It provides broad occupational classifications including green occupations, which can be labelled as 'increased demand', 'enhanced skills' and/or 'new and emerging'.[26]

- **ESCO:** The European Commission hosts the classification of European Skills, Competencies, and Occupations (ESCO), which are more granular.[27] In 2022, the classifications were updated to indicate the skills considered most relevant for a greener labour market.* [28]

Supply and demand

In 2023, 27% of working adults reported that they would describe any part of their job as a green job.† [29]

The UK Government's 10 Point Plan for a Green Industrial Revolution, published in 2020, aimed to support up to 250,000 green jobs by 2030.[30]

Some roles will see decreased demand from employers as part of the net zero transition, such as roles in the fossil fuel sector. These are described as 'brown jobs' or 'sunset jobs'.[31]

Approximately 20% of UK workers are in sectors (such as power supply, construction, and waste and resources management) that will see the biggest changes from the net zero transition over the next decade.[32] However, by 2030, between 135,000 and 725,000 net new jobs could be created in these sectors.[32] For example, the construction sector is projected to see a 0.1% reduction in 'sunset jobs', and has already seen a 3.6% increase in green jobs advertised since 2021.[31] A further 20% of workers are in enabling sectors, such as teaching and finance.[2]

These changes will interact with other workforce transitions, such as automation with artificial intelligence, which may also affect the prevalence and nature of work in these sectors. (PN 708).[33]

Stakeholders across consultancy and academia have emphasised that demand for specific skills will vary over time.[34] Examples include:

- **Home heating:** In 2022, there were approximately 3,000 skilled heat pump engineers in the UK (PN 699).[35] Achieving UK Government targets of 600,000 heat pump installations per year by 2028[36] would require 27,000 heat pump engineers.[35] Stakeholders have highlighted that training this workforce will be challenging, partly due to low numbers of training practitioners.[35]

- **Electric vehicle (EV) charging points:** The Government is aiming to install 300,000 public charging points by 2030.[37] The number of private charging points will likely be significantly higher.[38] However, once most vehicles have been replaced with EVs, demand for installers is more difficult to forecast.

* This work was conducted as part of the European Skills Agenda, a five-year plan published in 2020. The Skills Agenda emphasised that "the green transition requires investments in skills of people and presents a set of concrete actions to support the acquisition of skills for the green transition, including through the definition of a taxonomy of skills for the green transition."[28]

† Based on representative survey of 2,021 working adults in Great Britain, collected as part of the Opinions and Lifestyle Survey by the Office of National Statistics.

Routes for green skills development

Upskilling

The UK Net Zero Strategy highlights 2030 as a key target in various sectors.[39]

As 80% of the 2030 workforce are already in employment, the green skills transition will mainly involve upskilling existing workers.[40] Further Education (FE) colleges, formal training and qualification providers, employers, and Higher Education providers will play key roles in delivering this training.[41]

Some private companies operate skills academies and offer sector-specific training.[42] Many accreditations are not administered by the UK Government, and some stakeholders advocate for collaboration between governments and industry to identify skills gaps and communicate training routes to the public.[16] The Green Jobs Delivery Group is an example of this type of working at national level.[4]

Local Skills Improvement Plans (LSIPs), developed by local authorities in partnership with FE colleges, identify local skills gaps and strategies to fill these.[43] Stakeholders suggest that capacity building in local authorities could help align local action with national targets.[44]

There are several UK Government schemes focused on upskilling, though not all are specific to green skills.[45]

- **Skills Boot Camps** are free courses of up to 16 weeks for adults aged 19+, which focus on digital, technical, and green skills.[46]
- **Free Courses for Jobs** allows eligible adults aged 19+ to gain a free Level 3 qualification.* [47]
- **The Lifelong Learning Entitlement (LLE)** will apply from September 2025, and will provide loans for learners studying courses at Levels 4-6† up to age 60.[48]

The devolved executives have their own schemes, such as:

- the Welsh Government's **Personal Learning Accounts scheme**, which offers funded courses to adult learners, with incentives for digital and green skills[49]
- the Scottish Government's **Flexible Workforce Development Fund** is a scheme focused on Small and Medium-sized Enterprises (SMEs), offering funding for the upskilling of employees[50]

Stakeholders suggest that professional bodies may play a key role in upskilling via Continual Professional Development and defining best practice.[18,51] There is potential

* This is equivalent to A-Level, Advanced Apprenticeship, or Higher in Scotland.

† This is equivalent to post A-level/Higher up to degree level, or equivalent vocational level.

for greater collaboration, such as through the Professional Bodies Climate Action Charter.[18,52]

Vocational education

Vocational Education and Training (VET), encompasses routes for technical education in the UK,[53] such as apprenticeships, T Levels, and Higher Technical Qualifications (HTQs).[54] It is mainly provided by FE colleges, and includes industry placements.

VET provides entry level routes into key sectors such as construction, forestry, and engineering. The Institute for Apprenticeships and Technical Education has created new occupational standards for green apprenticeships, such as Forest Craftsperson.[55,56]

Since 2017, UK apprenticeships are funded via the Apprenticeship Levy.[57] Larger employers pay the levy, which funds apprenticeship training costs for both large and small employers.* [58]

Apprenticeship uptake has declined since 2015, with fewer apprenticeships at lower qualification levels.[57,59] Uptake has fallen by almost 25% since the introduction of the Apprenticeship Levy, and declined further during the Covid-19 pandemic.[57]

The are now a higher proportion of degree apprenticeships, which risks restricting access to the job market for people requiring Level 2† qualifications.[59,60] See House of Commons Library briefing, Apprenticeships policy in England.

Universities

Stakeholders have identified higher education as an important route into senior roles in decarbonising sectors.[61] For example, there will be high demand for sustainability professionals providing business advice.[7,62] Many universities have incorporated climate literacy into their curricula.[61,63]

Various strategies aim to increase the number of STEM graduates.[64] There is increasing demand for STEM subjects among prospective students,[65] but universities have faced challenges in recruiting and retaining students from under-represented groups for these courses.[64,66]

Schools

Schools will play a long-term role in teaching green skills, and in informing and encouraging young people to enter careers that contribute to the net zero transition.[2,3,45]

* Training courses must be a minimum of 12 months to be eligible for funding.

† This is equivalent to GCSE grades 9-4 or A*-C, or National 5 in Scotland.

Employers in key sectors are involved in schools outreach programmes. For example, National Grid is seeking to engage students from low-income areas.[7,67,68]

Challenges and opportunities for green skills development

Workforce demographics

Training a skilled net zero workforce is predicted to take several years.[15]

Reports from key decarbonising sectors (such as energy, home heating, agriculture, and steel) have identified that a substantial proportion of their workforce is approaching retirement.[21,69,70] Consequently, these sectors face losing a significant proportion of workers at the time they need to be growing.[71,72] Adults over 50 are also less likely to participate in training (PN 391).

There is a relatively high proportion of SMEs, sole traders, and micro-enterprises in key sectors such as forestry, heating, and construction,[15,73] which face distinct challenges in delivering training and engaging with policy.[60]

Commentators suggest that international talent attraction may be restricted by UK immigration rules.[16,74,75] Meanwhile, stakeholders from across sectors have expressed concern that the USA and the EU are investing heavily in net zero and may be seeking to attract talent from the UK workforce.[76]

Diversity in the workforce

The workforce in key decarbonising sectors is predominantly male and White.[21,69,70] In 2018, women constituted 22% of the STEM workforce and 8% of the skilled trades.[77]

In 2021/2022, 6.9% of construction apprenticeship starters were women, and 8.2% were from minority ethnic groups.[78]

Young people from low-income backgrounds are more likely to consider apprenticeships, but still face significant barriers to entry.[79]

Improving diversity in key sectors may help to mitigate green skills shortages.[3,80] To attract diverse talent, stakeholders suggest greater attention to hiring practices and organisational culture.[17] SMEs are often less likely to have a human resources department and capacity to implement diverse hiring practices.[81]

Schemes such as DWP's Disability Confident Scheme may help improve access for people with disabilities,[82] while the Multicultural Apprenticeships Alliance is an example of a public sector diversity initiative.[83] Campaigns may also target people that influence career choices, such as teachers, parents and careers advisors.[84]

Challenges for training

Vocational education

Vocational education and training (VET) is typically designed and prioritised to address skills needs defined by employers. Stakeholders suggest that this may favour large employers over SMEs and sole traders, who have less capacity to train apprentices, engage with Government, and forecast skills needs.[60] For example, stakeholders suggest that competitive tendering approaches* in forestry can reduce profits, which may act as a disincentive for businesses to invest in trainees and apprentices.

Academics and other stakeholders have suggested that collaborations with other employment organisations are important for delivering effective vocational training.[85–87] Compared to the UK, countries such as Germany have greater involvement of trade unions in VET, and more structures for managing competing interests between the Government and employers.[88]

VET often has lower visibility and prestige than the academic pathway.[60] Stakeholders suggest that improving the quality of technical training and jobs could present an opportunity to attract more young people in future.[60]

Quality of training

Government funding for FE in England has declined since the 2010s.[89] The past decade has also seen declining investment in training by UK employers.[59] The 2023 Autumn Statement announced that HMRC will rewrite guidance on tax deductibility of training costs for sole traders and the self-employed.[90]

Some stakeholders suggest that VET in the UK focuses on practical skills at the expense of theoretical understanding.[91] Workers might be taught what to do, but not why. Theoretical understanding is considered important for long-term missions such as net zero,[88,92] both for motivation and for complex multidisciplinary projects (such as building retrofit).[73,91,92]

Workers and employers often find it difficult to dedicate time to training in green skills.[7,70,93] As key sector needs become more urgent, stakeholders have argued that regulation and standardisation will be necessary to ensure quality and public safety (for example, in construction and heating).[94]

Regional variation

National targets can obscure regional inequalities.[44] Rural counties face distinct decarbonisation challenges such as greater car dependency, lack of grid connections, population flux due to tourism, and workforce gaps due to higher proportions of retirees.[95,96]

* Competitive tendering refers to a procurement method where potential suppliers bid against each other to win contracts.

Local Skills Improvement Plans allow local authorities to have greater ownership of skills policy. However, stakeholders suggest that implementation can be impeded by reduced financial resources, and insufficient analytical skills and data.[44,97]

Areas that are losing 'brown' or 'sunset' jobs may not align with where green jobs are being created, leading to a risk of unused skills.[15] For example, oil and gas jobs will be phased down along the east coast of the UK, while most green jobs are being created in London and the Southeast.[31]

Green jobs may not necessarily offer the same employment benefits as some sunset jobs.[98] A just transition approach may improve these prospects and help to avoid creating or exacerbating inequalities (PN 706).[99]

Shifting policy priorities

It is widely acknowledged among stakeholders that there is a lack of information and advice for the public to promote demand for green skills and services.[100]

Stakeholders advocate the importance of robust forecasting of required skills by government, employers, and skills providers. This will partially be addressed by the Green Jobs Delivery Group's outputs in 2024.[4]

Multiple stakeholders highlight that changes to net zero policies and targets can inhibit skills development, as employers lack confidence to invest in training without certainty for the future.*

Challenges in key sectors

Land-based sectors

Land-based sectors (including agriculture, horticulture, and forestry) will need to reduce emissions and sequester carbon under the net zero transition.[104] However, there is a shortage of skills to deliver nature-based solutions (such as peatland restoration and natural flood management) at scale.[105]

Land-based sectors are increasingly using new technologies to improve efficiency and reduce emissions, such as livestock genetics and remote sensing in forestry.[106–108] This requires new digital skills within the workforce.

A 2023 review of labour shortages in the food supply chain found that many people have negative perceptions of food and farming work, and that working hours and conditions can be unappealing.[109]

Small scale agriculture employers often struggle to train workers under time constraints, and the sector can be reliant on workers obtaining skills through having a

* For example, mechanics reskilling in electric vehicle maintenance now face lower demand for their services due to the extension of the phase-out date for sales of internal combustion engine vehicles. The phase-out date was delayed from 2030 to 2035 following consultation on the Zero Emission Vehicle Mandate.[101] Other examples provided by stakeholders included the scaling down of support for home insulation in 2013[102] and changes to the Boiler Upgrade Scheme.[103]

farming background; adding to barriers faced by new entrants.[110] The horticulture sector is particularly reliant on seasonal and migrant labour (PN 707).

Industry stakeholders suggest that skills development is inhibited by communication between farmers and policymakers, with phrases such as 'conservation' and 'green' having different connotations.

Young people and people from minority ethnic backgrounds remain under-represented in land-based sectors, due to factors including a lack of role models, poor rural public transport and broadband connections, and a lack of access to affordable rural housing.[111,112]

Construction and heating

The construction sector has a high prevalence of self-employed workers and sub-contractors.* This can present challenges for projects that require multidisciplinary collaboration, such as building retrofit and low-carbon construction.[91] Future professions will likely require skills that bridge several traditional trades.[94]

Government targets for home heating require an increased number of trained heat pump installers. However, short courses may be inadequate for delivering the training required to deliver efficient home heating in a range of properties (PN 699).[114]

Regulation of private training is limited in this area.[114] Training accredited by the Microgeneration Certification Scheme is available in the UK.[115] Some industry stakeholders suggest the use of skills cards† and post-installation performance data to ensure safety and raise demand for well-trained installers. [94,116,117]

Power supply

The renewables sector is experiencing rapid growth in energy generation and storage technologies (PN 688).[80] Stakeholders report a skills shortage of leadership and management, as well as in technical competency. While many skills from oil and gas sectors are transferrable to renewables,[118] there are barriers including lower salaries and differences in culture.[119] Developing the hydrogen sector will likely require collaboration between fossil fuel and renewables workers.

* This is likely due to benefits offered by the Construction Industry Scheme (an industry-specific tax scheme).[113]

† Skills cards show what qualifications and training an individual has completed and may be physical or digital.

Waste and resources

A major challenge for the waste and resources sector is talent attraction.[69]

A report by the Chartered Institute of Wastes Management indicated that apprenticeship funding in England can be inflexible, creating a barrier to entry-level training.[69] Current waste management systems tend to focus on recycling, while reuse and circular economy processes are under-valued despite being more skills-intensive and offering potential for development (PN 646).[120]

Transport and batteries

Transition to electric vehicles (EVs) will require a trained workforce to install EV charging points. Domestic battery manufacture in 'gigafactories'* could potentially reduce regional inequalities and replace some jobs in the automotive manufacture sector.[15,121]

A 2023 House of Commons Business and Trade Committee report suggested that increasing capacity of UK gigafactories will require significant investment, and the UK is currently behind global competitors such as the USA and China.[122]

The Government's 2022 Jet Zero strategy acknowledges the need for a skilled workforce in electric and hydrogen aviation technology.[123,124] The 2023 Future Aviation Skills Strategy report proposed new apprenticeship standards to target workers who currently maintain conventionally fuelled aircrafts.[125] The report suggested that training could be delivered efficiently and safely through remote training methods (such as augmented reality).

Heavy manufacturing

The UK steel industry is concentrated in specific regions, including Port Talbot in Wales and Scunthorpe in Lincolnshire. Steel sector decarbonisation solutions include electric arc furnaces that require fewer workers (PN 672).[126,127]

Steelworkers acknowledge the need for the net zero transition, but many feel mistrustful of employers and government.[70]

Policy considerations

Policy certainty

Achieving net zero targets will require significant changes for approximately 20% of the workforce,[32] and there is typically a delay between identifying skills needs and training competent workers.

Stakeholders across industry, academia, and overnment have advised that policy certainty and commitments on specific solutions are essential to increase investment, demand, and skills provision (Figure 2).[7,15,128, 61,70,80,129]

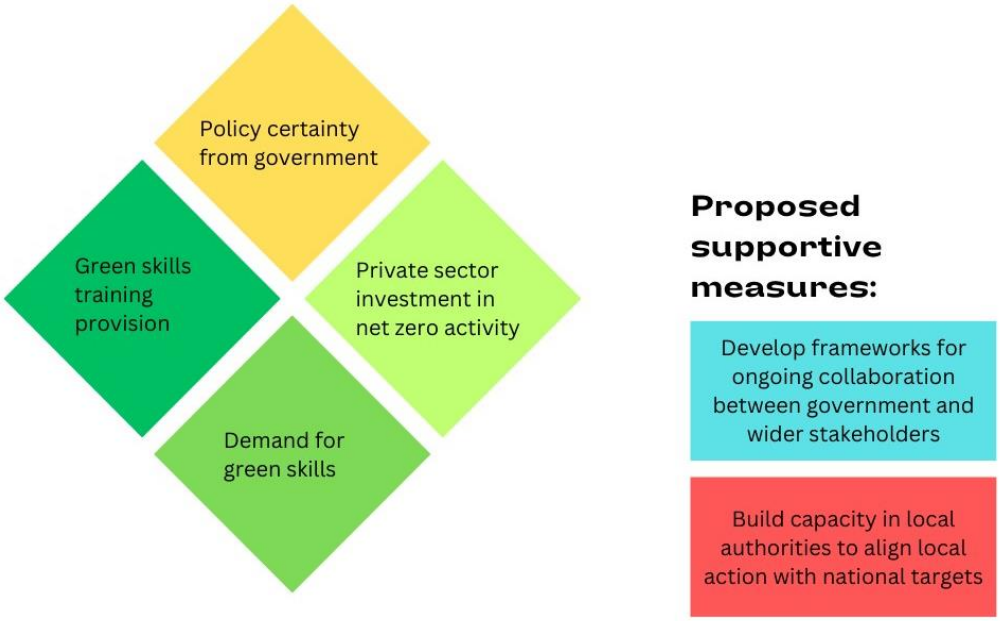
* Gigafactories are large-scale manufacturing facilities, often used to produce rechargeable batteries.

Government policies and funding may drive changes in green jobs. For example, the Heat Pump Investment Accelerator Competition offered £30m of grants to support domestic heat pump manufacturing (PN 699).[130]

Stakeholders suggest that public procurement of goods and services with a reduced environmental impact (for example, green construction) may also help to drive demand for green skills and promote quality jobs.[2,3]

The Green Jobs Taskforce recommended establishing a UK-wide body to maintain progress in the workforce transition.[3] Local skills audits to inform Local Skills Improvement Plans may support greater integration of local and national action.[131] The Mission Zero Coalition recommended improving collaboration and partnership between UK Government, devolved administrations and local and combined authorities.[132]

Figure 2 Drivers for green skills development in the workforce



Source: Adapted from IEMA and Deloitte (2022), Alvis et al (2022), Christie et al (2023), Skills Development Scotland (2023), CEDEFOP (2012), and Energy Systems Catapult (2022). [7,15,44,72,128,133] Stakeholders advocated government action on creating policy certainty to stimulate demand for green skills, facilitating ongoing collaboration with industry, workers and FE providers, and building local capacity to align regional initiatives with national targets.

Awareness of co-benefits

Several stakeholders suggest that the net zero transition can be planned to help mitigate negative impacts on workers and communities, and support levelling up ambitions.[15,134] Coordinated green skills development could deliver various co-benefits, including:

- a fairer society with fewer regional disparities[15,99,135]
- economic opportunities aligned with existing industrial strategies, including the Battery Strategy and the Advanced Manufacturing Plan[136,137]
- increased skills use by workers, promoting increased job satisfaction[138]
- increased workforce diversity bringing wider experiences and talent to solve complex problems[3,7,139]

Stakeholders also highlight economic and reputational opportunities for the UK, which could emerge as a global leader in developing a net zero workforce.[15]

Improving labour market information

The Green Jobs Delivery Group's 2024 report will seek to improve understanding of the supply and demand of green jobs.[4]

Detailed labour market information could help stakeholders to map, understand and forecast supply and demand of skills, and to provide timely and targeted training provision (PN 659).[15,72,140] Demographic and employee retention data could help identify barriers to inclusion and determine strategies for increasing diversity.[141]

Improving quality and accessibility of training

Stakeholders advocate for collaborative work between government, FE providers, trade unions and employers to map roles and skills,[7,88,142] and to improve standardisation of competencies across key sectors.[24]

Stakeholders highlight FE funding constraints as a key challenge.[89] There are calls for reform of the UK's vocational education system to produce resilient* workers with a broader understanding of their field,[91,98] as well as to increase prestige and routes into employment.[60] Facilitating teaching from experts in key sectors may help align training with employers' needs.[3]

Other measures could make key sectors more accessible for those without Level 2† qualifications or those who are seeking to retrain.[60] This would require collaboration with FE colleges and employers to identify clear progression routes from Level 2 onward.

Research suggests there is also a need for technicians at qualification Levels 4 and 5‡ to grow the green economy, which could be partly addressed through Higher Technical Qualifications.[144]

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* In a workplace context, resilience can be defined as the "positive psychological capacity to rebound, to 'bounce back' from adversity, uncertainty, conflict, failure, or even positive change, progress and increased responsibility"[143]

† Level 2 is equivalent to GCSE Grade 9-4 or A*-C, or National 5 in Scotland.

‡ Level 4 and 5 is equivalent to between A-level/Higher and degree level.

Stakeholders suggest better support for SMEs to take on apprentices and access Apprenticeship Levy funding.[60] Others suggest reforming the Apprenticeship Levy to a more flexible model.[59,144]

Public engagement

There is low public awareness of what green skills are, and the career routes available.[16,128,129,140,145]

Stakeholders suggest that there is an opportunity to engage young people,[146] who express concern about climate change[147] and their ability to find decent work,[148] but show limited enthusiasm for careers in decarbonising sectors.[149]

There may be opportunities to promote green skills and jobs in education via new qualifications,[109] increased climate literacy,[150] teacher recruitment and training,[141] and careers advice services.[45,84] Employers may also engage with schools to inspire learners and raise the profile of jobs currently seen as undesirable or non-inclusive.[151] This could be focused specifically on learners from under-represented backgrounds.[64,152]

Research suggests that offering financial incentives can significantly increase interest in taking up green skills training, while different incentives (including highlighting pro-environmental benefits and job security) did not have significant effects.[153]

Reliable consumer advice may also increase demand for green products, such as heat pumps, which could foster a demand for green skills.[93]

Stakeholders have highlighted the UK's comparative advantage in sectors such as offshore renewables. A coordinated public campaign could be valuable to raise awareness of opportunities for training and reskilling at every career stage, alongside incentives designed with key sectors.[3,15,153]

References

1. CEDEFOP (2010). Skills for green jobs: European synthesis report. 20. CEDEFOP.
2. Reay, D. (2023). Skills and Net Zero. Climate Change Committee.
3. Green Jobs Taskforce (2021). Green Jobs Taskforce report. GOV.UK.
4. Green Jobs Delivery Group (2023). Green Jobs Delivery Group: Summer 2023 statement. GOV.UK.
5. UK Government (2019). The Climate Change Act 2008 (2050 Target Amendment) Order 2019. King's Printer of Acts of Parliament.
6. McGuinness, S. *et al.* (2018). Skills Mismatch: Concepts, Measurement and Policy Approaches. *J. Econ. Surv.*, Vol 32, 985–1015.
7. IEMA and Deloitte (2022). A blueprint for green workforce transformation. IEMA.
8. Renwick, D. W. S. *et al.* (2013). Green Human Resource Management: A Review and Research Agenda*. *Int. J. Manag. Rev.*, Vol 15, 1–14.
9. CIEEM (2022). Discover Green Jobs for Nature. *Green Jobs for Nature*.
10. Kwauk, C. T. *et al.* (2022). A green skills framework for climate action, gender empowerment, and climate justice. *Dev. Policy Rev.*, Vol 40, e12624.
11. Harris, L. (2021). The challenges of defining a 'green job'. *Office for National Statistics*.
12. Sulich, A. *et al.* (2020). Green jobs, definitional issues, and the employment of young people: An analysis of three European Union countries. *J. Environ. Manage.*, Vol 262, 110314.
13. Stanef-Puică, M.-R. *et al.* (2022). Green Jobs—A Literature Review. *Int. J. Environ. Res. Public. Health*, Vol 19, 7998. Multidisciplinary Digital Publishing Institute.
14. IEMA (2023). Green Careers Hub. *Green Careers Hub*.
15. Alvis, S. *et al.* (2022). Closing the UK's green skills gap. Green Alliance.
16. Skills Development Scotland (2020). Climate emergency skills action plan 2020-2025. Skills Development Scotland.
17. Notman, G. *et al.* (2023). Net zero skills: Insights and evidence from emissions sectors in Wales. Wales Centre for Public Policy.
18. Childs, E. *et al.* (2023). Transforming the planet: Our vision for the future of environmental science. Institution of Environmental Sciences.
19. UK Government (2023). Introduction to systems thinking for civil servants. *GOV.UK*.
20. Oliver, T. H. *et al.* (2021). Knowledge architecture for the wise governance of sustainability transitions. *Environ. Sci. Policy*, Vol 126, 152–163.
21. Sørensen, L. B. *et al.* (2021). What Skills Do Agricultural Professionals Need in the Transition towards a Sustainable Agriculture? A Qualitative Literature Review. *Sustainability*, Vol 13, 13556. Multidisciplinary Digital Publishing Institute.
22. White, Y. *et al.* (2022). Skills for a net-zero economy: Insights from employers and young people. Learning and Work Institute.
23. Frontier Economics (2022). Review of skills taxonomies. Skills and Productivity Board.
24. UK Government (2023). A skills classification for the UK. Department for Education.

25. O*NET (2023). About O*NET. *O*NET Resource Center*.
26. O*NET (2023). Green Enhanced Skills Occupations - Occupational Listings at O*NET Resource Center.
27. European Commission (2023). ESCO Home. *ESCO*.
28. ESCO Publications (2022). Green Skills and Knowledge Concepts: Labelling the ESCO classification. *ESCO*.
29. Thomas, G. (2023). Experimental estimates of green jobs, UK. Office for National Statistics.
30. UK Government (2020). The ten point plan for a green industrial revolution. UK Government.
31. PwC (2023). Green Jobs Barometer. *PwC*.
32. Climate Change Committee (2023). A Net Zero workforce. Climate Change Committee.
33. Colombo, E. *et al.* (2019). AI meets labor market: Exploring the link between automation and skills. *Inf. Econ. Policy*, Vol 47, 27–37.
34. IfATE (2023). Future-facing Innovation strategy. IfATE.
35. Cretu, C. *et al.* (2022). How to scale a highly skilled heat pump industry. Nesta.
36. Department for Energy Security and Net Zero (2023). Heat pump net zero investment roadmap. UK Government.
37. Department for Transport (2022). UK electric vehicle infrastructure strategy. UK Government.
38. IEA (2023). Global EV Outlook 2023. International Energy Agency.
39. Department for Energy Security and Net Zero *et al.* (2021). Net Zero Strategy: Build Back Greener. UK Government.
40. Industrial Strategy Council (2019). UK Skills Mismatch 2030. Industry Strategy Council.
41. Jenkinson, M. (2023). London shows local FE partnerships are key to green skills. *FE Week*.
42. Octopus Energy (2022). Slough: the centre of the heat pump revolution. *Centre for Net Zero*.
43. Department for Education (2022). Local skills improvement plans - statutory guidance. UK Government.
44. Christie, I. *et al.* (2023). On multi-level climate governance in an urban/rural county: A case study of Surrey. The Place-based Climate Action Network.
45. Department for Education (2022). Sustainability and climate change: a strategy for the education and children's services systems. UK Government.
46. Department for Education (2023). Skills Bootcamps. *GOV.UK*.
47. Department for Education (2023). Free courses for jobs. *GOV.UK*.
48. Department for Education (2023). Lifelong Learning Entitlement overview. *GOV.UK*.
49. Careers Wales (2023). Personal Learning Accounts. *Careers Wales*.
50. Skills Development Scotland (2023). Funding and training. *Skills Development Scotland*.
51. Design Council (2023). Design for Planet. *Design Council*.
52. Professional Bodies Climate Action Charter (2023). Professional Bodies Climate Action Charter. *PBCAC*.
53. Machin, S. *et al.* (2022). Closing the Gap Between Vocational and General Education? Evidence from University Technical Colleges in England. Centre for Vocational Education Research.
54. IfATE (2023). Qualifications. *Institute for Apprenticeships and Technical Education*.
55. IfATE (2023). Climate change and environmental skills strategy. IfATE.
56. IfATE (2022). Forest craftsperson. *Institute for Apprenticeships and Technical Education*.
57. Cavaglia, C. *et al.* (2022). The Recent Evolution of Apprenticeships: Participation and

Pathways. Centre for Vocational Education Research.
58. UK Government (2023). How are apprenticeships funded and what is the apprenticeship levy? - The Education Hub. *The Education Hub*.
59. Crowley, E. *et al.* (2023). Devolution and evolution in UK skills policy. Chartered Institute of Personnel and Development.
60. Lord Knight *et al.* (2023). Fit for the future: A 5-point plan to grow and sustain engineering and technology apprenticeships for young people. EngineeringUK.
61. United Nations (2020). Teaching Carbon Literacy to Combat Climate Change. *United Nations*. United Nations.
62. Mole, K. *et al.* (2023). The less than 1% Club: Mapping net zero support for small businesses across England. Enterprise Research Centre, Federation of Small Businesses.
63. Hill, I. (2023). What is most important when integrating 'green skills' and sustainability topics into learning and teaching strategies? *The Open University*.
64. Institute of Physics (2021). Limit Less: Support young people to change the world. Institute of Physics.
65. UCAS (2021). Students turn to technology with university choices. *UCAS*.
66. Royal Society of Chemistry (2022). Missing Elements: Racial and ethnic inequalities in the chemical sciences. Royal Society of Chemistry.
67. OECD (2019). Skills for 2030: Conceptual learning framework. OECD.
68. National Grid (2022). 50,000 young people inspired by National Grid careers outreach programme. *National Grid*.
69. CIWM (2023). Beyond Waste: Essential Skills for a Greener Tomorrow report. The Chartered Institution of Wastes Management.
70. Antonazzo, L. *et al.* (2021). Preparing for a Just Transition: Meeting green skill needs for a sustainable steel industry. Community Trade Union, Cardiff University.
71. Wilson, R. *et al.* (2022). The Skills Imperative 2035: Occupational Outlook – Long run employment prospects for the UK. National Foundation for Educational Research.
72. Department for Energy Security and Net Zero *et al.* (2023). An Evidence Based Approach to Supporting the Transition to Net Zero. Skills Development Scotland.
73. Simpson, K. *et al.* (2021). Domestic retrofit: understanding capabilities of micro-enterprise building practitioners. *Build. Cities*, Vol 2, 449–466. Ubiquity Press.
74. Campaign for Science and Engineering (2023). The Skills Opportunity.
75. Department for Environment Food and Rural Affairs (2023). Skills gaps and opportunities in sectors and occupations of interest to Defra. UK Government.
76. Daume, P. *et al.* (2022). Renewable development: Overcoming talent gaps. *McKinsey & Company*.
77. WISE (2018). 2018 Workforce Statistics. *WISE*.
78. IfATE (2023). Delivering opportunity through technical education and apprenticeships: IfATE's equity, diversity, and inclusion (EDI) strategy. IfATE.
79. UCAS (2023). Where next? What influences the choices of would-be apprentices? UCAS.
80. IEA (2022). Skills Development and Inclusivity for Clean Energy Transitions – Analysis. International Energy Agency.
81. European Commission (2013). Diversity for Talent and Competitiveness: The SME Business

Case for Diversity. European Commission.
82. Khan, N. *et al.* (2019). Diversity in the workplace: An overview of disability employment disclosures among UK firms. *Corp. Soc. Responsib. Environ. Manag.*, Vol 26, 170–185.
83. Multicultural Apprenticeship Alliance (2023). Multicultural Apprenticeship Alliance. *Pathway Group*.
84. EAUC Scotland (2023). Showing the path to green jobs at college and university- A guide for careers and student support staff. The Alliance for Sustainability Leadership in Education.
85. Dr Dean Stroud (2023). Personal Communication (POST research interview).
86. Professor Linda Clarke (2023). Personal Communication (POST research interview).
87. Green Alliance (2023). Personal Communication (POST research interview).
88. Antonazzo, L. *et al.* (2023). Institutional complementarities and technological transformation: IVET responsiveness to Industry 4.0 – meeting emerging skill needs in the European steel industry. *Econ. Ind. Democr.*, Vol 44, 25–46. SAGE Publications Ltd.
89. Sibieta, L. *et al.* (2022). Latest trends in further education and sixth form spending in England. *Institute for Fiscal Studies*.
90. HM Treasury (2023). Autumn Statement 2023. *GOV.UK*.
91. Clarke, L. *et al.* (2017). What kind of expertise is needed for low energy construction? *Constr. Manag. Econ.*, Vol 35, 78–89. Routledge.
92. Clarke, L. *et al.* (2020). Transforming vocational education and training for nearly zero-energy building. Vol 1, 650–661. Ubiquity Press.
93. Caiger-Smith, D. *et al.* (2023). Equipping Building Engineers to Deliver Net Zero. Energy Systems Catapult.
94. Vaillant (2023). Vaillant installer survey report. Vaillant.
95. Rural England (2021). Opportunities and challenges for rural communities from net zero carbon legislation. Rural England.
96. Department for Environment Food and Rural Affairs (2023). Key Findings, Statistical Digest of Rural England. *GOV.UK*.
97. Barlow, D. (2022). Net Zero: Local Authority Powers. The Edinburgh Climate Commission, the Scottish Cities Alliance, and the Place-based Climate Action Network.
98. TUC (2020). Cutting carbon, growing skills – green skills for a just transition | Unionlearn. Trades Union Congress.
99. Sudmant, A. *et al.* (2021). Tracking local employment in the green economy: The PCAN Just Transition Jobs Tracker. *The Place-based Climate Action Network*.
100. Various stakeholders (2023). Personal Communication (recurring theme across POST research interviews).
101. Department for Transport (2023). Zero emission vehicle (ZEV) mandate consultation: summary of responses and joint government response. UK Government.
102. Climate Change Committee (2022). 2022 Progress Report to Parliament. Climate Change Committee.
103. UK Government (2023). Apply for the Boiler Upgrade Scheme. *GOV.UK*.
104. Climate Change Committee (2020). Land use: Policies for a Net Zero UK. Climate Change Committee.
105. House of Lords Science and Technology Select Committee (2022). Nature-based solutions: rhetoric or reality? The potential contribution of nature-based solutions to net zero in the UK. House of Lords.

106. CIEL (2022). Net Zero & Livestock Report. Centre for Innovation Excellence in Livestock.
107. Fassnacht, F. E. *et al.* (2023). Remote sensing in forestry: current challenges, considerations and directions. *For. Int. J. For. Res.*, cpad024.
108. Lehmann, J. *et al.* (2020). The concept and future prospects of soil health. *Nat. Rev. Earth Environ.*, Vol 1, 544–553. Nature Publishing Group.
109. Shropshire, J. (2023). Independent review into labour shortages in the food supply chain. UK Government.
110. NFYFC (2023). Route to Success Survey. The National Federation of Young Farmers' Clubs.
111. CPRE (2021). Outpriced and overlooked: Survey on why young people feel forced to leave rural areas. CPRE- The Countryside Charity.
112. Partheeban, N. (2023). Encouraging and Supporting Black and People of Colour in Agriculture. Nuffield Farming Scholarships.
113. UK Government Construction Industry Scheme (CIS). *GOV.UK*.
114. Gleeson, C. P. (2016). Residential heat pump installations: the role of vocational education and training. *Build. Res. Inf.*, Vol 44, 394–406. Routledge.
115. Vaillant (2023). Introducing Aspire, our new heat pump training journey. *Vaillant*.
116. Energy Systems Catapult (2023). RetroMeter. *Energy Systems Catapult*.
117. Energy Systems Catapult (2023). Skills for an integrated and customer-focussed retrofit process. Energy Systems Catapult.
118. de Leeuw, P. *et al.* (2021). UK Offshore Energy Workforce Transferability Review. Robert Gordon University.
119. Merson, A. (2023). Jobs 'pay cut' warning in switch from oil and gas to renewables. *Press and Journal*.
120. Bozkurt, Ö. *et al.* (2016). Skills in the green economy: recycling promises in the UK e-waste management sector. *New Technol. Work Employ.*, Vol 31, 146–160.
121. Gifford, S. (2022). The gigafactory boom: the demand for battery manufacturing in the UK. The Faraday Institution.
122. House of Commons Business and Trade Committee (2023). Batteries for electric vehicle manufacturing. House of Commons.
123. Department for Transport (2022). Jet Zero Strategy: Delivering net zero aviation by 2050. UK Government.
124. House of Commons Environmental Audit Committee (2023). Net zero and the UK aviation sector. *House of Commons*.
125. Hobbs, D. *et al.* (2023). Future aviation skills strategy. Connected Places Catapult.
126. UK Government (2023). Welsh steel's future secured as UK Government and Tata Steel announce Port Talbot green transition proposal. *GOV.UK*.
127. British Steel (2023). Sustainability. *British Steel*.
128. CEDEFOP (2012). Green skills and environmental awareness in vocational education and training. CEDEFOP.
129. CBI (2021). Skills and training for the green economy. Confederation of British Industry.
130. Department for Energy Security and Net Zero (2023). Heat Pump Investment Accelerator Competition (closed to applications). *GOV.UK*.
131. Central London Forward (2023). Meeting Central London's Skills Needs. Central London Forward and Institute for Employment Studies.
132. Skidmore, C. *et al.* (2023). The Future Is Local: The Local Mission Zero Network Report. Mission Zero Coalition.
133. Energy Systems Catapult (2022). Building a governance framework

for coordinated Local Area Energy Planning. Energy Systems Catapult.
134. UK Government (2023). Levelling-up and Regeneration Act 2023. King's Printer of Acts of Parliament.
135. Rattle, I. *et al.* (2023). Decarbonisation strategies in industry: going beyond clusters. *Sustain. Sci.*,
136. Department for Business and Trade (2023). UK battery strategy. UK Government.
137. Department for Business and Trade (2023). Advanced manufacturing plan. UK Government.
138. Morrison, D. *et al.* (2005). Job design, opportunities for skill utilization, and intrinsic job satisfaction. *Eur. J. Work Organ. Psychol.*, Vol 14, 59–79. Routledge.
139. Department for Work and Pensions (2022). Employing disabled people and people with health conditions. *GOV.UK*.
140. Welsh Government (2023). Net zero skills action plan. Welsh Government.
141. House of Commons Science and Technology Committee (2023). Diversity and inclusion in STEM. House of Commons.
142. Nye, C. *et al.* (2022). Labour and skills in the horticulture and agriculture sectors in England, 2022: Summary report. A report for The Institute of Agriculture and Horticulture (TIAH).
143. Luthans, F. (2002). The need for and meaning of positive organizational behavior. *J. Organ. Behav.*, Vol 23, 702.
144. Anwar, T. *et al.* (2023). Higher Technical Qualifications: How to liberate employers and skill workers for the future. Policy Connect.
145. Environmental Policy Forum (2023). Green Skills Survey: a summary of the headline findings and recommendations. Environmental Policy Forum.
146. Science Museum (2022). World's First Gallery Dedicated To Technicians Opens At Science Museum. *Science Museum*.
147. Lawrance, E. L. *et al.* (2022). Psychological responses, mental health, and sense of agency for the dual challenges of climate change and the COVID-19 pandemic in young people in the UK: an online survey study. *Lancet Planet. Health*, Vol 6, e726–e738. Elsevier.
148. Youth Employment UK (2023). Youth Voice Census 2023 Report. Youth Employment UK.
149. WSP (2022). Students not drawn to careers in sectors crucial to UK's net zero ambitions. *WSP*.
150. British Science Association (2023). Climate change in secondary schools: young people's views of climate change and sustainability education. British Science Association.
151. European Commission, Executive Agency for Small and Medium-sized Enterprises (2020). European vision on steel-related skills and supporting actions to solve the skills gap today and tomorrow in Europe. Publications Office of the European Union.
152. House of Commons Science, Innovation & Technology Committee (2023). Diversity and inclusion in STEM: Government Response to the Committee's Fifth Report. House of Commons.
153. Whincup, E. *et al.* (2023). How to increase the appeal of green skills and training. Nesta.

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