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Greening Construction:

A complex challenge for jobs, skills, and training

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About the partners

The Edge Foundation

The world is changing fast and education needs to keep up. Edge is an independent, politically impartial education foundation. We want education to be relevant to the twenty-first century. We gather evidence through research and real world projects and partnerships and use this to lead the debate and influence policy and practice. Edge believes all young people need to be equipped with the skills that today's global, digital economy demands, through a broad and balanced curriculum, high quality training, engaging real world learning and rich relationships between education and employers.

SKOPE

The Centre for Skills, Knowledge, and Organisational Performance (SKOPE) focuses on policy and practice at the intersection of education, skills, and employment. It is a multi-disciplinary research centre concentrating on the inter relationships between the development, demand, supply, and deployment of skill across the education and employment landscape in the UK and more broadly. SKOPE comprises a global network of researchers whose expertise spans the fields of education, sociology, economics, STEM, industrial relations, and assessment, amongst others.

ECI

The Environmental Change Institute does interdisciplinary research to understand – and contribute to management strategies for - future environmental change. The ECI's Energy programme addresses the necessary transition to secure, low-environmental-impact and equitable energy systems, especially in the built environment (buildings and transport systems). Research focuses on understanding current patterns and potential futures for energy demand and the integration of renewable energy across multiple domains: technologies, practices, markets, policy and governance.

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Acronyms

BEIS – Department for Business, Energy and Industrial Strategy

BTEC – Business and Technology Education Council

CIS – Construction Industry Scheme

CITB – Construction Industry Training Board

CPD – continuing professional development

COP26 – Conference of the Parties 26. This was the 2021 United Nations Climate Change Conference

CVET – Continuing Vocational Education & Training

DfE – Department for Education

ECI – Environmental Change Institute

EPA - End-Point Assessment

FE – Further Education

HE – Higher Education

HEI – Higher Education Institution

HMRC – Her Majesty's Revenue & Customs

I&C – Industrial and Commercial

ILO – International Labour Office

IVET – Initial Vocational Education & Training

LEP – Local Enterprise Partnership

NVQ – National Vocational Qualification

OECD – Organisation for Economic Co-ordination and Development

PTP – Private Training Providers

R&M – Repair and Maintenance

SKOPE – Centre for Skills, Knowledge and Organisational Performance

SME – Small and Medium-Sized Enterprise

T-levels – Technical Levels

UK – United Kingdom

VET – Vocational Education and Training

Executive summary

Governments, communities and individuals are moving consciously, albeit in some instances hesitantly, towards sustainable practices. Media interest in COP26 only heightened scrutiny of policy and practice around issues to do with greening the economy and providing for green skills and green jobs. Moreover, in a post-Covid world, skills that support swift economic recovery and respond to future skills demand will matter more than ever. UK policy attention is turning to the concept of a Green New Deal as a means of driving economic recovery. At the heart of this kind of Green New Deal lies localised job creation through investment in sustainable, low energy buildings and high-quality homes; renewable and affordable energy; and low-carbon transport infrastructure. The International Energy Agency identifies four strategic priorities for climate mitigation, of which two are directly relevant to buildings and the construction sector: a massive push for electrification of energy services, including heating; and a relentless focus on energy efficiency (IEA, 2021). Therefore, the construction sector is crucial to the drive towards net zero, a greener economy, and a greener future.

In England, the construction sector (building) is often a focus, and is one of the key industries highlighted in the recently published Green Jobs Taskforce report (Green Jobs Taskforce, 2021). This focus is understandable given buildings are responsible for a substantial proportion of global carbon emissions during their construction, but more importantly throughout their lifetime via their energy consumption. Moreover, this sector is a key focal point for many climate and energy policies: on the one hand it is an intuitive and widespread emitter that can be targeted by policymakers; and on the other it intersects with the behaviours of individuals and their role in curbing consumption and therefore emissions.

Emerging technologies related to energy, heat, and building materials are frequently positioned as a key part of the greening process within construction. The need for green technology deployment leads to a focus on skills in Science, Technology, Engineering and Maths (STEM) subjects or technical skills linked with specific emerging technologies. However, STEM skills are not the only ones that are needed; good communication, leadership skills, professional integrity, general business and administrative skills are also required. These 'employability' skills are just as important as specialist technical skills. At the same time, key skills that support continuing professional development (CPD) are critical to ensuring construction workers deal flexibly with uncertain futures and ongoing technological enhancements and continue to develop their competencies as technologies, economic and ecological landscapes, and legal frameworks change. This kind of adaptability through engagement in ongoing education and training (E&T) sits at the heart of a green future in the construction sector.

Understanding the skills required, demanded, supplied, and deployed for a greener economy is essential. Yet, we know little about the dynamic relationship between these emerging skills demands needed to meet net zero carbon targets and the structures of and pathways through the skills formation system that must supply these skills at the both the initial point of training and through CPD. Although an under-researched area, evidence suggests that education and training in the construction sector is unsystematic and fragmented and that before the pandemic, skills at intermediate levels (i.e., 3-4) (see Appendix 1) were already in low supply and that engagement with greener building practices was patchy and often confined to a small range of innovative providers. The complexity of the system is heightened by the minimally regulated nature of the sector, which is dominated by SMEs, micro businesses, and self-employed contractors, all taking different approaches to initial and ongoing E&T.

This report, therefore, maps out the relationship between the skills required for a greener future in construction and the E&T landscape. It is the result of a literature review, document analysis, and a stakeholder workshop with 40 participants providing insights into the issues surrounding the supply of employees with both the technical skills to engage with relevant green technologies and the broader employability, interpersonal and flexible skills to work in a transforming industry such as the construction sector.

The following are the key findings based around structural issues related to the shape of the system and the ways in which companies, particularly SMEs, micro businesses, and self-employed individuals relate to it; issues related to the demand for green skills; issues with regulation; and issues with the fragmentation and complexity of the skills formation system with variations across context and geographical regions, complex pathways, and often competition between providers. Ultimately, there is a tension between policy visions for the future: a narrow techno-economic view that available technologies will be installed at scale and work well with only small-scale investment to prime markets; and a broader view in which skills formation, industry practice and culture are key elements of successful technology deployment:

- **A broader conceptualisation of the skills required for a greener future:** our research has highlighted that a simple focus on only technical skills fails to capture the demands of complex building sites and the need for greener construction and business practices. Therefore, in relation to both initial training and CPD, education and training programmes should aim to work with the following framework:

- **An emphasis on CPD:** this analysis has highlighted the critical importance of ongoing professional development for everyone involved in the construction sector, particularly training undertaken in a meaningful and sustained manner that goes beyond simple 'bacon butty briefs'.
- **Training structures and incentives for SMEs, micro businesses, and self-employed contractors:** CPD means time away from site, which is challenging and costly and often hits smaller organisations hardest. There is therefore a need to provide meaningful incentives for CPD, potentially compensation, and to structure ongoing education and training at times that will fit around standard working days.
- **CPD for those involved in delivering training:** given the changing nature of the sector, it is essential that those involved in delivering training received adequate professional development to stay up to date in relation to technical developments, but are also able to support the development of broader employability skills and sustainability-oriented and CPD-oriented dispositions.
- **Stronger strategic partnership arrangements:** there is a clear need for greater strategic co-ordination between skills providers and industry with more effective working relationship between Further Education (FE) colleges and employers so that emerging skills needs can be responded to within the skills formation system in an agile manner and the pathways through initial training and CPD can be drastically simplified.
- **Greater regulation:** the construction industry in the UK and associated education and training pathways are relatively unregulated compared to other international skills systems. Closer regulation would both ensure skills demands are being appropriately met while also contributing to driving the changes in culture and practice required for a more sustainable future.

Introduction

> *There is a theory going round about 50 shades of green. There will be a light touch of green, sustainability, net zero carbon that will be required in this occupation, whereas in this occupation it is totally dark green and that is 100 %.* [1]

As governments increase their commitments to tackle climate change, policy makers and policy analysts emphasise the importance of the green economy, green jobs, and green skills in transitioning to 'net zero'. Recent reports from different government departments have emphasised the need for the skills required to attain the government's plans to reach net zero by 2050 (HM Government, 2020; DfE, 2021), highlighting a growing emphasis on the need for green skills for a green economy. Meanwhile, the government's Heat and Buildings Strategy places a strong emphasis on the need to electrify residential heating systems using heat pump technology, with no new gas boilers by the early 2030s (BEIS, 2021). The skills implications of such significant changes receive little attention, and the government has been criticised for being unclear about what green jobs are and for having no plan for green skills (EAC, 2021). We know little of what a green economy is, or of how to develop a strategic move towards it, beyond high-level rhetoric. What constitutes a green job? What are the key features that make a job 'green'? Who decides and how? If buildings are to perform as needed to meet climate change policy targets (net zero), is the whole construction industry part of a large-scale shift towards 'green' jobs? To illustrate the complexity:

Jack is a carpenter. He owns his own business and has done so for 6 years after completing his apprenticeship. He has forged a strong working relationship with a building company and often subcontracts on construction projects. As the owner of an SME with one other employee he is budget conscious, does not have time to retrain for new technologies, and is not in control of co-ordinating with other trades on a site. He often works under time pressure and with minimal briefing or supervision.

John, also a carpenter, is employed by a company specialising in green construction. He works as part of a team, although is the only carpenter, on a variety of new build and retrofit projects, with a clear delineation of duties and the opportunity to learn from each other. The owner of the company believes it is important to keep employees well-trained in the latest technologies and procedures. Employees and sub-contractors are managed as a team, with shared responsibility for the finished project.

Jack and John are worlds apart in terms of working as carpenters in construction. While occasionally they find themselves working on the same sites it is with very different collaborative action and often on different joinery elements.

This vignette highlights the difficulty in defining green jobs, green skills, and the green economy, even within a single occupation. The culture and context of employment is an important factor to consider along with skills training. This raises critical questions about how the E&T system can respond to shifting skills and practices as the construction sector is increasingly positioned as the key vehicle to a greener economy.

[1] Quotes are from workshop participants

Defining 'green' construction skills

The International Labour Office (2016) defines green jobs as:

> *decent jobs that contribute to preserve or restore the environment, be they in traditional sectors such as manufacturing and construction, or in new, emerging green sectors such as renewable energy and energy efficiency.*
>
> *Green jobs help:*
>
> - *Improve energy and raw materials efficiency*
> - *Limit greenhouse gas emissions*
> - *Minimize waste and pollution*
> - *Protect and restore ecosystems*
> - *Support adaptation to the effects of climate change*

In addition, the U.S.-based Occupational Network (O*NET) classification system (Dierdorff et al., 2009) have developed a useful classification approach based on three very broad categories:

- **Green new/emerging occupations (GNE)** – where the transition to a greener economy leads to new occupations, new tasks, and new skills requirements within existing sectors or in wholly new sectors; for example, the new role of Retrofit Coordinator has been proposed to help deliver better building renovations through effective management of sub-contractors;
- **Green enhanced skills occupations (GES)** – existing occupations that could contribute positively to green objectives if new skills are learned and integrated into practice; for example, a shared 'foundation' course in building performance could underpin better coordination and understanding among project teams; and
- **Green increased demand occupations (GID)** – where growth in a given sector will lead to more jobs and more need for skills training, but without significant changes to tasks or skills requirements; for example, solar panel installers, where all tasks can be considered to be green.

It is possible to identify needs for all three classes of 'green' occupations in the construction sector and we begin to do this on page 14 in the section *Conceptualisations of green jobs, skills, occupations, and the green economy*, yet the detail is still uncertain in terms of:

- Who needs to learn what;
- How many jobs are affected; and
- How education and training can lead to better outcomes on projects.

In the UK, there is a significant shortage of construction workers and an urgent need to train new members of the workforce, as well as upskill the current workforce. It is, therefore, important to provide detailed analysis of how construction work is changing, and needs to change, in response to the climate crisis to operationalise policy ambition and ensure E&T systems can respond to the changing skills demands of the sector in an agile manner. The challenge will be to re-train and up-skill the workforce as new technologies, practices and business models are developed and incorporated into the sector. There will be opportunities for existing trades people as well as new entrants. As such, this project sought to better understand the intersection between jobs, skills and E&T in the construction sector. We explored the following questions:

- What kinds of occupation and green skills development are needed in the construction sector?
- What types of training and/or learning are most suited to the green skills in question and for the construction sector specifically?
- To what extent does the existing vocational education and training (VET) system have the capacity to develop and deliver these skills?
- How can the supply, demand and use of skills all be improved to support the green economy?
- What other issues are relevant to the debate on green construction skills?

Methods

The project was structured around an innovative partnership between researchers at SKOPE (the Centre for Skills, Knowledge and Organisational Performance) and ECI (Environmental Change Institute) at the University of Oxford, and the Edge Foundation, drawing on their wide networks to bring together key stakeholders. Specifically, the aims of this project were to:

- To understand how green jobs and green skills are conceptualised:
  – within the construction sector
  – in the buildings and education research communities
  – in buildings, energy and education policy communities
- To develop understanding of future green skills needs and E&T in order to provide meaningful recommendations on how the construction skills formation system can best meet the skills demands of a greener economy.

It was operationalised through three core strands:

A literature review covering journal articles, conference proceedings, books, and book chapters published during 2000-2021 plus snowballing publications until we reached saturation. These publications were empirical and theoretical and formed two distinct groups of studies. First, more global studies that engage with definitional and conceptual debates around green jobs, green skills and the green economy. Second, we identified a group of localized studies focused on green skills within the construction and building sector in England.

Document analysis of current training provision in the construction section, focusing on apprenticeships and innovative courses at Further Education (FE) colleges. This provided a detailed map of current provision and the ways in which assumed skills requirements and pedagogic practice intersect.

A stakeholder workshop with 40 key stakeholders. These included: education and skills policymakers, energy policymakers, industry agencies, representative trade bodies, employers, educationalists, Awarding Bodies, FE Colleges, and energy, construction and education researchers. The workshop aimed: to share and test emerging findings and policy recommendations from the literature review and document analysis; to understand the changing nature of work in the sector; to map current and future skills needs and green skill requirements; and to understand trajectories of travel. Quotes from the workshop participants are used in this report; these have been anonymised to protect participants, and appear with no attribution.

Construction industry profile

Construction is a diverse industry, covering everything from handyman services to major infrastructure projects like HS2. Its output varies from year to year (reflecting economic cycles) and makes up about 7-10% of national GDP. Its output includes housing, industrial and commercial projects (I&C), and infrastructure (e.g. roads, bridges). Output can also be classed in terms of new construction or repair and maintenance (R&M) - see Table 1. The industry has about 45,000 firms, of which over 95% are small and medium-sized enterprise (SMEs); over 80% of firms in the sector are micro enterprises with 1-3 employees (ONS 2021b).

Table 1. UK construction annual output, 5-year averages 2016-2020 (source data: ONS 2021a)

£bn (% of total)	Housing	Industrial & commercial	Infrastructure	Totals – new and R&M
New construction	37.9 (24%)	47.1 (30%)	19.2 (12%)	104.1 (66%)
Repair and maintenance	28.8 (18%)	17.1 (11%)	8.4 (5%)	54.3 (34%)
Totals by sector	66.7 (42%)	64.2 (41%)	27.6 (17%)	158.5 (100%)

Construction is a complex sector characterized by fragmentation and risk-aversion, with a heavy reliance on sub-contracting, one-person self-employed enterprises, and a variety of SMEs often working next to each other on the same site. Within this complexity and despite the importance placed on green jobs and green skills in economic policy and industrial strategies, these terms remain ill-defined, in both general and industry-specific terms.

The structure and culture of a sector is reflected in its approach to skills, for example through levels of participation in continuing professional development (CPD). The construction industry generally operates in a 'low-skills equilibrium' (Green 2016; Killip, 2020)- where low educational attainment operates in parallel with low wages, low productivity, and low levels of innovation. Those who do increase their own knowledge and skill can be tempted into employment in better-paid and more prestigious sectors, thereby helping to perpetuate the low-skills equilibrium for those who remain.

Findings

The findings of the report are organised thematically in sections. It begins with an overview of the existing system for vocational education and training (VET) in construction. A summary of the conceptualisations of green jobs, skills, occupations, and the green economy comes next, followed by a discussion of the meaning of 'skill' in relation to key terms: 'knowledge' and 'competence'. Knowledge, skill, and competence is discussed in relation to wider policy for tertiary education and the importance of thinking about the demand and use of skills in the workplace (not just the provision of new training courses). Construction training, linking the training pathways to questions about jobs and careers, not just courses, focusing on regulation and how young people can be agents of change forms the penultimate section. Key findings are brought together in the concluding section.

The VET system for the construction sector

The vocational education and training system that services the construction sector is complex. It is a fragmented and complicated space offering apprenticeships, BTECs and standalone NVQs, new T-Level courses, as well as short CPD courses. Yet, FE colleges and private training providers (PTPs) are not the only providers with many manufacturers offering training on individual pieces of technology or equipment themselves. The E&T landscape is characterised by complexity and multiple training pathways (see Appendix 1):

- In 2020 there were 550 building and construction qualifications with college enrolments with the majority of these at levels 1-3 (Level 1 – 19%; Level 2 – 37%; Level 3 – 25%);
- In 2019-20 there were over 300 providers of construction related training in England, covering either courses and/or apprenticeships;
- Between 2015 – 2019 there were approximately 110,000 students per year enrolled in courses in the category of 'Construction, Planning and the Built Environment';
- There were approximately 12,000 apprenticeship and training starts per year between 2018-2020 (falling to 8,000 in 2020-21); and
- Between 2015-2019 there were on average ~45,000 construction apprentices at any given time.

Unfortunately, there are low levels of apprenticeship completions, with the top three reasons given by apprentice leavers being: better pay elsewhere; other job offers; and not liking the work (Holford, 2019).. In addition, a very high proportion of the industry are self-employed individuals where even if they are motivated to engage with E&T, the issue remains that any time they are training they are not working, which means they suffer the double whammy of losing income as well as paying the cost of training. With low current customer demand, it is potentially difficult to convince those micro firms and self-employed people that training is worth the investment. In addition, many of these businesses are currently very busy with a workload that takes them at least 12-months into the future so there is little incentive to look at doing anything differently. In addition, the incentive to train apprentices is also limited:

> *With SME, quite often they're not particularly keen on apprentices, because of the length of time they're required to invest in them. And also, if you're an SME, you're quite often not a levy payer. And if you don't pay the levy, somebody's saying to you, oh, well, you can draw down 90% of training costs, which you weren't going to pay any way. It's not much of an incentive.*

Construction firms are required to pay a levy into a fund administered by the Construction Industry Training Board (CITB), which is then distributed back to eligible firms through a system of grants and payments to support training (see CITB, 2022). The smallest firms (with an annual turnover of under £120,000) are exempt from paying the levy. Other firms pay a percentage of their annual wage bill, with different rates for wages on the payroll and net contributions to the Construction Industry Scheme (CIS), which is a tax collection mechanism set up by HMRC. Levy rates were halved during the Covid-19 pandemic but are expected to return to pre-Covid levels in 2021/22, which are 0.35% on payroll staff and 1.25% on CIS subcontractors.

Eligible firms can then bid for levy grants and payments to support their employees in training, with the amounts available varying by specific CITB scheme and by the size of firm seeking funding. In most cases, the grant funding is not enough to pay the full cost of training, so the employer is expected to meet the shortfall, as well as managing the impact of any lost hours in the workplace.

In all, the onus for undertaking training is often placed on individual workers and on small firms, who are typically the least well-placed in terms of time and resources to undertake training (Dainty, Green & Bagilhole, 2007). Moreover, while in many ways young people make rational labour market decisions in relation to the courses of

study they undertake, with green skills they are being asked to undertake a course of study for a job that they cannot see currently exists. While society, and government, may need young people to take this risk to provide a more realistic chance of successfully doing all that we need to do to meet net zero carbon, it is understandable why they would be hesitant:

> *So if it's saying to [young people] these jobs will be available in a few years. That's asking them to take a risk. We don't feel necessarily that it's a risk because we can see that there should be demand. But if there isn't demand yet, it's kind of putting the risk onto one of the more vulnerable parts of that chain.*

Apprenticeships in theory offer a way to build skills relevant to actual construction work, in the context of real projects. However, only one in four small businesses offer apprenticeships, while two in three of the largest construction firms do. Because small businesses dominate the sector, it is estimated that SMEs train over 70% of construction apprentices despite time-poor SMEs struggling to engage in the process of developing apprenticeships.

Continuing Professional Development (CPD) is more popular on-the-job. A recent survey (FMB, 2020) showed more builders are planning to upskill their employees on an informal, internal basis over the next five years (69%; 18% don't know) than are planning to invest in external upskilling (52%; 22% don't know). Informal training would include:

- focus on practical skills and knowledge;
- teaming up junior tradespeople with more experienced operatives;
- sending one person on a short external course; and
- cascading knowledge to their staff via toolbox talks.

With E&T devolved to the four nations of the UK, there is clearly variation in the amount of training available. Interestingly, this variation becomes quite local, specific to regions and cities. There are different targets and some of the cities in Scotland have earlier than 2050 net zero targets as do several city regions, Local Enterprise Partnerships (LEP's) and combined authorities, and local councils in England. However, the setting of targets does not translate easily or obviously into delivery on the ground, where the role of national policy is key to framing local action (Brocklehurst et al., 2021). Also, given the different awarding bodies, young people across the UK are not necessarily receiving the same curriculum and the same type of careers advice, which is an important factor in terms of planning and preparation for future skills and in relation to this report, future green skills, and employability. At the same time, local skills needs can vary given the prominence of some industries and employers in certain regions over others. This variation provides additional challenges in terms of engagement and understanding what future green skills needs means for those specific stakeholders (OECD, 2020):

> *What it means in their area at local level and recognizing that local area action is going to be really key in terms of delivering these targets and in terms of having those partnerships.*

Although complex and fragmented, this E&T is occurring in an industry positioned as critical to a net zero economy and facing increasing pressure to develop green jobs and ensure workers have the green skills that will contribute to sustainable construction infrastructure and facilitate greener construction practices.

Conceptualisations of green jobs, skills, occupations, and the green economy

Despite the importance placed on green jobs and green skills in economic policy and industrial strategies, these terms remain ill-defined, in both general and industry-specific terms. At policy level, the concept of green jobs is applied differently in a variety of contexts. While it is difficult to disagree with elements of the ILO definition cited above, short-term priorities may conflict with longer-term ones, adding to the contested and messy nature of the 'green skills' challenge. Our workshop participants highlighted that O*NET and ILO definitions of green jobs and green skills fail to fully capture the complexity of the UK construction sector where a self-employed sub-contractor may be deemed to be deploying green skills on one site that has a sustainable design, but not on another, despite doing very similar tasks in each context. These definitions may not capture the complexities and the associated skills requirements of working with multiple contractors across different sites, as illustrated in the vignette of Jack and John, communicating with clients in domestic construction settings, providing advice on emerging building practices and green building code, or taking responsibility for ongoing training needs for staff within a firm.

At the same time, stakeholders in the trades emphasised that conceptualisations of green construction jobs should not be reduced simply to discussion about skills. There is a need to emphasise the importance of 'job quality' and ensuring workers have 'decent jobs':

> *How do you define green jobs? I think we need to move away from defining it by skills, levels of skills. And the ILO definition has it as decent jobs. I think that is a huge issue. The quality of the jobs is something we need to look at … decent, high quality and inclusive jobs. I think that is part of the definition.*

This lack of a clear definition of how green jobs, green skills, and the green economy should be conceptualised in the construction industry is also clearly evident in the academic literature, which is disparate in terms of conceptualisations while also siloed into cognate areas. Studies focused on green jobs in a narrow sense tend to be drawn from the energy policy and economics literature. These are focused narrowly on policy questions about counting the number of jobs created by a certain set of policy choices. Studies focused on *green skills* include education systems, and training pathways as overlapping/related units of analysis. There is a rich diversity of theoretical frameworks used to conceptualize knowledge and how it relates to skill (know-how, know-that); links between skill, agency, and identity (capability theory) and actor-based theories of how skilled individuals are enmeshed in webs of relationship (with competitors, clients, and policymakers). Studies focused on green occupations, labour market structures and industry sectors are the most common, with considerable diversity within this single category/theme. Economics studies focused on occupations tend to draw on human capital theory and specific job counting theories such as input-output accounting. Finally, studies focused on *green economy*, with a wider view to entire economic systems at a macro level, are the most obviously critical. Theories range from neo-Marxism to discourse theory to feminist ecological economics. A common thread is the use of 'strong vs. weak vs. transformative green economy' (Ferguson, 2015) as a counter-narrative to the mainstream use of green economy as a label/signifier.

Despite the variety of conceptualisations in academic research, policy discourse related to green jobs and green skills in construction tends to focus on the transformative potential of technologies. This leads to a focus on technical skills. Given the complexity and future uncertainty in the construction sector, meaningful ongoing professional development will have to be normalised as workers will need to navigate changing practices, technologies, and legal frameworks. Indeed, policy debates on skills training tend to focus on the supply of courses and qualifications (outlined above). There is less attention paid to the real demand for skills training and the use of acquired skills in the workplace, both of which are essential. The demand for skills training can be closely allied to employment prospects (discussed further below). Equally, the structure and culture of a sector is reflected in its approach to skills, for example through levels of participation in CPD.

Knowledge, skills, and competence in construction

What counts as knowledge and skill is hotly contested and there have been many attempts to define what is meant by knowledge and skill (Eraut, 1994, pp15-16). Many focus on a distinction between conceptual knowledge – knowing that – and procedural knowledge – knowing how – which, while simplifying the terms, are not offering an inclusive and exhaustive account of knowledge and skill. As highlighted above, critical to any understanding of the skills, knowledge and competency requirements for a greener construction sector should be:

- Technical skills linked to emerging technologies, sustainable practices, and building regulations;
- Employability skills required for engaging in complex, fragmented, contexts dominated by sub-contracting, particularly: communication, digital skills, creativity, professional integrity, general business and administrative skills;
- Knowledge and understanding of broad issues related to climate change, building performance and the overarching goals of sustainable practice – a sustainability-oriented mindset; and
- Flexibility and adaptability to deal with future uncertainties and a likely period of changes in practice, requiring CPD beyond the point of initial training – an E&T oriented approach.

Apprenticeships have a long history as the vehicle for developing knowledge, skills, and competence in the construction sector. The standards are developed by the employers, they are job specific, and clearly define the knowledge and skill required by the job role. These standards are linked to the end point assessment (EPA) and the apprentice must demonstrate at the end of the apprenticeship that they developed the knowledge and skills at a competent level. The new T-levels are Level 3 qualifications aimed at 16–18 year-olds and they have been available in some subjects in selected schools and colleges from 2020. There are two construction-related T-levels already available in Building Services Engineering for Construction and Design, Surveying and Planning for Construction, and the third, Design and Development for Engineering and Manufacturing will be available from September 2022. These two-year courses are designed to offer a core introduction to the construction sector before students can specialise, hence T-level '*students will learn the core knowledge and skills for entry to a range of construction occupation*'. One core element of the T-levels is a 9-week industry placement when students can develop their practical and technical skills relevant to their course in the workplace.

A key element of the theory on workplace learning is moving on a trajectory from novice to expert (Lave and Wenger, 1991) through co-participatory practices (Billett, 2019). On that journey the learner is not only learning to become competent in that occupation, but to work in a workplace setting to perform in that occupation alongside other competent professionals developing the 'right' dispositions:

> *You can't teach dispositions, people have to learn them. […] what kind of learning experiences […] will actually bring them around to the view that there is a need to work sustainably and do all these things because that is ultimately where it is going to happen.*

Many believe these skills, knowledge and dispositions are best learnt through experience and observation, and if good green practice is not currently happening in industry then it can be difficult to teach:

> *A lot of dispositional learning comes from observations and they can be positive or negative. People see good practices they want to follow or they will see instances of practices they don't want to follow. It's putting people in a place where they observe stuff. Giving people kind of experiences that they can come to conclusions about. The need to engage and ways of working which are different. Think differently. It's not about telling people stuff. It's about finding ways of engaging people to think about these issues and add them to their practice.*

Even though policy emphasis is on green skills, the need for a broader approach was emphasised by stakeholders. Since specific skills may become outdated due to the development of technologies and new practices, it was recognised that in fact a broader knowledge about sustainability and sustainable practice needs to be developed alongside the development of the mindset of the workforce, both in terms of their positive attitude towards sustainability and the receptiveness to ongoing CPD throughout their whole career:

We're not talking about skills, or at least, it should be knowledge, skills and competence...

This last point is not about cognate skills but rather what is often referred to as dispositions, employability skills or transferable skills. Since the 1980's an emphasis on 'basic skills', 'soft skills', 'generic skills', 'transferable skills', 'employability skills', and more recently '21st Century skills' has featured in policy discourse and the language of these employability skills has increasingly dominated the curriculum in vocational education, based on the idea that qualifications need to include generic or transferable skills for employment and the specific competencies required to perform particular tasks and roles in the workplace (Wheelahan, Moodie & Doughney, 2022).

Employability skills

In so far as the need for green technology deployment leads to a focus on skills in Science, Technology, Engineering and Maths (STEM) subjects, these skills are not the only ones that are needed. The messy realities of the construction sector, the need for different trades to work together across a variety of contexts with shared green ambitions, and the requirements of client facing roles emphasises that good communication, professional integrity, and general business and administrative skills are also required. These 'employability' skills are just as important as specialist technical skills. Many employer surveys on the skills required at work cite skills that are not cognate specific. These are often classified as employability skills or transferable skills (Robson et al, 2022). Debates over what is included in these categories continues and can be as broad ranging as also encompassing dispositions, but often emphasise core skills related to communication, critical thinking, creativity, digital skills as well as professional integrity, general business and administrative skills. These skills were identified by key stakeholders as being critical within the construction industry in general, as well as in relation to green jobs. They were particularly highlighted as being essential for managers/leader/ trainers who need both to manage their business in sustainable and efficient ways and inspire their workforce to engage in sustainable and efficient practices. This closely aligns with analysis undertaken by Robson et al. (2021) of skills identified as essential for leaders across a wide variety of sectors. Robson and colleagues have developed a clear framework for combining these kinds of transferable skills with more technical skills, particularly for those in leadership positions – the Narrative Skills Framework (Robson et al. 2021). This emphasises the importance of using narrative to communicate with customers, stakeholders, and staff to sell products, ideas and practices. Our analysis suggests that these kinds of narrative skills are likely to be key for those in leadership and training positions in the construction sector to drive change and inspire the workforce.

An avenue for developing these skills could be through CPD but this means radical changes at both cultural and structural levels are required to embed the importance of continued development and up/reskilling in all parts of the sector. This is particularly challenging given the complex and fragmented nature of the sector and a lack of clarity over where responsibility for green approaches should sit in multi-contractor work contexts. And much of the UK vocational system, especially apprenticeships, is compared to the German dual system in terms

of occupations. The general belief is that the UK system is more task orientated, and in that sense, produces workers with narrow skills (Clarke, Winch, & Brockmann 2013). One suggestion was to incorporate a broad base of foundation skills within construction:

> *But perhaps it's in that sense, it's about the development of a broad base of foundational skills that might be required, within construction, of which green might be part.*

Of course, vocational education and training sits as part of a broader E&T system. Recently this E&T system, particularly post-compulsory E&T in FE and HE is referred to as a tertiary landscape.

Higher and Further Education context

Higher education institutions (HEIs) have been seen as the main vehicle to skilled employment (Davies and Ercolani, 2021). Indeed, higher education (HE) has been the focus of supply-side E&T policy for a long time. Particularly in recent decades, especially since the massification of HE, a policy focus in the UK has been on the knowledge economy (Brown et al., 2008). Government policies have been strongly influenced by the idea that HE leads to better jobs, greater social cohesion, and improves students' knowledge and skills levels, which then improve productivity and economic performance (Keep, 2020). While HEIs are clearly playing an important role in terms of the knowledge economy, generating intellectual property, this focus entirely alienates understanding and recognition of the skills underpinning the knowledge developed in FE.

The prestige of VET is an issue (James Relly, 2021), complicated by the reputation of low wage, poor-quality jobs in the construction sector. There are wide-ranging occupations in the construction sector all serviced by E&T across the tertiary landscape. Just as an emphasis on working together was paramount in the argument for training and developing well-rounded workers capable of working as a team, calls for working together across the tertiary sector were clear:

> *This could be resolved much more effectively if we stopped worrying about if this is HE or FE. We need to be working much more closely together to resolve this issue. There is plenty of people to go round. If we keep on insisting everybody's a failure unless they go to University we are never going to get the people with the level 3, 4, 5 skills that we actually need to fit the Heat Pumps and to deal with the retro fit stuff as well.*

We need to break down barriers of prestige and parity and advocate for meaningful, well-paid work and jobs in a sector, and occupations within it, that are supplied by knowledge, skills and competence developed in a tertiary landscape. This is what the ILO definition of 'green skills' is referring to when it relates the idea to the need for decent jobs.

Need for joined-up E&T approaches and engagement with local needs

We know that FE colleges have vast experience and expertise in employer engagement (James Relly and Laczik, 2021), including in strategic policy discussion with their local business communities. It is not just about FE colleges though. Better collaboration is required across training providers, employers, employer bodies, and Government. This collaboration is needed to ensure alignment between demand and supply. The training system, incentives, and funding for training need to be coordinated in order to develop the future workforce that is required to reach net zero carbon.

While the FE sector is actually very good at engaging with specific organisations like Green Register, and various others such as the Carbon Literacy Trust that help them enhance their delivery, it was clear that all stakeholders

throughout E&T sector and industry need to work collaboratively to drive the agenda forward. This means ensuring future knowledge and skills development is joined up:

> *We talked about collaboration across the different parties and education system and councils understanding what work is required in that local area and understanding what the skills situation is in that local area are really important things we are looking into at the moment.*

Supply, demand and use of skills

Discourses of green jobs, the green economy, green growth and a 'Green New Deal' have been constructed, promoted, and normalized by a coalition of influential multilateral organizations such as the World Bank, IMF, ILO, UNEP and others (Cock, 2014; Ferguson, 2015; Georgeson et al., 2017). These discourses emerged as a response to the 2008 financial crisis and have been re-established and adapted in 2020/2021 in response to the global pandemic. In recent years, the ILO has shifted the discussion slightly to include job quality through the lens of 'decent jobs'. Other, more radical organizations have called for a 'just transition' that challenges the power structures of capitalist economies (Velicu & Barca, 2020). Overall, such statements and arguments from influential global organizations provide the building blocks for governments and other national political actors to draw from in arguing for particular policies in their countries. While not specifically focussing on green skills, Keep (2016) has succinctly emphasised the market orientation of UK policymaking which leads to a simplistic notion of, and a belief in the direct matching of skill supply, demand and use. We can see these simplistic notions transferred to discussions on green skills. Many papers in economics, energy policy and buildings research equate green jobs with a desired, positive outcome for workers and society. This argument assumes that by definition, green jobs are those that contribute to reductions in carbon emissions (or other environmental impacts), a largely accepted societal value.

In fact, it is possible (and commonplace) for skills to be taught but not learned or used to full effect in the workplace (James et al, 2013), which can easily lead to unintended consequences, such as design-performance gaps. Any new training provision needs to be reflected in industry practices and culture if it is to avoid this kind of pitfall.

Even though policy emphasis is on green skills, the need for a broader approach was emphasised by stakeholders. Since specific skills may become outdated due to the development of technologies and processes, it was recognised that in fact a broader knowledge about sustainability and sustainable practice needs to be developed. Alongside the development of the mindset of the workforce, both in terms of their positive attitude towards sustainability and the receptiveness to ongoing professional development throughout their whole career:

> *If you have well-rounded well-educated workers they can contribute to the aim of reducing greenhouse gases, which is reducing waste and using less material. That's the main goal. I don't care if someone has a job title, retrofit or green job. If it doesn't do anything, it doesn't do anything.*

It was recognised that colleges and other vocational training providers hold a responsibility to teach these broader skills, knowledge and competencies. In some circumstances, this has started to take place, for instance through a whole-college approach to sustainability education:

> *Vocational courses are about more than just teaching people a set of tasks that they have to do, it should try and deepen their understanding, and make them enjoy the learning process. I think that's also important for future development of the workforce.*

> *What we need to do is make people aware they will need to be able to wield green hammers in the future so they need to be ready to have a mindset that says, I'm going out into industry now I am aware that my skill set will need to shift in response to changes in the workplace so I have to be receptive and ready for my need to upskill or as I call it add skill.*

Therefore, with just under 1.5 million workers in the construction industry (ONS, 2019) and approximately 45,000 construction apprentices, the challenge will be to re-train and up-skill the workforce, including professional trainers. This will require both technical skills, as new technologies are developed and incorporated into the sector, and broader knowledge and competencies related to sustainable approaches to work with much of the work delivered by existing trades people, as well as college tutors and trainers:

> *Some of [the existing workforce] will just be needing an update of their knowledge in terms of understanding the building and the system like how different elements interact like ventilation which is considered very poorly understood within the sector currently... there is a need to upgrade the knowledge.*

> *We need to train the entire planning design and delivery team. Everyone in the sector needs to understand how this works and the thing is you can't install say an air source heat pump in isolation. You need to understand the fabric of the building as well. The trades need to interrelate. Everyone needs to be communicating better and not really working in silos as we have been in the past.*

However, evidence suggests that existing programmes of professional development are limited and functional. As one stakeholder put it: '*a half hour briefing with a bacon butty is not education and training*'. This means radical changes at both cultural and structural levels are required to embed the importance of continued development

and up/reskilling in all parts of the sector. This is particularly challenging given the complex and fragmented nature of the sector and a lack of clarity over where responsibility for green approaches should sit in multi-contractor work contexts:

> *Green Skills? Not my job, mate! If this is not my job coming onto site, I'm not interested in it, because I'm liable for it.*

This challenge is exacerbated by a perceived lack of demand for green skills and more broadly green construction practices and the difficulties of dealing with emerging markets that are still in their infancy. The availability of a technology does not necessarily mean that it will be deployed at scale, nor that all workers are equally able to do the job well. This raises critical questions for employers about when workers should be trained in certain technologies:

> *The reality is that… students coming through FE, they're not likely to be overseeing the installation of an air source heat pump for quite a long way into their career. So it does then come back to how the employers are either required to, incentivized to or out of the goodness of their heart decide to, you know, enhance the skills of those young people.*

This highlights an inherent tension within the E&T system: employers only want to invest in upskilling or reskilling staff once demand for particular skills or technologies is clear. They are unlikely to up/reskill their workforce without overt incentives and strong signals of future market direction.

Limited incentives for self-employed to reskill

With so much of the construction sector operating as SMEs, micro firms and self-employed contractors the motivation to engage with training remains an issue: any time they are training they are not working, which means the issue of incentives is particularly critical for these businesses. With perceived low current customer demand, it will be difficult to convince those micro firms and self-employed people that training is worth the investment. In addition, with the rise in house improvements since the pandemic, many of these businesses are currently very busy with a good workload so there is no incentive to look at doing anything differently.

Similarly, stakeholders in the trades suggested that there is little incentive to train apprentices beyond basic competencies in either technical skills associated with emerging green technologies or in general sustainability knowledge. Some training providers have attempted to combat some of these barriers for SMEs, micro firms and self-employed contractors to train by offering free, compensated and/or flexible training which fits in with their usual workload. Yet government funding and regulation remains key for this to be sustainable:

> *An SME's time off site is money. We decided to run training later in the day 4 – 6pm in short bursts. We also gave them the training for free because we were funded by BEIS. It was recognition and acknowledgement of the fact if they were not on site, they were not earning money for those two hours. There are particular barriers that need to be overcome and government funding and regulation might help to do it.*

Clearly, it is important to bring colleges into the strategic discussion as large providers of initial (IVET) and continued training (CVET). FE colleges, through their business engagement employees, are positioned so that they can have discussions with their local businesses. This is important because the skilled workers currently fitting gas fired boilers would need to factor in the policy shift away from gas fired boilers. Consequently, conversations between FE colleges and local employers can begin to map supply and demand. It is imperative that this process begins now, working through to the 2030s:

With a big part of the work happening in the 2030's when do you want to start delivery, training and supporting and helping your staff to understand the shift that is coming because we already have got those people in the bag as it were.

The knowledge they have now or need now is probably going to be far greater in a year to two years, 5 years down the line and as technology improves.

Jobs, careers, and training pathways

The question of skills training needs to link to broader questions about job prospects and future careers in an industry which will continue to evolve over time. Appendix 2 provides an overview of career possibilities and progression. Clearly, it is important to bring colleges into the strategic discussion as large providers of initial and continued training. FE colleges are positioned so that they can have discussions with their local businesses. It was recognised that colleges and other vocational training providers hold a responsibility to teach this broader skills, knowledge and competencies, and in some circumstances, this has started to take place, for instance through a whole-college approach to sustainability education:

Vocational courses [should be] about more than just teaching people a set of tasks that they have to do, but [should] actually try and deepen their understanding, and make them enjoy the learning process. I think that's also important for future development of the workforce.

This means ensuring future knowledge and skills development is joined up across professions and craft trades.

Regulation

One key way for ensuring good jobs and clear training pathways is through regulation of occupations and license to practice (alluded to above) (Keep, 2005). Such licenses to practice in the UK could ensure that green skills are incorporated into it:

In the UK, you can just go onto a building site claiming to have the skills, you might evidence them through a dodgy CV. And you know, you're hired, because there's a shortage.

One trade association, the Federation of Master Builders (FMB),[2] is proactively developing strategy to aid occupational regulation. In turn, this can help improve quality in training and skill development:

The FMB are onto something here in their license to build. We suggested something several years ago that they should incorporate a low carbon training element into that. So that when you get your license you have some understanding about low carbon building. That affects that kind of culture change… I think that we need some sticks rather than carrots. Some carrot shaped sticks. We need to get contractors carded and force that change. People will adapt and, in a year, or two that will be completely normal for them to be building sustainably, I hope.

[2] The Federation of Master Builders (FMB), established in 1941, is the largest trade association in the UK construction industry representing the interests of small and medium-sized building companies and lobbying for members at both national and local levels: https://www.fmb.org.uk

Young people as agents of change

Young people entering the workforce in the next ten to fifteen years are key to any ambition of achieving net carbon zero. Promoting construction careers to young people will be an important aspect of this. Understanding the opportunity and career pathways within construction and emphasising those green credentials can inspire young people who aspire to be working in an environmentally conscious role but without good career advice and guidance, this becomes difficult:

> *A lot of young people don't choose to go into it. But what is on offer is not particularly interesting, either. And I think that's really, really hugely important. Not only do we need to make construction jobs interesting, but I think we really need to make construction, educational training for construction jobs, interesting too.*

> *I hadn't heard the term retrofit coordinator before today. And I bet there are lots of other people including school students and school careers advisors who don't know those terms either. So, I think part of what needs to happen is that we perhaps need to explain to school students, there are these options, there are these career paths and to promote those to schools as well.*

As well as ensuring schools' and teachers' knowledge and understanding is up to date about the construction industry, so that they can give well-informed advice to their students, another key stakeholder is parents:

> *Your first port of call is selling it to their parents, right, if you're not able to demonstrate to parents that there is a market need that, you know, their child is going to have a job at the end of this, it's going to be really hard to get buy in, I think, I think we're talking a bit of a chicken and egg situation here.*

In so far as we can argue for changes on the supply side, we need to also see young people as agents of change. It was discussed that in many ways we are already seeing a demand for change from the current generation of young people who are in education and initial training. This generation are more likely to be interested in employment that has a positive impact and to seek employers with green credentials. Equally they are expecting their E&T to provide them with a more comprehensive approach to sustainable knowledge and skills development:

> *We see a demanding generation entering the training and labour market. I think that is a bonus that we have and what I can see often is employers are reluctant to embrace that. [If] they get their heads on [they] will realize it's a win win.*

Conclusions

Through our analysis we and key stakeholders have identified a range of key challenges facing the construction skills formation system and the need to meet the diverse range of skills required for a greener economy. First and foremost is the inherent tension between skilling the workforce to meet net zero carbon targets, and the focus and emphasis on the responsibility of the individual (and by extension employers) to improve their human capital and train, and re/upskill for the perceived demands of the labour market.

Anderson, Rubio and Warhurst (2021) highlight how the translation of policy into practice is a continual, inherent problem due to the mismatch between what is happening in the labour market based on consumer demand with what the government would like to happen with green jobs and work. A good example is that illustrated in their work: Anderson et al's (ibid.) analysis shows that demand does exist and that, moreover, a good proportion of these green jobs are likely to be high skilled. However, as they argue, current levels of demand do not indicate a restructuring of the labour market towards green jobs. This raises the question asked by a number of our workshop participants regarding what kinds of green jobs, if any, will be needed in the medium- to low skilled jobs. Is it a case of replication of the scenario as illustrated by Jack and John, where extensive cross-over exists and it becomes nomenclature? That is, does a green job become green simply because it is deemed green?

If buildings are going to be an important part of the solution to climate change (as all the scenario-based studies suggest), then the reality of the industry's working practices need to reflect that in a broad, systemic way. As one participant stated:

> *The main measure, for me would be the outcome [...] and to enable an outcome to come about, you need a really [...] well educated workforce that doesn't just have technical skills, but also understands the wider context.*

A necessary challenge is to align the E&T system much more closely with a coherent industrial strategy whereby the government takes a prominent role in shaping and supporting the development of new markets in a clear and systematic way that will ensure long-term skills supply and gives assurances to firms that these skills are needed, valued, and will continue to be developed as technologies and new practices emerge. However, the reality is very far from this: high-profile policy failures in recent years (Green Deal and Green Homes Grant) have served to reduce confidence in government actions among employers, employees and consumers.

A joined-up policy approach is needed between E&T and industrial strategy if the construction sector is to be part of a future green economy. Ultimately, there is a tension between policy visions for the future: a narrow techno-economic view that available technologies will be installed at scale and work well with only small-scale investment to prime markets; and a broader view in which skills formation, industry practice and culture are key elements of successful technology deployment.

The key outcomes of this research are:

- **A broader conceptualisation of the skills required for a greener future:** our research has highlighted that a simple focus on only technical skills fails to capture the demands of complex building sites and the need for greener construction and business practices. Therefore, in relation to both initial training and CPD, education and training programmes should aim to work with the following framework:

- **An emphasis on CPD:** this analysis has highlighted the critical importance of ongoing professional development for everyone involved in the construction sector, particularly training undertaken in a meaningful and sustained manner that goes beyond simple 'bacon butty briefs'.
- **Training structures and incentives for SMEs, micro businesses, and self-employed contractors:** CPD means time away from site, which is challenging and costly and often hits smaller organisations hardest. There is therefore a need to provide meaningful incentives for CPD, potentially compensation, and to structure ongoing education and training at times that will fit around standard working days.
- **CPD for those involved in delivering training:** given the changing nature of the sector, it is essential that those involved in delivering training received adequate professional development to stay up to date in relation to technical developments, but are also able to support the development of broader employability skills and sustainability-oriented and CPD-oriented dispositions.
- **Stronger strategic partnership arrangements:** there is a clear need for greater strategic co-ordination between skills providers and industry with more effective working relationship between FE colleges and employers so that emerging skills needs can be responded to within the skills formation system in an agile manner and the pathways through initial training and CPD can be drastically simplified.
- **Greater regulation:** the construction industry in the UK and associated education and training pathways are relatively unregulated compared to other international skills systems. Closer regulation would both ensure skills demands are being appropriately met while also contributing to driving the changes in culture and practice required for a more sustainable future.

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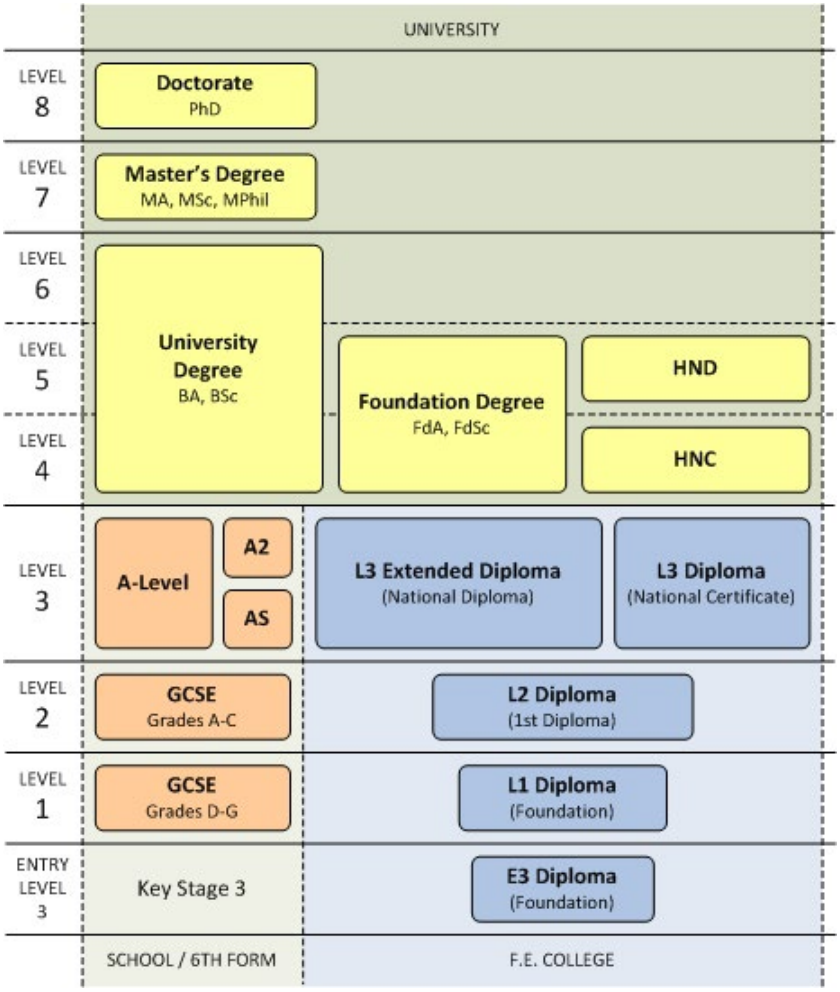
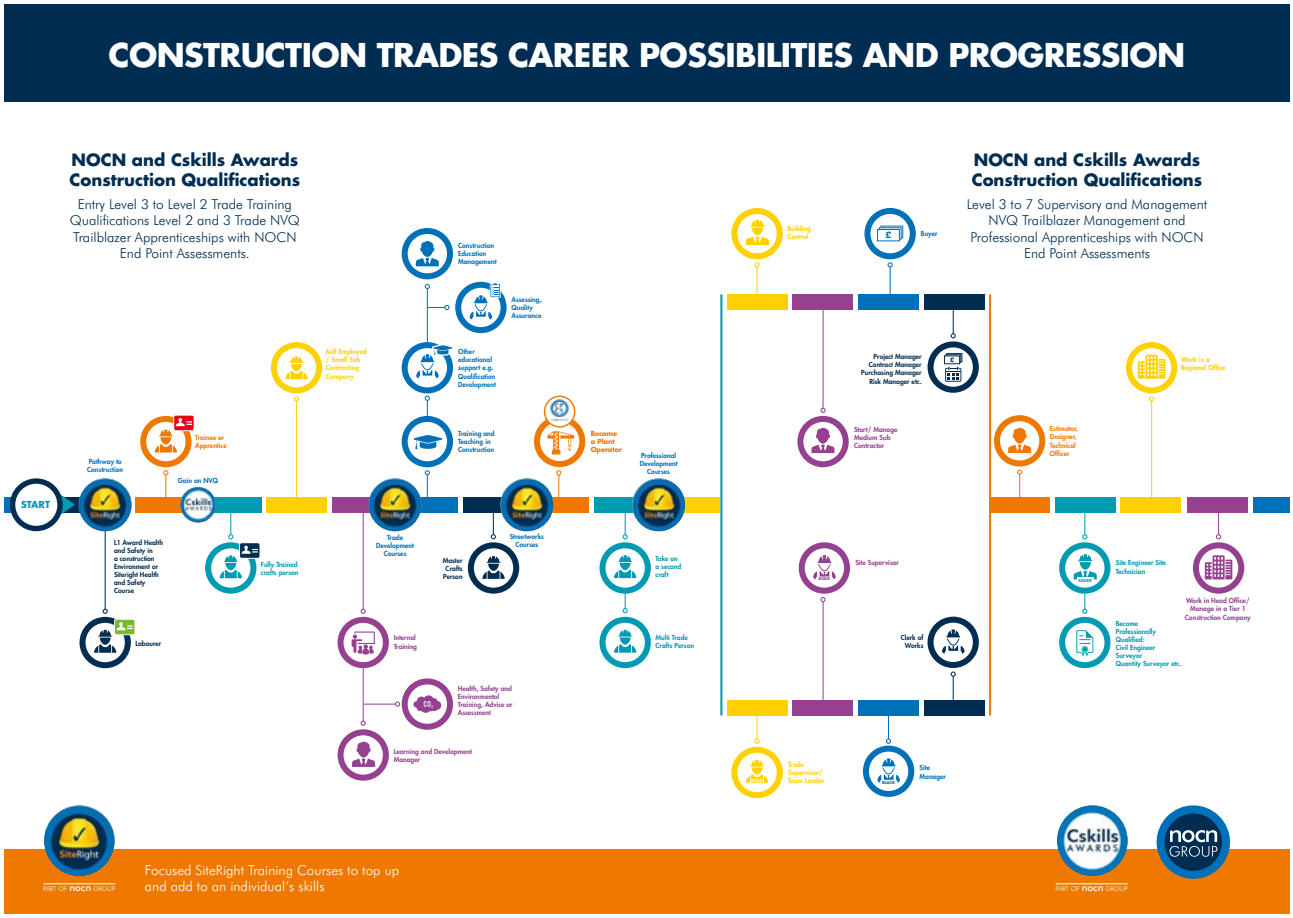
Appendices

Appendix 1 – Levels in the E&T system in UK



https://www.accreditedqualifications.org.uk/qualifications-and-credit-framework-qcf.html

Appendix 2 – Career progression routes through the Construction sector



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