# Building it Green: European Report

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**Abbreviations**

| | |
|---|---|
| BESA | Building Engineering Services Association |
| CAVC | Cardiff and Vale College |
| CEDEFOP | European Centre for the Development of Vocational Training |
| C&G | City and Guilds |
| CITB | Construction Industry Training Board |
| CME | Coordinated Market Economy |
| CVET | Continuing vocational education and training |
| ECA | Electrical Contractors Association |
| EPBD | Energy Performance of Buildings Directive |
| EU | European Union |
| FE | Further Education |
| FES | Foundation Energy Skills |
| GHG | Greenhouse gas |
| GJA | Greener Jobs Alliance |
| JIB | Joint Industry Board |
| IAA | Installation Assurance Authority |
| IfATE | Institute for Apprenticeship and Technical Education |
| IVET | Initial vocational education and training |
| LBC | Leeds College of Building |
| LEC | Low energy construction |
| LMC | Liberal Market Economy |
| MCS | Microgeneration Certification Scheme |
| NOS | National Occupational Standards |
| NZEB | Nearly zero energy building |
| OP | Occupational profile |
| SDG | Sustainable Development Goal |
| SDS | Skills Development Scotland |
| VET | Vocational Education and Training |
| WWETB | Waterford and Wexford Education Board |

# 1. The Context

## 1.l. Introduction

The European Team has been tasked with investigating the different approaches to incorporating climate and energy literacy into vocational education and training (VET) systems to inform the efforts of the Canadian Building Trade Unions (CBTU) to update the building curricula. To this end, the European team identified and analysed examples of VET for trainees and apprentices, as well as for workers already in the industry, drawn from six European countries: Belgium, Denmark, Germany, Ireland, Sweden and the UK. This report presents our findings.

In Europe, the development of VET for low energy construction (LEC) is largely driven by the Energy Performance of the Building Directive (EPBD) (EC, 2021a/2018a/2012a), which requires that all buildings from 31 December 2020 are nearly zero energy buildings (NZEB). The European Union (EU) Member States are required to transpose the directive into national legislation and develop policies and initiatives to facilitate implementation. It is recognised that equipping the building workforce with the appropriate expertise is essential for meeting the energy performance targets stipulated. NZEB, and LEC more generally, is fundamentally different from traditional construction, having to meet specific energy performance targets through airtight building envelopes, thermal-bridge free construction and on-site renewable energy sources. The building is conceived as a system whose parts must fit together precisely so as not to jeopardise the level of energy efficiency intended. Research shows that meeting these standards depends on expertise that is different from that developed for traditional construction VET; it calls for deeper theoretical knowledge and understanding such as building physics, higher technical skills, including understanding of thermal bridging, and a broader education and qualification profile, including competences such as inter-disciplinary understanding, project management and problem-solving (Clarke et al, 2019a). There are also implications for the labour process; overcoming the divisions between different occupations, greater teamworking and communication are essential, and these require a more co-ordinated and collaborative production process.

In 2011, the EU launched the Build UP skills initiative with the aim of supporting the development of NZEB competencies (EC, 2014). This, and follow-up evaluations of VET for LEC examples (Clarke et al., 2019ab), show that approaches to preparing the construction workforce for the transition to LEC vary hugely, ranging from long-term efforts to mainstream climate and energy literacy within initial VET programmes to selective enhancement of education in higher-level VET through add-on modules for more technical occupations. For the existing workforce, training often consists of short, specific courses relying on demonstration on-site by a range of providers including employers and manufacturers of renewable energy systems or other 'green' materials and products. The extent to which the knowledge, skills and competences required for LEC are addressed also vary, ranging from comprehensive coverage of all three dimensions of the expertise (i.e. knowledge, technical skills, and transversal abilities and competences) to those limited to developing technical and specific skills, neglecting the broader knowledge and occupational competencies underpinning and enhancing trainees' capacity to play an active role in the implementation of LEC requirements (EC, 2014; Clarke et al, 2019ab). These different approaches to climate and energy literacy in construction VET are shaped by the VET system in place, including governance arrangements and the role of different stakeholders, such as unions, employer representatives, government agencies, and VET providers, and the VET model itself, particularly the approach to VET and whether it aims for broad occupational development or narrow skills training for specific tasks.

In turn, the VET system is a product of broader historical patterns and relations of economic and political governance at the national level, with associated differences in construction sector and labour market structures and regulation. In analysing the individual case studies and making sense of their differences, we draw on Hall and Soskice' s (2001) Varieties of Capitalism (VoC) distinction between liberal and coordinated market economies (LMEs and CMEs). According to Hall and Soskice (2001), CMEs such as Germany are characterised by the presence of strong formal institutions and high levels of social partnership in the governance of the economy and VET system. By contrast, in LMEs, associated with Anglo-Saxon countries, governance is through market mechanisms marginalising stakeholders such as employers and unions.

This Varieties of Capitalism model provides a framework for understanding examples of climate and energy literacy development for construction in countries with distinctive political and economic systems and associated differences in construction sector and labour market structures. Studies of the institutional and conceptual contrasts between national VET systems also show that national political and economic systems are broadly associated with particular approaches to VET (Clarke et al, 2020a). At one end is the 'occupational' approach, resting on a statutory framework, social partnership, recognised qualifications, comprehensive, broad, and recognised VET programmes, multi-dimensional competence, occupational capacity and knowledge, general and civic education, permeability, and educational standards related to curriculum content. At the other, is a 'skill-based' approach, resting on weak statutory framework and stakeholder involvement and characterised as employer-based, with poor labour market currency, fragmented narrow skill sets, a functionalist-behaviourist conception of competence built on task descriptors, minimal underpinning knowledge, lack of permeability, and learning outcomes as performance criteria related to defined workplace tasks.

In our search for examples to benchmark against curricula for the Canadian building trades, we sought to provide case studies representing these different approaches, with a view to identifying the constellation of factors that result in good practice, whether these be examples of VET systems, qualifications, or curricula where climate and energy literacy has been successfully integrated. Our cases are therefore best conceived on a spectrum, from the occupational approaches of CMEs, whether heavily dependent on the state and educational institutions or more reliant on social partnership, to the skill-based approaches of LMEs, whether involving employers and unions or entirely employer-based. In our study, Belgium, Denmark, Germany, and Sweden represent CMEs in terms of the overall political-economic framework, but with some national variation in the role of stakeholders in the VET system, and the VET model in place. Ireland and UK represent LMEs and are largely similar in terms of the political economic framework, but with differences in terms of the VET model. Ireland, however, has begun to diverge from the UK particularly in its approach to climate and energy literacy in construction, supported by its involvement, as a member of the EU, in European-wide initiatives and the greater role assumed by the Irish government in driving the net-zero agenda.

## 1.2.Different European labour markets

Besides differences in the approach to VET, each country also has different characteristics with respect to the structure of the construction industry and its labour market. In terms of the size of firms, for instance, there are significant differences, an aspect that is critical to the success of any work-based element in the VET programme. Where the industry is composed of a myriad of small firms, for instance, as shown in Table 1 for Ireland, with 81% employed in small firms, the training infrastructure tends to be weak, as it can be difficult for trainees to cover a range of activities and for firms to have the capacity to ensure and monitor work experience. As can be seen in Table 1, the proportion of those employed in small firms is also lower in the Scandinavian countries than in Belgium and Germany, at 73% and 76% respectively (Eurostat, 2019). Were UK included in this series, it would be similar to Ireland.

The overall construction workforce in the EU is 22m, whilst those of each of the countries considered are of very varying sizes, with Germany (3m) and UK (2.2m) having the largest, followed by Belgium (500,000) and Sweden (465,000), and then the much smaller countries of Denmark (168,000) and Ireland (128,000). Of those employed in construction each country, an increasing number are self-employed, with Britain having the largest number of self-employed (727,000), whilst in Ireland 37% of the workforce is self-employed, in Belgium 25%, Sweden 17%, and in Germany only 11% (Clarke et al. 2019b).

**Table 1: Employment in construction by size of firm**

| Size of firm | Belgium | Denmark | Germany | Ireland | Sweden |
|---|---|---|---|---|---|
| Small | 73.4% | 65.4% | 75.7% | 80.9% | 59.4% |
| Medium | 12.8/% | 20.4% | 13.8% | 11.2% | 16.6% |
| large | 13.9% | 14.3% | 10.5% | 9.2% | 24.0% |

***Source:*** Eurostat (2019) *Number of persons employed by enterprise size class: Construction of Buildings*

Another difference between the countries is the overall unionisation rate, which in 2019 was highest in Sweden (68%) and Denmark (67%), followed by Belgium (50%), Ireland (26%), UK (25%), and lowest of all Germany (16.3%) (ILO, 2022). These rates compare with Canada (30%) and US (11%).

## 1.3. European Union (EU) low energy construction (LEC) policies

EU policy on climate change extends back several decades, from the Treaty of Maastricht of 1993 and the Treaty of Amsterdam of 1999, in between which the EU ratified the 1997 Kyoto Protocol and established specific targets and timelines for reducing GHG emissions and energy use (Rietig, 2013). Following these, climate targets became more ambitious, emphasising three key areas: reducing CO2 emissions, increasing the role of renewable energy, and promoting energy efficiency (Amundsen and Sorensen, 2009). In 2007 the 20-20-20 policy objective of reducing energy use by 20% was established, curtailing GHG emissions by 20% and expanding the use of renewable energy by 20% by 2020. At the same time, the Intelligent Energy Europe Programme (IEEP) to promote energy efficiency was also introduced, running until 2013. In 2008 the Climate Action and Renewable Energy Package was passed, including specific targets and timelines for energy efficiency gains, followed by the Sustainable Industrial Policy Action Plan (Bohringer, 2014; European Parliament 2019). The next year, 2009, the Renewable Energy Directive (RED) was enacted, followed in 2010 by the highly significant Energy Performance of Buildings Directive (EPBD), requiring member states to develop plans to reduce building energy use based on explicit targets and a clear timetable (ZCH, 2011; European Parliament, 2010).

The EPBD was designed to address the fact that the building sector accounted for approximately 40% of energy use and 36% of greenhouse gas (GHG) emissions in the EU. It established minimum energy performance requirements for new and renovated buildings and a methodology for calculating energy consumption of buildings, promoting zero carbon technologies, performance standards for HVAC (heating, ventilation, and air conditioning systems) and energy performance certificates to give building owners, tenants, and purchasers basic data about the energy consumption of different building components. Member states were required to train energy auditors and establish inspection systems with penalties for non-compliance with the new standards (ZCH, 2011). The EPBD recognized that the competency of the workforce was critical to implementing the EU's ambitious climate goals in the building sector, estimating that only 1.1 million workers were fully qualified to implement LEC, though the projected need was for 2.5 million by 2015 (EC, 2016). In 2012, another key piece of climate legislation complementing the EPBD was passed, the Energy Efficiency Directive, covering the entire economy including energy production (EC, 2012a). In 2018. the EPBD was revised, requiring that all new buildings be NZEB from 2020, and a further revision took place in 2021 (EC, 2018a). Its policy prescriptions are supported by, amongst other initiatives, the 2019 European Green Deal, calling for a set of 'deeply transformative policies' and stipulating that 40% of energy used be from renewable sources, and the 2020 Renovation Wave Strategy (EC, 2019a, 2020a).

The EU's increasingly ambitious climate policy and energy reduction targets, aiming to achieve net zero by 2050 and reduce emissions by 55% by 2030, were given statutory authority in the 2021 European Climate Law and align with the UN's 2030 Agenda and SDGs. Most recently, the European Commission (EC) recommended further revisions to the Renewable Energy Directive, with a target that 49% of building energy use be from renewables, accomplished by increasing the renewable share by 1.1% per year overall and 2.1% per year in district heating systems. It also recommends that the Energy Efficiency Directive require member states to commit to renovate 3% and reduce energy consumption by 1.7% annually in public buildings. Finally, the *Fit for 55* programme encompasses a broad range of initiatives including a revised target of all new buildings zero carbon by 2030 and all buildings zero carbon by 2050, involving substantial EPBD revision (EC, 2021b; EU, 2021).

In framing these objectives, the EU explicitly advocates that they address the needs of under-represented and vulnerable groups, both through initiatives to lower the carbon footprint of the construction sector and for a more representative construction workforce. For instance, proposed 2021 EPBD revisions require:

> The plans will present an overview of national policies and measures empowering and protecting vulnerable households, alleviating energy poverty and ensuring housing affordability…coherent with policy and measures across EU instruments supporting a socially just transition (EC, 2021a: 3).

In terms of implementation, however, whilst many member states, particularly Scandinavian, have initiated even more ambitious policies, with others this has been weak (Clarke et al 2019b).

### 1.4. EU VET for LEC policies and programmes

#### *1.4.1. Build Up Skills programme*

In conjunction with the enactment of the EPBD in 2010 and as part of the Intelligent Energy Europe Programme (IEEP 2007 – 2013), the EU embarked on Pillar 1 of the Build Up Skills programme (2011 - 2013), aiming to improve capacity to train the existing construction workforce for LEC. This was followed by Pillar 2 (2014-2016) and subsequently expanded under the Horizon 2020 programme and, more recently, the LIFE Clean Energy Transition programme to consolidate and expand lessons learned from the initiative. The initiative began in 2011 with an analysis of the existing qualifications of the construction workforce, identifying the changes needed in the construction VET and qualification systems of 30 countries (28 EU members plus Norway and Macedonia) (EC, 2019b; BUS, 2015, 2016).[1] Each state developed a National Qualification Platform, documenting and analysing its existing workforce VET system and identifying barriers to overcome to achieve the EU's climate goals. National Status Quo Reports were then produced, containing proposals to address shortcomings, leading to National Roadmaps with pathways for designing VET programmes needed (EC, 2018b). With BUS Pillar II, the EU funded 22 specific and very varied projects[2], including the Irish Qualibuild (EC, 2017) programme (see below), focused on designing and implementing qualification and VET programmes for current construction instructors and the existing workforce.

The objectives of the European Green Deal have also been embedded into other EU programmes relating to VET, including through the work of the European Centre for the Development of Vocational Training (CEDEFOP). CEDEFOP (2018, 2022ab) has incorporated climate issues into many of its efforts to strengthen the VET systems of EU member states and has established a Green Observatory to bring together data on skills development, including labour market projections, skills' needs forecasts and analysis of training gaps for member EU states to address. In addition, the EC has set out a detailed legislative plan, *On Learning for Environmental Sustainability*, for adoption by the European Parliament to strengthen the sustainability capacity of member states' VET systems, outlining a set of recommendations for accelerating the process and incorporating environmental sustainability into all aspects of member states' VET programmes:

> Achieving this requires a lifelong learning approach to learning for environmental sustainability with hands-on, engaging and action-based ways of learning which foster: (i) knowledge, understanding and critical thinking (cognitive learning); (ii) practical skills development (applied learning); and (iii) empathy, solidarity and caring for nature (socioemotional learning). Interdisciplinary approaches are needed to help learners understand the inter-connectedness of economic, social, and natural systems. (EC, 2022: 1)

This involves adopting and monitoring specific targets and emphasizes learner centred pedagogies, new supports for educators and trainers, and major investments in developing appropriate curricula to achieve 'deep and transformative change'.

## 2. Methodology – approach, data collection and analysis

The investigation adopted a case study approach and was guided by previous research on VET for LEC, including the transparency framework for NZEB qualifications developed in the VET4LEC project (Table 2) (e.g. Clarke et al, 2019a,b). We sought to apply this framework to the cases studied to identify elements and omissions most relevant to LEC and included in different qualification profiles. The cases are selected on a range to represent different VET systems and approaches to climate and energy literacy, from those of CME

[1] See https://www.buildup.eu/en/skills/about-build-skills.
[2] https://www.buildup.eu/ro/skills/bus-projects

countries, including education-based (Sweden), social partner-based (Denmark and Belgium) and dual systems (Germany), to the employer-based approaches of LME countries (Ireland and UK). We conducted 20 individual interviews, 18 via zoom and 2 face to face, plus visits to Wales and Ireland, involving 3 group discussions, in Cardiff, Waterford and Enniscorthy. In Wales the group discussions included 9 interviewees, in Waterford 5 and in Enniscorthy 3. A virtual group discussion with representatives from Denmark included 3 interviewees. Given the extensive number of interviews in Britain, that part of the report is very much more detailed and insightful. All in all, discussions have taken place with 40 different individuals:

**For the UK generally**

1. The Energy and Emerging Technologies Advisor, Electrical Contractors Association (virtual)
2. National Apprenticeship Skills Officer, Unite the Union (virtual)
3. Industry Insight Manager, Construction Industry Training Board (virtual)
4. Director of Training and Skills, Building Engineering Services Association (virtual)
5. CEO, Installation Assurance Authority (IAA)

*For England:*

6. Deputy Principal, West London College (virtual)
7. Principal, Leeds College of Building (virtual)

*For Wales*

8. SERO Homes CEO (face to face)
9. Group discussion at Cardiff and Vale College (CAVC) with:
    i. Chief Regional Officer, Department for Economy, Skills & Natural Resources
    ii. Future Generation Wales representative
    iii. CAVC Deputy Principal
    iv. CAVC Director of External Funding
    v. CAVC Dean of Technology and Creative Industries
    vi. CAVC Associate Dean of Technology and Building Services
    vii. 3 CAVC trainers

*For Scotland*

10. Construction Lead Scotland
11. Unite Scotland

**For Ireland**

12. Group discussion at Waterford NZEB Centre with:
    i. Area Manager (JC), Waterford and Wexford Education Board (WWETB)
    ii. WWETB Innovation and Development Manager
    iii. WWETB Quality Assurance Manager
    iv. WWETB Plastering Tutor
    v. Limerick Institute of Technology project worker (EO)
13. Discussion at Enniscorthy NZEB training centre with:
    i. NZEB Trainer, MosArt Training Academy
    ii. Passivhaus builder (MB)
    iii. WWETB Innovation and Development Manager
14. Interview with Irish construction union (SIPTU) officer (face to face)
15. Interview with Irish construction union (BATU) officer (virtual)

**For Sweden**

16. Senior Policy Advisor, The Swedish Installation Federation (virtual)
17. Education Coordinator, The Swedish Construction Federation (virtual)
18. Headteacher, REFIS free school for plumbing education (virtual)
19. Headteacher, Insu free school for electrical education (virtual)
20. Politician, former State Secretary in Ministry of Education (virtual)
21. Swedish union expert

**For Denmark**

22. General Secretary of BAT Kartallett (virtual)
23. Group interview with the Danish Union of Electricians /Dans El-Forbund (virtual)
    i. General Secretary of Dansk El-Forbund
    ii. ii. Technical Consultant for Dansk El-Forbund
24. iii. Consultant advising on climate change strategy

**Table 2. Outline of a Transparency Framework for nZEB Qualifications**

<table>
<tr><th colspan="6">Aims of qualification</th></tr>
<tr><th colspan="2">vocational</th><th>civic</th><th colspan="3">Liberal</th></tr>
<tr><td colspan="2">Yes</td><td>Includes critical appreciation of construction industry and nZEB barriers</td><td colspan="3">Yes, allows scope for continuing personal development</td></tr>
<tr><th colspan="6">Attributes</th></tr>
<tr><th colspan="2">knowledge</th><th>know-how<br>Each characteristic presupposes possession of one above (apart from skill)</th><th colspan="3">personal characteristics<br>(sometimes known as Competence or Attitude).</th></tr>
<tr><td colspan="2"></td><td>Mastery of technique</td><td colspan="3"></td></tr>
<tr><td>Systematic<br>Climate and Energy literacy, including the sources of climate change and possible counter measures, awareness of energy sources and expenditure.<br><br>Although technical knowledge – knowing why certain activities are undertaken, it also has a significant civic dimension.</td><td>non-systematic</td><td>Skill: specific abilities connected with installation and evaluation of nZEB technologies, including development of appropriate tacit knowledge.<br>e.g. Waste management<br>protecting environment and oneself and colleagues from harmful materials and substances;<br>organising sorting methods through trays and containers;<br>sorting disposables;<br>identifying and separating from other disposables asbestos and other dangerous materials<br>packing and removing them in secure manner</td><td colspan="2">individual<br>Curiosity<br>Independence<br>Self-evaluation<br>e.g.<br>to possess a sense of initiative, to tackle problems as they arise by oneself, without any request to do so.<br>To possess a critical and analytical frame of mind.</td><td colspan="2">social<br>Co-operation, ability to see different points of view<br>e.g.<br>to exchange information with colleagues and clients in friendly and constructive manner.<br>To have courage to accept remarks of colleagues relating to work and security and to take responsibility for pointing out dangerous situations.<br>To assist colleagues so that team can work ergonomically.</td></tr>
<tr><td>Technical theory, including some physics and engineering, knowledge of climate change theory.<br>e.g.: Principles of 'quality' building: airtightness and insulation<br>thermal bridging, moisture and ventilation, significance of window quality and positioning.</td><td>Contingent facts (e.g. local conditions)<br><br>To be acquainted with site layout, areas of potential danger, drainage channels.</td><td>Transversal abilities<br>Co-ordination<br>Communication<br>Evaluation<br>Negotiation<br>e.g.<br>Designing repair to moisture damaged structures.<br>Supervising wet room installations.<br>Controlling circulation onto and on site.<br>Reacting to diverse situations<br>Analysing state of site, diagnosing problems and solutions</td><td>Work-place<br>Yes</td><td>Other Locations<br>Yes, including simulations and classroom</td><td>Work-place<br>Yes</td><td>Other Locations<br>Yes, including simulations and classroom</td></tr>
<tr><td>Normative theory<br>Health and safety legislation. EPBD.<br>Legislation governing nZEB and barriers to making it effective</td><td>Local procedures<br>e.g. site procedures for disposal of waste.</td><td>Process management ability<br>Understanding of nZEB building process</td><td colspan="4">At least one of these will be involved in know-how above a threshold level</td></tr>
<tr><td>Social science theory<br>Understanding nZEB role in contemporary debates and constraints on its introduction.</td><td>Materials<br>Insulation</td><td>Occupational capacity<br>Displaying conduct, way of thinking and behaviour necessary to practise occupation.</td><td colspan="4"></td></tr>
</table>

*Source:* Elaboration of Transparency Tool (Brockmann et al 2010) applied to NZEB

**For Belgium**
21. Representative from *Constructiv*, social partner organisation for construction
Interviews and group discussions were recorded, and notes taken to compare with the zoom transcripts obtained.

In the following, we present country-specific cases, not with the aim of directly comparing, but with a view to illustrating the different approaches identified in each country. Each case encapsulates and reflects the main characteristics of the respective construction VET system, the approach to embedding climate and energy literacy, and the stakeholders involved. In analysing the cases, we have sought to identify the roles of different stakeholders, including unions, employers and employers' organisations, education and training organisations, local authorities, and governments, and their association with particular approaches. These roles are at the same time indicative of the importance attached to knowledge, skills or know-know, and attitudes or competences in the curricula, and of the extent to which VET is, at one extreme, education-based and, at the other, purely employer-based.

Specifically, for each case, we focus on certain occupations and evaluate:
- how climate and energy literacy has been incorporated into curricula
- whether and how occupational interfaces are addressed, and interdisciplinary learning facilitated
- the extent to which curricula seek to develop competences such as communication, team-working and self-management
- the challenges and barriers to developing and delivering climate literate curricula
- the role of stakeholders, including unions, employers, colleges, municipalities, and government and the ways in which they collaborate in developing and delivering effective VET in zero carbon construction

Based on this evaluation, we develop a framework that illustrates the relationship between:
a) different stakeholders; b) the approach to VET and in particular the understanding/ definition of climate literacy; and c) how climate and energy literacy is embedded in curricula.

# 3. Sweden: Case Study

## 3.1. Introduction

The Swedish Climate Policy Framework commits to the Paris Agreement with the objective of reaching net zero emissions by 2045. The latest report on progress by the Swedish Climate Policy Council calls for the acceleration of the transition with emphasis on strengthening policy instruments and investing in education to boost the knowledge base across all sectors and levels of society (Swedish Climate Policy Council, 2022).

In Sweden, the building stock accounts for 30% of energy consumption, which the government is aiming to cut by 50% by 2050. The EPBD (EC 2021a/2018a/2012a), which requires that all new buildings from 31 December 2020 are NZEB, was introduced into the Swedish Building Regulations in 2016. Although most elements were already in place in 2014, these were further tightened and specified in subsequent revisions, also addressing conditions in different geographical regions (EC, 2021c). The Building Regulations (BBR) of the regulatory body, National Board of Housing, Building and Planning (*Boverket*), which sets out mandatory energy performance requirements, address the building envelope and the energy system, with compliance verified by measuring the actual energy used in the finished building. Awareness of the performance gap is stated to be high and on-site inspections during construction aim to enforce BBR standards, with Energy Performance Certificates issued by certified energy experts (ECSO, 2021a; EC, 2021c). In existing buildings, the requirements are enforced when buildings are altered, regardless of the scale of alteration, with the altered part required to meet the new regulations. Several policy instruments are in place to incentivise energy efficiency in renovations, both in the residential and the industrial sector. The renovation of the existing building stock is the subject of Sweden's third Long-Term Renovation Strategy, which sets out a road map and targets for each decade up to 2050 (EC, 2021c).

The gross value added of the narrow construction industry is around 6%. The broad construction sector[3] employs 718,148 persons, of which 465,081 (nearly 65% of the total) are found in the narrow construction sector. Numbers employed in the narrow construction sector have gone up by over 40% in the last 10 years, with the great majority of the increase to be found among technicians, and associate professional occupations. In the same period, demand for elementary occupations declined by 80%. Among the workforce, 16.8% are self-employed. An upward trend in part-time employment has also been noted. (ECSO, 2021a).

There is a labour shortage, which increased by over 50% in the last ten years, argued to be also related to housing shortages preventing job mobility. For example, according to the Swedish Installation Association, there are at least 10,000 vacancies in plumbing and electrics. Attempts are made to facilitate the entry of migrants into the labour market. Some occupations, such as scaffolders and carpenters, can go on site without a formal qualification. For electricians, a competence test establishes skills and experience, with validation taking three days and paid for by an employer, unless individuals want to speed up the process and pay for it themselves. In response to the Syrian crisis, this was successfully implemented on a national scale; according to one of our participants involved in this implementation, a migrant with upper secondary education and around 10 years of experience easily passes, gaining the licence to work as a qualified construction worker.

As in all EU countries, construction in Sweden is a male dominated industry. In vocational schools too, there are few girls; they are more likely to enter if there is a family connection to the industry.

> It is a conservative industry, slow to change, finding itself in a fast-moving environment. (Headteacher of a free school)

The current workforce is also ageing:

> A lot of plumbers are old men who cannot cope with their phone. They rely on young apprentices for anything to do with technology. (Headteacher of a free school)

Education levels among construction workers are high, and there is also a strong culture of participation in adult continuing education, which, at 18.1 % of the broad construction workforce, is considerably higher than the EU average of 7.4%. This is further boosted by continuing investment in adult learning, including the availability of study loans and grants supporting work-based placements (ECSO, 2021a).

In the broad construction sector, there are 187,694 enterprises, with 87% of construction companies having less than 4 employees (ECSO, 2021a). Nine out of 10 employees are covered by collective agreements and the unionisation rate in the industry in 2022 is around 58-60%, having declined from 81% in 2006 (Swedish Construction Federation, 2022; Kjellberg and Nergaard, 2022).

## 3.2. The VET system and the role of stakeholders

In Sweden, VET starts after the completion of compulsory schooling at the age of 16. VET programmes include upper secondary, post-secondary and tertiary levels. Upper secondary VET for construction is provided by municipalities, county councils, the state and private training providers and is school/college-based, over three years, with up to 15% of the time spent in a work placement. As well as covering vocational content, schools follow the general secondary education curriculum, including the Swedish language, mathematics, history, and social studies. Students choose their specialization in the second year, and in the third year spend more of their time learning about their vocation. Short work-placements completed during this 3-year period are intended to provide opportunities for familiarisation with different occupations. The course leads to an upper secondary vocational diploma at EQF Level 4, the holders of which can access jobs at the lowest level of the occupation. Post-secondary VET programmes are then one-two years, with at least 25% of the time spent learning in a workplace, leading to a diploma or higher diploma in higher VET at EQF levels 5 or 6 (CEDEFOP, 2019).

VET is provided by different schools including public secondary schools and free schools. Free schools are set up by private individuals or organisations. Employer organisations, sometimes with the involvement of unions, also set up free schools to provide training for their members as well as secondary school age pupils.

[3] The broad construction sector includes manufacturing, real estate, architectural and engineering services, and building construction activities.

These schools are, effectively, set up as private companies, although not-for-profit, and receive public funding per student (CEDEFOP, 2019). According to our interviewees, there has been a rise in the number of such colleges set up by the industry together with unions as a reaction to the top-down imposition of the curriculum. Interviewees argued that recent changes in building construction, such as digitalisation and energy efficiency legislation, require rapid changes that the curriculum development process is slow to respond to.

For the current construction workforce and adult entrants, there are many options available, including adult education courses by municipalities, folk high schools, private training providers, manufacturers of renewable energy systems and employer associations. Participation in adult education is the highest in Europe, with access to continuing education secured by collective agreements. Adult entry into some construction occupations - and therefore demand for VET at this level - is also high. For example, in the plumbing and electrical occupations, adults make up 30% of new qualifiers, and the Swedish Installation Association has its own training centres, training new entrants as well as delivering short courses for existing members (CEDEFOP, 2019).

Education is funded by the state up to the end of upper secondary diploma, after which funding is by a combination of government grants and employer contributions; apprentices post-19 also receive an apprentice salary. There is a tension between the state and the social partners dating back to an agreement made in 1938, whereby the construction industry wanted to pay lower taxes and take responsibility for VET. For all other industries, social partners agreed to share the costs of VET, with the state and companies contributing through higher taxes. In practice, construction companies ended up paying tax at the same level as other companies, plus taking responsibility for workplace-based post-secondary VET. The government has the overall responsibility, through the Ministry of Education and Research and the Swedish National Agency for Education (*Skolverket*), setting the policy framework, goals and learning outcomes. Social partners are members of the national programme council for each vocational programme and support *Skolverkert* in the development and upgrading of vocational education (CEDEFOP, 2019). Since the 2011 reform of VET, social partners have more influence, but still play an advisory role, argued by our interviewees to be very limited.

## 3.3.Approaches to incorporating climate and energy literacy in construction VET

Sweden, along with other Scandinavian countries, has a long history of energy efficient building, insulation, being common practice since the 1970s. The VET curriculum was the subject of a major reform in 2010-2012, when the Swedish National Education Agency issued guidelines relating to energy efficiency, and sustainability more generally. The national curriculum for vocational secondary schools provides general guidelines that inform the development of occupation-specific course specifications. The guidelines are used by schools to develop curriculum and syllabi.

## 3.4. Climate and energy literacy in the curriculum

The curricula for the 3-year secondary VET Building and Construction Programme, equivalent to European Qualifications Framework (EQF) Level 4, is designed to ensure that students develop more general competencies as well as construction-specific training. The National Agency for Education guidelines state that teaching in the subject of Building and Construction should give students the opportunities to develop the following:

1. The ability to search for information and plan, organise and carry out common tasks.
2. Knowledge of different methods, materials, tools and machines.
3. Knowledge of laws and other regulations in the professional area.
4. The ability to carry out risk assessments of tasks.
5. Skills in following task descriptions and using drawings.
6. The ability to handle and maintain materials, tools and machines.
7. The ability to work safely with regard to health, the working environment and ergonomics.
8. The ability to assess work processes and results and document their work.
9. Knowledge of common professions and work processes in the building and construction industry, and what sustainable development means in the industry.

10. The ability to cooperate and communicate with others and use professional language appropriately.

Interviewees emphasised that students on the vocational path learn about climate change as part of their general education, as they study social and global issues and science. As this is mandatory, all those completing a secondary vocational programme would be expected to have developed some knowledge and understanding of climate change. Direct reference to sustainability suggests that building construction is re-envisaged in relation to the transition to a green built environment, and the requirements of green buildings would be expected to be reflected in the education and training of construction workers. However, both the employer federation and the training providers call for enhanced climate literacy in the curriculum to include more theoretical understanding of climate change and its relationship to building construction. After the first three years, much of the occupation-specific learning is practical, not theoretical. A common refrain is that the guidelines are too general. For example, although the guidelines refer to waste management, what this means and involves for different occupations is not spelt out. For electricians, learning is focused on energy efficient installations and largely practical, with strong emphasis on the requirements of building regulations.

#### *3.4.1. The example of plumbing VET*

Plumbing is part of the Heating, Ventilation and Plumbing Industry. The VET programme is agreed between the Plumbing Employer Association *Instalatörsföretagen* (IN.SE) and the Plumbing Union, which is part of the Swedish Building Workers union, *Byggnads*. Plumbing education is then co-ordinated by VVSYN, the joint Swedish Plumbing Industry Training Board[4].

The theoretical/knowledge that the apprentices are expected to have acquired by the end of their course makes no reference to climate change or energy efficiency. Most of the theoretical content is technical and relates to plumbing system structures, heating technology, sanitary engineering, soldering, plumbing welding, adjustment techniques and tool and material handling. Further knowledge includes:

- Knowledge of the various stages of the construction process from planning to management, as well as concepts and definitions in various contracts;
- Knowledge of how social contacts, collaboration and personal development affect people's health and ability to work, how the physical and psychological work environment and work organisation are important for individuals, companies, and society;
- Basic knowledge of fire and fire-fighting;
- Knowledge of laws and regulations on work environment and safety;
- Knowledge of applicable building legislation, standards, consumer laws, regulations, and industry rules;
- Knowledge of various quality and environmental assurance systems.

Interviewees stated that plumbing students are also familiarised with the principles of renewable energy sources, such as heat pumps as well as retrofitting.

### 3.5. Barriers to embedding climate and energy literacy into the curriculum

Interviewees highlighted the differences between regions and the cost of opening and maintaining schools in small municipalities. Recruitment of students on to VET programmes is also reported to be extremely challenging.

#### *3.5.1. Challenges of implementing energy efficiency standards*

There are insufficient data on how well the sector is doing in terms of reducing emissions. Buildings are not tested by an external authority upon completion, but only by the contractor in the process of building. The assumption is that the architect and the engineer calculated correctly to meet the standards. Public procurement was proposed as a way of driving up standards and demand for enhanced VET, but most public authorities are short of funds and seek to achieve results at the lowest cost possible. The Construction Federation also noted that enhanced energy efficiency competence in the workforce is not incentivised, as further training does not necessarily attract a premium in the labour market, and neither is having qualifications a requirement to work in the construction sector, except for electricians. Energy efficient

[4] Further information about plumbing education is available at: https://vvsyn.se/ https://vvsyn.se/

installations, such as heat pumps and solar panels, are expensive for most people, which means that there is not much demand for electricians or plumbers trained in such. Whilst comprehensive climate as well as energy literacy for all construction workers is essential, it also needs to be recognised that their role is limited to implementation. Decisions regarding energy efficiency are made by architects and engineers on behalf of contractors. There is no incentive to train as higher competence is not rewarded:

> Wages increase by experience, then workers reach a certain level and that's it until you retire. (Representative of employers' association)

#### *3.5.2. Challenges of embedding and delivering climate and energy literacy*

It takes too long to review and update curriculum and even longer to change qualifications. Similarly, it was claimed that 'we are in a very dynamic movement, and schools are not that flexible'. Vocational schools are not inspected like other schools and inspectors lack the competence to evaluate them. The result can be out of date content and approaches and lack of motivation to improve. The training of teachers is also a problem. Teacher training focuses on pedagogical issues, not technical or trade-specific competencies, which means that teachers rely on their own experience in class, not formal education. Following Sweden's participation in the EU Build Up Skills initiative, with the funds awarded for developing NZEB pilots, the Swedish Construction Federation, together with social partner-led training boards, developed a training in which a third of VET teachers (of 1500 teachers) participated (Douhan and Tullstedt, 2013). The training was only 3-4 days long and not particularly comprehensive and the training of the remaining two-thirds, as well as the continuing education of all teachers, are identified as major barriers. Teachers may get invited to presentations about new products, but this is not enough as this type of work is mostly learnt by installing:

> We have one modern heat pump. I'm not sure if our teachers know how to handle it. (Head teacher of a free school)

It was argued by interviewees that it is very difficult to keep up with the pace of innovation. New technology is expensive to instal in VET schools and new systems and products are coming out all the time. It is difficult to know what the students will handle, even in the near future. For example, there is not one type of heat pump and a set of instructions all teachers can follow and pass on. When it is not clear what the demand for new technology is, it makes little sense to spend money on it.

### 3.6.Considerations

The Swedish VET system, therefore, represents an interesting case of a state-funded school/college-based system, relying for work-based experience largely on the one-two years' of training subsequent to the initial three years in a school, which may be public or private, even run by industry. Climate literacy is part of general education, so there is little enhanced climate literacy in the curricula relating to particular construction occupations, though this is increasingly sought by employers as is more detailed technical knowledge. Barriers identified include the paucity of data on emissions reduction, the problems of training trainers, and the time taken to update curricula given the pace of innovation. An interesting article by Grytnes et al. (2018), attributes the 40% higher rate of fatal occupational injuries in the industry in Denmark compared to Sweden to the different learning processes. In the Danish construction VET system, trainees have the status of apprentices, whilst in the Swedish they are students and have a different understanding of safety practices as their teachers' have a greater influence.

## 4. Denmark: Case Study

### 4.1. Introduction

The Climate Act commits the Danish government to reducing greenhouse gas emissions by 70% by 2030, compared to 1990 levels. This legally binding Act requires the government to set sector specific targets that are assessed every five years (EC, 2020b). The Danish strategy of NZEB is aligned to the European Performance of the Buildings Directive (EPBD) (EC, 2021a/2018a/2012a), which requires that all new buildings, from 31 December 2020, are nearly zero energy buildings (NZEB).

Denmark takes a gradual approach to introducing new policy and regulation, giving time to stakeholders to prepare and adapt. An early adopter of one of the first versions of EPBD in 2002, the Danish government introduced energy performance standards in 2006, which gradually became tighter, and then mandatory in 2016. Indeed, Denmark has been trying to reduce energy consumption in new buildings since the 1960s. Successive standards of energy efficiency moved from voluntary to mandatory, culminating in the latest version of Building Regulation 2018, which sets the minimum standards for all types of buildings. The 2020 upgrade sets a higher standard than the EPBD and remains voluntary. There are two voluntary renovation classes for existing buildings, with further differences according to whether renovation consists of replacement of minor parts or a major refurbishment. A new suite of measures was introduced in 2020 to promote and support energy renovations of all types of buildings.

A very popular scheme in the residential sector offers a tax deduction on salary expenses for energy efficient building improvements. Building owners can also take loans with interest rates below 1%. BR2018 is enforced by municipalities based on documentation sent in by the building owner and evidencing that the requirements of the building regulations are met. Policy measures are supplemented by widespread information campaigns covering all aspects of the energy transition, with emphasis on local circumstances and implications for individuals. All Energy Performance Certificates are registered on a central database and displayed on a public website. Households can access unbiased advice from Energy Advisors trained by the Danish Technological Institute, and many act on the advice received on undertaking major renovations (EC, 2020b). A representative of *Dansk El Forbund* interviewed for this study described a shift in public awareness and motivation:

> I think most Danish people get it…even the Queen talked about it [climate change]. There is demand from consumers who ask about the training of workers on renovation projects. Manufacturers want their products to be applied correctly.

Similarly, *BAT Kartallett* describes the current state of engagement with climate change as being in *'*operation mode*',* crediting Danish government's proactive and ambitious policies.

The share of gross value added by the broad construction sector[5] in GDP was 16.5% in 2018, 5.3% for construction narrowly defined. The number of enterprises in the broad construction sector is 71,924 (ECSO, 2021b), with 32,742 in the narrow construction sector. The broad construction sector employed 322,456 persons in 2020, with over 56% of those found in the narrow construction sector. Skill shortages are reported by about 75% of firms, with carpenters, bricklayers, joiners, and plumbers listed as in-demand occupations for international recruitment. Only 7.2% of the workforce are women, a figure that includes both those in the professions and the operative workforce where figures are much lower (ECSO, 2020).

Whilst the overall unionisation rate in Denmark is 67%, for construction the rate is higher, at 80-90% (OECD, 2023; Clarke and Sahin-Dikmen, 2020). Through social partnership, Danish unions are embedded in policy making at all levels (national, municipal and workplace), including in the development of the national climate strategy, NZEB policies and VET governance. The interests of the seven construction unions are represented by *BAT Kartallet*, which is a lobbying organisation that works with employer organisations to influence government policy, working closely too with politicians:

> We are part of the system. As unions, we are everywhere and have a voice at every level. What this means is that we are actually able to change things. And it is the same with climate change. We are actually doing something about it. (Representative of *BAT Kartallet*).

*BAT Kartallett* is also represented in the European Federation of Building and Woodworkers (EFBWWW) and through this involved in EU policy processes, for example the development of EPBD and the Renovation Wave.

Unions are pro-actively engaged with the climate change agenda, and the green transition is perceived as an opportunity, with the main emphasis being on job creation. Examples of recent climate action by *BAT Kartallett* include:

[5] The broad construction sector includes manufacturing, real estate, architectural and engineering activities, and narrow building construction activities.

- Advising members to engage with municipalities, each of which has a climate action plan and is creating jobs not only in renovation but also in water management, traffic reduction, biodiversity, and urban sustainability initiatives, such as pedestrianisation and tree planting schemes. Municipal buildings, schools, hospitals, and nursing homes instal energy saving installations that need maintaining or need to optimise indoor air quality, which unions see as an opportunity. The issue is involvement, not climate literacy. How do they become part of what is already happening? (*BAT Kartallett*)
- Calling for fossil fuel free building sites, using electrically charged machinery, waste minimisation and circular practices.
- Campaigning for construction companies to become better at reuse, upcycling and recycling, to build in such a way that it is easier to re-purpose a building, and with physical functional and architectural quality in mind.
- Campaigning for use of low-carbon materials. The unions' view is that not everything can be built in wood as this would put too much pressure on forests. Low carbon cement has a place, and bricks can be made using less energy. Manufacturers of building materials are responding to regulation and invest in innovation.
- Calling for training for the existing workforce to be increased.
- Calling for training to be upgraded to enhance understanding of collaborative working, self-awareness and cooperation.

Unions also instigate pro-active participation of their members in the green transition. For example, the electrician's union Dansk El-Forbund together with the employer association has commissioned research to gain a better understanding of the skills required for the green transition and to identify the ways in which electricians can be part of it. The Union is working to raise awareness and articulate what climate change means for the day-to-day work of electricians. A concrete example of this is presented by the energy islands project of the Danish government, which, it is estimated, will need around 1500 electricians. The Union is pushing to be involved in the planning stage, to establish the training needed and prepare members in time.

> They are central to the transition, and this is what we need to highlight. People are excited to be part of the green transition. We need to capitalise on this. (*Dansk El-Forbund* Representative)

## 4.2. The VET system and the role of stakeholders

VET in Denmark begins after the completion of lower secondary education and results in both a general Upper Secondary Diploma and a Journeyperson Certificate. Upon completion, participants also gain access to higher education. In general terms, VET begins with a one year 'Basic Programme' where students are introduced to different vocational pathways. They then join the 'Main Programme' for their chosen specialisation, which is typically completed in 3-3.5 years and leads to EQF Level 4 qualifications. It is based on the dual system and involves alternating 4/5 periods of attendance between school and workplace. A placement with an employer is an essential part of VET, though if the apprentice loses an employer, the school will make efforts to find an alternative. Some programmes, for example for electricians, take longer than 3.5 years, but the training is organised based on the same principles.

The VET system in Denmark is comprehensive and jointly governed by the social partners, with unions involved in its development and monitoring through representation at all levels, including the Council for Vocational Training, Trade Technical Committees and Local Education Committees. The Advisory Board for Education and Training for Building and Construction Industry is responsible for setting competency outcomes in 300 construction-related courses. These are discussed and agreed by employer and trade union representatives. The colleges then turn these into teaching units, ensuring that the recommended competencies are developed (Clarke et al, 2018). Technical schools are funded by the government, well equipped, and benefitting from manufacturers donating equipment.

Recruitment and retention of apprentices are major challenges, and the Danish government has developed several initiatives to enhance quality as well as the content applied, and to improve teacher's education. Distance learning is used widely but is considered to contribute to disengagement. A new scheme in planning, involving municipalities and social partners and funded by the government, will seek to increase the number

of work placements. In terms of CVET, workers in the industry have a right to 14 days further training per year, paid for the government, employers or a combination of both.

### 4.3. Approaches to incorporating climate and energy literacy in VET

The IVET system is well-equipped to respond to the challenge of NZEB. It is comprehensive and combines work and college-based learning. NZEB expertise is embedded in IVET programmes, with Denmark leading in the EU with regards to the embedding of energy literacy in the curriculum. At the time of their participation in Phase I of the Build UP skills initiative of the European Union between 2012-2014, VET had already been updated to include knowledge and skills relevant to energy efficient buildings (EC, 2012b).

For the current workforce, there are short courses for the existing workforce provided by technical schools and some by manufacturers, although take up remains low.

### 4.4. Climate and energy literacy in VET

For Denmark, an illustrative example is the electrician's apprenticeship. The training programme is developed and co-ordinated by the Secretariat for the education committees for electricians and plumbers (EVU) and agreed between the Danish Mechanical and Electrical Contractors Association (TEKNIQ) and the Danish Union of Electricians (Dansk El-Forbund) (EVU, 2020). The electrician's training is 4.5/5 years depending on the path chosen and combines college education with work-based learning. Of the 4.5 years, 55-60 weeks are spent at college, 148-168 weeks at a work placement. Those enrolling after a break of longer than two years since secondary education are required to complete a 20-week course teaching general subjects, such as workplace culture, social science, and health, and expected to have acquired general competences, such as technical communication, work planning, collaboration, and methodology. Students can choose their trade specialisation at the end of this course. If it has been less than two years since the completion of secondary education, apprentices can begin electrician training. The apprenticeship programme consists of two parts: basic and main. All participants begin with a 20-week Basic Course, during which students study Danish, Maths, Physics and are required to pass exams before continuing onto the Main Course. Apprentices also receive training in first aid, firefighting and health and safety. The main course combines traditional electrician's training with optional modules allowing specialisation in new technologies. The 'green modules' relate to installation of renewable energy systems such as heat pumps, building automation to optimise energy saving, HVAC systems, electrical car charging points, as well as renewable energy generation, such as wind power, energy efficiency, installation of heat pumps, and building automation

*Photos:* Demonstration of insulation in Danish training centre

Union views on the extent of climate and energy literacy in the curriculum vary. According to the representative of *BAT Kartallett*, workers already know a great deal:

> Windows and roofing are done properly. Core competencies are covered. Our members are climate literate. (BAT representative).

Interviewees also highlighted areas that can be improved, including enhancing understanding of the importance of interfaces and strengthening the connection between energy and climate literacy. Relations with other occupations and good communication are underlined as important for addressing heat loss at the interfaces. Collaboration is also demanded by Building Information Modelling (BIM), which requires more advanced planning. The Union is promoting an idea called 'helping hand', encouraging workers to help each other and aiming to institutionalise cooperation. In addition, VET teachers invite architects and engineers to help with training in these aspects. By contrast, the electrician's union *Dansk El Forbund* argues that the interfaces are addressed, with strict rules about who does what on site and established practices.

In contrast to the BAT representative, the representative of *Dansk El Forbund* interviewed suggested that climate literacy is not covered adequately. For example, apprentices learn about energy efficiency, but that is not systematically and explicitly connected to climate change and its role in climate adaptation. Energy efficiency is also defined as zero energy, rather than zero carbon, so embodied carbon is not addressed. The union is in the process of completing a comprehensive review of the industry, including the apprenticeship curriculum, aiming to bridge this gap, linking energy efficiency to climate change through the grand narrative of green transition to a new economy.

## 4.5. Challenges – VET development and delivery, labour market, industry

### *4.5.1. Issues in IVET – curriculum, apprenticeship recruitment, teacher training and resources*

Changing the curriculum takes a long time; for example, changing any of the core modules taught in the first two years would take 18 months. Recruitment of apprentices is also reported to be challenging; at the upper secondary level, around 38% of learners are enrolled in a VET programme, which has high drop-out rates. The lack of suitable training placements is a significant problem. And, the equipment needed to teach modules such as Building Automation or Heat Pump Installation is expensive. Finally, teachers' training needs upgrading.

### *4.5.2. Labour shortages*

There is an acute labour shortage; for example, the number of electricians needs to double for the green transition. At the same time, around half of those completing the electrician's training do not work in the industry. Employers have begun to suggest recruiting migrant workers from abroad, for example from Philippines. The electrician's union is concerned as there have been terrible examples of work carried out to very poor standards and is pushing for more to be trained in Denmark, or alternatively recruiting from elsewhere in the EU. Organising migrant workers is a big challenge.

### *4.5.3. Foreign companies' practices*

Foreign companies working in Denmark do not play by the rules and compliance is a problem, although not with all companies. They are not interested in training their workers or building to high standards; they can be inefficient and produce shoddy work (e.g. the University building – one of the biggest scandal in Danish building industry). If foreign companies are fined, they just pay the fine and carry on as before.

### *4.5.4. Women in construction*

The lack of women in construction is an ongoing challenge. The emphasis on the culture of the industry hides other problems, such as the difficulty of balancing with child-care, and the fact that child-care remains women's responsibility, with fathers contributing much less.

### *4.5.5. Existing workforce – CVET take-up and engagement with the green transition*

For the current workforce, taking time off work to train is a major barrier, particularly for small businesses (e.g. sole practitioner electricians). Many will pass on the opportunity so as to complete projects. This is also exacerbated by the fact that not everyone is convinced of the value of further education. Upgrading the training of the existing workforce is a major focus for unions. Funding is not a problem; the main challenge is finding the time, and that tends to be between projects. This is made more difficult by the current labour shortages.

*Dansk El-Forbund*'s research with its members show that they are risk-averse and lack understanding of the full scale of the transformation, assuming they can continue working in the same way. They want to know there is going to be a job on the other side, and it is worth investing in further training.

### 4.6. Considerations

Denmark is perhaps the only country in Europe that continues, as in Canada and US, to apply the historical terminology, referring to 'trades' rather than occupations, to 'apprentices' rather than trainees or students, and to 'journeypersons' rather than skilled workers. In contrast to Sweden, which has a similarly high rate of unionisation, the joint social partner governance means that the unions play a much greater role in the VET system in Denmark, being engaged at all levels. The time spent by apprentices in workshops and classrooms rather than in the firm, whilst less extensive than for Sweden, is substantially more than in many other EU countries, though there is also – as elsewhere – a problem to obtain and increase the number of work placements. This is especially for the main trades of, for example, carpentry and bricklaying, for which the total duration of VET is 3.5 years, in contrast to the 4.5 years for electricians. The Danish construction VET system is well-equipped, of high quality, providing sufficient time for energy literacy to be embedded into the curricula, and up-to-date. It has long been regarded as one of the most comprehensive in the EU, and as contributing to high labour productivity in construction (Clarke and Herrmann, 2004).

## 5. Belgium (French speaking): Case Study

### 5.1. Introduction

There have been limited changes to the Belgian VET system since the VET4LEC reports (Clarke et al 2019a,b) as no major reviews of occupational profiles have taken place subsequently. There are currently serious labour shortages, partly due to an ageing workforce (a feature of other European countries in our study) and *Constructiv*, the Belgian social partner-based organisation for the construction industry financed through social security and employer contributions and providing vocational training services and additional social benefits, is seeking to help the workforce to diversify by drawing on a wider recruitment pool including immigrant populations. Recruitment and retention both of young people and new categories of workers entering the sector depend heavily on the quality of onsite mentoring, but improvements in this depend in the first instance on mentor training.

### 5.2. VET system and the role of stakeholders

The social partners govern VET and the state's role is limited to the development of education policy with advice from expert third parties, coordinated by the Department of Education and Training. Funding is through a combination of state funds and employer contributions. Initial VET (IVET) is a hybrid of college based and dual systems, with responsibility assigned in construction to *Constructiv*, which is supported by technical and regional advisory groups that include sectoral and training provider representatives. *Constructiv* leads the development of detailed occupational profiles, which do not include building services, such as plumbing and electrical. These profiles indicate the underpinning knowledge required for each training pathway and are used to draw up educational profiles. Educational programmes and curricula are drawn up by schools and training organisations who are responsible for ensuring that learning objectives are met through the training delivered. Regional steering groups in Flanders, Brussels and Wallonia are responsible for implementing sectoral frameworks and play a role in the development of courses. The key characteristic of the system is the involvement of all stakeholders: employer organisations, unions, training providers, regional authorities, and other experts. Pathways to obtain a qualification in construction include: Vocational Secondary Education, Technical Secondary Education, Day Release Training, Special Secondary Education (for students with special needs), and adult education. 40 % of participants follow the Vocational and Technical Secondary Education paths.

Continuing VET (CVET) or training for adults tends to be organised by employers and employer organisations. Since the 1990s, *Constructiv* has also been involved in further training and training for job seekers and career changers.

## 5.3.Approaches to incorporating climate and energy literacy into VET

Belgium is one of two European countries (the other is Germany) that the VET4LEC report identified as being relatively well prepared for LEC. There is a national structure for VET in the sector (albeit divided into Walloon and Flemish sections), which handles VET on a long-established social partnership basis, involving both employers and unions in drawing up and updating occupational profiles, producing handbooks and arranging onsite CVET. *Constructiv* finances both IVET and CVET and develops indicative syllabuses in the form of publicly available handbooks, provided cost price to training institutions. Use of the *Constructiv* handbooks and detailed instructional material is, however, optional as it is the training institutions that are ultimately responsible for constructing programmes within the parameters of the occupational profiles. Unions have limited expertise in this area and so do not contribute greatly to the creation of the occupational profiles or the syllabuses. Around 80% of IVET takes place in colleges and the rest is apprenticeship-based. The Belgian IVET system as predominantly college-based, but students do receive extensive onsite experience as well. *Constructiv* also finances the training of mentors working on-site and workplace-based training provided it meets certain standards. This is important in ensuring that the existing workforce is kept up to date with new technologies, practices, and regulations. Training of mentors is also important to ensure that they have appropriate pedagogic, communicative, and pastoral abilities, particularly when working with young people and populations new to the sector. However, employers need to take the initiative in commissioning *Constructiv* for workplace CVET, so that developments in CVET for NZEB and retrofit depend on them.

Photos: Belgian training centre with mock house and plumbing workshop

*Constructiv* develops detailed occupational profiles (OPs) for all construction occupations, bar those under building services, containing some common elements, for example insulation, and having a common format that details knowledge (*connaissance*), know how (*savoir faire*) and attitude (*savoir-être*). In this approach, knowledge is applied to know-how (theory into practice), but with an appropriate attitude of commitment, consideration, attention to detail etc. Although not explicitly stated, the idea is that a qualified worker will show these attributes in an integrated way in the workplace. The OP specifies attitudes appropriate to each occupation, which is important in ensuring that work is done and buildings function according to design specification. Attitude or '*savoir-être*' is an important feature of all OPs in Belgium, including in construction. Appropriate attitudes, such as concerns for teamwork, the needs of colleagues and the public implications of one's work, should ensure the cross-occupational co-ordination, so important for NZEB and retrofit.

This approach contrasts with the standards apprenticeships in England, which specify knowledge, skills and behaviours. Attitudes are different from behaviours in that they concern the motivation and agency of the worker, rather than focusing on outward compliance with norms and regulations. The 'Transparency Tool'

(Table 2, p.8), largely based on the Belgian occupation *Couvreur étancheur* (roofer – waterproofer), illustrates the range of attributes covered in the Belgian occupational profiles, requiring of a practitioner a whole range of knowledge, know-how and personal or attitudinal aspects, which in many cases are relevant to an individual beyond the immediate workplace. Indeed, the aims of the qualification can be extracted from the profile in terms of not only vocational attributes more or less directly related to practising the occupation, but also civic aims, such as 'critical appreciation of the construction industry and NZEB barriers', as well as liberal personal development ones.

A distinctive feature of the Belgian construction OPs is that there is often an overlap between different but related occupations, particularly those where an occupation requires close working with another. These overlaps also help to strengthen awareness of the needs of colleagues working on common projects without, however, providing a full understanding of NZEB projects. Nonetheless, even here, it is possible to identify potential problems. The occupational profiles incorporate significant occupational overlaps, allowing practitioners to practise and have insight into neighbouring occupations. However, although there is a strong emphasis on communication, coordination, and exchange of view, what is lacking is an appreciation of the project management aspect of NZEB that is more than basic. This would allow the practitioner a better understanding of the ways in which the different occupations need to work together to realise an NZEB project successfully. Missing also in the 'knowledge' categories, both systematic and non-systematic, is any element of climate literacy, and thus of the broader significance of NZEB, for example as a practice of civic significance.

*Constructiv* provides detailed, publicly available, modular curricula for construction CVET that are also applicable to IVET construction programmes.[6] Although they include material on LEC, there is not, as yet, material on climate literacy. However, the CVET material on different aspects of LEC is extremely detailed and practical. Here are examples from the module on thermal insulation, in this case for cavity walls. First (Fig. 1.), there is a diagrammatic description of how such walls work, showing how each material contributes. Figure 2 then provides illustrations of the stages of installation on site, showing the work process in detail.

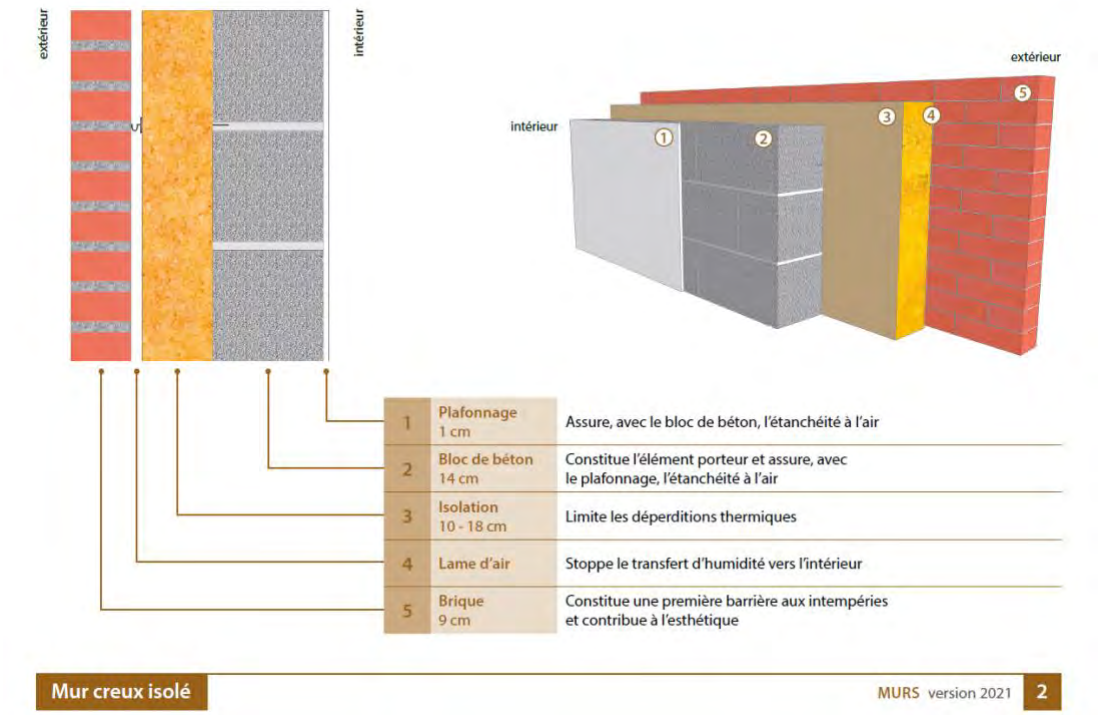


Figure 1: Belgian CVET module on cavity wall thermal insulation

[6] https://constructiv.be/fr-BE/Ouvriers/Publications.aspx

All workers can access this material. For instance, a link entitled 'Building your learning', leads to various themes that include '*toitures*' (roofs) and to a subtheme on thermal insulation of building. Before accessing this, there is a drop-down menu that allows students to specify the occupation/s they are interested in, providing an alternative way of accessing material. The site gives the modules deemed appropriate to teach a particular construction occupation, for instance a module on cavity wall insulation via a further filter on the principles of building insulation. The extracts above come from this document.

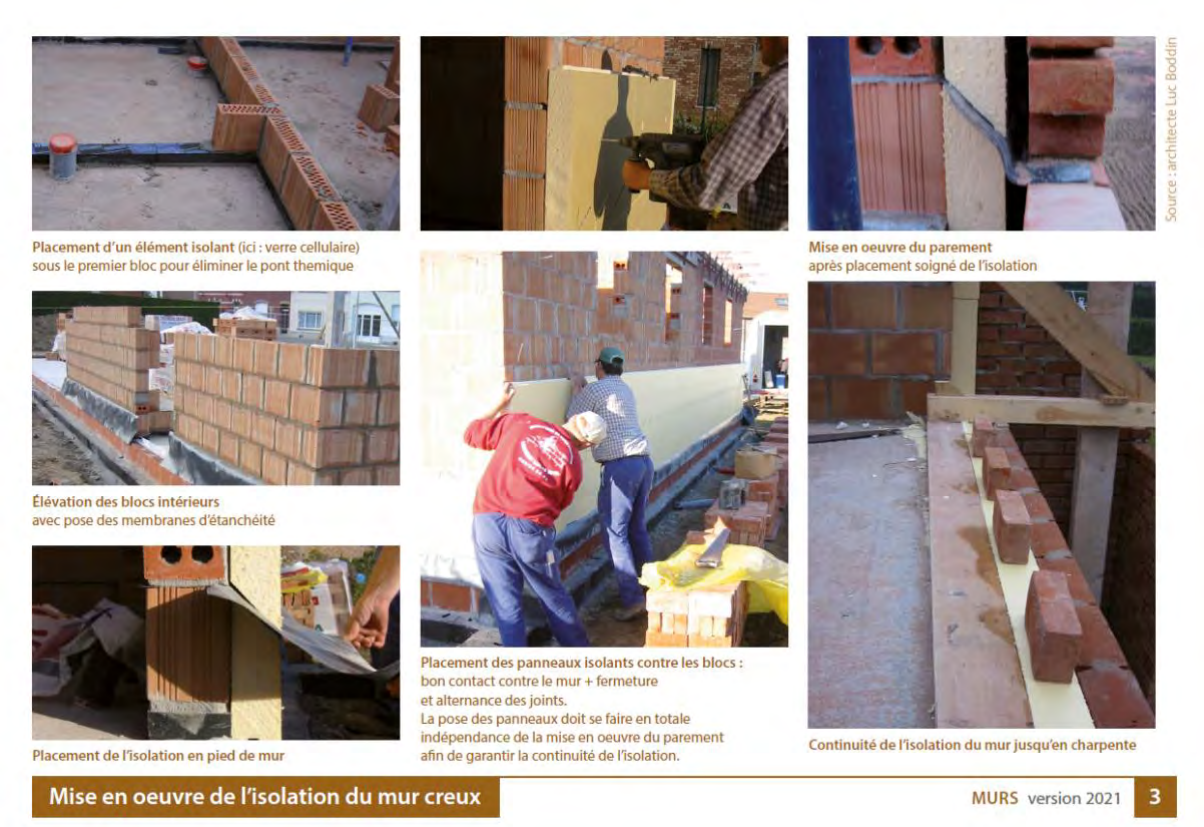



*Figure 2*: Installation of insulation on site

### 5.4.Barriers and possibilities for the incorporation of climate literacy in the curriculum

Although Belgium has not, as yet, developed IVET/CVET modules on climate literacy and there appear to be no current plans to do so, the detailed modules for the construction occupations incorporating material on LEC do contain some reference to climate change issues. The development of these modules is necessary for the workforce to meet EU and Belgian energy performance standards on site, but climate literacy, in the sense that it builds greater awareness of why zero energy and zero carbon standards are required in the first place and the role of each worker in fulfilling these, implies greater worker agency. Rather than simply responding to the demands placed on employees and driven by the market and by legislative and regulatory requirements, incorporating climate literacy therefore implies greater participation of the workforce, represented by their respective unions, together with the education institutions. As a social-partner-based system, in which unions play a significant part, the potential for this in the Belgium construction VET context is there.

## 6. Germany: Case Study

### 6.1. Introduction

Germany has one of the most comprehensive programmes for energy use, reducing GHG emissions and modernizing its VET system (CEDEFOP, 2020, 2022c). As early as 1977, it adopted an Act on Saving Energy in Buildings, focused on improving building fabric insulation and the operation of interior mechanical

systems. The first national CO2 reduction target was set in 1995, requiring that CO2 emissions drop by 25% by 2005 against 1990 levels. In 2002, an Energy Saving Regulation was implemented and in 2005 a new Energy Saving Act was passed. In response to EU's 2006 Directive on energy end use efficiency, the Federal Government released its National Energy Efficiency Action Plan (NEEAP) in 2007, with a target of reducing overall energy use by 9% by 2016. At the same time, an integrated Energy and Climate Programme was adopted, with 29 specific measures to promote the climate target of a 40% reduction in GHGs by 2020, including an Energy Passport system, requiring building owners to document the energy use of the various building components to facilitate upgrades and so that users could assess energy costs. Regulations were also introduced requiring energy auditors to have specific training and appropriate credentials. In 2010, the Federal Government also established a long-term plan that included climate and energy reduction targets to achieve an 80% reduction in energy use and emissions by 2050, in part by accelerating the rate of refurbishment of buildings from 1% to 2% annually (BUS, 2012a)

Germany's commitment to meeting the EU's targets involved documenting the numerous ways buildings lose energy and the development of specific proposals to address, for instance, gaps in the building envelope, making building services - such as HVAC and district heating - more efficient, and encouraging the adoption of solar hot water heating, where appropriate, to reduce reliance on burning fossil fuels (Clarke et al 2019b). An interesting insight into the extent to which energy efficient measures are being introduced in new and existing buildings is given in the number of heat pumps installed, which increased from just over half a million in 2013, half of which were air source and half ground source, to 1.3 million by 2020, when about two-thirds were air source (Statista, 2020). This already implies a substantial number of workers and firms equipped to meet energy efficient targets.

In terms of the construction workforce, according to Eurostat, the industry employed 2,306,615 construction workers in 2019 and in 2020 consisted of 394,639 firms, a figure that has risen from 238,924 in 2010, implying an increase in the number of small firms (Eurostat, 2022; ECSO, 2022). Indeed, as shown in Table 1 (p.4), about 76% of the workforce in 2019 was employed in small firms, 14% in medium and nearly 11% in large, rather similar to Belgium (Eurostat, 2019). However, the proportion of construction workers employed in medium and large firms in both countries is nowhere like as high as in the Scandinavian countries of Denmark (20.4% and 14.3% respectively) and Sweden (16.6% and 24%). This is important as it is the medium and large firms that are more able to provide a sound infrastructure for work-based training or experience, covering a range of activities and projects.

At the same time, as elsewhere in Europe, there is an ongoing labour shortage and various measures have been taken to diversify intake into construction, including 'fast track' programmes aimed at young people who might otherwise have chosen a university route to gain the senior worker *Meister* qualification at an early stage. There are also various programmes aimed at integrating migrant workers and young people of migrant origin into what is known as the 'dual system' of VET.

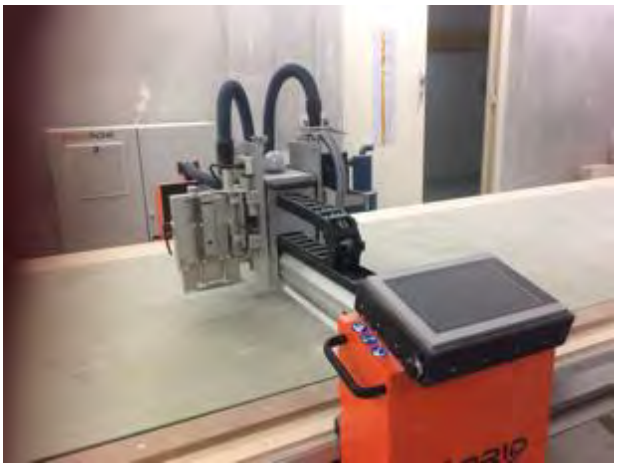
## 6.2. Approaches to VET: Social-partner-based VET

Under the original legislation of 1969 setting up the dual system, the *Berufsbildungsgesetz*, VET or *Berufsbildung* was conceived as a sector of tertiary education and was deliberately distanced from apprenticeship through the status of trainee (*Auszubildener*) as distinct from apprentice (*Lehrlinge*) (Clarke and Janssen, 2016). This Act was recently amended to ensure equal value be given to academic and vocational education, upskilling and providing higher training and qualification levels, stipulating minimum training allowances and promoting ease of transfer within the VET system (BMBF, 2020). Germany's construction VET system differs from Belgium's in being regulated by the social partners with the state responsible for setting the legislative framework and supervision and unions and employers associations involved formally in training and education bodies at all levels. Thus, the state and regional governments are much more significant partners than is the case in Belgium. The system covers over 20 construction occupations, whereby trainees apply to a company and levy-funded training takes place in the company (practical) and in a training centre, as well as in a vocational school (*Berufschule)*. In line with practice in much of Western Europe, VET for skilled occupations is for at least three years. The programme is stepped, whereby trainees begin in the first year with a broad introduction to all the different construction occupations, then specialise in the second year into

finishing, building or civil engineering, and only concentrate on a particular occupation in the final year (Clarke et al., 2019b). This has the advantage of providing an overview of the work of different construction occupations and their interactions, so conceiving the building envelope as a single unit, though building services belong to a different sector from building, and hence come under different social partners. This is a particular problem for occupational co-ordination in the German context.

Young people entering the construction sector are employees and spend up to a third of their time in a college environment, where they pursue technical and theoretical aspects of construction, as well as elements of civic and liberal education, thus giving them further potential opportunities for considering the ethical and political aspects of the environment. Another third is spent in levy-funded local or regional training centres, divided according to which section of the industry they are organised by, whether *Industrie,* predominantly the larger firms, or *Handwerk,* predominantly the smaller. These centres contain well-equipped workshops for the different construction occupations, regarded by one interviewee as 'training for the future', and the remaining time is with the firm, regarded as 'training for the market'. All occupations are kept under review by the national VET body, the *Bundesinstitut für Berufsbildung* (BIBB), which updates existing qualifications and develops new ones, though none are envisaged for the construction sector currently. However, the templates for the occupational curricula were formed in 1999 on the project learning (*Lernfelder*) principle and revision takes place within the framework of these templates.

LEC elements are as in Belgium mainstreamed into VET programmes of existing construction occupations, and national curricula for each construction occupation (including building services) incorporate these and are publicly available and downloadable. They demonstrate the embedding of LEC elements within the different units of learning, for example, for the bricklayer, Lernfeld 17, which takes place in the third year of VET and covers repair and renovation of a component specifies as part of the content, insulation and recycling[7]. These curricula frameworks were agreed in 1999 to reflect the decision to move to *Lernfelder* as an organising principle of the IVET curriculum and, therefore, exist at quite a high level of generality and might be expected to have limited detail with respect to climate and energy literacy. This does not, however, necessarily mean that the curricula are no longer relevant, since individual institutions are able to fill in the necessary detail and produce textbooks that accurately reflect new developments in the occupation.

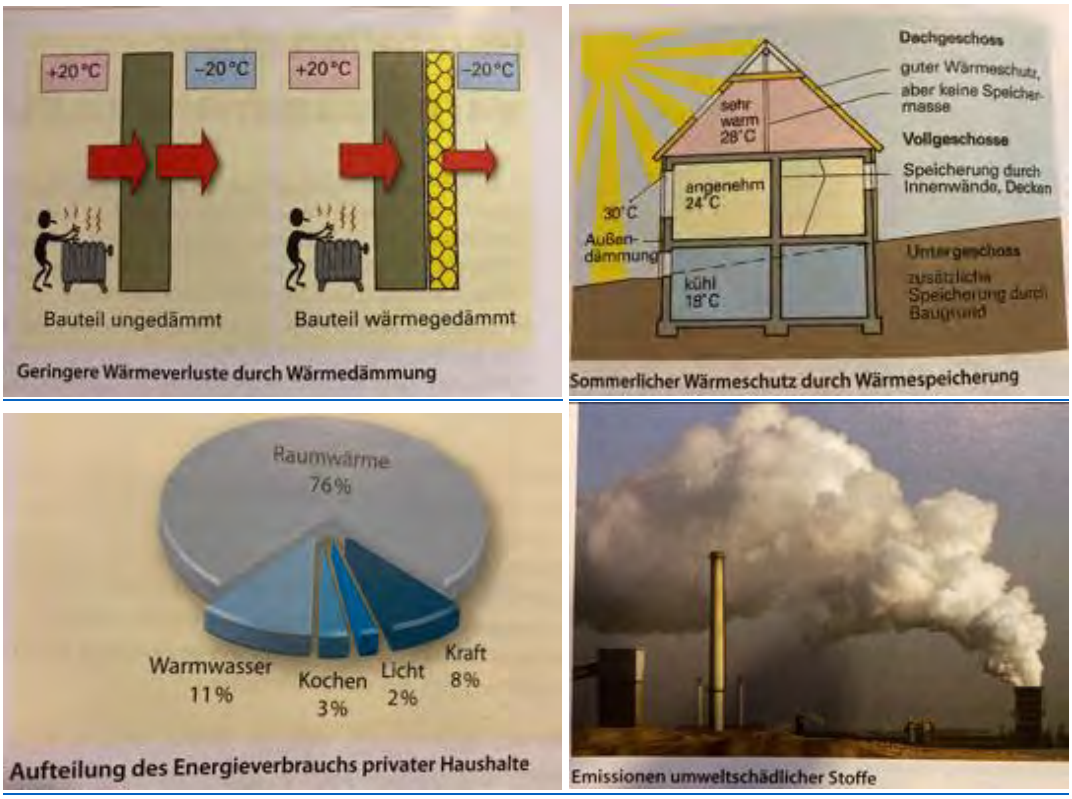



*Photos*: *Stuckateur* (Plastering) Training Centre

The illustrations below come from a textbook (HT, 2014) used for the IVET programme for plasterers (*Stukkateu*r), in a section Lernfeld 11 on 'Making a heat-insulating plaster system', referring to the different ways in which heat is best retained in buildings, damp prevented, energy usage, seasonal differences and the impact of carbon emissions and climate change, so embracing both energy and climate literacy. As well as explanations of the nature of climate change, so necessary for developing climate literacy, the textbook also includes the purpose of insulation, internal climate control, costs of heating and energy use, environmental

[7] The bricklayer curriculum is available at: https://www.kmk.org/themen/berufliche-schulen/duale-berufsausbildung/downloadbereich-rahmenlehrplaene.html?tx_fedownloads_pi3%5Bcontroller%5D=Downloads

protection, and thermal bridging (HT, 2014: 172-9). As in the Belgian CVET programmes, there are accessible diagrams and clear explanations.




*Source:* Lernfeld 11: Herstellen eines wärmedämmenden Putzsystems, from *Lernfeld Bautechnik Stuckateur Fachstufen*, Handwerk und Technik (HT), 2014

## 6.3.Climate and energy literacy in the curriculum

An important feature of German IVET is that it is structured on a project-based approach whereby trainees work on problems in particular fields of learning, '*Lernfelder*'. The implication is that knowledge is integrated within the project and assessment takes account of the extent to which climate and energy literacy factors have been incorporated into the finished product. The German system has a progression framework, which takes the qualified worker (*Facharbeiter*/erin) to the level of *Meister* or foreperson, with higher technical, supervisory, entrepreneurial and pedagogical capabilities. This qualification is achieved through both study and workplace experience and is classified as EQF level 6. CVET is often co-funded by employer associations within a region through a levy, providing an opportunity for the workforce to update knowledge and abilities. There are also 'hybrid' routes at Level 5 and above, involving part study at a polytechnic (*Fachhochschule*) coupled with placement in a firm or offered in dual training mode, akin to the 'higher apprenticeships' offered in England. Despite the prevalence of small and medium-sized companies, employer associations succeed in sustaining CVET training levies that allow the current workforce to update capabilities, including in relation to LEC principles and techniques, as evident from the increase in heat pump installations.

## 6.4.Barriers to and possibilities for the introduction of climate and energy literacy

Germany's Build Up Skills programme was designed to identify the measures needed to equip the country's construction workforce with the knowledge, skills and competencies required to deliver the country's climate agenda. It involved a collaboration among all the major stakeholders in the construction industry, including: the *Zentralverband des Deutschen Handwerk*s (ZDH), covering employers coming under the *Handwerk* section, the research centre for VET in the *Handwerk* sector, the *Deutsche Energie-Agentur* (German Energy Agency), the *Hauptverband Deutsche Bauindustrie* (HDB) (German Construction Industry Confederation) covering employers in the *Industrie* sector, and the *Bundesinstitut für Berufsbilding* (or BIBB - the Federal

Institute for Vocational Education and Training), as well as support from various academic institutions. The programme included an analysis of existing workforce competencies to assess the capacity to meet current and projected labour requirements for LEC. Although the construction VET system has a broadly based first year covering different construction occupations, thus providing construction workers with a good understanding of how their occupation relates to other construction occupations, because building services come under a different sector from construction, these are not covered. It is, therefore, perhaps not surprising that Build up Skills' recommendations for Germany included the need to strengthen systems thinking and interdisciplinarity, as well as how gaps in the existing system should be filled, mainly through tailored CVET programmes, and the need for more data on the construction workforce to facilitate long term labour market and skills development planning (BUS, 2012a, 2013).

One result of the German Build Up Skills initiative was comprehensive lifelong learning programmes in LEC for the existing construction workforce, including a) the development of a new 200-hour LEC CVET programme, providing participants with a recognized exam tested qualification as a Certified Renewable Energy Specialist, and b) a new 'Train the Trainer' programme to strengthen instructor's ability to deliver LEC. LEC principles have also been further integrated throughout the curriculum, including the *Meister* VET programme (Clarke et al, 2019b). Advanced training beyond the IVET qualifications is promoted and credited with credentials, viewed as equivalent to academic qualifications, including at the master's level.

### 6.5 Considerations

The social partnership-based mechanisms for updating VET curricula in Germany ensure that topics such as climate literacy are introduced. This broad structure provides scope for updating and is reflected in more detailed syllabi used directly for teaching. Working parties also write and update detailed syllabi through pedagogic materials and VET programmes are constantly reviewed and adjusted, taking account of technological changes, economics, the legal framework and social conditions (Clarke et al., 2020a,b). Social partnership structures ensure the representation of all relevant perspectives and inclusion of critical elements, overseeing curricula and publishing detailed pedagogic materials covering both practical and theoretical elements of VET for LEC. However, the low levels of unionisation in Germany, including for the construction sector, mean that unions have more limited capacity to intervene.

## 7. Ireland: Case Study

### 7.1.Introduction

The construction industry makes up around 6% of the entire workforce of Ireland. The narrow construction sector employs 159,300, of which 25-30% are estimated to be self-employed, and 8% female. It is an aging workforce, with 45% over the age of 45 and another 45% aged 25-44. Around 14% are of non-Irish nationality (Government of Ireland, 2022). There is a shortage of skilled workers, with 40-50,000 new workers needed by 2027 (ECSO, 2021c). Support for the expansion of the NZEB training centres is part of the government strategy to ensure the upskilling of the construction workforce. The Action Plan for Apprenticeships (2021-2025) aims to review and upgrade apprenticeships across all industries to respond to current skill needs, create a more inclusive system, and double the number of apprentices in the next ten years (Government of Ireland, 2021a). There were 4,870 apprentices registered in 2021, a record high, with numbers expected to increase in the coming years (Government of Ireland, 2022). 58,251 enterprises are registered in the narrow construction sector (Government of Ireland, 2022) and the sector is dominated by microenterprises, estimated to constitute 95% of all firms (Clarke et al, 2019a,b). According to our interviewees, around 25% of the workforce are union members.

The transition to 'green' buildings in Ireland is guided by EU legislation, including: the EPBD (EC, 2021a/2018a/2012a) and the Renewable Energy Directive (2021/2019). As a member of the EU, Ireland transposed these directives into national legislation and building regulations, putting in place policies to facilitate implementation. Accordingly, from 30 December 2020, all new buildings are required to be NZEB

and the new building standards are set down in Part L of the Building Regulations. The meeting of these standards is a key objective of Ireland's Climate Action Plan (Government of Ireland, 2021b), which committed to improving the fabric and the energy efficiency of buildings, rolling out zero-carbon heating solutions, and progressively strengthening buildings standards for all types of construction. In 2021, the updated Plan set out specific targets to be achieved by 2030 for the installation of renewable energy sources, such as heat pumps in residential and commercial buildings and residential retrofits (Government of Ireland, 2021b:115-116). A National Retrofit Plan has been set in motion and the Public Sector Energy Efficiency Programme foresees an enhanced role for governmental authorities in setting standards through good practice examples. Also identified in the Climate Action Plan is the need to skill-up current contractors and other industry players in deep retrofit, NZEB and new technology installations.

According to the interviewees, the strong legislative and policy steer has played an important role in ensuring the support of industry in the further development and rolling out the of Foundation Energy Skills (FES) programme, an EU-funded small pilot whose courses are linked to the upskilling required for meeting new building standards. The VET for LEC agenda has been further boosted by a regional development, the construction of an International Centre of Excellence in High Performing Buildings in Enniscorthy, supported by the United Nations Economic Commission for Europe, in a process driven and co-ordinated by a local contractor committed to LEC.

## 7.2.The VET system and the role of stakeholders

The Irish government, through the Department of Education and Skills, leads education policy including for VET, with social partners having an advisory role, which some participants described as 'inconsequential'. The IVET system is mainly college based, with a substantial work-based training element, and takes place at post-secondary level. Apprenticeships are delivered by the 16 Education and Training Boards (ETBs), most completed over four years and leading to a National Framework of Qualifications (NFQ) Level 6 (EQF L5, UK Foundation Degree) award. They are structured into seven phases:
Phase 1: Minimum 12 weeks with an employer
Phase 2: 20 weeks at an ETB
Phase 3: 12 weeks – 1 year with an employer
Phase 4: 10 weeks at Institute of Technology (IOT) for advanced theory, plus practical training
Phase 5: With an employer
Phase 6: 10 weeks at the Institute of Technology (IOT)
Phase 7: With an employer
Further Education and Training Courses (FETAC) are coordinated by SOLAS (*An tSeirbhís Oideachais Leanúnaigh agus Scileanna*, the *Further Education and Skills Service)* and more varied, ranging from 1 day to 3-years, with qualifications awarded by SOLAS/ETB Ireland (ETBI) and City and Guilds.

The evidence gathered for this report suggests that, although procedurally the role of unions and employers remains advisory and limited, in practice there are signs of change. The Irish Trade Union Congress is engaged with the national policy process and has a representative on the construction strand of Project 2040, the government's sustainable future 2040 strategy. In addition, the unions are on the national Apprenticeship Council, and on Quality Qualifications Ireland (QQI). The Construction Industry Committee includes representatives from all five construction unions - SIPTU, BATU, OPATSI, UNITE, CONNECT – and coordinates action on common challenges and issues, to which climate change was only recently added. A significant barrier for union engagement is lack of resources as officers tend to be occupied with industrial relations issues, such as pay, pensions, sick pay and other employment benefits. However, unions are acutely aware of the implications of the NZEB agenda and climate adaptation in general for their members. As one union representative put it, not engaging with climate change is not an option:

> If we don't get involved, events will overtake us. We can't be left behind. We have to move with it.

The green agenda and the skill implications are now also being discussed at the meetings of the National Joint Industry Council which represents employers and unions in construction in Ireland. A sub-committee was set up, including three employer and three union representatives. SIPTU is also involved in the Construction Skills Certification Scheme.

Signs of greater union and employer involvement are also apparent from the QualiBuild project, completed as part of Ireland's involvement in Build UP Skills, stakeholder collaboration being a requirement of participation of the EU-funded initiative (EC, 2017, Qualibuild, 2017). QualiBuild involved a broad range of stakeholders including five main partners of the Limerick Institute of Technology, the Irish Green Building Council, the Construction Industry Federation, Dublin Institute of Technology and Institute of Technology Blanchardstown, supported by a steering group of 14 organisations from industry, education and the Irish Congress of Trade Unions (Clarke et al, 2019a,b).

As with the original QualiBuild project, a notable feature of the roll-out phase was the collaboration between stakeholders, this time also including the government:

- Department of Housing, Planning and Local Government
- Department of Education and Skills
- Department of Communication, Climate Action and Environment
- Sustainable Energy Authority of Ireland
- SOLAS
- National Standards Authority of Ireland
- Irish Green Building Council
- Construction Industry Federation
- Connect Trade Union
- Limerick Institute of Technology
- Carlow Institute of Technology
- Waterford Institute of Technology

A lot of effort was put into including all relevant parties who could contribute to making the project a success. The course development process was inclusive and based on co-operation. Members of the steering group were experts in their areas and highly committed to supporting the Waterford and Wexford ETB (WWETB) and its own team of experts.

> We had the most senior people sitting around the table and working on syllabus. We had very competent people in house. We had people who write building regulations on board. We had City and Guilds at the table. We are a regional authority…limited by our remit, but we were designing a national specification. We had to have people on board. (WWETB Representative 1)

The active involvement of the Irish government was emphasised by all interviewees as the key to the successful completion of the project, lending authority to the initiative:

> Our advice to anyone attempting something similar is to ensure that you have buy-in at the highest level, the support of government agencies… we needed that authority on our side. (WWETB Representative 1)

Also instrumental in securing continuing stakeholder support was the prioritisation of the pilot as priorities and visions of what the course should include varied.

> Getting people move past these issues was very difficult. But once the pilot started, they could see what we were proposing would work, and it started to find its level. (WWETB Representative 2)

## 7.3. The approach to incorporating climate and energy literacy in construction VET

Efforts to equip the workforce with the appropriate NZEB expertise began with Ireland's participation in Build Up skills, an EU-wide initiative of the Intelligent Energy Europe Programme. The aim of Build Up Skills (2012-2017) was to map the training needs of the construction workforce, support the development of national road maps, and kick-start training programmes and qualification schemes across the EU. In Ireland, following the completion of a national status quo analysis and roadmap of action in Phase I, a pilot training programme funded by the Intelligent Energy Europe Programme was developed in Phase II (EC, 2013). QualiBuild set out to address some of the challenges identified in the status quo analysis through two pilot training schemes: The FES Programme and Train the Trainers. FES pilot training was completed by 196 workers and Train-the-Trainer by 59, with participation thought to have been affected by the downturn in the industry. As part of QualiBuild, an online register of site operatives and craft workers trained in low energy building was also set up, the Construction Worker Skills Register.

Following the completion of the pilot programme, led by the Waterford and Wexford ETB, the FES course was further developed and adapted to different occupations by the Limerick Institute of Technology in collaboration with the WWETB as a first step in a national roll-out. The courses are City & Guilds 'assured', which the interviewees described as a faster route to launch compared with the two years required to validate courses by QQI. In relation to the national qualification system, the Fundamentals was judged by the interviewees to be around Level 3-4, and the specific courses aimed at qualified workers around Level 6. The participants are awarded the WWETB NZEB Digital Badge by City & Guilds, indicating that the NZEB Training Programmes are benchmarked against their quality standard.

The syllabi were agreed between March-July 2018 and the first introductory course was delivered by WWETB in September 2018, followed by the first occupation-specific course in January 2019. There has been a steady increase in attendance on the different courses, totalling 582 until the Covid 19 lockdown in March 2020, including for NZEB fundamentals (457), electrical (18), retrofit (36), plumbing (6), ventilation (60) and carpentry (5). NZEB courses are also delivered by Laois & Offaly ETB, and preparations are underway by Limerick and Clare, Mayo Sligo and Leitrim and Cork ETBs, with the aim of achieving nation-wide coverage. Responding to a major gap in provision, WWETB's plans include training in heat-pump installation, maintenance and servicing aimed at qualified electricians and plumbers.

The courses are delivered at two training centres in Waterford (building fabric focused) and Enniscorthy (energy focused). Delivery was transferred online during Covid 19 closures. The teachers/instructors of the WWETB Training Centre are among those completing the training. The courses are currently delivered by MosArt, the contracted training provider, which is a subsidiary of a well-known Passive House designer and builder. Courses are delivered on-demand, free to Irish builders, and otherwise with a minimal charge, aiming only to cover costs. Delivery was hampered by Covid restrictions, which 'killed the momentum built for the launch …. Instead of the flood we expected, the take up has become a trickle.' (WWETB representative 1). During Covid, the courses were transferred online, with live teaching and participants coming to the training centre for demonstration under restricted conditions. Following lockdown, take up continued to be low, with many citing the difficulty of taking time off work for training. In response, a combination of online delivery with face-to-face demonstrations has been adopted, and this has made a difference to take up. The online component is designed for self-study. For example, the theoretical component of the 3-day course on ventilation is delivered online, with participants spending one day at the Enniscorthy training centre for demonstration. WWETB also certifies participants in airflow use equipment as part of an agreement with the National Standards Authority of Ireland (NSAI), which attends the assessment and registers those successfully completing the course.

*Photos*: Mock house to demonstrate air tightness, Enniscorthy retrofit training centre

There is demand for courses from a wide range of industry actors, including self-employed builders, architects, engineers, council workers. There has also been interest from unexpected parties, such as bankers and auctioneers interested in understanding the impact of incoming legislation on financing, and hardware associations wanting their employees to be able to advice customers on related products.

## 7.4.Climate and energy literacy in the curriculum

The courses are developed as continuing VET (CVET) but are also adaptable to IVET. Currently, there are 10 short courses including:
NZEB Fundamental Awareness
NZEB for Carpenters
NZEB for Bricklayers
NZEB for Plasterers
NZEB for Construction Workers
NZEB for Electricians
NZEB for Plumbers
NZEB for Ventilation
NZEB for Site supervisor
NZEB for Retrofit

Carpenters, bricklayers, plasterers, general construction workers, plasterers, plumbers, and electricians receive 1 day training in NZEB Fundamentals, emphasis tailored according to the occupation. The curriculum includes:
1. NZEB Principles, Building Regulations and Product Standards
2. Building Fabric
3. Building Physics
4. Building Services
5. Renewable Energy, Photo-Voltaic, Metering and Electric
6. Communication and User Information.
Supervisors receive 4 days training, covering all of the above. Additional modules are: Introduction to NZEB for each occupation, NZEB for Ventilation, and Quality Assurance.

Training for Retrofit is 1 day, and covers the following modules:
1. Introduction
2. Part L Retrofit Requirements for Major Renovations
3. Thermal Envelope and Building Physics
4. Thermal Insulation
5. Thermal Bridging
6. Airtightness, Vapour control and wind tightness
7. Windows
8. Ventilation
9. Heating
10. Renewable Energy

For Ventilation, the 3-day course covers the following modules:
1. Introduction
2. NZEB Principles: Part L and Part F
3. Air Permeability
4. Ventilation Strategies
5. Ventilation in the Dwelling Energy Assessment Procedure (DEAP)
6. Flow Rate Design Activities
7. Installation and Commissioning of Ventilation Systems for Dwellings (Achieving Part F Compliance)
8. Ventilation Commissioning Activities
9. Communication and User Information

The course specification for each occupation sets out in detail the knowledge, skills/ know-how, communication and responsibilities the participants are expected to gain upon completion[8].

*Photos:* Enniscorthy training centre

#### *7.4.1. NZEB Fundamentals Course Specification – knowledge, skills and competencies*

Most of the content of the NZEB Fundamentals course is aimed at developing knowledge and understanding of different aspects of energy efficient building construction and maintenance, and thereby enhance energy literacy. This is also specified in detail for each occupation. The course specification makes a brief but clear reference to climate change as part of the introduction to NZEB.

*Knowledge and understanding*

- Knowledge and understanding of the principles of NZEB, building regulations and product-standards, including: the importance of energy efficiency, the need to use renewable energy, the relevance of buildings to energy demand and consumption, and the European legislation as a driver.
- Understanding of building physics, including heat flows in a building, thermal bridging, insulation, air permeability, and U-value and R value and their relevance to achieving NZEB compliance.
- Understanding building fabric, continuous insulation, thermal bridging, air permeability and windows/ doors.
- Understanding building services including heating and domestic hot water, controlled ventilation, lighting ICT and smart technology.
- Understanding of renewable energy, including photovoltaics, smart metering, and electrical vehicles.
- Understand communication and user information, including: the importance of good communication between all occupations on site as part of a system-thinking approach; collaborative teamworking; and the sequence that must be followed to achieve and not to jeopardise NZEB standards.
- Understand and apply drawing specifications precisely, communicate clearly with homeowners.
- Understand the importance of obtaining Continuing Professional Development (CPD) relating to NZEB.

*Skills/Know how*

Specified in detail for each occupation.

*Competences (personal and social)*

The 'Communication' module aims to develop cross-trade understanding as well as underlining the concept of NZEB as a coherent system that depends on collaborative working towards the same goal and everyone taking responsibility for the result. Project management and independent working are not addressed, except in NZEB for Supervisors.

### 7.5. Barriers to embedding climate and energy literacy into the curriculum

#### *7.5.1. Relevance of theoretically enhanced and continuing education for construction*

In relation to adapting the NZEB courses for IVET, participants suggested that most apprentices will have completed their leaving certificate and have had a good science education, including climate science as part of the Secondary Curriculum. This is somewhat contradicted, however, by reports that many apprenticeship recruits tend not to be academic, might have achieved the Junior Certificate, and perhaps not done so well at the Secondary Leaving Certificate. For electricians and plumbers, by contrast, a Leaving Certificate is required. In relation to CVET, although a minority view among the participants, some argued that 'throwing

[8] For further information, see: http://nzeb.wwetbtraining.ie/

lots of information at trades people does not make sense' because their job is practical. Lack of CVET and entrenched ideas about CPD for construction workers might also hinder the upgrading of the current workforce.

### *7.5.2. Coordinating stakeholders*

Working with a large group of stakeholders, while lending authority to the initiative and benefiting from the expertise of participants, also presented challenges, mainly relating to the writing of the course specification:

> Everybody wanted everything in, and that was a huge challenge. We were writing a national skill specification that was then to become a training programme. You'd end up with hundreds of learning outcomes and it just does not work…. The result is that the specification is very detailed and precise and has to be adopted as it is by any future NZEB training providers...presents a challenge around upgrading in the future. (WWETB Representative 3)

### *7.5.3. Cost of training facilities*

Setting up suitable training facilities/workshops can be very expensive, as are the materials used in training, so that it is difficult to give trainees sufficient practical experience. WWETB is investing in the development of a virtual learning tool to supplement the demonstration element of NZEB training. The aim with this is to provide an experience similar to hands on practice; for example, whilst air-tight fitting of a window can only be done once, in the virtual environment trainees can repeat this process as many times as they need to.

### *7.5.4. Low demand from contractors and unclear returns to training*

Demand continues to be low for all occupations, except for the course on ventilation, which has been busy right from the start and continues to be so because the qualification requirement for ventilation is specified in Part F of the Building Regulations.

### *7.5.5. Low take up*

Difficulty of taking time off work was reported to be an ever present and ongoing problem. In addition, the returns in the labour market are unclear, with no demand for workers trained and qualified in these areas. One way to tackle this is for companies to register with the Smart Industry Readiness Index (SIRI), run by the Construction Industry Federation and having CPD requirements. However, the membership cost is high for very small companies and self-employed sole-traders. Another motivator of training could be procurement by local authorities. Interviewees argued that, unless training and qualifications become a requirement, demand for training is likely to be low.

The discussion about low take-up of and demand for NZEB training brought to light other reasons. Unions, whilst agreeing that lack of employer demand is the main challenge, also emphasized lack of continuing education for construction workers beyond a couple of hours by a manufacturer promoting their product. They argued that, as a result, workers do not expect CVET once apprenticeship is finished, in striking contrast to CPD requirements for construction professionals.

> During my time working over 25 years, there have been huge changes in materials, regulations. I've had no upskilling opportunity. That is a big weakness. And that's becoming more important. (Union Representative)

### *7.5.6. Lack of monitoring and enforcement of building regulations*

Weaknesses in building control and enforcement of regulation mean that surveyors assess on the basis of design intentions, not actual result. Many councils do not have building control departments. While contractors are responsible for meeting the building standards and self-declaring that the standards are met, it is unlikely that all new buildings are tested. Even if the air-tightness test is met, the membrane can be punctured afterwards and, unless it is tested again at the end, no leakage would be identified. Even if it is identified, it cannot be fixed once the building is completed. Many new builds, especially in rural areas, are self-build and do not have an architect or engineer in charge and therefore little monitoring of energy efficiency standards takes place; all that is required is a commencement notice at the start of construction. In other words, there are not data on the extent to which energy efficiency standards are being met, whether there is a performance gap, and the scale of the problem.

The case of retrofit shines light on the significance of monitoring and enforcement of legislation. In contrast to new build, retrofits are monitored and, where homeowners receive a grant, they are audited. If the standards are not met, the contractors would not be paid, and could be struck off the National Standards Authority of Ireland (NSAI) register. No similar deterrent exists for new build; contractors are free to meet the standards in any way they choose, which raises questions about how this is possible with a workforce not trained in NZEB. Interviewees suggest that training of workers in NZEB could be made a requirement for contractors. Participants also argued that, in practice, divisions on site present a barrier to achieving a more coordinated production process.

> Training does and can emphasise high standards, precision, and the interfaces, but at the end of the day, a lot of decisions are made by contractors and developers, and that is out of the control of educators. (WWETB Representative 2)

### 7.6. Considerations

Even if union involvement is relatively weak, though improving, VET for NZEB in Ireland has the great benefit of state support, coupled with membership of the EU. As a result of the imaginative and strategic advantage taken of the BUS initiative, the Qualibuild project was able to develop the effective Foundation Energy Skills (FES) programme, which is subsequently being rolled out across the country. There is ever-increasing participation in the varied NZEB VET courses provided for construction workers, including through well-equipped NZEB training centres for new build and retrofit in both Waterford and Enniscorthy. Ireland thus provides an excellent good practice example of how VET – in particular CVET - for NZEB can be put in place through the involvement of a wide range of stakeholders.

## 8. The UK: Case Study

### 8.1.Introduction

Like other EU member states, until Brexit, the UK adopted an extensive package of legislation and policies to address climate change, ratifying the 1997 Kyoto Protocol and subsequently strengthening its commitments through increasingly ambitious policies. In 2008 the Climate Change Act was passed, committing the country to a legally binding approach to mitigating climate change that included reducing emissions by 80% by 2050[9], a target subsequently increased to 100%. The Climate Change Committee was mandated to deliver carbon budgets at 5-year intervals and committed to meeting the EU's 2020 goal of a 20% reduction of GHG emissions, 20% saving in energy use and expanding the role of renewable energy by 20%. And regulatory tools have also been used, such as strengthened national building regulations and the Code for Sustainable Homes, intended to help implement new, greener approaches into building methods and techniques but withdrawn in 2015. The UK's 2012 Analysis of the National Status Quo for the Build UP Skills initiative focused on identifying the existing skills of its workforce and assessing what changes would be required to VET programmes to meet the projected demand for low carbon skills by 2020 as required by the EU legislation (BUS 2012b). Besides governmental measures, some of the most innovative approaches to LEC have been pioneered in the UK, for example, the emergence of 'green entrepreneurs' committed to addressing climate change by adopting passive house or similar design objectives and the work of the subsequently defunct Zero Carbon Hub (CEDEFOP, 2018; ZCH, 2011, 2014, 2015). Though the institutional framework, weak government support, and exodus from the EU have placed major limits on the effectiveness of initiatives, there remains considerable support for reducing the carbon footprint of buildings and the construction process.

With respect to Hall and Soskice's (2001) Liberal and Coordinated Market Economies (LMEs/CMEs), the UK's VET system sits firmly in the LME camp, associated with Anglo-Saxon countries, reliant on market mechanisms and hence more oriented towards shareholders, which can mean the relative marginalisation of VET. Our earlier research characterised construction VET in Britain as a 'skill-based' approach, resting on a

[9] https://www.legislation.gov.uk/ukpga/2008/27/enacted/data.pdf

weak statutory framework and stakeholder involvement and as employer-based, with poor labour market currency, fragmented narrow skill sets, a functionalist-behaviourist conception of competence built on task descriptors, minimal underpinning knowledge, lack of permeability, and learning outcomes as performance criteria related to defined workplace tasks (Clarke et al 2013). This remains the case today, as evident from this report, as government stubbornly clings to an employer- and market-based approach to a VET system desperately searching to be driven not by need but by an elusive demand, whilst skill shortages rage!

Though there exists an apprenticeship framework, construction VET in Britain is hampered by the undervaluing of Further Education (FE) Colleges responsible for classroom and workshop elements, lack of regulation, low levels of unionisation in construction, the marginalisation of union involvement in VET, and the absence of a training infrastructure for the work-based element given extensive self-employment, subcontracting and the dominance of micro-firms (Relly et al., 2022). Consequently, most construction trainees are not apprentices but full-time in colleges, in anticipation of obtaining a work placement, though many never succeed and hence are demotivated by the lack of a clear career path through the labour market. There is double the number of construction trainees compared to apprentices, but no clear pathways at present for those who transfer from trainee to apprentice. College trainers may have little workplace experience, so work-based training is also important for trainees. However, everything is focused currently on time and cost in the workplace, though quality in all its aspects is important and would have a positive effect on productivity and so eventually cost, especially as work would be done right first time. On projects, there is always a retention pot for making good, but this is too often regarded as a sunk cost because the defects are not likely to be fixed. Inevitably this has an impact on attempts to embed climate and energy literacy into construction VET, especially given the need for an ever-greater knowledge component.

A critical issue too, one common to all the countries examined, is lack of equity, including gender diversity, though higher proportions of women are found as construction trainees than as construction workers on sites. Meeting the challenge of a green transition in construction should open up possibilities to include women and other excluded groups and improve migrant workers' status (Clarke and Sahin-Dikmen, 2021). Indeed, technologically up-to-date, well-resourced, and high-level VET, leading to qualifications valued in the sector and equipping trainees for LEC, could help achieve a just transition to an environmentally and socially sustainable industry.

Despite the challenging context, there is a myriad of inspiring initiatives across the country to address the green agenda and furnish construction workers, present and future, with the knowledge, skills and competences needed. Unions, FE Colleges, employers, local and regional authorities, and training and environmental organisations all provide examples of good practice, seeking to embed climate and energy literacy into construction VET. The report shows how these may often fall short, given the market-based approach, and lack of funding, regulation, and collaboration between key stakeholders. However, in highlighting these shortcomings, the reasons for them, and attempts to overcome them, the report points to a way forward, including the coalition of stakeholders needed.

## 8.2. The role of stakeholders in construction VET

This UK report is based on a series of interviews with key stakeholders, including unions, employers, employer associations, trade bodies, FE colleges, and the Construction Industry Training Board (CITB). Each was questioned about the ways in which climate and energy literacy have been incorporated into initial and continuing VET and curricula, the interconnection between occupational qualifications, support for trainers, the inclusiveness of training programmes, and future developments. This section concerns the roles of different stakeholders and their involvement in VET for LEC, focusing on those that challenge the dominant market-based approach, promote a just transition involving good employment and working conditions, and present an alternative model for construction VET and the industry.

### *8.2.1. Unions*

Despite the employer-based approach to construction VET, the main construction union, Unite, seeks to play a proactive role in influencing the zero carbon construction policy agenda. It has, for instance, produced an

Environmental Charter calling for the decarbonisation of workplaces, industries and society and elaborating the ways in which a green society means a socially just and equal society, entailing a just transition for industries affected, job guarantees (decent work), and solidarity. The Charter, however, only makes passing reference to the training and development of workers needed. More focussed on skills and education as well as high quality green jobs is the national Environmental Taskforce established for Unite members, whose premise is that climate change means workplace change and that members need to be at the forefront of that change. The Union seeks to develop a campaign from the bottom up, for instance by running education and awareness-raising courses on the environment using positive examples to show what can be achieved.

*Union initiatives in Scotland*

In Scotland an energy skills partnership fund was established by Unite in 2020 making available CPD courses and short 'bolt on skills' training. There are challenges, however, in how far the discussion on the environment reaches the members, including on oil and gas platforms. A survey of 1,383 oil and gas workers carried out by Platform showed that, though they are prepared for an energy transition, this depends on the path taken[10]. The Scottish Government has also set up a Just Transition Commission, involving Prospect, RMT and Unite unions[11], which feeds back to the Scottish government and has even discussed the proposal for a public sector energy infrastructure company. In addition, Unite has called for an offshore industry passport to allow workers leaving the oil and gas sector to be redeployed into onshore work, including renewables and onshore low carbon construction work. Though the salary in renewables can be half that for offshore oil platforms, in terms of knowledge and skills offshore roles such as engineers, electricians, plumbing/gas engineers and wider construction trades should be able to transition easily into renewable industries, such as heat pumps, other new domestic heating systems, on/offshore wind etc. Onshore there will be a huge demand for workers to upgrade the power grid to take the loads that will be needed to power the transport network and replace gas as a form of heating both domestically and industrially, employing Unite members in the heating and engineering sectors. In addition, deep retrofitting of housing and commercial buildings, envisaged in the Scottish Government's *Heat in Buildings Strategy* of 2021, and the need for construction to develop net-zero building solutions, all require skilled construction workers.

At a grassroots level, ScotE3[12], set up in 2017 by Unite members linked to the Unite Rank and File group in Scotland, aims to take ideas about climate into workplaces and working-class communities, organising conferences and seminars. ScotE3 has established a broad network, with significant local, national, and international reach, having made links with climate job campaigners internationally. It seeks to strengthen the practical politics of what a just transition needs to entail and the steps to be taken, building a case for a worker-led transition away from fossil fuels.

*Northern England union initiative*

One important Unite initiative is the North-East Yorkshire and Humberside (NEYH) Retrofitting of Homes Taskforce, which is particularly concerned to explore industry training provision, skills gaps/upskilling, apprenticeships, CPD (continuing professional development), competence assurance/qualifications and building safety in construction and the built environment. Its five-point plan requires:

- *Appropriate workforce skills, assessments, materials, inspections and standards*, including:
    - 3rd Party Certification, core and personnel skills competency schemes,
    - Construction Skills Certification Scheme (CSCS) and partner cards e.g. Joint Industry Board-Electrotechnical Certification Scheme (JIB-ECS)
    - JIB (Joint Industry Board) Plumbing Mechanical Engineering Services
    - Construction Charter; national industry collective agreements.
- *Skilled workforce and Apprenticeships* utilising FE College Building Departments
    - Development of 'in-house' workforce, experience, cards, negotiated terms and conditions in context of 'decent work'.

[10] see https://platformlondon.org/wp-content/uploads/2020/09/Oil-Gas-Workers-Report.pdf
[11] https://www.gov.scot/groups/just-transition-commission/
[12] see https://scote3.net

- Contractors/Councils, linking with bona fide training providers (e.g. JTL – the training provider for building services engineering, Leeds College of Building), Electrical Contractors Association (ECA), and the Construction Industry Training Board (CITB)
- Resurrect local authority building departments, known as Direct Labour Organisations (DLOs), for retrofitting, repairs and maintenance.

Any energy policy of Unite around retrofit has to include rights and skills, not just for the construction industry but also local authorities and the energy sector. The union engages with the private sector, where there are many SMEs and agencies but few collective agreements and where direct employment is key for acceptance as bona fide contractors, though the workers employed are not always union members. Unite challenges the lack of respect, dignity and inclusivity in the industry and seeks to overhaul VET, the apprenticeship system and delivery for construction to become a green industry with green 'decent jobs and work'. The sector today is, however, recognised as age weighted, rich in experience but poor in qualifications, and 'atomised', with false self-employment, an apprenticeship crisis, and the domination of micro companies. The concern of the workforce is about maintaining jobs, though young workers have more understanding of climate literacy, not just because of the phasing out of fossil fuels but because of moving to different sectors, such as renewables, and from children at school as there is much more emphasis on this in the curriculum. Workers see that the sector is moving away from, for instance, gas central heating to heat pumps, so realise they need to learn to install heat pumps to be more employable.

### *8.2.2. Environmental partnerships*

There is an increasing number of environmental groups, seeking to secure a green economy, though only a few are union-based and focus on VET issues and the construction sector. These include:

*Green Skill Partnership*

An interesting offshoot of the unions is Green Skill Partnership, a network of over 60 experts and from a range of sectors, coming together to develop skills solutions to the low carbon agenda, and originally founded in 2011 by the Trade Union Congress' (TUC) UnionLearn. Membership covers a range of organisations (e.g. Transport for London) and private training providers and the partnership seeks to bridge gaps in social exclusion and skill shortages, including through courses on:

- *Becoming a Green Ambassador within the Construction Industry*, with units on environmental awareness, the green agenda, good practices, and reducing environmental impact.
- *An Introduction to the Retrofit sector and related multi-skills*, covering different types of insulation, rendering and renewable energy systems.
- *The Retrofit Sector and Operations,* with units on the planning stage and techniques used.

*Greener Jobs Alliance (GJA)*

The Greener Jobs Alliance (GJA) is mainly an alliance between unions and environmental groups, which liaises at national and local levels to build the broadest possible support for the policies, investment, partnerships, and commitments needed to drive the transition to a low carbon economy. GJA works with training bodies, colleges, universities, employers, local and national government, unions, housing associations, campaign and community groups to build the policies, investment and partnerships needed to drive the transition to a zero-carbon economy. A key campaigning issue currently is the need to upgrade buildings through retrofitting to provide more efficient heating, in terms of generation and retention, and thereby also ease fuel poverty. In 2021 GJA ran a special insulation issue of its newsletter[13] and, in conjunction with the Campaign against Climate Change Trade Union Group presented a detailed chapter on retrofit in its Climate Jobs booklet (CACCTU, 2021). GJA has also formed a working group of relevant experts to align the objectives of the many retrofit/insulation campaigns, local and national, into a cohesive set of demands. In 2022, GJA published *Getting the union voice heard on green jobs and skill: A trade union guide to action on local authority retrofit and energy*[14] proposing that every local authority needs to be linked into a FE College, Construction Skills Academy or similar institution, covering the range of skills needed for

[13] see https://www.learnwithunite.org/assets/Uploads/GJA-Insulation-Special.pdf

[14] see https://greenerjobsalliance.co.uk/wp-content/uploads/2022/07/Getting-the-union-voice-heard-on-green-jobs-and-skills.pdf

energy efficiency and retrofit work. The guide points out that reliance on the market cannot deliver at the scale needed to meet local and national targets, that unions and local authorities need to make the case for public ownership models on energy, and that bringing housing and construction back into public sector direct labour organisations (DLOs) offers the co-ordination needed at scale.

### *8.2.3. Industry /Employers*

Across the UK, there exist numerous individual firms, taking initiatives to secure low energy construction. Here, the focus is on key employer-associations, representing many of these firms, concentrated on key areas, especially those required for large-scale retrofitting - including electrical, building services engineering and insulation – and concerned to qualify the workforce needed.

*ECA: Electrical Contractors Association*

The electro-technical sector in the UK consists of 48,000 firms and between 230,000 and 342,000 'skilled' workers and, though dominated by small firms, is regarded as having a much stronger record in skills development than the rest of construction. It is a sector essential to the delivery of net zero energy, involving installation techniques not especially difficult for already qualified and experienced electricians to achieve, though the additional design and cross-discipline/whole-system understanding required is critical. ECA works with the IET (Institute of Engineering Technology) on codes of practice to accomplish these installations, is involved in updating government regulations (Parts L and F of the building regulations) and helps create British product standards.

ECA recognises the structural problems within the sector that lead to difficulties in building according to design specification, let alone to low energy design specification. These are partly connected with the industry's domination by micro-businesses and self-employment leading to difficulties in providing training and more generally to a lack of integration of interdependent processes on site. This is also a consequence of the 'skills' conceptualisation of workplace know-how; it is usually enough for workers to do their set tasks without much regard to the work of colleagues in other occupations or to the integrity of the project as a whole. This can lead to mistakes, often attributable to cost pressures as contractors tend to compete on price rather than quality, which compromise the project's design aims if unrectified. Our ECA interviewee considered that it would assist low carbon construction and retrofit if these structural issues could be addressed through regulation and procurement policies and that the business environment needs to change to match policy ambitions, providing adequate incentives to make 'green pivotal' and to overcome skills gaps. However, there is currently no overarching strategy or plan or investment of resources to back up policies.

ECA has a zero carbon group, including Energy for Tomorrow (EFT) in Wales, which has been involved in a low carbon project of about a hundred homes. The association has also been encouraging members to use Publicly Available Specification (PAS)2035, required for local authority/housing association work but not individual jobs. PAS2035 provides a much broader framework for the installer to ensure the work is done in a coordinated fashion though it can be difficult to navigate. The targeted programme to replace gas boilers has been delayed and PAS2035 is no longer required for such replacements, though installers still need to be MCS (Microgeneration Certification Scheme) accredited to ensure good quality and provide consumer protection.

The ECA is a partner in a bid for a Green Skills Academy bid and is keen not just on short courses but also lengthy courses, which are more thorough and make operatives fully qualified; indeed, there is a new course at L3 that ECA members are guided to. This would include solar panel installation, which is already in the plumbing apprenticeship and crosses over with electrical. For insulation, there is currently a working group on installer competency, which may lead to another certification scheme though this needs to be linked to continuing professional development (CPD) and carefully scrutinised to ensure good practice. Smartphone apps can be linked into all relevant systems and certification incorporated in an electronic card together with all the relevant information that an employer or anyone else would need.

*Building Engineering Services Association - BESA*

The BESA maps qualifications onto national occupational standards, which differ little between Wales, Scotland and England and are at a preferred minimum level 3. Some funding has been obtained from the Department of Business Energy and Industrial Strategy (BEIS) for upskilling. Manufacturers are also

members of BESA, so it is possible to work with them on what products are coming out and on short courses. BESA sees the need for an occupational labour market and seeks to develop apprenticeship standards and deliver apprenticeships through its Apprenticeship Board. Delivering new standards in England compared to Wales and Scotland is, however, a challenge, as is obtaining records of achievement.

*Insulators – Installation Assurance Authority (IAA)*
The IAA has about 150 members out of about 600 in the market, with a 60-70% coverage for Cavity Wall Insulation. The organisation has growing recognition, including from the Federation of Master Builders, major contractors and the supply chain, and has been pushing for proper regulation to promote trust in assurance and lobbying for the auditing of certification bodies to police standards as builders tend to jump from one certification body to another. IAA is an accreditation and PAS certified body, with microgeneration accreditation ability, and with its own best practice guides. It is thorough and follows best practice, carrying out 10% onsite inspection and then issuing a 25-year guarantee. IAA has written National Occupational Standards (NOS) for insulation and is moving towards retrofit and developing an interface module (thermal bridges, property care etc.). The organisation also undertakes building forensic testing, has written a standard to verify requirements for background ventilation and helps with design and thermography.

### *8.2.4. Client partners: A Welsh example*
The Welsh government works with some innovative private sector organisations pursuing a low carbon strategy through consultancy and partnership, notably SERO which is a company specialising in low carbon (as opposed to low energy) housing construction.

*SERO Homes:* Between 2017 and October 2021 SERO had worked with other partners on 500 low carbon new build houses and 2,500 retrofit units, providing expertise in achieving net zero carbon and embedding this into digital products aligned with the decarbonisation of the grid. In our interview, SERO clarified key principles differentiating zero carbon from zero energy construction, deriving from the variable nature of the carbon footprint of electricity, in that zero carbon:

i. includes humans
ii. the grid is being decarbonised
iii. homes will become decarbonised with the decarbonisation of the grid by 2035.

The organisation, which employs 41 people in four diverse technical teams, concentrated on software coding and with computer expertise, is unique and knowledgeable. It pulls together a consortium of contractors and sets common standards so avoiding reduplication, identifying where change needs to happen. SERO provides the tools, technical expertise, and software for the construction industry to decarbonise and is, therefore, ultimately a tech company, providing digital technologies. Digital products and tools are provided to help the construction industry to decarbonise and people to run their homes with less carbon and lower energy bills.

In 2021 alone SERO Homes in Cardiff retrofitted 1724 homes, developing significant economies of scale and carefully planning what needs upgrading, for example external wall insulation. This work has included ground source heat pumps, either large -and thus distributing further - or smaller. District systems have, however, more challenges as they need a stronger contractual framework, allowing the contract to be completed and to deliver what is designed. It is also a challenge to set a fabric energy efficiency standard as the thermal performance of the wall, the roof or the windows can differ. SERO therefore seeks to start from the other end of the process, looking at how every detail can be accomplished, advocating a homes- rather than a methods-based approach. If a whole terrace is not possible, retrofit can be on an area basis, whilst, for the actual homes to be ‘retrofit ready’, including all the power, it is first necessary to break down what needs to be done and when. Planning together with the user, SERO builds a digital data set about every home, including each facet, such as bay windows, and so develops a tool. Historically, the market has tended to rely on a measures-based approach, but what SERO can do is to individually assess each home to work out whether the measures are appropriate, and thus build the tools and the capability to support all its homes.

SERO has been involved in large schemes across Wales and in England, low energy and low carbon, and providing homes with an app on a monthly subscription, including housing associations and not-for-profit organisations. The energy bills for residents are in the region of £60-£70 per month, which is very low. SERO Homes builds to an incredibly high performance, using ground source heat pumps primarily for district

heating systems. Every home is seen as a pathway to zero carbon, built to the design specifications and so overcoming the performance gap and breaking down the hurdles to producing net zero carbon in reality. As far as projects go, SERO does the design, so in that regard is the client, whilst also supporting the delivery. This can be a three-way joint venture, with the developer investing, but SERO also sitting at the table.

### *8.2.5. FE Colleges*

Given the employer- and demand-based nature of the VET system, FE Colleges are constrained by a lack of demand and of a work-based training infrastructure given extensive self-employment, subcontracting and the dominance of micro-firms. As a result, most construction trainees are full-time in colleges, in anticipation of eventually obtaining a work placement. For instance, in a London FE College visited, which covered all construction occupations, there were 500 full-time and 200 part-time students and only 150 apprentices. Research conducted for CITB in 2017 concluded that, of approximately 104,000 learners on construction courses in the 2015-2016 academic year, just 29,150 (28%) joined the construction workforce six months later. Learners may see college courses as a route to an apprenticeship, whereas employers regard them as an alternative to one and expect a college leaver to be site-ready, though learners need more support to prepare for the labour market (CITB 2020). A model, as yet officially unrecognised, is beginning to emerge, of many young people entering FE colleges and acquiring a level 2 (L2) qualification in a construction occupation after two years and going on to a one-year apprenticeship to reach level 3 (L3) if an employer is found. The colleges also envisage that more stringent procurement requirements, including for supply chain contractors to adhere to PAS2035 standards, will gradually come in and will help to create demand.

Interviews conducted with staff in just three FE Colleges in England and Wales, discussed below, present a picture of the range of built environment courses run, how far these incorporate energy efficient aspects and the growing concern with VET for LEC.

*Leeds College of Building - LCB*

A notable FE College that is specialised in building is Leeds College of Building (LCB) where most students are on 16+ courses, with about 1,100 16–18-year-olds hoping to go into the industry. 57% of the total 2,800 students are on apprenticeships, ranging from L2 to degree level. There are also 120 14–16-year-old school students, others on Higher National Diploma (HND) courses and the rest on adult education CVET courses. The college has a national reach with some 1700 actively engaged across the country and apprentices from different parts of the country, such as students with the building firm Bam Nuttall who go on block release training programmes outside the Leeds area. NG Bailey is another firm for which LCB manages its apprenticeship provision nationally, with some students subcontracted with other colleges to avoid travel and accommodation costs. There is a tendency to do block rather than day release for apprenticeships, with the length of block training varying from 1-2-weeks to 9-week blocks. JTL, the private not-for-profit training provider for electrical, which employs about 500, also in practice subcontracts to colleges such as LCB. The problem the college has is to find competent assessors.

Training for qualifications from City and Guilds (C&G), the awarding organisation for work-based qualifications, and from the Business and Skills Education Council (BTEC) is also offered. These qualifications are based on need rather than just on demand, though employers have an input, whilst delivery is up to the college as long as occupational competences are met. In 2022 LCB also phased in the T level course on Construction, Design, Planning and Built Environment, which includes work experience. T Levels are technical-based qualifications for 16-19-year-olds in England, developed in collaboration with employers and businesses, with content that purportedly meets the needs of industry and prepares students for work, further training, or study. There is only one awarding body per T level, so there should be no contestation that might detract from quality. LCB has a work-based learning unit, managing the interface with employers, supporting employers by explaining what is on offer, and supervising the progress of an individual apprentice, so providing a seamless tripartite linkage between the college, the apprentice, and the employer.

LCB is regarded as one of the most forward-looking FE Colleges in England. Though it does not run specifically green courses, plumbing, gas, building services engineering, construction management and civil engineering are all relevant to the green agenda, as are many aspects of roofing, including solar and photovoltaic. Indeed, the current cohort in VET has many of the relevant skills, which can then be built on to

promote zero carbon construction. Many new aspects have been incorporated into existing qualifications, including cold bridging, warm bridging etc, and different occupations need to know how each occupation operates, particularly through working with them on site. It is, therefore, important that apprentices from different occupations work with each other on site. By using add-ons onto programmes, new technologies such as heat pumps can be introduced. The College has a renewables workshop that demonstrates renewable technology - photovoltaics, solar, and ground and air source pumps - and the roofing workshop has the capacity to demonstrate renewable installation, including cavity insulation and new technology involving roof structures. Plastering is about rendering, and the workshop includes a bay for retrofit insulation. In the plumbing facilities, there are air source heat pumps and mobile rigs with solar panels that can be attached to working areas; electricians are also involved in fixing the electrical connections. Carpentry and joinery are concerned with airtightness, insulation, the external envelope. Each occupation depends on particular products. LCB is integrating more aspects of zero carbon into existing courses, and for this involves, for instance, the Passivhaus Institute, retrofitting expertise, and an insulation manufacturer. PassivHaus modelling has also been brought into the college in flat pack form, whilst LCB's own building acts as a learning aid and includes various new energy saving technologies.

The Mayor of West Yorkshire, of which the City of Leeds is administrative centre, has made pledges concerning the green agenda, but typically LCB depends on employer demand, which is limited, except perhaps for air source heat pumps, delivered in plumbing and heating & ventilation. There is a lot of traditional work available, and employers are reluctant to turn to risky zero carbon work, though most colleges offer relevant courses.

*West London College (WLC)*
Similarly in London, WLC has a dedicated campus with 500 full-time 200 part-time trainees and 150 apprentices, covering all occupations, including plumbing, apprenticeships, and short courses. The College works with the organisation Women into Construction (WiC)[15] and probably 5% of students/trainees are women, with some women-only courses. About 56% of trainees are from BAME (Black, Asian and Minority Ethnic) groups, the target being at least 33%, and these are also tracked. Courses at WLC cover insulation, external and internal, and one campus has workshops for plumbing, electrical, carpentry and plastering (using a bay structure), as well as block work for insulation plus special cladding, with British Gypsum and Saint Gobain providing materials. Short courses are 3-4 weeks plus work experience. Some courses are also for new entrants from the JobCentre.

Younger learners start at L1, but their progression has been decreasing since standards came in to replace frameworks, often at L3 and above in construction occupations. Qualifications in construction offered include a National Vocational Qualification (NVQ) diploma in wall insulation, aligned with Occupational Standards and typically L2. There is also a preliminary taster, including for some of the third of students/trainees who might then do a two-three-year apprenticeship, as well as a multi-skills generic programme called General Building Operative. Offering the L3 Lifetime Skills Guarantee has also given another option to offer new, previously unfunded, qualifications; for instance, plumbing, carpentry, and plastering funded under this has given an opportunity to offer some programmes effectively for free. Qualifications are offered to upskill those in work who have reached a ceiling, the only criterion being that to qualify for funding they must be 19+ with no previous L3 qualification; the government, working with employers, has produced a list of qualifications approved for this funding, including in construction.

T levels are scheduled for 2023 delivery with engineering and construction occupations both envisaged. L3 BTEC has 300 fewer hours than T level, and T levels have work placement in addition and higher entry requirements. BTEC typically requires school-leaving GCSEs (General Certificate of Secondary Education) at lower grades than for T levels, potentially meaning fewer possibilities for students who currently do BTECs.

FE College funding allows flexibility to incorporate elements into courses within the 550 hours allocated, which must include Work Experience, Maths and English; for City & Guilds for construction 350 -400 hours are prescribed. Adult courses are also quite flexible. Apprenticeships are, however, more difficult because the

[15] https://women-into-construction.org/

funding is just for that, so climate awareness and energy efficiency have been added in as a loss leader. The situation has improved as National Vocational Qualifications (NVQs) have become more content led. West London College is carrying out a gap analysis and will plug in green skills, such as for plumbing, which needs a substantial sustainability content, for instance for wastewater etc. Reference to energy efficiency systems could include heat pumps but is not explicit.

West London College seeks to achieve connectivity between occupations by setting out training for all construction occupations together under the same roof, in an old industrial warehouse, so that each – tutors and students - can see how the others work. Some programmes introduce students to different occupations e.g. the L2 18-month Property Maintenance Operative course and entry L1 1-year construction skills taster course for 16-17-year-olds. In the workshops, there are not yet facilities for, for instance, heat pumps though the College intends to install both ground source and air as well as set an example of sustainability operationally, including recycling on campus, curriculum, engaging with community and other organisations. Zero carbon is seen as having many implications, including materials, supply, transport, and even a Passivhaus installation.

*Cardiff and Vale College (CAV*C)
CAVC is typical of the overall situation for construction students in FE colleges in Wales, with 30% on apprenticeships, 30% going through the full-time route, and 40% on the BTEC route, so that there is a 60/40 craft/professional split whereby above L3 counts as professional, L3 is seen as apprenticeship standard and L2 as traineeship. Work experience in construction is regarded as particularly important.

On a visit to CAVC, discussions took place with a range of stakeholders. CAVC works closely with the Welsh Government and Qualifications Wales and cooperates with various bodies across Wales, including the Centre for Alternative Technology (CAT)[16]. It is the fourth largest college in England and Wales, with 26,000 learners in all, full time and part time, and places particular emphasis on inclusivity and aspiration, working with the local community, and promoting a skills and employability agenda. The college has a flourishing apprenticeship programme, holding a total 40,000 apprenticeship contracts across Wales, including the Cardiff and Vale area, which contains half the population of Wales. It offers a pathway to full-time education at 16 or apprenticeships, including in the construction sector and has an extensive college-based construction programme. The World Skills Centre of Excellence at CAVC is one of four in the UK.

The college is developing a Green Academy and green concerns run through all sectors catered for, each of which has an employer advisory board including SMEs. CAVC has invested £160,000 in new green qualifications, including facilities such as a mock-up house to demonstrate air tightness that students can reverse engineer to see how it works. It has well-equipped workshops, including solar panels and heat pumps, and enthusiastic and knowledgeable staff. It has also been developing online upskilling resources, for instance concerning hydrogen and heat pumps. New campuses will be future proofed for low carbon technologies.


*Photos*: Solar panel installation and heat pumps at CAVC

[16] see https://cat.org.uk

The College has its own work units and plays a role in strategic initiatives of the Welsh Government such as the Advanced Manufacturing Centre in the Vale of Glamorgan and the Centre of Industrial Excellence, so assisting with the retrofit challenge and the green agenda more generally. CAVC also undertakes much upskilling of the existing workforce, including monthly workshops with employers for lecturers, symbolising the interrelation between employers and colleges. Lecturers need to be on site to keep up to date and some employers have helped in this, so keeping apprenticeships up to date. There is a short-term lack of knowledge as many more heating engineers are needed but these tend to be unfamiliar with low energy construction; it takes 12 weeks training to become familiar and SERO has been working with FE colleges on this. A podcast has been produced for heating engineers, involving collaborative learning from each other and a support network if needed.

*Overall*
The FE colleges visited all had slightly different programmes and facilities. Whilst the Cardiff and Vale College (CAVC) workshops visited had solar panels and heat pumps for trainees to learn how to install, a key problem for many FE colleges is the facilities, though everywhere they are improving these to include provision related to insulation and renewably energy. Most noteworthy too are events organised to promote green construction to women, combining the need to green the industry with improving its inclusivity. Indeed, from our visits it was impressive how much effort is being put into developing and training a workforce for green construction by FE Colleges across the country. While apprenticeships are restricted in number due to the nature of the construction labour market, which fails to provide an adequate infrastructure for work-based VET, there is generally a higher proportion of apprentices to be found amongst construction trainees the further north of the British island one goes. Nevertheless, in terms of construction qualifications, there is a constant process of review, and these are increasingly incorporating knowledge, skill and competence elements required for VET for LEC. FE colleges too, despite lack of funding and government support, are launching courses that respond not just to demand but to need, though there is much more that needs to be done, including CVET for the existing workforce.

Colleges so far have only delivered frameworks rather than standards and some are struggling to adapt to moving from frameworks to standards. Fleshing out the standards is seen as a big challenge, including developing the assessments themselves, which are reportedly of low quality. Earlier Framework apprenticeships tended to be at L2, for instance carpentry, whilst electrical and plumbing are L3, though these trainees will first do general preparation at L2. There is a trend to drop the L2 apprenticeship and L3 has been growing, plus L4 and higher; in FE Colleges too, the 25+ age group is doing L4 and higher apprenticeships. There is also a Level 5 apprenticeship with significant sustainable environment elements, but there is no ‘green apprenticeship’ as such.

### *8.2.6. Regional Authorities*
FE colleges across the country rely on initiatives from regional, metropolitan and local authorities. By 2022, 93 per cent of the population in Britain lives in areas where local authorities – over 525 councils altogether – have declared a climate emergency and set carbon emission reduction targets to address climate change. Many are also carrying out assessments of the green construction employment and training required in their areas and beginning to draw up retrofit strategies. Most notable is Glasgow City Council in Scotland, which owns City Building Glasgow, a company employing 2,200 construction workers and taking on 60 apprentices a year, which has a large low energy new build and retrofit programme and its own extensive training facilities (Clarke and Sahin-Dikmen, 2018).

*London Mayor’s Academy Programme*
The Greater London Authority Mayor’s Construction Academy seeks to coordinate and promote ‘green skills’ through hubs of key stakeholders, including employers, universities, FE Colleges and local authorities, though rarely unions. West London College is part of the Mayor’s Academy Programme, working over a three-year period from 2022 with employers to identify needs and pinch points and to address these. The Green Skills Academy hub is mainly about co-ordination, to ensure there is no duplication in the supply of VET, and about working with employers on the demand side to make sure that employment is there, unemployment of those graduating is avoided, the green skills needed are articulated, and education and training are aligned. The

Mayor also works with Solar Energy UK, which together with Microgeneration Certification Scheme (MCS) offers training solutions.[17]

*Welsh Government*
Wales is a self-governing region of the UK, though with limited powers exercised through a unicameral parliament (Senedd). The Welsh government is more proactive than that prevailing in England both in relation to VET and environmental policy. It has set up a Ministry for Housing and Climate Change and launched an Optimised RetroFit programme (ORP)[18] open to Registered Social Landlords (RSLs) and local authorities (LAs) to install a variety of home decarbonisation measures in the existing social housing stock. This involves a whole house, pragmatic, approach to decarbonising existing homes, linked to climate policy and taking into account the materials homes are made from, how these are heated, and how energy is stored and sourced, with the main difficulties in implementation lying in the amount of work concerned and insufficient training of those carrying it out. A major policy announcement made in the *Programme for Government* included the launch of the *Young Person's Guarantee*, aiming to support under 25-year-olds into education, training or work, and create 125,000 all-age apprenticeships in Wales.

VET is closely aligned with the English system in terms of overall approach and curriculum, although Wales follows its own policies to some extent and has issued reports on various aspect of the VET system in Wales. It uses UK national qualifications, such as from City & Guilds and BTEC, but has not taken up the T levels, which are seen as narrowing the options though they are the English government's preferred L3 qualification (upper secondary leaving certificate equivalent). In Wales the overhauling of construction qualifications, including retrofit, is the responsibility of the national qualifications body, Qualifications Wales (QW), which is moving away from single occupations and becoming more 'pick and mix'. At L3, for example, trainees can go on a multidisciplinary programme, having first undertaken a traditional L2 programme. The debate is whether the competence level is sufficient and whether this qualifies for L3, though the person would have a core occupation rather than dual core occupational qualifications. As in Germany, the first year of construction training provides a broad basis. Incorporating sustainability aspects into construction VET is taken particularly seriously, including in terms of qualifications relating to higher level skills. Wales is introducing new curriculum and reviewing 14-16 provision to include more project-based learning. Apprenticeship frameworks and NOS are also maintained with no end-point assessment (EPA).

One solution proposed to reduce costs of providing a range of college training facilities is centres of expertise for different manufacturers to work with, serving as specialist hubs responsive to the rapid pace of innovation and preventing inter-provider competition. There are many innovative products, but manufacturers will not work with every college, and not every college needs heat pumps, so there could be just three centres working in partnership, including with higher education. The well-used and renowned Centre for Alternative Technology near Machynlleth[19] serves as a good example. In terms of materials, too, wood, for instance, is necessary and can be re-used, so showing practically how more sustainable work and recycling are achieved.

*Scottish Government*
In Scotland, a key problem is how to ensure a just transition for workers from the oil and gas sector to renewable energy. These are highly skilled workers who are used to working on oil refineries and offshore platforms and know how large jobs run in that sector, coming also under the highly regarded National Agreement for the Engineering Construction Industry (NAECI), which ensures good employment and working conditions. There are 3,000 Unite members on refineries, where there is strong union density and direct employment, though offshore is more like the construction industry with contractors and specialists and less direct employment.

The Scottish Government (SG) declared a climate emergency in April 2019 and subsequently increased its ambition to reach zero greenhouse gas (GHG) emissions by 2045 and a 75% reduction by 2030. The *Climate Emergency Skills Action Plan* of 2020 has been developed by Skills Development Scotland and underpinned

[17] see https://solarenergyuk.org/resource/solar-skills-london/
[18] https://www.gov.wales/optimised-retrofit-programme
[19] https://cat.org.uk/about-us/

by SG, Economic Development Agencies, Scottish Cities Alliance, industry bodies, unions, and the Scottish Funding Council. However, the *Heat in Buildings Strategy* of 2021 refers simply to supporting 'skills development and training opportunities in the supply chain' through procurement measures and sees regulations as 'helping to provide supply change confidence to invest in training, skills and new projects', so reaffirming the market-based approach to VET of the UK government (Scottish Government, 2021). A report *Green Jobs in Scotland,* commissioned by Skills Development Scotland, identified construction as a key sector, set to gain about 25% of 'Increased Demand green jobs', including, for example, solar system technicians, able to install and determine the use of solar technology on a specific site (Rubio et al 2022). In terms of training, there is a Scottish Government National Training Transition Fund[20], delivered by the Energy Skills Partnership Fund[21], which offers short CVET courses at FE Colleges across Scotland, including extra training for high voltage. These are mostly between 1 day (e.g. energy battery storage awareness for L3 electricians), and 4 days (e.g. heat pumps, solar PV for L3 plumbers and heating& ventilation engineers, and electrical vehicle charging for L3 electricians). For the electrical apprenticeship framework in Scotland, the Scottish Electrical Trust has been involved in discussions aimed at ensuring that union members who are doing the work have the skills. In terms of the quality, these would be L3 for electrical and plumbing, whether concerning heat pumps or new hydrogen heating systems.

The Scottish Government has introduced an Installer Skills Matrix for Energy Efficiency Measures (EEMs)[22] in support of the British Standards Institution (BSI) PAS2035 installer retrofit standards and within the Scottish Vocational Qualification (SVQ) framework, intended to recognise a minimum level of competence leading to industry-accredited qualifications. It is rated at L6/7 in the Scottish Qualifications Framework (L3 in the English), for example for heat pump installation, and covers basic 'pre-expertise' followed by 'bolt-ons' for additional specialisms. However, there is no standard for the retrofit coordinator role; though nominally there is a L5 (English NQF) qualification, this is not recognised in Scotland as there is no occupational standard attached. To gain recognition it would be necessary to set up an industry group to determine performance thresholds and the total cost of developing the standard would be around £40,000. The UK government tends to be against national occupational standards (NOS), but not the Scottish, Welsh, and Northern Irish governments and, as a result, Skills Development Scotland (SDS) became the custodians of NOS for the UK. The Unite officer responsible for apprenticeships spoke of excellent relations with the Scottish Qualification Authority (SQA), while for him England is like a Foucauldian fog.

A six-month 'transition apprenticeship' at Scottish L5/6 is planned for, plus between 600-900 JIB-linked electrical and 300 craft apprenticeships. The regulator has also been trying to push through plasterer training. It is projected that both apprenticeships and CVET for insulation will increase. There is now a Building and Engineering Services qualification, approved by Ofqual, with the aim of making insulation a professional sector. There are five new training centres and apprenticeship funding to support this – Edinburgh, West Lothian, South Lanarkshire, West College Scotland, and Dundee College. Scotland is committed to investing £800 million over the next 4 years of which £600 million will be committed to insulation projects.

In Scotland there is a policy to upskill the existing workforce; indeed, in one FE college in Edinburgh 600 workers have been signed up. However, there are problems with the supply especially as the workforce is largely self-employed. In the ventilation sector, for instance, 99% of installation is by those without credited qualifications. Training is needed for experienced workers, and it is currently estimated that there are about 2,500 in immediate need for qualifications. This is where Accreditation of Prior Learning (APL) comes in, whereby those with 5 years' experience can be assessed on site by colleges. In addition, 'add-ons' are proposed, including a five-day programme on converting from gas to heat pumps. 150 were upskilled last year and 300 this year. However, some colleges have no heat pump facilities, though there are external partnerships involving different manufacturers and it is anticipated that these will operate their own equipment training at different locations. There has also been industry support (including the CITB) for virtual training, including knowledge, theory, and health and safety. However, the workforce and employers, especially SMEs, often cannot afford to undertake training; it costs about £2,500, for instance, to upskill for heat pump installation.

[20] https://www.gov.scot/news/sustainable-economic-recovery/
[21] https://esp-scotland.ac.uk/
[22] https://esp-scotland.ac.uk/scottish-installer-skills-matrix/

A major issue in Scotland is recruiting staff as trainers, even though salaries are higher than in England. Recruits to the sector from the construction industry risk a major loss of earnings as skilled practitioners can earn far more than in a FE college. 17 colleges expect to be training in retrofit, ten are currently training in heat pumps and eight are coming online. There are also 19 plumbing courses in Scotland and a heat pump assessment centre.

### *8.2.7. Training, Qualification and Awarding bodies*

There exist a maze of training, qualification, and certification bodies in the UK, too numerous to list. Interviews were conducted with three of the main organisations, to present a picture of the extent to which efforts are being made to secure a zero carbon and low energy construction workforce and how far the structural framework itself slows down progress and precludes wider involvement of different stakeholders.

*The Institute for Apprenticeships and Technical Education (IFATE)*

IFATE oversees any approval of apprenticeship standards, which can include green guidelines. IFATE agree funding bands for a particular apprenticeship, then funding is assigned to a standard, anything from £6-£27,000, with 20% of funding available for end point assessment (EPA). To trigger the levy, to reserve the funding, colleges sign up and then the employer monitors expenditure, which is a particular problem for small businesses leading some, particularly the micro companies, to drop out. Most employers want the least trouble possible and do not get involved in funding administration. Whilst some organisations have been generous, others are less scrupulous, hurting FE colleges nationally as they would previously have had that funding.

Apprenticeships are moving away from frameworks, which contain Maths and English and sometimes IT, to standards, designed to align to an occupational route through Trailblazer groups and with the Maths and English content specified by the employers. Standards require end point assessment (EPA), which is carried out by a separate organisation, a process that has created problems in high volume areas as there are insufficient assessors to cope with the demand and some assessors have not met regulatory requirements. EPA involves going through a gateway, and, as 80% of work practice is on site, some assessment might be on site when the gateway is reached; there is a practical activity over up to five days in which FE College staff cannot be involved. The IFATE standards tend to look like long lists to be ticked off, with no overall competence and referring to behaviours rather than attitudes, so difficult to award merits and distinctions; only one element needs to fail to lose the distinction category. Nevertheless, there is scope for changing EPA to reflect a more holistic approach when reviews come up after full cycle.

*Electrical Joint Industry Board*

The previous Sector Skills Councils looked after apprenticeship frameworks, and Summit Skills, the Council for building services, would consult with industry and the JIB (Joint Industry Board) – the employers' associations and the unions (ECA and Unite) – to set the standards, though these were not legally enforceable. Since 2017 in England, with the establishment of the IFATE, the employers' associations and the unions have been excluded from this process. Instead, in theory, Discipline Employer Groups or DEGs can be set up to promote an apprenticeship, say for smart homes, which is employer-led and under employer ownership (not associations). In practice, however, these are JIB employers and work with JIB unions, as occurred with the trailblazer apprenticeship programme, where the JIB managed to keep control. The programme was launched in England in 2013 and intended to gradually replace the existing apprenticeship system by setting new skill and assessment standards to ensure their standing as high quality and relevant vocational qualifications. A quasi-statutory footing has been established for end point assessment (EPA) for electrical, set up by the union and employers association as a charitable trust. Under Summit Skills, the union had developed green NOS, and then course certifications, leading to national qualifications and based on upskilling the existing workforce in, for instance, heat pump installation and solar. When Summit Skills collapsed in 2017, these efforts were wasted though for building services there is an electrical technical skills partnership and one for plumbing and heating, as well as the Building Engineering Services Association, BESA.

*Construction Industry Training Board – CITB*

The CITB is a statutory, levy-based, organisation, originally tripartite when established in 1964 but today entirely employer-based, working with industry to encourage training and help build a safe, professional and

fully qualified construction workforce. CITB develops and maintains national occupational standards (NOS) for the construction industry and has a research organisation, publishing reports on, for instance, low energy construction. To begin with the emphasis was on retrofit, which was seen as the key driver of skills needs in the industry, but since the government's 2021 *Heat and Buildings Strategy*, the retrofit momentum temporarily diminished, and the focus shifted towards skills training and qualifications for new build (HM Government 2021). With new build, requirements can be mandated and more consideration given to aspects like waste and water management associated with embedded carbon. CITB considers that retrofit is not going to be the driver for skills and employment and is not particularly concerned with Passivhaus. The organisation used to work with apprentices, but staff involved were made redundant and any review of apprentice progress is now undertaken by trade bodies. CITB development officers liaise and work directly with companies to access funding and courses. The awarding organisation for construction, NOCN, an educational charity, is based at CITB and regulated by Ofqual, the Office of Qualifications and Examinations Regulation, a non-ministerial government department that regulates qualifications, exams, and tests in England.

The CITB's National Construction College undertakes training, though CITB's role is more about how to ensure training is in place. FE colleges are the most likely to provide training, though the difficulty envisaged by CITB is the lack of demand as employers do not train until customers are demanding that training; our interviewee regarded this reliance on demand as where the *Heat and Buildings Strategy* falls down, because it does nothing to incentivise uptake; there are targets, but it is not clear how to achieve them. Building services – electrical and plumbing – are out of scope to the CITB in terms of the training levy/fund though are considered as part of the wider built environment. This means that, though CITB has an overview, heat pump installation and gas boiler installation are not its focus, rather installation and repair and maintenance.

#### *8.2.8. Considerations*

Besides the UK government, these then are the key stakeholders in developing, providing, and monitoring VET for LEC: the unions, employers, clients, FE colleges, regional and local authorities, environmental partnerships, and training, qualification and awarding bodies. Rarely do they work together, though the London Mayor's Academy Programme and the Retrofit Taskforces being promoted by Unite the union seek for better cooperation between different stakeholders in greening the construction process and setting up retrofit programmes. As can be seen from the above account, however, in the absence of a coordinated government policy and extensive funding, initiatives tend to be piecemeal, scattered across different parts of the country and more effective in Scotland and Wales than in England. The employer- and market-based nature of the VET system marginalises unions and hampers stakeholder efforts in planning for the construction VET required to reduce energy consumption and carbon emissions and to create a qualified workforce with the necessary knowledge, skills, and competences.

### 8.3. Incorporating energy and climate literacy into construction VET

This section identifies and evaluates what has been achieved for certain occupations and curricula, mapping where possible against the transparency tool (Table 2) elaborated in the VET4LEC project. Whilst there are different approaches to incorporating energy and climate literacy in construction VET, what employers really want is unclear and, though there are massive local and national targets, there is still a lack of awareness within the public and housing associations on what these means to a landlord, tenant, house owner etc. Research commissioned by CITB on building skills for net zero by 2050 found that about 200,000 workers are needed for this by 2028, predominantly those working in existing occupations, though with units added on to their qualifications, such as the unit on sustainable materials and dealing with waste added on to the L2 carpentry qualification (CITB, 2021). According to interviewees, most construction qualifications can be updated quickly to take account of new requirements, this being generally an on-going process taking months rather than years. T levels, however, written 3-5 years ago, contain little about environmental issues, including climate awareness, representing a missed opportunity though refreshment with such content is anticipated.

#### *8.3.1. Building Services*

In many respects building services overall, including electrical and plumbing, can in themselves be considered 'green', for instance in terms of electrical efficiency where the most efficient equipment tends to be used to reduce electricity costs. Likewise, historically, plumbers (for instance in terms of rainwater harvesters) and air

conditioning technicians on the mechanical side have integral skills sets. Between electrical and plumbing there is considerable interaction, for instance for heat pump installation. However, electrical and plumbing work is beset by private training providers and companies purporting to train electricians to, for instance, install solar panels in just a few weeks. The union demands that a competent person needs to be a judicial entity and qualified under a personal specification scheme, but only in Scotland is L3 recognised as a minimum level of competency. There is much that the Microgeneration Certification Scheme (MCS) can be mapped against, including L3 and PAS installer scheme, so establishing minimum competences and then upscaling. However, as there is much potential work available, with an estimated 90,000 heat pumps to be installed per year, it is important to coordinate and ensure that work is carried out correctly; it should not be possible just to do a 5-week course and then become an electrician, or a 2-day course to become a PV installer. Currently training for heat pump installation tends to be insufficient, with students acquiring basic knowledge but not enough practical knowledge to install onsite. Qualifications in this respect are falling behind the pace of innovation. Ground source pumps are more efficient (4 units) than air source (3 units) but need a larger area because energy taken out of the ground needs to be replenished; otherwise, those in small, terraced houses would freeze the neighbour's lawn!

*Building services engineering*
The basic curriculum for the building services engineer qualification is L3 in Scotland, and L2 in England and Wales, with 70% going on to L3; Maths and English need to be contextualised for trainees to move on to L3. Installers too start on L2 and then go on to L3, both as an apprenticeship. Building engineering services occupations are reviewed by BSE Skills Partnership every two or three years. The apprenticeships are rather traditional, though critical to addressing climate change, and for these apprentices learn about low carbon as well as low energy. There is also the pipework group: heating & ventilation, facilities management and ductwork/ ventilation, the latter gaining in importance in relation to LEC. What is seen as a pressing need by BESA is collaboration to eliminate tunnel vision for each relevant occupation.

*Plumbing*
Plumbing qualifications are also coming up for review. As these are intended to be employer-led, educationalists are not included in this process, though they make sure City & Guilds and the awarding organisation EAL (Excellence, Achievement, Learning – specialising in construction industry qualifications) are involved. For plumbing and electrical, after the apprenticeship standard is written, an assessment plan is devised and then given to City & Guilds to design the qualification handbook, which is then given to the training provider, the College. For L3 plumbing, the intermediate craft plumber leading to a blue not a gold card, the core skill set, and undertaken first by the apprentice, has four pathways: oil, solid fuel, gas, and environmental technologies (e.g. heat pumps, solar thermal). Currently the environmental technologies pathway is not much used, gas being the most popular route, for which it is necessary to be registered to install. On site, the plumbing apprentice is assessed by the training provider according to the basic skill sets and the full qualification is the diploma, taking four years to accomplish with knowledge and competence units mixed into one qualification. Besides diplomas, there are awards and certificates as separate qualifications, with the technical certificate undertaken outside the workplace. Such competent person schemes are important for third party certification of companies needed for quality warranties to protect consumers, though the person doing the work is best qualified under a personal specification scheme, such as the Construction Skills Certification Scheme (CSCS)[23] partner.

*Electrical*
A lot of what electricians do is about stopping electrocution or fire, which concerns the original wiring regulations. The danger now is, for instance, with high voltage electrical charging points in terms of earthing, which should be installed by a qualified electrician; batteries can also cause fire problems. Solar panels, too, feed into the grid so there is a direct current and an inherent safety issue, requiring qualified personnel. Apprentice standards for electrical were last set down in 2015, and those for the installation electrician and the maintenance electrician are under review, with the JIB pressing for the integration of more environmental content, for instance in relation to electrical vehicle charging. Photovoltaic Cells (PVC) have also, for instance, developed and need integrating to future proof apprenticeships. The electro-technical apprenticeship

[23] see https://www.cscs.uk.com

framework is also coming up for review and needs greater environmental content regarding, for instance, solar and photovoltaics.

There are issues for self-employed taking time out to do courses, though for larger contractors it is easier and for electrical there is some JIB funding towards courses. Until March 2021, however, the only training available for electrical energy systems or batteries was through manufacturers, which may be skewed to be product specific. Manufacturers also tend to work with particular colleges in the first instance. Electrical contractors need to be registered on the Microgeneration Certification Scheme (MCS), which requires that work such as heat pump installation is done correctly. The Electrical Contractors Association (ECA) has also been encouraging its members to use PAS2035 as a framework for installation, required for local authority and housing association work, which is intended to ensure that work is carried out in the coordinated fashion essential for effective zero carbon construction.

Efforts are being made by the Electrical Joint Industry Board (JIB), consisting of the unions and the electrical contractors' association (ECA), to introduce climate as well as energy literacy into the apprenticeship framework, above all through the development over the past 2-3 years of a L3 domestic electrician qualification, for which the curriculum and all the learning materials are to be introduced in 2023. With the electrical qualification, there has only been an environmental option till now, offered by just four training centres. The new qualification includes onsite generation, such as small wind energy storage, heat pumps, solar, PVC, load control, and all the smart technology to reduce energy consumption and maximise efficiency, control systems etc., as well as electrical charging as part of the main installation. It is thus mainly a question of introducing new technologies and pushing for advanced level competency, L3, which applies in Scotland. Training centres need support in obtaining the necessary equipment and motivating trainers, especially those towards the end of their careers who may anyway have little training themselves.

The domestic electrician is L3 whereas a full commercial electrician is 4 years. With the commercial electrical qualification, it is up to 415 volts, whereas domestic is 330 volts and an additional year is required to move from domestic to commercial. Everything needs to be integrated and this is where there are some difficult overlaps, for instance between the electrician and the plumber. Firms can possibly be a mixture of plumbers, or heating & ventilating and electricians. Existing ECA members are thus being encouraged to collaborate with other occupations to make sure that different activities involved are carried out in the correct order, as part of a push for green technologies. The domestic electrician should include climate and energy literacy as there needs to be an understanding of why the new technologies are needed. In terms of theoretical content, the physics remains the same as with the electrician framework, and the electrics are fundamentally the same; it is more about a change in technology, low carbon technologies. However, there is much reticence in the industry, especially from Scotland, concerning this qualification, which though at L3 is seen as watering down. It is, nevertheless, ideal for some local authorities, helping with rewiring and retrofitting and to ensure units are available for sustainable conversion.

The installation electrician, at advanced L3, is currently being considered, going deeper into environmental technology, such as solar PV, micro wind, smart technologies for elderly or disabled people, assisted living technology etc. Under the Electrotechnical Certification Scheme (ECS), installation electricians qualify for a gold card[24], certifying that they can work unsupervised on the installation, commissioning and maintenance of low voltage electrical and electronic equipment and appliances. There needs, however, to be a conversion pathway so that someone can transition from domestic to installation electrician.

### *8.3.2. Insulation*

For the CITB, the current focus is on installation, as a prerequisite, and research is being undertaken on what level is appropriate. The view of installation associations is that the process is quite straightforward, though it is important that installers be qualified, even to levels 5 and 6, and the expectation is that people should be trained to a high level. Currently a task group is updating an insulation and maintenance qualification for sustainability, at L3, though this is not yet available, but then another update will be needed specifically for retrofit. It is also complex as different companies have different products and each seeks to show they are

[24] https://www.ecscard.org.uk/card-types/electrotechnical/installation-electrician

making a difference, through for instance vendor qualifications. There is heritage insulation, such as lime and hemp, which is seen as a L2 heritage qualification, though the heritage sector does not want to incorporate its qualifications into mainstream programmes, which will impact on retrofit courses.

As explained by the IAA, the problems for insulators are lack of concern about upskilling, that there are no career pathways, and that the occupation does not have the apprenticeship qualifications needed focussed on the necessary competences. With insulation, for instance for cavity wall, an installer can be classed as semi-skilled. There has never been an apprenticeship on insulation and building treatment, just NVQs assessed onsite. Nor are there any standards in new build, so that processes may take place at the wrong time and property is thereby damaged. In contrast, retrofit standards are rigorous. Only now is the CITB developing national occupational standards (NOS) for insulation, taking the core elements; insulation standards are there but need to be mapped out. The problem is that insulating work and the level, whether L2 or L3, is different for each occupation involved in insulation and an interface unit is needed to cover where occupations encounter each other.

IAA is developing a national academy for insulation with career routes. FE colleges are, however, seen as too focussed on affordability, rather than on need, partly due to funding arrangements, and as a result, lag behind with new developments. Insulation is incorporated within different occupations but there is also a lot of subcontracting to specialist companies, for instance for high rise where there is complexity and a general lack of knowledge and understanding. There are myriads of different insulation activities, so what is needed are both specialists and different elements in existing occupations; electricians and roofers have, for example, different needs.

Insulation itself has implications for carbon emissions. Thus, while it is claimed that 26 million tonnes of carbon have been reduced through cavity wall insulation, buildings also need to be maintained. Logistics, which can be carbon intensive, are also important. Materials, mineral wool for instance, often require intensive industrial processes, whilst hemp & lime remains the preserve of specialist trade companies in UK. Cost drives nearly all operations and there is nervousness about new products, especially if they are not insured. A product may have good thermal capacity but, if installers have not been trained to install it properly, it can be problematic as moisture is trapped and the building is damaged. Robots, for instance, can also cause problems, such as the Q-bot, which sprays foam insulation under the floor, but if used wrongly can cause damage to the building through, for instance, trapping moisture and causing rot. Material cannot be removed when it goes wrong so, in this respect, innovation has been driven by the wrong motive and such a process cannot be given a 25-year guarantee.

#### *8.3.3. Retrofit*

For retrofitting, before the installation of heat pumps, for instance, it is necessary to make sure the house is insulated and insulation is a key stumbling block, including whether it is internal wall insulation or external wall, underfloor or loft. CITB has been looking at best practice but there are not many qualified training providers, with most training being by manufacturers, for their own products. The problems then are how to scale up the training for installation operatives and who is going to train the trainers. Nor is it clear who an insulator is; they are not counted in the Construction Skills Network forecasts, though may appear as 'building envelope specialists' or under 'specialist building operatives not elsewhere classified (NEC)'.

Of the new occupations envisaged for zero carbon construction, the PAS35 L5 Retrofit Co-ordinator qualification and L4 Domestic Retrofit Assessor qualification, training courses for which are offered by the Retrofit Academy[25], stand out and are heavily in demand. Both require cross-occupational awareness and criticisms have been raised that they are the not practical or long enough to provide the depth required, that entry levels may be inappropriate, and that they should ultimately be part of a wider curriculum within existing qualifications. The retrofit coordinator coordinates all the occupations involved, insulation operatives, painters etc., whilst the assessor makes sure everything is working. The 'skills' required for retrofitting are regarded as customer facing, including communication, understanding what the client wants and then developing that. There needs from the beginning to be an engagement with the building occupier and the

[25] https://retrofitacademy.org/level-4-domestic-retrofit-assessment/

relevant occupations need to be able to deal with those in the building and to consider how it is going to be used by the occupiers. Material use is one of the key areas though currently it was envisaged by interviewees that retrofit at scale would be delivered with the materials currently available due to price. However, for the future, artificial intelligence is seen as playing a role for some of the design work, coordinating the dimensions of building materials etc.

The not-for-profit Retrofit Academy[26], which develops retrofit training and qualifications, aims to train and develop 200,000 retrofitters by 2030. Funded by BEIS, it has developed qualifications and accredited courses, including:

- L2 Understanding Domestic Retrofit,
- L3 Retrofit Advice,
- L4 Retrofit Assessment,
- L5 Diploma in Retrofit Coordination and Risk Management.

One of the FE Colleges visited, partnered with the Retrofit Academy, considered introducing short L4 or 5 retrofit coordinator courses, focused particularly on supervisors and quantity surveyors. There currently exist L4 and 5 project management roles, the Site Supervisor Co-ordinator qualification, aimed at managing the supply chain. Firms remain wary of PAS2035 standards attached to the Retrofit Coordinator role because they are difficult to achieve, just as they are wary of, for instance, the Green Homes grant in case there is insufficient demand.

One of the biggest problems with retrofit is to use a heat pump. Heat pumps operate at lower temperatures and cannot just be switched off as with a gas boiler, which is good at heating up a space quickly. To install a heat pump, the house has first to be airtight, though making an old house airtight that was never meant to be can give rise to damp issues and require mechanical ventilation. Concerns have, as a result, been raised about the feasibility of the government's market-based *Heat and Building Strategy* to be delivered by 2050, especially given uncertainty about whether hydrogen boilers provide a viable alternative to heat pumps (HM Government, 2021). The Government projects 600,000 heat pump installations per year by 2028 but this relies on an untested market-based approach for heat pump roll-out and cannot be achieved in the period envisaged without faster progress in training and skills development, enforcement and governance (e.g. CCC, 2022). Currently, apart from FE Colleges, training in heat pump installation relies on short courses, such as those offered by the National Inspection Council for Electrical Installation Contracting[27].

#### *8.3.4. Connectivity of occupations*

BES referred to the technology platform 'Building People'[28], an aggregator of initiatives, intended to avoid doing the same thing over again and to equip engineers to cope with nearly zero issues. Emphasis is being placed on the connectivity of occupations, including informally through toolbox talks, to understand and appreciate the role of each within a particular project, including the heritage subsector. When asked about knowledge required of the work of other occupations and the development of holistic understanding, the CITB interviewee explained how NOS now include how occupations relate to each other. Each needs to understand what other occupations are doing for net zero and within tight tolerances, though with existing qualifications this was not dealt with to any great degree. It might be possible to include an awareness module to incorporate overlaps in occupations that work alongside each other. Site managers' and Clerks of Works' understanding needs to be improved as well, as often site managers just tick a box without ensuring proper completion and fitness for purpose of a building. Co-ordination needs to be ensured in new design and there is currently no consumer protection, as evident from underfloor fan heating, not covered by a 25-year guarantee.

#### *8.3.5. New occupational profiles?*

In terms of future developments, besides the new retrofit occupations, a range of examples was given by respondents. The CITB is, for instance, developing a digital competency framework, focusing initially on emerging technologies. The expectation is that the same customer skills required for retrofit will be required for new build. Data processing and sharing are other areas as a key weakness of the construction sector is data

[26] https://retrofitacademy.org/about/
[27] https://www.niceic.com/contractor/training-courses/renewables-courses/heat-pumps
[28] https://www.buildingpeople.org.uk

sharing; data are captured but not then shared for the future so that every project becomes one-off. Such a digital competency framework is, however, at the developmental stage. Rather than going through specific occupations to determine what is needed, CITB is looking at broad occupational areas for all operatives - whether installers, carpenters, bricklayers, sustainability operatives, supervisors or site managers – to determine the knowledge required in terms of digital literacy, security, signing developments etc. By using the framework, the competencies can then be derived.

#### *8.3.6. Considerations*

From the range of responses given by interviewees, an overall picture can be gleaned of what is needed for zero carbon construction, what the obstacles to implementation are, and what the current stage of development is for the UK construction sector. In general, the industry is far from being climate literate, including in the sense of considering the impact of its own actions on the environment right through the supply chain. There is, however, increasing understanding of what is needed for large scale retrofit in terms of competences and new occupational profiles, though the training necessary is only at early stages. Coordination, communication, digital literacy, project management ability, and occupational connectivity are all terms frequently used. However, looking at the main occupations involved in realising zero carbon construction, the building services appear more advanced than those involved in the building envelope. Thus, whilst the domestic electrician qualification is being introduced, equipping trainees to install, for instance, heat pumps, insulation remains a relatively neglected area, including in terms of training. The danger, therefore, is that the air tightness necessary for renewable energy sources to be effective and energy consumption to be reduced, will not be achieved or, if it is, then the result may be serious problems of moisture given insufficient knowledge of insulation or ventilation.

### 8.4.Barriers to embedding climate and energy literacy into the curriculum

The obstacles to achieving climate and energy literacy in construction in UK are many, not the least the lack of a clear government policy and the marginalisation of key stakeholders, including the unions and FE Colleges, as well as particular problems raised by those interviewed, including:

#### *8.4.1. Problems of FE College training*

Currently lecturers often do not have the new knowledge and skills needed and there are also problems of college rivalry, coordination, and loss of facilities. Updating staff is important but is compounded by recruitment and staffing issues. In launching a new qualification, such as for the domestic electrician, the first thing is to gain acceptance by colleges and make sure training and equipment are in place. This needs, however, to be accompanied by stronger gatekeepers and more regulation as often training provision can be just commercial, so the quality of training needs vetting and entry requirements specified. The problem is who will train the trainers. Experienced workers may be prepared to spend part of their time training the next generation without necessarily being employed by the colleges or involved in the administration. Another significant problem for FE Colleges is the costs involved in equipping and running workshop facilities with up-to-date equipment and appropriate resources.

#### *8.4.2. Lack of interest in the industry in employing trained and qualified personnel*

An obstacle constantly raised, including by building services experts, is the lack of interest shown by the industry in providing work experience and employing trained and qualified workers, as well as a lack of coordination with and responsiveness to what industry needs.

#### *8.4.3. Procurement and Policy requirements*

The question of procurement, how far it is an obstacle and how it can be used to drive change, was raised by many respondents, for instance through local authority supplementary planning documents (SPDs), laying down a wide range of social and environmental conditions for developers, and Section 106 planning requirements referring, for instance, to training, employment, environmental and equality targets that contractors should meet. One problem, however, is the duration of building projects as lead times for the development of a workforce capable of handling the design specifications of low carbon construction are to be measured in years and only very large projects last that length of time.

Another problem is how robust are the processes of monitoring compliance and auditing qualifications and certifications. Apart from those working with gas, there is no licence to practice, though a competent person needs to be a judicial entity. For instance, when Part P in domestic electrical work was introduced, requiring only L2 rather than L3 qualification, the London Fire Brigade reported a 97% increase in fires as many called themselves electricians when they were not.

Another policy stick is the need for an Energy Performance Certificate (EPC) grade before a house is released. However, what was seen as the key driver was the government banning the sale and then the installation of gas boilers, though this incentive has been removed and gas boilers will still be available and installed up to 2035. Despite this, increasingly, LETI (London Energy Transformation Initiative)[29] guidelines, laying down minimum standards for net zero carbon building, are referred to as necessary for contractors to meet if they are not to lose contracts. It is argued that companies that can readily supply environmental technologies are going to find it easier to compete, especially if, through procurement, local authorities require contractors to use PAS2035 or suppliers to guarantee, for instance, that no plastic-only source materials.

#### *8.4.4. Other*

A range of other obstacles to ensuring zero carbon construction was raised, above all the lack of a diverse workforce. However, the construction industry is changing rapidly through the increased use of offsite technologies, so sites have become more inclusive. The profile of students coming into the sector is also shifting and a larger pool of recruitment emerging, with many looking at what they can do at higher levels, including L7, or well-qualified school leavers entering with the capability to progress who see construction occupations as a good grounding. There are also more women and those from BAME groups on some FE college courses and young people are coming in who are aware of changes that need to take place and want 'to make a difference'. In this respect, climate change represents an opportunity, and more women coming in has contributed to challenging inertia and raising recognition that collaboration is necessary to drive change. Nevertheless, careers advice remains a problem, as does too early tracking in schools. Qualification awarding bodies too are geared to financial return rather than what the industry needs.

### 8.5.Conclusion

All in all, the UK is at a low level of development in terms of incorporating climate and energy literacy into the curricula of the different construction occupations, though the situation is changing. In large part this slow progress is due to lack of regulation by government and the insistence on an employer-led system, the marginalisation of unions and employers' associations, and lack of recognition of NOS. Many initiatives on the ground by the different industry organisations and in the separate nations – Wales, Scotland, and Northern Ireland – represent attempts to overcome these restrictions.

## 9. Overall conclusions

LEC means a transformation of VET systems to encompass deeper knowledge of energy efficiency, higher technical and precision skills and, above all, a holistic approach so that the building envelope is conceived as a single thermal unit and the social interaction of different occupations is understood. The high-quality construction labour process required involves teamwork and cross-occupational coordination, which imply interdisciplinarity, as well as transversal abilities such as communication, project management, precision, problem solving and coordination. But over and above this, climate as well as energy literacy is needed to give meaning to the knowledge, skills and competences acquired, so that trainees and workers are empowered and can appreciate why they are doing what they are doing and recognize their contribution to creating a safer and more equitable society. Climate literacy is tied to social equity and climate justice, comprising affirmation of the social contribution and responsibility construction workers, their unions, and the industry have to reduce emissions and the influence they have in determining policy direction.

[29] https://www.leti.uk/cedg

In addressing these LEC requirements, each of the VET systems outlined has its own strength and weakness. With the CMEs, whilst the construction curriculum of the Swedish school-based system, with its emphasis on knowledge and general competences, is underpinned to an extent by climate literacy and the inclusion of transversal abilities, it is insufficiently detailed or occupation-specific. The curriculum of the other largely school-based system, Belgium, succeeds in mainstreaming LEC elements, breaking down broad occupational profiles into knowledge, know-how and attitudes and developing transversal abilities, so facilitating trainees to work independently and in teams across broad interfaces. Yet, climate literacy is not directly embraced. The other CME, Germany, has the advantage of a stepped programme of gradual specialisation, helping trainees to understand the whole building envelope, as well as covering climate change relating to different occupations, but is weakened by low unionisation and dependence on individual employers to take on trainees.

In many respects the construction VET systems of LMEs, more constrained by market conditions, are at a disadvantage in their ability to meet LEC requirements and incorporate climate as well as energy literacy. They have nevertheless the advantage of being less constrained in developing new initiatives, particularly at local level and by the unions, as evident in the countries considered. Whilst VET for LEC initiatives in North American LMEs are rooted in the unions, this is far less the case in LMEs such as Ireland and Britain, where unions play a marginal role in developing curricula and in the VET system. In Ireland, the state is pivotal in supporting LEC and the training courses needed for the existing workforce through the Training Boards and Institutes of Technology, though curricula lack the emphasis on climate literacy and the impact of climate change on different occupations and efforts to embed climate literacy into VET lack urgency. The success achieved in turning a pilot LEC training course into a (nearly) national programme tailored for different occupations owes much to a process that mimics aspects of co-ordination and stakeholder partnership found in CMEs. In Britain, despite the employer-based VET system, unions play a role in promoting LEC elements in building services curricula, and politically accountable local authority direct labour building departments together with the FE colleges provide an important alternative model. In other respects, VET suffers from lack of regulation and curricula are narrow and largely restricted to developing technical skills for LEC rather than the underpinning knowledge required or climate literacy.

Whilst each system has its pros and cons, what is evident is that the 'skill'-based LEC VET systems need to move towards the 'occupation'-based CME approaches if LEC requirements are to be addressed in curricula. Whether CME or LME, whilst energy literacy is increasingly incorporated, only rarely do curricula address climate literacy per se, though this represents an important means to empower construction workers, providing both a motivation for building a zero-carbon economy and a threat to the status quo. Above all, achieving equity remains a critical issue in construction and for construction unions if they are to be a positive force in transitioning to a green economy. Indeed, valuing labour is key to valuing the environment and combatting climate change.

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