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Overcoming diverse approaches to vocational education and training to combat climate change: the case of low energy construction in Europe

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ABSTRACT

Vocational education and training (VET) can play a transformative role in reducing CO_2 emissions and improving the energy efficiency of buildings across Europe. Nearly zero energy building (NZEB) requires an energy literate workforce, with broader and deeper theoretical knowledge, higher technical and precision skills, interdisciplinary understanding, and a wide range of transversal competences. Through an investigation into VET for low energy construction (LEC) in 10 European countries, the article identifies a range of different strategies advanced under constraints imposed by the VET systems and construction labour markets. At one extreme, representing the 'high road', LEC elements are mainstreamed into broad-based occupational profiles, curricula and qualifications, whilst at the other, the 'low' road, short, specific and one-off LEC courses simply aim to plug existing 'skills' gaps. It is argued that the 'high road' approach, in encompassing a broad concept of agency, successfully addresses NZEB requirements whereas the 'low road' represents an instrumentalist approach to labour that jeopardises the achievement of higher energy efficiency standards. The article concludes by presenting a transparency tool set within the European Qualifications Framework, against which different VET for LEC programmes can be assessed.

KEYWORDS

Vocational education and training; low energy construction; climate change; European Union; qualification frameworks

Introduction

All too often, the issue of climate change is treated as a purely technical one, outside the realm of social sciences or education unless to raise awareness. To address it effectively, however, requires a transformation in VET and qualification systems as well as in labour markets. With the example of the construction industry across Europe, this article explains why this is so and what can be done to implement change. The aim is to identify the changes in the quality of labour and in VET required to achieve nearly zero-energy buildings (NZEB) and to present a trans-European framework or transparency tool (Table 1) against which different VET programmes for low energy construction (LEC) can be assessed.

According to the International Labour Organization (ILO, 2011), the world of work in industrialised countries produces 80% of human-created greenhouse gas emissions; work, worksites and production supply chains are major polluters. Improving the energy

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Table 1. Outline of a Transparency Framework for NZEB Qualifications.

Aims of qualification						
Vocational		**Civic**		**Liberal**		
Yes		Includes critical appreciation of construction industry and NZEB barriers		Yes, allows scope for continuing personal development		
Attributes						
knowledge		**know-how** *Each characteristic presupposes possession of one above (apart from skill)*		**personal characteristics (sometimes known as Competence or Attitude)**		
systematic	***non-systematic***	Mastery of technique				
		Skill: specific abilities connected with installation and evaluation of NZEB technologies, including development of appropriate tacit knowledge.		***individual*** Curiosity Independence Self-evaluation e.g. • Possessing a sense of initiative, tackling problems arising by oneself, without requesting to do so. • Possessing a critical and analytical frame of mind.		***social*** Co-operation, ability to see different points of view e.g. • Exchanging information with colleagues and clients in friendly and constructive manner. • Having courage to accept colleagues' remarks relating to work and security and taking responsibility for pointing out dangerous situations. • Assisting colleagues so that team can work ergonomically.
Technical theory, including some physics and engineering, knowledge of climate change theory. e.g.: *Principles of 'quality' building*: • Airtightness and insulation • thermal bridging, • moisture and ventilation, and • significance of window quality and positioning.	*Contingent facts* (e.g. local conditions) To be acquainted with site layout, areas of potential danger, drainage channels.	*Transversal abilities* Co-ordination Communication Evaluation Negotiation e.g. • Designing repair to moisture-damaged structures. • Supervising wet room installations. • Controlling circulation onto and on site. • Reacting to diverse situations. • Analysing state of site, diagnosing problems and solutions.	*Work-place* Yes	*Other Locations* Yes, including simulations and classroom	*Work-place* Yes	*Other Locations* Yes, including simulations and classroom *At least one of these locations will be involved in know-how above a threshold level*
Normative theory Health and safety legislation. EPBD. Legislation governing NZEB and barriers to making it effective	*Local procedures* e.g. site procedures for disposal of waste.	*Process management ability* Understanding of NZEB building process				
Social science theory Understanding NZEB role in contemporary debates and constraints on its introduction.	*Materials* Insulation	*Occupational capacity Displaying conduct, way of thinking and behaviour necessary to practise occupation.*				

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

efficiency of buildings across Europe is essential to tackling climate change given that the built environment is responsible for 36% of CO_2 emissions and 40% of energy consumption (Dupressoir, 2008). The European Union (EU) strategy to transition to a low-carbon economy is to reduce emissions by 20%, increasing the share of renewables by 20% and improving energy efficiency by 20% by 2020, and to achieve an 80% CO_2 reduction in building emissions by 2050 (European Commission [EC], 2011). This implies a major role for the construction industry, set to experience the highest employment growth of any sector (ILO, 2018). A vital element in this transition is an energy literate labour force equipped with the knowledge, skills and competences (KSCs) to carry out the work.

In relation to employment in green construction, Ramioul et al. (2016) consider the effects of team design and work organisation on job quality in two firms specialising in low energy housing and distinguish between a 'high' and a 'low' road. The 'high road' is more employee-centred than the 'low road', with greater worker participation, empowered teamwork, investment in developing workers' capabilities and better job quality. It is focussed on collectively carrying out projects, enhancing qualified labour to actively participate in planning and carrying out the work and recognising qualifications acquired, thus implying a broad concept of agency (Winch, 2014). By contrast, the 'low road' is characterised by high levels of control, standardisation, increased specialisation and a production flow that resembles automated manufacturing. In effect, these roads describe two extremities on a diverse scale of approaches to the development of labour, which has significant implications for VET and consequently also VET for LEC.

The 'low road' strategy accords with Taylor's (1911) approach, expressed in his fourth principle of scientific management, developed and applied through a study of construction (Taylor & Thompson, 1912). This approach implies replacing the judgement of individual workers by 'rules, laws and formulae', so departing from a VET system dependent on 'initiative and incentives'. Management becomes responsible for determining the best method to complete each task and training the worker accordingly in what is essentially a task-based system, with each activity in the work process broken down into a series of tasks, in a manner akin to Smith's (1776/1981) division of labour. Smith assumed that the specialisation and concentration of work on single subtasks, matching skills with equipment, would lead to greater productivity than if each worker carried out a broad activity. However, in contrast to Taylor, Smith saw a problem in applying this concept as leading to 'the almost entire corruption and degeneracy of the great body of the people … unless the government takes some pains to prevent it'. (Smith, 1776/1981, p. 781). Nevertheless, the concept underpins the notion of human capital in Becker's (1994) theory, which represents an instrumental approach to labour, developed to respond to employer-identified needs for workers with specific skills. The capacity of labour and potentially more enhancing and productive ways of organising the production process are secondary to employer needs.

This instrumentalist approach is echoed in the European Skills, Competences, Qualifications and Occupations (ESCO) initiative to identify all the 'skills' associated with a particular area of activity. With its focus primarily on 'skills' and only secondarily on knowledge and attitude, ESCO contrasts with the European Qualifications Framework (EQF), the 'meta-framework' developed to allow comparison of different qualifications,

built on common understanding of KSCs and intended to establish equivalence between occupational qualifications at different levels and thus facilitate the development of European-wide occupational labour markets. In this respect, the EQF – as with the 'high road' – has the potential to accord with the 'training' approach identified by Marsden (1999) and defined as institutionally regulated, related to a person's ability and certified qualifications, usually collectively and industrially organised, and long term by equipping him or her over a working life to operate in a specific occupation and sector. Marsden contrasted this with what he termed a 'production' approach, akin to the 'low road', where skills are work-based and firm-specific, with training dependent to a large extent on the individual employer and on-the-job learning. As demonstrated in previous research on bricklaying qualifications across Europe (Brockmann et al., 2010; Clarke et al., 2013), this distinction can well be applied to the construction sector. Indeed, the two roads are encapsulated in Weil's (1955, p. 95) description of construction workers discussing and resolving a problem on site:

> … a team of workers on a production-line under the eye of a foreman is a sorry spectacle, whereas it is a fine sight to see a handful of workmen in the building trade, checked by some difficulty, ponder the problem each for himself, make various suggestions for dealing with it, and then apply unanimously the method conceived by one of them, who may or may not have any official authority over the remainder. At such moments, the image of a free community appears almost in its purity.

Drawing on research on VET for LEC in 10 EU countries, this article argues that such contrasting conceptions of labour are also evident in the different strategies advanced under constraints imposed by both the VET system in place and the construction labour market (Clarke et al., 2019a, 2019b). VET systems based on social partnership and consensus, often criticised for their rigidity and inability to adapt, are at the forefront of innovation to address LEC requirements. In these, LEC elements are mainstreamed into broad-based occupational profiles, curricula and qualifications, representing the 'high' and most effective road to a low-carbon built environment. In other VET systems, attempts to develop more comprehensive VET for LEC provision are found, though having differing degrees of success. However, those simply plugging 'skills gaps' with short, specific and one-off courses represent the 'low road', one that jeopardises the achievement of energy efficiency standards and corresponds to an instrumental approach to labour.

Context: EPBD, NZEB and build up skills

In its requirement that all new buildings are NZEB, the Energy Performance of Buildings Directive (EPBD) is driving the LEC transition and steering the VET system towards a high road. Member States are responsible for transposing the Directive into national law and implementation, utilising instruments such as national energy action plans, financial incentives and energy performance certification schemes. The 2018 amendments include measures to support the renovation of existing buildings and set higher energy performance standards through, for instance, an airtight physical separator between the conditioned and unconditioned environment of a building, known as the building envelope, thermal bridge-free construction and on-site renewable energy sources. Within the EPBD

framework, individual EU countries are, however, allowed to define their own, cost-optimal minimum energy performance requirements so exact NZEB technical specifications vary (EC, 2016a)

Raising standards has major implications for construction VET as achieving EPBD targets depends on an adequately qualified workforce. As part of the Intelligent Energy Europe Programme (IEE), intended to build capacity and expertise in energy efficiency and in the installation of renewable energy systems (RES), the Build Up Skills (BUS) investigation (2010–2017) was launched to support up-skilling of the current workforce and provide an overview of VET needs and developments across Europe. Pillar I (2010–12) involved a Status Quo analysis to identify the 'skills gap' in each of the 30 participating countries and a national roadmap for addressing these, followed by Pillar II (2013–17) involving projects in 22 countries designed to develop the infrastructure needed.

BUS (EC, 2014) highlighted the sheer scale of the task facing the construction sector. The number of construction workers in need of training runs into millions across the EU, whilst upgrading occupational competences and learning resources, developing new courses and qualifications, and training the trainers suggest a major transformation. These challenges are compounded by under-resourced VET systems in many countries, with several also undergoing major reforms to align national qualification frameworks (NQFs) with the EQF. Moreover, the sector faces a severe recruitment crisis, an ageing workforce and reliance on migrant labour, with millions of workers having low general education levels and lacking formal training or qualifications. Many employers neither value nor see the need for qualifications and the sector is dominated by micro firms and casual and self-employment – factors leading to a low road and presenting a momentous challenge to retraining the workforce (Clarke et al., 2019a, 2019b).

A sharp difference exists between EU Member States in the structure of the construction labour market, on the one hand, and in initial VET (IVET) and continuing VET (CVET) systems on the other. Though faced with the same objectives, the scale and timing of what needs to happen and the resources in place vary substantially. VET programmes have been developed as part of BUS Pillar II (EC, 2016b) and through Horizon 2020, but questions concerning LEC KSCs and how to embed these into existing VET pathways remain unanswered. In terms of 'qualitative' change, BUS highlighted knowledge of climate change, energy efficiency, energy performance standards and inter-disciplinary learning as essential for ensuring the closely co-ordinated and collaboratively organised construction process needed. NZEB calls for the deployment of a broader and deeper theoretical knowledge base, encompassing principles of energy efficiency and building physics, higher technical and precision skills and a wide range of transversal competences, in new build and retrofitting (Clarke et al., 2017). Cross-occupational coordination on site requires enhanced inter-disciplinary understanding and substantial and varied practical experience, particularly for eliminating thermal bridges in buildings, involving actions at the interfaces of different occupations, such as between the work of electricians and insulators. The implication is that energy performance requirements can only be met by overcoming obstacles that lie both in the VET system (achieving broad and comprehensive know-how) and the construction labour process (bridging occupational interfaces). Improving VET quality is of fundamental importance, given persistent evidence that energy performance requirements specified in NZEB are not met in practice because of incorrect and poor-quality installation, effectively jeopardising EPBD emissions savings stipulations (Sunikka-Blank & Galvin, 2012; Zero Carbon Hub, 2014).

The higher and more comprehensive education for construction workers required for successful NZEB implies a radically enhanced and broad sense of agency as each worker needs to take responsibility for completing tasks with precision to standards specified and to understand the consequences of not doing so (Clarke et al., 2013; Winch, 2014). By contrast, VET models designed to teach specific skills imply workers are responsible only for completing narrow tasks, without any necessary involvement in the big picture of producing a building and therefore opportunity to connect their own role with outcomes such as energy performance standards.

This article demonstrates the disparate approaches to NZEB across Europe, each shaped by the respective VET system, labour market regulatory regime, and particular NZEB implementation strategy in place (Streeck, 2011). Our analysis of IVET and CVET LEC programmes in 10 European countries reveals the expertise and range of KSCs required, facilitating further development of the transparency tool (Table 1), in conformity with the EQF, to compare programmes and identify KSCs not included. However, achieving equivalence and standardisation of LEC expertise across Europe is challenging, given that VET models reflect specific labour market situations and government policies and that qualification systems gain currency within the framework of the existing VET-labour market relationship (Allais, 2017). Nevertheless, even countries characterised by a 'low road' approach can begin to identify what is necessary to develop and deliver VET appropriate to NZEB and address fundamental problems rooted in their respective VET system and labour market.

Methodology

The article draws on a study of VET for LEC developments in Belgium, Bulgaria, Finland, Germany, Hungary, Ireland, Italy, Poland, Slovenia and Spain, which analysed current provision in the contexts of NZEB implementation, construction labour market and workforce characteristics, and national VET systems (Clarke et al., 2019a, 2019b). The project partners represented employer organisations, unions, and training providers and the focus of the study was building envelope occupations, such as bricklaying, carpentry, roofing, insulation and groundworks, rather than building services occupations, including plumbing, heating and ventilation, and electrical work. The findings are based on analysis of documentary evidence and interview data. For all 10 countries, secondary data sources consulted consisted of National Reports produced by the project partners to provide information on VET for LEC developments in their respective country; European Construction Sector Observatory country reports,[1] BUS country reports,[2] European Centre for the Development of Vocational Training (CEDEFOP) country reports,[3] and EU NZEB national progress reports (EC, 2019). These sources were supplemented by the expert knowledge of project partners in response to specific queries, requests for clarification and through discussions over a two-year period. In addition, seven of the countries – Belgium, Bulgaria, Finland, Germany, Italy, Ireland and Poland – were selected as case studies representing different VET approaches, to gain further insight into VET for LEC strategies and implementation. In visits to these countries, additional primary data were gathered through in-depth interviews with VET providers, unions and employer representatives and on LEC sites.

The first phase of the research, analysis of documentary evidence and interview data, identified challenges to developing and delivering effective IVET and CVET for LEC and

approaches emerging in response. In the second phase, examples of IVET and CVET for LEC were assessed, including occupational profiles from Belgium (IVET); curricula from Germany (IVET and CVET), a sectoral qualification framework (SQF) from Poland (IVET); and specific modules from Finland (CVET). These examples were supplemented by a module-based programme for construction professionals (e.g. site/project managers, architects, engineers) from Slovakia; and course content guidance from Britain, developed by Leeds College of Building for the Construction Industry Council (CIC, 2017). Examples from Finland and Slovakia are valuable in illustrating a modular approach to developing the existing workforce, adaptable for building envelope and services workers. On the basis of this assessment, the transparency tool (Table 1) was elaborated and guidelines developed for VET providers.

Approaches to developing VET for LEC

From our analysis, a divergence in approaches to VET for LEC is evident, whether:

(1) LEC elements are mainstreamed into VET programmes of existing construction occupations (Belgium and Germany);
(2) NZEB is embraced and VET for LEC developed comprehensively (Finland and, to a lesser extent, Ireland);
(3) VET for LEC just relies on many regional and local initiatives, particularly CVET (Italy, Spain, Slovenia and Poland); or
(4) only limited and sporadic efforts are made (Bulgaria and Hungary).

At one extreme (1 above), VET systems are organised along occupational pathways and provide a comprehensive programme incorporating theory, workshop simulation and on-site practice. These represent the equivalent of a high road strategy in adopting a broad approach to LEC expertise and embedding relevant KSCs into all construction occupational profiles. As well as developing occupational capacity, this approach supports the development of transversal abilities, such as project management, communication skills and continuous learning in response to innovations (Winch, 2006), all crucial for meeting LEC site challenges (Clarke et al., 2017). At the other extreme (4 above) are VET systems organised for narrow specialisations, representing the low road in taking a fragmented approach to LEC expertise, only addressing specific aspects (e.g. RES installations), and with little, if any, emphasis on theoretical understanding of the 'big picture'. With limited involvement of the social partners (unions and employers), this approach is underpinned by a narrow and instrumental concept of labour leading to inadequate development of the whole person, with self-monitoring replaced by increased site supervision. In between these two extremes, lies a hybrid, 2 and 3 above, consisting of elements of both approaches.

High road VET for LEC

Considering the expertise needed for successful implementation of NZEB standards, the occupational approach or 'high road' emerges as more suitable for providing the broad, high level, inter-disciplinary education required. From our study, Belgium and Germany come closest to this, with KSCs required for VET for LEC deeply integrated into existing profiles, curricula and exam regulations for each occupation, for example, the bricklayer,

plasterer, plumber and electrician qualifications. These broad-based IVET systems emphasise LEC underpinning knowledge, such as of Building Physics and Materials, and provide workers with an overview of the sector, as well as stressing transversal abilities such as communication, coordination and teamwork. In Germany, national curricula for each construction occupation (including building services) incorporate VET for LEC elements and provide detailed syllabi through pedagogic materials, such as lesson plans, teacher notes or supporting textbooks. For example, the textbook for the plasterer (*Stukkateur*) includes, amongst other aspects, the purpose of insulation, internal climate control, costs of heating and energy use, environmental protection and thermal bridging (Handwerk und Technik, 2014, pp. 172–9). IVET programmes are under constant review and adjusted to take account of technological changes, economics, the legal framework and social conditions. 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.

Belgian VET operates within a relatively decentralised framework, where the state's role is more limited than in Germany and where employer organisations and unions work together to construct IVET occupational profiles, which then serve as templates for colleges and other VET organisations to construct curricula. Profiles have a tripartite structure, including knowledge (*savoir*), know-how (*savoir-faire*) and attitude (*savoir être*), with the latter covering elements such as care, attention to detail and teamwork. Each profile consists of a detailed description of what is involved in practising the particular occupation and is designed to include overlaps with related occupations, allowing for mutual understanding of and competence in relevant LEC activities so important to meeting the holistic requirements for successful NZEB.

LEC in Belgium and Germany has a long history and both countries were early adopters of NZEB, with established expertise and knowledge on energy efficiency and renewable energy sources incorporated in VET systems and the respective governments providing a strong lead and investment in implementation. For these countries, BUS recommended only specific changes, including strengthening systems thinking and interdisciplinarity in Germany (BUS, 2012) and improving theory-practice integration and teacher training in Belgium (EC, 2014). Both VET systems are resourced and up-to-date, combining school-based and practical learning through a substantial off-site, workshop-based component and work placements, so breaking the division between hand and brain, which, as expressed by Pring (1995, p. 83), 'bedevils our deliberations on education'. This broad-based model provides a suitable framework for developing knowledge and understanding of energy efficiency and opportunities for gaining a holistic view of construction to enhance occupational coordination. With its scope for developing transversal abilities, such as communication, collaboration and coordination, VET develops 'occupational capacity' and implies a broad understanding of agency (Clarke et al., 2013; Winch, 2014), thus responding to the demands of an LEC labour process that workers operate independently, apply expertise acquired appropriately, problem solve as necessary and take responsibility for meeting specified standards and quality.

In Belgium and Germany, the construction labour market is regulated and less fragmented than in many other European countries, providing an infrastructure for the work-based element of VET that is difficult to achieve elsewhere, so conforming to Marsden's (1999) 'training' approach. In Germany, micro firms, which can lack the resources and

capacity to train across a wide range of activities, constitute less than a quarter of total firms and only 12% of the workforce is self-employed and thereby in no position to train. The structure of the Belgian construction sector is less conducive to work-based VET as 50% of firms are micro and 25% of the workforce self-employed, though IVET is anyway predominantly school-based. In both countries, about 15% of all construction workers are non-nationals. Indicative of the importance of VET qualifications is that 62% of the workforce in Belgium is skilled, 32% semi-skilled, and only 16% classed as labourers. Similarly, in Germany, between 67% and 72% of the workforce hold a recognised vocational qualification and IVET recruitment patterns show relatively high qualification requirements (Bundesagentur für Arbeit, 2017). A highly qualified workforce is important for successful CVET for LEC activity, signifying that employees already possess basic knowledge and competence to master new concepts and techniques. As a result, in Germany, which has a well-developed career path through CVET up to EQF level 7, work-based CVET addresses immediate KSC requirements and leads to qualifications at levels 4, 5, 6 and 7. In both countries, CVET for LEC provision is extensive in range and geographical availability.

The historically strong and encompassing collective institutions, juridical industrial relations procedures (Streeck & Hilbert, 1991), substantive regulation of employment conditions, and social partnership and consultative structures in both countries allow for the input of all stakeholders in setting common goals, meeting national and EU VET targets, and solving problems. Social partners alongside educationalists are involved in developing and implementing VET policy at national, regional and local levels, including drawing up occupational profiles, making regional adjustments and developing VET programmes and curricula. This makes for relatively unified 'high road' VET systems that allow for regional variations within nationally applied frameworks, which set out overall standards, occupational profiles, learning outcomes and qualification structure. At the same time, levy-grant arrangements facilitate co-ordinated development and responses to new developments within the sector, such as insulation and timber framework in Belgium and 'certified renewable energy specialists' in Germany.

On the way to a high road

Though IVET systems in Finland, Ireland, Italy, Poland and Spain are under-resourced and need considerable improvement, recent efforts to develop a more coordinated and comprehensive approach to integrating LEC elements place these countries in a middle, hybrid road. Ireland, Italy and Spain were particularly affected by recession, seeing their construction workforces halved. Finland is unique in that only IVET for building services occupations has been upgraded to include LEC topics in its school-based system, though the country is otherwise similar to Belgium and Germany in terms of social partner involvement, a long history of energy efficient construction and strong government lead in EPBD implementation. For building envelope occupations, however, IVET in Finland is closer to 'low road' countries, lacking particularly in theoretical knowledge and with out-of-date learning materials and limited practical learning opportunities. In Poland, an important development is the construction of SQFs within the overall EQF architecture, providing a panoramic view of the construction sector to facilitate co-ordination of occupational profiles and to make occupational overlaps transparent before

occupational profiling for specific occupations. In each country, new LEC 'occupations' have emerged, including insulation in Poland; heat pump, boiler, biomass and cooling device installation in Finland, Ireland and Spain; and air permeability testing and energy assessment in Ireland.

With CVET, some limited lower level opportunities exist for building envelope occupations in Finland, Italy and Spain, where provision is by private companies. In Poland and Spain, provision is mainly at higher levels, catering to those with some existing technical training, mostly in RES installations. This emphasis on training those with existing technical training and qualifications rather than the development of thermal literacy in all workers is characteristic of a 'low road' approach, implying concentration of expertise at higher levels.

Under BUS in Ireland a short six-unit CVET course on LEC for the current workforce was developed, Foundation Energy Skills, leading to a certificate and covering much the same ground as the German curricula but in less detail (QualiBuild, 2014). In contrast to the German and Belgian systems where LEC expertise is embedded in curricula, this serves as an introduction to LEC principles and has been adapted for IVET use as a standalone unit added to current training pathways. The course represents an important step in integrating LEC into IVET at national level and sets an example for countries making little significant progress with VET for LEC curricula. The approach, whereby modules are self-contained and not necessarily part of a larger qualification, corresponds to the fragmentation concept of modularisation (Ertl, 2002, p. 59) rejected for IVET in countries such as Germany, which depend on end-point assessment for an integrated completion qualification.

The BUS Pillar II programme and subsequent Horizon 2020 projects in these 'middle road' countries prioritise the development of future VET for LEC capacity and infrastructure and include: preparing learning/teaching materials and setting up training centres (Ireland), the training of teachers (Poland and Ireland), and developing short, introductory courses for the existing operative workforce (Finland, Ireland and Italy). Short CVET courses for building envelope workers, developed as part of BUS projects in Finland, Italy and Spain, ended with their completion, though the learning materials continue to be accessible.

In these middle road countries, the labour market, characterised by a phenomenal number of small and micro firms, undermines any training infrastructure and is more characteristic of Marsden's (1999) 'production' as opposed to 'training' approach. For instance, in 2015, at least two-thirds of firms in Italy and Ireland were micro firms and a half in Finland and Poland. In addition, nearly 98% of firms are SMEs in Italy and in Spain, where 64% of firms are classified as having no employees, whilst in Finland, Poland and Italy over 96% of firms employ fewer than 9 or 10 workers (Eurostat, 2015). In Italy 43% of the construction workforce is self-employed, followed by Ireland at 37%. Where there is a myriad of micro firms (e.g. Ireland and Italy) and extensive subcontracting, little substantial work-based training takes place as each has limited scope to provide placements and/or work-based learning covering a broad range of activities, contribute to training funds, and afford CVET in LEC.

Given this weakening of the work-based training infrastructure and dramatic changes in employment, all these 'hybrid' countries complain of skill shortages, especially in specialist and technical areas, such as in Finland communication and supervisor skills. Many have consequently come to rely on non-national workers, who constitute 30% or more of the construction workforce in Italy and Poland, 18% in Ireland (especially

bricklayers, plasterers and carpenters), and 17% in Finland, posing further challenges to meeting NZEB standards (Clarke et al., 2019b).

Unlike high road countries, in middle road countries social partner involvement in VET can be relatively weak, varying from commenting on national policies and participating in coordinating bodies to having joint responsibility at sectoral levels (Italy, Poland and Spain). VET development is a state responsibility and the regulatory framework in place may play little or no role, as in Ireland, in facilitating social partner engagement.

Low road VET for LEC

In contrast to the high and middle roads, Bulgaria, Hungary and Slovenia closely conform to Ramioul et al.'s (2016) 'low road' to green construction, where tasks are narrow and skills deployed and learning opportunities limited, and sit firmly in Marsden's (1999) 'production' model. VET for LEC in these countries is in a state of flux, with VET systems undergoing reform and NZEB implementation at an early stage. BUS investigations show LEC elements within mainstream IVET to be completely lacking or very limited. VET for LEC is provided at higher education levels, specialised in scope, focussed on RES installations and aimed at building services occupations. Rather than LEC expertise being incorporated into existing VET pathways, new LEC 'occupations' are reported, including insulation and heat pump, boiler, biomass and cooling device installation in Bulgaria. As workers are trained to carry out highly specific LEC activities, the coordinative role takes place at supervisory level or through the development of technical LEC specialists, so conforming to a Taylorist instrumental approach.

CVET for LEC is organised by a combination of further education organisations, technical colleges, and private providers (training providers, construction companies or manufacturers of energy efficiency/RES related systems and materials) and around emerging specialisations, such as insulation or solar panel installation, targeting the development of specific skills. It is fragmented, limited in occupational range and geographical reach, with stand-alone courses, often not monitored and mostly at a higher level, catering to those with some existing technical training (e.g. Bulgaria, Hungary).

These patchy efforts to develop VET for LEC are framed by the VET system and spurred by NZEB legislation and EU funds. Whilst the EPBD has been transposed into national law, implementation is stalled by low awareness of energy efficiency within the construction sector and lack of funds. VET systems in Bulgaria, Hungary and Slovenia are under-resourced and, according to BUS analyses, in need of major reform and improvement to facilities and teaching resources, upgrading teacher training and increasing work-based learning. BUS recommended improving co-ordination of the existing fragmented VET provision and strengthening the institutional framework of governance and regulation of training and qualification standards. The BUS Pillar II programme and subsequent Horizon 2020 projects in these 'low road' countries reflect these circumstances, with projects including the development of learning/teaching materials and the training of teachers (Bulgaria), setting up training centres (Bulgaria), and establishing a register of qualified workers to regulate newly emerging occupations (Hungary).

In 'low road' countries, not only are the scale of the changes and improvements needed enormous, but also resources available are inadequate. Limited government investment and employer input reflect the severe impact of recession on the construction

sector. Between 2008 and 2013, Slovenia lost one-third of construction employment, with many leaving the country, whilst Hungary saw 85,000 leave the sector altogether. Skill shortages in specialist and technical areas, such as façade makers in Slovenia, are acute and, as with high and middle road countries, there is great reliance on non-national workers, who in Slovenia constitute 30% or more of the construction workforce. As with middle road countries, the labour market undermines any training infrastructure with its high number of small and micro firms. In 2015, micro firms constituted around half of firms in Hungary and Slovenia, though only about a quarter in Bulgaria. Over 96% of firms in Slovenia employ fewer than 9 or 10 workers and 59% of the construction workforce is self-employed. In low road countries, any work-based training is limited in extent and scope because firms simply do not have the funds or the training capacity, given the myriad of micro firms, extensive subcontracting and considerable self-employment.

Another challenge in transforming the VET systems in 'low road' countries is the weak organisation and involvement of social partners, who may play only an advisory role, commenting on national policies and participating in coordinating bodies (Bulgaria, Hungary and Slovenia), participating at local level (e.g. sitting on examination boards in Bulgaria) and helping develop occupational standards (Slovenia). The development and implementation of VET remains a state responsibility and the input of social partners, though varied, is limited.

In summary, in 'low road' countries, the structure of the construction sector, lack of labour market regulation and the VET model in place do not allow for the development of the broad expertise required and jeopardise the coordinated labour process needed on site. Although NQFs are being aligned with EQF, this is not sufficient for reforming VET systems to promote the LEC expertise needed where the existing VET system is designed to meet specific employer needs and the construction labour market is structured according to narrow specialisations. Qualification frameworks are interpreted and implemented differently in different countries (Clarke et al., 2013; Méhaut & Winch, 2012) and their relation to the labour market depends on a complex array of factors (Allais, 2017). The challenge of reforming established labour market structures and VET models means that efforts to achieve consistency in VET for LEC provision across Europe rely on common qualification frameworks.

European qualification frameworks and LEC expertise – the right tool for the challenge?

Given disparities between countries and sharp differences between the VET systems of 'high', 'medium' and 'low' road countries, expression of LEC expertise in a common qualification framework gains increased importance. The qualifications frameworks introduced since 2004 by the European Commission (EC), designed to facilitate labour mobility across the EU and increase transferability of qualifications, should enable LEC KSCs to be encoded in national occupational profiles and qualifications and understood by employers and workers in other countries. It should then be possible to determine whether a worker applying for a job is able to fulfil relevant KSC requirements. The question is, whether EQF and ESCO, each attuned to a different approach to VET and labour, can assist with the recognition of LEC-related qualifications.

EQF, developed by Directorate General (DG) Education of the EC, is a matrix with three vertical dimensions of Knowledge, Skills and Autonomy/Responsibility and eight horizontal dimensions, equivalent in range from secondary entry (1) to doctoral level (8), thereby

integrating academic and vocational qualifications. This framework has encouraged the setting up of NQFs with the same structural properties across EU member states, incorporating levels of complexity reflective of national VET traditions and each with descriptors expressed in learning outcomes (Méhaut & Winch, 2012, p. 369; Bjornavold & Pevec Grm, 2009). In practice, different countries have different understandings of 'learning outcomes' so a 'constructive ambiguity' hovers over acceptance of the EQF by educational institutions and social partners. Nevertheless, the EQF has gained little acceptance in the labour market, partly because, whilst seeking to achieve a comprehensive approach to developing labour, it is designed and expressed at a high level of generality instead of providing the specific information required, including details of the range of activities or scope that an occupation covers.

ESCO, in contrast, developed apparently independently by DG Employment, is a multilingual classification, whose design is closely based on the four levels of increasing specificity of the International Standard Classification of Occupations (ISCO), though having another, more detailed, '5 digit' level. It represents an attempt to identify all the different 'skills' and tasks associated with particular employment activities or 'jobs', which in aggregate can be combined to form what are termed 'occupations'. The current register of 2,943 'occupations' formed in this way is composed of various combinations of some 13,486 'skills'. ESCO is intended to be dynamic, so that, if cross-national sectoral skills observatories can identify new 'skills' required in the labour market, these are added to the ESCO database to configure new 'occupations' or reconfigure old ones.

ESCO is, like EQF, based on outcomes: the skill descriptors are largely framed in terms of actions or behaviour that the skill possessor can undertake, though some are framed in terms of knowledge. Unlike EQF, however, there is no vertical classification of educational levels with different types of ability or knowledge, and skills are not hierarchical. This poses problems for using ESCO as a basis for making qualifications with VET for LEC elements sufficiently transparent for labour market purposes. Indeed, ESCO is driven by an instrumentalist view, designed to identify the specific skills and tasks involved in a given job rather than in broad occupational areas of expertise and thus, as Pring (2004, p. 115) describes, trapping 'us into a limited language which transforms and impoverishes the educational enterprise'. For instance, skill number 1285 in ESCO is 'Cut insulation material to fit snugly into a space if that space is too small, too large, or of an irregular shape', so conceptualising 'occupations' as bundles of discrete, task-related skills. Six 'skills' are associated directly with insulation and three knowledge requirements, and two further skills are associated with inspecting insulation installation. None of these has a specified level and there is no indication of relative importance or how each relates to the other.

This approach contrasts with the complex occupational profile developed for the Belgian *couvreur-etancheur* or roofer/insulator, which includes such 'skills' but is also concerned with integrating underpinning knowledge (*savoir*) and attitudes (*savoir-être*) needed for broad occupational competence. For example, the block of activities entitled 'Laying underroof and freestanding roof panels' includes as 'know-how' 'to lay roof panels according to the technical instructions of the manufacturer' and under 'attitude' 'to do so with care and precision', as well as incorporating 'knowledge of the different types, properties and commercial dimensions of under roofing panels, together with the materials used in under roofing' (author translation) (Constructiv, 2018, p. 10). This comparison

shows that the ESCO approach does not recognise the *capacity* of the worker to complete the job in accordance with the standards required or to appreciate the reasons for meeting standards specified. It is, thus, attuned to the 'low road' to VET for LEC, leading to fragmentation that must be avoided for NZEB to be achieved.

Whilst EQF represents a broader, more holistic approach than ESCO, neither EU tool is suitable for defining LEC expertise without extensive modification. To achieve a meaningful standardisation of VET for LEC based on common understanding and agreement on the nature of the expertise required, it is necessary to articulate what exactly NZEB implies for the definition of an entire occupation. Despite its limitations, the EQF provides a starting point to promote a holistic approach to developing NZEB expertise; its KSC structure can be built upon to provide a comprehensive, clear and detailed definition and a complete body of conceptual, practical and personal abilities and attributes. The transparency tool presented in Table 1, designed in accordance with EQF and incorporating LEC elements from the VET for LEC programmes investigated, represents an attempt at explicating NZEB expertise.

These programmes include not only those found in the countries investigated but others, representing approaches adaptable to less well-developed VET systems. For instance, unlike the stand-alone QualiBuild (2014) course in Ireland, guidelines for VET for LEC developed in England by Leeds College of Building are indicative and cover a range of topics for construction and service occupations (CIC, 2017). These guidelines are organised by theme, with learning outcomes set out for each and content differentiated for Designers, Managers, Construction and Building Services occupations. Though cursory, they provide a tool to serve as the basis for the construction of occupational profiles and for developing both IVET and CVET curricula for specific occupations for non-high road VET providers, moving learning outcomes between different categories of worker (e.g. from managers to operatives), thus potentially enhancing worker agency. Elsewhere, for instance in Slovakia, a BUS Pillar 2 project developed specific CVET modules for the existing construction workers at supervisory and managerial levels as stand-alone accredited courses. This represents an instrumentalist approach to VET for LEC that assumes knowledge lies only at managerial and supervisory levels and that those employed at these levels deploy managerial techniques to ensure VET for LEC principles are followed on site.

Set within the EQF, the transparency tool (Table 1) exemplifies how a given construction occupation can be elaborated and re-defined so as to embed a new approach to building construction, including new knowledge, understanding, materials and techniques. It provides the means for different countries, whether high, medium or low road, to approach the incorporation of LEC elements in the same way. The different elements of NZEB expertise – whether technical theory, site procedures or process management ability – constitute *together* the occupational capacity needed to perform adequately and thus should be used as a whole package.

Conclusions

Successful NZEB depends on co-ordination and overall project awareness, teamwork and the application of theoretical knowledge to particular circumstances. This implies a transformation of the construction labour process and qualification and VET systems

across Europe. The depth and breadth of expertise required by NZEB need to be expressed in qualification frameworks to facilitate a uniform approach across the EU. On the evidence presented here, broadly based VET systems, constructed and maintained through consultation and co-ordination and based on imparting relevant knowledge, represent the 'high road' to energy efficiency in buildings and are best placed to respond to the challenges of climate change. Developing the agency and powers of judgement of workers through VET is not only a promoter of personal development but also a means of providing up to date construction expertise.

Most countries in the EU have a long way to go before meeting the criteria necessary for VET systems up to the task of providing for successful NZEB. Countries like Belgium and Germany are relatively well equipped to meet these, whilst others, such as Finland, Ireland, Italy and Poland, though taking steps to improve VET provision, still fall far short. Many others, such as Slovenia and Hungary, show few signs of reforming construction VET to meet the challenge. The problem is not simply one of adapting to the demands of construction at a time of climate change, but of taking a fresh look at the agency required of workers in the construction industry and reforming VET to take account of increased requirements for worker autonomy, integrated teamwork, project management awareness and applied knowledge, as well as of specific skill gaps. For some VET systems, this may require a considerable rethink of what their aims are, particularly in IVET.

In the context of fundamental differences between countries, often the result of historically divergent industrial relations, labour market regulation and VET development trajectories, qualification frameworks are perceived to provide the means to achieve standardisation across the EU. The challenge here is that EQF in itself is no guarantee that 'learning outcomes' will be defined in relation to broad occupational profiles. Superficially, national qualification schemes mimic the same structure and therefore imply that standards of education are the same, but, in practice, EQF can also facilitate a fragmented certification of LEC expertise, emphasise practical competencies more than theoretical knowledge and give no indication of the actual content of learning that takes place. This is, therefore, where the transparency tool (Table 1), detailing the expertise and range of KSCs required for LEC, comes into play. However, attempts to create transnational standards in LEC expertise are up against a drive to 'quantify' all the possible tasks and skills associated with an occupation, as epitomised in ESCO. Such quantitative (or output driven) conceptions of LEC expertise could undermine the depth and breadth of climate literacy needed by construction workers, essential for successfully transitioning to a climate-neutral built environment and enabling their full participation in the process.

Notes

1. European Construction Sector Observatory Country Reports for all partner countries, available at: https://ec.europa.eu/growth/sectors/construction/observatory_en.
2. Build Up Skills National Status Quo Analysis and Pillar II activities for all partner countries, links to national pages available at http://www.build-up.eu/en/skills.
3. CEDEFOP Spotlight reports on all partner countries, available at http://www.cedefop.europa.eu/en.

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