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Preface

Technological change, globalisation, ageing populations and climate change dramatically increase the pace of change in labour market and skill needs, for new and current jobs alike. The growing importance of sustainable development and the shift to a low-carbon economy imply structural changes across sectors and occupations. This shift leads to new 'green' jobs and 'greening' of existing ones that translate to new skill sets, update of curricula or even new qualifications; for example, the adoption and dissemination of clean technologies requires skills in technology application, adaptation and maintenance.

Skills gaps are already recognised as a major bottleneck in sectors closely linked to 'green economy', such as renewable energy, energy and resource efficiency, renovation of buildings, construction, environmental services, manufacturing. At the same time, the 'greening' of the economy creates skill needs across other sectors, as businesses, workers and entrepreneurs have to rapidly adapt to changes as a consequence of environmental policies.

Given the challenges, Cedefop and ILO joined forces in 2010 and produced the report *Skills for green jobs: a global view* (ILO, 2011). The research was based on 21 country studies with a primary focus on good practice examples of how national policies for greening economies are complemented by identification of skills needs and efficient skills response strategies. Cedefop covered country studies (Cedefop, 2010a) in six EU Member States: Denmark, Estonia, France, Germany, Spain (Cedefop, 2010b) and the UK. All studies were conducted based on the same research methodology and criteria for selection of case studies, and following identical structures.

In 2017, these studies were updated for the ILO flagship report *World employment and social outlook (WESO) 2018: greening with jobs*, published in May 2018⁽¹⁾. The country studies were used as background material for chapter 5 of the report on *Skills for the green transition* with the objective to analyse the trends towards decent work and environmental sustainability since 2010; and assess the impact of a transition towards a low-carbon, resource-efficient economy on the world of work.

This country report was produced by Cedefop, Department for skills and labour market, under the supervision of Alena Zukersteinova. Stelina Chatzichristou, Cedefop expert, was responsible for the research conducted from April 2017 to October 2017.

Cedefop would like to acknowledge the research team of the consortium led by Fondazione Giacomo Brodolini who conducted preliminary analysis and drafted their findings under project team leader Andrew McCoshan.

The full country reports are unedited and available only electronically. They are used as background information for Cedefop's synthesis report *Skills for green jobs: 2018 update*⁽²⁾.

⁽¹⁾ Available from: https://www.ilo.org/weso-greening/documents/WESO_Greening_EN_web2.pdf

⁽²⁾ Available from: <http://www.cedefop.europa.eu/en/publications-and-resources/publications/3078>

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Executive summary

This report covers developments since Cedefop's report on Skills for Green Jobs (2010). It presents evidence on changes in the green economy, employment and skills, and the main legislative changes and their drivers.

Since 2010, employment levels in low carbon and environment jobs in the United Kingdom (UK) have been significant and this is anticipated to continue to grow. Policy has shifted its focus onto new environmental technologies, new ways of working and 'greener consumption'. The main legislative change has been The Energy Act 2013 (TSO, 2013) ⁽³⁾; it is the main driver for the green economy. Attempts have been made to understand the size and performance of those services, products and technologies which contribute to the green economy. Whilst definitions are developing, research has evidenced significant growth in activities, output and employment in activities contributing to a green, low carbon economy.

There are no national active labour market programmes that focus on developing skills for green jobs/the green economy. There are, however, some charitable/not-for-profit organisations that offer labour market programmes, which create green jobs and support people to develop green skills. It is important to note that trade unions are playing a greater role in supporting the workforce and the transition to a greener economy.

⁽³⁾ <http://www.legislation.gov.uk/ukpga/2013/32/contents>

1. Introduction

The UK country report covers developments that have occurred in the green economy since the 2010 Cedefop report Skills for Green Jobs.

The research includes desk-based data collection and analysis, policy analysis as well as interviews with experts and stakeholders. The in-depth literature search included searches of academic databases, grey literature and relevant websites for evidence on green skills and the green economy in the UK. The search was focused on evidence from early 2010 onwards. All evidence was analysed and synthesised for this report. See Annex 1 for more information on the methodology and research tools.

The report presents evidence on the main shifts in employment and skills resulting from the green transition, along with legislative changes since 2010 and the drivers of change. In addition, education and training programmes and measures that have been implemented to support the workforce are presented. An assessment on how successful these programmes have been is included. Finally, some conclusions and recommendations are presented. Overall, the report offers policy makers and researchers robust information and improved understanding of the state of play and anticipated skills developments in the UK.

2. Major changes in the economy and employment shifts in the green transition after 2009-10

2.1. The UK economy and labour market

The UK labour market is currently described as buoyant and seen to be doing well in terms of labour market indicators (CIPD, 2017; ONS ⁽⁴⁾, 2017a and 2017b). First, Gross Domestic Product (GDP) has remained relatively stable over the last few years with a 2% increase between 2016 and 2017 (ONS, 2017a). The services sector has been a significant contributor to this growth, so it is seen as one of the main drivers of the economy. The construction sector continues to contribute to GDP, but it is a relatively minor contributor compared with the service sector. Secondly, UK employment rates continue to increase and in June 2017 it was at its highest since 1971 (75.1% for those aged 16-64 years) (ONS, 2017b). Unemployment rates for those aged 16 years and over have steadily decreased from 8.4% in 2011 to the current rate of 4.4%. The CIPD reports that the UK labour market has changed due to a number of long-term trends, such as the rise in knowledge-based services, innovative technology and globalisation, changing workforce demographics, and the decline in collective workplace institutions (CIPD, 2017). These all impact on how work is carried out and workforces are managed. Future drivers of the UK labour will continue to be the shift to a service and knowledge intensive economy, technological changes, and changes to the way people work. The main challenge, however, for the UK labour market will be managing and planning for exiting the European Union (Brexit). It is recognised that with so much uncertainty of what Brexit means for the future workforce, their skills, plus overall aggregate demand, it is difficult to forecast the impact on the workforce, businesses, and the economy.

The latest data from the ONS on the UK economy and environment reports an improvement in energy efficiency with overall reductions in greenhouse gas emissions (ONS, 2017c). Since 2010 and the economic downturn, UK GDP has started to increase and UK households have become the largest users of diesel fuel. Comparing data on the devolved nations, Scotland has the highest rate of renewable electricity consumed per capita across the UK (22%), followed by Northern Ireland (11%), Wales (6%), and England (6%) (Green Alliance, 2012). 2012 data estimates that Scotland is well on its way to reaching its emission reduction targets for 2020 (The Scottish Government, 2015).

Across different sectors of the economy, energy consumption is variable with some making significant reductions. The move from manufacturing to a more service-based economy has resulted in reductions in energy usage. Furthermore, the manufacturing and transport, storage and communications sectors, which have always been energy intensive, have reduced energy consumption as they have become more energy efficient. The

⁽⁴⁾ ONS stands for Office for National Statistics.

transport, storage and communications sector has increased in size, but efficiencies are the result of low carbon and energy efficient vehicle usage. In comparison, the energy supply, water and waste sector is the most energy intensive sector.

2.2. Green jobs and employment

Employment forecasts for 2014-24, report that the UK manufacturing sector is dominated by high tech industries which will impact on the overall prospects of the sector and future employment (UKCES, 2016). Productivity growth and competitiveness in the sector will be driven, in part, by green technologies. So, whilst productivity prospects are good as a result of the transition to a green economy, employment prospects are poor over the longer-term due to improvements in production efficiencies.

Importantly, the 2014-24 forecasts report that energy policies and environmental legislation over this period will have a significant impact on employment in some sectors. Long-term opportunities are reported to be in some of the primary and utilities sectors as low carbon energy alternatives are sought and implemented. Waste reduction in the water and minerals sectors are also noted to provide long-term opportunities.

Employment levels in the mining and quarrying sector will continue to decrease as the economy moves away from coal-fired energy generation to low carbon alternatives. At the same time, the low carbon alternatives to energy generation are likely to increase employment levels in other sectors; e.g. it is forecast that up to 70 000 extra direct jobs may be generated between 2013 and 2023 in the wind and marine energy sectors (RenewableUK, 2013).

Since 2012, there have been attempts to shift to green building methods and techniques in the building and construction sector by the UK government as part of developing a green economy (Greenwood, 2012). UK policy developments have included, for example, the Code for Sustainable Homes which was later withdrawn and included in revised national Building Regulations and Standards in 2015. These new standards mean the sector is more environmentally conscious compared with other sectors in the UK, but that standards could go further (Gibbs and O'Neill, 2015). These environmental and regulatory policies on building and construction processes will present challenges and opportunities for the sector, particularly in terms of employment. Construction growth to 2024, however, is likely to be positive as technologies are developed to address environmental concerns (UKCES, 2016).

In the nuclear sector, a report by EDF Energy pointed out that a significant number of UK power stations will close by 2030 (EDF Energy, 2016), and it is reported that new nuclear power would provide reliable low-carbon power and should be part of the addressing the UK's future energy needs. Hinkley Point C ⁽⁵⁾ construction is underway providing education

⁽⁵⁾ Information on Hinkley Point C is available at: <https://www.edfenergy.com/energy/nuclear-new-build-projects/hinkley-point-c/about>

and training opportunities for those wishing to enter the nuclear power sector. Opportunities are likely to grow in this sector if the government expands the nuclear sector further.

2.3. The shift to a green economy

Recent commentators suggest that shifts to a green economy are being driven by ‘green entrepreneurs’ who have the potential to influence economic development practices (O’Neill and Gibbs, 2016). Green entrepreneurs delivering environmental solutions have been found to be driven by environmental concerns and ideals that are contrary to entrepreneurial narratives of growth and profitability. These entrepreneurs are developing new skills to ensure their business practices fit with a green economy.

The UK government has recently commissioned research to understand the size and performance of those services, products and technologies which contribute to the UK transition to a greener economy (BIS ⁽⁶⁾, 2015b; ONS, 2017c). First, the environmental goods and service sector (EGSS) includes the production of goods and services for environmental protection purposes, as well as activities to conserve and maintain natural resources. Second, a narrow sector defined as the low carbon sector includes products and technologies that deliver low carbon outputs or energy efficiencies (Annex 2 for a definition). Research has evidenced significant growth in initiatives, output and employment in activities contributing to a green, low carbon economy (BIS, 2015b; Green Alliance, 2012; ONS, 2017c). Employment in low carbon and environment jobs in England and the devolved nations is significant and anticipated to continue to grow.

In 2013, it was estimated that 11 550 businesses were engaged in the UK low carbon economy accounting for approximately 1.6% of UK employment (BIS, 2015b). This comprised 269 800 people directly employed in low carbon activities and 190 800 people indirectly employed in the supply chain. Between 2010 and 2014, the low carbon economy is reported to have grown in output and employment levels.

The ONS estimated that in 2014 the EGSS ⁽⁷⁾ contributed £29 billion to the UK economy in terms of gross value added (GVA) (ONS, 2017c, p. 32). This is an increase from 2010, when GVA was estimated at £26.1 billion. From these data, it is estimated that there were 373 500 full-time equivalent jobs in the EGSS in 2014. The production of renewable energy activities is reported to have doubled between 2010 and 2014, which has resulted in employment growth.

UK government environmental protection expenditure is reported to have risen from £4.1 billion to £14.7 billion from 1990 to 2006 (ONS, 2017c). This suggests that environment

⁽⁶⁾ BIS stands for Department for Business Innovation & Skills.

⁽⁷⁾ The methodologies to estimate the EGSS is still under-development by the ONS. It is used to ‘*indicate how much the economy is engaged in producing goods and services for environmental protection purposes and resources management activities relative to the wider economy and provide information the number of jobs created.*’ (ONS, 2017c, p. 32).

protection activities and related activities will continue to be a driver of growth and employment as the UK transitions to a greener economy.

3. Key policies and regulations

3.1. Shifting policy focus

Until recently, the green economy was considered to be about a low carbon economy with UK policy not prioritising the economic development opportunities (Gibbs and O'Neill, 2015; Greenwood, 2012). Policy focused on reducing national carbon emissions through strategies such as the Low Carbon Transition Plan (2009) (HM Government, 2009). The plan set out five points through which to tackle climate change which included supporting individuals and businesses to develop green skills. Commentators have suggested that, like policy in a number of other European countries, it was too narrow in its focus (Gibbs and O'Neill, 2015; Hamdouch and Depret, 2010). Whilst government strategies no longer focus on just plans to reduce carbon emissions, it continues to devolve responsibility to sectors and regions (Smith, 2007; Sofroniou and Anderson, 2015). Across the UK's devolved nations, different approaches have been developed and adopted that meet shared environmental objectives set by EU directives ⁽⁸⁾. One criticism is that there is no mechanism through which these approaches can be integrated and/or adopted into a national approach.

Since 2011, economic development and environmental improvements have become mainstream with policy now broader: focusing on new environmental technologies; new ways of working; and 'greener consumption' in the UK (Gibbs and O'Neill, 2015). The 'UK 2020 renewables targets and targets to reduce carbon emission levels by 2050' ⁽⁹⁾ has driven government policies and strategies across England and the devolved nations. Achieving these targets is considered challenging, but technology is seen as key to meeting these commitments. New technologies are needed to renovate buildings to be more efficient, to create electrification of heating, industry and transport, and to ensure cleaner power generation, which require green jobs and green skills. It is recognised that this requires significant investment as well as changing energy consumption by individuals and industry (DECC ⁽¹⁰⁾, 2013).

No green policies, programmes or regulations were found that include gender issues in developing green skills.

⁽⁸⁾ See for example The Scottish Government (2015) and The Welsh Government (2012).

⁽⁹⁾ <https://www.gov.uk/government/publications/2010-to-2015-government-policy-greenhouse-gas-emissions/2010-to-2015-government-policy-greenhouse-gas-emissions>

⁽¹⁰⁾ DECC stands for Department of Energy & Climate Change.

3.2. Legislation

Recent legislation, namely The Energy Act 2013 (TSO, 2013) is, and will continue to be, one of the main drivers for the green economy in the UK. The Act set out targets to lower carbon emissions and how these will be achieved, including, for example: reforming the electricity market; encouraging low carbon electricity generation; ensuring security of supply, pipe-line and storage; and the role and responsibilities of the Office for Nuclear Regulation. The aim is to address some of the challenges of climate change. As part of these legislative changes, the DECC has invested in four offshore wind projects, and a new nuclear power station at Hinkley Point has been given the go ahead.

The Energy Company Obligation (ECO) ⁽¹¹⁾ was implemented in 2013 and means that large energy suppliers have the responsibility to support energy efficiency to reduce emissions. It comprises: Carbon Emissions Reduction Obligation (CERO); Carbon Saving Community Obligation (CSCO); and the Home Heating Cost Reduction Obligation (HHCRO). It is reported that between January 2013 and June 2015, ECO resulted in approximately 1.5 million measures being delivered in Great Britain (Ryan-Hume, 2016). This legislation has, therefore, impacted on a range of sectors (as discussed later in Section 4) changing the way they work and on Local Enterprise Partnerships (LEPs) ⁽¹²⁾ which have drawn up plans for their areas to transition to a greener economy.

In addition, the Infrastructure Act 2015 (TSO, 2015) ⁽¹³⁾, set out a number of provisions. In terms of the green economy, it set out building regulations for off-site carbon abatement measures, plus provision for local renewable electricity generation facilities and renewable heat incentives. Controversial elements of the Act were around onshore petroleum recovery ⁽¹⁴⁾. Overall, the Act introduces measures to reduce carbon emissions by supporting zero carbon homes and renewable heating systems.

In 2015, a range of green subsidies were withdrawn by the government, including subsidies for onshore wind, biomass conversions, solar PV of 5MW and below, as well as the Feed-in-Tariff scheme. Plans to make all new homes carbon neutral were also withdrawn in order to encourage business to invest in construction and to ensure the demand for new homes was met. These changes are expected to have a negative impact on green jobs over the medium to long-term.

⁽¹¹⁾ Information on the Energy Company Obligation is available from ofgem;s website: <https://www.ofgem.gov.uk/environmental-programmes/eco>

⁽¹²⁾ Set up in 2011, LEPs are partnerships between local authorities and businesses. There are 39 LEPs in operation across England. It is their role, through a range of activities, to determine local priorities, drive economic growth and support job creation in their local area. More information is available from the LEP network, see: <http://www.lepnetwork.net/the-network-of-leps/>

⁽¹³⁾ <http://www.legislation.gov.uk/ukpga/2015/7/introduction/enacted>

⁽¹⁴⁾ Examples of the public debates are available at: The Guardian (13/06/16) <https://www.theguardian.com/environment/2016/apr/13/uk-governments-fracking-definition-could-allow-drilling-without-safeguards>; and DesmogUK <https://www.desmog.uk/creation-uk-infrastructure-act-2015>

3.3. Skills, industrial and economic strategies for a greener economy

Since 2010, there have been a number of national skills, economic and industrial strategies produced by the government and devolved governments that have talked about transitions to a low carbon and greener economy, but much responsibility has been devolved to regions and sectors as discussed in Section 4. The following paragraphs outline the main relevant strategies since 2010.

The 2010 Skills for Sustainable Growth Strategy Document (BIS, 2010) set out a plan for to improve skills '*essential to building sustainable growth and stronger communities*' (p. 3). It set out a commitment to fund skills and training programmes for new or rapidly changing sectors, including the transition to a low carbon economy. Skills and apprenticeships were seen to be key to creating, in part, an environmentally sound economy as part of the, then, government's 'Big Society' agenda.

In 2011, the UK government stated that the transition to a green economy was a central part of the economic growth plans for the future (BIS/DECC/Defra ⁽¹⁵⁾, 2011). This strategy document highlighted the benefits for the economy and UK business in terms of generating investment, stimulating entrepreneurship and innovation, as well as transforming skills that can respond to new and emerging markets. The House of Commons Environmental Audit Committee (2012) criticised the transition plan as failing to set out a strategic or long-term plan for a greener economy. It was noted that there are no requirements or legislation for business to follow with an emphasis on voluntary action.

The recent Green Paper on building an industrial strategy (2017) focuses on increasing productivity, increasing skills and taking an active role in supporting business and individuals in a post-Brexit Britain (HM Government, 2017). Working towards a low carbon economy is mentioned, but it is not known whether and how this may have an impact on green skills. Results of the consultation and resulting strategy are to be published in late 2017. Whilst social partners, employers, trades unions and workers can contribute to skills strategies through national consultations, such as the Green Paper on building an industrial strategy, there is no coordination. This may be the result of declining collective workplace institutions.

Across the devolved nations, energy efficiency, decarbonisation and investment in green technology and innovation are central to industrial and economic strategies. For instance, in Scotland, the 2015 economic strategy reported that Scotland generates 44% of electricity from renewables, so it is unsurprising that investment priorities remained focused on resource efficiency and low carbon technology (The Scottish Government, 2015). The strategy noted the importance of all sectors transitioning to a greener economy. Resource-efficient homes were seen as a priority to reduce energy demand and emissions. The

⁽¹⁵⁾ Defra stands for Department for Environment, Food and Rural Affairs.

strategy set out a number of programmes, such as Resource Efficient Scotland ⁽¹⁶⁾ and Zero Waste Scotland ⁽¹⁷⁾, to support businesses, the third sector and the public sector to become resource efficient. For individual households, domestic energy efficiency is supported by the Home Energy Efficiency Programmes for Scotland (HEEPS) ⁽¹⁸⁾ and the Green Homes Cash Back ⁽¹⁹⁾. The programmes are funded by the Scottish Government and the European Regional Development Fund.

In Northern Ireland, the recently launched industrial strategy consultation has as one of its pillars 'building the best economic structure' (Northern Ireland Department for Economy, 2017). A new energy policy is central to this pillar and recognised as a challenge for Northern Ireland in terms of reconciling the tensions between economic, social and environmental objectives. Its aim is to achieve affordable decarbonisation and enhance the security and sustainability of its energy supply. With these objectives, the green economy will grow in Northern Ireland.

3.4. Potential implications of Brexit for transition to a green economy

Environmental policy in the UK has for a number of years been led by the European Union, which is viewed to have had a positive impact on the UK environment (Green Alliance, 2017b; House of Commons Environmental Audit Committee, 2016). According to the House of Commons Environmental Audit Committee (2016) future EU policy will be around reducing the regulatory costs placed on businesses. It is suggested that this something the UK may also wish to consider in the future.

There are concerns that with the UK leaving the EU, environmental policies would become less stringent. The UK, however, would still have to meet international environmental commitments set by the UN and adopted in EU policy. It is noted that the UK has, to date, had a significant influence on environmental policy development at a European level (House of Commons Environmental Audit Committee, 2016) and this may no longer be possible post-Brexit. If the UK wishes to have access to the European Single Market, it would probably need to comply with EU legislation (House of Commons Environmental Audit Committee, 2016).

⁽¹⁶⁾ Information on Resource Efficient Scotland is available at: <http://www.resourceefficientscotland.com/about-us>

⁽¹⁷⁾ Information on Zero Waste Scotland is available at: <http://www.zerowastescotland.org.uk/content/who-we-are>

⁽¹⁸⁾ Information on HEEPS is available at: <https://beta.gov.scot/policies/home-energy-and-fuel-poverty/energy-saving-home-improvements/>

⁽¹⁹⁾ In 2015, this became known as the HEEPS: Cashback Scheme closed in November 2016 and replaced with HEEPS: Loans.

The Committee on Climate Change's recent publication suggests that there are concerns that post-Brexit, the UK may change its plans to reduce carbon emissions as there will be no need to meet EU targets. Carbon emissions targets, however, and the need to cut emissions are set in UK law, so there are unlikely to be significant changes (Committee on Climate Change, 2017). Whilst there has been a reduction in carbon emissions, this is noted to be variable by sector with coal-fired generation at low levels and transport emissions remaining high. Therefore, the Committee makes the recommendation for new policies on, for instance, low carbon power and vehicles, plus carbon capture and storage in order to meet upcoming carbon budgets. These policy changes would have a significant impact on green skills needs and gaps.

4. Skills development measures for the green economy

4.1. Skills needs identification and anticipation

Identifying and anticipating skills needs for the green economy ⁽²⁰⁾ has been greatly debated with a number of attempts to define and measure green skills (Bowen and Kuralbayeva, 2015; BIS/DECC/Defra, 2011; Dierdorff et al., 2009; Sofroniou and Anderson, 2015). The following provides an overview of the main definitions used.

4.1.1. Identifying green skills

'Green skills' were defined and listed in the government report Skills for the green economy (BIS/DECC/Defra, 2011). This is considered to be the most definitive list of skills for a green economy as it includes skills supporting: resource efficiency, the low carbon industry, climate resilience, and skills to manage natural assets (BIS/DECC/Defra, 2011). Table 1, below, provides an overview of how the report classified the skills needs of a green economy. The list reflects a different approach to that taken by an earlier report that was published under the New Labour Government in 2009 and referenced in the 2010 case study on green skills in the UK (Cedefop, 2010b, p. 49, Table 7). The earlier list identified nine groups of skills and 45 sub-groups, giving a more detailed breakdown of green skills. Neither of the lists prepared by the relevant government departments discusses core/generic and technical/specialist skills.

Table 1: Official definition of skills for a green economy, 2011

Skills for a green economy	Skills needs
Skills supporting resource efficiency	<ul style="list-style-type: none"> • Strategic business management to build resource-efficient business models leading to bottom line benefits and in preparation for new regulations • Business/financial accounting services around carbon and natural environment accounting • Skills to design and adopt technologies, products and processes increasing resource efficiency, including lean manufacturing • Project management skills with clear understanding of resource efficiency • Operator level actions to maximise resource efficiency (e.g. reducing waste in production)
Skills supporting low carbon industry	<ul style="list-style-type: none"> • Scientists and engineers with training or transferable knowledge for nuclear and renewable energy (including wind and marine) • Technicians with training or transferable knowledge to install energy efficiency measures and retrofit at a household and business premises level • Skills to design and adopt technologies, products and processes to

⁽²⁰⁾ It is important to note that the skills landscape described in this section primarily refers to the situation in England. The devolved administrations in Scotland, Wales and Northern Ireland have different skills policies and governance arrangements.

	<ul style="list-style-type: none"> minimise carbon emissions • Operator level actions to minimise carbon emissions (e.g. driving in a fuel efficient manner)
Skills supporting climate resilience	<ul style="list-style-type: none"> • Scientific and technical skills such as modelling and interpreting climate change projections • Risk management such as assessments of future resource availability • Skills to design and adopt technologies, products and processes to improve climate resilience • Operator level actions to improve climate resilience (e.g. retrofitting water efficient technologies in households and business premises)
Skills to protect and manage natural assets	<ul style="list-style-type: none"> • Accounting services for the natural environment • Understanding of environmental impact assessments • Understanding and interpretation of environmental legislation targets, ecosystem services design and management and land use planning • Skills to design and adopt technologies, products and processes to manage natural assets

Source: BIS/DECC/Defra (2011) Table 1, pp. 8-10

Other UK sources adopt a different definition and classification of green skills and structure the skills anticipation exercise differently. In particular, the authors of the document *Green Skills and Jobs in Scotland* ⁽²¹⁾ adopt a framework for anticipating green skills that is based on the O*NET classification of green occupations ⁽²²⁾. They outlined three sets of green occupations, according to the level of new and enhanced skills required as shown in Box 1.

Box 1: Green occupations

New and emerging green occupations: a need for unique work and worker requirements, resulting in the generation of new occupations. These new occupations could be entirely novel or 'born' from an existing occupation. An example is solar system technicians who must be able not only to install new technology, but also to determine how this technology can best be used on a specific site.

Green enhanced skills occupations: a significant change to the work and worker requirements of an existing occupation. There may or may not be an increase in employment demand for these occupations. An example is the occupation architect, with a requirement of increased knowledge of energy-efficient materials and construction.

Green increased demand occupations: an increase in the employment demand for an existing occupation, without significant changes in the work and worker requirements of the occupation. The context of the work may change, but the tasks themselves do not. An example is the increased demand for electrical power line installers and repairers related to energy efficiency and infrastructure upgrades.

Other occupations.

Source: Dierdorff et al. (2009), pp. 11-12.

⁽²¹⁾ Sofroniou and Anderson (2015, p. 1) did not carry out a skills anticipation exercise, their aim was to '*consider occupations in relation to identifying increased demand for green jobs and emerging green workplace skills in Scotland*'.

⁽²²⁾ These were developed by Dierdorff et al. (2009).

These occupational groups suggest increasing levels of green up-skilling and new green skills required from minimal or no green skills needs in 'other occupations' to high levels in 'new and emerging green occupations':

Other occupations < Increased demand < Enhanced skills < New and emerging

Others argue against the term 'green jobs', and refer instead to the 'green economy' in its broadest possible sense; which is also reflected in recent shifts in policy focus as noted in Section 3. The 'green economy' includes environmental goods and services, activities of the low-carbon sector, and supply chain jobs (McNeil and Thomas, 2011).

4.1.2. Anticipating green skills demand

There are no regular UK-wide skills anticipation activities which focus specifically on green skills or jobs. Commentators suggest there may be less interest in the green economy today than in the 2000s because expectations seem not to have been fulfilled and there are not many (obvious) green jobs around. This apparent shift coincided with the change of government in 2010 and a change of skills policies (as discussed in Section 3). There are, however, a number of relevant skills anticipation initiatives, which are described below.

The government report (BIS/DECC/Defra, 2011) reviewed and synthesised published research findings and stated that in general businesses were uncertain about their future green skills needs. Another, related government report (HM Government, 2011) states that the transition to a green economy presents particular skills challenges because the information available may not be able to reflect the rapid change in labour markets (HM Government, 2011).

The Working Futures series offers the most comprehensive review of skills implications in the UK derived from technological change, changes in government policy and legislation and other socio-economic factors affecting the UK labour market⁽²³⁾. The most recent forecasts (2014-24) discuss the predictions for employment change in broad sectors, including those that are key to the low-carbon transition. The construction sector's long-term global commitments to climate change and sustainability and regulatory policies are anticipated to create new opportunities and areas of growth in the sector (UKCES, 2016).

Perhaps the most in-depth skills anticipation exercise undertaken in relation to green skills is RenewableUK's report 'Working for a Green Britain and Northern Ireland', published in 2013 (a follow up of the 2010 exercise). It provided an assessment of the total number of people employed in the renewables sector (both directly and indirectly through the wider supply chain) (RenewableUK, 2013). It provided estimates of the number of people employed in various sub-sectors (onshore wind, offshore wind, marine), the functions in which people were employed (planning, manufacture, construction, etc.), and the jobs they undertook. It estimated that 34 373 full-time equivalent jobs were supported directly and indirectly by wind and marine energy in 2013 (18 465 directly). Over the period to 2023

⁽²³⁾ See UKCES (2016) for the latest data.

substantial employment growth was forecast (under the most positive scenario about the future around 70 000 additional direct and indirect jobs could be created). Employment was reported to be relatively high skilled: 'The occupational profile of the wind and marine energy sector is skewed towards relatively higher-skill occupations than the UK economy as a whole, with a higher proportion of jobs in management and technical and professional occupations reported' (p. 12). Around a third of employers reported that they experienced hard-to-fill vacancies in 2013 (compared with a quarter in 2010), with the availability of skills supply being the most commonly cited reason for the vacancy proving difficult to fill.

4.1.3. Sector skill assessments of green skills

Most skills anticipation exercises are carried out by sectoral bodies, such as the Sector Skills Councils (SSCs). Sector Skills Assessments are important sources of labour market intelligence in the UK undertaken by the SSCs. Originally, SSCs produced bi-annual assessments (as a condition of their continued grant-based funding). These were widely shared by the UK Commission for Employment and Skills (UKCES) ⁽²⁴⁾ and supplemented by skills assessments of 'emerging sectors', many of which contributed to our understanding of the green economy. These included sector assessments of the 'low carbon' and 'advanced manufacturing' sectors ⁽²⁵⁾. However, since 2010 more competitive, project-based funding of SSCs has led to SSCs producing assessments on a more ad-hoc basis, provided that an employer or an employer association is willing to fund the work.

For the construction and built environment sector, evidence from selected skills assessments and projects that discuss green skills needs have reported the following. (It should be noted that whilst the Construction Industry Training Board (the SSC for the construction industry) regularly conducts a 'Skills and training in the construction industry' survey, the issue of green skills is not mentioned in the reports.)

The 2012 Sector Skills Assessment for the construction and built environment sector (the latest assessment recognising green skills) reported that two of the main drivers of skills were the Green Agenda in terms of regulation and governance, plus environment change (Breuer, 2012). Employers in the construction and built environment have noted particular skills gaps in understanding 'the importance and implications of green issues and sustainability' (Breuer, 2012, p. 78). Demand is anticipated for basic skills in low and zero carbon technologies and green products. Specific green skills needs have been identified:

- (a) assessment/surveying of building fabric performance in relation to estimated energy and costs savings, and identification of the most effective solution for different building fabrics and ages;

⁽²⁴⁾ The UKCES closed in 2017 and whilst most of its work was transferred to the Department for Education, there were no plans at the time of writing this report to repeat these skills anticipation activities.

⁽²⁵⁾ See the archived UKCES website for sector skills assessments:
<http://webarchive.nationalarchives.gov.uk/20140108104814/http://www.ukces.org.uk/ourwork/nssa>

- (b) installation – of solar, ground and air source heat pumps, biomass heating systems and insulation of all types (particularly in the context of needs of different building fabrics/ages);
- (c) maintenance of energy efficiency measures once installed;
- (d) use of software required in property assessment, and estimation of cost/energy savings (Breuer, 2012, p. 122).

In 2014, research found that a major infrastructure investment programme to improve the Energy Performance Certificate (EPC) of UK homes by 2035 would see employment increase by up to 108 000 net jobs a year over the period 2020-30, the majority of which would be in the service and construction sectors. It was suggested that even as the initial investment stimulus wore off, there would be a net increase of 70 000 jobs to 2030.

The 'Build Up skills' project funded a number of initiatives at a local and regional level to identify key skills in the construction sector (Build Up skills, 2012). Funded by the European Union's Intelligent Energy Europe initiative ⁽²⁶⁾ it aimed to identify the craft and technical skills that are required to meet EU 2020 energy efficiency targets (Build Up skills, 2012). Green skills and the infrastructure to support their development were found to be lacking. The research project also found that training provision was severely limited in relation to emerging technologies; this was explained by low levels of demand from employers.

In the power generation sector, the following skills assessments have identified the green skills needs and jobs. The most recent Sector Skills Assessment for the low carbon energy production sector (2009) reported that the rapid development of the low carbon economy would result in a demand for new roles as well as the 'greening' of existing jobs (Asset Skills et al., 2009). Therefore, it was reported that there was a training need to update the skills and knowledge of the existing workforce. This was to ensure familiarity with the concepts and practices and, importantly, enable the workforce to continue working in the sector.

A more recent report, (RenewableUK ⁽²⁷⁾, 2013) provided employment figures for the wind and marine energy industries, stating that the number of jobs created by the renewable energy industries rose by 74% between 2010 and 2013 to at least 35 000 (RenewableUK, 2013). They anticipated that if there was sufficient growth in deployment of these technologies around the UK coastline, there was the potential for 70 000 new jobs, mainly in the offshore wind industry.

In the energy and utilities sector, the Energy & Utilities Skills Partnership was formed (2016) to ensure that the gas, power, waste management and water industries have the skills they need. The Skills Partnership focuses on creating a sector skills strategy for workforce

⁽²⁶⁾ Information on the Intelligent Energy Europe project is available at:
<https://ec.europa.eu/easme/en/intelligent-energy-europe>

⁽²⁷⁾ RenewableUK (<http://www.renewableuk.com>) is a not for profit renewable energy trade association commissions skills anticipation exercises and focuses on skills and training in a number of ways.

renewal and making the sector more attractive to potential employees (Energy & Utilities Skills Partnership, 2017). Workforce and skills assessments will be produced in the future.

In the waste management sector, the 2012 SITA assessment reported that as many as 36 000 new jobs could be created directly by 2020 (SITA, 2012). The majority of these are forecast to be in operator and manual positions.

The institutional set up of skills anticipation for the green economy has become weaker with the closure of the UKCES leading to increased fragmentation. The UKCES was not only an important co-ordinating body, but it also researched and led on sector-wide skills assessments and employer skills surveys. The lack of a co-ordinating body can be considered an institutional barrier to green skills identification and anticipation. Up to 2016, skills anticipation and occupational forecasts were regularly conducted at UK and national levels (e.g. Working Futures), though there was not a specific emphasis on green skills and occupations. This may be explained by the shift towards an employer-led model of skills development, which will be discussed below in detail.

4.2. TVET provision for new green occupations and for greening established jobs/occupations

4.2.1. Green skills policy in the UK

Skills are a devolved matter in the UK and hence some developments are discussed separately for England and the devolved nations. An overview of the UK skills system is presented in Annex 3.

Across the UK, there is currently no government-led effort to develop technical and vocational education and training (TVET) provision for new green occupations or for greening established occupations. The institutional set up for skills and training has a strong element of devolution to sectors and to local actors, with employers playing a key role in sector bodies and at the local level (such as Local Economic Partnerships in England, Scottish Enterprise⁽²⁸⁾ and Invest NI⁽²⁹⁾). Thus, in its report (HM Government, 2011) the government stated that the vocational education and training (VET) system was increasingly demand-led, with businesses articulating their skills needs, training providers responding to them, and prospective trainees making informed choices about what to learn (HM Government, 2011). In certain sectors, however, which are of key importance to green skills, such as the nuclear sector⁽³⁰⁾ and the construction industry, there are also national skills strategies.

The 2010 government skills strategy set out various measures to support green skills in the context of the national skills strategy (BIS, 2010). These measures included a new 'skills

⁽²⁸⁾ Information on the Scottish Enterprise is available at: <https://www.scottish-enterprise.com/>

⁽²⁹⁾ Information on InvestNI is available at: <https://www.investni.com/>

⁽³⁰⁾ Information on New nuclear power (2013, updated 2016) is available at: <https://www.gov.uk/guidance/guidance-for-operators-of-new-nuclear-power-stations>

for a green economy' group of SSCs (discussed below in more detail) to help businesses understand and address skills needs; improving the quality of information, advice and guidance available on careers in a green economy through the new National Careers Service; improving the quality of green skills training programmes in the further education and skills system; setting up a renewables training network (RTN) (RenewableUK, 2012), with 2 000 places on training courses specifically tailored to those wanting to make the move into the renewable energy sector; sending 'STEM ambassadors' into schools; and making funding available for up to 1 000 Green Deal Apprenticeships (subject to business take-up). Discussing the implementations of these measures, the Environment Audit Committee (EAC) of the House of Commons argued against government-led initiatives and called for the government to do no more than provide a stable long-term policy framework on the green economy, which will then provide the certainty that businesses need to make long-term investment in a skilled workforce (House of Commons Environmental Audit Committee, 2012).

In Northern Ireland, through the Innovation Fund Employer Support Programme the Department of Employment and Learning NI supports the Carbon Zero Northern Ireland sector-wide initiative, which comprises six colleges across the country⁽³¹⁾. Led by the South West College, a range of courses are offered to support the development of skills and knowledge for clean energy development in Northern Ireland. Courses are offered on: renewable energy awareness; technologies for wind, solar, biomass and hydro; waste management; responsible sourcing of materials; and sustainable construction. No similar consortia of TVET providers were found in England, Wales and Scotland. Across these countries a range of educational institutions offer courses up to postgraduate level to support skills and knowledge for a green economy.

It is difficult to assess how important new green occupations (and the related competency standards, curricula and training) are in the UK, because the development of standards, curricula and training are sector-based and thus rather fragmented. Furthermore, the system of competency standards, qualifications and training delivery has undergone important changes since the latest green skills report. Thus, competency standards and qualifications have been revised independently of the green skills agenda. The main elements of the new skills system are outlined in Section 4.5.

4.2.2. Institutional set-up of TVET provision

The assessment of the need to upgrade current competency standards and design the competency/occupational standards for new green occupations at the strategic level is the responsibility of those sector bodies that are part of the green economy. SSCs and Sector Skills Bodies, some of which are relevant to the green skills agenda, develop, maintain and update occupational standards and job competencies. National Occupational Standards

⁽³¹⁾ Information on Carbon Zero Northern Ireland is available at: <http://www.collegesni.ac.uk/carbon-zero.aspx>

(NOS) are reviewed on a priority basis to ensure programmes and qualifications include new technologies, innovations and working methods used in the labour market. The government in England is no longer mandating the use of NOS in the vocational qualifications system (UK NARIC, 2016). Until 2017, SSCs were supported through the UK Commission for Employment and Skills (UKCES). Other sector bodies with a remit for skills include 'Industrial Partnerships' ⁽³²⁾, which have recently been established in the following relevant sectors: Energy, Science, Information Economy, Nuclear, Aerospace, Automotive and Tunnelling. Many SSCs have joined relevant Industrial Partnerships as members.

Strategic decisions about occupational standards and the content of green occupations are implemented (in line with regulators' guidelines) by organisations awarding qualifications. A new qualifications framework encompassing academic and vocational qualifications in England and Northern Ireland was introduced in October 2015. The new Regulated Qualifications Framework (RQF) gives awarding organisations increased freedom and flexibility to develop qualifications that meet specific labour market needs. Qualifications are now expected to be validated and supported directly by employers rather than follow prescriptive rules and structures imposed by government agencies (Annex 3). Existing qualifications from the previous Qualifications and Credit Framework (QCF) continue to be offered until they are withdrawn by the awarding organisation responsible for them (UK NARIC, 2016).

One example of how an awarding organisation works in a green sector is from the Waste Management Industry Training and Advisory Board (WAMITAB). It is an awarding organisation that develops qualifications and certificates for those working in the waste and resource management sector. WAMITAB certifies the competence of some 7,000 candidates annually in qualifications ranging from the level 1 (EQF Level 2) Award in Waste and Resource Management to the Level 4 (EQF Level 5) Diplomas (ESA ⁽³³⁾, 2016).

The system of apprenticeships in England, Wales and Northern Ireland is also being restructured. In 2017-18 apprenticeships will move from Apprenticeship Frameworks to Apprenticeship Standards, which are being developed by groups of employers. These Standards are linked to specific occupations. This creates the potential for creating standards for a variety of specific green occupations. The introduction of the Apprenticeship Levy in 2017 may increase employer demand for apprenticeship training across many sectors leading, possibly, to more apprenticeships in occupations of relevance to the green economy.

Education providers, responsible for the more detailed tasks of designing curricula and delivering the training, first and foremost include further education colleges, but also private training providers. National Skills Academies ⁽³⁴⁾, and National Colleges ⁽³⁵⁾, many of which

⁽³²⁾ Information on industrial partnerships is available at: <https://www.gov.uk/guidance/industrial-partnerships-an-overview>

⁽³³⁾ ESA stands for Environmental Services Association.

⁽³⁴⁾ Information on National Skills Academies is available at: <http://www.nsa-network.co.uk/#>

are relevant to green skills are designed to enable industry stakeholders to set training standards and to develop the learning opportunities needed most by their industries. Selected examples of sector bodies supporting the development of skills for the green economy include:

- (a) Power Generation: RenewableUK (and its member organisations) launched the RTN (36) with support from the industry and the UKCES. The Network is developing 'RTN Assured' courses, which meet the needs of employers. Two courses (Blade Repair and Inspection Awareness and Basic training) were launched in 2014 and there are further courses currently being developed. RenewableUK has also launched its Career Mapping Tool (37) for those interested in a career in the sector, as well as a collection of case studies of people working in the sector (the Faces of Wind Energy campaign) to promote careers in renewable energy. Lists of specialist courses (in Further and Higher Education) relating to renewable energy are also available on their website. RenewableUK also aimed to develop a National College for Wind Energy (with the Humber LEP), but the plans were not supported by the government.
- (b) Construction Industry: the Construction Leadership Council (CLC) (38) is a body that works between industry and government to identify and deliver actions supporting UK construction in building greater efficiency, skills and growth. The CLC has a sustainability work stream, the Green Construction Board, which was established in October 2011 as a consultative forum for government and the UK design, construction, property and infrastructure industry. The membership of the Green Construction Board represents both government and senior representatives from industry. The CLC published a free Sustainable Building Training Guide in 2017 (CLC, 2017) and the UK Green Building Council (39) has also developed training in sustainability known as the Sustainability Training and Education Programme (STEP).
- (c) Businesses in the waste and recycling industry signed up to the Energy & Efficiency Industrial Partnership (40). The Partnership aims to solve skills shortages by filling critical

(35) Information on the National Colleges is available at: <https://www.gov.uk/government/news/cable-new-generation-of-national-colleges-will-lead-revolution-in-hi-tech-skills> and <https://www.gov.uk/government/news/government-confirms-80-million-for-national-colleges-to-deliver-the-workforce-of-tomorrow>

(36) Information on the RTN is available at: https://www.oceanologyinternational.com/RXUK/RXUK_OceanologyInternational/documents/marine_renewables_renewables_training_network_s_green_renewableuk.pdf

(37) Information on the Career Mapping Tool is available at: <http://www.renewableuk.com/page/CareerMapping>

(38) Information on the Construction Leadership Council is available at: <http://www.constructionleadershipcouncil.co.uk/>

(39) Information on the Green Building Council is available at: <https://www.ukgbc.org/>

(40) Information on the Partnership support by Energy & Utility Skills is available at: <http://www.euskills.co.uk/about/energy-utilities-skills-partnership/>

gaps with a younger, more diverse and productive workforce. According to the 2016 report, 1 500 learners had received training, including up-skilling programmes and apprenticeships (ESA, 2016). Industry-specific training programmes, including ‘utilities engineering technicians’ and ‘maintenance engineering operations technicians’ were developed to meet the industry’s skills needs (ESA, 2016).

4.2.3. The local dimension and the role of LEPs in skills supply

Decisions about training provision are also made at the local level predominately through the LEPs, which can create links between employers and training providers. An example is provided in Box 2.

Box 2: Liverpool City Region: skills for the low carbon economy

The skills development strategy adopted by the Liverpool City Region (LCR) LEP concentrates on skills for the low carbon economy. LCR has developed a Low Carbon Economy Action Plan and a Sustainable Energy Action Plan to ensure the region is at the forefront of the transition to a low-carbon economy. The approach taken by LCR treats low carbon as a sub-sector of existing industries, such as transport and construction, rather than an independent sector. To meet the demand for skills in offshore wind, the LEP worked to co-ordinate the skills training in higher education colleges with the demands of local companies manufacturing products used by offshore wind. The LEP has also played a central role in filling a skills gap reported by the company Scottish Power, whose central office is in Liverpool. When the company informed the LEP of an imminent shortage of workers, caused by an ageing workforce and the lack of new apprentices, the LEP set out to create a strategy to help up-skill the existing workforce and train new engineers.

Source: Aldridge and Simons (2016).

The process of devolution has opened up the possibility for other local employment and training agencies to develop employment and skills policies, adjust training programmes to local labour market conditions and to build on the opportunities opened up by growing local sectors. Some examples include:

- (a) the Sussex Learning Network which has developed a Low Carbon Skills Strategy and a programme for delivering ‘energy efficiency awareness’ training to employees of local businesses (Sussex Learning Network, 2015);
- (b) the Trade Support Scheme ⁽⁴¹⁾ run by Low Carbon South West ⁽⁴²⁾ and the Centre for Sustainable Energy ⁽⁴³⁾ which offered advice and subsidised training to electricians, builders, and heating engineers employed by small and medium enterprises (SMEs) in the construction industry in the south west of England. The aim of the scheme was to support local businesses to expand into the low carbon home improvements sector and to improve the energy efficiency of homes.

⁽⁴¹⁾ Information on the Trade Support Scheme is available at: <https://www.cse.org.uk/news/view/2080>

⁽⁴²⁾ A sector partnership between businesses, academia, investors, local authorities, and both regional and national agencies promoting the growth of low carbon industries in the South and West of England. Information is available at: <https://www.lowcarbonsouthwest.co.uk/about/>.

⁽⁴³⁾ Information on the Centre for Sustainable Energy is available at: <https://www.cse.org.uk/about-us>

As discussed, the private sector plays an important role in shaping the VET provision for new green occupations and for greening established jobs. The UK skills system is increasingly employer-led: at the sector level, businesses can shape occupational standards and training programmes through involvement in SSCs and Industrial Partnerships. The Industrial Partnerships and SSCs also play a role in providing recommendations to government. For example, RenewableUK has published their Skills Manifesto, which accompanied the skills assessment and set out skills policy recommendations (RenewableUK, 2016). At the local level, businesses can also influence skills training through LEPs or through direct engagement with training providers, such as further education colleges. Aldridge and Simons (2016) argue that the introduction of the LEPs is symptomatic of a wider move to shift employment and skills development from a centrally-driven supply-side focus to a demand-led system with greater input from employers and learners into its design and delivery.

4.2.4. Government's role

At the highest level, the government department responsible for skills policy in England (until 2016) was the then BIS. There was a 'Green Economy Team' at BIS, which was responsible for influencing TVET policy and provision. There was also a Green Economy Council, formed in January 2011 whose task was to bring together business leaders from a cross-section of industries and sectors to advise government on green and green growth policies such as infrastructure, innovation and investment and to 'help reduce unnecessary regulation'. The Council worked with two departments (DECC and Defra) to 'minimise costs for business and maximise opportunities'. The membership of the Green Economy Council is currently being reviewed. The Council's last document was published in 2015; it comments on the government's industrial strategy.

In 2016 responsibility for skills in England was moved to the Department for Education (DfE) and a separate Institute for Apprenticeships (IfA) ⁽⁴⁴⁾ was set up. The IfA's remit is to: ensure high-quality apprenticeship standards; advise government on funding for each standard; support the development of standards and assessment plans by employer groups and review and approve them and publish approved standards and assessment plans. The institute is employer-led, to ensure employers continue to drive apprenticeship quality to the highest level.

The Scottish Government is noted to have had a number of developments underway since 2005 to prepare the economy for a transition to a green economy. See for example Skills Development Scotland (2015).

⁽⁴⁴⁾ Information on the Institute for Apprenticeships is available at:
<https://www.gov.uk/government/organisations/institute-for-apprenticeships/about>

4.2.5. The role of social partners

With the recent closure of UKCES, the role of social partners has become weaker in the UK skills system. UKCES was a social partnership set up to enable dialogue between social partners. Its Board included employer and trade union representatives. In relation to the role of trades unions, there has been a notable rise in their activity in relation to green skills. While preparing the 2011 government report Skills for the Green Economy, the Department for BIS asked the trade union organisation 'unionlearn' to explore how the workforce could engage with the opportunities presented by the green economy. unionlearn published a report (unionlearn, 2012), which presents the work of trades unions in this field. unionlearn is one example of how trade unions are playing a role in the transition to a greener economy. For instance, unionlearn has engaged many different stakeholders in their green economy agenda through dissemination activities, awareness raising events, partnerships and policy advocacy ⁽⁴⁵⁾. It has also facilitated the development of trade union policy, operational responses to the green economy and set up Green Skills Partnerships ⁽⁴⁶⁾. The University and College Union (UCU) has formed the Greener Jobs Alliance, which focuses its attention on building trade union activities in localities and regions and influencing the curriculum of schools, and further (post-16) and higher education. They have also published a Green Skills Manifesto (Greener Jobs Alliance, 2013), which calls for a 'green skills strategy' and improved co-ordination of relevant activities within central government and among sector bodies (Greener Jobs Alliance, 2013).

4.3. ALMPs and retraining measures

There are no UK-level active labour market programmes (ALMPs) that focus on developing skills for the green economy. The UK's public employment service (Jobcentre Plus) can refer clients to training providers (further education colleges, the third sector and private training providers). Jobcentres may also co-operate with employers who are trying to recruit staff for green jobs, but there is no information readily available on such partnerships. Employment service providers, public and private, do not play a role in planning green skills retraining measures. They may, however, play a role in designing and delivering retraining, in partnership with relevant sector body/bodies, but no information is readily available.

In terms of specific provision for unemployed people and those outside the labour market, the most important recent ALMP was the Work Programme, which ran between 2011 and 2017. It was designed to provide intensive, personalised support for people who were long-term unemployed or who are at risk of becoming long-term unemployed. Support was provided for up to two years for each unemployed participant. The Work Programme was

⁽⁴⁵⁾ For example the unionlearn Skills for a Green Economy agenda:
<https://www.unionlearn.org.uk/skills-green-economy>

⁽⁴⁶⁾ Information on the unionlearn Green Skills Partnerships (GSP) is available at:
<https://www.unionlearn.org.uk/green-skills-partnership>

delivered by private sector organisations (known as Prime Providers) which had control over the approaches they took to support their participants into sustained employment in the hope that this encourages creativity and innovation. The Work Programme is to be replaced in autumn 2017 by the new Work and Health Programme⁽⁴⁷⁾. This programme will provide specialised employment support for the long-term employed and people with disabilities. Those not qualifying for the programme will receive support through Jobcentre Plus. There was no centralised effort to focus on green skills in the Work Programme and current information suggests that this will also be the case in the new Work and Health Programme.

Sector-based Work Academies (SBWAs) are available to people claiming Jobseeker's Allowance (unemployment benefit) or Employment and Support Allowance (a social welfare benefit for people who cannot work for health reasons)⁽⁴⁸⁾. SBWAs were introduced in 2011 and were designed to support unemployed jobseekers back to work before they were referred to the Work Programme. They offer training and work experience for up to six weeks in a particular industry or area of work, which may be linked to the green economy.

Across the UK there are a number of charitable/not-for-profit organisations that offer ALMPs and support people, particularly vulnerable groups of people, into education, training and/or employment. A number of these organisations play a key role in training and re-training schemes. One example includes the Groundwork charity which provides skills training leading to recognised qualifications in green jobs to unemployed people⁽⁴⁹⁾. Groundwork operates across the UK, focusing on activities at the local level to support local communities with environmental projects. These can include: tackling climate change; helping young people improve their local area; improving parks, playgrounds and other green spaces; plus creating green jobs. Their work is typically project-based and funded by special programmes, such as the European Commission's LIFE+ programme⁽⁵⁰⁾.

Whilst there is a number of training and retraining initiatives across the UK targeted variously at young people, long-term unemployed people, (women) returners, older workers and career changes, there are no measures or initiatives specific to the green economy. Any retraining and other ALMP measures focusing on green skills/occupations are developed at the sector level. The following selected examples highlight some sectoral retraining initiatives:

- (a) in the energy and utilities sector, the SSC works in partnership with organisations that can provide access to 'target talent communities'. Communities they want to recruit from

⁽⁴⁷⁾ Information on the new welfare-to-work programme to be known as the Work and Health Programme is available at:

<http://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-7845>

⁽⁴⁸⁾ Information on the SBWAs is available at: <https://www.gov.uk/moving-from-benefits-to-work/job-search-programmes>

⁽⁴⁹⁾ Information on the GroundWork is available at: <https://www.groundwork.org.uk/green-teams>

⁽⁵⁰⁾ The following project by Green Teams London was funded by the LIFE+ programme. <https://www.groundwork.org.uk/Sites/urbanclimateproofing/Pages/ucp-about>

include leavers of the armed forces (through the Career Transition Partnership); unemployed people (through Jobcentres Plus) and possible career changers who currently work in other sectors (such as oil and gas and advanced manufacturing). The objective of these partnerships is to make the energy and utilities sector more visible to talented people and remove barriers to entry (Energy & Utilities Skills Partnership, 2017);

- (b) in the environmental services sector (recycling and resource management), the company SUEZ has formed a partnership with the social enterprise Doncaster Refurnish. They collect and upcycle unwanted furniture to reduce the amount of waste going to landfill. They work with people in long-term unemployment and ex-offenders. In 2010-11, the partnership created five new jobs and provided voluntary training to 175 people in vulnerable groups (ESA, 2016).

There is no UK-level strategy on green skills and thus there are no data on the number of people who have been retrained.

New government funding announced in 2017 aims to encourage lifelong learning in sectors and industries that are changing or need support, which may support the development of skills for the green economy. A sum of £40 million for lifelong learning pilots 'to test different approaches to help people to retrain and upskill throughout their working lives' was announced ⁽⁵¹⁾.

4.4. The role of the private sector in skills training

The role of the private sector is of key importance to the skills system in the UK. As noted earlier, employers are in leading positions in various sector bodies (SSCs and Industrial Partnerships) and the Local Economic Partnerships (LEPs). These bodies emphasise their employer-led character; the Industrial Partnerships are chaired by employers (for example, GlaxoSmithKline lead the Science Industrial Partnership and Jaguar Land Rover the Automotive Industrial Partnership). Sections 4.1 and 4.2, above, include examples of the role these sector organisations play in skills anticipation and shaping the development of occupational standards and the content of VET courses, including apprenticeships. In addition, some individual employers have direct links to training institutions, for example: Siemens is the strategic partner of the University of Sheffield on wind power ⁽⁵²⁾; and the Skills Academy for Sustainable Manufacturing and Innovation (SASMI) is based at Nissan's plant in the North East of England ⁽⁵³⁾. As a result of the shift towards employers, the

⁽⁵¹⁾ Information on the Chancellor's speech is available at:
<https://www.gov.uk/government/speeches/spring-budget-2017-philip-hammonds-speech>

⁽⁵²⁾ Information on Strategic partnership with Siemens is available at:
<https://www.sheffield.ac.uk/business/partners-collaborators/siemens>

⁽⁵³⁾ Information on the Gateshead College SASMI is available at:
<http://www.gateshead.ac.uk/facilities-conferencing-and-room-hire/sasmi/>

influence of trades unions (and employees) on SSCs has become weaker. As a result, trades unions tend to run their own organisations and initiatives around skills, including green skills. Labour market and skills assessments are now carried out in a way that is more focused on the direct needs of employers.

Government funding is available to employers, who have been given direct incentives to offer training on green skills. One such measure announced in the Enabling the Transition report was the Green Deal and its apprenticeship training element (Section 4.1). In the Green Deal scheme ⁽⁵⁴⁾ (which ended in 2015) households were able to take up loans and use the money to pay for retrofitting technology – making their homes more energy efficient. The Green Deal also made it possible for public bodies in the construction industry to develop apprenticeship courses in retrofitting. These courses were aimed at people who would work on site, for supervisors and for project managers. The take up, however, of Green Deal loans was much lower than expected (NAO ⁽⁵⁵⁾, 2016) and there was no real demand for the newly trained workers. Critics of the programme agree that the Green Deal was a missed opportunity, but they are divided when it comes to the analysis of the causes. Some argue that the failed initiative is an example of too much state intervention, while others assert that the failure was caused by setting the interest rates on the loans for home owners too high.

There are further initiatives to give employers more direct control over the design and delivery of training to address skills shortages, including potentially in green skills. The Employer Ownership of Skills Pilot and its successor, the Employer Ownership and Skills Fund provided public money until around 2015 (through a competitive bidding process) to employers so that they could design and deliver more flexible training packages (BIS, 2015a). Some of these funds were specifically targeted at small businesses. Engineering skills relevant to the green economy were the focus of some offers (BIS, 2014). The government contributed up to 50% of eligible costs to SMEs that directly employed people in engineering occupations. The aim was to help businesses to invest in the skills of current and future engineers.

While there is a clear policy shift to increase employer ownership of the skills system, employer-led bodies in a number of sectors that are relevant to the green economy have called for stronger government intervention in the skills system. RenewableUK, representing the wind and marine energy sector, called on the Government ‘to deliver a national skills strategy that can address the skills challenges’ (RenewableUK, 2016, p. 2). In their view, the Government should co-ordinate skills bodies to minimise duplication and ensure that there is a clear message on skills.

⁽⁵⁴⁾ Information on the Green Deal Initiative is available at: <http://www.greendealinitiative.co.uk/>

⁽⁵⁵⁾ NAO stands for National Audit Office.

4.5. The role of the institutional set up

There are currently no specific government bodies focusing on green skills. There are a number of sector-based, employer-led organisations whose work includes a focus on green skills, such as the Green Building Council. Other employers' organisations, such as the Confederation of British Industry, also focus on green skills within their broader mission. Other relevant organisations include the trade union based Greener Jobs Alliance and charitable organisations, such as the Green Alliance which engages with business leaders ⁽⁵⁶⁾.

As noted earlier, sector organisations (such as the SSCs, Industrial Partnerships, National Colleges and National Skills Academies) are all employer-led. There is some co-ordination among these organisations by the UK Skills Federation ⁽⁵⁷⁾, which represents, promotes and supports the SSCs and National Skills Academies across the UK. It aims to develop innovative skills solutions and to galvanise employer ambition and investment in skills and job creation.

It is important to note, however, that the primary focus of these organisations is not green skills. Skills for the green economy concern a number of sectors, as highlighted throughout Section 4. Some sector organisations have called for more co-ordination between different skills bodies within the training and education system to ensure clear messages on skills.

⁽⁵⁶⁾ See for example Green Alliance, 2017a.

⁽⁵⁷⁾ Information on the UK Skills Federation is available at: <http://www.ukskills.org/about-us/>

5. Conclusions and recommendations

At the time of writing the labour market in the UK is relatively buoyant. The evidence also points to significant growth in activity, output, and employment related to the green, low carbon economy. Since 2010, employment growth in low carbon and environment jobs across the UK has been significant and it is anticipated to continue to grow. Environment protection and related activities will continue to drive growth and employment as the UK moves towards becoming a greener economy.

Key policy and legislation

Since 2011, UK green policy has been broad, focusing on new environmental technologies, new ways of working, and 'greener consumption'. The UK 2020 renewables targets and targets to reduce carbon emission levels by 2050 are continuing to drive government policies and strategies. Two legislative changes in the UK have had an impact on the development of green skills and occupations: The Energy Act 2013 (TSO, 2013); and The Infrastructure Act 2015 (TSO, 2015).

That said, a range of green subsidies put in place by these legislative changes have been subsequently withdrawn by government along with plans to make all new homes carbon neutral. Future employment growth in the green jobs will be driven, at least in part, by the policy drivers/incentives in place to reduce carbon emissions. It is important, therefore, that all sectors of the economy continue to be steered towards the take up of those technologies and practices that will bring about a low carbon, green economy (see low carbon generation technologies and carbon capture networks).

Skills needs identification and anticipation

There have been a number of national skills and industrial strategies produced by the UK government that have talked about the transition to a low carbon and greener economy. Identifying and anticipating skills needs for the green economy has been substantially debated with a number of attempts to define and measure green skills. Evidence on green occupations (however defined) suggests that there are increasing levels of green up-skilling, and new green skills being required for new and emerging green occupations.

There are no regular UK-wide skills anticipation activities which focus specifically on green skills or jobs. The Working Futures forecasts report that the transition to a low carbon economy will have an impact on employment levels to 2024. For many sectors, it is anticipated that the transition to a greener economy will create new opportunities and areas of growth. This will particularly be the case in the construction and the primary and utilities sectors.

The drive to achieve a green economy will be dependent upon the green skills being available to bring this about. The evidence from the Working for a Green Britain and Northern Ireland study by RenewableUK in 2013 revealed that many employers in the renewables sector experience hard-to-fill vacancies often with skills being the root cause of vacancies

proving hard-to-fill. This evidence points to the need for skill anticipation exercises to be undertaken – utilising appropriate methodologies – so that skills shortages might be offset before they become a barrier to realising a green economy.

TVET provision for the green economy

Across the UK, there is currently no government-led effort to develop TVET provision for new green occupations or for greening established occupations. The institutional set up for skills and training has a strong element of devolution to sectors and to local actors, with employers playing a key role in sector bodies and at the local level. Devolution has opened up the possibility for local employment and training agencies to develop employment and skills policies, adjust training programmes to local labour market conditions, and to build on the opportunities opened up by growing local sectors. The number of sectoral bodies that support the development of skills for the green economy has increased over recent years. Employers now have an opportunity to shape occupational standards and training programmes through their involvement in these bodies. The private sector, therefore, plays an important role in shaping TVET provision for new green occupations and for greening established jobs. Trades unions are also playing a greater role.

It is difficult to assess how important new green occupations (and the related competency standards) are in the UK, because the development of standards, curricula and training are sector-based, rather fragmented, and undergoing change. The rationale behind the reforms of the UK skills system is to make it more responsive to the needs of the labour market. Given that the responsibility for the development of green skills is likely to be distributed across several sectors of the economy, various institutions, and manifold skills courses and programmes, there is merit in conducting stock taking exercises so that there is a store of information about the supply of green skills. This would potentially highlight gaps in supply.

ALMPs and retraining measures

There are no ALMPs that focus on developing skills for green jobs or the green economy. Employment service providers are not involved in planning green skills retraining measures, but may play a role in designing and delivering training initiatives in partnership with relevant sector bodies. Whilst there are a number of training and retraining initiatives targeted variously at young people, the long-term unemployed, (women) returners, older workers and career changers, there are no measures or initiatives specific to the green economy.

Any retraining and other ALMP measures focusing on green skills/occupations are developed at the sector level. There are some not-for-profit organisations that offer labour market programmes for particular groups linked to green jobs and the development of green skills. At this juncture, it is not clear what the employment outcomes of incorporating (more of) a green skills component in ALMPs might be in the UK, or what green skills should be delivered under the umbrella of an ALMP. This potentially provides an avenue for further investigation.

Private sector in skills training

Employers have central place in the skills system. Employers are in leading positions in various sectoral bodies and the LEPs, whilst some have direct links to training institutions supporting the development of green skills. While there is a clear shift to increase employer ownership of the skills system, employer-led bodies in a number of sectors relevant to the green economy have called for government intervention in the skills system. Employer ownership has been designed to ensure that skills supply meets labour demand.

There is a need, however, to ensure that future skill needs are met too. Potentially there is a risk that skills supply under the employer ownership agenda becomes overly focused on meeting current rather than future demand. There is, therefore, a need for policy makers, employer groups, and sector bodies to keep an eye on the future to ensure that both current and future green skill needs are being met.

The role of the institutional set up

As noted above, there are currently no specific government bodies focusing on green skills, but rather a number of sector-based, employer-led organisations, trades unions and charitable organisations whose work includes a focus on green skills. To a large extent this reflects the wide variety of economic activities, jobs, and skills that are likely to be affected by greening of the economy. At the same time, this points to the need for stock taking exercises that periodically review the demand for, and supply of, green skills and for organisations to commission such exercises. It also points to the value of producing reports such as the current one.

List of abbreviations

ALMP	Active Labour Market Policy
BIS	Department for Business, Innovation & Skills
Cedefop	European Centre for the Development of Vocational Training
CLC	Construction Leadership Council
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DfE	Department for Education
ECO	Energy Company Obligation
EGSS	Environmental Goods and Service Sector
EPC	Energy Performance Certificate
ESA	Environmental Services Association
EU	European Union
GDP	Gross Domestic Product
GVA	Gross Value Added
HEEPS	Energy Efficiency Programmes for Scotland
IfA	Institute for Apprenticeships
ILO	International Labour Organization
LCR	Liverpool City Region
LEP	Local Enterprise Partnership
NAO	National Audit Office
NOS	National Occupational Standards
ONS	Office for National Statistics
QCF	Qualifications and Credit Framework
RQF	Regulated Qualifications Framework
RTN	Renewables Training Network
SASMI	Skills Academy for Sustainable Manufacturing and Innovation
SBWA	Sector-based Work Academy
SMEs	Small and Medium Enterprises
SSC	Sector Skills Council
STEP	Sustainability Training and Education Programme
TVET	Technical and Vocational Education and Training
UK	United Kingdom
VET	Vocational Education and Training
WAMITAB	Waste Management Industry Training and Advisory Board

References

- Aldridge, J.; Simons, J. (2016). *Low-carbon skills development in the UK: the approach of Liverpool City Region*. London: Institute for Public Policy Research.
<http://www.ippr.org/files/publications/pdf/nsaw-case-study-aldridge-simons-feb2016.pdf>
- Asset Skills et al. (2009). *Low carbon cluster. Sector skills assessment report*. London.
<http://webarchive.nationalarchives.gov.uk/20130102164157/http://www.euskills.co.uk/download.php?id=986>
- BIS (2010). *Skills for sustainable growth. Strategy document (full report)*. London: Department for Business, Innovation and Skills.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32368/10-1274-skills-for-sustainable-growth-strategy.pdf
- BIS (2014). *Employer ownership: improving engineering skills in smaller companies*. London: Department for Business, Innovation & Skills.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/386305/bis-14-1266-employer-ownership-improving-engineering-skills-in-smaller-companies-guidance-for-applicants-r1.pdf
- BIS (2015a). *Evaluation of the employer ownerships of skills pilot, round 1: initial findings* (BIS Research Paper No 221). London: Department for Business, Innovation & Skills.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/412685/BIS-15-178-evaluation-of-the-employer-ownership-of-skills-pilot-round-1.pdf
- BIS (2015b). *The size and performance of the UK low carbon economy. Report for 2010 to 2013*. London: Department for Business, Innovation & Skills.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/416240/bis-15-206-size-and-performance-of-uk-low-carbon-economy.pdf
- BIS; DECC; Defra (2011). *Skills for the green economy. A report on the evidence*. London: HM Government.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32373/11-1315-skills-for-a-green-economy.pdf
- Bowen, A.; Kuralbayeva, K. (2015). *Looking for green jobs: the impact of green growth on employment*. Policy Brief. London: Grantham Research Institute on Climate Change and the Environment and the Global Green Growth Institute.
http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/03/Looking-for-green-jobs_the-impact-of-green-growth-on-employment.pdf
- Breuer, Z. (2012). *Sector skills assessment: construction, building services engineering and planning*. Wath-upon-Deerne: UK Commission for Employment and Skills.
http://www.citb.co.uk/documents/research/evidence-report-65-construction-building-services-ssa_tcm17-33271.pdf
- BUILD UP Skills (2012). *United Kingdom – analysis of the national status quo*. Belgium.
https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/build_up_skills_uk_status_quo_report_en.pdf
- Cedefop (2010a). *Skills for green job. European synthesis report*. Luxembourg: Publications Office of the European Union.

- Cedefop (2010b). *Skills for green jobs. Country report: UK*. Thessaloniki: Cedefop. Available at: <http://www.cedefop.europa.eu/en/uploads/dfu/country-reports/pain>
- Cedefop (2019). *Skills for green jobs: 2018 update. European synthesis report*. Luxembourg: Publications Office. Cedefop reference series; No 109. <http://data.europa.eu/doi/10.2801/750438>
- CIPD (2017). *Megatrends. The trends shaping work and working lives*. London: CIPD. https://www.cipd.co.uk/Images/megatrends_2013-trends-shaping-work_tcm18-11401.pdf
- CLC (2017). *Sustainable building training guide*. London: Construction Leadership Council. <http://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2017/05/Sustainable-Building-Training-Guide.pdf>.
- Committee on Climate Change (2017). *Meeting carbon budgets: closing the policy gap. 2017 report to Parliament*. London: Committee on Climate Change. <https://www.theccc.org.uk/wp-content/uploads/2017/06/2017-Report-to-Parliament-Meeting-Carbon-Budgets-Closing-the-policy-gap.pdf>
- DECC (2013). *Energy bill summary impact assessment*. London: Department of Energy & Climate Change. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/204800/energy_bill_summary_ia.pdf
- Dierdorff, E. et al. (2009). *Greening of the world of work: implications for O*NET[®]-SOC and new and emerging occupations*. North Carolina: National Center for O*NET Development. <http://www.ctdol.state.ct.us/wia/memos/2009/ONET-GreeningOfWorld.pdf>
- EDF Energy (2016). *Hinkley Point C. Building Britain's low-carbon future*. London: EDF Energy. https://www.edfenergy.com/sites/default/files/hpc_building_britains_low-carbon_future_-_july_2016.pdf
- Energy & Utilities Skills Partnership (2017). *Many skills one vision. Energy and utilities workforce renewal and skills strategy: 2020*. Solihull: Energy & Utility Skills. <http://www.euskills.co.uk/sites/default/files/Workforce%20Renewal%20and%20Skills%20Strategy%20FINAL.pdf>
- ESA (2016). *Delivering sustainable growth: how the resource and waste management industry benefits people, the environment and the economy*. London: Environmental Services Association. http://www.esauk.org/reports_press_releases/esa_reports/20160510_Delivering_Sustainable_Growth.pdf
- Gibbs, D.; O'Neill, K. (2015). Building a green economy? Sustainability transitions in the UK building sector. *Geoforum*, Vol. 59, pp. 133-141.
- Green Alliance (2012). *Green economy: a UK success story*. London: Green Alliance. <http://www.green-alliance.org.uk/resources/Green%20economy%20a%20UK%20success%20story.pdf>
- Green Alliance (2017a). *Industrial strategy fit for the future. Perspectives on building a competitive UK economy*. London: Green Alliance. http://www.green-alliance.org.uk/resources/Industrial_strategy_fit_for_the_future_perspectives.pdf
- Green Alliance (2017b). *Negotiating Brexit. Positive outcomes for the UK on energy and climate*. London: Green Alliance. <http://www.green->

alliance.org.uk/resources/Negotiating_Brexit_Positive_Outcomes_For_UK_Energy_Climate.pdf

- Greener Jobs Alliance (2013). *Green skills manifesto*. London.
http://www.greenerjobsalliance.co.uk/wp-content/uploads/2016/04/Green_skills_manifesto_2013_to_print_1_.compressed.pdf
- Greenwood, D. (2012). The challenge of policy coordination for sustainable sociotechnical transitions: the case of the zero-carbon homes agenda in England. *Environment and Planning C: Government and Policy*, Vol. 30, No 2, pp. 162-179.
- Hamdouch, A.; Depret, M. (2010). Policy integration strategy and the development of the 'green economy': foundations and implementation patterns. *Journal of Environmental Planning and Management*, Vol. 53, No 4, pp. 473-490.
- HM Government (2009). *The UK low carbon transition plan: national strategy for climate and energy*. Norwich: TSO, The Stationery Office.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228752/9780108508394.pdf
- HM Government (2011). *Enabling the transition to a green economy: government and business working together*. London.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/183417/Enabling_the_transition_to_a_Green_Economy__Main_D.pdf
- HM Government (2017). *Building our industrial strategy*. Green paper. London.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/611705/building-our-industrial-strategy-green-paper.pdf
- House of Commons Environmental Audit Committee (2012). *A green economy. Twelfth report of session 2010-12, Vol. 1*. Ordered by the House of Commons to be printed 30 April 2012) HC 1025. London: The Stationery Office Limited.
<https://www.parliament.uk/documents/TSO-PDF/committee-reports/cmenvaud.1025.pdf>
- House of Commons Environmental Audit Committee (2016). *EU and UK environmental policy. Third report of session 2015-16*. Ordered by the House of Commons to be printed 23 March 2016) HC 537. London: The Stationery Office Limited.
<https://publications.parliament.uk/pa/cm201516/cmselect/cmenvaud/537/537.pdf>
- ILO (2011). *Skills for green jobs: a global view*. Synthesis report based on 21 country studies. Olga Strietska-Illina, Christine Hofmann, Mercedes Durán Haro, Shinyoung Jeon. Geneva: International Labour Office, Skills and Employability Department, Job Creation and Enterprise Development Department.
http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_159585.pdf
- ILO (2018). *World employment and social outlook (WESO) 2018: greening with jobs*. Geneva: International Labour Office. https://www.ilo.org/weso-greening/documents/WESO_Greening_EN_web2.pdf
- McNeil, C.; Thomas, H. (2011). *Green expectations: lessons from the US green jobs market*. London: Institute for Public Policy Research (IPPR).
https://www.ippr.org/files/images/media/files/publication/2011/07/green-expectations_July2011_7756.pdf

- NAO (2016). *Green deal and energy company obligation*. London: National Audit Office, Department of energy & climate change. <https://www.nao.org.uk/wp-content/uploads/2016/04/Green-Deal-and-Energy-Company-Obligation.pdf>
- Northern Ireland Department for Economy (2017). *Economy 2030. A consultation on an industrial strategy for Northern Ireland*. Belfast: Department for Economy. <https://www.economy-ni.gov.uk/sites/default/files/consultations/economy/industrial-strategy-ni-consultation-document.pdf>
- O'Neill, K.; Gibbs, D. (2016). Rethinking green entrepreneurship – fluid narratives of the green economy. *Environment and Planning A: Economy and Space*, Vol. 48, issue 9, pp. 1727-1749.
- ONS (2017a). *Statistical bulletin. Quarterly national accounts: Jan to March 2017*. Newport: Office for National Statistics. <https://www.ons.gov.uk/economy/grossdomesticproductgdp/bulletins/quarterlynationalaccounts/jantomar2017/pdf>
- ONS (2017b). *Labour market economic commentary: August 2017*. Newport: Office for National Statistics. <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/labourmarketeconomiccommentary/august2017/pdf>
- ONS (2017c). *Statistical bulletin: UK environmental accounts: 2017*. Newport: Office for National Statistics. <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/ukenvironmentalaccounts/2017>
- RenewableUK (2012). *Renewables training network. Green skills, green jobs*. London: RenewableUK. https://www.oceanologyinternational.com/RXUK/RXUK_OceanologyInternational/documents/marine_renewables_renewables_training_network_s_green_renewableuk.pdf
- RenewableUK (2013). *Working for a green Britain and Northern Ireland 2013-23: employment in the UK wind and marine energy industries*. London: RenewableUK. <http://c.ymcdn.com/sites/www.renewableuk.com/resource/resmgr/publications/reports/working-for-a-greener-britain.pdf>
- RenewableUK (2016). *Skills manifesto: skills recommendations from the wind and marine energy industries*. London: RenewableUK. http://c.ymcdn.com/sites/www.renewableuk.com/resource/collection/CCDED43F-322D-4559-9D80-B7EF579CC80A/ruk13-027_03_-_skills_manifesto_web.pdf
- Ryan-Hume, J. (2016). *Domestic energy efficiency schemes in Scotland*. SPICe Briefing. Edinburgh: The Scottish Parliament. http://www.parliament.scot/ResearchBriefingsAndFactsheets/S4/SB_16-01_Domestic_Energy_Efficiency_Schemes_In_Scotland.pdf
- SITA (2012). *Driving green growth: the role of the waste management industry and the circular economy*. Maidenhead: SITA UK. <http://www.sita.co.uk/wp-content/uploads/2017/08/DrivingGreenGrowth-SITAUK-120423.pdf>
- Skills Development Scotland (2015). *Skills investment plan for Scotland's energy sector (2nd edition)*. Glasgow: The Scottish Government/Skills Development Scotland. https://www.skillsdevelopmentscotland.co.uk/media/35691/sds_energy_sip_digital.pdf

- Smith, A. (2007). Emerging in between: the multi-level governance of renewable energy in the English regions. *Energy Policy*, Vol. 35, Issue 12, pp. 6266–6280.
- Sofroniou, N.; Anderson, P. (2015). *Green skills and jobs in Scotland*. Unpublished report.
- Sussex Learning Network (2015). *Building sustainable skills: a low carbon skills strategy for the Sussex Learning Network*. Brighton: Sussex Learning Network (SLN).
- The Guardian (13/06/16). *UK government's fracking definition 'could allow drilling without safeguards'*. <https://www.theguardian.com/environment/2016/apr/13/uk-governments-fracking-definition-could-allow-drilling-without-safeguards>
- The Scottish Government (2015). *Scotland's economic strategy*. Edinburgh: Scottish Government. <http://www.gov.scot/Resource/0047/00472389.pdf>
- The Welsh Government (2012). *Green growth Wales: investing in the future*. Cardiff: The Welsh Government. <http://gov.wales/docs/det/publications/140623-green-growth-en.pdf>
- TSO (2013). *Energy act 2013*. Norwich: The Stationery Office. http://www.legislation.gov.uk/ukpga/2013/32/pdfs/ukpga_20130032_en.pdf
- TSO (2015). *Infrastructure act 2015*. Norwich: The Stationery Office. http://www.legislation.gov.uk/ukpga/2015/7/pdfs/ukpga_20150007_en.pdf
- UK NARIC (2016) *Vocational education and training in Europe – United Kingdom*. Cedefop ReferNet VET in Europe reports; 2016. https://cumulus.cedefop.europa.eu/files/vetelib/2016/2016_CR_UK.pdf
- UKCES (2016). *Working Futures 2014-2024: evidence report 100*. Wath-upon-Deane: UK Commission for Employment and Skills. Available online: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/513801/Working_Futures_final_evidence_report.pdf
- unionlearn (2012). *Stewarding the green skills agenda. A think piece commission by unionlearn for the consideration of trade unions and partner organisations*. London: unionlearn. <https://www.unionlearn.org.uk/publications/stewarding-green-skills-agenda>

Further reading

- Garman, J.; Davis, R.; Pearson, P. (2015). *Green collar nation: a just transition to a low-carbon economy*. Economic report series 2015. London: Greenpeace UK and Trade Union Congress (TUC). <https://www.tuc.org.uk/sites/default/files/GreenCollarNation.pdf>
- Washan, P.; Stenning, J.; Goodman, M. (2014). *Building the future: the economic and fiscal impacts of making homes energy efficient*. Verco Global and Cambridge Econometrics. <http://www.energybillrevolution.org/wp-content/uploads/2014/10/Building-the-Future-The-Economic-and-Fiscal-impacts-of-making-homes-energy-efficient.pdf>

Websites

Carbon Zero Northern Ireland. <http://www.collegesni.ac.uk/carbon-zero.aspx>

Career Mapping Tool. <http://www.renewableuk.com/page/CareerMapping>

Centre for Sustainable Energy see: <https://www.cse.org.uk/about-us>

Construction Leadership Council. <http://www.constructionleadershipcouncil.co.uk/>

DesmogUK. Creation of the UK Infrastructure act. <https://www.desmog.uk/creation-uk-infrastructure-act-2015>

EASME. <https://ec.europa.eu/easme/en/intelligent-energy-europe>

Energy & Utility Skills. Partnership support. <http://www.euskills.co.uk/about/energy-utilities-skills-partnership/>

Gateshead College skills academy for sustainable manufacturing and innovation. <http://www.gateshead.ac.uk/facilities-conferencing-and-room-hire/sasmi/>

Green Building Council. <https://www.ukgbc.org/>

Green Deal Initiative, see: <http://www.greendealinitiative.co.uk/>

Green Teams London. Funded by the LIFE+ programme. <https://www.groundwork.org.uk/Sites/urbanclimateproofing/Pages/ucp-about>

Groundwork. <https://www.groundwork.org.uk/green-teams>

HEEPS. <https://beta.gov.scot/policies/home-energy-and-fuel-poverty/energy-saving-home-improvements/>

Hinkley Point C. <https://www.edfenergy.com/energy/nuclear-new-build-projects/hinkley-point-c/about>

HM Government: chancellor's speech. <https://www.gov.uk/government/speeches/spring-budget-2017-philip-hammonds-speech>

HM Government: greenhouse and gas emission policy. <https://www.gov.uk/government/publications/2010-to-2015-government-policy-greenhouse-gas-emissions/2010-to-2015-government-policy-greenhouse-gas-emissions>

HM Government: industrial partnerships. <https://www.gov.uk/guidance/industrial-partnerships-an-overview>

HM Government: new nuclear power. <https://www.gov.uk/guidance/guidance-for-operators-of-new-nuclear-power-stations>

HM Government: sector-based work academies. <https://www.gov.uk/moving-from-benefits-to-work/job-search-programmes> Unionlearn. Green skills partnerships (GSP). <https://www.unionlearn.org.uk/green-skills-partnership>

Institute for Apprenticeships. <https://www.gov.uk/government/organisations/institute-for-apprenticeships/about>

InvestNI: <https://www.investni.com/>

LEP network. <https://www.lepnetwork.net/the-network-of-leps/>

Low carbon South West: <https://www.lowcarbonsouthwest.co.uk/about/>

National Colleges. <https://www.gov.uk/government/news/cable-new-generation-of-national-colleges-will-lead-revolution-in-hi-tech-skills> ;

<https://www.gov.uk/government/news/government-confirms-80-million-for-national-colleges-to-deliver-the-workforce-of-tomorrow>

National Skills Academies. <http://www.nsa-network.co.uk/#>

OFGEM. <https://www.ofgem.gov.uk/environmental-programmes/eco>

Resource Efficient Scotland. <http://www.resourceefficientscotland.com/about-us>

Scottish Enterprise: <https://www.scottish-enterprise.com/>

Skills Panorama analytical highlight: skills anticipation in Spain.

http://skillspanorama.cedefop.europa.eu/en/analytical_highlights/skills-anticipation-spain

Trade Support Scheme. <https://www.cse.org.uk/news/view/2080>

TSO Energy act. <http://www.legislation.gov.uk/ukpga/2013/32/contents>

TSO Infrastructure act. <http://www.legislation.gov.uk/ukpga/2015/7/introduction/enacted>

UKCES archived website for sector skills assessments.

<http://webarchive.nationalarchives.gov.uk/20140108104814/http://www.ukces.org.uk/our-work/nssa>

UK Skills Federation. <http://www.ukskills.org/about-us/>

Unionlearn. Skills for a green economy. <https://www.unionlearn.org.uk/skills-green-economy>

University of Sheffield. Strategic partnership with Siemens.

<https://www.sheffield.ac.uk/business/partners-collaborators/siemens>

Work and Health Programme.

<http://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-7845>

Zero Waste Scotland. <http://www.zerowastescotland.org.uk/content/who-we-are>

ANNEX 1.

Methodology and research tools

Over 20 experts and key stakeholders from government, trade unions, academia, professional bodies and non-governmental organisations were contacted both by email and telephone, and invited to contribute to the research. Four people were available for interview.

Ahead of the interview, interviewees were sent a project information sheet providing details of the project and what their contribution would involve.

ANNEX 2.

Definition of low carbon sectors

Table 2: Low carbon sectors and groups

Grouping	Sectors
Low carbon electricity	Onshore wind Offshore wind Nuclear energy Hydroelectric energy Marine energy Solar Photovoltaic (PV) Carbon capture and storage
Low carbon heat	Geothermal heat Heat pumps Solar thermal Heat networks
Waste processing, energy from waste and biomass	Recycling - recovery and reprocessing of materials from waste Generation of energy from waste and biomass Alternative fuels Biomass equipment
Energy efficiency products	Energy-efficient lighting Insulation Energy-efficient windows and doors Heat recovery and ventilation Energy controls and control systems Sustainable architecture and buildings
Low carbon services	Low carbon advisory Low carbon finance
Other low carbon	Low emission vehicles

Source: Department for Business, Innovation & Skills (2015b), p. 9

ANNEX 3.

Overview of UK skills authorities and agencies

Table 3: Policy making authorities across the UK, 2016

England	Department for Education (DfE) – all levels of education
Scotland	Scottish Government
Wales	Welsh Government/Department for Economy, Skills and Infrastructure – further education colleges and higher education
Northern Ireland	Department for the Economy – further education colleges and higher Education

Source: ReferNet UK, cited in UK NARIC (2016), p. 49.

Table 4: VET regulators and inspection/accreditation agencies in the UK, 2016

England	<ul style="list-style-type: none"> • Office of Qualifications and Examinations Regulation (Ofqual) – further education and non-degree higher education qualifications • Office for Standards in Education, Children’s Services and Skills (Ofsted) – further education colleges
Scotland	<ul style="list-style-type: none"> • Scottish Qualifications Authority (SQA) - further education and higher education qualifications not awarded by higher education institutions • Education Scotland – further education colleges
Wales	<ul style="list-style-type: none"> • Qualifications Wales – further education and non-degree higher education qualifications • Her Majesty’s Inspectorate for Education and Training in Wales (Estyn) - further education colleges
Northern Ireland	<ul style="list-style-type: none"> • Council for the Curriculum, Examinations and Assessment (CCEA) – further education and non-degree higher education qualifications • Education and Training Inspectorate (ETI) – further education colleges and other providers delivering publicly-funded training programmes

Source: ReferNet UK, cited in UK NARIC (2016), p. 49.

Table 5: Training providers in the UK, 2016

England	<ul style="list-style-type: none"> • Schools/academies – vocational secondary education • Further education colleges – secondary and post-secondary VET • Independent training providers – secondary and post-secondary VET • Higher education institutions – higher vocational education
Scotland	<ul style="list-style-type: none"> • Schools – vocational secondary education • Tertiary colleges – secondary and post-secondary VET • Private training providers – secondary and post-secondary VET • Higher education institutions – higher vocational education
Wales	<ul style="list-style-type: none"> • Schools – vocational secondary education • Further education institutions – secondary and post-secondary VET • Colleges – secondary and post-secondary VET • Higher education institutions – higher vocational education
Northern Ireland	<ul style="list-style-type: none"> • Schools – vocational secondary education • Further education colleges – secondary and post-secondary VET • Private, community and voluntary sector providers – secondary and postsecondary VET • Training organisations – secondary and post-secondary VET • Higher education institutions – higher vocational education

Source: ReferNet UK, cited in UK NARIC (2016), p. 50.

Table 6: UK Qualifications Frameworks: owners, 2016

Regulated Qualifications Framework (RQF)	<ul style="list-style-type: none"> • Office of Qualifications and Examinations Regulation (Ofqual) • Council for the Curriculum, Examinations and Assessment (CCEA)
Scottish Credit and Qualifications Framework (SCQF)	Scottish Credit and Qualifications Framework Partnership
The Credit and Qualifications Framework for Wales (CQFW)	Welsh Government
Framework for Higher Education Qualifications (FHEQ)	Quality Assurance Agency for Higher Education (QAA)

Source: ReferNet UK, cited in UK NARIC (2016), p. 50.

Table 7: Qualification design stakeholders – TVET, 2016

National Occupational Standards describe the competences needed in the workplace	Developed and managed by: <ul style="list-style-type: none"> • Skills Development Scotland • Sector Skills Councils (SSC) and other standard setting bodies 	Including: <ul style="list-style-type: none"> • Employers/employment advisers/trade union representatives/education providers/voluntary sector • Employers/employer organisations/trades unions/education providers/voluntary sector organisation in specific occupational sectors
Qualifications frameworks set guidelines for how qualifications are developed	Including: <ul style="list-style-type: none"> • Regulated Qualifications Framework (RQF) • Scottish Credit and Qualifications Framework (SCQF) • Credit and Qualifications Framework Wales (CQFW) 	Qualification Frameworks owned by: <ul style="list-style-type: none"> • Office of Qualifications and Examinations Regulation (Ofqual)/Council for the Curriculum, Examinations and Assessment (CCEA) • Scottish Credit and Qualifications Framework Partnership • Welsh Government
Awarding organisations develop qualifications for inclusion on qualifications frameworks	Including: <ul style="list-style-type: none"> • Pearson, City & Guilds, OCR and organisations with qualifications registered on the Ofqual Register of Regulated Qualifications • Scottish Qualifications Authority (SQA) and other organisations • Organisations with qualifications registered on the Qualifications in Wales Database 	Regulated by: <ul style="list-style-type: none"> • Ofqual, CCEA • SQA Accreditation • Qualifications Wales
Education providers create curricula and deliver qualifications created by awarding organisation	Including: <ul style="list-style-type: none"> • Further education colleges/work-based learning/adult and community learning • Tertiary colleges/private further education schools • Further education colleges/work-based learning/adult community learning • Further education colleges/work-based learning/adult and community learning providers 	Regulated by: <ul style="list-style-type: none"> • Office for Standards in Education, Children's Services and Skills (Ofsted) • Education Scotland • Estyn • Education Training Inspectorate Northern Ireland

Source: UK NARIC (2016), Table 5, pp. 32-33.