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Greener Skills and Jobs for a Low-Carbon Future



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OECD GREEN GROWTH PAPERS

The OECD Green Growth Strategy, launched in May 2011, provides concrete recommendations and measurement tools to support countries' efforts to achieve economic growth and development, while at the same time ensure that natural assets continue to provide the ecosystems services on which our well-being relies. The strategy proposes a flexible policy framework that can be tailored to different country circumstances and stages of development.

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Foreword

In February 2012, policy makers, researchers, experts from international organisations and academia met in Paris to debate the role of "green skills" in moving towards a low-carbon future. The 2012 Green Skills Forum was organised jointly by the OECD and Cedefop and this volume collects the papers from participants. The Forum raised policy makers' and stakeholders' awareness of the need to integrate skills strategies in order to succeed in the transition to a low-carbon economy. Such strategies include measures for more flexible and dynamic education and training programmes at local, sectoral and regional levels.

Green skills are those skills needed to adapt products, services and processes to climate change and the related environmental requirements and regulations. They will be needed by all sectors and at all levels in the workforce. Demand for green skills is driven by a range of factors, including public policies and targets, and defined by three main trends: i) across occupations and industries, greening requires upgrading skills and adjusting qualification requirements; ii) new or emerging economic activities create new or renewed occupations and related qualifications and skills profiles; and iii) structural changes create a need to realign sectors that will decline as a result of the greening of the economy and retrain workers accordingly.

Understanding and quantifying the industrial and spatial impact of economic transformations is paramount and is at the heart of efforts to analyse skills needs in a low-carbon economy. Underestimating the role of skills and related education and training policies in the ecological transformation risks creating negative trade-offs between environmental and employment goals. The successful transition to a low-carbon economy will only be possible by ensuring that workers are able to adapt and transfer from areas of decreasing employment to other industries and that human capital exists and is maximised to develop new industries. This publication pays particular attention to how these changes play out in SMEs, which have less awareness of the technological and operational adaptations required by a low-carbon development than larger enterprises and which exhibit low provision of training and skills development opportunities.

Policy implications emerging from the Forum underline the need to better co-ordinate policy and involve social partners and educational institutions in the governance of change; identify, assess and create green skills to maximise all social, environmental and economic promises of a low-carbon economy; and focus on developing strategic capacity in small and medium-sized enterprises and support them in integrating green skills transformations into their business strategies.

The OECD and Cedefop will pursue their joint efforts to increase policy makers' and stakeholders' awareness of the changes and requirements brought about by the development of greener and sustainable economies. In 2014, our organisations will renew their successful collaboration to organise a second Green Skills Forum entitled "Green skills and innovation for employment growth".

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Deputy Secretary-General of the OECD

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Acting Director, Cedefop

Acknowledgements

This publication resulted from the OECD-Cedefop Green Skills Forum 2012, which was held on 27 February 2012 in Paris, France and brought together academics, policy makers and international organisations with the specific aim of analysing and drawing lessons from the impacts of the green economy on skills development and training policies. The European Commission, DG Employment, Social Affairs and Inclusion supported this publication.

We would like to thank all of the speakers who contributed papers to the Forum. In particular, we acknowledge the contribution of the keynote speakers Yves Leterme, Deputy Secretary-General, OECD and Pascaline Descy, Head of Area Research and Policy Analysis, Cedefop; session chairs: Paul Ekins, University College of London; Petra Schwager, UNIDO; Robert Strauss, DG Employment, Social Affairs and Inclusion, European Commission; Sergio Arzeni, OECD Centre for Entrepreneurship, SMEs and Local Development (CFE); and the session discussants: Ray Pinto, Microsoft Europe, Middle East and Africa; Roland Schneider, Trade Union Advisory Committee to the OECD (TUAC); Lucia Cusmano, OECD CFE; Paul Swaim, Directorate for Employment, Labour and Social Affairs, OECD; and Wolfgang Mueller, German Federal Employment Agency.

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Chapter 1

Green skills for a low-carbon future

Cristina Martinez-Fernandez, Antonio Ranieri and Samantha Sharpe

This chapter defines the key concepts that are central to this volume: what are green jobs and green skills and what are the implications for low-carbon economies of not enough of either. Labour market impacts from the transition from high- to low-carbon intense production will affect all workers. However, changes will be minor for the majority, but substantial for a small number of industries and professions. The skills and training implications are threefold: i) upgrade skills sets in industries experiencing only minor adjustments; ii) gearing up educational institutions and firms to provide the new skills for new occupations and sectors that will emerge from the green economy; and iii) retraining and realigning skills in sectors that will decline as a result.

Climate change is a major issue facing all countries. Set out on the path to a lower carbon future, while fostering adaptation to a climate that is already changing occupy the attention of policy makers across a broad spectrum, from environment and economic policy to industry, employment, education and social policy.

Recent OECD reports (OECD, 2012a; Martinez-Fernandez et al., 2012) describe the fundamental demographic and economic forces that will shape the globe in the four decades to 2050:

- An additional 2 billion people will need to be accommodated, with rising living standards across all countries and a quadrupling of global GDP.
- Increasing life expectancy will mean an aging population for some countries, while for other countries, particularly developing countries; young populations and workforces will be a competitive advantage.
- The majority (70%) of people will be living in cities, offering resource efficiency opportunities but also placing greater emphasis on the need for solutions to air pollution, traffic congestion, and the management of water, waste and energy in urban environments.

The efforts to improve resource efficiency and de-carbonise our energy supply and production systems has given rise to the term "green economy", and a new suite of terms such as "low-carbon economy", "green jobs", "eco-literacy" and "green skills". This publication is specifically concerned with the last term: green skills.

Skills or competencies are inherently individual qualities. In the OECD *Skills Strategy*, skills are defined as the "bundle of knowledge, attributes and capacities that can be learned and that enable individuals to successfully and consistently perform an activity or task and can be built upon and extended through learning" (OECD, 2012b). In line with this, Cedefop defines green skills[1] as "the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society" (Cedefop, 2012). More generally, since the transition towards a sustainable economy is increasingly pervasive and horizontal across economic activities, green skills can be defined as the skills needed by the workforce, in all sectors and at all levels, in order to help the adaptation of the products, services and processes to the changes due to climate change and to environmental requirements and regulations.

Although the concept of green skills depends very much on the context of its use, it is important to separate out the definition of green skills from other terms. Green skills and green jobs are often conflated; even the definition of green jobs is not fixed but varies across contexts, jurisdictions and organisations.

The United Nations defined green jobs as sectors and jobs in which waste creation and pollution is minimised (UNEP, 2008). The International Labour Organisation (ILO) includes in its definition of green jobs any sector that has a lower than average environmental footprint (ILO, 2012). Statistical agencies across the world usually focus their definition of green jobs on the definition of the environmental goods and services sector.[2] The distinction between jobs and skills is important because the labour market dynamics of "greening" in the economy are, and will be, complex into the future. Skills analysis offers a disaggregated level to examine and unpick these dynamics.

This chapter has three sections. First, an analysis of the labour market changes presented by greening economies is discussed, including the likely positive and negative impacts and how these will be distributed. The chapter then looks at green jobs and green

skills, highlighting the issues of skills shortages, and matching skills demand and supply. A firm-based view is then presented with an analysis of the implications for small and medium-sized enterprises (SMEs). The chapter concludes with policy recommendations and highlights areas for continued research and analysis.

Labour market dynamics of greening economies

The labour market will feel both the costs and benefits of action to reduce emissions and to address climate change. Climate change is expected to affect labour markets in three ways (Martinez-Fernandez et al., 2010), each with different implications on businesses and workforces:

- impacts from regulations affecting the supply (businesses) and the demand (consumers) side of the economy
- direct impacts on natural and built environments
- social consciousness, and how it will influence and drive policies, regulations and labour markets by changing consumers' choices for "green" resource efficient products and services.

A number of prominent recent reports have sought to define and isolate these impacts in further detail. The *Green Jobs: Towards Decent Work in a Sustainable, Low Carbon World* (UNEP et al., 2008) highlighted that the impacts of greening would be far-reaching within the labour force, and felt at the individual, firm and associated labour-organisation level. This finding was reinforced by further research that showed that the boundaries between what is and what is not considered a low-carbon job was becoming increasingly blurred (Cedefop, 2010).

A recent OECD report, "The jobs potential of a shift towards a low carbon economy" (OECD, 2012c), compares the forthcoming changes to similar industrial transformations such as the information and communications technology (ICT) revolution. Impacts of the ICT revolutions were extensive, but unevenly distributed; some occupations were significant and had direct impacts on the positive (job creation) and the negative side (job destruction). This also applied at the sector level – some sectors grew rapidly in response to ICT, other contracted.

For the vast majority of sectors and occupations, however, the ICT revolution bought moderate changes to the tasks of their work for individual workers, and the processes and products of businesses. A similar impact is forecast for the low-carbon economy. Recent analysis (The Economist, 2013) has highlighted that the productivity gains flowing from the ICT transformation took more than 20 years to materialise. *This is a useful reminder that such large and extensive industrial transitions will not happen quickly and that policy actions can strategically influence the transition.*

Other reports have identified the economic sectors likely to experience the most profound changes in the type and volume of employment. These sectors include agriculture and fisheries, beach and skiing tourism, infrastructure, finance and insurance (Council of the European Union, 2010). Cedefop identified further sectors such as renewable energy, energy efficiency (particularly in buildings, new and old), transport, primary manufacturing and recycling sectors (Cedefop, 2010; 2012).

The debate on the need for action on climate change initially highlighted the job creation potential of the low-carbon economy. This continues, with the reality of recession and austerity in many countries making the idea of green employment growth a welcome antidote to the high unemployment rates in many countries. However, in countries and areas where there are large concentrations of sectors in carbon-intensive employment, climate change action is usually framed in a "job killer" context.

On the whole, there now seems agreement that a low-carbon economy will have in aggregate, a neutral or slightly positive overall impact of the labour force in terms of total employment (Cedefop, 2013; OECD, 2012c; UNEP, 2011), but impacts will be spread unevenly across countries, regions and types of workers.

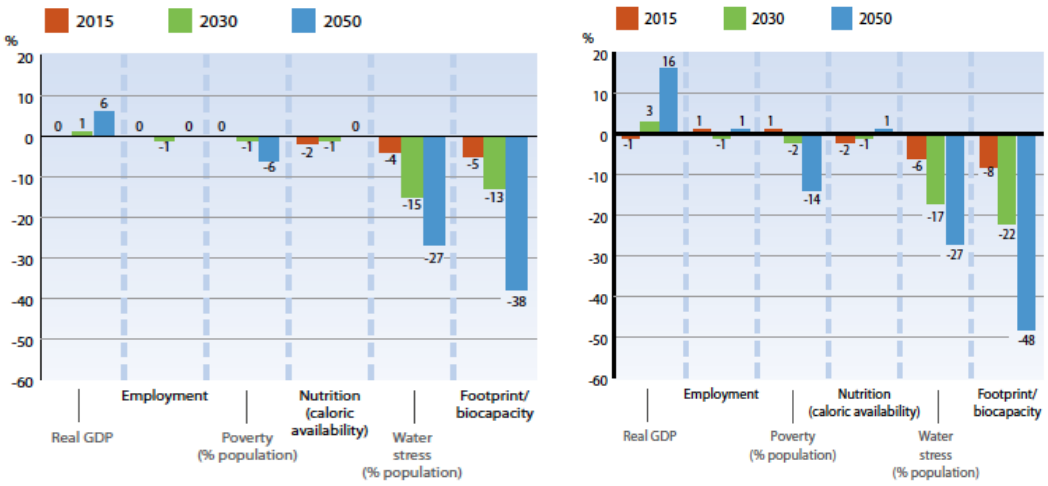
The net positive employment forecast of climate change regulation is derived from the expansion of economic sectors involved in the production of environmental goods and services (EGS). The economic opportunity of these green industries was estimated to be worth USD 548 billion in 2004 and projected to grow to USD 800 billion by 2015 (UNEP, 2011). The UNEP estimates that 20.4 million jobs will be created in renewable energy industries (wind, solar, bio fuels).

A recent UNEP (2011) report produces analysis of the economic and emissions impacts of the transition to a lower carbon economy. The modelling includes two "green" scenarios with different levels of increased investment over the period 2010-50, contrasted with two business-as-usual investment patterns. The two green scenarios build on an extension of the work done by UNEP's Global Green New Deal Policy Brief (UNEP, 2009) which called for at least 1% of GDP to be directed towards green investments. This generated the first green scenario. The second scenario assumes that 2% of GDP is directed to green investments with priorities at the sectoral level emphasising energy and climate change activities that limit emissions to the target range of 450 ppm.

In both of the scenarios there is a positive effect on gross domestic product (GDP) in the longer term as a result of the transition to lower carbon economy (Figure 1.1). This effect is magnified in scenario 2 with higher levels of green investment. The employment impacts are neutral in these scenarios, but these are net results, and therefore account for job losses as well as gains. The environmental impacts are significant, with large reductions in the ecological footprints of economies.

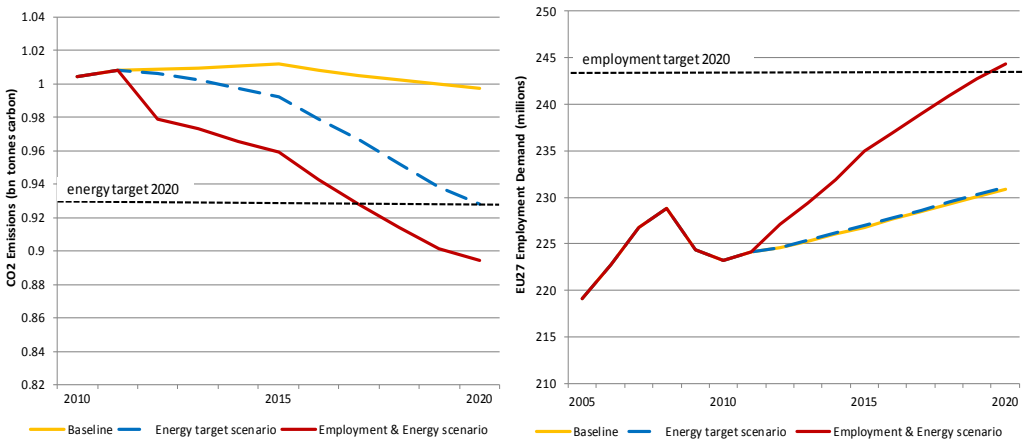
More recently, a new Cedefop study explores various policy scenarios for EU countries and confirms that a sustainable and energy-efficient economy can be achieved at the same time as employment growth (Cedefop, 2013). However, the study also warns that to have both requires greater integration of climate and energy polices with measures to support employment and innovative and responsive vocational education and training (VET) policies that encourage the development of the skills needed by a low-carbon economy.

Figure 1.1. **Results of Green 1 and 2 scenarios against business-as-usual**



Source: UNEP (2011), "Modelling global green investment scenarios: Supporting the transition to a global green economy", in UNEP (2011), *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*, available at: www.unep.org/greeneconomy.

Figure 1.2. **Europe's energy and employment policy scenarios**



Source: Cedefop (2013), *Skills for a Low Carbon Europe: The Role of VET in a Sustainable Energy Scenario*, European Commission, Luxembourg.

The uneven and weak economic recovery from the crisis indicates that, under the first "business-as-usual" scenario, shown by the yellow lines in Figure 1.2, Europe will fail either on its energy or its employment targets. The employment rate rises to 71% in 2020 compared to 68% in 2011, but falls short of the target.

Under the "energy target" scenario, shown by the blue lines in Figure 1.2, energy-related measures will have the effect of achieving the EU energy goals. The scenario also shows an increase in employment levels similar to the baseline scenario. In both cases, failure to reach the employment target implies that additional measures are needed to increase labour demand.

The "employment and energy" scenario, shown by the red lines in Figure 1.2, is based on an assumption of measures likely to have significant employment effects integrated with those to reduce energy consumption and emissions. Employment measures would include incentives for employers to hire additional workers (such as lower labour taxes), work incentives for individuals (such as lower unemployment benefits) and greater investment in research and development and skills.

Are green jobs good jobs?

Green jobs are not guaranteed to be good and decent jobs. Decent work is defined as opportunities for women and men to obtain decent and productive work in conditions of freedom, equity, security and human dignity (ILO, 2012). Decent work includes aspirations for opportunity and income; rights, voice and recognition; family stability and personal development; fairness and gender equality. These dimensions are seen as central to reducing poverty and achieving inclusive and sustainable growth, and essential underpinnings of peaceful communities and society.

The forecast green jobs are not homogeneous in terms of skill requirements, pay levels or working conditions. The workers that are likely to be displaced in the low-carbon economy are also heterogeneous. Low-qualified workers are over-represented in agriculture, mining and inland transport. Older workers are represented in agricultural and water transport. The workforce in electricity generation and chemicals, however, includes high-skilled workers (OECD, 2012c). Most of these workers have traditionally faced difficulties in accessing new skills, and also have below average mobility. Some of these industries also concentrate geographically adding another layer of concern for the transition. This means that a policy response that includes a one-size fits all approach will not be appropriate.

It is clear that the industrial impacts of the low-carbon economy will not be even, this is also true for the impacts when considered spatially. Understanding and quantifying both these industrial and spatial impacts are key in order to diffuse tensions around decisions on action to mitigate carbon emissions. Skill analysis offers a method to disaggregate impacts at the occupation level and look at sets of knowledge and attributes that individual workers possess. They also show how this knowledge can be built into qualifications, and this stock of knowledge can be enhanced through training.

Green skills and why they are important

While it's not easy to say how many jobs will be created and/or destroyed by the greening of the economy, it is certain that the on-going process of transformation of the economy will lead to significant changes in labour demand both between and within economic sectors. The previous section discussed the labour market impacts of greening and identified three categories of impact. A similar process is also relevant for examining the impact of greening on skills needs and acquisition.

Greening the economy will affect skills needs in three ways (Cedefop, 2012):

- Structural changes lead to increased demand for some occupations and decreases for others.
- New economic activity will create new occupations and there will be a need for new skills profiles and qualification and training frameworks.

- Many existing occupations and industries will experience greening changes to tasks within their jobs, and this will require adjustments to the current training and qualification frameworks for these occupations.

In light of this, the drive towards new development strategies based on low-carbon technologies and products offers opportunities but also major challenges. Analyses show that, without further action to break the link between economic activity and energy demand, the strong interrelations between socio-economic and technological dimensions of energy and climate policies may exacerbate the negative trade-off between environmental and employment targets (Ranieri and David, 2013). This is because green skills are essential to ensuring we make the transition to a low-carbon economy.

The successful transition to a low-carbon economy will only be possible by ensuring the labour force is able to transfer from areas of decreasing employment to other industries, and if adequate human capital exists to develop new industries that will grow as a result of climate change mitigation and adaptation activities. Skills development activities will play a major role in each of these transitions (OECD, 2012c).

Skills development itself is becoming explicitly important for socio-economic development more broadly. People without adequate skills have a greater chance of experiencing economic disadvantage, a higher likelihood of unemployment and dependency on social benefits (OECD, 2012b). Conversely, even moderate improvements in skill levels have a significant pay-off for the economy in the long term (OECD, 2010a). Green skills are important for the successful transition to a low-carbon economy, but also to ensure we maximise the potential of our human capital.

In developing countries the socio-economic impacts from skills development have the potential for even more dramatic impacts (ADB, 2013). Asian countries in the post-global financial crisis era are looking at increasing the knowledge intensity of their labour force and the sophistication of their domestic markets. As these economies move towards higher levels of services activity within their economies, the skills and competencies of the labour force must also transition. These economies can benefit by embedding the greening of the skills of the labour force in this wider upgrading of skills.

A further risk in not understanding and addressing green skills needs and the labour force gaps that may ensue is skills bottlenecks. This is where economic activity is stalled because of the unavailability of the correct range of skills, or the availability of these skills but at a cost that is too high to make their use viable.

Skills shortages, gaps and bottlenecks

Skills can be difficult to define and measure at an aggregate level because they are a socially constructed concept, intangible and often unobservable. A key distinction is whether skills are deemed to lie in the person or the job (Cedefop, 2012), and in consequence, whether skills shortages or deficiencies should focus on those within people or those that are measured through volumes of jobs.

Skills shortages are defined as “a situation in which the demand for a particular type of skill exceeds the supply of available people with that skill” (Cedefop, 2012). This is marked by the absence of sufficient appropriately qualified people to undertake particular roles when and where employers need them. Skills shortages may be caused by a shortage of applicants with the relevant knowledge, personal qualities, qualifications or experience or by low pay and unattractive working conditions, which may deter suitable recruits from applying. Skills gaps are defined as a situation in which the level of skills of the

currently employed is less than that required performing the job adequately or in which the type of skill does not match the requirements of the job.

Skills shortages and gaps are a major impediment of many emerging industries. In a low-carbon economy these bottlenecks can lead to increased costs to climate change mitigation and adaptation. These additional costs can diminish support for these actions and, if they defer action on climate change, can lead to greater costs in the long term.

Supply and demand of green skills

Public policy is influencing both the supply and demand for green skills. Environmental regulation and government's role in creating markets that price carbon and the other negative externalities of industrial processes that are impacting on climate change are driving significant change in labour markets.

In a study of nine occupations that are explicitly green, regulatory and public policy incentive schemes introduced as part of energy and environmental policies were a major driver of demand for these occupations and associated skills (Cedefop, 2012). Other policy areas such as industry and innovation policy indirectly influenced both the supply and demand for green skills and occupations through tax breaks, subsidies and direct government investment in infrastructure, which are aimed at stimulating market activity particularly for renewable energy and resource efficiency technologies.

The supply side dynamics of green skills, particularly the market-driven supply dynamics, are nascent. Green skills are an emerging area of skills development as are the suppliers of these skills. Learning providers are aware of the implications of transitioning to low-carbon economies but as yet the requisite changes in curricula and competency frameworks required for the widespread adoption of green skills is limited. These changes have mainly been occurring in explicit "green" jobs such as energy auditors and solar photovoltaic installers. They are also more likely to be present in higher skilled occupations and through formal qualification frameworks. The hesitancy on the part of learning organisations is in part explained by insufficient demand from the market for these services, and an uncertainty around the pathway for market development (Cedefop, 2012).

Where there is a demand for green skills in business, this demand is strongly related to building competitive advantage. The environmental awareness of firms is an important feature in attracting high-skilled employees. This is especially also true for young employees. Employees want to work with firms that align with their values. Evidence from the United Kingdom and the United States (Aiman-Smith, 2009; Chartered Institute of Personnel Development, 2007) shows that positive environmental images are a string attractor for graduates in selecting which firm to work for. Investing in environmental awareness by developing these skills in staff is an important form of "employer branding". Green skills development within the workforce can provide a further competitive advantage for firms, particularly in frontline staff, because if these staff are well trained in resources efficiency, they are the best placed to identify and minimise wastage (Roy and Therin, 2008).

Greening skills in SMEs

Evidence from a number of countries shows that skill shortages have already developed in certain sectors and occupations, which are not well served by traditional training institutions (Cedefop and ILO, 2010). Transitioning to a greener economy is not

new for large firms, particularly for firms operating in the resources industries. SMEs are more often than not relatively unaware of the technological and operational adaptations required by the low-carbon development. Furthermore, they are usually poorly linked to the often more savvy larger corporations. SMEs also have the additional challenge of a low participation rate in training and skills development programmes and the extent of this participation is usually unknown at the local or regional level.

The impact of these challenges do not only fall on SMEs; the greening of global supply chains and therefore the pace of greening for larger and multi-national firms is also hampered by the inability for SMEs to green at the same pace. This means that the challenge SMEs face is shared throughout the economy (Box 1.1).

SMEs generally rely upon on-the-job forms of training and learning-by-doing which means that if green skills development progresses through formal qualification and competency frameworks, the transition for SMEs will be slow.

Box 1.1. **Greening global supply chains**

Issues for SMEs in greening global supply chains

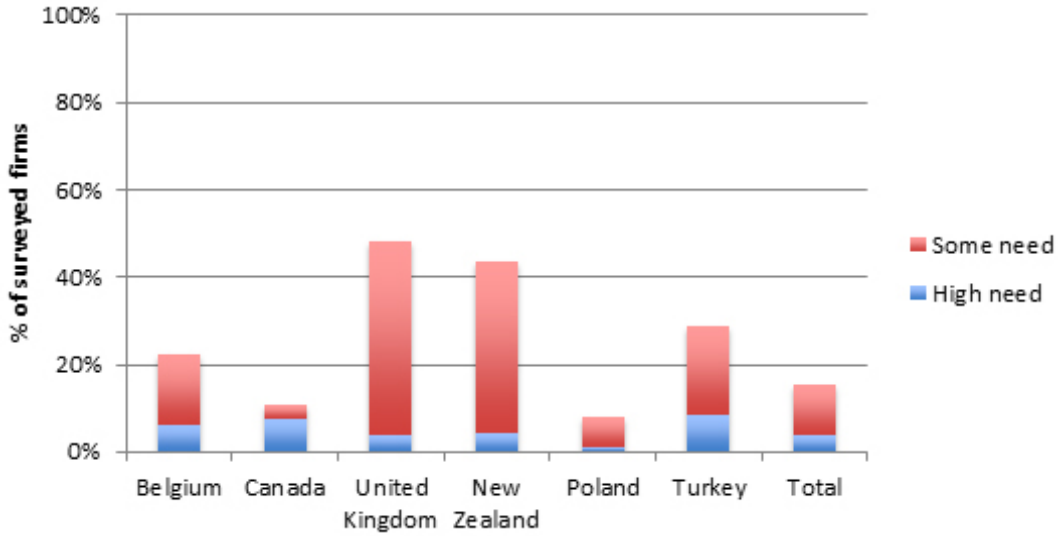
- Greening global value chains (GVCs) implies a high level of collaboration with the SMEs (formal and informal) for greening processes. Selection criteria can help but need to go beyond compliance because it is not possible to "police" the SMEs to see if they are complying or not with all of the criteria – education and awareness raising via working together in projects can work better.
- Greening global supply chains (GSCs) requires a focus on greening generic skills and competences to stimulate green innovation in SMEs more than a focus on specific green skills. However, SMEs' competitiveness will depend on particular specific/technical skills which are needed for green innovation. Large companies can help through collaborative projects on raising the skills levels of SMEs.
- Greening GVCs can contribute to social equity through fostering inclusive growth. The firms in the GVC can promote increased skills linked to the integration of disadvantaged groups into the labour market. Firms (large and SMEs) can also increase the managerial skills for inclusiveness (e.g. women in management positions, positions for people with disabilities, etc.). Inclusiveness is about integrating disadvantaged groups in firms throughout the GVCs. This needs targeted inclusiveness policies and management practices accompanying the greening of jobs and skills.
- Greening GVCs requires the participation and partnerships of local institutions and local stakeholders to facilitate policy co-ordination and strategic initiatives where the SMEs participating in the GVCs are located and to foster global action. However, the size of SMEs limits their capacity to participate formally in partnerships and to contribute formally to local and regional networks due to their financial and size constraints.

Source: Session on Greening Global Value Chains at the Green Growth Knowledge Platform Forum 2013, OECD, Paris.

A recent OECD study of training and skills development activities with SMEs in six countries found low levels of awareness and activity in skilling employees for green skills (OECD, 2013). As shown in Figure 1.3, only in New Zealand and the United Kingdom did more than a third of the surveyed firms indicate the need for green skills. As SMEs account for approximately 99% of all enterprises and two-thirds of employment

across the OECD (OECD, 2008; 2010b), their transition to sustainable practices is key to the large-scale uptake of a green growth model.

Figure 1.3. **Green skills needs among SMEs**



Source: OECD (2013), *Skills development and Training in SMEs*, OECD Publishing: Paris.

In other research by the OECD (Martinez et al., 2013a), SMEs within Copenhagen's clean tech cluster showed that these firms, even when embedded in one of the world's most sophisticated and well-developed clean tech clusters, faced difficulties in business and skills development.

The linkages between SMEs and knowledge institutions such as universities and technical colleges are one avenue to increase knowledge intensity and innovative activity of firms, but there are few pathways to link these institutions to SMEs. Students through their employment in SMEs report training is the most prevalent connection, but it is difficult to assess the intensity of these connections as data on green skills training is a major piece of missing information. Figure 1.4 shows the Copenhagen Dashboard on Local Green Growth. Copenhagen is performing well on the majority of these measures at the local level, however, with the clear gap of green skills.

Figure 1.4. **Copenhagen Dashboard for Local Green Growth**



Source: OECD (2013a).

Policy response to green skills

Many post-global financial crisis (GFC) economic strategies reference green growth of some kind – the EU's economic strategy for 2020 highlights "smart, sustainable and inclusive" growth, and the 20-20-20 targets by 2020 targets (20% emissions reduction, 20% renewable energy and 20% energy efficiency).[3] Development of the market for renewable energy and energy efficiency services has also been highly influenced by government policy.

Even though there is unison about the need for policy action around green growth, and therefore for green skills, there is as much diversity in policy response as there is in forecast impacts. This diversity is due to the different starting positions of each country, their aspirations and resources.

In Europe, Cedefop (2010; 2012) studies have shown weaknesses in EU countries' forecasting ability in regard to adequate skills supply, as well as diverse responses to skills needs ranging from centralised updating of the curricula of tertiary programmes to regional and/or market-led development of training, depending largely on the structure of the VET systems in the different member countries. Furthermore, they found that in promoting a green economy, there was very little policy co-ordination of social policy measures, industrial and innovation policy measures, and energy and environment measures.

Policy co-ordination to date appears uncertain and fragmented. This fragmentation can be traced back to resistance and uncertainty about environmental regulations and policies, which makes it difficult to assess skills need. There is also uncertainty around mechanisms for skill development, particularly the acquisition of skills through non-

formal means. This is despite the fact that recent research shows that small and medium-sized firms can access better skills development through these informal mechanisms (OECD, 2013).

Box 1.2 highlights the suggested policy implications, which are outlined in further detail below.

Box 1.2. **Policy response to green skills**

- Supporting green skills is integral to the transition to a low-carbon economy.
- Optimising public policy co-ordination is also key for the transition.
- Fostering portable skills and lifelong learning.
- Matching market development to regulatory activity.
- Focusing on transparency around policy action.
- Developing strategic capacity within micro, small and medium enterprises.
- Investing in R&D for anticipating and addressing gaps in knowledge.

Supporting green skills is integral to the transition to a low-carbon economy

Contributions from authors to this publication demonstrate that the identification, assessment and creation of green skills is essential in transitioning to a low-carbon economy and being able to capitalise on all the social, environmental and economic benefits that this brings. Failure to adequately support developing green skills in the labour force will put the continued and future public support for carbon mitigation action to address climate change in jeopardy. It also means that the adoption of resource efficient practices will not be swift, and the costs of mitigation and adaptation will be higher in the long term.

Optimising public policy co-ordination is key for the transition

The major role for public actors will be to provide direction and co-ordination for skills development and training activities to occur. This policy implication has been identified by other groups working in this area, including the G20 Inter-Agency Working Group on Greening Technical and Vocational Education and Training and Skills Development (2013). This inter-agency working group includes the OECD and Cedefop, as well as the ILO, UNESCO, UNITAR, the ETF and other important international organisations.[4] The group recommends to policy makers that green skills development needs to be integrated into the wider training and skills development policy rather than being seen as additional or separate to other forms of skills development.

Public actors play a major role in the delivery of skills development and training and this will continue into the future. Public actors also are, and willing to continue to, play an equally important role in stimulating demand for green skills (such as through support for market demand for environmental goods and services such as renewable energy or energy efficiency retrofits). Public actors' role in managing the supply and demand for green skills is another aspect requiring co-ordination. This will prevent the situation of green skills demand being stimulated by government policy, but not being matched by

equivalent action to meet this demand, leading to skills bottlenecks and/or programme failure due to unskilled operators.

In order to increase co-ordination, closer dialogue between employers, workers, policy makers and educational institutions is needed. Information and tools will also be required to inform this dialogue. This will require clarity around definitions and the parameters of green skills needs and provision, measures and indicators to demonstrate progress and recalibrate policy responses when conditions change. Policy and governance activities are needed to bring stakeholders together to increase this dialogue, and have meaningful channels of activities and communications available for these stakeholders to contribute to decision making in this area. Policy makers also need to take responsibility for data collection, as this is an emerging area for skills, as it also is for data collection that analyses the demand and uptake of these skill areas. Individual stakeholders will not be able to adequately capture the data necessary to inform future directions; public actors will need to take the leadership role.

Fostering portable skills and lifelong learning

One of the ways to achieve policy co-ordination and institutional integration is for agreement among institutions to a focus on transversal skills in resource efficiency rather than on the skills required by specific and identified green occupations (Inter-Agency Working Group on Greening Technical and Vocational Education and Training and Skills Development, 2013). This focus would require the broader involvement of all the relevant actors? including employers, workers, unions, industry associations, educational institutions and governments at local, regional and national levels. These interactions would need to be resourced appropriately and may require changes in the focus of current activities. However, the impact on individuals and firms of this focus on transversal skills is lower, and less obvious.

Matching market development to regulatory activity

Chapters throughout this publication show the impacts that public policy action through increasing environmental standards and regulations, and the development of new markets through carbon pricing have had in driving green skills and jobs demand. This is particularly apparent in energy and environmental policy, including support for energy efficiency and renewable energy. Policy action also needs to consider whether the pace of regulatory activity is supported for the resultant market development.

A focus on transversal skills alone will not be enough in the areas where public policy is driving significant demand for specific occupations and skill sets. In these circumstances, explicit actions to develop these skills are required, and these actions may require public support to ensure that skill standards are established and met.

Public support will be needed to fill a gap in the market, a gap that is due to uncertainty around the stability of public incentives in driving demand (such as those for renewable energy generation, energy efficiency retrofits and water management).

Focusing on transparency around policy action

Over the medium and long term, market actors will be able to participate more in informing the requirements of skill development and providing skill services. Public policy actors can accelerate the participation of market actors in the provision of skills activities by providing transparency around the path of these stimulating policies. This

allows private actors to make investment decisions about growing businesses in these sectors. This also creates more resilient sectors that can withstand the eventual step down and withdrawal of public support.

Developing strategic capacity within micro, small and medium-sized firms

Developing green skills is part of a broader challenge to increase the strategic management capabilities of SMEs. SMEs have limited awareness of their needs and options in terms of green skill development. This is coupled with an established acknowledgement that SMEs participate in substantially less formal training and skills development. To engage SMEs in the green skill transition requires a broader understanding of how SMEs respond to skills deficits and of their use of informal mechanisms for skills development.

Recent research by the OECD highlights that SMEs can achieve better skills development outcomes from informal training and skills development activities (particularly through participation in knowledge-intensive service activities) than from formal vocational training. However, there is still much to learn about how this potential can become reality; how skills developed informally can be recognised through qualifications and competency assessment, in the same way as there is for formal skills development, and what this may mean for SME skills development.

The integration of informal skills development into the wider development activities of SMEs will not mean a shift away from formal training, but will require increased flexibility by allowing the combination of both to exemplify lifelong learning for the labour force. About 80% of the current workforce will still be in the labour market in ten years' time; they thus represent a central source of skills. Informal skills development represents a flexible and adaptive route for skills development within this population (OECD, 2013).

For SMEs there are further policy implications. In order for SMEs to identify their skills needs and gaps they need a well-developed business strategy. Strategic management is often a challenge for SMEs as it requires skills from a range of skills sets (including finance, marketing, research, regulatory affairs), which all may not be present in the individual(s) that manage the firm. The challenge of upgrading the management skills of SMEs is not new; yet the challenge seems to be intractable, with much policy failing to make a significant difference to the strategic management capability of SMEs, despite the known benefits to profitability and innovation. Policy makers need to carefully evaluate past policy on SMEs' skills development and look to innovate in the development of new activities to achieve movement on strategic management skills within SMEs.

Investing in R&D for anticipating and addressing gaps in knowledge

Research to date has focused on skills needs for a number of high-technology occupations plus a few niche industries. This now needs to broaden out to encompass a broader range of skills. The importance of training and skills development activities within firms has been supported by much research. While the evidence for small and medium enterprises is not as well developed (OECD, 2013), attention now needs to turn to making the case for why investing in green skills pays. Investment in research and development need to scale up as the transition unfolds new challenges for inclusive economic growth and sustainable employment.

Gaps in knowledge exist in the following areas:

- How can transversal skills be captured and transferred to new occupations in the low-carbon economy?
- How will new streams of demand for green products and services impact on skills, employment and employability?
- Does the low-carbon transition offer an opportunity for wider strategic management skills adoption within SMEs?
- How can monitoring and evaluation of policy co-ordination provide feedback and incentive for continuing activities?

About this publication

This publication emerged from a joint OECD and Cedefop forum on green skills held in February 2012. The aim of the forum was to gather the recent work of researchers, government advisers, employment and policy analysts, and other social partners on skills development and training needs for a lower carbon economy.

The papers presented at the forum discussed new research, policy approaches, tools, strategies and local initiatives for green skills development. The forum acted as an "expert meeting" to draw theoretical work into policy practice and provide an evidence base for implemented policies for the OECD and Cedefop in their advisory capacity. This collected volume presents some of the papers from the forum in an effort to continue the contribution to these emerging issues.

The publication is divided into three parts.

Part I: Gearing up education and training for green growth

This part discusses the creation of new markets and transforming existing markets; creating different demands on skills and forcing labour markets to change order to remain competitive and innovative. The focus is specifically on education and training systems and chapters present empirical evidence of European countries' activities to co-ordinate the development of green skills within their labour forces.

Part II: Enterprise approaches for a workforce fit for a green economy

This part examines methods for skills identification and forecasting skills needs. Again, empirical evidence is presented regarding the anticipation of skill needs in green sectors and responding to them with appropriate training design. Chapters also discuss the importance of how delivering training at the appropriate time can be crucial for the green change to happen and to benefit all rather than generating winners and losers, where losers are likely to be concentrated in specific sectors or regions

Part III: Integrating skills into local development strategies for green job creation

This part explores the challenge of developing green skills given the extreme diversity of needs in different industries, localities and countries at different levels of economic development. C-coordination between different levels of government, as well as between different areas of policy including environmental policy, employment and education and VET policy is essential.

Notes

1. The starting point for identifying "green skills" is always the job (or the occupation) involved in a green (economic) activity in its strict sense (Cedefop, 2012).

2. The environmental goods and services (EGS) sector includes solutions for problems such as air, noise and marine pollution; land and water contamination; as well as activities such as environmental analysis and consultancy and waste management and recycling. It also includes a range of rapidly growing renewable energy technologies (such as hydro, wave and tidal power, geothermal, wind and biomass), as well as a number of other emerging low-carbon activities (such as reduced emissions from within the transport and construction sectors, nuclear energy, energy management, carbon capture and storage, and carbon finance).

3. The EU has a "green pillar" as part of its Europe 2020 strategy and has the green economy at the centre of the Commission's "Towards a Job-Rich Recovery" recommendations.

4. See: www.unevoc.unesco.org/fileadmin/user_upload/docs/IWG_Leaflet__June21__2012_.pdf.

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Part I:

Gearing up education for training and growth

Chapter 2

The case for a global green skills training action plan

Joel Marsden, James Medhurst and Pat Irving

It is increasingly recognised that training in a full complement of skills is required across a broad range of jobs so that economies can become more resource efficient and environmentally sustainable. Research and experience suggest that a successful transition to a new economic paradigm requires proactive steps to facilitate effective education and training, which better match the needs of enterprises to adjust and operate in new business environments. While skills development and training actions to foster green growth need tailoring to local circumstance, a global view can enhance the exchange of experience among policy makers, researchers and practitioners alike, recognising the globalisation of the economy.

This chapter sets out such a global view. Building on ICF GHK's extensive experience in researching and evaluating international developments in green growth, green jobs and green skills, we identify key actions for policy makers and social partners to ensure that vocational education and training are better aligned to the needs of enterprises and entrepreneurs, in the context of transition. The employment, skills and training strategies developed by the EU and the G20/ILO provide the framework for this analysis.

In order to identify, assess and address the types of skills challenges associated with the dynamic process of structural change driven by the low-carbon agenda, considerable investment in training and new forms of governance are required, which need to be developed systematically, across social, employment and economic policy areas. In what follows, this chapter applies the five critical elements of the G20 Training Strategy to the case of green structural change, and outlines five key policy actions.

The case for a global green skills training action plan

The greening of industries and economies is best seen as a dynamic process with the potential to drive changes in skill needs for all individuals, in all jobs. Environmental awareness and management responsibility are required of every individual consumer, worker and entrepreneur (EU Skills Panorama, 2012).

Research and experience suggest that a successful transition requires proactive steps to facilitate effective education and training responses, which better match the needs of enterprises. While skills development and training actions to foster green growth need tailoring to local circumstance, a global view can enhance the exchange of experience among policy makers, researchers and practitioners alike.

This chapter sets out such a global view. Building on ICF GHK's extensive experience in researching and evaluating international developments on green skills, we identify key actions for training providers to ensure that vocational education and training are better aligned to the needs of enterprises and entrepreneurs, in the context of a changing environment. The employment, skills and training strategies developed by the EU and the G20/ILO provide the framework for this analysis.

The EU Agenda for New Skills and Jobs

Linked to the target to increase the European Union's employment rate to 75%, the Agenda for New Skills and Jobs acknowledges that "EU employment and skills policies have a key role to play in making the transition to a green, smart and innovative economy" (European Commssion, 2010). Education and training has a key role to play in upgrading skills to boost employability and is one of four identified actions for the EU as follows:

- better functioning labour markets
- more skilled workforce
- better quality jobs and working conditions
- stronger policies to promote job creation and demand for labour.

Two of these priorities are pertinent to this chapter: a more skilled workforce and stronger policies to promote job creation and demand for labour.

Concerning a more skilled workforce, a key challenge is to ensure that governments invest in education and training, based on anticipation of skills and training needs; and matching and guidance services to help develop a flexible, skilled workforce, able to contribute to, and respond to, technological change. Such activities provide the means through which productivity, competitiveness, economic growth and the overall employment rate increases.

Turning to policies to promote job creation and the demand for labour, the economic recovery has to be based on job-creating growth. Employment growth is anticipated through stimulating the demand for high-skill jobs, and requires R&D-intensive business models, and the promotion of entrepreneurship and self-employment.

The G20 Training Strategy: A replicable template for the green skills agenda?

All G20 countries[1] have identified skills development as a strategic objective: all are stepping up their investment in skills.

In 2009, the G20 afforded the International Labour Organization (ILO) responsibility for the development of a G20 Training Strategy (ILO, 2010). The resulting training strategy "A skilled workforce for strong, sustainable and balanced growth" provides a platform for further exchange of ideas and experiences among a wide range of institutions, enterprises and experts from all countries. The strategy highlights five critical elements:

- quality education as a foundation for future training
- continuous workplace training and lifelong learning to enable workers to respond to the increasingly rapid pace of change.
- building bridges between the world of work and training providers to match skills needs to the needs of enterprises
- anticipating and building competences for future needs to ensure early identification of skill needs
- ensuring broad access to training opportunities, especially for vulnerable groups (e.g. youth and those with low-level skills).

When applied successfully, approaches comprising the type of elements listed above result in a virtuous circle through which more and better education and training leads to innovation, investment, economic diversification and competitiveness, and social and occupational mobility. In turn, such approaches lead to more productive and more rewarding jobs.

Good-quality primary and secondary education, complemented by relevant vocational training and skills development opportunities, prepare young people for their working lives, providing them with the necessary core skills that enable them to remain employable and engage with lifelong learning that allows them to adapt to change throughout their productive lives.

Effective skills development systems work throughout the policy cycle:

- anticipate skill needs
- engage employers and workers in decisions about training provision
- maintain the quality and relevance of training
- make training accessible to all sectors of society
- ensure viable and equitable financing mechanisms
- continuously evaluate the economic and social outcomes of training.

Bringing together business and workers, government and training providers, at the local, industry and national levels, is an effective means of securing the relevance of training to the changing needs of enterprises and labour markets. Policies to improve skills combined with policies to sustain growth and investment facilitate the job search, and support entry and re-entry into the labour market and can lead to more and better jobs.

Technical change and the green economy: Outlining the challenges

The transformation of the present global economy to one that can be sustained over the long-term, given the physical limits to the use of natural resources, represents a major challenge to businesses and workers. As with any other form of structural change, the speed and extent of the transition to a greener economy will be substantially affected by how successfully technical skills and entrepreneurial abilities are matched to new investment and job requirements, how quickly new technology spreads and how effective labour market policies are in supporting workers and businesses in making the transition.

Legislative reforms and emissions targets will bring about downsizing and restructuring in carbon-intensive industries. On the other hand, employment growth can be expected in renewable energies and activities to support energy efficiency, especially in construction and transport. It is widely acknowledged that turning this potential into real jobs requires skills gaps to be identified and addressed.

Changes in the physical climate, environmental policies and regulation, in aggregate, are having little impact on net employment levels. Looking beyond the relatively stable aggregate economic trends, however, reveals a much more dynamic and turbulent process of change, with very substantial churn and recycling of resources related to the closure and contraction of existing businesses alongside new and expanding businesses (ICF GHK et al., 2011). Moreover, although job growth in low-carbon activities is estimated to offset job losses in energy-intensive ones, the skills needed in the new activities are not necessarily the same as those in contracting sectors. Adjustments within sectors can also have a substantial impact on occupational skill needs (Cedefop, 2010a). In response, firms across all sectors need to (re)train and upgrade the skills of their existing workforce to improve their resource and energy efficiency and environmental awareness; with up-skilling a necessary pre-requisite to the formation of new firms.

Green skills development is not only reactive, but can also be an important driver of change itself: fostering investment in environmentally sustainable activities and long-life, low-carbon capital stock. This can generate positive lock-in effects; stimulate learning, innovation and long-term social returns (Bowen et al., 2009).

In general, the consensus is that technical change is biased in favour of higher level skills. This has been the general direction of change in employment patterns in recent years across most sectors, although in Europe there is some indication of polarisation of demand, with growth in less-skilled jobs, but fewer jobs requiring middle ranking skills (Cedefop, 2010b). Green technical change is no different. The more investments are made in new technologies – many of which are likely to be energy saving or related to new forms of energy generation – the more demand there will be for people in higher skilled jobs. The ILO, for instance, estimates that in the EU-15 the share of high-skilled labour in low-carbon intensive sectors is higher than those in high-carbon intensive sectors (ILO, 2011).

To identify, assess and address these types of skills challenge, considerable investment in training is required and needs to be developed systematically, across social, employment and economic policy areas. In what follows, this chapter applies the five critical elements of the G20 Training Strategy to the case of green structural change.

Applying the G20 Training Strategy in support of the green transition

Quality education as a foundation for future training

The basic skills that form the foundation for future employability are acquired through initial education and training, and enable individuals to adapt to new skill requirements throughout their working lives. Compulsory education has a major role in developing a skilled, flexible workforce able to adjust to and manage change. Successfully building the labour force's capacity and continued opportunity to work depends on the ability of initial education to provide learners with two key faculties:

- the willingness to learn
- the ability to learn.

While these two elements in themselves can provide a sufficient foundation, the effectiveness of this provision, in turn, relies on the quality, relevance and transferability of what is learnt in the labour market. The development of green skills and competencies builds upon the foundation of core skills – including literacy, numeracy, communication, teamwork and problem solving – which along with awareness of environmental issues and entrepreneurship, facilitate lifelong learning and adaptability to environmental change. Initial training then provides the technical, work-based skills, knowledge and competencies that facilitate the transition from education into the world of work.

The effective transferability of learning in these key stages is particularly important in the context of environment-driven structural change, as the need for occupational mobility is pronounced as the nature and location of emerging opportunities often differs from those in decline. Transferability is based first on the level and type of core skills developed, and second on systems for assessing and documenting the outcomes on a commonly accepted and understandable form.

Environmental awareness is itself a core skill and merits inclusion in education from early childhood and continuing through lifelong learning. Mainstreaming environmental topics across compulsory education is seen as effective in generating overall environmental awareness. Several countries have adjusted curricula to cover resource efficiency and climate change themes, while the UN Decade on Education for Sustainable Development (ESD) has spurred further initiatives. The ESD lays the foundations for the inventors, workers and consumers of tomorrow, able to drive as well as adapt to changes. Assessments suggest that active learning/participation using the school infrastructure work best, especially where links to the local community are provided (ICF GHK, 2010a).

Converting this awareness into career opportunities requires technical vocational education and training (TVET) and university systems that are more responsive to the new demands of the green economy. Research has shown that skills needs are compounded by general weaknesses in the labour force, and in particular the lack of interest in science and engineering, leading to a deficit in the available technical skills. National responses to this shortage, to entice students into science and technology studies after compulsory education, will have particular benefits for climate change policies.

Continuous workplace training and lifelong learning

Skills development can fruitfully be viewed from a life-cycle perspective of building, maintaining and improving skills. Having provided an initial quality foundation in education and training, opportunities for the workforce to maintain and upgrade existing

skills and gain new skills, while also certifying the skills and competencies acquired in the working life, are essential.

Systems of lifelong learning and the promotion of workplace training ensure the continuous adaptability and employability of all workers, and enable firms to maintain levels of productivity across all ages of their workforce. Lifelong learning can also play an important role in providing older workers with the key foundation skills they may lack and contributing to improve environmental awareness, and thereby the resource efficiency and consumer habits, of the wider population.

Quality and efficiency in this learning provision ensures that the right skills are acquired at the right time, in the right place and in the most effective mode. Apprenticeship training and other types of hands-on experience are seen as particularly valuable in increasing workers' adaptability in changing labour markets, with countries operating dual systems of vocational education and training, such as Germany and Austria, particularly well-positioned.

Sectors with the greatest negative impact on the environment, emitting high volumes of greenhouse gas emissions, are most likely to be negatively affected by green structural change. Internal adjustment to innovate and introduce sustainable production practices and measures to improve the efficiency of resource use, all necessitate significant skills upgrading (up-skilling). The depth and breadth of training needs are proportional to the extent of skills change. The main need, however, is to revise and upgrade the skills of existing workers (Cedefop, 2010).

The main objective is to invest in human capital in order to respond to rapid change and innovation by providing opportunities for employees to develop the necessary practical skills and knowledge. For example, Virgin Atlantic has trained its pilots in more fuel-efficient procedures for take-off and landing; similarly, Coca Cola trained its packaging designers to develop lighter packaging (ICF GHK, 2009). In order for smaller firms to engage in such training practices, flexibility in training provision is necessary – allowing people to study/train what they want, when they want and how they want, at low cost – offering modular instruction, short- and distance-learning options.

Green restructuring also generates demand for the provision of entirely new skills, or the application of skills in entirely new circumstances, as existing producers re-orientate activities towards emerging technologies, products and markets. The most prominent examples of such radical restructuring are in the automotive sector and shipbuilding, which are increasingly responding to low-carbon demands for hybrid vehicles and offshore investment in wind and tidal energy, respectively. The potential for growth sectors to absorb workers from other industries relies on the effective co-ordination, timing and management of workforce retraining programme. The motivation and ability of workers to take advantage of opportunities for continuous learning and the availability of appropriate support mechanisms to help them in doing so is a pre-requisite.

Examples from case studies have shown that short, intensive vocational training courses, tailored to employers' needs, can deliver retraining for specific new job opportunities (Strietska-Ilina et al., 2011). These shorter training courses, which build on a solid base of general technical and core skills, can be sufficiently flexible to minimise time lags between the emergence of skill needs and the provision of appropriate training.

For the skills gained through such courses to have continued relevance in a changing world, low-costs of re-entry to refresh, review and top-up existing skills with the latest knowledge is important, and in the context of intra-industry churn, emphasis is placed on the recognition and portability of informal and formal learning.

A further area for development emphasised in the literature is the need to continuously update the training of trainers and education providers. In the face of rapid technological innovation, a lack of teachers or trainers with sufficient environmental awareness or expertise in low-carbon technologies can limit the potential of any training strategy to achieve success and can also drive up costs (Szovics et al., 2009). By rapidly developing "greening" or technological modules, embedding these dimensions into the curricula and efficiently accrediting those working in newly emerging areas, such potential bottlenecks can be avoided.

Building bridges and skills matching

The gap between the learning environment and the working environment can be large. Innovations and technological and market developments can cause rapid changes in the demands of labour markets, enterprises and workplaces in different economic sectors and industries. Keeping pace with these changes is a continuing challenge for learning providers. The active engagement of representatives of employers and workers in the provision of vocational education and training is vital to bridging this gap.

Establishing solid links between vocational education and training and the world of work increases the chances that the skills and competencies workers learn are relevant, timely and well-targeted. Engaging with trade unions and employers' associations in the planning, design and implementation phase of training offers can boost the responsiveness of education and training. In particular, collaborative approaches can enable the development of practical, hands-on experiences, essential for the learner to apply academic, classroom-based learning in relevant contexts. At the level of the training providers, better links to the innovators and professionals leading technological developments can enhance the quality and relevance of their training offers.

Effectively organised and managed networks and groupings of government, employers, workers and providers of training and education across industry can facilitate the exchange of information. Given that green activities do not fit neatly within traditional sectoral boundaries, better co-ordination is also called for to analyse and monitor developments across sectors and occupations. In this respect, evidence from case studies emphasise that industry- and regional-level initiatives, typically consisting of public-private partnerships, are capable of having a greater impact on the national workforce than company specific initiatives (ICF GHK, 2010). Through constructive tripartite social dialogue, the economic and social costs of adjustment to an environmentally sustainable economy can be limited.

This interaction and dialogue between stakeholders is also a key element for policy makers, particularly in developed EU countries where the level of green structural change is rapidly advancing, to ensure that the manufacturing sector, in particular, is capable of functioning by avoiding the build-up of bottlenecks and skills gaps in the workforce (UNEP, 2008).

Shortages generally reflect underestimates of growth and labour demand, particularly in technology- and policy-driven sectors, when projects are undertaken without sufficient provision for skills development. Bottlenecks can arise in the economy as a result of this

lack of efficient co-ordination between investment in the green economy and investment in skills.

While skills and employment policies are appropriately viewed together with increasing frequency, skills and environmental policies are still often dealt with in isolation from one another. One of the hallmarks of successfully deployed green training programmes is that they have overcome this policy co-ordination challenge.

Co-ordination mechanisms of this kind often involve substantial investments of time and money, and they are much more likely to work when, and only when, all stakeholders are able to see their own objectives supported by others; businesses seek a well-trained, adaptable workforce; workers and trade unions know that training leads to better employment; and line ministries responsible for environmental protection, urban and rural development, climate change, infrastructure and innovation, among others, rely on the availability of a skilled workforce.

Co-ordination with and across economic sectors is necessary to provide greater certainty, and smooth the pace of investments over time – with greater gains to be had from focusing first on "shovel-ready" initiatives, whereby trained workers in sufficient numbers can be effectively deployed at short notice. Public employment services can also play an important role in matching skills and jobs, and in directing workers and jobseekers towards appropriate training to meet these emerging needs.

Early identification of skill needs

Labour market information systems, including key skills information, anticipation and forecasting tools are at very different stages of development across the world. These systems, where developed, are able to provide insight to guide adjustments to qualifications and curricula in response to changing demands, including those driven by investment in low-carbon goods and services. However, where the scale or pace of change in demand for environmentally driven skills outstrips the capacity of existing systems, then, in the short term, more immediate and specific initiatives are required. In the long term, only by adopting rigorous approaches to analysing and anticipating the demand for jobs and skills, which take account of the impact and interactions with environmental change, can evolutions of the labour market and skills needs be anticipated and inform the design of reforms.

To the extent that existing systems need to be established, revised or expanded, the role of social partners is likely to be important in establishing the necessary analysis for this subsequent reform. Some case studies in Europe reflect this process in operation – *an illustration is the important role of trade committees and councils in Denmark in defining changes in competence requirements and promoting changes in the vocational education and training system*.

There is a balance to be struck between improving present systems for anticipating skills needs and developing specific responses for climate change-related pressures on skills. Where improvements in resource efficiency are an economy-wide requirement, then improvements in current systems are needed. Where there are clear priority industries or sectors (energy, transport and construction), focused foresight research and responsive initiatives are likely to be required. Perhaps in contrast to other forms of structural change, the sectoral changes likely to come about from the greening of the global economy are reasonably predictable, allowing forward planning and retraining as

well as the establishment of redistribution mechanisms to compensate for adjustment and transition such as the European Globalisation Adjustment Fund.

The further mapping of the demand for, and the nature of, environmentally driven competences is a common global requirement to minimise the risks of policy failure and insufficient co-ordination. This process of mapping could also benefit from being linked to strategies for green growth. In developing countries, the challenge is particularly great because relevant information is scarce and the tools for analysing the linkages between the environment, economy and employment are often inadequate (Jarvis et al., 2011).

Labour market information systems also serve to provide long-term signals to inform learners, guidance counsellors and public employment services about training pathway decisions. Such decisions, typically taken during one's youth, are likely to impact on the labour market after completion of the training, often in three to five years. In making the future demand for green skills more predictable for learners, providers of training, education and guidance services, greater numbers of learners can be enticed to develop the technical skills and environmental awareness necessary to respond to the demands of the green economy (ICF GHK, Economix, 2011).

Broad access to training and decent work

Broad and continued access to training and skills development opens up the opportunities for, and benefits of, both initial and lifelong learning to all, making all groups in society able to contribute to the transition to a greener economy. Initial skills development of individuals and groups is often hindered by a variety of barriers, including low incomes, ethnic origin, disability, migrant status or rural location. In this respect, it is important to address institutional rigidities, prohibitive upfront fees and restrictions by providing a variety of cost-effective entry pathways. Generally speaking, efforts to combat marginalisation in working life are best focused on early education and youth employment.

The availability of training later in life can also be hindered by employment status, with those self-employed or working in small enterprises and those outside the labour market – unemployed or in the informal economy having less ability to take advantage of training opportunities. These groups typically require dedicated policies and measures to facilitate access to training and re-entry pathways (ICF GHK et al., 2012).

If the skill content of jobs changes as a consequence of technical change then there are also likely to be distributional issues with respect to who obtains access to various jobs, and implications for the quality of employment. Whilst the greening of the economy is associated with the expansion in employment of some high-quality, high-skilled jobs, some groups appear to have less access to green jobs than others. There is *prima facie* evidence that women and young people are less likely to be employed in green jobs. In other words, the evidence points to green structural change reinforcing occupational trends that are less favourable for women and young people.

With respect to young people, one may observe nothing more than a life-cycle effect in that the green jobs are relatively high-skilled jobs which individuals are more likely to access as they get older and gain in experience and competence. With respect to women, the observation is related more to the extent of gender segmentation in the occupational structure. Many green jobs are more likely to be found in occupations which have historically been disproportionately filled by men. On the other hand, newly emerging occupations, less burdened by a history of gender stereotyping and segregation, can be

seen to provide a unique opportunity to break these existing gender barriers (ICF GHK, 2010b).

The promotion of female enrolment into science, engineering and other types of technical education and training geared towards employment in the traditionally male-dominated environments of manufacturing and construction could go some way to ensure that men and women achieve an equitable share of employment in low-carbon jobs in the years ahead. In short, the impact of greening on the distribution of occupational employment should be closely monitored.

Restructuring from traditional industries to newly emerging, environmentally sustainable activities also coincides with shifts away from traditionally unionised, regulated sectors with commensurate social and labour rights and obligations. Managing a successful transition requires the protection and upholding of these rights in emerging sectors. In particular, the employment security conditions for lower qualified new jobs (e.g. low-wage installers of solar panels), and jobs with modified tasks (e.g. labourer in the recycling management chain), created as a result of environmentally driven change, will enjoy less secure employment conditions than in established branches (European Trade Union Confederation, 2009). Across many countries where labour rights and working standards are lower, there is also no guarantee that the working conditions associated with green jobs are "decent". By ensuring and promoting broad and equal access to training and work in a safe environment, the potential for transformation can be maximised (ILO, 2011).

Policy recommendations

- Engage learners with hands-on, active participation in environmental issues throughout their compulsory education through experiential learning by, for example, building links to environmental issues in the local community.
- Increase the flexibility of training offers, in terms of their content, delivery and design, and target education and training policies at groups of small and medium-sized enterprises in the sectors the most vulnerable to structural change.
- Establish platforms for dialogue and partnership between local, regional and national stakeholders, with agreed planning and implementation responsibilities, to co-ordinate environmental policies with formal and informal training systems.
- Labour market information systems, and their underlying surveys and models, need to integrate environmental drivers of change and consider interactions between employment, energy and environmental outcomes.
- Promote alternative entry and re-entry pathways to education and training, and provide incentives to address the under-representation of women, jobseekers and vulnerable groups in technical training programmes.

Note

1. Argentina, Australia, Brazil, Canada, China (People's Republic of), France, Germany, India, Indonesia, Italy, Korea, Mexico, the Russian Federation, Saudi Arabia, South Africa, Turkey, the United Kingdom and the United States. The EU is the 20th member.

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Chapter 3

The New Skills for Green Jobs Project: European context

Costanza Pagnini and Jo Pye

This chapter provides an overview of the European Union context for skills and employment within the Europe 2020 Strategy, both to stimulate economic growth at a time of global recession and support development of greener economies in Europe. It examines the nature of green jobs and occupations, and sets out the contribution that green skills and employment can make to achieve economic stability and promote the mitigation of climate change. It is important to ensure that the green economy does not act to disadvantage already marginalised groups, such as female workers who are poorly represented in green industries.

The chapter also describes the New Skills for Green Jobs Project, which was funded by the EU PROGRESS initiative – specifically to link with the Europe 2020 Strategy. The 2012 project sought to promote an adequate skills base to support the transition towards a green economy by identifying and exchanging good practices across partner countries.

European Union policies for a sustainable green economy

The Europe 2020 guidelines for economic policies call upon member countries and the Union to aim at sustainable growth:

> … decoupling economic growth from the use of resources, building an energy and resource-efficient, sustainable and competitive economy, a fair distribution of the cost and benefits and exploiting Europe's leadership in the race to develop new processes and technologies, including green technologies. Member States and the Union should implement the necessary reforms to reduce greenhouse gases emissions and use resources efficiently, which will also assist in preventing environmental degradation and biodiversity loss. They should also improve the business environment, stimulate creation of green jobs and help enterprises modernising their industrial base.

The sustainable growth that Europe 2020 anticipates contains several elements, of which the following are most relevant for present consideration:

- building a more competitive low-carbon economy that makes efficient, sustainable use of resources
- protecting the environment, reducing emissions and preventing biodiversity loss
- capitalising on Europe's leadership in developing new green technologies and production methods.

To these we can add the inclusive growth that the Europe 2020 strategy also calls for, specifically "raising Europe's employment rate **– more and better jobs**, especially for women, young people and older workers".

The new skills paradigm: Implications for education and training policies

Moving towards a greener economy poses a major challenge globally: ensuring through adequate and effective policies that the necessary skills are available to support this transition, addressing possible shortages of skills and avoiding risks of skills mismatches.

This has gained further importance as the European Commission's Draft Joint Employment Report 2009-10 (European Commission, 2009) clearly underlines, the crisis has accentuated structural labour market problems. There is now a higher risk of long-term and structural unemployment in the coming years. Skills mismatches persist, despite high unemployment, and require "continued efforts in human capital investments and improved anticipation and matching of job needs".

This means that employment policies are needed to support the transition to a green economy in a number of ways, such as addressing and anticipating skills needs supporting the "greening" of existing jobs and educating the workforce in resource efficiency. Employers and learning providers alike need support in identifying the skills that need to be taught, given the current lack of clear signals of skills needs. In this respect, social dialogue is likely to be a key element in the development of these initiatives (European Employment Observatory, 2010a).

Below member country level, their constituent regions are taking the lead in both identifying skills needs associated with a low-carbon economy and providing the skills development responses to match. Joined-up approaches, where the regions, industry and

educational bodies work together to identify gaps and provide solutions, are emerging as successful collaboration models across several member countries (Cedefop, 2010).

In other words, in order to promote an efficient and inclusive model of new skills for green technologies, education and training systems will have to be developed to support continuously changing requirements. These will need to reflect new occupational standards and skills demands and also address the needs and characteristics of the different segments of the labour force, so that the skills base for the development of green technologies is as wide as possible.

The *Cedefop Skillsnet Flash Report* (Cedefop, 2009) stresses how all occupations and skills will need to adapt to new demands and that each related technology will require a mixture of skills. The most effective combination consists of specific skills – related, for example, to *ad hoc* technological expertise –accompanied by generic skills, such as good communications skills for counselling businesses and consumers, as well as the skills to manage and lead multidisciplinary teams. It is in the light of this more holistic approach that it has been said that the green economy will create a new skills paradigm.

Implications for education and training policies are particularly important. Students can benefit from a revised curriculum providing the necessary knowledge, while professionals and blue-collar workers would find lifelong learning programmes more appropriate. In both cases, a multidisciplinary approach should be adopted. Encouraging the education system to take a broader view of how competences and qualifications are acquired is an important step. The European Commission's New Skills for New Jobs initiative promotes the early identification of skills and labour market needs and also develops the green economy.

A number of key success factors are thus needed to support the green jobs agenda and the new skills paradigm. These include:

- a significant cultural change among training and education providers and employers
- an inclusive and joined-up approach to policy making to foster collaboration between national and local governments, institutional and non-institutional actors, social partners, training institutions and private businesses, to find the most adequate and effective ways to tackle the new challenges ahead
- the identification and dissemination of good practices.

A mismatch between the skills required by companies and those available within the labour market could lead to short-term unemployment, as well as negatively affect their transition into a fully functioning green economy. The *European Employment Observatory Review: Autumn 2009* on green jobs (EEO, 2010b) states that while national skill forecasting measures do exist across countries, they do not yet include details of green jobs and so cannot provide information on potential mismatches between the demands of the labour market and the supply of certain skills. The current evidence suggests that monitoring labour market bottlenecks in different sectors (e.g. in terms of skills shortages) will be crucial in order to develop adequate employment policy responses.

What do we mean by green jobs?

What do we define as "green jobs"? In what follows, some definitions by UNEP, the ILO and the EEO are provided.

- UNEP (2008): The United Nations Environmental Programme (UNEP) defines green jobs "… as work in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high-efficiency strategies; de-carbonise the economy; and minimise or altogether avoid generation of all forms of waste and pollution".
- ILO (2010): According to the International Labour Organisation (ILO): "'Green jobs' does not lend itself to a tight definition but certainly includes the direct employment which reduces environmental impact ultimately to levels that are sustainable. This includes jobs that help to reduce the consumption of energy and raw materials, decarbonise the economy, protect and restore ecosystems and biodiversity and minimise the production of waste and pollution … A somewhat wider concept of 'green jobs' might embrace any new job in a sector which has a lower than average environmental footprint [and] contributes to improving overall performance, albeit perhaps only marginally".
- The *European Employment Observatory Review: 2009 Autumn* defines green jobs as "decent work created in economic sectors and activities which reduces their environmental impact, ultimately leading to environmentally, economically and socially sustainable enterprises and economies. This includes jobs that help to reduce the consumption of energy and raw materials, decarbonise the economy, protect and restore ecosystems and biodiversity and minimise the production of waste and pollution".

Another definition, by Eurostat, does not explicitly refer to "green jobs", but to employment in the environmental goods and services sector (EGSS). The EGSS is a heterogeneous set of producers of technologies, goods and services that prevent or minimise pollution and minimise the use of natural resources. Thus, environmental activities are divided into two broad segments: environmental protection and resource management. Only those technologies, goods and services are considered that have an environmental protection or resources management purpose as their prime production objective (i.e. "environmental purpose"), and hence this excludes goods and services that are not provided mainly for environmental purposes.

These definitions of green jobs (in particular those from UNEP, the EEO and Eurostat) can be considered as activity-based, as they focus on specific sectors or occupations. Nonetheless, the ILO definition opens up a broader concept, as it states that green jobs "might embrace any new job in a sector which has a lower than average environmental footprint". The difference between the two concepts results in both direct and indirect impacts. As the European Commission Employment Committee (2010) suggests, "the employment impact of greening the economy goes beyond genuinely green activities. Next to direct employment effects in green industries, greening the economy can have indirect effects in other areas, such as substituting environmentally inefficient jobs (e.g. reduced employment in fossil fuel-based industries), contributing to the greening of existing jobs, and eliminate existing jobs as well as establishing new jobs".

In other terms, the greening of the economy will not only foster the creation of new occupations ("green jobs" in a strict sense) and the progressive scrapping of old occupations (in highly carbon-intensive sectors) – substitution effects will be in force – but will also involve a gradual greening of all occupations, as existing jobs become more environmentally friendly. To this purpose, it is interesting to observe that, according to existing estimates, a low overall impact on employment will emerge, but large effects within sectors could be observed (EEO, 2010).

Identifying sectors and occupations to be analysed

According to this framework, in our study we will focus on both a narrow definition of green jobs – jobs created in specific sectors – and a broader policy-based approach, that acknowledges the complex inter-linkages between the greening of the economy and labour markets. This approach appears the most appropriate, as the focus of the New Skills for Green Jobs project is on skills: accordingly, the assessment of training strategies and programmes in participating countries will be carried out taking into account both the creation of specific "green" skills (suited to new occupations) and the adaptation of existing skills across occupations. According to the EEO (2010), "the transition towards a competitive eco-efficient economy is being driven by a number of key forces: the improvement of energy efficiency; the development of the use of renewable energy sources; the creation of conditions that encourage climate-related research and innovation; and efforts to modernise European infrastructure".

Existing evidence (Cedefop, 2010) shows that most green jobs will not require entirely new skills but a "topping up" of existing skills. According to Cedefop,

> …boundaries between what is and is not low-carbon work are becoming increasingly blurred as economic activities improve their resource efficiency ... much of the skills base relevant for low-carbon jobs can be found in existing occupations. Strategic skills responses, therefore, ought to focus more on topping up current competences than to try to "reinvent the wheel" in creating new competences. For this reason, the distinction between new green occupations, existing occupations which require greening skills and those declining and deemed to require retraining, is only relative and highly dependent on the country context and the stage of greening the economy. (Cedefop, 2010)

Cedefop (2010), taking into account the above concept, identifies a list of cases for green skills classified by the nature of the underlying jobs, which can be various: *i)* totally "new"; *ii)* existing jobs that need a "greening" of their skills sets; and *iii)* existing jobs, for which a more thorough "restructuring/retraining" process is needed. This list, which is not exhaustive, can be taken into account as a reference and a starting point for the New Skills for Green Jobs project (Table 3.1).

Differential impacts across the labour market

The process of greening the economy is likely to have significant effects across sectors and upon EU member countries' labour markets (EEO, 2010). As with all labour market changes, the effects on different sectors and different segments of the labour force are likely to be different. The crisis has also shown that some groups are particularly at risk – and that labour market exclusion of disadvantaged groups remains a continuing problem, unresolved without proper active policies.

The development of the green economy will affect the employment structure of member countries by creating new jobs, "greening" existing jobs (including both those with greener skills sets and those requiring significant restructuring), and destroying some others which will become obsolete. Some sectors or regions will suffer and jobs will be lost, while other activities will expand and generate new employment. In general, very little information is available on the potential effect of the greening of the economy on social and territorial cohesion. It is generally recognised that the transition to a competitive eco-efficient economy is likely to have a stronger impact on lower skilled workers, whose skills might no longer be marketable (through job destruction or substitution), than higher skilled workers (more likely to benefit from job creation, or through implementation of new technologies calling for additional skills).

Table 3.1. **Green sectors and occupations identified by Cedefop**

Typology	Sector	Occupation
New	Process industries	Research and training
	Power	Renewable energy management
		Solar energy
		Wind power
	Waste	Waste recycling
	Services	Green business management
		Energy auditing/smart energy
Greening	Primary	Agriculture and fishery
		Forestry/land management
	Power	Marine technology
		Power technology
		Nuclear
	Water	Desalination plant maintenance
	Waste	Recycling and waste management
	Construction	Schemes for up-skilling across construction sector occupations
		Technology installers
		System mechanics
	Services	Eco-design
		Energy auditing
		Carbon trading
Restructuring/retraining	Extractive industries	Oil shale mining
	Process industries	Chemical technician
	Manufacture	Shipbuilding to wind turbine manufacture (diversification)
	Power	Solar energy entrepreneurs
		Power technology
	Transport	Low-carbon vehicles

Source: Cedefop (2010), *Skills for Green Jobs: European Synthesis Report*, European Commission, Luxembourg.

As with all labour market changes, the effects on women and men are unlikely to be the same. Given the actual situation of female employment, characterised by high levels of horizontal and vertical segregation, there is a risk that the transition to a green economy and subsequent policies, including training and education, could magnify gender inequalities and undermine the employment and social cohesion goals of the EU.

Thus it is important that policies for promoting green jobs and green sectors do not reinforce or exacerbate existing inequalities (UNEP, 2008). The segregation of women and men into different sectors of the labour market means that effects will be experienced differently between mixed-gender activities and those dominated by one sex, for example male-dominated energy, agriculture, fishing and other STEM-related fields (Sustainlabour, 2009).

Inequalities in gendered employment across Europe are currently being addressed through the European Commission's Strategy for Equality between Women and Men 2010-15 (European Commission, 2011), which highlights the contribution of gender equality to economic growth and sustainable development, and supports the implementation of the gender equality dimension in the Europe 2020 Strategy. It is a comprehensive framework committing the Commission to promote gender equality in all its policies for the following thematic priorities: equal economic independence for women and men; equal pay for work of equal value; equality in decision making; dignity, integrity and ending gender-based violence; promoting gender equality beyond the EU; horizontal issues (gender roles, legislation and governance tools).

The European Commission annual *Report on Equality Between Women and Men* (European Commission, 2012) found that in the labour market, the employment rate for women is 62.1%, compared to 75.1% for men, meaning the EU can only reach the overall Europe 2020 target rate of 75% employment with a strong commitment to gender equality. Under the Europe 2020 strategy, the Commission has highlighted the need to promote a better work-life balance, in particular through adequate childcare, more access to flexible working arrangements, and by making sure tax and benefit systems do not penalise second earners. These can all help to make sure more women enter and remain in the labour market.

The PROGRESS programme has the explicit aim of supporting the Europe 2020 strategy through strengthening measures for employment equality, promoting shared understanding of objectives across member countries, and developing effective European partnerships in conjunction with policy stakeholders. PROGRESS' objectives support effective information sharing and learning, evidence-based EU policies and legislation, the integration of cross-cutting issues (such as gender and disability), building the capacity of national and EU networks, and stimulating high-quality policy debate.

The European Commission made three calls for proposals between 2009 and 2011 on improving gender mainstreaming in national policies and programmes under the framework of the PROGRESS programme. Funding has aimed to support national initiatives that:

- raise awareness of the importance of gender mainstreaming in national policies as an effective contributor to gender equality and its importance to better governance
- improve knowledge of the key concepts and issues of gender mainstreaming and ensure a better understanding of gender mainstreaming in policies and programmes
- develop the necessary methods and tools, including dissemination to the main stakeholders, thus ensuring a more long-term effect.

Integrating a gender perspective into green technology training

The principle of gender mainstreaming is based on the assumption that there is no such a thing as a gender neutral policy or practice. This is due to the fact that men and women are characterised by a different distribution of material (e.g. money, income) and immaterial (e.g. time) resources and face separate obstacles in accessing goods and services provided by public policies. Therefore each policy will impact differently on men and women.

It is widely recognised that the female workforce is represented across all member countries, although with significant differences. In practice, women comprise one of the weaker segments of the labour force due to their lower activity and employment rates, higher barriers to participation in continuing vocational training and education, and their under-representation in certain sectors and professions. Low female employment rates are especially noticeable in STEM (science, technology, engineering and mathematics) professions, which are also those most likely to be involved in the transition to the green economy. To illustrate this point, Table 3.2 presents occupational figures for gender employment extracted from a sample of STEM professions in the UK:

Table 3.2. **Percentage of female employees across selected STEM industries in the United Kingdom**

Two-digit standard industrial classifications	% female employees
42: Civil engineering	14%
38: Waste collection, treatment and disposal activities; materials recovery	15%
39: Remediation activities and other waste management services	15%
43: Specialised construction activities	17%
37: Sewerage	23%
41: Construction of buildings	25%
35: Electricity, gas, steam and air conditioning supply	25%
36: Water collection, treatment and supply	27%

Source: UK National Statics (2012).

Therefore, due to a number of factors, women – although not a disadvantaged or marginalised group *per se* – run the risk of their horizontal and segregation employment patterns being reinforced by incoming green employment opportunities. As well as increasing gender inequality, this would also imply that the considerable potential for human capital to contribute positively to the development of the green economy would be left untapped.

In order to ensure that public policies benefit men and women equally, it is important to analyse existing gender differentials when forecasting future skills developments, to re-assess at an early stage the impact on gender of policies or strategies and to re-adjust the gender balance wherever necessary. Gender mainstreaming takes an overview of gender differentials, which is able to integrate a gender perspective in all stages of the policy cycle.

Training in new skills for green technologies could have important positive effects on the female labour market if a gender mainstreaming approach is adopted. It could ease the gender gap and at the same time bridge the shortage of skills. The development of the

green economy represents a unique opportunity, both to increase employment opportunities for women and to facilitate women's integration into more male-dominated scientific disciplines and professions. By reducing gender segregation (both in terms of lower employment rates and lower quality jobs), gender equality in the workplace can be promoted.

In other words, an enhanced gender perspective in "green" employment policies, particularly as regards training, could contribute to a better understanding of labour market processes around the growth of green sectors and the supply of skills. Understanding and including the gender dimension also improves the possibility for the promotion of green jobs to contribute to greater social cohesion for both men and women.

Integrating gender into the analysis of green jobs and related policies could produce a number of important benefits including:

- Tracking the gendered employment processes put in motion by the transition to greener economic activities would show how segregation creates differential access to jobs for women and men. This perspective could be also beneficial for men, for example highlighting how certain groups of men – such as low-skilled workers in typically male sectors – may be affected negatively by the transition to a green economy.
- Recognising in advance that the effects of the greening of economic processes are likely to be uneven across sectors, contractual status and gender lines, allows for the identification and implementation of counter-balancing measures.
- Using public funds to both promote green jobs and, at the same time, reduce gender inequalities. Given the marked gender segregation patterns in the labour market that are likely to be reflected in green employment, addressing segregation in growing green occupations and sectors would help limit the continuation of such segregation patterns and make sure that both women and men benefit from quality green jobs across occupational hierarchies.

The PROGRESS project: New Skills for Green Jobs – a case for a more gender inclusive labour market?

The European Commission Directorate of Employment, Social Affairs and Inclusion funded the New Skills for Green Jobs project under the PROGRESS programme. Of the European Union Employment Guidelines supported by PROGRESS, the New Skills for Green Jobs project has a particular emphasis to "Improve matching of labour market needs" (Employment Guideline 20) and "Expand and improve investment in human capital" (Employment Guideline 23).

The overall objective of the project was to promote an adequate skills base to support the transition towards a green economy. Within this framework, the project stimulated mutual learning among partners and key stakeholders, and enhanced transferability of the most effective and gender-sensitive strategies to provide training for new skills in green technologies. Of particular interest were developments in the field of "green" skills forecasting, with special attention to the gender sensitivity of identified strategies.

The project sought to identify:

- tools for the early identification of skills needs for the greening of the economy
- initiatives improving the efficiency and adequacy of existing training practices in partners' countries (and at the wider EU level), with a focus on encouraging the active participation of women.

The New Skills for Green Jobs project brought together partners representing individual regions in four European countries. The regional base of partners permitted them to interact flexibly with policy stakeholders at local, regional and national level, as well as to identify and disseminate training practices being delivered by local providers in their home regions. Partners were:

- Fondazione Giacomo Brodolini (Italy) (project promoter and joint author)
- Assessorato al Lavoro e Formazione, Regione Lazio (Italy)
- The National Centre for Technical and Vocational Education and Training Development (NCTVETD) (Romania)
- Agenzia Liguria Lavoro, Regione Liguria (Italy)
- Marchmont Observatory, University of Exeter (United Kingdom) (joint author)
- Servicio Andaluz de Empleo (Spain)
- Sociedad de Desarrollo Medioambiental de Aragón (SODEMASA) (Spain).

The project's work programme combined both desk research and extensive consultation with stakeholders and included the following three stages:

- building the knowledge base and the conceptual framework for analysis
- the mutual learning process (including identification of good practice)
- dissemination of reports and follow up.

The project developed a conceptual framework incorporating both desk and field research to guide its activities. Desk research called on partners to produce country reviews covering current skills training at national level, including how it related to national and regional strategies for greening economies, and identify any forecasting methods used to predict future skills needs. Research also highlighted gender dimensions and relative male and female participation rates in both skills and employment in partner countries.

In parallel, field research was launched in the form of workshops to bring stakeholders at all levels together to exchange experience in providing for green skills and gender. Workshops considered the adequacy and effectiveness of "green" policies, the extent to which their skills implications were understood, and the adequacy of the skills response. Crucially, the events also covered the identification of examples of good and interesting practice to be shared with transnational partners, which were eventually published in online catalogue form as a final project deliverable.

The follow-up programme in spring and summer 2012 consisted of a series of peer review workshops held in partners' countries, which involved visiting delegations of experts, stakeholders and partners. Participants presented selected national programmes, policy responses and promising practices that had the potential of being transferable

across borders. The final project conference in October 2012 disseminated the results of the country analyses and the peer reviews to an audience of participating stakeholders and policy makers. Findings and conclusions are set out below.

New Skills for Green Jobs – findings and conclusions

In the current crisis the green economy is often seen as one of the few bright hopes. "Dark" green jobs – in renewable energy and waste management – are still widely forecast to make a significant contribution to economic recovery. This will place huge pressure on training systems. Prioritising green training budgets and making sure that training of high quality is developed is therefore vital.

But balance has to be achieved as well. A too-narrow focus on "dark" green jobs risks failing to do enough for the "greening" of other occupations. Responsible authorities should embrace a wider set of principles based on sustainable development, which would help to encourage the development of green knowledge, skills and attitudes across the economy. This, in turn, fuels demand for green products and services produced in dark green sectors, helping to establish a virtuous circle of growth.

A narrow focus during times of economic retrenchment also risks overlooking gender equality. Women's under-representation in green jobs is a waste of resources. Ensuring their full participation would help to meet the challenge of finding large numbers of people to fill emerging vacancies. Women drop out of programmes leading to green jobs early in school education, and then at every subsequent decision point into the labour market. Training programmes offer a remedy. But evidence from the project shows clearly that getting a good participation rate by women needs a strong or exclusively female focus. Women need opportunities not only to acquire skills but also to develop "social capital", building mutual support networks.

Local and regional action is a key feature of training for green skills. This action reflects local enthusiasm and expertise and leads to a wide range of partners being involved. Sometimes it takes place in the context of wider policy frameworks; but not always. Good practice in supportive government policies deserves to be widely disseminated to encourage more local action.

Green attitudes need to become the norm. Too often policies for green jobs focus on technical knowledge and skills and leave out attitudes. Schools have been in the vanguard in environmental education and their good practice lessons need to be integrated into all training.

Achieving a more gender-inclusive labour market will require the joining up of policy across a wide range of policy areas. It will also involve drawing together a wide range of partners. This has the potential to be a new "green" model of governance that deserves wide dissemination. It also enables the drawing together of resources and expertise from both public and private sectors, offering the opportunity to develop cost-effective training at a time of resource scarcity.

For its part, government at all levels needs to make sure that all relevant departments and ministries work together effectively to address the green skills challenge. There is little evidence that this is widespread across EU member countries and regions. Such co-operation is essential if coherent green training strategies are to become more common. This message applies equally to relevant directorates general of the European Commission and national and regional governments.

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Chapter 4

The interaction of environmental and labour market policy: An overview of the quantity and quality of green jobs in Europe

Hector Pollitt, Terence Hogarth, Richard Lewney, James Medhurst, Mark Peacock and Rob Wilson

The scale and nature of "green" jobs has come to the fore in political discussion in Europe at both national and international levels. Particularly in the light of the continuing recession, the idea that economic growth could be stimulated and new jobs created by activities that also meet environmental objectives is clearly attractive. Green jobs are an important part of the EU's Europe 2020 strategy, which explicitly quotes figures for jobs that could be created from meeting environmental goals.

This chapter gives an overview of the current situation and possible development of green jobs in the period up to 2020. It combines quantitative and qualitative analysis, at both the macro and detailed sectoral level, to develop an understanding of the number and nature of green jobs and how they might be influenced by future policy.

Introduction

The scale and nature of "green" jobs has come to the fore in political discussion at both national and international levels. Particularly in the light of the continuing recession, the idea that economic growth could be stimulated and new jobs created by activities that also meet environmental objectives is clearly attractive. Green jobs are an important part of the EU's Europe 2020 (European Commission, 2010b) strategy, reflected in two of the key flagship initiatives ('Resource Efficient Europe' and "An Agenda for New Skills and Jobs"). The strategy explicitly quotes figures for jobs that could be created from meeting the renewable energy target and energy-efficiency objective (European Commission, 2010b: 13).

However, the task of analysing what this might mean in practice is far from straightforward. Even the most basic question of how we distinguish "green" jobs from other jobs proves difficult to answer, and this is of course a critical issue to resolve as we try to set about quantifying the number of green jobs.

This chapter seeks to contribute to the debate by addressing the following questions.

Quantity of jobs: How many green jobs can and will be created in Europe? Is it enough to offset potential job losses elsewhere in the economy? Will the adjustment towards an economy with a greater share of green jobs have adverse social effects?

Quality of jobs: How do green jobs differ from existing employment profiles? What are the skills implications of these differences? How would this affect social welfare?

Our analysis is generally quantitative in nature, using systematic modelling techniques where possible and appropriate, and informing these results with case studies focusing on particular issues. The chapter has four sections. The first discusses how the concept of green jobs may be defined and quantified in Europe using existing information. The second presents our estimates of the macro- and meso-level impacts of policies designed to meet the EU's 20-20-20 targets (European Commission, 2008). In the third section we examine effects at a more detailed sectoral level to gain a deeper understanding of possible economic and social impacts. The final section concludes with policy recommendations.

This chapter summarises a report that was produced for the European Commission (DG Employment, Social Affairs and Inclusion); for further information the reader is referred to this report (referenced as Cambridge Econometrics et al., 2011). We acknowledge with gratitude the feedback received as that report was prepared. Nevertheless, the views expressed here remain solely those of the authors.

Defining and understanding the quality of green jobs

Quantifying green jobs

There is no single definition of what should be counted as a "green" or "environmental" sector in the economy. The OECD/Eurostat definition is often used in research (OECD/Statistical Office of the European Communities, Luxembourg, 1999) and some of the available data reflect this definition (see Eurostat's environmental monetary flow accounts). GHK et al. (2007) use a much wider definition, including the agriculture and mining sectors that are reliant on the natural environment. However they are defined, the data available cannot typically be mapped easily to support a measure of

green jobs, because standard sectoral definitions typically include both environmental and non-environmental categories.

When it comes to defining a job by the nature of the work that is being done instead of by its sector, O*NET in the United States has developed a taxonomy of green occupations (Dierdorff et al., 2009) as follows:

- **Green increased demand occupations:** The impact of green economy activities and technologies is an increase in the employment demand for an existing occupation, although this does not entail significant changes in the work and worker requirements of the occupation.
- **Green enhanced skills occupations:** The impact of green economy activities and technologies results in a significant change to the work and worker requirements of an existing occupation.
- **New and emerging (N&E) green occupations:** The impact of green economy activities and technologies is sufficient to create the need for unique work and worker requirements, resulting in the generation of a new occupation.

These categories provide a basis for devising a classification system for estimating the extent to which there is a green component to existing jobs in Europe. But even so, a substantial element of estimation is still needed to produce a classification of green jobs. This requires not only the cross-classification of the occupation codes used in O*NET's classification of occupations with those in ISCO, but also a degree of interpretation of what might constitute a "green enhanced" or "green increased demand" occupation within the context of the European labour market. Accordingly, the results of such an exercise should be regarded as indicative, and treated with a certain amount of caution.

Understanding the quality of green jobs

Both green enhanced and green increased demand occupations can be defined according to the O*NET Standard Occupational Classification (SOC).[1] This allows us to compare the characteristics of the occupations that we can regard as green jobs to those of other jobs, which in turn provides information for comparing job quality. In Europe, the same approach can be applied using the Labour Force Survey (LFS), but with an additional transformation to match classifications. This adds another layer of uncertainty to the analysis, but some broad conclusions may be drawn from the data:

- Both green increased demand (GID) and green enhanced skills (GHS) jobs are less likely to be in the public services than non-green jobs.
- GID jobs are much more likely to be in manufacturing and construction.
- Both GID and GHS have a greater tendency to employ men rather than women than is the case for non-green jobs.
- Green jobs are much less likely to be part-time and slightly less likely to be temporary jobs.

By cross-referencing the classification of *job quality* used by the European Foundation (Eurofound, 2002) with the data that are available from the European LFS, it is possible to construct a partial measure of job quality for GID and GHS jobs, and to compare this to similar indicators for other occupations. Data limitations make it necessary to supplement this with data gathered from job satisfaction surveys. The result

is an analysis which provides an assessment of job quality based on the distinctive occupational characteristics of green jobs. Table 4.1 summarises the findings.[2]

Macro-level analysis

Introduction

This section has two parts. The first provides an assessment of the employment and labour-market impacts of meeting Europe's "20-20-20" targets. The second part then discusses how any negative impacts could be mitigated through policy intervention. An important point to note is that governments typically treat the formulation of environmental policy, on the one hand, and labour market policy on the other, as completely separate domains, so that in practice the design of a package that explicitly relates policies across the two domains is not easy to achieve.

The analysis was carried out using an extended version of the E3ME model.[3] E3ME is a computer-based econometric model of the EU member countries' economies and energy systems, including greenhouse gas emissions. It includes a quite detailed sectoral disaggregation of 42 economic sectors defined at NACE 2-digit level.[4] The model also includes a detailed treatment of labour markets, including econometric equations for employment demand, wage rates, working hours and labour market participation rates. The extended version, described in Wilson et al. (2010), provides results for occupational demand and skills demands.

Table 4.1. **Job quality and the distribution of green jobs**

Occupation	Green in demand		Green enhanced	
	% of jobs green in demand	% of jobs associated with high quality employment	% of jobs green enhanced skills	% of jobs associated with high quality employment
Legislators, senior officials and managers	High	High	Low	High
Professionals	High	High	Low	High
Technicians and associate professionals	High	High	Low	High
Clerks	Low	High	Low	High
Service workers and shop and market sales	Low	Medium to low	Low	Medium to low
Skilled agricultural and fishery workers	Low	Low	High	Low
Craft and related trades workers	Medium to high	Medium to high	Medium to high	Medium to high
Plant and machine operators and assemblers	Medium to high	Low	Medium to high	Low
Elementary occupations	Medium to high	Medium to low	Medium to high	Medium to low

Source: Eurofound (2002), *Quality of Work and Employment in Europe: Issues and Challenges*, Eurofound, Dublin; Cedefop (2010), *Skills for Green Jobs: European Synthesis Report*, European Commission, Luxembourg.

The economic and social impacts of meeting the Europe 2020 environmental targets

This section describes the impacts of the additional policies required to meet Europe's 20-20-20 targets over and above the policies that are already in place,[5] namely that in 2020:

- EU greenhouse gas emissions will be at least 20% below 1990 levels
- 20% of EU energy consumption will come from renewable resources
- energy consumption will be 20% below a "business as usual" projection.[6]

To assess the impacts of meeting these targets, we carried out two scenarios in the E3ME model and compared the results to those of a baseline (essentially business-as-usual) case. The first scenario focused on achieving the first two targets (for reductions in greenhouse gas emissions and for raising the share of energy production coming from renewable sources).[7] The second scenario went on to consider, in addition, the more ambitious energy-efficiency objective.[8]

In many cases, specific policies to meet the targets have not yet been announced, and so it was necessary to make assumptions about these. We assumed that the targets were met in an economically efficient manner (energy prices increase, but not excessively), but did not generate revenues for government (apart from the current ETS arrangements).

The model's results suggest that the policies will lead to a small increase in GDP and employment in Europe in the period to 2020. This is because substantial investment is required to meet the targets, primarily in building renewables and energy-efficient equipment, and E3ME does not assume that additional investment in one sector crowds out investment in the rest of the economy. There are other smaller benefits, for example improved efficiency reduces fossil fuel imports and there is some switching from energy to labour inputs in production. However, there are also some negative impacts on energy suppliers and a loss of competitiveness effects in some energy-intensive sectors.

These results suggest that there are some important sectoral impacts in the scenarios and this is indeed the case. The E3ME results imply that there are benefits to the sectors that produce investment goods and their suppliers (Table 4.2). On the other hand, sectors that stand to lose out are the energy-supplying sectors and certain intensive users of energy.

Table 4.2. **Employment effects in selected sectors, EU27 (2020)**

% difference from baseline in 2020

	Selected most positive			Selected most negative	
	Reference	Energy-efficiency		Reference	Energy-efficiency
Communications	0.6	1.2	Gas supply	-7.3	-13.9
Rubber and plastics	0.5	1.4	Manuf. fuels	-0.6	-3.7
Mechanical engineering	0.4	0.1	Electricity	-0.3	-1.8
Metal goods	0.4	0.6	Miscellaneous services	-0.2	-0.6

Source: Based on European Union (2010), E3ME.

This, in turn, has important distributional implications for high- and low-skilled workers and particular socio-economic groups. Although these impacts are typically at a level too detailed for the modeling, some immediate questions are raised:

- Is it really possible for workers to shift from declining sectors to growing ones? Are there some age/gender or socio-economic groups that could be adversely affected?
- What are the differences between skill groups? Are there implications for wage rates? Will inequality widen?

The question of transitions between and within sectors is discussed in the next section. However, there are some general observations that can be made from the modelling results. For example, many of the jobs that are lost are in traditionally male-dominated sectors, and the sectors that create jobs are also ones in which the share of male employment is high (and sectors that were particularly affected by the economic crisis). However, one could expect older workers to find the required reskilling a challenge.

The issue of income inequality is especially complex. The modelling results show that low-income households disproportionately suffer the impact of higher heating costs, and low-income households that also own cars are likely to be particularly affected (because of the higher cost of fuel). What is more difficult to gauge is the impact of skills polarisation effects. The newly created jobs seem likely to include a higher share of highly skilled positions, putting upward pressure on wages for these occupations; this could be exacerbated by particular bottlenecks (see the next section). However, we think it likely that this effect will be modest compared to the widespread trend in skills polarisation driven by a range of factors that are not related to environmental transition.[9]

How some of the negative impacts may be offset

While our model results suggest that society as a whole would not suffer significant costs if the policies required to meet the targets are implemented, it seems unlikely that the benefits will be universal to either business or workers, as there are shifts between sectors and also within sectors. As discussed in the next section, frictional unemployment is certainly possible. However, the policies that are implemented could be designed to generate revenue for government, for example through carbon taxation rather than regulation and, depending on the scale of market-based instruments used, these annual revenues could be large (in the region of EUR 75bn in 2008 prices, depending on carbon prices); there is therefore scope to use revenues to offset some of the negative impacts.

The analysis of the mitigating effect of such policies in this section is at a macro-sectoral level. More localised policies, including training schemes, are described in the next section. Several options for the use of revenues were considered:

- Reductions on employers' social contributions, lowering the cost of labour. This would result in an overall increase in employment, providing more potential opportunities for displaced workers.
- Subsidies for investment in energy or carbon-saving equipment. The cost of actions to curb emissions would therefore be paid for, in part, by government, meaning that business must bear a lower share of the cost; the negative impacts (in terms of higher prices of products and lower profitability) of meeting the targets are thus to some extent limited.

- Increases in social benefits. This supports income for those who are unable to find new jobs.

The modelling results suggest that the middle option provides the largest boost to GDP and employment, while reductions in employers' social contributions would also lead to employment increases. In reality, however, a combination of all three options would likely be the optimal policy arrangement, with as much specific targeting as possible to ensure efficient use of revenues.

Overall conclusions

The modelling analysis suggests that, at the macro level, the impacts of meeting the 2020 environmental targets on employment are quite small and may, in certain circumstances, be positive. The most positive outcomes will be achieved if the revenues that are generated from market-based instruments are used efficiently. However, it is also clear from the analysis that there are groups in society that stand to benefit and groups that will lose out. The modelling gives an indication of who these groups might be, but can only go so far due to the data constraints. To go further we need to carry out an assessment at a more detailed level, which is the subject of the next section.

Sector-based analysis

Introduction

The results from the modelling suggest that the net employment impacts of meeting the 2020 targets will be quite modest (i.e. the number of jobs created is roughly equal to number of jobs lost). However, it is important to consider the gross impacts and their possible implications. For example, if the workers who are displaced from declining sectors are not able to find employment in growing sectors, then the social costs could be quite considerable. Similarly, if the available workforce lacks the skills to perform the new jobs, then there are potentially high economic costs.

The question is therefore closely related to the wider issue of mobility of labour. In this section we attempt to identify some potential bottlenecks that, although small in scale, may have strong localised effects. We focus on labour, although there may also be bottlenecks due to capital/technology or other factors that have knock-on effects on jobs. This type of analysis must be carried out at a much greater level of detail than can be distinguished in the modelling, and this is carried out through analysis of specific examples and case studies.

We first consider movement between sectors and occupations, and then geographical mobility.

Occupational mobility

The issue of "churn" (gross changes in jobs created and lost) in the economy is, of course, not limited to the consequences of climate change mitigation policies. Any change in economic circumstances, whether due to policy, technology or globalisation, leads to the creation of new jobs and the obsolescence of old jobs. In the context of environmental regulation, the important questions to ask are whether the greening of the economy increases the rate of churn and whether there are workers who are unable to make the transition between occupations.

Governatori (2009) reports that only around 2-3% of total churn in the EU (48 million jobs in 2009) is accounted for by green sectors; this figure is obtained by dividing net impacts in employment studies by the total number of jobs lost or created in the economy. This is quite an insignificant effect when compared to the standard business cycle or, in particular, the effects of the economic crisis. There is a clear conclusion that developments in the economy that are due to environmental regulation are small when compared to all the other things that are going on.

However, rates of churn show substantial variation within sectors and, as the modelling showed, also between sectors. It is therefore worth considering where frictions might occur in both parts of the transition cycle:

- where laid-off workers may struggle to find jobs
- where new green industries may struggle to find workers.

We examined a wide range of specific sectors. Cambridge Econometrics et al. (2011) summarises the findings, and considers several of the sectors that are often considered to be at risk from climate policy, in more detail. Typically these sectors are producers of fossil fuels (coal, refined petroleum) or are intensive users of energy (fertiliser, lime, aluminium). In all cases there are clear risks to employment from production levels that are either falling or relocating overseas. However, there are often more subtle changes to the content of remaining jobs, with much more focus on designing and implementing more efficient production methods. In addition, some new jobs, such as carrying out environmental audits, may be created; these will have their own skills requirements.

Cambridge Econometrics et al. (2011) also considers a selection of sectors that are growing as a result of environmental legislation. In many cases, the skills that are required are similar to those in existing sectors (e.g. production of biofuels) or have only minor differences (e.g. production of electric vehicles, for which the car companies are providing training). More often, it was found that the required skills are at management level in the use of products. For example, buildings can be made more efficient by better design or use of insulation. The examples did not find any major skills gaps but noted that many of the developing sectors are likely to increase demands for the same particular skills. This could put pressure on resources in the R&D, design and engineering sectors, and lead to skills shortages in the future.

The requirements for policy in this area therefore point to training programmes, but do not in all cases require public intervention. The case for public support is much stronger for retraining workers who currently have specialised roles in industries that are declining. The analysis also highlights the importance of understanding the growing sectors and making estimates of their future demand for skilled labour so as to highlight possible future shortages in advance.

Geographical mobility

Location-specific impacts tend to be discussed less frequently but can have important social consequences. The issue can be particularly relevant to environmental policy as some of the sectors that may be most affected are concentrated in large sites in specific locations because they are characterised by large economies of scale. Examples include mining operations, refineries and aluminium smelters.

While retraining programmes usually offer at least a partial solution to improving mobility between sectors, the closure of a large plant in an isolated area presents more difficult problems. The only complete solution is to attract a replacement business to the

area that would create similar employment opportunities; however, in practice this is very difficult and a more likely outcome is a combination of skilled workers relocating, down-skilling and unemployment.

Policy implications

This analysis has shown that, at a macro level, the impacts of climate change regulation on labour markets are quite modest, especially when compared to the effects of the economic crisis, or even the economy's normal pattern of job creation and destruction. This finding is consistent with a wide range of studies discussed in Cambridge Econometrics et al. (2011, Chapter 2). It provides support for environmental policy, as it suggests that the net economic and social effects are only modestly negative (and may even be positive). However, the findings do not suggest that the scale of creation of green jobs will be sufficient to lead the economic recovery from recession.

The analysis has also shown that the implementation of environmental policy will create both winners and losers. The role for policy intervention is to ensure that the individuals and social groups that lose out are able to make the transition to satisfy the needs of growth industries and, as a last resort, to provide support for those who are unable to do so in the form of social benefits.

It should be noted that these policies need not necessarily be directly related to the labour market. For example, by providing a policy environment that encourages investment in energy-saving equipment, the transition to a low-carbon society is likely to be smoother and carried out at a lower cost to society. The use of market-based instruments in environmental policy also provides the resources to ease this transition.

Within labour market policy there is clearly a role for training schemes to aid occupational labour mobility, particularly from sectors that are likely to suffer steep declines, such as coal mining, and to some of the very specific sectors that may become bottlenecks to development, such as research and engineering. However, in many cases this will not be in the form of retraining for new jobs, but in more subtle changes to existing jobs. It could be viewed more as providing information rather than final training. In some cases the main (usually large) companies involved will have a clear commercial case for providing information and training, but there may also be a role for public policy, particularly in fragmented sectors.

The main policy conclusions from this analysis are therefore:

- not to place too much focus on green jobs at the expense of other policy areas or sectors
- to provide a policy environment that allows for a smooth transition to a low-carbon society at minimal cost, for example with stable price signals and smart regulation
- to identify where future bottlenecks in the labour market may be; to encourage the development of skills to fill these gaps; and to ensure that training is provided to workers who find that their skills have become obsolete.
- to provide support to workers who are unable to make this transition.

Notes

1. New and emerging green occupations cannot be identified separately because they have only emerged recently and are not yet distinguished in the data.
2. These findings make the assumption that the nature of the green jobs in a given occupation is similar to that of other jobs in the same occupation. This assumption is supported by much of the evidence that has been collected (see e.g. Cedefop, 2010). The findings of this study and that of Cambridge Econometrics et al. (2011) are that the differences between green jobs and similar "regular" jobs are modest both with respect to working practices and job content.
3. Further information about E3ME can be found at www.e3me.com.
4. As will be seen in the next section, some questions of interest can only be addressed by adopting methods that explore the effects at a more detailed level.
5. The targets are described in detail in European Commission (2008).
6. See European Commission (2011).
7. The policies implemented in the scenario to achieve these targets are similar to those in the reference scenario described in European Commission (2010b).
8. Described in European Commission (2011).
9. Refer to OECD (2011).

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Chapter 5

The Austrian Masterplan for Human Resources for Renewable Energies

Gerhard Geiger and Tanja Bacher

The expanding renewable energy and environmental engineering sector is creating new, green jobs in Austria, which are leading to a higher demand for green skills. Thus, a comprehensive plan is required to develop the adequate skills necessary to maintain and expand the production and consumption of renewable energy sources.

The Austrian Masterplan for Human Resources in Renewable Energy Sources (Masterplan HR-RES) attempts to ensure the supply of qualified people for renewable energy sources. This chapter discusses, besides European policy measures in the field of vocational education and training (VET) and the renewable energy sector, the situation in Austria and the approach followed for the development of the Masterplan HR-RES. This will be a strategic tool for VET governance in the field of renewable energies, with a combined view on employment and education and training. For photovoltaic technology, the scenario-based forecast shows that an ambitious expansion by 2020 finds expression in employment needs exceeding those of a "moderate expansion" by a factor of 20.

Quantitative labour market demand is expected to rise especially in the "planning and installation" stage of the value chain and, in terms of qualification, in technical apprenticeship occupations. Based on previous studies and our own observations, the Masterplan HR-RES sets out recommendations for actions to foster future employment and education and training. With regards to photovoltaic technology, interdisciplinary skills are required for building-integrated photovoltaic solutions. Synergies and interfaces between disciplines (e.g. mechatronics, building physics) should be integrated in initial and continuing VET provision. The recommendation for actions was discussed within a participatory framework with a broad range of stakeholders, including those from the world of work and others from the world of education and training.

Introduction

Energy from renewable sources plays an important role in Austria in reducing the dependency on imported fossil fuels and in supporting a reduction of greenhouse gas emissions. For decades the Austrian energy policy has focused on securing a sustainable and socially balanced supply of energy. Austria, compared with other European member countries, therefore ranks highly in renewable energy consumption. Already in 2005, approximately 22% of the Austrian energy mix came from renewable energy, with the greatest proportion of renewable energy sources coming from biomass, followed by hydro power, heat pumps, solar energy, wind and photovoltaic (Federal Ministry for Agriculture, Forestry, Environment and Water Management, 2009: 10-13).

In the course of the European Union's climate and energy package, Austria has committed to reduce greenhouse gas emissions by 2020 by another 16% compared to 2005 levels and to increase the percentage of renewable energy sources up to 34% by 2020 (Federal Ministry for Agriculture, Forestry, Environment and Water Management 2011: 6). This aim seems realistic since in 2010, 30.8% of the total energy consumption was already assigned to renewable energies. These developments demonstrate the intention of the Austrian government to become energy self-sufficient and to base the Austrian energy consumption entirely on renewable energies by the year 2050 – a scenario-based study estimates that this plan as feasible (Streicher et al., 2010). The increase in renewable energy production and consumption in Austria leads also to a higher demand for qualified personnel able to work in the growing sector of renewable energy.

There are already discussions and measures in place to foster generic and technical green skills to support Austria's growing green economy, and particularly the renewable energy sources (RES) sector. Vocational education and training (VET) provision for developing technical green skills in RES is manifold, but in sum it is difficult to determine what exactly leads to inefficiencies. Lassnigg (2009) assumes that the coexistence of different governance systems in VET and a missing common co-ordination is one reason why the Austrian VET system is not able to respond constantly to changing skills and qualification needs (Lassnigg, 2009: 5).

Another reason for the inefficiency of the VET system to develop the needed green skills is that the concept of "Education for Sustainable Development" (ESD), designed to strengthen generic green skills, has not yet been mainstreamed in VET. Little is known about contemporary and future green skill needs and qualification levels in different technological fields in RES. In order to avoid a mismatch between the skills provided by vocational education and training programmes and those required in the labour market, which could lead to short-term unemployment, the transformation of traditional and emerging occupations, and related changes in competence requirements, call for better communication between the two societal spheres of the world of work (demand side) and the world of education and training (supply side). At least since 2002 the European Union has recognised the importance of an adequate match of skills supply and demand in order to stay competitive in a global economy and has responded with several European measures to foster VET-labour market co-operation.

A master plan for the medium- and long-term security of human resources that will promote communication and co-operation between the labour market and the world of education, improve further education and serve as a strategic decision document for the policy can facilitate these needs. In Austria, the public sector-funded project[1] Masterplan

HR-RES tackles the problem of green skills development in the RES sector by using an integrated approach.

This chapter discusses European policy developments regarding VET-labour market co-operation in general and in the renewable energy sector in particular. The situation in Austria is also discussed: How is the renewable energy sector embedded in the Austrian economy? Which strategies are followed and what challenges are faced in supplying green skills? And finally we look at masterplans as a tool for the governance of VET in general, as well as the objectives, methodological approach and intermediate findings of the "Masterplan for Human Resources for Renewable Energy" project in particular.

European Union's policy measures to foster VET-labour market co-operation and to address the green growth paradigm

Globalisation, demographic changes, rapidly changing technologies and the on-going transition of most European member countries towards knowledge societies require a better qualified labour force to stay competitive in a global economy. Particularly, the aftermath of the global financial crisis has stressed the need to look critically at current economic growth models and to rethink current consumption and production practices (Martinez-Fernandez et al., 2010: 5). Besides all the negative impacts of the global financial crisis, it could be an opportunity to re-think the global model of economic growth while simultaneously taking the challenge of moving towards a cleaner, low-carbon economy. This calls for the identification of policies, measures and strategies to foster green growth and an increased need for a labour force qualified to work in the renewable energy sector (Martinez-Fernandez et al., 2010). It is estimated that in the European Union alone, the industry sector of renewable energies could generate 5 million jobs across Europe till 2020.[2]

Since 2000, when the Lisbon Strategy (2000) and its European Employment Strategy (EES) were implemented – with the aim to enhance competitiveness, increase employment and improve social cohesion across Europe – the European Union has established several measures to enhance the participation in VET and to institutionalise lifelong learning strategies. The Maastricht Communiqué (2004) established action plans at a national level to increase investment in VET and to enhance the flexibility of VET systems, so they are able to react more effectively and quickly to labour-market needs. The Bruges Communiqué (2010) stated that national VET systems need to be connected to the wider world in order to remain up to date and competitive (EC, 2010c).[3]

With Europe 2020 "A strategy for smart, sustainable and inclusive growth" the European Commission fostered its attempts to harmonise different policy areas within the European Union. In terms of VET and RES, the strategy aims to increase the employment rate of the population aged 20-64 up to 75% including a greater integration of women, older and migrant workers and to meet the "20/20/20" climate/energy targets (European Commission, 2010b: 3, 8), which attempt to "increase the share of renewable energy sources in final energy consumption to 20% and a 20% increase in energy efficiency" (EEC, 2010).

In order to achieve these objectives the European Union fostered the open method of co-ordination (OMC), which promotes co-operation and policy development, and creates space for actors at different levels. The OMC is a newer intergovernmental means of governance with both formal and informal arrangements, and the involvement of more actors and levels of organisational authority than is the case for centralised governments

(European Commission, 2009). These developments reflect the important challenge of the EU and its member countries to offer vocational education and training programmes that appropriately match the skills needs of the labour market, especially in the renewable energy sector.

National developments in Austria

The renewable energy sector and the need for green skills

In Austria in 2009, the environmental sector accounted for approximately 200 000 "green jobs" and a turnover of EUR 5.22 billion (Federal Ministry for Agriculture, Forestry, Environment and Water Management, 2010). The renewable energy sector alone employed 39% of all green jobs and generated 52.8% of the overall turnover (Statistik Austria). Biomass and hydropower, in particular, have a long tradition and a great economic value, since these are resources are in high demand across the Austrian territory (*ibid*.). Another factor for the high proportion of renewable energy sources (RES) in Austria was the rejection of atomic power, which was consolidated in 1978 in a referendum against atomic energy. This long-term energy policy has resulted in a mix of energy sources, characterised by a significantly high proportion of RES (Umweltbundesamt).

These developments also contributed to the establishment of energy-autonomous model regions abstaining from fossil energy. The first of these initiatives started in 1990 in Güssing (Southern Burgenland), when the municipal council decided to stop using fossil energy supplies. In 1996, with funds from the European Union, the Centre for Renewable Energy Güssing (*Europäisches Zentrum für Erneuerbare Energie*, EEE) was established and since then has been working to develop sustainable, regional and local approaches to energy generation, conservation and the use of renewable energies (EEE Güssing). Currently there are already 85 climate and energy model regions in Austria, which are energy-autonomous and only rely on regional resources for their energy supply (Klima- und Energie Modellregionen).

These developments have also influenced the renewable energy sector and its growth. The above numbers show that the RES sector now offers a great labour market potential, which could lead to a higher number of "green jobs", where "green skills" are needed. UNEP's definition of "green jobs" (2010) shows that green jobs can be found at any point of the supply chain of green firms and/or businesses and therefore span a wide array of skills, educational backgrounds and occupational models (UNEP, 2010).

A study conducted on behalf of the Austrian Public Employment Service comes to the conclusion, that besides technical skills, soft skills will also become more and more important in the "green economy" in the coming years. The study estimates that the RES sector already faces a shortage of qualified personnel, and concludes that there is a lack of VET offers to qualify to work in the field of RES (AMS, 2008: 61). The general skills anticipation system has several shortcomings, such as no defined job or educational profiles which affect the availability of data on skills and occupational profiles in the green economy. The system is characterised by a variety of single instruments and the absence of a coherent and integrated approach, which leads to a lack of concrete results (European Commission, 2009: 14).

The Austrian VET system: A short overview

The VET sector plays a major role in the Austrian education landscape. Competence for various VET programmes is divided between national and regional governments. A key role is met by the Austrian social partnership. Traditionally, based on legal entitlements of various kinds, social partners are integrated in all major educational issues, thus contributing – particularly in VET and adult education – to intensive interconnections between educational institutions and society (ReferNet Austria, 2011: 9).

The Austrian education system is characterised by an early differentiation of VET paths from lower secondary level onwards and a broad VET provision at upper secondary level. Austria has a qualification-oriented VET system, which prepares for broad, well-structured, legally defined vocations ("*Berufe*") via the combination of an apprenticeship system with a comprehensive school-based VET system (at upper secondary level). The great importance of VET within the education system and the educational expansion since the 1970s has led to a higher qualification of the labour force. Some 80% of all employees have a vocational and/or higher education (HE) qualification.

Initial vocational education and training (IVET) includes VET schools (*berufsbildende mittlere Schulen*, BMS), VET colleges (*berufsbildende höhere Schulen*, BHS) and dual VET (apprenticeship, *Lehre, Lehrlingsausbildung* – from year 10). At the tertiary level, universities of applied sciences ("*Fachhochschulen*") can also be defined as IVET in Austria (ReferNet Austria, 2011: 34). This diversity of tracks reveals the special importance of VET in Austria. Some 40% of young people take up dual training in one of the approximately 205 apprenticeships at the end of compulsory schooling. Of all students in VET at the upper secondary level, 45% are in apprenticeship training, while 55% are in a school-based VET institute (VET school or college). Austria has, together with the Czech Republic, the fourth highest rate of "combined school- and work-based programmes" in Europe (following Denmark, Hungary and Germany) (ReferNet Austria, 2011: 37).

Governance in the Austrian VET system

The term "governance" has gained great usage in contemporary public administration in recent years. The popularity of the term lies in the fact that it can be applied to a wide range of issues, relationships and institutions involved in the process of managing public and private affairs. The term "governance" enlarges and better illustrates what governments should be focusing on (United Nations Economic and Social Council, 2006: 2-3).

In this respect, the concept of "good governance" evolved and describes the co-ordination of new forms of partnership and co-operation, meaning horizontal activities of states, companies and non-profit organisations (Kyrer, 2009: 71). The main assumption behind the governance paradigm is the experience that an organisation, city, region or country, etc. cannot be controlled hierarchically by one group, but that good performance is only possible when there is an interplay of many actors – including those with different interests (*ibid.*, p. 73).

There are three fundamental criteria of the governance concept in order to guarantee high performance – effectiveness, efficiency and sustainability. These criteria should be supplemented by co-ordination, coherence, co-operation, control and communication (*ibid.*: 75-76).

Lassnigg (2009) describes the Austrian VET system as being characterised by different, coexisting governance systems, controlled by different actors, without a coherent overall control of the VET system (Lassnigg, 2009: 5). For example, the apprentice training is jointly managed by the national government and the nine federal governments; in contrast, the full-time vocational schools are managed by the federal governments alone (*ibid.*). The VET governance system in Austria could also be described as a bureaucratic governance model, in which the necessary information flows are not given, hindering the development and implementation of accurate monitoring systems on the required input, process and outcome variables, which are a prerequisite for improving the efficiency of the governance system (Lassnigg, 2009: 9).

Addressing the green growth paradigm in VET in Austria

As illustrated above, there is growing interest in "green growth" in almost all economic sectors in Austria (OECD, 2010). The expanding sector of renewable energy and environmental engineering creates new, green jobs "[which] leads to a higher demand [for] green skills".[4]

The Austrian government has established several measures to develop generic and technical green skills. For example, the Austrian Strategy for Education for Sustainable Development (Federal Ministry for Agriculture, Forestry, Environment and Water Management, 2008), aims at raising the awareness of all learners and teachers/trainers about sustainability issues. The "Masterplan Environmental Technology" ("*Masterplan Umwelttechnologie*") focuses on improving green skills for workers (Federal Ministry for Agriculture, Forestry, Environment and Water Management, 2007) and the "Masterplan Green Jobs" targets the creation of 100 000 "green" jobs by 2020 (Federal Ministry for Agriculture, Forestry, Environment and Water Management, 2010).

Although the Austrian renewable energy sector has a long tradition, it is still a very young sector which up-to-now has not lead to the establishment of a specific labour market or a specific mode of supplying the required skills. Hardly any information is available about which qualifications and competences are relevant to companies in this sector. Beside hard skills (educational background, technical skills), soft skills (language, intercultural or social skills) seem to be becoming more and more important. These skills are often not gained through formal vocational education and training programmes, but are acquired informally in practice (AMS, 2009: 11). Therefore, instruments are needed to ensure the supply of qualified human resources for the RES in Austria.

Master plans as tools for the governance of VET

As mentioned earlier, different sectors of the VET system are shaped by specific governance[5] systems in Austria. Complexity is a common feature of all VET governance arrangements, because VET systems serve a wide range of students and many stakeholders are involved in decision making, funding and financing (Damian, 2010). To overcome complexities in society, the economy, and politics, Kyrer (2009) proposes the development of a masterplan following comprehensive planning and co-ordination in different political fields.

A masterplan serves as a co-ordinated system for the government, social partners and the public and may also provide a basis for company decision making (for example, in human resource issues and investments). It combines old and new approaches to plan and

implement future projects and also considers fundamental changes in national and international framework conditions.

Masterplans are instruments characterised by: *i)* awareness of the complexity of planning; *ii)* more transparency and better communication between those involved; *iii)* working with module principles[6] and interfaces between the modules; and *iv)* an integration of all planning areas and working with systemic procedures to uncover contradictions and limitations at an early planning stage (Kyrer, 2009: 77-78). It is assumed that masterplans could allow for an optimisation of economic resources. Usually the vision, the mission statement, strategies and objectives of a masterplan are developed in a top-down approach, while the development and implementation of specific projects (national and supranational projects, regional projects) follow a bottom-up approach (Kyrer, 2009).

Since masterplans are important tools for governance to deal with increasing societal complexities, and are therefore functioning as control and co-ordination instruments, several countries are currently developing and implementing them for co-ordinating different policy areas. Australia, for example, developed a governance Masterplan "Education for Sustainability" aiming to address the requirements Australia faces to educate its population on the importance of sustainable living and re-orienting the way in which people live and work. Ultimately, "the aim of the plan is to equip all Australians with the knowledge and skills required to live sustainably" (Commonwealth of Australia 2009).

Objectives of the Austrian Masterplan for Human Resources in the Renewable Energy Sector (HR-RES)

The reduction of climate-changing CO_2 emissions and the aftermath of the economic crisis and the resulting job losses pose pivotal challenges that the Masterplan HR-RES must meet. In tackling these problems, priorities on a European level (Europe 2020 strategy – intelligent growth, sustainable growth and integrative growth), on the one hand, will be considered, while on the other, the interests of relevant stakeholders from energy, education and labour market policy will be taken into account by involving them in a broad participatory consultation and development approach. This participation process is seen as a necessary pre-requisite to ensure the relevance of the masterplan and maximise its potential for implementation.

The Masterplan HR-RES has the following objectives:

- A strategic document will be developed to ensure that sufficient human resources exist in the Austrian renewable energies sector in the medium and long term, including for all relevant areas of technology (solar and thermal energy, photovoltaic, wind energy, hydropower, biomass, etc.).
- This document will be developed with a participatory approach (broad involvement and discussion) in "accordance with all participant"' in terms of the stakeholders.
- The masterplan will outline future trends and technical and economic developments and set targets/guidelines regarding which qualification measures and programmes VET must incorporate. Scenario techniques and a broad feedback process in the form of workshops and online surveys will thus be used.

- The masterplan will serve as a basis for decision making on education and labour market policy in the form of scenario-based recommendations. Decision makers from these political fields will also be involved in the masterplan's development process by participating in workshops and feedback circles. The masterplan may be used as a strategic basis for both educational policy decisions and for administration.
- The masterplan will assist educational organisations and providers of educational programmes and vocational training in shaping efficient educational offers within the existing education system (in the sense of transitions, permeability and credit transfers).
- The masterplan will investigate educational and development opportunities in the areas of renewable energy technology for parts of society often excluded from the formal labour market (e.g. women, youth, migrants, workers 50 years and older).
- Framework conditions for credit transfer systems will be discussed and recorded on the basis of a "common language of skills and competences". An example will be provided in the form of a competence matrix for the job profile of "eco engineer".

Methodological approach of the Masterplan HR-RES project

The following sections describe the methodological approach for achieving the aims of the Austrian Masterplan for "Human Resources in Renewable Energy Sources" (Masterplan HR-RES).

1. Scenario-based skills forecast

Based on an extensive literature review, impact parameters for the development of scenarios based on climate and energy policy objectives are identified and described. These impact parameters build the basis for developing two to three different, but internally consistent, human resources scenarios for the quantitative demand of each renewable energy source. The following energy technologies are considered: wind power, photovoltaic (small-scale roof, large-scale roof and ground-mounted systems), solar thermal (small-scale and large-scale systems), heat pumps, hydro power plants (small and large systems), biogas (small and large plants), biomass, small and large thermal plants, bio oil, bioethanol and biodiesel. In the scenarios, the development of renewable energy sources will be estimated for the years 2020 and 2030.

The starting point for the calculation is the final energy produced per energy technology (GWh) and the derived energy capacity (MW) in the year 2010. Employment effects are calculated for each value chain. This is based on information about the full-time equivalents per MW, which is obtained from literature (*cf*. Hirschl et al., 2010). The following value-added steps are distinguished:

- plant production
- planning and installation
- technical management
- the operating company.

The input parameters for the human resources model (final energy and energy capacity) are derived from two different scenarios. The first scenario is based on the National Renewable Energy Action Plan, the second scenario is based on the action plans of the various renewable energy associations, which include very ambitious assumptions. In order to assure market-related factors (e.g. export and import quotas, development of productivity factors over time, etc.) were considered, expert interviews with relevant stakeholders (e.g. representatives of companies in the renewable energies sector, labour market experts, etc.) were conducted.

2. Qualitative educational needs analysis

The qualitative educational needs (regarding the content of initial and continuous education and training programmes for developing green skills in RES) are analysed through qualitative research. In a first step, key stakeholders from industry (companies, interest groups, etc.) and relevant research experts were identified and illustrated in a stakeholder matrix. On the basis of an interview guideline, semi-structured expert interviews were conducted dealing with labour market trends and developments in the renewable energy sector, required qualifications and skills (technical, methodological, interdisciplinary, personal/social skills), future education and training needs, development of new job profiles, new target groups and the permeability between different education pathways. In order to assure the results were valid, an additional online survey was developed based on the results of the expert interviews.

In the interviews special attention was paid to aspects of gender mainstreaming and reference to existing estimations from other studies and to the specific situation of the company was made. Leading questions were: "Why do roadmap predictions and reality often not match and what could be solutions for improvement?"[7] "What factors are central for innovation?" "What time dimensions are relevant for different objectives?" "Is a transition period necessary to build the necessary infrastructure for innovation?" "Which qualification requirements for human resources result from this?" "Do qualification requirements refer to experienced persons or entry-level workers?" "What qualification level is addressed by these questions?" "Which human resources strategies are used by the companies?" "How is recruitment working (external vs. internal labour markets)?" The interviews were analysed through content analysis.

3. Screening of VET provision in Austria

A comprehensive screening of initial and continuous vocational education and training offers (on the basis of curricula, examination tasks, teaching material, but also existing research) available for the renewable energy sector was conducted. In total, 104 educational programmes with more or less focus on renewable energy were identified and screened. Among the screened training offers were programmes at universities of applied sciences, VET schools (*berufsbildende mittlere Schulen*, BMS), VET colleges (*berufsbildende höhere Schulen*, BHS), in dual VET (apprenticeship), master craftsman schools (*Werkmeister Schulen*), for energy consulting and management, non-formal education and training (e.g. *Interessengemeinschaft Windkraft*, *Kleinwasserkraft*) and offers of adult education providers (e.g. Wifi, bfi).

The screening considered the following indicators: education and training programmes for specific target groups (e.g. installers, energy efficiency advisors, energy service providers); e-learning offers for specific target groups (e.g. installers, energy efficiency advisors, energy service providers); energy efficiency and target group-specific

training for company employees; education and training offers for young people in the vocational orientation phase, practice orientation. The analysis also includes statistical data (e.g. women/men as a proportion of people in education and training, of teaching staff and graduates) based on available data. In the next phase, those training providers and programmes of particular strategic importance, were analysed more in depth and described in more detail.

4. Recognition of learning outcomes

An important aim of the European Union is to enhance the comparability and transparency of educational programmes within the European Union, therefore several European Transparency instruments have been developed (e.g. European Qualification Framework, European Credit System for Vocational Education and Training). Central for achieving more comparability and transparency are educational standards that are based on a common understanding of qualifications and their contents in the form of learning outcomes. A shift from inputs to outputs in education and training facilitates the process of establishing mutual trust between different education providers or different countries. Further, such an approach could be used for enhancing the permeability of educational offers.

In the field of renewable energies in Austria there is no overview available on the "competence landscape", mainly due to the fact that different occupations are involved in renewable energy technologies (e.g. in planning, development, installation, operation, maintenance, etc.). To solve this problem, the development of competence matrices seems very feasible. The Masterplan HR-RES will develop a competence matrix for the profession of "eco energy technician". A competence matrix can be used, for example, for transferring and recognising competences acquired within the official VET system as well as competences achieved through non-formal or informal learning or for developing qualifications, training programmes and curricula.

The leading questions for the analysis are: Which technology fields (solar/heat pump/biomass, etc.) are addressed on each qualification level? What are the core areas of work? In which areas are learning outcome-oriented descriptions of competence (training regulations, examination regulations, course descriptions) available? What standards play a role in certain areas of expertise? The first step for developing a competence matrix is to empirically derive the core work tasks of eco energy technicians. Expert interviews were conducted with companies, technicians and teachers/trainers working in the field of eco engineering to gain insights into this question. In addition, existing curricula and training offers were screened, for example, the use of learning outcomes, job or educational profiles, etc. to complement the analysis of core work tasks.

A competence matrix consists of a vertical axis containing the main competence areas for a specific profession, derived from the identified core work tasks. The horizontal axis of the matrix shows the steps of competency development described in learning outcomes, which indicate the progress of competency development, for example of a learner.

A competence matrix can show organisational and individual profiles. The organisational profile is formed from individual parts of the matrix and reflects the range and extent of competence development offered by a specific training programme. By using an organisational profile, the competences acquired so far by a person in training can be made visible (individual profile). An individual profile illustrates the stages of competence development a person has already achieved. This procedure can be used as a

starting point for training providers to communicate on the organisational profile of their own training programmes, to understand the training programmes of other contexts or training providers and to identify commonalities/differences in the training programmes (*cf*. Luomi-Messerer, 2006: 15-40; Markowitsch, 2000).

Preliminary findings

The on-going project has revealed some preliminary findings. For photovoltaic technology, for example, the scenario-based forecast shows that an "ambitious expansion" by 2020 finds expression in employment needs exceeding those of a "moderate expansion" by a factor of 20. Quantitative labour market demand is expected to rise especially in the stage of "planning and installation" and – in terms of qualification – in technical apprenticeship occupations. In general, the results from the scenario-based forecast indicate that it is expedient to consider any measure for employment and education and training in connection with plans and framework conditions for the expansion of renewable energy technologies, with incentives for settlement of researching and manufacturing enterprises in-country and with supporting measures for an enhanced export success of Austrian businesses.

Based on previous studies and the author's own observations, the Masterplan HR-RES sets out a recommendation for actions to foster future employment and education and training. With regards to photovoltaic technology, interdisciplinary skills are required for building-integrated photovoltaic solutions.

Synergies and interfaces between disciplines (e.g. mechatronics, building physics) should be integrated in initial and continuing vocational education and training provision. Besides recommendations for specific areas of technology like photovoltaics, there are some that are more general in nature which encompass the whole renewable energies sector.

The Masterplan HR-RES recommends measures for demystification and visualisation of existing, emerging and hidden occupational images and paths among students and parents. Pilot initiatives are recommended for the development of a credit system for vocational education and training to describe and accredit learning achievements in vocational education and training. As to the provision of vocational education and training, information about "frequently made mistakes" from damage and deficiency reports should feed in to discuss how to avoid such resource demanding mistakes with students.

The project consortium responsible for the development of the Masterplan HR-RES also recommends that decision makers find a qualified organisation for the future supervision of the Masterplan HR-RES. Since the recommendations of the Masterplan HR-RES address a broad range of stakeholders from the world of work and the world of education and training, this organisation should have a good overview of stakeholders and arrangements between them as well as of the processes that shape renewal of education and training. All of the recommendations were to be further developed until the end of the project (February 2013).

Policy implications development of "green skills" in Austria is especially relevant to the expanding and promising economic and labour market sector of RES. Significantly enhanced knowledge of efficient employment in the RES sector of and modern energy systems is a prerequisite for the sustainable development of modern societies, modern economic systems and the environment.

Thus, VET provision for occupations in the different areas of technology of RES should combine up-to-date technical and engineering knowledge with an understanding of sustainable energy provision as well as with the competence to act and consult successfully in complex professional situations. The modern image of technical employment combines ecological viability with economic reality and social acceptance of technological solutions for a modern society. People in "green jobs" must therefore acquire the appropriate skills so their knowledge can be put into practice in an ecologically and ethically acceptable way, and to enable the development of economically viable solutions, which will be accepted by consumers/customers. These comprehensive competences are essential to ensure that environmentally sustainable technologies are not only created and developed, but also more widely used by the public.

In Austria, there are individual measures in place for forecasting future skills needs, but there is no comprehensive approach including a "green dimension". Hence, there is a lack of measures that acknowledge generic green skills as core competences in VET in the field of RES. The development of the Masterplan HR-RES as tool for steering labour market demands and educational supply is a means to these ends.

The Masterplan HR-RES should ensure that an expected positive development of renewable energy technologies in Austria is accompanied by sufficient human resources educated and trained adequately for this sector. The necessity for such an integrated overall plan derives from the following requirements: a foresighted co-ordination of education and training provision regarding future skill demands of the labour market, avoidance of redundancies in education and training provision, eradication of quantitative and qualitative deficits in education and training for different technology areas of renewable energies.

The final implementation of the Masterplan HR-RES is highly dependent on policy measures that guarantee a better interplay between the world of education and the world of work, which should ensure that the skills supply meets the skills demand in the Austrian RES sector.

Notes

1. Project duration 2011-13, see: www.masterplan-energie2020.at.
2. http://laboureconomics.wordpress.com/2012/04/26/renewable-energies-lead-to-new-jobs-and-economic-growth/ (accessed 1 June 2012).
3. *Cf*. Bruges Communiqué 2010.
4. There is no common understanding of the term "green skills" in Austria. Here, we refer to Cedefop's definition: "Green skills refer to knowledge, abilities, values and attitudes needed to live in, develop and support a society which reduces the impact of human activity on the environment: generic Green skills help improve resource efficiency or raise awareness of eco-activities, eco-citizenship, etc.; technical green skills are required to implement standards, processes to protect ecosystems and biodiversity, reduce energy, materials and water consumption; highly-specialised Green skills are required to develop and implement green technologies (e.g. renewable energies, sewage treatment or recycling)". (Cedefop, 2010a: 13)
5. Here, we refer to "governance" as "a generic concept for the attempts of the state, and its private sector allies, to steer the economy and society", involving "making decisions and utilizing resources in order to alter conditions in society" (Peters, 2011).
6. For VET, the module principle can be defined as modules organised in units for sequencing and structuring qualifications and the related learning outcomes. Through the modules, specific foci of VET programmes can be achieved, for example modules dealing with renewable energy vocational education and training (Ehrke, 2003: 2).
7. Regarding this point, it has to be considered that companies mostly set high requirements regarding the skills and competences required of their workforce, but due to a shortage of skilled workers, many companies have to rely on what is available on the labour market (Der Standard, 2-3 June 2012: K1).

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Chapter 6

Skills for green jobs: Gearing up education and training for green growth

Christine Hofmann and Olga Strietska-Ilina

Skills development is critical to unlocking the employment potential of green growth. To avoid future skill shortages, countries need to devise strategies based on well-informed policy decisions, social dialogue and co-ordination among ministries and between employers and training providers. Changes in skill profiles happen at all levels of qualification and across all sectors. Co-ordination between skills and environmental policies, mainstreaming environmental content across all training programmes, as well as designing specific courses for new or changing occupations are important building blocks for a coherent strategy to gear up education and training for greener jobs.

This contribution draws on findings from the book Skills for Green Jobs. A Global View, *arising from an ILO/Cedefop collaboration, and two sector studies on renewable energy and green building as well as a comparative analysis of methods of skills identification, resulting from a joint project between the ILO and the European Commission.*

Introduction

Green jobs are jobs that reduce the negative environmental impact of enterprises and economic activities, ultimately to levels that are sustainable. "Green jobs" is a dynamic concept defined in the *Green Jobs Report* as work that contributes to preserving or restoring the quality of the environment while also meeting requirements of decent work. As this contribution differs across economies and changes over time, it is useful to conceive jobs in varying shades of green (ILO/UNEP/IOE/ITUC, 2008).

The green jobs and the decent work agendas are mutually supportive and include several interdependent elements, such as rights at work, more and better jobs for women and men, social protection measures, labour protection, and social dialogue – including freedom of association and collective bargaining. The International Labour Organization (ILO) does not use the concept of "green skills" but rather refers to skills for green jobs, i.e. those generic and technical skills applied to fulfil the requirements of productive and gainful employment in the green economy.

This contribution is based on the ILO publication *Skills for Green Jobs. A Global View* (Strietska-Ilina et al., 2011) arising from a collaboration with Cedefop, and on three reports produced in the framework of an ILO/EC joint management agreement on "Knowledge sharing in early identification of skill needs: The comparative analysis of methods of identification of skill needs on the labour market in transition to the low-carbon economy" (ILO, 2011c), and two sectoral studies on skills and occupational needs in renewable energy (ILO, 2011a) and in green building (ILO, 2011b).

Why are the skill needs changing?

Skills for Green Jobs identified four drivers of change: physical change in the environment; policies and regulation; technology and innovation; and markets for greener products and services, and consumer habits. The four drivers of change are interrelated. Physical change in the environment is the basis for policy decisions on environmental regulation. Regulation, in turn, can affect the development, availability and dissemination of technology. Regulation and the availability of technology affect national and global markets. Consumer habits, and thus the demand for greener products, can affect the way companies do business and can encourage them to adopt new technologies that allow them to meet new consumer needs.

Of particular importance is how these drivers of change have evolved. Markets and consumer behaviour are defining drivers of change in those developed countries with a long history of environmentalism (Denmark, France, Germany) but this strength did not come overnight. It took the green market three to four decades to gain the power it exercises today, nourished in the first place by policy and regulation, which in turn triggered technology and innovation and made the greening process commercially attractive for businesses and individuals. Developing countries, emerging economies and those industrialised countries where the green transition is in its early stages, can learn from this evolutionary process. Although at present the main driver of skills change in these countries is environmental change (especially in developing countries), which requires a repertoire of adaptation skills, and policy and regulation, it is clear that well-designed policies will trigger the market driver and thereby boost the green transition.

In spite of the growing influence of globalisation, skill changes resulting from the transition to a greener and low-carbon economy remain country specific, determined by different environmental challenges, national policy and politics, and thus the regulatory framework, which can include credits, tax exemptions and other incentives. However, international policy and legislation are playing a greater role and are driving further change at the national policy level. This activity will eventually further bolster already vibrant global markets and business-driven technology transfer. As a result, patterns in skill changes may become more similar across countries and regions.

The key skills challenges

Country level research pointed to the following major skills challenges as economies go greener:

1. Skills shortages are already hampering the transition to greener economies. Shortages of engineers and technicians apply to both developed and developing countries, which is the result of a low number of enrolments in technical subjects, or STEM (science, technology, engineering and mathematics) when it comes to tertiary education. The shortage of technical specialists primarily affects technology-driven green sectors. Shortages of qualified teachers and trainers in newly emerging green vocational fields and with the up-to-date environmental knowledge are another type of skill shortage found in both advanced economies and developing countries. The situation is aggravated by a general shortage of teachers and trainers in many countries.

2. Skills and environmental policies are not sufficiently co-ordinated, either at national or at sector level. The implementation of ambitious environmental policies and green stimulus packages is put at risk by negligence of the need to cater for complementary human resource planning and eventually by the lack of a qualified workforce.

3. Green structural change, as part of a broader economic restructuring process, will be profound in certain sectors, particularly in high-carbon emitting sectors and in agriculture. While net employment effects are expected to be neutral to positive, workers losing “brown jobs” cannot be expected to walk into green alternatives without efficient and targeted active labour market policy measures.

4. Occupations change at different rates and in different ways. The extent of skill change determines if new occupations emerge or if existing occupations become greener. Changes in existing occupations by far outnumber brand new occupations. This presents a challenge for training and qualification systems as a whole which need to update and keep up with the change in the content of existing occupations. It is, however, a particular challenge for technical and vocational education and training (TVET) which, unlike compulsory and tertiary education, lags behind in the skills-for-jobs race.

5. “Green jobs” is a relatively new concept and the transition to the green economy is an on-going change that is hard to fully capture and grasp when it comes to the impact on skills change. The existing systems of anticipation of skill needs and labour market information only partially perform their task when it comes to green jobs. The situation is aggravated in developing countries by a lack of functional LMIS as such.

What makes education and training systems responsive to new green challenges?

Adjusting training programmes to on-going, and forthcoming, green changes in the labour market is a transversal task across levels and types of education and training, in particular in TVET (see Challenge 4 above). A number of building blocks are essential to improve responsiveness of training and to avoid high social costs in the transition to the green economy:

Anticipation of skill needs

In countries with developed systems for early identification of skill needs and labour market information, skills anticipation for the transition to the low-carbon economy does not require new institutional approaches. Existing institutional mechanisms such as sectoral skills councils (SSCs), observatories and skills advisory groups have proven to be an effective mechanism for identifying and addressing skill needs for a low-carbon economy. While anticipating skills for green jobs has been mainstreamed in many existing institutional structures, such as sector or industry skills councils, new institutions are also introduced into existing systems to focus on green economic activities or to bridge between and across sectors (Box 6.1).

Box 6.1. **Examples of co-ordinated approaches in skills development**

In Australia, a green skills agreement promotes collaboration and co-ordination between government, employer and worker representatives, the education and training sector and community organisations. Its mandate covers developing national standards, up-skilling training practitioners, reviewing training programmes and reskilling vulnerable workers in the transition to a low-carbon economy.

In the United Kingdom, the Alliance of SSCs works to support SSC members in cross-sector activity, including identifying and addressing skills for a low-carbon economy, and recently convened a new high-level Cross-Sector Strategic Group to lead this. The Alliance also works in a collaborative partnership with the UK Commission for Employment and Skills to ensure that top priority cross-sector areas are tackled effectively. Some SSCs have developed specific skills strategies for sectors affected by the transition to a low-carbon economy, such as LANTRA (land-based and environmental industries), SEMTA (manufacturing), SummitSkills (building services engineering), ConstructionSkills and Cogent (chemicals, nuclear, oil and gas, petroleum and polymers).

In France, the network of sectoral and regional observatories for employment and training identifies and addresses skill needs working on a tripartite basis. The new Mobilisation Plan for Green Jobs co-ordinates the efforts of ministries, regions, training providers, advisory bodies, social partners and employment agencies in updating training programmes and designing new qualification standards. It includes the establishment of a new observatory for emerging environmental professions. It also establishes 11 green sectoral committees (*comités de filières*) – such as building, tourism or renewable energy sectors – with a remit to carry out analysis of each sector's skill needs, training and employment policy.

In many developing countries, systems for skills anticipation are much less developed than is usual in advanced economies. In their attempt to satisfy the information thirst on skills for the low-carbon economy, these countries tend to create a parallel system of analysis or conduct one-off, non-sustainable, surveys. Neither of these approaches contributes well to developing capabilities in skills anticipation at country level. In countries with weaker statistical and skills anticipation systems, work on skills

anticipation for the transition to a low-carbon economy should be designed as a building block towards a future national system for skills anticipation rather than a one-off initiative. It represents an opportunity to put in place the beginnings of structures such as a national human resource development council involving government, employers, workers, and providers of training and education (to facilitate exchange of information) and to establish industry groupings whose role could later be formalised as sectoral skills councils.

When it comes to methods of analysis of skill needs in the transition to the green economy, purely quantitative approaches, such as workforce model-based forecasts, always need some additional qualitative efforts to capture industries and occupations that "qualify" for green in the national context.

Coupled with upgrading training provision

Not all greening will involve a fundamental change in occupations. Some occupations will not change at all: the woman sitting behind the wheel of an eco-friendly bus fuelled by compressed natural gas (CNG) will need the same skills as the drivers of the other buses. There will be far more established occupations requiring skill upgrades than brand new occupations, affecting therefore the broader training and qualification system. Where new occupations are created they often call for higher level qualifications, either because of their dependence on new technologies or because they require sophisticated skills in, for example, networking, organisation or consultancy. The rate of skills change determines the training response (Table 6.1). Short training courses to upgrade specific skills are sufficient in many cases, but not in all.

Table 6.1. **Changes in skills and occupations for green jobs**

Degree of skill change	Occupational change	Typical skills response	Examples
None	None or only quantitative	None or increased training in existing occupation	Bus driver in CNG buses; national park ranger
Low	Changing established occupation	On-the-job learning or short training courses	Welder in wind turbine production; organic farmer
Medium	Changing or emerging occupation	Short courses or longer continuous training	Energy consultant in building; car mechanic for electric or CNG cars
High	New and emerging occupation	Initial training, university degree or longer continuous training	Solar energy technician; eco-designer; biofuels technician

Source: Strietska-Ilina, O., C. Hofmann, M. Durán and S. Jeon (2011), *Skills for Green Jobs. A Global View*, ILO, Geneva.

Countries with well-developed and responsive skills development systems are incorporating environmental considerations as cross-cutting issues in training programmes at all levels. Environmental awareness as an integral part of education and training at all levels, introduced as a core skill from early childhood education up to the level of training managers and leaders, will eventually push consumer behaviour and preferences and the market itself.

A focus on portable and practical skills

Portable skills refer to skills for employability such as literacy, numeracy, decision making, teamwork, risk management and so forth. Competencies in these areas affect the ability to learn, and thus the adaptability of workers and their occupational

mobility. Portable skills serve as employment security for workers in times of rapid economic changes and therefore reduce the adjustment costs of structural change caused by green transitions. Good communication skills are particularly needed so that workers in different sectors can work together effectively towards green solutions. In the green building sector, for example, the ability to work with other trades is critical to improving a building's energy efficiency. Entrepreneurship is a core skill, which generates employment and promotes the green transition (Box 6.2). Opportunities to gain competence in these areas can be provided through both initial and continuing training.

Box 6.2. **Examples of programmes to support entrepreneurship**

In the People's Republic of China, the Ministry of Human Resources and Social Security and the Ministry of Education address the need for TVET to accommodate green skills and knowledge through the development of entrepreneurship training on green job skills, including green skills in business start-up training, encouraging the set-up of green enterprises, and adding a green enterprise skills category into the entrepreneurship training offer, including subsidies for workers participating in training for green jobs and micro credits and taxation breaks for those involved in green entrepreneurship training.

In Spain, in response to the increasing need for skills in solar technologies, the Biodiversity Foundation and Telecommunications Installations Businessmen Association (FENIE) teamed up to provide a skills training programme to retrain construction sector electric installers to become solar entrepreneurs. "Proyecto Sol" has provided courses since 2009 with a focus on solar installation in buildings. The courses are offered to electric installers to allow them to diversify their activities and develop a comprehensive set of skills for all the phases related to the start-up of solar energy projects in buildings.

Workplace training, which embeds learning in practical work processes, also helps build up foundational skills relevant to business needs and to increase the employability and productivity of workers. Apprenticeships, internships, job placements, projects on the job, etc. are effective ways to ensure that practical skills and tacit knowledge are acquired. Upgrading or greening such skills will be easier than training a workforce with no hands-on experience or capacity.

Making green jobs an option for all by targeting training provision to include women, youth and other disadvantaged groups

The transformation to greener economies provides an opportunity to reduce social inequalities. Social justice dictates that training initiatives target those who lose jobs during the transition, especially those who are typically at a disadvantage in the labour market and may require special assistance. The employment growth dividend from greening the economy will only be attained if training measures are made accessible to dislocated workers, disadvantaged youth, persons with disabilities, rural communities, low skilled and other vulnerable groups (Box 6.3).

Career guidance and counselling plays a crucial role in boosting participation of women, youth or other disadvantaged groups in green jobs (Box 6.4). Korea, for example, is providing green career guidance to students after higher secondary education to inform them about job and career prospects in green sectors.

Box 6.3. **Targeting women, youth and people with disabilities in green jobs: Examples from South Africa and the United States**

The "Working for Water" programme in South Africa trains unemployed people in local communities to use a range of methods to control and remove invasive alien plants, which pose a significant threat to both South Africa's water security and to the sound functioning of natural ecological systems. Skills development is considered an essential element of the programme, vital for environmental conservation and for the provision of sustainable and decent jobs. Short-term contract jobs are created in the clearing activities, with the emphasis on endeavouring to recruit women, young people and people with disabilities. The Expanded Public Works Programme has provided over 1 million work opportunities since its inception in 2004.

In 2009, the Office of Disability Employment Policy (ODEP) in the US Department of Labor hosted a roundtable to develop "Strategies for Including People with Disabilities in the Green Jobs Talent Pipeline". The active steps it identified are being used to provide guidance to the country's workforce development system, educators and employers about the role people with disabilities can play in the green economy. As the green grant competitions run by the Employment and Training Administration (ETA) build the capacity of service providers to train workers for green jobs, ODEP and the ETA are working together to ensure that the workforce development system implements universal design strategies in courses and materials for all training providers, thus opening doors to many individuals previously overlooked as potential workers in the green economy.

Environmental changes and their repercussions in the world of work and skills needs are not gender neutral (ILO, 2009). Technology-driven emerging and changing occupations remain dominated by men. Women are vastly underrepresented in technology-related studies, including STEM subjects, at both secondary and tertiary levels of education and in the overall technical workforce (OECD, 2007). Occupations in the renewable energy sector confirm this trend: men are generally overrepresented (Thielmann, 2005). Efforts to raise environmental awareness and increase the attractiveness of science subjects need to be used to entice more students, and in particular more female students, into science and technology studies after compulsory education (good examples exist, for example in Denmark and Estonia). As a proactive measure, in some developing countries such as Bangladesh and India, non-governmental organisations (NGOs) are deliberately focusing on training women as solar energy technicians and engineers.

Women are also disproportionately over-represented in low-end jobs in, for example, waste collection and recycling. In order to ensure that green jobs are also decent jobs, training provision needs to focus on health and safety and encourage women to form co-operatives to improve their bargaining position. In Brazil, a law recognises co-operatives as formal entities in municipal waste collection and thus improves their status and the attractiveness of their work. Some country studies suggests that new green jobs in areas where gender stereotypes have not yet developed (e.g. in eco-tourism) provide excellent employment opportunities that break gender barriers and ensure that existing discrimination is not replicated or entrenched.

Box 6.4. **A woman's guide to green jobs in the United States**

In the United States, more women than ever are working in higher paying occupations and in management positions, but many still cannot access jobs in fields traditionally dominated by men. This is making it hard for them to enter, for example, green building. To enhance women's opportunities in the green economy, the US Department of Labour is putting together *A Woman's Guide to Green Jobs*. The guide is a roadmap showing how women looking for jobs in the green economy can locate training and entrepreneurship opportunities, access support structures like child care, and find their own career paths. *A Woman's Guide to Green Jobs* also provides information on hiring needs and challenges, on in-demand and emerging jobs in green industries, and on related training options.

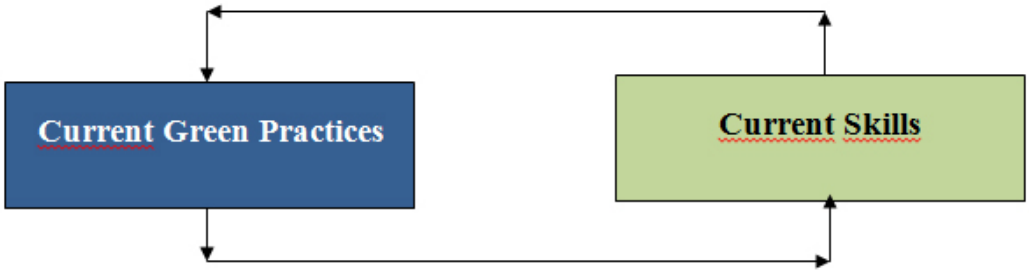
In addition, the Women's Bureau has nine green jobs training projects around the country. These were developed in conjunction with experts in green industries and serve as models for engaging women and preparing them for a variety of high-growth and emerging green jobs over the next decade. In addition to technical skills training, the projects teach basic skills, such as writing a CV, interview preparation, computer skills and financial education.

Source: www.dol.gov/wb/media/Greenhome.htm (accessed 1 April 2011).

Hand-in-hand with employment generation measures

There is a dynamic relationship between the skills needed for green jobs and the actual green practices they refer to (Figure 6.1). If green practices change, either in content or in scale, this opens up a skills gap unless the change has been well anticipated and a response is in place ahead of time. This creates pressure at industry and enterprise level to put in place measures to ensure that skills and capabilities catch up. The corollary is also true; investing in skills and capabilities for green jobs can open up a gap where current green practice lags behind the skills potential. This creates space to raise the standards of energy efficiency and sustainability, and drives the creation of more sophisticated green practices as people seek application for their new skills. Skills-led strategies may drive investment and green jobs creation forward. This, however, requires coherent decision making and investments in skills and jobs.

Figure 6.1. **Dynamic relationship between green practices and skills**



Source: ILO (2011), *Skills and Occupational Needs in Green Building*, ILO, Geneva.

Yet, skills remain only one factor among many which provide an environment enabling job creation, increased productivity and enterprise development. Good governance, a regulatory framework, access to efficient business and financial services, social stability, taxation mechanisms and other equally important factors contribute to a good investment climate and job creation. Therefore, without trying to under- or

overvalue the role of skills, the right policy mix should include the whole range of policy measures coming together in order to generate green growth and jobs. Such a policy mix may align industrial, technological, sectoral and trade policies among others. Co-ordination with environmental policies and the right incentives to stimulate investment in green practices alongside investment in skills for green jobs are paramount to facilitate the creation of green and decent jobs.

Combination of bottom-up and top-down approaches

Decentralised approaches at sectoral and local levels by industry associations or multi-stakeholder initiatives often complement national initiatives and lead to immediate dividends for all partners involved. There are many good examples of bottom-up initiatives at regional level (e.g. in Australia), public-private partnerships (e.g. in the United Kingdom and the United States) and sectoral initiatives, which have grown into systematic and comprehensive policy development and implementation. A good combination of top-down co-ordinated policy making and such bottom-up initiatives, with skills playing an important role, can pool funds and support the green transition more effectively.

For effective and targeted responses, the close involvement of all stakeholders concerned is key. Where this is achieved, there is most likely to be a sustained and just transition to a greener economy.

Policy Implications; Education and training systems can give new impetus to employment-centred and fair green transitions and require the following key policy messages to be addressed:

1. Improve policy co-ordination at planning, design and implementation stages. Countries have found various effective ways to integrate skills issues with environmental policy development and to include the social partners in the development of skills and the work of line ministries on environmental policy. These include setting up task forces for human resource development for a greening economy; enabling active labour market policy measures to take into account green structural change and to provide access to relevant training and other employment activation measures; incorporating training and skills issues into a council for environmental development; and incorporating the functions of devising strategies, identifying skill needs, and developing skills and training, all in the context of greening, within an existing structure. Training measures need to be developed hand-in-hand with other job generation measures and be part of broader environmental, economic, sectoral, technological and development policies.
2. Focus on retraining and the development of portable skills to encourage occupational mobility. Policy makers and social partners need to commit resources to retraining and focus in particular on the development of portable skills. Core skills such as decision making, leadership and readiness to learn remain essential and will continue to underpin occupational mobility. Matching classroom and practical training through apprenticeships, internships, job placements, projects on the job, etc. plays an important role as does equipping teachers and trainers with up–to-date knowledge on environmental issues and on green technologies.

3. Prioritise training for disadvantaged groups. Access to green jobs is conditional to access to training opportunities through formal and non-formal education and training provision, active labour market measures, private sector training and so on. Targeting dislocated workers, women, youth, people with disabilities, rural communities and other vulnerable groups in training programmes will help both positive employment affects and social cohesion. Such measures will help to avoid negative consequences of restructuring in the green transition and to avoid skill and labour shortages for green businesses.

4. Identify skill needs and related training measures through social dialogue. Bringing trade unions and employers' associations into the planning, design and implementation of skills development does a great deal to boost the responsiveness of education and training and can trigger green transformation on a larger scale. Collaborative approaches embedded in an effective institutional framework allow information from the "front line" of industrial production to inform skills development, adjusting the length and breadth of training provision according to different types of skills change. Whatever the specific challenges faced by individual countries, industries, enterprises and workers, a successful transition to greener work will depend on the coming together of government, trade unions and employers in constructive social dialogue.

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Chapter 7

Education and training for sustainability: An ecological vision

Jesús Alquézar Sabadie and Adeline Kroll

The authors defend the idea that a sustainable society is only possible through a systemic approach, which integrates (new) green production and consumption patterns, in a unique eco-system. This chapter focuses on research and innovation in the area of industrial technologies. It shows how research and innovation must be interrelated for a sustainable and competitive economy. Despite delocalisation, industry continues to play a capital role for Europe in what we call "the industrial paradox": industrial economies are more crisis-resistant than those dominated by low added-value activities. For the authors, Europe still maintains competitive advantages, such as its human capital. Maintaining or increasing such advantage requires the development of a whole set of skills, both technical and "soft" skills. The needs of industry in terms of skills and capacities are therefore analysed, combined with values and attitudes necessary for a sustainable society. The chapter includes some policy recommendations that put into question current European education and training discourses and policies.

Green markets or a green society?

"Green", "bio", "ecological" or "sustainable" have become fashionable words. In our daily lives, such adjectives are applied to a whole set of products or services: bio-food, green buildings, sustainable energy or transport, green jobs or even green finance appear as new markets with a promising growth potential. The increasing degree of public consciousness about environmental issues (i.e. climate change; environmental degradation; scarcity of food, energy and raw materials) creates new business opportunities.

Sustainability is also at the core of public policy in most countries, at least in the political discourse. A good example is the Europe 2020 strategy, published in 2010 (European Commission, 2010a). This strategic document of the European Union (EU) underlines three interrelated challenges:

- "smart growth": Europe must remain competitive through a knowledge-based economy
- "sustainable growth": Europe must address the environmental challenges, through a resource-efficient economy
- "inclusive growth": Europe must reinforce its social and territorial cohesion.

Even in the United States, a country that has not ratified the Kyoto Protocol, in 2009 President Barack Obama identified the development of a green economy as one of his main priorities (Goldenberg, 2009). Indeed, the People's Republic of China, which is at the top of the ranking in terms of CO_2 emissions, formalised its Circular Economy Law in 2008, aimed at decoupling economic growth from resource consumption (Zhu, 2011).

Despite these positive trends, both at political and micro level, the path towards sustainability is full of difficulties and contradictions. We can find several examples of this in our supermarkets, where "bio" or "green" goods produced on another continent and/or sold in non-renewable packages are common, or where supermarkets are situated outside of the city and reachable only by car.

The increasing ecological consciousness of large parts of the population and the positive image of green products is creating new markets, but a comprehensive picture of sustainability issues is often lacking at the micro and macro levels. The idea behind several business and/or political initiatives is to exploit the potential of emerging "green markets", considering them as a niche within the whole economy. The Europe 2020 strategy is based on seven flagship initiatives, related to issues like education, innovation or environment. These initiatives are presented, developed and implemented in almost independent ways, rarely interconnected.

This fragmented conception is wrong. Sustainability requires a systemic approach, which integrates new production and consumption patterns in a unique eco-system. A sustainable society is unrealistic if new socio-political paradigms are not developed, including not only new green products and technologies, but also new lifestyles and behaviours, shared between citizens, political leaders, researchers and industry (FutMan, 2003).

In that sense, a sustainable economy and society are challenged by some of the pillars of globalisation. Increasing freedom of trade, openness of markets and cheaper and easier international transport implies that local products are not necessarily the most convenient

for consumers. This means that energy consumption, CO_2 emissions and other pollution linked to transport heavily increase. In 2008, transport represented around one fifth of world's energy use (EIA, 2011). In fact, the ideal of unlimited progress and growth, founded on science and technology, which was dominant since the Enlightenment, has proved to be an illusion (Alquézar, 2011). The concept of sustainable growth is considered by some authors as contradictory; any sustainable growth would be a non-growth and a sustainable economy just a steady-state one (Daly, 1996; 2008).

The current economic and financial crisis may be another challenge for sustainability, but its actual impact will be the result of contradictory forces. On the one hand, ecological issues are no longer a priority for policy makers, companies or even citizens. At the political level, the first goal currently is to tackle the financial crisis and re-launch the economy. Any trade-off between economic objectives and sustainability is clearly favourable to the former, as experienced with the shrinking European public investment in sustainable energy (Scott, 2012). Something similar could be argued about individuals. During a crisis, it may be expected that consumers' choices would be less ecologically oriented, as a result of lower incomes. However, the correlation between income and environmental behaviour is not always supported by empirical research (Straughan and Roberts, 1999). Indeed, it is even possible that austerity measures, at macro and micro levels, might have a favourable impact on the environment as a consequence of less consumption and products' increased lifespan.

Despite the higher and increasing concerns about sustainability, a green economy and society still look like a utopia. Current fragmented actions and initiatives, at policy, enterprise and individual levels, are positive steps towards a green society, but an integrated vision is still needed. Sustainability requires an ecological approach, which takes into account the links and inter-relations between different parameters. It requires a holistic approach based on integrated efforts between consumers, businesses and policy makers (FutMan, 2003), with a key role of (green) technology. None of these actors and factors alone are able to establish a sustainable society.

Research, innovation and industry in a globalised economy: European challenges

Like sustainability, innovation is another fashionable concept in political discourses. Unsurprisingly, the first flagship initiative of the Europe 2020 strategy is called Innovation Union, which states "innovation has been placed at the heart of the Europe 2020 strategy. Innovation is also our best means of successfully tackling major societal challenges, such as climate change, energy and resource scarcity, health and ageing, which are becoming more urgent by the day" (European Commission, 2010a: 2).

The concept of innovation is linked with technology, but includes other dimensions such as organisation, design or marketing. As defined by the *Oslo Manual*, "a technological product innovation is the implementation/commercialisation of a product with improved performance characteristics such as those which deliver objectively new or improved services to the consumer. A technological process innovation is the implementation/adoption of new or significantly improved production or delivery methods. It may involve changes in equipment, human resources, working methods or a combination of these" (OECD/Statistical Office of the European Communities, Luxembourg, 2005: 9). Innovation also occurs outside of business, in areas like the public sector, education, health or even between citizens themselves, in the so-called "social innovation".

These different facets of innovation are mentioned by the European Commission's Innovation Union. Nevertheless, this Communication focuses mainly on technological innovation and the role of research. Research is dominant within the document and, symbolically, once the Communication was published, the Directorate-General on Research of the European Commission (EC) became the Directorate-General for Research and Innovation. The logic behind Innovation Union consists of improving the exploitation of research results or, in the Commission's jargon, "bridging the Valley of Death" between research and commercialisation, through better access to finance, strengthening the links between research and industry or further international co-operation, amongst other measures. In other words, the strategy looks to enhance and facilitate a *continuum* between research and innovation.

In fact, such a *continuum* between research and innovation is arguable. All innovation does not come from research, as not all research leads to innovation. Some authors even estimate that just a small minority of profitable innovations in the last years were born in R&D labs, while more than 70% of them were from the workers themselves (Bhidé, 2004). Innovation appears in companies able to adapt themselves to clients' demands, or to create new needs (e.g. SMS, which did not exist some years ago, or Apple's devices). Favourable framework conditions to innovate, such as a creative and dynamic environment, scientific and technological capacities, and efficient and dynamic infrastructures (e.g. public institutions, the financial sector, education, training and R&D systems) are certainly assets, but the main actor in innovation is enterprise, not research centres, universities or policy makers.

In any case, research, innovation and sustainability are interrelated topics. R&D develops technical solutions to tackle environmental or societal challenges (e.g. technologies to reduce or capture CO_2 emissions, to be more energy-efficient, to replace scarce raw materials, etc.), but such technologies do not have any impact if they are not successfully commercialised, replacing less environmentally friendly ones. Therefore, the role of industry is critical, both for sustainability and for competitiveness. Even if nowadays the industrial sector represents less than 30% of the European Union's economy, energy, transformation and construction industries produce 42% of CO_2 emissions, according to Eurostat. Indeed, our ecological footprint depends heavily on industrial processes for producing goods and during our own consumption of such goods. A car, for instance, means energy and pollution during its production process, but also during its use and even after its lifetime.

Despite delocalisation, industry continues to play a leading role in European competitiveness, in what we may call "the industrial paradox". The traditional European manufacturing sector can hardly compete with emerging low-wage economies like China but, on the other hand, the current crisis is showing that industrial economies like Germany are more resistant than services or construction-based ones like Greece or Spain (Beck and Scherrer, 2010; Deutsche Bank Research, 2011). It is a matter of added-value: low added-value economies suffer more from the effects of the crisis than high added-value ones.

Nevertheless, there are some weak signals of re-localisation of industries that formerly moved to Asia. Even Apple is re-locating some production activities (Fournier, 2012). This is due to different factors. First, the wage differential between Asia and Western countries is being reduced little by little. While salaries in Asian countries more than doubled in the last decade, wages in Europe slightly increased or are even decreasing

(ILO, 2010; 2012) – a trend that risks being accentuated in Southern Europe due to the crisis and financial cuts. Second, transport costs are increasing, because of high oil prices.

Third, the ecological and social consciousness of European consumers sometimes challenges products from other continents, for example when they are manufactured by a labour force employed under unacceptable conditions.

Fourth, in sectors like textile, there is a certain market shift towards higher added-value products, which makes wages less relevant amongst total costs. This market trend is also occurring in emerging countries, where a new middle class is growing (Kharas, 2010). Fifth, outsourcing part of the production to China or other emerging countries very often implies logistical problems (e.g. low quality of products received, transport or customs issues, etc.) that may challenge the quality and on-time delivery needed for Western standards and may therefore affect the brand image of the final producer.

But these are just weak signals. We cannot talk about an actual re-localisation trend. Indeed, European (and the United States') industry is challenged by a disconnection between knowledge creation, production and consumption. Gabriel Crean illustrates this by giving some examples:

- Europe registers 31% of Li-ion batteries patents… but 87% of them are produced in Asia.
- For biotechnologies, 36% of patents are registered in Europe… but the European production of bio-ethanol is just 5% of global production.
- The European share of photovoltaic patents is 29%, compared with a production of 13%... While the European market represents 77% of the global market.

Indeed, there is just one semiconductor factory planned in Europe, compared with 20 in Asia. This shows very clearly that few industrial developments are expected in Europe in the coming years, and follows the trend of other (mature) sectors like chemicals, for which the only new European plants are for biotechnologies.

This disconnection between knowledge creation and actual production is critical. It calls into question the whole European strategy for economic development, especially if we consider that, for example, the four major Chinese photovoltaic companies are publicly supported by government-owned bank "loans" of around USD 21 billion. Can Europe be the victim of its own solid principles, like free trade or competition rules?

However, this is not just a European issue. Similar questions are asked in the United States, where *The New York Times* published a series of articles about the delocalisation of high-tech industries to China and the reasons for it (Duhigg and Bradsher, 2012). Relevant economists like Paul Krugman are also discussing the long-term economic sustainability of this phenomenon (Krugman, 2011; Rein, 2012).

In fact, the big problem with delocalisation is employment. In financial terms, the highest share of profits come back to the brand' country of origin, and are linked to design, development and retail costs. For instance, it is estimated that around half of the total value of an iPad remains in the United States (Kraemer et al., 2011). The picture is completely different when looking at jobs. Is European industry still viable? Does it have the competitive advantages to be competitive and create jobs?

Human capital: A European competitive advantage

There is a wide consensus in the literature about the key role of human capital in economic development: "Human capital will replace physical capital at the core of competitive advantage" (FutMan, 2003: 23). Industrial foresight studies insist on the critical role of education and training for competitiveness, but they generally focus on high-skilled workers' profiles, in particular engineers and scientists needed for R&D and production functions, the areas that are most directly affected by new technological developments (Gelderblom et al., 2012). Actual or expected shortages of scientists and engineers appear as the biggest threat for industry's future, precisely at a time of increasing technological needs (Johnson and Jones, 2006; Kiparissides, 2010; BusinessEurope, 2011).

In spite of such theoretical consensus on the relevance of human capital, it is not easy to find concrete policy proposals. Indeed, education and training seem to play a rather secondary role in Europe 2020. In this strategic document, education appears for the first time to mention the issue of early school leavers and establishes a target for the share of population having obtained a tertiary education diploma. It prioritises "improving educational outcomes and the quality and outputs of education institutions" (p. 10), but does not provide specific orientations.

The "knowledge triangle" concept (education-research-innovation), that was so important in the former *Lisbon Strategy*, is no longer mentioned explicitly. The centre of gravity is now clearly situated between research and innovation, while education and training look like "the forgotten side of the knowledge triangle" (European Commission, 2010b: 11). Of course, it may be argued that education and training are not competences of the EU; they remain national prerogatives. This explains why initiatives like *New Skills for New Jobs*, included in the Europe 2020 strategy, only focus on improving skill needs analysis and matching capacities and international co-operation through already existent EU programmes (European Commission, 2008). However, the Innovation Union communication states, "our education systems at all levels need to be modernised. Excellence must even more become the guiding principle. We need more world-class universities, raise skill levels and attract top talent from abroad" (European Commission, 2010a: 3), which is a policy objective with potential implications.

The current economic and financial crisis is challenging education and training in several EU countries. Between 2000 and 2008, public investment in education grew 1.66% more than the total public expenditure and 3.9% more than the GDP. Nevertheless, the situation varied depending on the country. During this period, EU member countries like Estonia, France, Ireland, Italy, Lithuania and Portugal, experienced a decrease of public investment in education and training as a share of total public expenditure, sometimes very strongly. Now, countries like Greece and Spain are introducing radical financial cuts in education. Teachers' job conditions are worsening and private education costs are increasing, as in the United Kingdom where the new, increased, university fees have been strongly contested. It seems clear that education and training are no longer a real political priority. Does this mean that Europe is losing one of its major competitive advantages: human capital (Salhberg, 2010)?

Although very important, financing and being high on the political agenda are not all that matter for education and human capital development. It is primarily a matter of quality. What kind of human capital (e.g. skills, attitudes, values) is and will be

necessary? Which reforms, which education models are needed to move towards a sustainable economy and society? How should they be implemented?

This debate is wide amongst education specialists and practitioners, appearing more and more in the media (Álvarez and Ortín, 2011; Montserrat, 2011). Experts on industry and R&D, who always emphasise the major role of education, training and skills, rarely take part in this discussion.

For a large part of the education and training community, including policy makers, to be competitive in markets, education, training and even research must follow market principles: competition between pupils, between educational institutions (schools, universities and/or research centres), competition between teachers, competition between researchers, competition between education and the research system. As a consequence, market principles are applied to education and training systems. This logic leads to benchmarking, standardisation and accountability.

These solutions are proposed to improve the quality and effectiveness of education almost everywhere, under the influence of Anglo-Saxon countries (Salhberg, 2006). Probably the best example of this so-called Global Education Reform Movement is the OECD's Programme for International Student Assessment (PISA), which is often presented, especially in the media, as the main international comparison tool between "good" and "bad" educational systems and has a strong impact on reforms implemented in national systems (Grek, 2009).

Other authors, who consider that standardisation and accountability may be counterproductive for enhancing economic competitiveness, contest this rationale. In our current changing societies, transversal or "soft" skills like flexibility, interpersonal skills, risk-taking and creativity, essential to promote innovation, may be more efficient than just focusing on numeracy, literacy and scientific competences (Salhberg, 2006). The basic idea of these experts is based on a paradox: to enhance the economic competitiveness of our societies, education and training systems should be based on less competition. Education should be founded on principles like collaboration, mutual trust and social interaction (Salhberg and Oldroyd, 2010). Interestingly, countries that have in-depth implemented market principles in their educational systems (e.g. Chile, the United Kingdom and the United States) are not the most successful in PISA, while Finland is generally at the top and follows an opposing rationale.

Interestingly, the EC has recently published a new Communication, *Rethinking Education* (European Commission, 2012), which since its very beginning underlines the need for developing transversal skills. This is probably the first time that the Commission has emphasised the relevance of soft skills for employment and competitiveness. *Rethinking Education* does not enter into the debate about which educational models are more effective, but this was to be expected considering that education remains a national competency.

What skills for what economy and society?

In this context, the EC's Directorate-General for Research and Innovation launched a study called "Assessment of the impacts of NMP technologies and changing industrial patterns on skills and human resources". "NMP", in the Commission's jargon, means "nanotechnologies and nano-sciences, materials and new production technologies". It is one of the thematic areas covered by the Seventh Framework Programme for Research and Technological Development (FP7). The study, carried out by SEOR-Erasmus

University of Rotterdam and Technopolis, aimed at analysing the impact of new developments in the industrial technologies area on current and future skills needs and skills gaps. The central assumption was that new technological developments in industry may offer a strong contribution to a competitive, sustainable and knowledge-based European economy. It was therefore necessary to provide insight into the possible current and future skills gaps in the industrial technologies field, between what companies in Europe consider they need and what the education and training system offers (Gelderblom et al., 2012).

The study aimed to be situated in the gap between the education and training environment and industry. Its rationale consisted of analysing trends in industrial technologies and their potential impact on human capital, through desk-research and case studies. Hypotheses were then tested by an analysis of the results of fieldwork consisting of surveys and interviews. The surveys covered a sample of industries and another sample of higher education institutions, at European level. Staff of vocational education and training (VET) institutions were interviewed.

The study methodology presented some relevant caveats. The sample of companies was not a random one and therefore its results cannot be considered statistically representative. The target group of the survey was built on a snowball technique, consisting of conference attendants, Framework Programme participants and members of sectoral organisations. As a consequence, a large share of companies close to the EU's R&D funding and activities biases the sample. Companies from Germany and the United Kingdom were also dominant in the sample, while several European regions were under-represented and had to be grouped in the analysis (Southern and Eastern Europe, mainly). Last but not least, the questionnaires were answered online, which introduced another potential source of bias. A total of 502 companies and 178 higher education institutions responded to the questionnaire.

Even if not statistically representative, the study provided some interesting conclusions, complementary to other publications on the future of industry.

Industrial and technological trends and their impact on skills

For literature on the industrial and technological trends, "integration" is the key word: integration between different technologies and materials, integration between production and services, integration between different actors (e.g. between research centres and industry, and between suppliers, producers and customers), integration between different sectors and activities, integration between different stakeholders towards common goals. A competitive industry must adapt its products very quickly to the changing customers' needs, or create new needs.

The ways of working and, therefore, machines and tools, are increasingly flexible. Manufacturing must be self-adaptive, reconfigurable, multi-functional and cross-technological, with a user-friendly human-machine interaction. The role of ICT is expected to continue to increase: industrial processes are more and more complex, which implies the need for computer-aided modelling and simulations.

For these studies, technological development and innovation needs must lead to changes in management styles. Manufacturing has to solve technical demands (adaptability, economic performance, reliability), but also needs to be environmentally friendly and safe. New business models have to take into account increasing social and environmental responsibility, and be open to innovation. This means that management of future industries should be able to integrate short- and long-term thinking, as well as the

ability to recognise weak signals and to learn from front-line workers' skills and expertise (Willenius, 2008).

It results that multidisciplinarity and "soft" or "transversal" skills (like communication, creativity, risk-taking, analytical capacities, problem-solving, interest for learning, methodological rigor, adaptation to a changing environment, critical spirit or interpersonal skills) are considered to be at least as important as technical ones (Manufuture, 2006).

The companies surveyed confirm this theoretical statement. Respondents underlined the relevance of personal skills, like innovation, creativity, problem solving and management. In particular, innovation skills and creativity are expected to become more important in the future.

Material science, nanotechnologies, process engineering and chemistry are the technical skills in which relevance is going to grow the most, according to respondents. An increased demand is expected for R&D and engineering and design functions. In these areas, limited changes in terms of skills are foreseen. Last but not least, innovation (again) and environmental management are quoted as being the most relevant managerial skills.

Interestingly, several authors point out that highly qualified Chinese and (to a lesser extent) Indian engineers and scientists often lack the experience to apply their technical knowledge, especially to other domains (multidisciplinary) (Gereffi et al., 2008, as quoted by Gelderblom et al., 2012). Personal skills like leading innovation, team working and the capacity to work in multicultural environments are often less developed. The limited development of generic skills like communication, problem solving and interpersonal skills for engineers in Asian countries is also criticised (Zaharim et al., 2009, as quoted by Gelderblom et al., 2012).

Shortages of highly qualified staff

When talking about skills, the main concern of industry is shortages. Eurostat and OECD data show that the number of graduates in mathematics, science and engineering (MST) has been increasing in absolute figures at least since 1993, but in relative terms, as a percent of total graduates, MST diplomas are clearly becoming less popular than other fields. The lack of attractiveness of scientific and technological careers has been deplored by several studies (Johnson and Jones, 2006; Kiparissides, 2010).

The survey of industrial companies confirms this concern. A majority of respondents (78%) said they currently experience skills gaps due to new technological developments, even if most of them stated that these problems are still limited and only 15% consider these skills gaps to be substantial. A majority of companies said they are already experiencing recruitment problems (57%), even if they are not yet substantial (15%). More respondents expect skills gaps (84%) and recruitment problems (69%) in the future. Unsurprisingly, actual and expected skill gaps and recruitment problems are higher in industrial countries like Germany, with significant differences between countries (Gelderblom et al., 2012).

The problem of shortages is amplified by some other issues, like the still reduced mobility of workers within Europe and from outside Europe. Evidence shows that migrants' skills are often misused in Europe, in a phenomenon of "brain waste" instead of "brain drain" (Alquézar et al., 2010). On the other hand, the most common strategies that companies use to tackle skill gaps and shortages consist of recruiting young people from

the education system, followed by on-the-job training. Lifelong learning activities, like external training and education programmes, were mentioned by around one third of respondents (Gelderblom et al. 2012). These results put into question the lifelong learning policies defended by the European Commission. Apparently, the labour market, at least in technologically advanced industries, follows a different logic. The societal issue of ageing, together with the rather low use of re-skilling schemes, raises the question about what to do when highly qualified workers attain a certain age, while increasing the shortage issue.

Last but not least, the careers of engineers have some specificity in Europe. Generally, promotions convert engineers into industrial managers, and therefore they cease to perform technical work. This has some positive effects, like including a long-term view in the company's decisions instead of making short-term benefits the guiding principle. However, it makes the shortage issue worse. Especially, as the attractiveness of scientific and technological careers is waning compared to economic and financial profiles.

At the same time, China has the capacity to provide engineers and middle-skilled assembly-line workers at a scale that neither the United States nor Europe can match. This happens in spite of the criticism about the generally low quality of higher education studies (with the exception of some top universities). Asia's competitive advantage is not really a matter of low wages, but of scale and extreme "flexibility" of the work conditions of qualified workers – to use a diplomatic word (Duhigg and Bradsher, 2012). Under such conditions, Europe (and the United States) can hardly compete in terms of jobs, at least in the short and medium term.

Is the quality of the higher education system a real issue?

Companies were asked about the adequacy of university studies to fulfil skill needs related to new technological developments. The majority of answers were positive, although there were regional and national differences. Overall, 77% of respondents answered positively, with 23% saying that the system was to a great extent able to fulfil their needs. German and Northern European companies were even more positive, with nearly 40% stating their high satisfaction, while Eastern European and UK respondents presented lower degrees of satisfaction, even if they were still positive.

For companies, the three main options for improvement are enhancing collaboration between university and industry, providing more possibilities for PhD programmes and improving international co-operation. The first item is not at all surprising, since the weak collaboration between industry and academia has always been considered a challenge for Europe in advanced technological fields (OECD, 2010). This is indeed one of the main goals of Innovation Union and the EU's R&D programmes: "Researchers and innovators must be able to work and co-operate across the EU as easily as within national borders" (European Commission, 2010a: 3).

However, in the survey on higher education institutions, the vast majority of respondents (84%) said that their university already had contacts with industry, with insignificant differences between member countries. According to higher education institutions, most of the contacts with industry are organised in the framework of research collaborations (78%), and significantly less important are traineeships (48.6%), exchange of information (37%), and alumni contacts (35%). It is interesting to note that curriculum-related types of contacts, such as the evaluation of graduate skills (31%), the setting up of new courses (27%) and lifelong learning actions (15%) are mentioned less

often (Gelderblom et al., 2012). The latter may partially explain the insufficient role of lifelong learning actions to tackle industrial skill gaps: they do not seem to be perceived by companies as a potential source of the knowledge and skills that they need.

The vocational education and training (VET) system is criticised more often by industry, especially in the United Kingdom and Southern and Eastern Europe. The assessment is much more positive in Germany and Northern Europe, where strong VET systems, which include dual-models and apprenticeships, are well developed. Again, enhancing co-operation with industry is considered to be the main possible improvement. Nevertheless, the survey's bias towards high technology and R&D-intensive companies, make these statements difficult to generalise.

Also for the VET institutions interviewed, the NMP technologies are very rarely covered by their curricula, considered too "fundamental" and too "strategic" to be taught in a system focused on practical skills (Gelderblom et al., 2012). On the other hand, sectoral case studies and forward-looking analysis in the area of industrial technologies show trends towards automation, with user-friendly man-machine interfaces, and the replacement of traditionally VET-trained workers by university graduates. The roles, functions and skills of front-line workers should necessarily evolve, but little attention is given to this in the literature on future industry.

In any case, the quality of education is not being questioned by the survey. Companies' views are divided on their need for in-depth and specialised knowledge on the one hand, and the necessity of interdisciplinary and "out of the box" thinking, on the other. The results of the study do not infer that radical changes are needed in the education systems. Industry requires punctual improvements (e.g. more collaboration with academia), but not for a strong "modernisation" of the system.

Education for sustainability

'The key for sustainable economic development is believed to lie in better technology and changing patterns of human behaviour" (Viertel, 2010: 222). Technological development and competitiveness are not and cannot be the unique goals of education. An education system must also encourage values and behaviours to create not only professional skills, but also a real social capital, understood as "the values and beliefs that citizens share in the everyday dealings and which give meaning and provide design to all sorts of rules" (Maskell, 2000: 112). As defended above, a sustainable society is only possible by creating new socio-political paradigms, with new consumption patterns and lifestyles. Education, as one of the main socialisation factors, has the potential to promote values and behaviours consistent with a green society. This includes raising awareness about sustainability issues, as well as soft skills like critical reflection, mental models able to go beyond individual thinking, the ability to deal with interrelated and complex systemic problems, participatory attitudes and capacities to think about the future (Viertel, 2010). Promoting such attitudes is hardly possible through education models based on competition and market principles, which lead to short-term individual benefits, logics and behaviours.

Promoting education consistent with this vision is mainly a matter of political will. However, many countries seem to move in the opposite direction, by promoting numeracy, literacy and models based on success or failure, with narrow views hardly consistent with sustainability attitudes and values (Grek, 2009; Salhberg and Oldroyd, 2010). In spite of this, the current crisis may be an opportunity to change the social and economic paradigms of our societies. Austerity is not just the *leitmotiv* of states' financial

reforms. It is now reaching the day-to-day life of European citizens in several countries, which may represent a Schumpeterian phenomenon of "creative destruction", towards new models no longer based on consumerism.

We have already mentioned that innovation is not just a matter of technology. Sustainability also requires social innovation, with examples like the so-called "creative communities" (i.e. active, enterprising people who invent and implement new ways of dealing with everyday problems – childcare, care for the elderly, alternative means of transport, shared facilities and services, etc.) or the Slow Food Movement, which defends the consumption of local and seasonal products, coming back to older, safer and more ecological practices (Meroni, 2007).

Education alone cannot promote a sustainable society. New paradigms are only possible with long-term efforts shared between citizens/consumers, political leaders, researchers and industry. This process should include leadership, political will and consistent and interrelated policies, combining education (to create the skills and social capital), research and innovation (to design and develop new green technologies) and legislative measures pushing towards the application of new green technologies and sustainable social innovations. A sustainable society is only possible through integrative, systemic and ecological policies.

Conclusions and policy recommendations

> Our education systems at all levels need to be modernised. Excellence must even more become the guiding principle. We need more world-class universities to raise skill levels and attract top talent from abroad. (European Commission, 2010a)

Literature and evidence discussed in this chapter put into question these objectives. European industry's competitiveness is not challenged by the quality of its education and R&D systems. Indeed, human capital remains a competitive advantage *vis-à-vis* emerging economies. The survey carried out amongst industrial companies in Europe shows a rather high level of satisfaction with the capacity of education to fulfil their skill needs related to technological developments. Companies focus on specific improvements, in particular on enhancing collaboration between academia and industry.

Such collaboration exists already, but mainly in the area of research – something consistent with open innovation models. This experience could be expanded to education-related areas, to establish bridges between academic studies and future working life. This is particularly important for scientific and engineering careers. The current dominant technique of industry to fulfil skill gaps consists of recruiting young staff from higher education institutions and training them in-house. Such training could be facilitated by prior collaborations. Examples of this already exist in Europe and models like the "teaching factory" (Chryssolouris and Mavrikios, 2007), similar to medical doctors training in hospitals, but applied to industry, could be tested and implemented. The fact that the expected careers of the vast majority of researchers in higher education institutions consists of staying in the same institution or another university, proves that there are still a few bridges between academia and industry.

Emphasis on "excellence", "world-class universities" or attracting "top talent from abroad" is, of course, a positive objective. Excellence should indeed be the guiding principle of any personal or collective practice, be it educational, professional or even amateur. But only an *élite* can reach excellence and be at the top of the world in their speciality. "Producing" Nobel prizes is fantastic, but European industry is challenged by

shortages and therefore needs a critical mass of highly qualified, medium-class engineers and scientists. It is then crucial to increase the attractiveness of scientific and technological careers.

There are already EU actions to promote science from the youngest of ages, but decisions about university studies are generally taken in the last few years of secondary education and are strongly influenced by market signals: unemployment, salary, status, image of the profession, career perspective. Comparatively, technological careers (generally more difficult and longer) nowadays do not offer advantages as financial ones, or MBAs. Indeed, engineers often become financial experts or managers, ending their technical careers too early. And what can be said about scientists, one of the most precarious professions in Southern Europe? Market signals are essential to choose careers. To increase the attractiveness of scientific careers, a change of status would probably be more efficient than actions geared towards younger children.

Lifelong learning activities should be another area of collaboration between academia and industry. The survey shows that companies prefer to train new staff in-house instead of outsourcing re-skilling actions. With shortages and an ageing population, the lifelong learning strategy should be reformulated. Its potential is not being sufficiently exploited, because academia is not perceived as the place to obtain the technological knowledge that industry needs. Once again, any re-design of lifelong learning action must be based on collaboration between universities and companies. There is a promising market to be created in this area.

The extent and impact of shortages varies significantly between European countries and migration is becoming a solution for many young qualified workers from the countries the most affected by the economic crisis. However, in spite of free movement of workers, initiatives like the European Research Area or diploma recognition, and programmes like Erasmus or Marie Curie, mobility within Europe remains a non-extended practice. In the meantime, highly qualified potential migrants from outside of Europe encounter plenty of obstacles to living and working in Europe, and their skills are often misused. The EU wants to attract top talent from abroad, but it also needs middle class qualified immigrants.

Is Asia catching up to Europe in terms of human capital? This question has become more and more common amongst education specialists and industrialists. The investments in education in different emerging countries are impressive. Nevertheless, such a catch up, or even overcome, will depend on the capacities for innovation of both systems. Copycat strategies permit relatively faster advances, with fewer risks, but hardly facilitate overcoming competition. This means that, to maintain a competitive advantage in education, Europe should avoid policies based on standardisation, numeracy and literacy.

The open character of European society is an advantage for promoting values and behaviours like creativity, critical thinking, the ability to deal with complexity and interpersonal skills, which are also considered more adequate for innovation and a sustainable society. Policy makers must not forget that education cannot be managed as a market company. Education and training must prepare competent workers, but also citizens, with values and attitudes that correspond to the society we want for the future. In this sense, the current crisis can be an opportunity to change the current social paradigm based on consumerism to a more sustainable one.

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Part II

Enterprise approaches for a workforce fit for a green economy

Chapter 8

Licensing and certification to increase skills provision and utilisation amongst low-carbon SMEs in the United Kingdom

Nick Jagger, Timothy Foxon and Andy Gouldson

This chapter focuses on the use of licensing and certification as a means of increasing appropriate levels of skills provision amongst a range of low-carbon occupations in the United Kingdom. In previous work, the range of market and governance failures in the provision of low-carbon skills and the measures adopted to address these failures was addressed (Jagger et al., 2012). This chapter examines the potential to increase the use of licensing and certification to address these market and governance failures, and the resulting challenges that may arise. Currently, licensing is used in the United Kingdom for energy auditors producing Energy Performance Certificates and for SMEs working under the Microgeneration Certification Scheme. Additionally, similar licensing schemes are currently under development for green deal assessors and green deal installers.

These new schemes will be vital to the success of the new Green Deal Scheme, which enables households to finance energy efficiency improvements recommended by an accredited adviser and undertaken by an accredited installer. Work undertaken for the CCCEP's Mini Stern Review for Leeds City Region highlights the size of the potential Green Deal market and the types of skills that will be required (Gouldson et al., 2011) and provides a local case study of licensing. Previous UK experience with CORGI, Gas Safe and Electrical Installers licensing schemes have shown increased competence and consumer confidence with gas installers and electricians using these schemes, who largely come from SMEs, and so the new low-carbon licensing schemes could provide greater low-carbon skills and greater confidence in these skills.

Introduction

Increasingly, the UK Government is using licensing to ensure standards are maintained and encourage training amongst emerging low-carbon occupations. Licensing is the process by which a certification, based on specific qualifications, is required in order to practice a specific occupation or to undertake specific functions. The proposed licensing is explicitly aimed at addressing consumer confidence in new energy efficiency schemes, such as the Green Deal, and this has been tested with potential consumers (DECC, 2011d). It has also been argued that licensing improves standards and encourages training and, as such, should be encouraged in the United Kingdom, as part of developing a more highly skilled workforce (Cox et al., 2009). A report for the UK Department for Education and Skills argued that licensing was best applied when there was evidence of market failures, at apprentice or intermediate skill level, where the skills required can be easily tested, and where there are potential safety issues (Frontier Economics, 2003).

However, in the United States there is little evidence that licensing improves either the safety amongst construction workers or their competence levels (Kleiner and Park, 2010). The main impact of licensing in the United States appears to be increasing the wages of those who are licensed construction workers (Perloff, 1980). This potentially calls into question the current low-carbon skills strategy in the United Kingdom. Therefore, this chapter examines the impact of past and proposed occupational licensing in the low-carbon area in the United Kingdom and seeks to establish whether or not this approach will be successful at improving low-carbon skills and encouraging the adoption of low-carbon technologies within the small- and medium-sized enterprises (SME) dominated UK construction sector.

Licensing

Licensing can be based on statutory powers whereby it is illegal to operate within certain occupations without certification, or mandatory, or on sector-based agreements, to employ only those who can demonstrate competence through certification. There are also some hybrid arrangements wherein the certification is a statutory requirement for obtaining subsidies or other privileges, but non-certified activity is not banned.

Traditionally, licensing has applied to safety critical occupations in which unqualified operators can cause death or other damage, such as doctors and gas appliance installers. However, partly under pressure from professional and industry bodies, as well as political and consumer pressures, the role of licensing has become more widespread. In the United States it has been estimated that 29% of occupations require a license of some form (Kleiner and Krueger, 2010). A more conservative estimate for the United Kingdom is that 13.5% of occupations require a license to practice.

Importantly, in both countries, licensing is rising as a labour market structure at the same time as unionisation is falling, and there is evidence of increased earnings amongst the licensed workers compared with the unlicensed ones (Bryson and Kleiner, 2010). Although, there is no established link between licensing and the decline in unionisation, licensing does encourage self-employment as a way to maximise the return on the training costs and this would lead to a decline in unionisation. Despite this apparent importance as a labour market structure, licensing and occupational regulation has been under researched (Stephenson and Wendt, 2009). In part, this could be because much of

the debate surrounding licensing has been dominated by libertarian economists (e.g. Potts, 2009).

Despite the lack of clear evidence for benefits in terms of increased training, or increased safety, licensing does appear to have some benefits which particularly apply to SMEs engaged in the low-carbon transition. The main benefit is that statutorily based licensing schemes generally increase consumer confidence (Sadler, 2008). This aspect will be particularly beneficial within the building retrofit market in the United Kingdom, which is currently dominated by SMEs, many of whom have earned a reputation as "Cowboy Builders" (Holt and Edwards, 2005). Equally, the rest of the UK construction sector is dominated by a few main contractors, and a mass of sub- and sub-sub-contractors, which have been associated with low levels of training, safety and productivity (Forde and Mackenzie, 2004; Arulampalam and Booth, 1998).

In order to explore these issues, this chapter:

- outlines the historic use of licensing amongst technician level occupations in the United Kingdom
- outlines the existing and proposed licensed, low-carbon occupations with a focus on SME employers, including formal and informal licensing systems
- examines the, admittedly limited, evidence covering the effectiveness of licensing within the United Kingdom
- discusses the possible implications for low-carbon skills and SMEs in the United Kingdom.

History of construction sector licensing in the United Kingdom

Doctors, lawyers and other professions in the United Kingdom have had various forms of registration for many years and are now generally overseen by professional bodies, many of which are chartered. Chartered status means that in order to practice the profession, individuals need to be a member of the chartered professional body. Often the occupational title is also protected and one needs to be a certified member of the professional body in order to use the occupational title.

The UK construction sector is dominated by SMEs, with 93% of the 200 000 UK building firms employing 13 or fewer staff. This means that many of the issues surrounding SMEs and training apply particularly to the construction sector. The breakdown of the apprentice system in the 1980s and 1990s further aggravated the decline in training within the UK sector (Toner, 2008). Recent initiatives have seen a return of construction apprentices, although with problems caused by a culture of low levels of training (Abdel-Wahab, 2011).

Technician level occupations have less of a tradition of licensing, compared to the professions. The first important technical level occupation to be covered by licensing was gas installation. In 1970, the Confederation for the Registration of Gas Installers was set up as a voluntary register. In 1998, membership of the Council for Registered Gas Installers (CORGI) became mandatory, by law, for anyone working on gas installations (DWP Secretary of State, 1998). In 2009, the legally required body, and associated required qualifications, became "Gas Safe". This scheme currently has about 137 000 registered and licensed gas installers in the United Kingdom (EU- Skills, 2010).

The Gas Safe scheme and its predecessor have been associated with the declining number of gas accidents and deaths (Cross Government Group, 2011).

From 2005, Part P of the UK Building Regulations has meant that only someone appropriately qualified can design, undertake and certify electrical works (DCLG, 2008b). This means that either an external certifier, or an appropriately competent person within the company, is needed to sign off electrical work which, in turn, needs to be undertaken by an appropriately qualified person.

These gas and electrical statutorily based licensing schemes both have a clear basis on the potential health and safety impacts upon others. They have also succeeded in increasing training in these areas and relative earnings. Elsewhere in the construction sector, non-statutory licensing schemes operate around a wide range of safety and skills cards (Pye Tait Consulting, 2011), which are often used as a condition upon sub-contractors (UKCG, 2009). Similarly, there are a range of voluntary schemes which allow the competent person to self-certify the installation of windows (FENSA), of solid fuel boilers (HETAS), and of oil fuelled boilers (OFTEC) (Shahriyer et al., 2009). These schemes have operated with varying success and offer models for extending licensing to cover low-carbon occupations.

UK low-carbon licensed occupations

The United Kingdom's low-carbon energy strategy has a range of elements which aim to increase low-carbon electricity generation and improve energy efficiency. Low-carbon generation is encouraged through the Renewables Obligation for large-scale generation (DECC, 2011e) and the Feed in Tariff for small renewable generation (NAO, 2011), with new measures including the Contract for Difference Feed in Tariff for large-scale low-carbon generation in the Government's Energy Bill. Energy efficiency is encouraged through a range of schemes including the Green Deal for household energy efficiency improvements, for which the first deals were offered from 28 January 2013 (DECC, 2012), and the Energy Company Obligation (ECO) supporting households in older properties and those on low incomes.

The authors have previously identified four generic barriers and four low-carbon specific barriers to an appropriate level of provision of skills for the low-carbon transition (Jagger et al., 2013). These included the lack of skills training and qualifications that could result from employers' and workers' uncertainty over the scale and rate of the low-carbon transition. Licensing seeks to address these problems, which arise particularly due to the structure of the UK construction sector.

There are two current, and two new, low-carbon occupations that are subject to licensing or certification schemes that function as licensing schemes.

The two current licensed low carbon occupations are:

- energy auditors
- microgeneration certification scheme installers.

The two new occupations are:

- green deal advisors
- green deal installers.

These will be examined in turn.

All of these schemes ultimately derive from schemes run by the United Kingdom Accreditation Service (UKAS), which sets standards and then accredits a range of accreditation bodies, which in turn accredit individuals and companies.

Energy auditors

The longest established low-carbon licensed, or certified, occupation is for energy auditors who produce Energy Performance Certificates (EPCs) for domestic properties. EPCs were introduced in 2008 as a result of a European Directive of 2002, as part of the Home Information Packs (HIPs) which were intended to increase the information available to homebuyers and encourage higher energy performance within the domestic building sector.

EPCs were kept as part of house sales, while HIPs were withdrawn, and EPCs extended to the private rental sector as well (DCLG, 2008a). However, the government has recently announced changes to the EPCs that will be in effect from 2012was introduced, In addition to providing an energy efficiency rating for the property, improvements to the software used will provide recommendations for energy efficiency measures, including the estimated costs and subsequent savings using the Green Deal (Behavioural Insights Team, 2011). It is also expected that the bulk of advisors operating under the Green Deal will be recruited from energy auditors, who, with some additional training, will be able to provide advice on measures that could be financed using the Green Deal (DECC, 2011a).

The Green Deal will enable households to finance energy efficiency measures meeting the "Golden Rule", which is where the savings on their energy bills resulting from the efficiency measures are greater than the costs of those measures, which are recovered via a charge on their energy bills (DECC, 2011c). The related Energy Company Obligation (ECO) can be used to finance measures that do not meet this rule, such as solid wall insulation.

The UK EPC process has been criticised on a number of grounds, mainly due to perceived inaccuracies of the process. The Royal Institute for Chartered Surveyors notes that the EPCs measure the notional energy efficiency of a building but that by ignoring user behaviour, they do not measure actual efficiency (RICS, 2008). English Heritage argues that the process often underestimates the energy efficiency of historic and traditional buildings and, hence can make inappropriate suggestions for improvement (English Heritage, 2008). In part, these criticisms reflect the underlying process used to generate the energy efficiency rating for the property, as this is based on a reduced and necessarily simplified model. The software used is based on the Reduced Data Standard Assessment Procedure (RdSAP) intended for existing properties, which is a simplified version of the Standard Assessment Procedure (SAP) used for new properties (BRE, 2011b).

Further criticisms focus on the apparent lack of impact of the EPCs. A study based on a survey of people who had purchased a property in the first year of EPC use found a high awareness of EPCs but a relatively low incidence of take up of the recommended energy efficiency measures (Watts et al., 2011). This is consistent with wider experience with EPCs in Germany (Amecke, 2011). The wider European experience suggests variable success with implementing the underlying Directive and a relatively small impact on consumer behaviour, where investment in energy efficiency measures remains sub-optimal (BPIE, 2010). Recent work in the United Kingdom has attempted to address this lack of behavioural change in the uptake of cost-effective efficiency measures

(Behavioural Insights Team, 2011). This study recommended a simplified format of the certificates and more explicit messages about potential cost savings resulting from energy efficiency measures. From April 2012, a new version of the EPC certificate, based on the work of the Behavioural Insights Team, was introduced with explicit linkage to Green Deal measures (DCLG, 2011).

Partly as a consequence of the new versions of the certificate, but also in response to concerns about the underlying knowledge and understanding of energy auditors, the DCLG has identified a range of additional skills that are required. These are:

- "Need to review recommendations and ensure they are appropriate.
- Better overall knowledge of principles of building structure, elements and fabric.
- Greater familiarity with software used to produce EPCs.
- Ensuring evidence is collected and retained.
- Better understanding of the interaction between building fabric and services.
- Greater emphasis on interaction with the consumer.
- Better understanding of the operating requirements." (DCLG, 2011: 2)

The terms of the energy auditors certification means that the DCLG is able to oblige energy auditors to undertake an additional eight hours of training to cover the above points, in addition to their regular ten hours of annual continuing professional development. This training will be assessed following the training, using a one-hour, 40-question online multiple choice test. Undertaking the additional training, and passing the test, will be a requirement to maintain the accreditation.

Microgeneration Certification Scheme

The Microgeneration Certification Scheme (MCS) operates at the company and product level but one of the registration requirements is that installers have to be qualified and adequately trained (DECC, 2008). The actual licensing is of both products and installers. In order to obtain government subsidies for microgeneration, both the product installed and the installer need to be certified by the MCS scheme. Amongst a wide range of requirements, there is a requirement in terms of the skills of the staff employed to install the microgeneration products:

> All staff employed in installation activities must have received adequate training in each of the areas/operations in which they are involved. The [c]ompany must have a training record for each employee which details methods of training and approved areas of operation. These should identify the training authority and be signed by the employee as well as the training authority." (DCLG 2011, p 18).

Although this is not a direct licensing of the employees, the terms of the corporate licensing ensure that the staff has appropriate levels of qualifications and skills.

Green Deal assessors

The UKAS is also developing the criteria for certification bodies that will allow them to certify Green Deal assessors. The Green Deal assessor qualification and certification will be based on the qualifications and certification required for energy auditors who produce Energy Performance Certificates for domestic dwellings. Asset Skills, which is

the Sector Skills Council (SSC) covering facilities management, housing, property, planning, cleaning and parking, is leading the work to develop the skills requirements for Green Deal assessors and advisors.

The underlying qualifications for the Green Deal assessors will be based on two existing qualifications: the City and Guilds 6281 Level 3 Award in Energy Awareness and the Renewable Energy in the Home and the Awarding Body for the Built Environment (ABBE) Level 3 Certificate in Energy Advice (Home) qualification (ABBE, 2011). The full details of the licensing still have to be worked out (DECC, 2011a), but the probable pattern will be similar to the energy auditors process, with a requirement for an underlying qualification, professional practice and continuing professional development (CPD).

Green Deal installers

In parallel with the Green Deal assessors certification process, a similar process is underway covering Green Deal installers. The Green Deal installers' qualifications and certification process is based on the qualifications and processes involved in becoming a certified installer under the Microgeneration Certification Scheme or the Microgeneration Installation Standard (DECC, 2008).

However, whilst this system is clearly appropriate for any microgeneration products and for products such as loft insulation which can easily be quality assured and inspected, there may be a problem with cavity wall insulation where quality is much more dependent on processes adopted during installation. The Green Deal installers' skills requirements are being established by Construction Skills SSC and will be based on a draft outline of the technical requirements prepared by the Building Research Establishment (BRE) as Publically Accessible Specification (PAS) 2030 (BRE, 2011a).

The draft specification outlines the training and skills requirements for staff to be employed in Green Deal installations, as follows:

"The installer shall establish and operate procedures to:

- a) Determine the skills and competence levels required by operatives to undertake the required installation tasks.
- b) Recruit and retain a sufficient number of operatives possessing the required skills at the required level of competence, or capable of acquiring those attributes with appropriate training.
- c) Provide or arrange access to any training required.
- d) Assign operatives to installation projects commensurate with the levels of skill and competence required and maintain a record of the operatives assigned to and working on each project.
- e) Ensure that operatives undertaking installation tasks are informed of and understand the importance of their installation activities and how they contribute to the achievement of the efficiencies specified.
- f) Assess the effectiveness of procedures operated under a, b, c, d and e.
- g) Maintain records of current capability, training and competence for each operative." (BRE, 2011a: 6)

This reflects the requirements of the Microgeneration Certification Scheme and implies a range of appropriate underlying qualifications and skills required for the staff employed. However, the specific qualifications and skills for the various types of installations have yet to be agreed (DECC, 2011b).

It seems, from informal discussions with those involved in the process, that there are particular problems with cavity wall installers, as there are no established qualifications and quality processes in this area. Loft insulation installations, for which it is easier to check the quality of the installation, are less problematic. As mentioned, microgeneration installations are already covered by the MCS system and standards can be derived from this experience. Some members of the Federation of Master Builders see Green Deal installer certification and licensing as the beginning of a process leading to the more general licensing and up-skilling of the construction sector. This may be an added incentive to acquire the Green Deal installers accreditation.

The UK licensing track record

Although, licensing is relatively common in the United Kingdom, there is not a great deal of evidence as to its effectiveness. Partially due to problems in establishing what would have happened in the absence of the licensing, most of the evidence is around health and safety issues and customer confidence. Additionally, what evidence is available is largely outside of the construction sector, but does often apply to SMEs or the self-employed. A recent study on financial advisors (Sadler, 2008) showed that licensing controlled entry into the occupations and improved public confidence. The regulation and licensing of bouncers or door security has greatly improved their public image and reduced criminality (Lister et al., 2001).

A recent study (Forth et al., 2011) has emphasised the importance of rigour in the underlying qualifications both in terms of ensuring additional training and ensuring respect for the qualification by customers and the holders themselves who are more likely to help monitor the qualification if they have invested time and money obtaining it. Another study, this time focusing on the nursing home sector, found that to the introduction of regulations covering the number of people with various levels of qualification needed within nursing homes resulted in an increase in the volume of training and qualifications within the sector (Gospel and Lewis, 2011).

Case study: Employment, skills and the growth of the low-carbon sector

At a national level in the United Kingdom, there is certainly awareness and discussion on the employment generating potential of the transition to a low-carbon economy. In 2009, key government ministries (including the now Department for Business, Innovation and Skills – BIS, and the Department for Energy and Climate Change – DECC) published a report on the low-carbon and environmental goods and services sector and the employment generating potential associated with it (Innovas, 2009). It suggested that the United Kingdom has a GBP 106 billion share of a global market worth over GBP 3 trillion, which sustained 880 000 jobs in the United Kingdom. The sector was seen to be growing at 4-5% a year, and it was forecast that this growth would create a further 400 000 jobs by 2017. Whilst the report briefly recognised that skills constraints could impact on these forecasts, no other mention is made of skills provision in the analysis.

However, the skills issues associated with the growth of the low-carbon sector come into sharper focus at the local level. As one example of this, in 2010-11, the DECC funded a series of low-carbon framework pilot schemes, one of which involved the development of a methodology for conducting a "mini-Stern" review on the economics of low-carbon cities (see Gouldson et al., 2012). This methodology was piloted in the Leeds City Region, an area with a population of 3 million, an economy worth GBP 52 billion (5% of the United Kingdom's gross domestic product) and an annual energy bill of GDP 5.4 billion.

The mini-Stern review assessed the costs and benefits and the energy and carbon saving potential of hundreds of energy efficiency and small-scale renewable options, and the scope for their deployment in the domestic, commercial, industrial and transport sectors in the city-region. It found that at commercial rates of interest, and using real energy prices, GBP 4.9 billion could be profitably invested with a payback period of 4 years to cut the city-region's energy bill by GBP 1.2 billion a year and reduce its carbon emissions by 36%. If also found that this level of investment would create 4 500 jobs in the low-carbon goods and services sector within the city-region, and that this would lead to a further GBP 200 million in extra economic activity every year.

The employment generating potential of this level of investment was forecast based on a review of the low-carbon goods and services sector within the city-region (Quantum Strategy and Technology, BE Group and University of Hull, 2011). When assessing the scope for this sector to absorb very significant levels of investment, to grow and to create jobs, the mini-Stern review assumed that levels of employment per unit of turnover would continue at their current level. However, it is recognised that the growth of the sector depends on a number of factors, several of which relate to skills (Quantum Strategy and Technology, BE Group and University of Hull, 2011).

The first of these factors is the generic skills gaps in science, technology, engineering and maths (STEM), as well as in project management, electrical engineering and low/zero carbon construction. The second is the lack of engagement between further education (FE) colleges and industry, which results in businesses feeling that the courses do not meet their needs. The third factor is that many skills issues/needs are specific to individual sectors e.g. maintenance technicians able to work at height in a marine environment for offshore wind or energy assessors for whole house surveys in the low-carbon buildings retrofit sector. These factors suggest that there is a need for local government, FE colleges, universities, employers and local business networks to work together to develop local skills strategies and plans for high-growth sectors, which is increasingly becoming recognised.

One key issue related to licensing concerns the take-up of the Green Deal finance in the domestic sector within the Leeds City Region. Here it is widely acknowledged that private sector service providers will struggle to convince householders to take up Green Deal finance because of concerns about the quality of their work. Public-private schemes are emerging whereby local governments providing Green Deal services also license private installers. Local government therefore will both market the scheme locally and assure the quality of work carried out by licensed private sector providers. These initiatives are driven by the local government's desire to see as much Green Deal finance as possible flow into their area as it will create jobs, cut energy bills, reduce fuel poverty and contribute to carbon reduction targets.

Policy implications

The above analysis shows that there are two main ways in which licensing is used to ensure minimum levels of competence amongst the low-carbon workforce. The licensing can operate at the individual level or at the corporate level. For instance, the Green Deal energy advisors will require appropriate individual level qualifications. By comparison, the Green Deal installers and the Microgeneration Certification Scheme use company level licensing and require that staff be appropriately qualified.

Both approaches have a track record with earlier comparable, but non-low carbon schemes and allow a degree of flexibility when skills requirements need updating. However, experience with licensing suggests that the process does not always lead to more training, competence or safety. Equally, as licensing minimum standards places the responsibility for training on individuals, or their employers, the approach may not increase the number of people with low-carbon skills. Indeed, licensing often tends to create skills shortages, as those with the certification discourage others, in order to maximise the return on their qualifications and registration (Maurizi, 1974). Despite this, in the domestic market consumer confidence is an important barrier to uptake of low-carbon measures and minimum levels of training are better than no training. Given that licensing increases consumer confidence, this should be a positive factor in increasing the take- up of the Green Deal.

In future, the critical factor will be the level of take-up of the Green Deal. If the uptake is lower than the government expects, then few building companies will become involved and few building workers will become certified. However, if the take-up is equal to or greater than the levels the government expects, then it is possible that the certification process will become the norm within the sector. Indeed, beyond the low-carbon agenda, bodies such as the Federation of Master Builders are looking to Green Deal certification as a way of driving "cowboys" out of the industry (Lane and Power, 2010).

However, the Committee on Climate Change, which has a statutory role in monitoring the United Kingdom's progress towards carbon reduction targets, has recently questioned the government's forecasts of Green Deal take-up (CCC, 2011). With low levels of take-up, there is likely to be low levels of training and, in turn, it will be more difficult to reach the levels of critical mass needed to create positive customer confidence in the scheme. In this case, licensing could act as a barrier to the success of the Green Deal, if employers become unwilling to risk the costs associated with training and certification. This is especially the case as the bulk of the sector is composed of SMEs and they are more likely to hold back from investing in training and certification in the face of uncertainty.

The most onerous requirements in terms of quality systems and certification apply to the main contractor while the actual staff installing Green Deal systems will largely be qualified through existing single trade qualifications such as Gas Safe for installers of efficient boilers. The installers are also likely to be sub-contractors or self-employed in line with the structure of the UK construction sector (Briscoe et al., 2000). This means that there are fewer incentives for installers to obtain multi-trade qualifications and there will continue to be a resistance to multi-skilling in the UK construction sector (Ejohwomu et al., 2006).

A further potential problem is that the proposed standards for obtaining Green Deal installer certification (BSI, 2012) recognises that for many areas, including cavity wall insulation and loft insulation, appropriate qualifications do not currently exist. The proposed standards also suggest that people who have worked in the industry for three or more years could be qualified using an experienced worker assessment. This factor combined with a range of qualification bodies, including those offering "cheap" or "easy" Green Deal installer certification, means that there will in practice be a range of underlying skills as part of Green Deal Certification. This means that potentially not all certified installers will really have the required competencies (Pye Tait Consulting, 2012). In turn, this means that the certification may become devalued in the eyes of consumers and other construction workers, with substantial negative impacts on the uptake of the Green Deal.

These considerations suggest that policy makers will need to pay close attention to the role and effectiveness of licensing and certification schemes, especially to how they relate to SMEs, as this could have significant impacts on the provision of low-carbon skills and on the success of key policy measures for promoting a low-carbon transition.

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Chapter 9

Anticipating and managing the effects of greening of industries in the EU: Skills development in the overall context of job quality

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Research into the employment effects of greening of industries largely focuses on job quantity, while the effects on job quality are considerably less often addressed. Present research on the effects of greening on job quality focuses either on quantitative aspects, including indicators and forecasts, or skills. Skills development is the job quality dimension that is most affected by greening.

However, green skills are not developed in isolation from other job quality dimensions including career and employment security, health and well-being, and work-life balance. In combination, these dimensions form a working culture that could be either less or more favourable for green change processes in a company. This chapter thus examines the relationship between skills development and other job quality dimensions in the context of anticipation and management of effects of greening industries.

The chapter consists of three parts. The first part summarises the available evidence on the effects of greening of industries on job quality. The second part provides an overview of the approaches companies use to anticipate and manage these effects. The third part outlines some of the measures that public authorities could take to facilitate the development of the workforce in preparation for a green economy. The chapter's key message is that successful green change depends not only on a smooth development of green skills, but may also be facilitated by positive changes in the employee culture, which relates to other job quality dimensions. Successful green change, combined with relevant cultural changes, may result in a "triple win" situation: greater competitiveness and profitability for companies, more and higher quality jobs for employees, and a stronger economy and a healthier environment for all.

Introduction

Research on the employment effects of greening of industries largely focuses on job quantity issues. Effects on job quality are considerably less often addressed. The 2009 *Employment in Europe* report concluded that "... there appears to be almost no literature with an equivalent level of detail on working conditions within environment-related sectors in Europe" (European Commission, 2009). Current research on the effects of greening on job quality focuses either on quantitative aspects including indicators and forecasts (EMCO, 2010; Cambridge econometrics et al., 2011) or skills (e.g. Cedefop, 2010; Strietska-Ilina et al., 2011).

Skills development is the job quality dimension that is the most affected by greening. However, green skills are not developed in isolation from other job quality dimensions, including career and employment security, health and well-being, and work-life balance. Green skills development usually takes place in the overall context of rising job quality standards. This chapter thus examines the relationship between skills development and other job quality dimensions in the context of anticipating and managing the effects of greening industries. The key message of the chapter is that successful green change depends not only on a smooth development of green skills, but that it may also be facilitated by positive changes in the employee culture that relate to other job quality dimensions.

This chapter is based on the Eurofound study "Growth and employment: Anticipating and managing the effects of greening of industries in the EU"[1] including 48 company case studies[2] carried out in the European Union (EU) in the automotive, chemicals, construction, distribution and trade, energy, furniture, non-metallic materials, shipbuilding, textiles and transport sectors. The available evidence does not allow for generalisations, either at national or sector levels, but does allow an exploratory analysis of recent approaches to developing a workforce fit for a green economy.

This chapter focuses, as does the study, on the effects and approaches of greening in relation to mitigation (i.e. practices addressing causes) rather than on the adaptation (i.e. practices addressing consequences) to climate change.[3] It focuses on the direct effects in the supply chain that provide the intermediate products or services for the target sectors.

This chapter consists of three main parts. The first part summarises the available evidence on the effects of the greening of industries on job quality. The second part provides an overview of the approaches that companies use to anticipate and manage these effects. The third part briefly outlines a few of the measures that public authorities could take to facilitate the development of the workforce for a green economy, while the final section contains conclusions and recommendations.

Effects of greening of industries on job quality

The greening of industries may affect the following four job quality dimensions (Eurofound, 2002):

- Skills development, including requirements for qualifications, demand for training, patterns of organisation of learning activities, career development issues.

- Career and employment security, which covers employment status (e.g. full- or part-time, self-employment), wages, workers' rights (e.g. equal opportunities, information, consultation and involvement in organisational change) and social protection.
- Health and well-being of workers, which encompass psychosocial or physical health problems, risk exposure, work organisation (e.g. work intensity, share of monotonous tasks, job satisfaction, length and organisation of working hours in relation to health) and ageing-related issues.
- Reconciliation of work and family life covering such issues as length, flexibility, predictability of working time, ability to carry out non-working tasks and the availability of social infrastructure such as day care centres.

Available evidence suggests that the effects of the greening of industries on the quality of jobs are moderate and differ across these four dimensions. Skills development is the job quality dimension that is the most notably affected by greening. Employees working with green business practices[4] face somewhat higher qualification requirements and greater demand for training than other employees. However, skills development is mostly about improving existing skill sets and not about introducing new occupational profiles. The Eurofound study (2013a) reveals that skills development is likely to be positively associated with other job quality dimensions – the higher the level of skills associated with an occupation, the better the career and employment security, health and well-being, and work-life balance of the occupation. Companies focus their resources on higher skilled employees who tend to have better job quality.

Studies (e.g. AKL WIEN, 2000, Cambridge econometrics et al., 2011, European Commission, 2009a), company cases and sector overviews (Eurofound, 2013a) show that, *ceteris paribus*, at least in the short term greening may increase the demand for highly skilled workers (e.g. managers, engineers, business and computer professionals, technicians) and decrease the demand for or have no effect on medium- or lower skilled ones (e.g. clerks, operators and assemblers, labourers). Thus greening may imply contrary effects for employees – higher job quality for highly skilled employees and unchanged or lower job quality for lower skilled employees. However, over the medium to long term, when technologies mature, demand for high-, medium- and low-qualified workers (e.g. maintenance workers in windmills) may even diminish (Cambridge econometrics et al., 2011; European Commission, 2009a). This may soften the above-mentioned negative effects on employees. Generic, STEM (science, technology, engineering and maths) and interdisciplinary skills as well as multi-skilling are increasingly important in this process. The effects of greening of industries on other job quality dimensions are less clear. Approximately half of the companies studied have experienced at least some effects on career and employment security, and health and well-being. For career and employment security, the key effects were the under-representation of certain groups (e.g. women, young or older workers) and the lack of involvement of employees in the green change processes. For the health and well-being dimension, the key effect was a more intense development of new combinations of risks (compared to conventional jobs) that still need to be anticipated, assessed and managed. The reconciliation of work and family life was likely to be the least affected job quality dimension, in which greening effects are still the most contested.

Evidence suggests that the effects of greening on employees' job quality depend not only on their qualifications, but on the overall attitude of the company management as well. Some cases show that green companies, which are very innovative and technology

driven, have progressive management that is highly concerned with the job quality of their employees. Examples of this are provided in the next section.

Overview of businesses' approaches to anticipate and manage the effects of greening on job quality

This chapter is based on 48 case studies carried out in the Eurofound study (2013b). The first two sections discuss autonomous (internal) and collaborative approaches that companies apply when anticipating (first section) and managing (second section) greening effects on job quality. The third section analyses cross-cutting issues, including the importance of a favourable employee culture for a successful green change process.

Anticipating greening effects on skills development

Companies are more often likely to manage rather than anticipate green change – only approximately one quarter of the companies studied (and an even smaller share of SMEs) has carried out some form of anticipation activity. Additionally, all anticipation activities were related to skills development. In most cases, the greening effects on skills development were anticipated by a few years and on the basis of estimated business development trends. For example, skills demand was estimated when considering a particular business strategy, plan or concrete action such as planned production facilities or commercial openings, and then differentiated by qualification and occupational groups. Less common anticipation approaches are outlined in Box 9.1.

Box 9.1. **Examples of other autonomous approaches to green skills anticipation**

Volvo Penta, a Swedish manufacturer of engines and power systems for industrial and marine applications, anticipates skills on the basis of a clearly defined strategy, outlined in a grid. On one axis, the company estimates how difficult it is to recruit a person with the needed skill or up-skill an existing employee with a particular skill if someone leaves. On the other axis, it assesses the strategic influence that specific skill has for the company. The company then focuses on anticipation (and management) of skills that are the most difficult to replace and that have the largest strategic influence (see table below).

		Strategic influence of the analysed skill for the company	
		Low	High
Difficulty in recruiting a person with the analysed skill or up-skilling an existing employee with the analysed skill	Low		
	High		

Other companies leave the anticipation of green skills for particular departments. *Danfoss Trata*, a Slovenian manufacturer of district heating products and solutions, has established a Product Development Management Department, which analyses megatrends and makes suggestions on what products and processes it should engage in the future, including new skills that are needed for those. It carries out systematic idea generation based on specific target products and geographical area.

Meanwhile, the Environment Protection Department of *Sofiyska Voda AD*, the largest water utility company in Bulgaria, adheres to already established standards (e.g. ISO 14001) and elaborates a special procedure entitled "Human resource management: Environment training and sharing information/communications" to continuously assess the need for particular green skills in a company.

Box 9.1. **Examples of other autonomous approaches to green skills anticipation** (*cont.*)

Finally, there are companies which leave anticipation of skills to so-called "gradual development", then managers note relevant skills gaps and plan their training or recruitment accordingly; or employees themselves care for their up-skilling. For example, *System Photonics*, an Italian efficient photovoltaic surfaces producer, encourages workers to develop and share the best methods of production in order to maximise the benefits for both themselves and the company. Employees therefore develop a deep knowledge of the whole production process and feel encouraged to anticipate problems as they know that there is reciprocity in such an effort.

Source: Eurofound (2013), *The Greening of Industries in the EU – Database of Case Studies*, European Foundation for the Improvement of Living and Working Conditions, Dublin, available at: www.eurofound.europa.eu/emcc/labourmarket/greening/search.php (accessed 25 February 2013).

Out of all of the companies studied, only a few have co-operated with other partners in anticipating the effects of greening on skills development. Box 9.2 overviews collaborative approaches used to anticipate greening effects on skills development.

Box 9.2. **Examples of collaborative approaches to anticipate greening effects on skills development**

The companies studied co-operated with different actors in anticipating the effects of greening on skills development. For example, some companies involved trade unions in green change development through work council discussions about future employee skills and sustainability oriented behaviour.

Companies also actively co-operated with various different associations. For instance, Kinnarps, a Swedish furniture manufacturer, collaborated with the Swedish Forest Stewardship Council in anticipating changes in wood certification standards. This helped the company to prepare for emerging new skills requirements. OHL ŽS, the fifth largest construction company in the Czech Republic, through co-operation with the Branch Council (an association of employers in the industry), was in constant dialogue with schools to ensure that their theoretical and practical training were up-to-date and that they acquired new green skills emerging in the market.

Other companies collaborated with universities, trying to foresee trends in technological advancement. They also provided inputs to shape university curricula to adhere to the latest product developments in the markets. Some companies also commissioned research at academic institutions in order to drive green change in their respective sectors.

Source: Eurofound (2013), *The Greening of Industries in the EU – Database of Case Studies*, European Foundation for the Improvement of Living and Working Conditions, Dublin, available at: www.eurofound.europa.eu/emcc/labourmarket/greening/search.php (accessed 25 February 2013).

For one online survey (Eurofound, 2013a), some stakeholders indicated that companies that adopt environmental management systems are usually well ahead of other companies in anticipating green change. This may be a result of the requirement for continuous improvement that is present in environmental standards.

Managing greening effects

Most of the management approaches, both autonomous and collaborative, are applied to skills development rather than to other job quality dimensions. However, most companies are likely to use traditional or conventional approaches (e.g. formal discussions, amendment of current partnership agreements and provision of traditional

internal training courses). Only a few engage in more innovative approaches, such as new types of training (e.g. on-site training), innovative partnership agreements with education providers or new ways of involving employees in green change processes.

Autonomous management of green skills

Almost all of the companies analysed had applied at least some autonomous approaches in the management of greening effects on skills development. Most of these approaches were related to internal training. This type of training, if effectively provided, could significantly reduce a company's need for external services and thus business costs. Internal training in the companies studied was provided selectively as a one-off intervention or continuously through on-the-job training and was often based on educational plans. Traditional autonomous management approaches adopted by companies to develop the green skills of their workers include the following:

- Training for a limited number of senior or environmental staff usually accompanied by some additional obligations (e.g. provision of on-the-job training to their colleagues, see below). Such training is often specific and provided for technical staff (especially for new employees who have been hired for technical positions, but did not have prior work experience) and company management.
- Introductory training is provided to all employees, including non-technical staff, to acquaint them with generic green skills (e.g. energy saving in the workplace, principles of energy efficiency in the production process, tools such as a sustainability scorecard, etc.).
- Self-training (for example to provide energy performance labels to buildings or certify wood according to established guidelines) or on-the-job training through, for instance, direct in-house mentoring in which senior employees train and consult their less experienced colleagues. Continuous dialogue transfers knowledge and skills from those who plan the green change process to those who implement it.
- Educational plans elaborated in collaboration between HR and production, commercial or other departments. They summarise the most important skills and foresee measures to ensure their adequate provision. Very often plans are a constituent part of environmental standards such as the Eco-Management and Audit Scheme (EMAS) or ISO 14001. Companies often report the positive effects of environmental standards on training – they not only structure the training, they also increase its incidence.
- Less widespread autonomous management approaches such as training abroad, information sessions providing the latest news on the greening agenda and/or identifying needs for further information/training, computer-based guidelines (e.g. eco-driving guidelines), information packages for self-learning and paid or unpaid training leave.

Some companies do not limit themselves to the above-identified traditional approaches; some of the more innovative management approaches are outlined in Box 9.3.

Box 9.3. **Examples of innovative autonomous management approaches to green skills development**

EDP, a large wind energy producer in Portugal, set up a company university to effectively manage its human resources. The university is split into five business schools which provide specific skills and two transversal schools which provide generic skills. As a whole, the schools co-ordinate training, career development, knowledge management and change management in line with the present and future needs of the company.

Willmott Dixon, a large British construction company, has introduced a "skills matrix" initiative to identify skills gaps and address them with the necessary learning interventions. Firstly, employees' performance is gauged against certain sustainability criteria, to identify skills gaps and signpost areas where an individual requires training. Secondly, where skills gaps are identified, the company has over 200 learning interventions available on its intranet, to ensure that employees maintain and develop green skills. The training provided via these learning interventions might interface with the different sustainability criteria e.g. training in waste handling or refreshing one's knowledge of the "Building Research Establishment Environmental Assessment Method" issues. The skills matrix covers all employees in the company and serves as a gateway to training.

Tesco Plc, one of the world's largest retailers, trains all their truck drivers with eco-driving skills. They are trained on a one-to-one basis by internal trainers. In addition, company trucks are equipped with telematic monitoring systems, which track vehicle movements and speed, facilitating efficient driving behaviour: after each journey, drivers have a debriefing session with their manager to evaluate the driving performance.

Source: Eurofound (2013), *The Greening of Industries in the EU – Database of Case Studies*, European Foundation for the Improvement of Living and Working Conditions, Dublin, available at: www.eurofound.europa.eu/emcc/labourmarket/greening/search.php (accessed 25 February 2013).

Collaborative management of greening effects on skills development

The analysed case studies showed that companies that often manage green skills development, do so in co-operation with a partner. Partners usually include vocational schools, universities and associations. Examples of collaborative approaches with these and other types of partners are summarised below:

- Vocational schools: apprenticeship programmes when part of a student's time is spent at school and part working in a company. After completion, the apprentice is often hired by the company.
- Universities: traineeships through which students reinforce and enrich knowledge learnt at the university and the company becomes familiar with someone who may become an employee; development of new study programmes (e.g. bachelor engineering programme with a focus on renewable energy carried out part-time thus enabling employees to study); sponsorship of PhD students in examining issues relevant to the company; joint organisation of contests or conferences for students; research on new technological breakthroughs.
- Associations, networks (e.g. National Passive House Association, Association of Photovoltaic Technology and Business or the Society of Electric Vehicles): collaboration with training providers to include green skills in the curriculum; organisation of informational events for targeted audiences to raise their awareness of greening; exploratory work aimed at improving existing green solutions.

- Trade unions: formal or informal dialogue or collective bargaining with the company's management to agree on skills development requirements and include them in collective agreements and co-ordinate the implementation of training.
- Employment agencies: co-operation in providing guidance for jobseekers (e.g. company recommends suitable training providers to prepare jobseekers for employment in the company).
- Private training providers, consultants: often contacted to address specific training needs of the company. Examples include training in the development of product certification standards, of environmental training content and creation as well as transfer of environmental practices such as eco-driving .
- Suppliers of products or services, business partners: provision of training needed to use specific products or services. Usually suppliers or business partners train a few specialists who, after the training course, transfer the knowledge and skills to their colleagues.

The company cases analysed for this study did not provide many examples of collaboration between companies and public authorities, except in a few instances where the public authority supported study programmes or training for jobseekers or those changing jobs.

The case studies showed that the key driver for co-operation is cultural, as the company should benefit from long-term intangible benefits arising from such co-operation, beyond those visible in the delivery of new products or services.

The traditional examples outlined above are complemented by more innovative and complex management approaches that companies, together with their partners, use to develop skills. Some of these are summarised in Box 9.4.

Box 9.4. **Examples of innovative collaborative management approaches to green skills development**

To manage the needs of blue-collar workers, Swedish office furniture manufacturer, Kinnarps, co-operates with a local VET school through a specialised division of the company, called Kinnarps Academy. Students spend two days per week in the school and three days in the company, where they are provided with all the practical aspects of their training. Sixteen students are accepted each year to the three-year course. Teachers are employed by the company and the municipality compensates the company for their training. The students learn all aspects related to the industrial production of wooden products, so that they are able to work in production from the start of their career.

British retailer Tesco Plc funded the launch of the Sustainable Consumption Institution (SCI) at the University of Manchester. SCI researches major issues associated with sustainability and climate change. The company collaborates with SCI on various projects to understand the possibilities and options for suitable technologies in order to pursue its vision of a zero-carbon business.

The large Portuguese wind energy producer EDP is highly involved in internship programmes. However, the company does not simply accept university graduates, but instead provides the option of summer internships for the children of its employees who are currently studying at university. This not only supplies the company with a potential new workforce, but also reinforces the motivation of existing employees to work for the company.

Box 9.4. **Examples of innovative collaborative management approaches to green skills development** (*cont.*)

When French electronic vehicles producer Mia Electric hired a number of new employees, they received 19 days of training in co-operation with the local branch of the Public Employment Service. Training was carried out in the framework of an "Action Plan for Pre-recruitment Training" (*Action de formation resalable au recruitment*). A plan to secure the career path of various professionals (*plan de sécurisation des parcours professionnels*) was funded by the state, which took charge of those who were in part-time work, and the regional public authority, which was responsible for training those who had lost their jobs as a result of the bankruptcy of a former car producer in 2009. The plan is intended to avoid laying off experienced workers, who are crucial for the production of electric cars, and the costs associated with redundancies. The training plan, with financial support from the government and other involved parties, has helped some 300 people to acquire the skills necessary for the production of electric cars. In addition, the regional administration encourages the reallocation of workers from different parts of the former producer. The receiving employer may benefit from a training subsidy of up to EUR 3 000 per employee.

Construction company Willmott Dixon is a member of the UK Green Building Council (UKGBC), an organisation established to provide leadership in sustainable practice in the sector and to influence government policy. The UKGBC has established the Sustainability Training and Education Programme (STEP) which aims to improve the recognition and awareness of sustainability within the sector and to develop leadership skills in the area. Launched in September 2010, STEP offers an introductory course to sustainability as well as leadership in the built environment course, which is designed to transform the sector through training senior managers, directors and decision makers in the sector and beyond. Training is provided through the College of Estate Management and the University of Cambridge. Senior managers in the construction company have completed or are undertaking STEP training.

One of the largest shipbuilding companies in the United Kingdom, A&P Group, uses knowledge transfer partnerships (KTP). The KTP helps businesses to improve their competitivity and productivity through the better use of knowledge, technology and skills. There are three players in this partnership: the shipbuilding company, which provides a two-year job contract; a knowledge base partner – in this case, a university, but it could also be a public or private college or research organisation; and a KTP associate – a recent university graduate who is temporarily working in the company and who transfers the knowledge the company is seeking into the business via a strategic renewables projects. Part of the KTP associate's salary is paid by the company and part by the university. The KTP associate also has a personal development budget that can be spent on relevant training (e.g. on small vessel driving courses). The KTP associate, who had a direct link to the academic source, acted as a knowledge transfer agent and helped the company enter the renewables market.

Source: Eurofound (2013), *The Greening of Industries in the EU – Database of Case Studies*, European Foundation for the Improvement of Living and Working Conditions, Dublin, available at: www.eurofound.europa.eu/emcc/labourmarket/greening/search.php (accessed 25 February 2013).

SMEs and large companies anticipate and manage green skills differently. Large companies have more resources – they often have staff whose job it is to estimate skills needs and organise training, foresee large investments for training, and assess and manage new health and occupational risks, launch new initiatives to improve work-life balance, etc. Meanwhile, SMEs, due to limited budgets and widespread multi-tasking or intensive work practices are often unable to devote significant time and effort to green skills development. Thus they rely heavily on partners such as local associations and networks. If specific knowledge is needed, the SME trains one or several employees externally at the national level or if the local market cannot provide the training, at an

international level. For example, *Statybos Projektu Sprendimai*, a Lithuanian passive house construction company, sent a project manager on a half-year long training course conducted by the Passive House Institute in Germany. In turn, the project manager then trained his colleagues on-the-job. External training of few employees who then train the remaining staff is often the most affordable option for SMEs.

Management of greening effects on other job quality dimensions

Those companies studied, particularly the SMEs, have managed greening effects considerably less often on the other job quality dimensions. Approximately half of them applied some measures to manage the effects on the career and employment security dimension and approximately a quarter on the effects in the health and well-being dimension. Only a few companies have applied some management approaches to address work-life balance. Informing and involving employees was one of the most often applied approaches in the remaining job quality dimensions (Table 9.1).

Table 9.1. **Autonomous approaches to manage greening effects on other job quality dimensions**

Types	Description/examples
Career and employment security	
Saving jobs	DPD, one of the largest parcel and logistic services providers in Germany, has introduced the position of a waste and sustainability manager in each distribution centre. Sometimes the new position is used to secure employment for persons who are no longer able to do physical work in the centres. They are retrained in order to give them a new opportunity within the company instead of dismissing them.
Information and consultation	Information and consultation are usually provided to all employees to make them understand the company's philosophy towards the environment and to accept the green change processes that are underway. Services are usually provided by the company's management or senior/environmental staff who are responsible for ensuring that co-workers have the ability and tools to receive and comprehend relevant information. Companies inform employees during meetings, via newsletters, through their intranet, regular briefings, booklets, etc. Ecociclo, a wood recycling company in Portugal producing raw materials for the furniture industry, uses written messages, often in the form of printed sheets hanging on a wall, as the main method of keeping staff informed and providing recommendations. The company's staff are mostly blue collar workers, and this type of approach tends to work better.
Involvement	Companies involve employees in different ways: by emphasising a flat structure, reducing hierarchy and introducing a culture of debates and participation of the personnel at the workplace level; by organising a number of moderated discussions with employees and other stakeholders to formulate the company's vision; or by involving trade union representatives in green business initiatives and in the management of the company. EDP, a Portuguese renewable (wind) energy producer, encourages employees' children to visit their parents' workplaces in the company. The purpose of this is to heighten the involvement and the feeling of belonging between the company, workers and their families. Meanwhile, once or twice a year, employees of the Portuguese wood recycling company Ecociclo, attend a one-day greening event with their families, to plant new trees and informally discuss sustainability issues. These events help workers to better understand the benefits of the wood recycling process undertaken by the company.
Employment status	Some companies undertake specific measures to improve the employment status of their employees as a means of implementing green change. For example, Biogros SA, a specialised bio-products wholesaler in Luxembourg, supports full-time work (compared to the part-time conditions that are prevalent in rest of the sector), which allows their employees to have better living conditions in the context of the high prices existing in this country.
Adapting remuneration	To create a culture favourable for green change, some companies provide green bonus schemes. For example, DSm, a Dutch life and materials sciences company, created a remuneration structure for higher ranking employees incorporating bonuses tied to performance on sustainability targets. The overall income level has not changed significantly, but it did increase employee engagement. Meanwhile, the large British construction company Willmott Dixon, uses a sustainable project criteria system to partly determine the level of employee bonuses. Under this arrangement, managers must meet six out of ten of the criteria to earn between 100% and 120% of their bonus. Some other companies, such as retailers, make sure that all employees aim for carbon reduction targets through non-monetary performance appraisals.
Equal opportunities	Equal opportunities policies are rarely managed by companies. Some have more general measures, ensuring gender equality in terms of access to employment, training, career development and average wages, and retirement options. Others, like Wienerberger, an Austrian clay bricks and roof tiles manufacturer, have more concrete measures, such as a commitment to increase the share of females by giving priority to female job applicants over a male one when they are equally qualified and apt for the job.

Table 9.1. **Autonomous approaches to manage greening effects on other job quality dimensions** (*cont.*)

Types	Description/examples
Health and well-being	
Addressing disability	Mia Electric, a French electric car producer, to facilitate the employment of disabled workers, has introduced special workplaces in the plant which are adapted to the needs of disabled employees and constitute around 6% of the total jobs.
Insurance	A representative of Successori Reda, an Italian woollen mill, stated: "when the [global financial] crisis was announced, we provided supplementary health insurance to all employees' family members, in order to give them a signal against uncertainty". Some other companies also provide pension or life insurance schemes, or well-being initiatives.
Physical risks	For shop floor workers, the Portuguese wood recycling company Ecociclo provides and encourages using individual protection gear. It also builds physical barriers in the compound to reduce wind speed and thus airborne dust and, with the help of local fire-fighters, consults their employees to reduce fire hazards.
Job satisfaction	Every two years, Sonae Indústria, a mother company of Ecocilo, assesses employee satisfaction. Results show that (green) wood recycling workers always rank as the most content and are also more embedded with the company's values than other (non-green) employees in the group of companies.
Psychological risks	Stress usually arises in situations where staff are not sure what to do or lack experience. To reduce employee stress arising from the wood auditing procedure, Kinnarps, a Swedish furniture producer, provides very clear guidelines.
Work environment	British construction company Willmott Dixon has invested in eco-cabins – portable structures that provide on-site offices as well as a kitchen, rest, drying and toilet facilities. Eco-cabins have been designed to include a range of energy saving technologies such as lighting controls, timed heating controls and double glazing. The eco-cabins provide qualitatively better on-site accommodation for workers than was available previously.
Work-life balance	
Commutation	Some green companies (e.g. wind or hydro energy producers) are located in remote areas, sometimes more than 100 kilometres between residence and workplace. To address this, companies either provide a free bus shuttle for employees who do not have a car, or provide financial compensation of transport costs.
Culture, leisure	Companies located in remote areas also sponsor cultural activities in their region to increase the general attractiveness of the area for existing and new employees. To attract employees, some companies in the offshore wind energy industry promote their jobs as an opportunity to combine well-paid work with leisure activities such as wind or kite surfing.
Social infrastructure	Distant employers also sponsor kindergartens in regions around their headquarters to ensure that there are enough places available for all of their employees' children.
Friendly working time	Green companies strive to reconcile the working and non-working time of their employees. For example, Danish energy producer EnergiMidt and Irish green cement manufacturer Ecocem emphasise flexible working time – for example, in cases of family emergency, staff may work from home. However, working time is more flexible for non-manufacturing staff than manufacturing-based employees (who tend to work shifts).

Source: Eurofound (2013), *The Greening of Industries in the EU – Database of Case Studies*, European Foundation for the Improvement of Living and Working Conditions, Dublin, available at: www.eurofound.europa.eu/emcc/labourmarket/greening/search.php (accessed 25 February 2013).

Employees were involved in green change processes not only internally; they were also engaged in co-operation activities such as training of sub-contractors or voluntary work with schools (Table 9.2).

Studied company cases have shown a positive link between approaches that address skills development and those that address other job quality dimensions. For example, more intense skills development was noticed in companies that tried to involve their staff in green change processes and to incorporate greening in the company's work culture and hereby overcome initial scepticism or the unwillingness of its employees to implement or initiate green change processes. This positive link is more discussed in more detail in the next section.

Table 9.2. **Collaborative approaches to manage greening effects on other job quality dimensions**

Type of partner	Description/examples
Career and employment security	
Trade unions	Co-operation between companies and trade unions is usually based on formal or informal discussions. Discussions often focus on the environmental impacts of the company's activities, the implementation of green business strategies, formation of sustainability oriented behaviour, etc. However, trade unions are also involved with integrating the sustainability dimension into employee appraisal forms, reward schemes and collective labour agreements, to encourage staff to develop sustainable ideas and form a culture that is favourable for green change.
Sub-contractors/ suppliers	Companies not only require, but also provide training for their sub-contractors or suppliers. For example, technical supervisors in the Lithuanian passive house construction company Statybos Projektu Sprendimai provide training to their sub-contractors' staff on issues which are of critical importance in this type of construction. This pro-active training not only ensures that the buildings' design requirements are met, but it also increases the involvement of both the contractors' and the sub-contractors' workers in green change processes.
General	Companies also use various *ad hoc* opportunities to involve their employees, including networking; organisation of information events addressed to the general public, businesses, the scientific community or policy makers; and contributing to energy saving events, etc. These approaches increase the participation rates of employees' involvement in the green change process and thus formulate a corporate culture which is favourable for green change.
Health and well-being	
Secondary schools	Co-operation with schools could contribute to increasing employees' job satisfaction. Portuguese wood recycling company Ecociclo has been contacted by a local secondary school asking them to give a presentation to the children on recycling and its benefits. The workers continued their presentations in other local schools, which in turn, has boosted workers' self-esteem and job satisfaction. Workers who participated in these activities have developed a sense of pride in relation to their role in the recycling process.
Work organisation	Some working arrangements, such as shift or night work, may negatively affect people's health. Green Cargo, a Swedish railway-based transport services provider, had train drivers assigned to a particular route and schedule depending on their ability to drive a particular type of locomotive. Thus, there was a need for more flexibility to allow the drivers to drive different locomotives. The work organisation issue was discussed between the company, drivers and trade unions to balance staff working time and business needs.
Work-life balance	
Housing providers and schools	Remotely located companies such as wind energy producers engage in regional co-operatives aimed at solving specific problems of their employees. For example, companies co-operate with housing providers to provide their new employees with pre-selected apartments or houses in the region. Similarly, they co-operate with local schools and kindergartens to ensure that there are sufficient places available for the children of their new employees.

Source: Eurofound (2013), *The Greening of Industries in the EU – Database of Case Studies*, European Foundation for the Improvement of Living and Working Conditions, Dublin, available at: www.eurofound.europa.eu/emcc/labourmarket/greening/search.php (accessed 25 February 2013).

Cross-cutting issues: Successful green change needs cultural change

As the previous section showed that a successful green transition is conditional on the overall development of staff. Companies tend to focus on the development of green skills in their employees. However, as discussed above, some companies invest considerably to improve other job quality aspects, including informing and involving employees in green change processes. This section discusses the importance of creating an employee culture which is favourable for a successful transition to a low-carbon economy.

Smooth green change requires a clear understanding and acceptance among employees. TClear and open communication is therefore very important. Evidence (Eurofound, 2013a) shows that although green change definitely brings savings to business, it is not automatically beneficial for employees in terms of, for example, saved jobs, higher income or qualification, better health and safety, etc. The benefits resulting from green change are usually either not clearly communicated and thus not understood or not provided altogether. In contrast, energy efficiency is often invoked by companies to cut business costs (e.g. smaller offices and thus lower fixed costs, car parking charges, fewer or more productive staff meaning smaller wage bills, etc.). The recent economic

crisis further reinforced such cost-cutting policies. Lack or limited awareness of the benefits of green change and a lack of understanding of this process may lead to employee resistance to green change, inadequate efforts and adverse attitudes towards the implementation of green change processes. Thus, benefits need not only be shared, but also clearly communicated.

One-way communication (i.e. from management to employees) of green change and its benefits may not be enough for a successful transition to a low-carbon business. Decreasing marginal benefits of green change are a widespread challenge to companies carrying out green business practices. To ensure stability and continuity of green change companies need to create not only external (e.g. environmental standards) but also internal long-term drivers. Internal drivers could be created through continuous investment in cultural change (i.e. bottom-up involvement of employees based on two-way communication) which is needed to ensure the successful transition to a low-carbon business.

An online survey (Eurofound, 2013a) shows that employees are usually not involved in discussing green change. They are thus often not willing to change. For example, a case study of Arginta, a provider of metal processing, water management and renewable energy solutions in Lithuania, showed that employee consciousness is vital for the smooth implementation of greening processes: adherence to the "green" rules inevitably makes the technological process longer, requires care and internal discipline. Meanwhile employees, especially those in a lower chain, are unwilling to adapt to some additional requirements without a clear understanding and/or incentives; thus a lot of policy and patience is required from management to turn the implementation of green processes into a conscious act.

The involvement of employees in the green change process could increase employee awareness, accommodate their initial doubts and thus lead to increased consciousness for green change. This could result in higher employee motivation to up-skill and thus a smoother implementation of the related new green procedures and technologies. Furthermore, literature shows that employee participation can reduce the negative effects of green change on job quality (AK WIEN, 2000). Thus, involving employees could lead to a circle of positive green developments within the company (Figure 9.1).

Available evidence (Eurofound, 2013a) suggests a few pointers to win the "hearts and minds" of employees and create an employee culture which leads to a smooth transition to a low-carbon business:

- Commitment to green change needs to be viewed as an imperative, rather than an option, leaving no doubts for those who implement it. As a representative of DSM Engineering Plastics, a Dutch global supplier of high-performance engineering thermoplastic solutions, noted, the: "[sustainability strategy] is not really a skill, but a mind-set. People need to believe that there is no other way for a business to survive, but to implement green business practice".
- The company's green vision and action plan should not only be understood, but also shared (or owned) by employees. To this end, employees should participate in the formulation and implementation of this vision and subsequent action plan.

Figure 9.1. **Cultural change leads to successful green change**



- Companies (particularly large ones) need to embed the climate change dimension into their business operations from the strategic to the operational level. Possible measures include setting climate change performance targets, regularly monitoring them and integrating them into remuneration systems. With a continuous flow of information, companies could also create positive competition where employees in different departments compare and try to exceed each other's performance in achieving environmental targets.
- Employee involvement in SMEs should be ensured through continuous direct contact between management and staff. Meanwhile, large companies need to ensure practically functioning and institutionalised employee representation in green management structures.
- Green change is usually enforced by external specialised environmental agents (especially in SMEs) who develop internal expertise and disseminate it across the company. Larger companies sometimes establish separate climate departments formulating the company's green strategy, setting targets for CO_2 emission reductions, and sharing the expertise on climate science and policies. However, companies rarely foresee the need for a green workplace representative or additional green responsibilities for existing representative(s). Such a representative could effectively create an employee culture which is favourable for green change. However, this representative would need to have adequate resources, both to gain an understanding of green change issues and to carry out his/her environmental functions. A 2009 survey of 940 UK union representatives on climate change showed that 73% of them did not have the facility for environmental work and lacked the available time to put their enthusiasm into practice (Labour Research Department, 2009).
- Higher autonomy and flexibility of employees may be encouraged by, for example, providing them with the means to apply their ideas and experiment with new technology applications. This could not only increase employee engagement, but also stimulate eco-innovation.

- Surveying staff on green change issues may: *i)* provide management with ideas for further green actions; *ii)* give mandate for the company to act; *iii)* provide employees with a sense of ownership of the green processes; and *iv)* help formulate the company's green vision.
- Close attention needs to be paid not only to skills, but to other job quality dimensions as well in order to facilitate the greening transition. For example, measures aimed at reducing stress at work could improve employees' mental conditions and increase motivation to perform. Thus not only skills development may lead to better health, but improved health conditions may lead to more greater skills development.
- White-collar employees easily master green change processes, while a significant share of blue-collar workers find it difficult to translate new knowledge and skills into their daily activities. To enforce a culture favourable for green change amongst all employees, companies need to focus on blue-collar staff and provide additional resources to facilitate their engagement. For example, blue-collar workers could receive more generic green skills training accompanied by realistic work-based simulations. This may lead to behavioural changes that are positive for greening.

To conclude, a successful green business transition goes hand-in-hand with a cultural change that relates to all job quality aspects rather than one particular dimension or separate business unit. A successful cultural change could lead to a successful green transition and, as a result, significantly increase employee satisfaction. The companies studied often report that successful green change has brought significant benefits in terms of improved work processes, skills development and working conditions. Apart from the financial benefits, such developments also contribute to the company's reputation and desirability as an employer. For example, they increase levels of employees' pride and loyalty to the company. As one company representative said: "employees and management want to be engaged with the green approach, because it's a good thing. It's not only business, but it is something that you should do if you have a possibility". Increased job satisfaction further reinforces green change processes leading to a circle of positive green developments (Figure 9.1), which spreads both within the company and outside of it, from suppliers to other sectors and leading to a stronger economy and a healthier environment for all.

Role of public authorities in facilitating the development of a workforce for a green economy

An online survey of stakeholders (Eurofound, 2013a) showed that regulatory and financial measures are one of the main actions public authorities could take to facilitate the development of job quality of employees working with green business practices. In regulatory policy measures, particular attention should be paid to a establishing and enforcing a clear, consistent and uniform legal framework. Financial measures need to be well-balanced, flexible and targeted at those most in need of support, including SMEs and blue-collar or vulnerable employees. A good example of public authorities' involvement is the UK government's decision to set up a Union Modernisation Fund to support Trade Union Congress's (TUC) Green Workplaces project[5] aimed at stimulating environmental behavioural change at work. European Social Fund funds[6] also support green activities

and could be used more actively by EU member countries. Public funding is indispensable as it provides a long-term perspective to green change.

However, regulatory and financial measures are not enough to develop a workforce for a green economy. To increase their effectiveness in reaching those the most in need, public authorities should implement the following additional measures.

Firstly, public authorities could devote significant resources to raising public awareness of green change and particularly the importance of green skills and an overall cultural change for successful green change processes. Increased awareness of green change among company shareholders and employees as well as (sub)contractors, suppliers, investors and clients could strengthen the need for green change within companies. Secondly, greening could be stimulated by the additional guidance services for companies (especially SMEs) by, for example, providing information on relevant support schemes or tools for implementing green change.

Thirdly, public authorities could support networks of SMEs aimed at facilitating green change. Networks such as the Retail Forum for Sustainability,[7] Green Workplaces Network,[8] BUILD UP Skills Initiative[9] and their tools could help SMEs gain the necessary knowledge and skills for green change and could become vital for their quick adaptation to the green business environment. Sector-based training funds linking SMEs in a particular sector with pre-determined green skills providers could also be an important initiative.

Fourthly, public authorities could play a significant role in adapting education and training policy for green change. There are currently not many education and training providers for the new specialised programmes needed for green skills (particularly in initial education and training levels) and this gap needs to be closed. Recognition, validation and certification of competences are yet to be developed for new green or greening occupations.

Furthermore, co-ordination of education and training policy with environmental, labour market and other public policies need to be strengthened to achieve higher coherence and synergy of different policy efforts. Greening of initial education and training is of particular importance as the 2050 targets will need to be met by young workers entering the labour market "today" and not by existing workers leaving the labour market "tomorrow". Finally, there are a number of measures that public authorities could consider which stretch beyond the scope of this chapter, including changes in working time policies, giving more responsibility to local communities and encouraging community-based sustainability initiatives to name but a few.[10]

Policy implications

Analysis shows that most of the effects of the greening of industries are concentrated in skills development. Effects on other job quality dimensions such as career and employment security, health and well-being, and work-life balance are far less prominent. However, companies that anticipate or manage the effects on other job quality dimensions reveal the importance of providing information and involving employees in green change processes. Case studies demonstrate the positive link between changes in work culture and successful green change – the more employees are informed and involved in green change, the more motivated and aware they feel, the more they learn and the more successful the green change process and the greater job satisfaction. The implementation of green business practices thus can result in a "triple win" situation:

- greater competitiveness and profitability for companies
- more and better quality jobs for employees
- A stronger economy and a healthier environment for all.

Public authorities play a key role in ensuring that greening benefits everyone. They could facilitate the workforce development for a green economy not only through traditional regulatory or financial measures. *Green culture and greening of businesses could be effectively stimulated with the help of accompanying measures, including awareness raising, provision of specialised guidance services, facilitation of networks, adaptation of education and training policy and its better co-ordination with other public policies*. Any measure needs to be focused on the "weak links" in greening processes such as SMEs or blue-collar workers.

Research of greening effects on job quality is still in its infancy. There are a lot of limitations to this research, including: difficulties in disentangling the effects of greening of industries from those of broader contextual factors such as technological development; differences of greening effects across sectors, occupations, regions, time to name but a few; and a lack of evidence on a clear-cut cause and effect relationship between greening and job quality. This chapter has outlined only tentative/exploratory trends instead of providing hard evidence. Further research at sub-sectoral level is needed to verify these trends. Amongst other issues, future studies could research innovative approaches for anticipating and managing green change (especially those involving public authorities and SMEs) and greening strategies across value chains that are very significant at industry level. This chapter is based on evidence collected during the period when the effects of the financial and economic crisis were still very prevalent. Future research could also try to examine whether or not the crisis has made any significant effects on employer's perceptions of greening and what measures could prevent or mitigate this.

Notes

1. The study is available at: www.eurofound.europa.eu/publications/htmlfiles/ef1248.htm [accessed 25 February 2013).
2. Case studies are available at: www.eurofound.europa.eu/emcc/labourmarket/greening/search.php (accessed 25 February 2013). The sample includes companies which are well advanced in greening processes in the sector. The sample therefore does not reflect a common trend in the sector, but represents high-achieving companies in the market. Furthermore, 14 of the 48 companies studied were SMEs. SMEs were very hard to reach not only due to their lower awareness of the topic, but also due to the lack of resources for any additional activities (including green change), which was further escalated by the crisis.
3. Climate change mitigation includes all of the measures to reduce the negative impacts of human activities on the environment and is achieved by reducing both the energy intensity of GDP and the carbon intensity of the energy used. Climate change adaptation consists of deliberate actions undertaken to reduce the adverse consequences of climate change as well as to harness any beneficial opportunities (Martinez-Fernandez et al., 2010). If radical mitigation measures are not taken in due time, adaptation could eventually prove impossible (European Commission, 2009).
4. "Green business practices" are understood as business activities and processes that contribute to climate change mitigation by minimising greenhouse gas emissions from economic activities or using fewer natural resources.
5. www.tuc.org.uk/greenworkplaces (accessed 25 February 2013).
6. For example, the ESF has contributed to the training modules for SMEs on energy consumption/saving and on climate protection in Denmark and Germany. In Poland, the ESF is currently supporting a post-graduate course for employees of companies dealing with environmental engineering and the management of environmental protection in enterprises (European Commission, 2010). A few of the companies reported the use of EU funds for environmental training for their employees: for example, one construction company implemented a project entitled "Training of employees in the construction sector" which also covered environmental management training; a chemicals producer has received EU support for two research projects in bioplastics industry; a waste treatment company has carried out few ESF projects aimed at enabling and encouraging environmental awareness through the empowerment of socially disadvantaged persons through adequate training and skills transfer.
7. http://ec.europa.eu/environment/industry/retail/about.htm (accessed 25 February 2013).
8. www.tuc.org.uk/workplace/index.cfm?mins=392&minors=87&majorsubjectID=2 (accessed 25 February 2013).
9. www.buildupskills.eu (accessed 25 February 2013).
10. An overview of these and other measures that public authorities could take to ensure the transition to a green economy is provided in Jackson (2009: 171-187).

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Chapter 10

Greening technical vocational education and training in the European steel industry

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This chapter studies the first results of the European Lifelong Learning Programme funded project, Greening Technical Vocational Education and Training (GT VET). Within this project, responsive vocational education and training (VET) pathways are explored to meet the environmental, and health and safety skill needs of the steel industry. As a model, the project will develop an industry-driven European sustainable training module, in co-operation with national VET systems. Independent of the different VET systems of EU member countries, VET practices and learning outcomes need to be evaluated with respect to environmental skills, expertise and awareness. Based on these insights, a European training module will be developed to obtain identical European learning outcomes in the field of green skills and sustainable awareness, which complement current technical VET programmes in this area.

Using the example of the steel industry and the VET of mechanical and electrical technicians, the modules and process of implementation may possibly be developed for adaptation and transferral to other technical VET professions and production industries. The module and the tested implementation processes are intended to become a blueprint for updating and the implementation of training for new skills into the VET system, which are focused on meeting industry driven requirements for environmental sustainability in an immediate and responsive way.

Green skills as a competitive advantage for the European steel industry

Compared to many other industries the European steel industry is energy intensive and has a high production emission intensity. Whilst there are huge investments in breakthrough technologies (such as ULCOS: Ultra Low CO_2 Steel)[1] to reduce emissions, the steel industry's skilled technical workforce also needs to be provided with the appropriate green awareness and technical skills (e.g. ecological and health and safety) for "green" industry labour processes.

A timely response to demands for new mandatory skills is essential to the global competitiveness of European industries. The European Steel Technology Platform (ESTEP)[2] has focused its agenda on education and training to ensure that skills needs are met and the long-term competitiveness of the EU steel industry is secured. Since 2006 special attention has been given to the anticipation of skills needs in the steel industry within the framework of the Sectoral Social Dialogue Committee on Steel by both European social partners (EMF, now IndustriALL, and EUROFER).

Against this background, the Greening Technical Vocational Education and Training (GT VET)[3] project was created which has reference to:

- Basic European strategies and guidelines: Implementing new skills for new job demands (new skills for new high-skilled workers in the steel industry), designed to be complementary to the Lisbon strategy by taking the greening of the steel industry as a European competitive advantage and refocusing the steel or production industry to be a key industry for European competitiveness. In addition, the EU 2020 strategy paper outlines ecological sustainability as being crucial for the competitiveness of European industries in global markets.
- The industry and job-oriented implementation of the EU environmental directives (IPPC, GHS, REACH, LEED, etc.) and national guidelines and recommendations.
- The steel industry itself, by focusing on the main challenges of "recruitment and training" that were stated at the European Steel Industry Conference in Warsaw in 2007: recruiting and attracting of young employees by offering high-skilled, safe and healthy jobs to overcome the demographic change in an ecologically oriented production industry; continuously developing training modules for future-oriented skilled workers in co-operation with the VET system and stimulating a short-term implementation of industry required qualifications (e.g. the German Federal Institute of VET – BIBB – stimulates sector-based VET on sustainable development with public funding as well).

Greening technical VET: The GT VET project

The Greening Technical Vocational Education and Training (GT VET) project aims to explore how vocational education and training (VET) pathways meet environmental and health and safety skill needs, which are key to the global competitiveness and sustainability of all European industries. As a model, the project will develop an industry driven European sustainable training module in line with national VET systems. A partnership of steel companies and research institutes from each participating member country aims to identify and anticipate the impacts of environmental legislation on the everyday work of two occupational professions: "mechanical/industrial technicians" and "electrical technicians" (for the short and the long term). Independent of the different

VET systems in member countries, VET practices and learning outcomes need to be evaluated with respect to environmental skills, expertise and awareness.

The global concept of sustainability comprises economic, social, cultural and global dimensions. The concept remains, however, vague, abstract and open to discussion. Whilst accepting that sustainability is a sometimes nebulous concept, the GT VET project places itself within the realms of sustainability and opts to concentrate on ecological, health and safety issues. In the last decade these topics have formed part of nearly all of the curricula of the regulated professions, but they are not necessarily at the forefront of VET practices. Such concerns are not always realised as concrete training activities, and it is becoming necessary to turn the present reactive learning outcomes into proactive ones.

Based on these insights the GT VET project is developing a European training module that aims to obtain identical learning outcomes in the field of green skills and sustainable awareness, which complements current technical VET programmes. The module will be tested in four steel companies (ThyssenKruppSteel Europe, ArcelorMittal Poland, Tata Steel UK, and ThyssenKrupp Acciai Speciali Terni) and four European member countries (Germany, Italy, Poland and the United Kingdom). Adjustments for each involved company and national system of VET will be made and learning outcomes will be evaluated based on transferable credit points (ECVET).

Using the example of the steel industry and the VET of mechanical and electrical technicians, the module and process of implementation could possibly be developed for adaptation and transfer to other technical VET professions and production industries. The module and the tested implementation processes are forecast to become a blueprint for updating and implementing the training of new skills into the VET system, focusing on industry driven requirements for environmental sustainability in an immediate and responsive way.

Again, the main GT VET objectives are:

- the timely and responsive **implementation** of new mandatory skills within VET systems (national and industry related)
- to investigate the scope for the development of ongoing and responsive training pathways by **focusing on skills for environmental sustainability**
- to develop a model of an **industry driven and run European sustainable training module** and to match the demands of industry with the VET system, obtaining identical European learning outcomes in the field of green skills and sustainable awareness within technical VET (focusing on preventing pollution and securing occupational health and safety)
- to identify and anticipate the **impacts of environmental legislation on the everyday work** of skilled workers, both for today and the future
- **to adapt and test the module** in four steel companies and member countries (Germany, Italy, Poland and the United Kingdom)
- to use the example of the steel industry and the VET of industrial mechanics, electrical and electronic technicians for the **adaptation and transfer to other technical VET professions and production industries**

- to produce a **blueprint** for the implementation (process) of new skills for the industry sector and the appropriate VET systems.

These objectives will be reached by consecutive research and development:

1. An **industry driven analysis of job requirements** concerning the green aspects (ecological sustainability, health and safety) of technically skilled workers in the steel industry: the background of this analysis is the collection and analysis of relevant EU-wide directives and resulting member country directives, as well as roadmaps and strategic papers for ecological sustainability, health and safety in the European steel industry. Additional interviews and workshops with the environmental and health and safety departments of the steel companies ensure the practical transfer perspective and the relevance of the legislative background at the workplace. Objectives in this regard are the identification of current and future job requirements for skilled workers, respective working conditions, critical situations and appropriate acting and behaviour on the one hand and – based on these results – the definition of qualification requirements for skilled workers concerning green awareness and skills (including health and safety).
2. The **national VET system** of each participating member country was and will be analysed as to how it meets the identified future industry needs. Each involved VET system has different regulations and institutional frameworks. Using the example of two main apprenticeships and regulated professions (industrial and electrical technicians) in each represented member country, an analysis was carried out of the existing curricula and its implementation possibilities for the identified skills. Interviews and workshops at the regional level with the training department in steel companies (target group: trainers), environmental and other technical departments, e.g. health and safety (target group: managers), recently graduated apprentices, vocational schools (target group: teachers), chambers of industry (representatives of VET) and other VET relevant institutions were conducted. Against this background, concrete training practices in the member country concerning green awareness and skills were scaled in relation to the identified future job requirements and to propose or identify preliminary outlines of a training module to bridge the identified gap between future job requirements and current education and training practice.
3. Based on the industry driven requirements and their reflection in the VET systems, a first definition of a European standard concerning green skills and green awareness in technical professions will be defined and a **European training module** will be developed as a blueprint for each involved member country. This will be a pilot for continuous implementation and development within the European steel industry, to be continued over the time horizon of the project and transferred to other professions and industry sectors. The comprehensive "continuous progressing training module" will keep the technicians' qualifications up-to-date and "up-to-future" and stimulate the short-term implementation in the national VET systems. The structure of the training module will be oriented towards a European learning outcome and be evaluated and assessed, if possible, with ECVET credit points. The training module will facilitate learners' engagement with future skill needs and ensure high levels of green awareness. The outcome will be more responsible workers who are better placed to tackle what might be the highly unpredictable future challenges of green issues in production industries.

4. The developed European training module will be piloted in the steel companies and in VET institutions at the regional level. The European green training module therefore has to be **modified and tested in each participating member country's** VET system. Assessment is still required to determine how the training modules can be implemented in the curricula and current training procedures in several education and training venues (vocational schools and companies) of each participating member country and how the module can be used in addition to present VET systems (continuous vocational training).
5. The consortium (project partners and associated partners) of the project is composed of 11 organisations from 6 different member countries and 4 different steel-producing regions. It combines different perspectives, competencies and responsibilities in regard to VET: research (universities, institutes), practice (steel companies) and policy (public authorities and European associations) at a regional, national and European level. Valorisation (dissemination and exploitation) is at a European level mainly by EUROFER and the European Steel Technology Platform ESTEP, and the European Metalworkers' Federation (EMF – now IndustriALL) and in the Sectoral Social Dialogue Committee on Steel (SSDCS).

Preliminary results

This section highlights the preliminary results of the industry driven job requirements on green skills for technicians, and their place in different VET systems (in Germany, Italy, Poland and the United Kingdom). The next section presents a preliminary outline (or pilot draft) of the training module.

Industry requirements

This project focuses on two occupations broadly used in metallurgical plants, i.e. mechanical and electrical technicians (according to the International Labour Organization's classification of occupations – ISCO-08 Draft Definitions; 9 July 2009), employed in three crucial departments: blast furnace, steelmaking shop and hot rolled mills. Against this background, the environmental legislation and directives at European, national and company level were summarised by environmental threats on wastes and emissions mainly:

- **Wastes:** Mechanical technicians' influence is limited to handling waste resulting from the maintenance and repair of machines and mechanical installations. Mechanical technicians, among others, should pay special attention to hazardous waste. Generally, European or national directives do not have a direct influence on the daily work of mechanical and electrical technicians, but research suggests that the WEEE and Packaging Directives, in particular, greatly affect the work of their day to day duties and meeting the internal requirements of company regulations. Entire obligations in that range should be described in individual job descriptions for workplaces where mechanical technicians are employed.
- **Emissions to atmosphere:** Technicians (both mechanical and electrical) should be aware of the requirements of the permit (based on the IPPC Directive) to ensure that no uncontrolled releases occur (e.g. during maintenance activities). Mechanical technicians should apply the best available techniques accepted for their workplaces. Based on Pure Air for Europe Directive, technicians (both

mechanical and electrical) should be aware of the regulation in the legislation to ensure that no uncontrolled emissions occur (e.g. during maintenance activities).

- **Emissions to water:** Technicians (both mechanical and electrical) have the potential to cause the uncontrolled release of contaminants to controlled waters through maintenance activities (replacement of fluids such as coolants and oils, blow down of cooling towers, chemical storage, etc.) or through the setup of control instrumentation and monitoring systems.
- The legislation in this range is of a rather general character. It describes different threats and risks (e.g. dangerous agents at work, chemical agents, noise, vibrations and artificial optical radiation). From the point of view of the analysed directives, mechanical and electrical technicians are exposed to the same threats and risks while performing their duties (maintenance and repairs) as other employees/colleagues in the company. The European environmental and health and safety law is completely implemented in the national laws of the partner countries of this project. In some countries additional legal documents were implemented in the legal systems (e.g. Poland in its Law on Health and Safety has the labour code as its main obligatory legal document, and for the steel sector in particular, the decree on health and safety in iron and steel metallurgy).

The directives of the steel companies involved in this project are in line with national/European legislation and reflect the specific needs of steel companies. They are developed in different forms depending on the management system of the company. For example, at Tata Steel there are strategies (e.g. Air Quality Strategy Group) and policies (e.g. Environmental Policy), at ThyssenKrupp Steel the information is organised in guidelines (e.g. "Environmental protection is an overriding aim of the corporate policy") and at ArcelorMittal Poland books, policies, operating procedures, plans and the Directive of the General Director (e.g. Procedure PS/US/S.21 Identification, assessment and supervision over environmental aspects) exist. In each company, an Environmental Management System (EMS) guarantees the implementation of the environmental policies, rules, strategies and legislation.

Companies implement the environmental (and related health and safety) legislation in different ways. Knowledge centres for environmental issues could be found in all major steel companies. They have European contact points or bureaus and are engaged in "environmental networking" in Brussels. The legal requirements have been "translated" into procedural instructions and handbooks and good practice examples for "application-oriented diffusion" of environmental legislation have been developed ("every employee has to understand the message"). Strict corporate targets ("no accidents") exceed legal requirements to some extent (from complying to improving) and there is a steering approach through highly diversified target figures at the company, plant and department level, ensuring a high influence of environment-related instructions on everyday work.

Responsibility for environmental (and related health and safety) issues is taken by distinct departments for environmental issues and occupational health and safety. Hybrid working groups meet and define implementation pathways to: *i)* comply with new legal directives; and *ii)* integrate new requirements into training (VET, further training). But different levels of autonomy of plants are found, e.g. TKSE plants have recently installed their own environmental representative. A common "culture" of shared responsibility regarding environmental issues is aimed at skilled workers, who are increasingly expected to be responsible for "green performance".

Environmental regulations influence basically every maintenance routine of skilled workers, especially electrical technicians and mechanical technicians; but they are differently integrated in VET and further training, plant protocols and the operational instructions of the involved companies. Green projects are being implemented to a high degree in the training and day-to-day work in TKSE to improve environmental performance. More and more training resembles everyday work (integrative learning approach, autonomous problem solving and reflection as pedagogic concepts gaining importance).

The main recommendations for the VET system and the production of the training module can be summarised as follows:

- Basic knowledge about environmental laws is obligatory in VET. Can this knowledge presuppose while planning learning contents? How could the actuality, transparency and reflection of the different legislation be guaranteed?
- Do skilled workers also have to be knowledge managers in their respective teams? Does the module have to include basic knowledge management information and strategies, adapted to the specific occupation?
- Would it be reasonable to choose a pedagogic approach, which makes the learners act autonomously (project- or action-oriented didactics)?
- Could the core of the module be a set of concrete, industry-related case studies on environmental topics? Such a set of case studies could be modified or supplemented when industry requirements change.

VET systems reflection

The results of the industry driven analysis of job requirements were reflected in the background of the related national VET systems of the involved member countries:

- Germany: A “dual system” with a social partnership model that reflects the agenda of different responsibilities (at national, *Länder* and regional level) and partners (labour, state and capital).
- Italy: A state-directed system, with significant regional (and provincial) autonomy in the regulation and delivery of VET.
- Poland: A state-directed system filtered through various regional, district and local authorities and inclusive of social dialogue (at national, regional and district levels).
- United Kingdom: A voluntary and market-orientated system driven by employer needs, where the state regulates standards and intervenes in the case of market failure.

The analysis showed a varied set of curricula, policies and practices, which is indicative of the different levels of skills, competence and knowledge across the case study countries:

- Germany: Beneath general instructions, green skills are explicitly named in 9 of 15 learning fields of the apprenticeship of mechanical technicians and in 7 of 13 learning fields of electrical technicians.

- Italy: No specific training on green skills, no specific training module, no specific chapter in school handbooks. However, there is an apprenticeship training catalogue in the Umbria Region: the main social partners' training agencies have recently included a training module concerning general competences on legislative matters and professional procedures to make their work "environmentally safe".
- Poland: VET is more generally implemented by the utilisation of metals, scraps and other waste, waste segregation (separate containers for plastic, paper and glass); the utilisation of used materials such as oil, lubricants etc.; and the treatment of waste.

United Kingdom: Green skills are an aspect of workplace practice (e.g. company induction, waste disposal), more than they are a part of the formal curricula; health and safety training incorporates elements of environmental practice. Besides the far-reaching directives and regulations of almost every involved company on a general level, practice and awareness of environmental issues varies at the workplace. Given the lack of centralised guidance or policy, it can be inferred that the emphasis accorded to environmental matters differs, based on the importance placed on such issues by section heads. The GT VET project requires a clear definition of green skills; such a definition should be formulated bottom-up to reflect the specificity of the steel sector, and top-down to incorporate wider "green" policy imperatives (such as those deriving from EU 2020 strategies).

Wider recommendations were made for greater co-operation between companies and vocational schools to make school content relevant, specific and applied to company practice. Further, it is important that in-company training programmes are reinforced by wider campaigns and information distribution.

In terms of module delivery, a series of smaller modules was postulated to be run over the course of the apprenticeship training. The focus of the introductory module could be relevant environmental legislation and its impact upon and application to the steel industry. Modules on specific practice could then ensue. The main consideration is that such training should be applied and role-specific, with numerous examples of concrete learning provided and supplemented by the use of projects and applications of tools, such as life cycle or productions process assessment. It was also suggested that critical incidents could be documented and form the basis for analysis – students could work out what went wrong in a situation and how it could have been prevented through the identification of the appropriate actions at each stage. These are deemed to be essential for effective learning by the trainees themselves. An emphasis on consequences of behaviour – the "why" as well as the "what" – and the implications for individuals, the organisation and society should be included.

Conclusions for the training module

Based on the background of the industry requirements and their reflection within the different VET frameworks, a preliminary definition of European standards concerning green skills and awareness in technical professions was made, as well as a framework for the development of the first pilot training module.

Box 10.1. **The German case**

For vocational schools and companies, the training directives and the framework curricula build the basis for the vocational training. The schools are organised systematically through learning fields. The principle of integrated action forms the basis for teaching and learning by creating concrete learning situations. Regarding environmental policies, the first attempts to integrate training initiatives on environmental issues took place in 1982. However, this had no major effect on the staff or company structures at TKSE. From the school's perspective, the relevance of green skills and the general awareness of daily and occupational life should be shown to the trainees. This could be accomplished by specific tasks like a life cycle assessment. As important topics for trainees' emissions, resources, water and waste were mentioned. Furthermore, the exercises in schools and learning processes should be action-orientated with an environmental context. The trainees should ask themselves what they can do about different environmental issues in a practical way. Therefore, trainees need to be sensitised and empowered. Thus, the rise of learning motivation needs reputation and a context of benefits (e.g. monetary effects by saving energy).

From the trainees' perspective, applied learning is by far more effective. In general, there are hardly any environmental issues taught at school. Moreover, they criticise the poor or sometimes non-existent co-operation between school and the company. The main problem is that they are confronted with "too many empty phrases" while concrete examples are absent. The trainees demand far more "learning by doing" so that they have the possibility to learn from their mistakes. In addition, a lot of issues are treated superficially. Particular topics, especially hazardous materials, particulates and waste, are essential for daily work while energy, emissions and resources are of less importance. The electronic technicians want to focus more on frequency converters, control engineering, the treatment of oils and hydraulic systems. The industrial mechanics would like to have a deeper insight into gear boxes and clutches. In their opinion, environmental awareness is mainly dependent on personal background and secondary school.

Definition of green skills

There is still no conclusive definition for the term *green skills*. The ILO defines green skills "…as specific skills required to adapt products, services or operations to meet adjustments, requirements or regulations designed to stem further climate change or adapt to the impact it is already having" (ILO, 2011). As this definition is a part of the OECD's broader skills classification, it remains general. A more vocational education and training (VET) oriented definition is given by the Australian Ministerial Council for Tertiary Education and Employment. Green skills are defined as "… the technical skills, knowledge, values and attitudes needed in the workforce to develop and support sustainable social, economic, environmental outcomes in business, industry and the community" (Ministerial Council for Tertiary Education and Employment, 2010: 3).[4]

When using the term "green skills", the GT-VET focuses more on environmental sustainability. But there are also clear benefits in terms of social and economic sustainability. As skills are acquired and then applied by individuals in different contexts, skills become green when they are applied in green contexts. Our point of reference is with respect to the context of the European steel industry and its green requirements concerning legislation, innovation and stakeholders' perspectives – both for now and the foreseeable future. In addition to the analysis of relevant documents, the following definition is also a result of interviews and workshops with steel and VET experts within the framework of the GT-VET project.

Green skills for technical VET in the European steel industry include the technical skills and appropriate awareness to prevent and reduce the negative impacts on the individual and environment (neighbourhood, employees, air, water and ground) caused or initiated by operations and work in and around steel production. Green skills aim to equip skilled workers with competencies for ecologically and environmentally sustainable behaviour whilst maintaining high health and safety standards.

This comprises knowledge, abilities and attitudes:

- To save and reduce input of resources, particularly energy and raw materials.
- To prevent and reduce emissions, pollution and noise.
- To utilise, store and dispose of waste materials in a manner that conforms with best practice environmental procedures and understands the consequences of nonconformity.
- To understand the value, impact and lifecycle of resources and materials.
- To keep track of current standards and best available techniques.

Development of the training module

Based on the results of the industry requirements and its reflection on the VET systems, an activity oriented learning approach for the first draft of the European training module is postulated. Instead of a purely e-learning approach, a workplace and activity based learning sequence (with smaller sub-modules and action-oriented green skills projects) supported by digital media (e.g. PowerPoint presentations for teachers, videos) is recommended. Preliminary ideas suggest the implementation of specific green content (on energy, resources, waste, pollution) in new or enriched existing projects with green aspects. Measures like a lifecycle or production process assessment and other apprentice activities could be projected, uploaded and benchmarked, e.g. on the GT VET website. Co-operation between all learning venues (vocational schools, training centres, production sites) should be promoted by the module as well.

Learning outcomes must be tangible and raise awareness. The content should be workplace related and relevant for steel production and its further processing. The more complex didactics are the more they should be oriented towards activities. All content should also be able to be used at different learning facilities (school or company). Learning impacts should be based on critical events (including which kind of misconduct led to an accident or other negative impact).

As there is still no valid ECVET credit point system in Europe, the workload will be used to assess the module for the European VET systems and the module will be split into different cognitive levels.

As a next step, the main topics (energy, raw materials, noise and waste) of the involved companies will be developed in sub-modules of four different learning or knowledge levels (Table 10.1). These levels follow each other sequentially, improving the level of self-learning and learning outcomes step-by-step. The specific learning contents and activities are oriented for typical situations and matters close to the workplace and company requirements. While levels 1 and 2 are more input oriented (with self-learning and group work as well), levels 3 and 4 are based on the individual activities, tasks and projects of the trainees.

Table 10.1. **Matrix of learning areas and levels**

<table>
<tr><th>Industry related main topics</th><th>Level 1:
Basic information</th><th>Level 2:
Understand background and linkages</th><th>Level 3:
Professional practical knowledge/ competencies</th><th>Level 4:
Process know-how</th></tr>
<tr><td>Save and reduce the input of resources: Sub-module Energy</td><td rowspan="4">Introduction of each issue: Easy access to the very basics combined with examples of the steel industry</td><td colspan="2" rowspan="4">More difficult exercises linked to industrial issues/cases</td><td rowspan="4">Professional experience in industry to be reflected</td></tr>
<tr><td>Save and reduce the input of resources: Sub-module Raw Materials</td></tr>
<tr><td>Prevent and reduce emissions pollution and noise: Sub-module: Noise</td></tr>
<tr><td>Utilise, store and dispose of waste materials: Sub-module Waste</td></tr>
</table>

Policy implications

In line with the objectives of lifelong learning, by creating an innovative and continually developing VET module, GT VET is improving the European VET system by:

- developing sustainable, immediate and industry driven pathways that fit between industry and national VET systems
- securing a corresponding exchange from a European level to the national VET systems
- embedding valorisation possibilities in other steel companies and production industries, to other member countries and to other professional occupations.

The European training module, which has European-wide application and is run by the European steel industry, with correspondent pathways to national VET systems, will anticipate actual and future industry needs (thus tackling a lack of short-term implementation of industry required new skills, improving co-operation between industry and the VET system, etc.). In terms of concrete skills, the module aims to improve green skills and awareness for technical professions in the steel industry. In line with the Lisbon agenda, the EU 2020 strategy and the European environmental directives, GT VET aims to contribute to European VET systems as a basis for lifelong learning pathways and industry competitiveness by making production and industry as a whole greener.

To foster this approach, the following key policy recommendations could be suggested:

- The VET systems should be flexible and provide leeway to include modules of VET with industry driven demands systematically and in immediate and responsive ways, to be integrated in different institutions (secondary and vocational schools, company oriented vocational education and training) for different reasons (general education, initial vocational education and training, further vocational training to adjust missing competences).
- Overarching European-wide learning objectives on green skills should be defined for all technical occupations to foster bindingly cognitive and empirical learning

as well as awareness building in close relation to everyday work and the workplace challenges, in co-operation with national VET institutions and systems; based on an industry related European definition of green skills – reflecting the specificity of the industry sectors and top-down to incorporate wider "green" policy imperatives bottom-up (such as those deriving from EU 2020 strategies).

- The European Credit System for Vocational Education and Training ECVET should be implemented as soon as possible to provide the basis for a European-wide and accepted certification of the training module contents.
- The co-operation and involvement of enterprises and social partners as well as stakeholders of VET institutions like vocational schools and chambers of industry should be improved at the regional level, where people live, work and learn.
- The New Skills for New Jobs initiative focused on 19 industries, but the European steel industry was not considered. However, this project follows the direction of this European flagship initiative. Not only the new economy, but also the "traditional" production industries like the steel industry with it high-technology based production processes and products should be considered in European advanced manufacturing activities to a much greater degree (because industry is still the backbone of European competitiveness).

Notes

1. For more information, see: www.ulcos.org/en.
2. http://cordis.europa.eu/estep/home_en.html.
3. http://gt-vet.com.
4. For a comprehensive definition of occupational categories on green skills see also: Dierdorff et al. (2009).

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Chapter 11

Managerial skills in the green corporation

Jeremie Fosse and Daniel Arenas

This chapter discusses a framework for organisational transformation towards green corporations that shows the link between change management and corporate sustainability. The chapter highlights the new leadership skills needed by middle and top managers. Four European companies are analysed, from diverse sectors, countries and sizes to consolidate the results of the research.

This study supports the view that incorporating environmental sustainability within a firm is a non-linear and on-going journey, which involves deep, organic and systemic change within the organisation, catalysed by the following leadership skills of the middle and top managers:

– *Change management focus: Fostering a dynamic, positive and widespread organisational change, involving all the levels of the organisation.*

– *Openness to collaboration: Collaborating with strategic external stakeholders such as non-governmental organisations (NGOs), experts and policy makers to inspire wider, faster and deeper change.*

– *Eco-innovative mind set: Rethinking operational processes through the entire value chain to reduce environmental footprints and increase innovation in green products and services.*

Challenges and opportunities of crises

Our society is currently facing an unprecedented series of crises in modern history – financial, economic, industrial and environmental – as a consequence of an unsustainable development model based on the mismanagement of our limited natural resources. More precisely, fossil fuel combustion, irresponsible land use and extensive deforestation are all contributing to an increase in the level of greenhouse gas emissions, the main cause of global warming. If no significant steps are taken to reverse this phenomenon, the rise in temperature and loss of biodiversity could lead to massive ecological disasters, social unrest and the inability of most societies to maintain their current level of well-being.

However, as in natural ecosystems, structural crises offer opportunities for positive and selective evolution. Visionary companies are leading the change of their business models to offer a more sustainable future based on natural resource efficiency, development of eco-innovative products and empowerment of eco-conscious stakeholders. The businesses engaging in this emerging "green economy" race are nowadays obtaining a key competitive advantage, being recognised clearly as inspiring leaders within their industry. In a recent survey (Global Compact, 2010), 93% of chief executive officers (CEOs) believe that sustainability issues will be essential to the future success of their business.

Context and scope of the study

It is easy to feel overwhelmed by the challenge. Where do you start and how can you monitor the impact of changing small parts of the complex global system? The main sustainability challenge is translating the concept into actionable, practical steps. This is also mentioned as one of the main barriers to implementing environmental business strategies (Oppenheim et al., 2007). In fact, there is no "one size fits all" model. Whilst tools such as a circular economy or a carbon footprint provide useful instruments for change, there is still a lot left to be done regarding new approaches instead of applying ready-to-use frameworks. The need to innovate and provide creative, long-term alternatives is recognised as a major characteristic of business environmental sustainability.

Environmental sustainability does not merely consist of complying with existing or future regulations. It means proactively seeking to create innovative business models which will lead the way for future regulations. Compliance implies seeing environmental issues as a cost, when sustainable businesses consider it as an opportunity to innovate and improve performance and efficiency. Although regulation is needed to create environmental sustainability standards and ensure coherence regarding actions, businesses also have responsibility in this area. They are responsible for the impact of their activities and they have the potential to design new frameworks based on sustainability.

To analyse organisational change towards environmental sustainability, we apply theories from change management approaches (Senior and Fleming, 2006), centred on organisational politics, culture and values. In fact, all parts of an organisation are interconnected and have a role to play in finding creative solutions towards eco-effectiveness. Moreover, introducing environmental sustainability within the remits of a company's agenda is a new conception of business which calls for a profound paradigm shift. This shift will certainly be driven by values and organisational culture

even though it is enabled by people. Organisational development sees people as the central enablers of change and advocates of focusing change programmes on communication, empowerment, learning and collaboration.

Analysing the role of organisational culture, we look to define how top and middle managers have engaged their employees and how a positive environmental sustainability paradigm can be created within an organisation. Moreover, as sustainability is not an individual quest but, rather, demands global action and co-operation, we also seek to understand the role of collaboration within the change process: How do leading green businesses inspire and how are they inspired?

Finally, to reduce the complexity of translating global sustainability into practical action, we examine the process of transforming operations through innovation: How can the value chain be reworked to better integrate environmental sustainability?

Organisational culture and change management

Organisational cultures share common traits. Firstly, culture is shared by a group such as the members of an organisation. It is therefore primarily concerned with people. Secondly, culture is generally considered as the informal, "softer" side of an organisation. It also encompasses all the habits, attitudes and beliefs that are not necessarily written down. The cultural web (Johnson, 1998) explains that cultural manifestations (stories, symbols, power and organisational structures, control mechanisms, rituals and routines) are, in fact, the visible sides of a central paradigm based on core organisational values. Organisational cultures are discovered and developed by the members of the group themselves (Schein, 1984). Thus, culture is dynamic and always evolving. Finally, he states that the new beliefs can be taught to new members. We can then deduce that, if culture can be learnt, it can be changed.

To implement such a change process a sense of urgency (Kotter, 1996) needs to be established by communicating the risks involved in maintaining the status quo while, at the same time, explaining the opportunities to be found in adopting a new approach. The opportunities or "why people should strive" to make the image a reality, should be crystallised in the development of a new vision. To be effective, this vision should be shaped by the people who are going to implement it. This guiding coalition should include enough positions of power, expertise and knowledge necessary for the organisation. Communicating the vision, in a variety of forms, vectors and over a long period of time should be a central focus. Questions and doubts about the new vision need to be listened to and addressed.

Finally, and perhaps most importantly for successful cultural change, it is crucial to insist on collective ownership of the change (Cameron and Green, 2007). In fact, people are key to the change process' success or failure. Throughout the organisation, they will transform, or not, the way they work to make the vision a reality. For this reason, people need to be involved in the process from the beginning and then empowered to be able to make the necessary decisions in favour of the change agenda.

Field research with four European corporations

Given the exploratory nature of the research, a qualitative approach was advisable and different companies were selected to verify the validity of the model, following the method of "theoretical sample". We chose four companies that have already publically

started a transformation process including environmental sustainability into their vision, operations and communication strategy. We undertook an analysis of the internal change processes using both secondary and primary data. The four cases selected were:

- Desso, a European carpet manufacturer applying the circular economy based on *Cradle to Cradle* (Braungart and McDonough, 2009) philosophy, in its new range of products and services
- Acciona, a Spanish construction company, shifting from its old traditional and national civil work and real estate activities towards new global eco-infrastructure, water and renewable energy
- Scandic, a Scandinavian hotel chain, using an academic framework called *The Natural Step* (Robert, 2000) to integrate environment into its vision, operation and marketing strategy
- Havas, a global advertising and communication agency integrating the new environmental awareness of its consumers into the brand value of its corporate customers.

Two semi-structured interviews for each primary case study were carried out, and visits were made to the company offices. We were given access to company information, to allow triangulation of information. The interviews with middle and top managers were semi-structured with common questions, although ensuring flexibility to expand the questions to the specificities of the organisation analysed.

This initial review of literature suggested that three managerial skills were of particular interest when adapting a company's activities to environmental challenges: change management leadership, collaborative openness and eco-innovative mind set. The analysis of the four selected case studies confirmed the importance of these elements. The four companies have all made a strategic change to incorporate environmental sustainability internally. We deliberately chose businesses from different sectors and different locations to broaden the wealth of the lessons learnt.

Change management leadership

As mentioned above, environmental sustainability implies a new conception of business models, very distant from the mainstream and traditional industrial paradigm. This model moves away from a take/make/waste approach to a more circular and regenerative production system (Lovins et al., 1999). This new framework needs to be reflected throughout the organisation to create new ways of functioning. Different ways of thinking lead to different ways of behaving. Therefore, if people working in organisations are to be influenced in terms of their actions, they first need to be convinced to transform their values and ways of thinking. Furthermore, environmental sustainability is not a "one size fits all" model applicable to any organisation. As such, people need to create innovative ways of working, suitable to the specificities of the organisation. This flexibility can be created through cultural change. Combining our initial model of cultural change and the field study, four ways to transform organisational culture can be highlighted as particularly relevant.

Design a positive and ambitious vision

Designing a compelling vision, which explains the need for change and the expected result, is one of the most common first steps towards cultural change (Senge, 2008). A sustainability vision creates a shared set of beliefs and common mental images and should

provide an absorbing positive image about the future (Doppelt, 2003).The companies studied have developed a series of aims, goals and objectives in the sustainability area. In some cases, this ambitious and positive vision was developed with help from external consultants and supported by scientific methodologies.

Educate and engage with employees

In fact, because visions of being green embrace so many different realities in each company, educating and engaging with employees is critical. Training programmes and rewarding learning might help convey the new environmental sustainability values. Furthermore, as for any new change agenda, people need to fully grasp the underlying concepts to successfully implement them. Environmental sustainability is highly complex, and human understanding of this field is constantly evolving. This implies a need to continuously update the organisation's knowledge. Training and on-going learning lead people to feel empowered to innovate.

Secure the leader's endorsement

To design and convey a compelling vision, the new "green" paradigm needs to be embraced by the top of the organisation, the only part that has the power to successfully align the whole organisation (Epstein, 2008). In fact, sustainability is not a peripheral task to be relegated to public relations or CSR department; it requires leadership by the CEO and co-ordination throughout the organisation. Information will circulate more easily; crucial data that would otherwise have remained known only by a few will be disclosed to the whole organisation. Finally, the aggressive goals from the top can provide pressure and incentive to drive the search for breakthrough innovations that create sustainable value.

Adapt the organisational structure

To consolidate the cultural change, a new organisational structure that reflects the new priorities has to be implemented. Change agents (sustainability champions or ambassadors) help to create and maintain the momentum and mainstream environmental actions across the organisation. They might have other expertise (from financial to maintenance), voluntarily undertaking environmental responsibilities. New operational structures have to integrate environmental issues within the organisational charts. In some companies, the quality, environment and R&D departments can be merged under an Innovation and Sustainability Vice-Presidency with wider and more strategic responsibilities. This can help raise awareness and commitment both inside the company and outside with external stakeholders.

Openness to collaboration with stakeholders

Businesses that have started a sustainability journey are engaging in multi-sector partnerships to understand where former practices have had a negative impact on the environment and to find ground-breaking innovations for the future. Collaborating with other businesses, organisations and institutions is central to the success of change processes for sustainability. In fact, it can help companies' access valuable data and information across the supply chain and distribution channels. Involving stakeholders (Freeman, 1994) in the transition process broadens the impact of a company's environmental sustainability strategies and vision. Engaging with NGOs enables businesses to communicate objectives, progress and results. Finally, building partnerships

with specialised organisations (e.g. NGOs, scholars, scientists, etc.) can prove very important in the design of more innovative solutions based on their expertise. Four directions could be given to this collaboration: influence the whole supply chain, network with external stakeholders, communicate with customers and develop sectorial initiatives.

Influence the whole supply chain

Outsourcing is no longer an excuse to free a company from the responsibility of the social and environmental impact of its products or services. Many scandals related to sweatshops in the textile industry have aptly illustrated this argument. Engaging the supply chain in an organisation's quest for environmental sustainability should include strategies such as: more long-term partnerships, closer assessment of the supply chain and collaboration during suppliers' transitions towards environmental sustainability.

Network with external stakeholders

Specialised NGOs, academic institutions and scientific institutes all have expertise in environmental sustainability. This knowledge can play a pivotal role in learning about challenges and opportunities, gathering data and specific research information, and adding technical know-how to the design of strategies. They can help a company access cutting-edge technology and information.

Communicate and engage with customers

Companies should aspire to offer better information to consumers and customers to ensure that they understand clearly the benefits of the environmental strategies enacted by the company (Bonini and Oppenheim, 2008). Moreover, as environmental sustainability is a long and complex adventure, being transparent about the steps taken as well as about the challenges faced and the actions that still need to be accomplished reassures consumers and partners about the company's intent (Goleman, 2009; Werbach, 2009).

Develop sectorial collaborative initiatives

Again, environmental sustainability is ultimately a societal objective: the greater the number of people, companies and organisations that are on board, the greater the impact. Business partnerships are developing in this area. The World Business Council for Sustainable Development (WBCSD) is a coalition of CEOs whose objectives include creating a business case for sustainable development, participating in policy development and promoting best practices in this area. These partnerships have a real potential to change the rules of the game.

Eco-innovative mind set

Environmental sustainability represents major operational opportunities. Savings from energy, waste reduction and the emergence of new markets are just a few of the development prospects for green companies. A plethora of tools (ISO 14000, EMAS) exists to guide businesses in deciding where to find these opportunities and to redesign their operational strategies. Environmental sustainability strategies are not all at the same level; some are merely tokens while others are truly innovative and have a major impact on the environment. Because there is no "one size fits all" strategy, each company has to target its own approach to the specificities of the company's context. The journey towards sustainability needs to be comprehensive and considered in a strategic way to be fully

transformative. The companies studied have not necessarily followed the same order but they have all gone beyond implementing token initiatives to enact deeper changes in their activity structures through four main mechanisms.

Secure quick wins

Planning for quick wins is widely acknowledged as a major success factor in change processes (Kotter, 1996). In change processes towards environmental sustainability, these measures are also called "low hanging fruits". This refers to actions which, for example, improve raw materials management and energy efficiency relatively easily and rapidly.

Measure your progress

Measurement is central and helps focus efforts on the weakest areas. Key environmental indicators such as energy efficiency, water use, waste produced, etc. are normally published in the respective companies' sustainability reports along with their medium- and long-term goals.

Redesign the value chain

Re-designing the whole supply chain and operations triggers systemic change of the company's eco-system. It brings sustainable value and drive innovation both in the company and in the industry. Certifications have been helpful for some of the companies studied to achieve a real and lasting competitive advantage and improve transparency and trust.

Reposition the company

Eco-innovation policy needs to be part of the company's mainstream R&D investment to boost its creativity and out of the box thinking (Nidumolu et al., 2009). It can include the development of a new line of eco-products or the implementation of broader resource efficiency strategies. It then becomes a driver to strategically reposition the company as innovative and sustainable (Esty and Winston, 2006).

Policy implications

This study supports the view that incorporating environmental sustainability within a firm is a **non-linear and on-going journey** which involves deep, organic and systemic change within the organisation led by middle and top management. Those emerging sustainability leaders need to acquire new management skills to successfully and efficiently implement green business models and environmental corporate strategies, such as:

- **Change leadership:** Fostering a dynamic, positive and widespread organisational change, involving all the levels in the organisation.
- **Openness to collaboration:** Collaborating with strategic external stakeholders such as NGOs, experts and policy makers to inspire wider, faster and deeper change.
- **Eco-innovative mind set:** Rethinking operational processes through the whole value chain to reduce environmental footprints and increase innovation in green products and services.

These three aspects are reflected in Figure 11.1.

Figure 11.1. **Green business transformation framework**



Source: Arenas, D., J. Fosse and E. Huc (2010), *Business Going Green*, ESADE-Institute for Social Innovation, Spain.

At present, these managerial skills are barely included in the university and lifelong learning curriculum. Targeted awareness campaigns together with soft regulations or recommendations shall help to bring those issues within the national, regional and local educational policies.

More specifically, management schools, as massive educational institutions for business leaders, have to urgently develop or adapt new learning programmes to train, capacitate and empower the future agents for change towards a green economy.

Finally, more academic research has to be undertaken to clearly understand, at a micro-level, the behavioural triggers that transform a mere employee into a committed sustainability ambassador.

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Part III

Integrating skills into local development strategies for green job creation

Chapter 12

Local development strategy, green jobs and skills in the Indian context

Sunita Shanghi and Jeevan Sharma

Eco-friendly approaches for adaptation and mitigation of the impact of climate change and environmental degradation on economic growth affects the labour market. The market needs to adjust in terms of changes in the occupational structures and skill responses to be able to sustain the environment and growth at national and local levels. As a result of the transition towards a green economy, some new jobs will be created while some existing ones will be eliminated, some new occupations may emerge and there may be a need to retrain some of the existing employees to adapt to the changing conditions.

The main challenges addressed include skills identification, mapping, availability and shortages, as well as a lack of infrastructure for skill development. The role of social partners and the community is very important. This brings into focus the urgency for co-ordination at the policy planning stage, retraining of the existing workforce, developing processes for identifying skills and community mobilisation. The present chapter analyses these issues in the Indian context.

Introduction

The increasing pace of globalisation and technological changes associated with climate change have shifted the focus to sustainable development requiring appropriately trained staff for green jobs and preventing environmental degradation (ILO, 2010). The new activities in the green economy and changes in the existing occupations provide ample opportunities for the labour force. The green job report (ILO, 2008) has estimated that efforts to tackle climate change could result in the creation of millions of new green jobs requiring new skills. However, this requires change in public policies to achieve the economic sustainability for improved and decent employment opportunities. The environmental aspects need to be part of the growth and the employment policies. India's 12th Five year plan also lays emphasis on sustainable development also.

A job can be green or brown depending upon the resources, technology and processes used for the job. The International Labour Organization (ILO) has defined a "green job" as one that reduces the environmental impact of enterprises and economic sectors to levels that are sustainable. This definition covers work in agriculture, industry, services and administration (ILO, 2011a). However, for green jobs to facilitate the transition to a green economy requires that an adequate number of people to be available who are trained in the desired skills. For a developing economy like India, where the level of skill training is very low and institutional capacity is limited to catering to the requirements of the exiting economy, this would require coherence in development, labour and environmental policies to meet the needs of the changing economy.

The chapter is divided into four sections. The first section discusses the key challenges and priorities for the transition to a green economy. The second section analyses the policy response to climate change, new job creation and skill response. The third sheds light on the measures for anticipating, matching and monitoring skill needs and the final section suggests a way forward for integrating skills into development strategies to create green jobs for sustainable development. This is all done within the Indian context.

Challenges and priorities for transitioning to a green economy

The transition to a green economy involves the expansion of green production and consumption, to help to reduce the depletion of natural resources and the degradation of ecosystems and the increasing reliance on low-carbon energy sources to mitigate climate change. However, the transition needs to be supported by development policies and actions that ensure sustainable and inclusive growth (UNCTAD, 2011). In a diverse developing economy like India, challenges in the economic, social, political, cultural and environmental arenas need to be addressed for a transition to a green economy.

These all merge into the dominant imperative of alleviating mass poverty reckoned in the multiple dimensions of livelihood security, healthcare, education, empowerment of the disadvantaged, etc. The sustainable development concerns in terms of enhancing human well-being have found a place in India's development process. The Twelfth Plan (2012-17) is guided by a vision of India that would ensure the improvement of the standards of living of all sections of the population through growth, that is faster, more inclusive and environmentally sustainable.

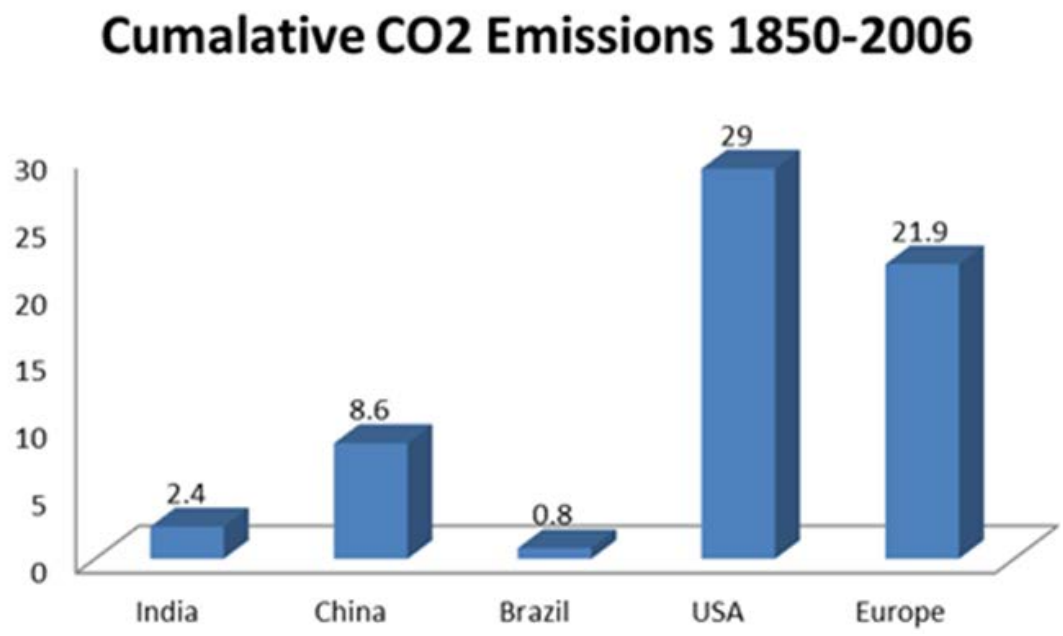
Environmental degradation

The movement towards a sustainable economy is challenged by environmental degradation in terms of pollution of water, land and air, irreversible loss of bio-diversity on the one hand, and deprivation in terms of more than 30% of the Indian population living below the poverty level on the other hand, with 94% working in the informal economy with negligible or no social security. Environmental degradation perpetuates poverty, particularly among the rural poor, where such degradation impacts soil fertility, the quantity and quality of water, air, forests, wildlife and fisheries and the weakening of employment opportunities (National Environment Policy, 2006).

In the transition to a green economy for sustainable development, the labour market plays an important role in the production, generation and distribution of income to reduce poverty. The ILO (2011) has recognised the maintenance of the environment and gainful employment as key factors for the transition to a green economy.

India is one of the lowest greenhouse gas (GHG) emitters in the world, at 1.18 tonnes of CO_2 equivalent per capita in 2008. That is nearly one quarter of the corresponding global average of 4.38 tonnes and less than one fifth that of the United States and the People's Republic of China (Figure 12.1). India has announced its intention to reduce the emissions intensity of its GDP by 20-25% of the 2005 levels by the year 2020 through proactive policies, while maintaining its process for inclusive growth.

Figure 12.1. **Share of different countries in global emissions**

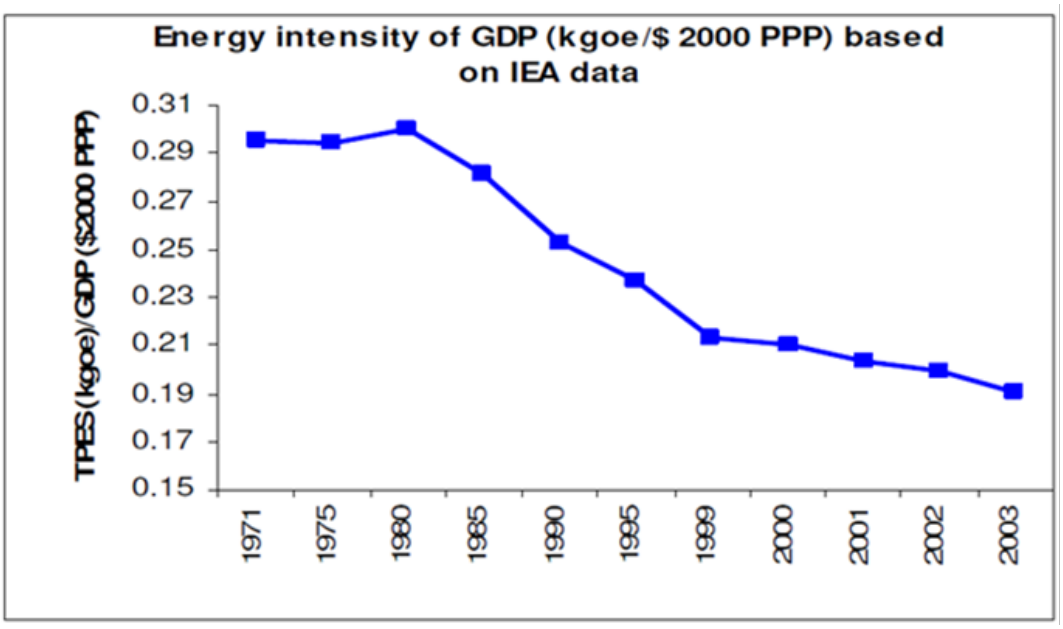


Source: Planning Commission (2011).

The need of the hour is investment in climate friendly technologies to reduce emissions by 50%. Emission reductions need to be factored into people's quest for development (Planning Commission, 2011). A country's greenhouse gas emissions depend on many factors: level of income, living conditions, lifestyle, need for

heating/cooling, population, level of economic activities, size of country, urbanisation, transport infrastructure, natural resources, etc.

Figure 12.2. **Energy intensity of GDP in India**



Source: Planning Commission (2011).

India's approach to low-carbon inclusive growth recognises that policies for climate change mitigation differentially affect development objectives, including poverty alleviation improvement in quality of life, the even distribution of justice, job creation competitiveness, industrial growth and improving the quality of the local environment. Thus, a strong adaptation and mitigation framework is required, and substantial resources in terms of finance, technology and capacity building will be needed to implement this framework.

This can be achieved through linkages between developmental and environmental policies at all levels in all sectors. Including all sectors is important in terms of greenhouse gas emissions and use of natural resources as well as in terms of their contribution to the economy and employment. To be able to analyse how these sectors can contribute to the generation of green jobs at a local level using different skills levels, it is necessary to look at the problem areas and then see how skills have been integrated for green jobs at the local level in the response strategy.

Agriculture: Soil degradation, flood, droughts, fertilisers

Agriculture, the principal source of livelihood for 58% of the population, for food and nutrition security, contributes about 14.2% of India's GDP. However, it is a challenge to support 17.5% of the total world population with just 2.3% of the world's total land area and with more than three-quarters of crop production critically dependent on the southwest monsoon, for which rainfall has been erratic in four out of the last ten years.

This puts huge pressure on cultivable land and exposes farmers to many risks including droughts, floods, disease in both crops and animals and unpredictable market irregularities. It is estimated that a 1°C increase in temperature is likely to lead to a 5-10% reduction in the yield of some crops. In addition, the size of land holding in India is very small.

Land degradation poses the biggest threat to the sustainable livelihood security of the farming communities across India, leading to food insecurity. Therefore, there is a potential for green jobs in agriculture through the use of sustainable practices on farms, organic production and successful adaptation to climate change. Technical and infrastructural support through the Krishi Vigyan Kendras can improve the yields from small farms using crop rotation, maturing, natural pesticides and other sustainable methods that can match larger, but often more environmentally damaging, facilities (UNEP/ILO/IOE/ITUC, 2008). The government of India has also been implementing programmes to conserve soil in order to enhance input efficiency.

Water scarcity: Contamination, shortage

India has to support 16% of the world's population and 15% of its livestock with 4% of its water resources. The per capita water availability has dropped to about one third since independence. The over-exploitation of ground water led to 14% of the assessment blocks falling into the critical and semi-critical categories. The unsustainable consumption pattern, inadequate sanitation, unregulated extraction of ground water, discharge of toxic waste, inefficient irrigation and farming practices, and overuse of chemical fertilizers and pesticides have led to contamination and overuse of water resources. There is an emergent need to address the issue of water resource management in a sustainable manner.

Deforestation: Soil degradation, conversion for agriculture

There has been significant loss of forest cover, due to the conversion of forest to agriculture, settlements, infrastructure, illegal extraction, cattle grazing, etc. resulting in soil degradation, flood, droughts, etc. Enhancing forest and tree cover mitigates climate change by absorbing carbon dioxide (CO_2) from the atmosphere and turning it into biomass. The forestry sector of India can help mitigate climate change by directly increasing the forest and tree carbon sink on the one hand, and by promoting the efficiency of fuel-wood use and by replacing energy intensive building and household products with wood substitutes, on the other hand. Needless to say, actions aimed at the sustainable supply of domestic wood products would also aid mitigation and adaptation efforts, as sustained supplies would not be possible unless forests and tree vegetation themselves are first secured at reasonable levels (Planning Commission, 2013).

The target is to increase forest cover to 33% by 2020, from its current level of 23%. Green jobs in forestry will play an increasingly important role in recharging mountain aquifers, conserving soil, thereby preventing floods and droughts, the habitat for wildlife, and ecological conditions for the maintenance and natural evolution of the diversity of the flora and fauna. The afforestation programme, the Green India campaign, and the MGNREGA Programme are enabling the regeneration of forest land on the one hand and creating decent jobs on the other, which do not require high levels of skills.

Transport: Air quality and vehicular pollution

Transport is the second largest contributor to energy related GHG emissions in India and its share in national GHG emissions has increased, from 6.4% in 1994 to 7.5% in 2007 (Planning Commission, 2011). Air quality has been an issue of social concern in the various developmental activities. Road transport contributes about 87% of the total GHG emissions. Therefore, reducing GHG emissions from the transport sector requires a shift from road and air transport to rail and water, in addition to improving efficiency of individual transport modes. Among the road transport system, public transport and mass rapid transport systems can reduce the effects of transport on climate change.

Waste hazard, including sanitation

The increase in population has resulted in an increase in solid waste and waste water output. India's waste generation stands at 0.2 to 0.6 kg/person/day. In most cities, waste disposal involves dumping it in a landfill. According to the Energy Research Institute, this will require 1 400 km² by 2047. The burning of waste in the open is hazardous to people's health. Further, open defecation is affecting the health of the poor and marginalised who are forced to live in overcrowded conditions with limited access to water and sanitation. Rising sea levels are also resulting in coastal population migration, thus perpetuating disease and infection due to limited sanitation facilities and access to clean water and food. Systematic collection of solid waste, recycling it to recover energy, and composting have a large potential for reducing emissions from this sector and improving production. However, in India, systematic collection and dumping of waste is only carried out in urban areas. The incineration of waste for energy has begun in one or two sites, but only on a pilot basis.

Energy management and energy efficiency

India is suffering from huge energy shortages (2008-09), approximately 11% in energy terms and 12% in peak energy, with over 400 million people without access to electricity and 90% of rural India dependent on traditional fuels for cooking (ILO, 2010). The per capita energy consumption of a developing country is likely to be high in order to keep pace with its development path. To stay in line with international commitments to keep pollution levels low, the use of alternative sources of energy and the adoption of energy efficiency measures will be needed to help to reduce GHG emissions as well create new green jobs. The use of alternative sources of energy and energy efficient technology requires intensive research and development to create technological capabilities (Vipin Kumar, 2009).

There is energy efficiency potential in all sectors, i.e. domestic and commercial where one can use energy efficient appliances or construct energy efficient buildings. In many European countries and the United States, approximately 4 million direct green jobs have been created based on improving energy efficiency in existing buildings (ILO, 2011). The latest *Environmental Performance Index* shows that India is performing poorly on a number of environmental indicators such as environmental health, air pollution, water resources, bio-diversity and habitat. The latest Environmental Index released by Yale University, shows India at 125th place out of 134 countries.

The need of the hour is to have an environmentally friendly development policy which can improve the environment and generate sufficient employment. However, the creating new employment opportunities requires the integration of skills in accordance with the occupation.

Response strategy at the local level for low-carbon inclusive growth

Government plays a key role in the transition to the green economy in terms of investment in innovation and the development of new technologies as well as in the education system to train people with the right skills so as to maintain the created structure. The government's policies are one of the major drivers for low-carbon employment. The UNDP (2009) referred to environmentally friendly investment that can create employment for the poor, which provides income on the one hand and rehabilitates or conserves the environment on the other.

The key focus of the India's low-carbon strategy for inclusive growth is to improve agricultural activities, the availability of clean drinking water, a safe environment, household electricity, protecting forests to sustain the ecological balance and safeguarding the rights of the local community, land degradation and clean transport. The national low-carbon strategy needs action at the local level in order to achieve these objectives. The key sectors which have the potential for green job development include: agriculture and forestry; waste management; mass rapid transport; energy efficiency; renewable energy; micro, small and medium industries, etc.

The adoption of greener technology in these sectors would affect the labour market in terms of the creation of new jobs, the replacement of old jobs by green jobs, the elimination of certain jobs and the transformation and redefinition of skill sets and work methods of jobs. The shift to the green economy will not only affect employment but will also result in a change in the occupational structure and associated skill sets (ILO, 2011). The quantity and quality of jobs, as well as the availability of skills to access those jobs, will affect the transformation to the green economy at the local level.

A look at the current status of the workforce in India indicates that there is a huge unorganised sector employing about 94% of the workforce, who are either unskilled or have very little skills. The workforce with formal skills only constitutes 2% with another 6% with some kind of informal training, leaving a large segment of workforce without any training (11th Five-Year Plan, 2007-08). The dropout rate is very high at primary and secondary levels. On this backdrop, in order for India to reap the demographic dividend that it enjoys, with more than 50% of its population between 15 and 29 years old, a concerted effort to upskill the workforce and train new entrants to the labour force is required to meet the job requirements of the new economy (11th Five Year Plan, 2007-08).

Strategy for environmental sustainability

To enhance ecological sustainability, India unveiled the National Action Plan on Climate Change in 2008, with eight core national missions (Table 12.1). The objective is to maintain a high economic growth rate as well as to address the effects of climate change. The Prime Minister's Council on Climate Change has approved the National Missions on Solar Energy Efficiency, Water, Agriculture and Sustainable Habitat. State governments are preparing state action plans, aimed at creating institutional and programme-oriented capacity under the advice of the central government to address

climate change. These, together with the National Mission, will enhance the climate change related action plan in the public and private domain.

Table 12.1. **India's Action Plan on Climate Change and the eight national missions**

National missions	Objective	Responsible entity
Solar mission	20 000 MW of solar power by 2020	Ministry of Non-Renewable Energy Sources
Enhanced energy efficiency	10 000 MW of energy efficiency savings by 2020	Ministry of Power
Sustainable habitat	Energy efficiency in residential and commercial buildings, public transport, solid waste management	Ministry of Urban Development
Water	Water conservation, river basin management	Ministry of Water Resources
Sustaining the Himalayan ecosystem	Conservation and adaptation practices, glacial monitoring	Ministry of Science and Technology
A green India	6 million hectares of afforestation over degraded forest lands by the end of the 12th Five-Year Plan	Ministry of Environment and Forests
Sustainable agriculture	Drought proofing, risk management, agricultural research	Ministry of Agriculture
Strategic knowledge for climate change	Vulnerability assessment, research and observation, data management	Ministry of Science and Technology

Source: Ministry of Environment and Forests, GOI.

Besides the action plan, India has also initiated a comprehensive approach to reduce emissions from deforestation and forest degradation with a stress on conservation, afforestation and the sustainable management of forests. A network of research institutes has been set up for preparing national communication on climate change. The initiatives under these missions would create a large number of jobs. The activities under the "Solar mission" and "Energy efficiency" have already started and are generating employment either in existing occupations or in new occupations, which necessitates the development of some new skill levels.

Local development strategy, green jobs and skills

The concept of a green job is not new to India. The artisans in the traditional industries in the micro, small and medium enterprises sector have been using natural resources produce to generate products for their livelihood. A number of projects initiated well before the issue of environmental sustainability caught the world's attention such as the use of biogas, solar energy, waste recycling and composting, etc. were creating clean jobs. However, the specific emphasis on maintaining the ecosystem has been highlighted only recently. Different case studies discussed below highlight how local development strategies for low-carbon growth aimed at mitigating the negative effects of climate change have resulted in green jobs using different skill sets.

Recycling and waste management

Occupations in waste management depend on the processes being used: collection, source separation, storage, transport, transfer, processing, treatment and disposal. These processes involve the use of manpower, capital, tools, energy and water. Waste management in cities is the responsibility of the local bodies.

It is apparent that waste collection alone requires a large number of personnel. In addition, it is also a source of employment for those who are engaged in converting the waste into manure or energy and those who produce the related machines and vehicles. The jobs created are helping to maintain a clean environment.

Box 12.1. **Recycling and waste management in Delhi**

Delhi generates a total of about 7 000 metric tonnes of waste. More than 50 000 people are employed in the collection, transport and disposal of waste. There are more than 700 trucks, private vehicles and loaders for lifting and carrying waste. The waste is collected in large bins and is used to generate energy and composting at different plants. The Municipal Corporation spends about INR 503 million for managing the municipal waste. The waste is recycled to make vermipost and generate energy/biogas. The waste management project in Delhi is resulting in high employment levels. Projects have also been undertaken with World Bank assistance to convert kitchen waste into compost in government canteens and to educate people in co-operative societies to adopt the practice. There is a need to generate awareness among people about the ill effects of waste.

The city of Delhi has also launched the first integrated solid waste management system in India, covering door to door collection, transport, treatment and disposal of waste. This was jointly developed through Clinton Climate Committee initiatives and the Municipal Corporation of Delhi. It would solve the growing sanitation problem and will prevent the release of 96 000 tonnes of CO_2 equivalent into the atmosphere each year. It will process 1 000 tonnes of waste a day, converting organic waste into compost and recycling plastic and paper to create a refuse derived fuel product. The project will generate employment for local people, including those who used to eke out a living by scavenging for saleable material in open dumps. This will not only help reduce the city's dependence on landfills, but will also help to improve health conditions and deliver critical sanitation services to citizens.

Plastic waste is recycled to make degradable bags and incentives are provided to the manufacturers. Universities are involved in research on using plastic for making nano particles. Projects have also been undertaken to process bio medical and industrial waste. The government has put in place the regulatory infrastructure as well as an awareness generation campaign.

Source: Government of Delhi, various reports.

Box 12.2. **SEWA and waste pickers in the city of Ahmedabad, Gujarai**

The city of Ahmedabad accounts for 40% of the urban poor and a significant number of them are engaged in waste picking activities. There are around 40 000 waste pickers in Ahmedabad, out of which SEWA has organised 31 505 waste pickers. In the city of Ahmedabad, around 2 400 tonnes of waste is disposed of daily, 300 to 400 tonnes of which is collected by female waste pickers. Waste collected by women waste pickers includes: paper, plastic items, iron and steel, wood, old cloth and glass bottles.

In 2004, the co-operative of the waste picker women (promoted by SEWA) entered into a contract with the municipal body to collect waste from 46 000 households in the city of Ahmedabad. According to this contract, wet waste collected by the waste pickers would be dumped into the waste bins of the Municipal Council and dry waste collected would be recycled. In all, 366 local waste pickers made a decent livelihood and each waste picker earned around INR 2 000-INR 2 500 per month. This system of door to door waste collection promotes the three "Rs" (reduce, recycle, reuse), which are essential for preventing global warming and for protecting the environment. SEWA is also training these waste pickers to convert waste into useful items.

Source: SEWA.

The different waste treatment interventions are helping to keep the environment safe and are also generating high levels of employment in new occupations, additional occupations in existing jobs in terms of numbers, such as waste collectors, segregators, drivers, loaders, workers for treatment and processing, disposal, packers and different occupations in recycling and energy generation. To manage the waste and recycle it for energy generation and composting requires skilled manpower. The huge quantity of waste in the country as a whole provides ample jobs while processing and recycling provides a clean environment, organic manure and local off-grid energy to people. There is a skill gap in processing and recycling waste to energy as well as in composting. The above case studies also indicate that at the local level both the government and social partners are involved in the greening activities.

Renewable energy: Solar, biomass, biogas

India has been placing emphasis on the generation of renewable energy in order to meet the growing demand for energy. The vision is to make India's development energy efficient and based on non-fossil sources, like solar, wind, hydro, biomass, etc. This is done through governmental intervention and by providing adequate financial resources for the requisite infrastructure. India has witnessed growth in the renewable energy sector, achieving a total installed capacity of 17 174 MW, which is 10.4% of total energy generation capacity.

The wind sector contributes a major portion of this capacity followed by small hydro facilities. However, the rapid growth in the sector requires an extensive pool of competent manpower to design, install and maintain the renewable energy system. This requires including the relevant courses at all levels of the skill pyramid to provide a skilled workforce in both new and existing occupations (CII-MNRE, 2010). It is estimated that the solar industry will employ at least 100 000 specially trained persons across the skill spectrum including management, engineering and R&D personnel.

This involves an R&D programme to enable the creation of more affordable and convenient power systems and to promote innovations that enable the storage of solar power for sustained and long-term use. Similarly, emphasis on the production of bio-fuel derived from renewable biomass resources such as Jathropha wasteland or deserted land would provide energy as well as livelihood security to people. This is done in co-operation with the local community through Gram Panchayats, gram sabha and intermediate panchayats. This would generate direct employment not only to local people but in value chain employment to the large number of people engaged in the research, processing and marketing of such fuel.

Jobs in renewable energy cut across a wide spectrum of specialists along with some generic skills. The generic skills occupations include communication, engineers, community outreach, marketing, planning, finance, accounts and IT (CII-MNRE, 2010). The specialist occupations include particular energy specific knowledge for engineers. The key occupations in the renewable energy sector include a range of high-, medium- and low-skilled occupations. The high-skilled occupations include project designers, architects, atmospheric scientists, resource assessment specialists, environmental consultants, lawyers, facilitators, land development advisors, NGOs, public relation officers, etc. However, in the Indian context, illiterate or semi-illiterate women are trained to take up activities such as those provided by the Barefoot College, to assemble solar lamps, lanterns and charge controllers; test and fabricate these parts; unit installation and maintenance. A large number of technicians are trained in these sectors.

Box 12.3. **Rice husks for energy: A case study from Bihar**

The Husk Power System (HPS) initiative was launched in 2007 to provide affordable, reliable and environmentally sustainable energy to rural populations by using rice husks as fuel. Today, HPS has 57 plants across 250 villages of Bihar and Uttar Pradesh impacting 200 000 lives. It provides electricity to about 10 villages every week and plans to install 6 000 plants by 2014, which would provide electricity to around 6 million people.

These villages fall under the Indian rice belt and previously had no access to electricity, which had adverse effects on the development of these villages. HPS builds, owns and operates 35, 100 KW "mini power plants" that use waste rice husks to deliver electricity to off-grid villages in the "Indian Rice Belt". After paddy rice is processed, a huge quantity of bio-mass is left as a residue in the form of rice husks. This rice husk, when used in efficient gasification or combustion systems, has a considerable potential to generate energy. HPS initiatives save 42 000 litres of kerosene and 18 000 litres of diesel per year.

About 300 kilograms of rice husks are required as raw material to provide 40 kilowatts of energy, which in turn is sufficient to supply energy to 500 households for 6-12 hours per day. For each megawatt of power generated, about 5 800 tonnes of CO_2 emissions reduction can be achieved every year. HPS also provides training to unemployed literate and neo-literate local villagers on the operation and maintenance of the power plants.

Source: Information provided by ICAR (2013).

Box 12.4. **Barefoot College of Tilonia, Rajasthan – Solar Energy**

The Barefoot College works to improve the living conditions in remote and disadvantaged village communities across India. One of its main objectives is to secure durable access to clean energy. With this aim, it has been encouraging rural people in Rajasthan to gain practical knowledge and skills leading to work as barefoot solar engineers to install and maintain solar photovoltaic lighting systems in their communities.

The project works on a community basis and at the beginning an energy and environment community is formed, with at least 30% female representation. The committee determines the monthly payment each family must make for their solar lighting system, which includes costs for maintaining the systems. The committee chooses men and women from the poorest families to train as barefoot solar engineers who are trained for three to four months at the Barefoot College, Tilonia at Rajasthan in the fields of installation, maintenance and repair of home solar lighting systems, solar water heaters, solar vegetable dryers and solar cookers.

By 2009, a total of 472 barefoot solar engineers had been trained in India and other parts of Asia and Africa and about 20 000 solar lighting systems and 65 solar water heating systems had been installed. With the introduction of the solar lighting/heating system, there is less reliance on kerosene, which reduces air pollution and CO_2 emissions.

Source: Information provided by Bare Foot Engineers (2013).

There are both generic and specific skill gaps in the sector. The generic gaps include planning and co-ordination, project management, erection, commissioning and grid integration of large-scale renewable energy projects, installation and commissioning skills and technological marketing skills. The specific skills gaps include design and fabrication of bio-mass gasifier, erection and commissioning of large-scale bio-mass plants, feed stock planning and management of bio-mass plants, design and installation of BIPV systems, grid integration of MW scale, solar PV, etc.

The skills required for development and deployment of cost-effective renewables need inter-disciplinary approaches, innovative financing and marketing. In 2010, the sector was estimated to employ about 350 000 people, in both direct and indirect employment. The main functional areas include manufacturing, fabrication, installation, operations and maintenance, project development and marketing. It is estimated that the employment opportunities in India will increase manifold by 2015, when it is estimated that in a high growth scenario, employment would be in the order of 700 000 and in the long term 14 000 000 (CII-MNRE, 2010) This has given rise to new occupations, such as managers and operators of renewable energy systems, and hybrid or cross-sectoral occupations, such as energy auditing and efficiency services.

Managing drinking water and sanitation using clean technologies

The availability of safe drinking water and a safe environment is must for a healthy life. The government of India has initiated a large number of programmes using the community model. Community mobilisation has not only helped achieve the objective but also helped generate local employment. Village communities and NGOs play an important role in achieving these objectives.

Box 12.5. **Migrant brick kiln workers and rural sanitation movement in West Bengal**

The Rama Krishna Mission Lok Sikha Parishad initiated sanitation promotion activities in 1981 as part of integrated child development activities in some villages in West Bengal, and later designed a demand-driven sanitation project jointly with UNICEF. It implemented the same project in the district with the help of Midnapur Zila Parishad. It associated and affiliated the village youth club and cluster organisations as grass root partners and provided facilities. The model was replicated in ITAMOGROW Gram Panchayat to construct common toilets for brick kiln workers by persuading and convincing the brick kiln owners of the need to build sanitation facilities.

Today all the brick kiln works in ITAMOGROW provide toilets for their workers and open defecation has become history. The faith-based NGO has achieved this major work in sanitation by mobilising people and in setting standards of rural sanitation by training and employing local people, many of them women. The Midnapur Model involves building community awareness through folk media and ICT to generate awareness. A delivery network has also been established in Midnapur District which has played an important role in making the distribution of toilets easy and cost effective.

Source: Taken from information from Rama Krishna Mission Lok Sikha Parishad.

Water and sanitation related activities can be grouped into three categories: hardware operation, maintenance and monitoring, and social mobilisation. It requires master masons, village masons, mechanical fitters, caretakers, trainers and motivators. It was found that as regards hardware operations for safe drinking water, women could be engaged with the help of trained village masons. Operation, maintenance and monitoring have been the responsibility of the village community, trainers and caretakers.

The village people have no previous experience of performing these jobs but acquiring the masonry skills was not difficult. A high emphasis was placed on intensive, area-specific and time-bound social mobilisation activities for demand generation involving different skills sets. Training was provided by the village mason to women involved in hardware management and operation and maintenance training was provided by the NGOs (Vipin Kumar, 2010).

Maintaining environmental sustainability through afforestation: Production forestry (medicinal plants), social forestry

Afforestation helps in socio-economic development, employment generation, ending migration and the development of infrastructure. The total forest cover in India is about 23% of the land area. It is proposed to increase this to 33% by 2030. The Prime Minister of India has announced a Green India Campaign for the forestation of 6 million hectares. This would result in the protection and conservation of natural resources through the active involvement of people and provide ample employment opportunities to rural communities, including disadvantaged populations, using the traditional skills of planting. However, it would also result in skill enhancement, improving the employability of rural people in terms of knowledge about different plants and in occupations that may emerge using these plants.

The NREGA is an example of how public policy can facilitate environmental protection public employment. Intervention of the NREGA like water harvesting, recycling, installation of solar water heaters, tree plantations, composting, sustainable harvest of forest produce not only have direct employment benefits, but in the process can create green jobs. These activities have significant socio-economic benefits as they employ poor, unskilled and semi-skilled workers who would generally be able to do this type of work with minimal or limited training.

Under this programme, the plantation of Jathropha and Pongamia are encouraged, which is helping with biofuel, substituting diesel and ethanol, thus reducing GHG emissions. This is creating direct and indirect employment on the one hand and protecting the environment on the other.

Energy efficiency and green building

Meeting increasing energy demands through energy conservation is one of the objectives of the government's policy for increasing energy efficiency. The consumer and local government are the key players in promoting and implementing energy conservation technologies. The Energy Conservation Act, the Energy Conservation Building Code and the Bureau of Energy Efficiency have been put in place. They facilitate the optimisation of energy consumption. A study by the Ministry of Environment and the Ministry of Power, Bureau of Energy Efficiency entitled "India: Addressing Energy Security and Climate Change in 2007" indicated that application of the energy conservation building code has reduced the energy demand by more than 50% in new buildings constructed in New Delhi area. The emphasis is placed on the construction of new green buildings or converting existing buildings. A green building encompasses features such as sustainable site planning, optimum energy efficiency, use of renewable forms of energy, water and waste management strategies, use of fly ash bricks, etc.

The employment of new technologies and a management system gave rise to new skills as a result of green restructuring and also to new occupations, such as energy auditing and efficiency services.

Box 12.6. **Green Building Initiative at Pune for Energy Conservation**

The Pimpri-Chinchwad Municipal Corporation (PCMC) is the first municipal corporation in India to introduce energy efficient buildings by giving incentives to builders and property tax incentives to residents. Through this initiative, there is a saving in potable water use, waste water treatment and solid waste management. The developer gets a discount in premiums for building permission charges and discounts in property tax for end users after taking possession from the developer. The property owners of green buildings benefit from a reduction in pollution related to air, noise, soil and water.

PCMC is making a conscious effort towards its responsibility to natural resources and the impact on society by incentivising the Green Rating for Integrated Habitat Assessment System, which is suitable for all types of buildings in different climatic zones in India. This rating system not only takes care of energy conservation but also looks into water and waste management, minimum destruction of natural resources and various other aspects in an integrated way.

The Green Building Movement in India is progressing quickly and has already covered 1 billion square feet in area. Green building involves a number of professionals. As of 7 October 2011, more than 25 000 people were directly involved in green building projects. By 2015, India will be a world leader in green building.

Source: Taken from information from Pimpri Chinchwad Municipal Corporation (2012).

Box 12.7. **Promoting energy efficiency in existing buildings: Sir J.J. Hospital, Mumbai**

The Maharashtra Public Works Department implemented energy conservation initiatives at the Sir J.J. Hospital in Mumbai. The hospital functions on a non-stop basis and operation theatres, high-usage medical equipment, HVA lighting systems, water heaters, elevators and water pumps are responsible for energy consumption. The awareness campaign initiated helped to substantially reduce energy consumption. It was recognised that staff lacked awareness, which resulted in wasting of electricity. In addition, there were inefficiencies due to deferred maintenance and replacement, suboptimal operating schedules, and reduced emphasis on operation and maintenance. The Sir J.J. Hospital adopted a multifaceted energy conservation strategy identifying effective methods and techniques to improve energy efficiency and reduce wastage.

The main measures taken to conserve energy included:

- maximising the use of natural light during the day in corridors
- turning off office equipment, fans and air conditioners during unoccupied hours
- educating people about reasonable and efficient use of water heaters and other electrical appliances
- plugging air leakages in air conditioner rooms
- turning off water pumps when tanks filled up.

The project used the quality circle concept wherein a small group of 6-12 employees from similar work groups meet on a regular basis to identify areas of improvement in their respective work areas. A quality circle team consisting of 11 members is implementing the schemes. It conducts several brain storming sessions using cause and effect to assign responsibility and delegate to team members. The tool helped in identifying the factors responsible for energy use and developing an effective strategy to use energy efficiently, minimising energy consumption. It has been estimated that the project has resulted in overall savings of USD 90 000 over a three-year period and resulting energy savings of up to 8.12 kwh.

Source: Maharashtra Public Works Department (2012).

Management of environmental pollution through mass rapid transport and adoption of cleaner technology – CNG, Delhi Metro

India is poised for rapid economic growth which, according to the 12th Five-Year Plan, will largely come from the manufacturing and service sectors. Since economic activities in these sectors are largely concentrated in urban areas, the environmental conditions of these towns and cities are important for India's growth. For cities and towns to be able to support the required level of activities, they must provide for an easy and sustainable flow of goods and people. Appropriate transport systems, which are both fuel efficient and lower in emissions, are thus the current priorities.

Vehicular pollution levels are hazardous to people's health and needs to be addressed by adopting suitable modes of transport using energy efficient clean technology, for example CNG and mass rapid transport programmes.

Box 12.8. **Towards clean air: Delhi Compressed Natural Gas Programme**

Delhi, the capital of India, consistently has levels of total suspended particulates that are above the standard level, and which sometimes reach 5-12 times above the recommended level. Air pollution sources are: transport, industry and domestic waste/emissions. The government of Delhi, with the aim of addressing this vehicular pollution problem, made it compulsory for all public transport vehicles to shift to compressed natural gas (CNG) in a phased manner for vehicles that are more than 15 years old. It therefore introduced Bharat Stages II, III and IV to replace the Euros II, III and IV.

The introduction of CNG buses has resulted in a substantial reduction in PM emissions, as they are 50 times lower than a Euro II bus. As a result of these reductions in toxic emissions, 3 629 lives have been saved per year (World Bank, 2005). The introduction of CNG has resulted in the creation of job opportunities for drivers, mechanics, CNG filling station employees, etc. There is a need for trained mechanics to handle and repair the CNG tools and machineries, which requires an immediate increase in the number of training institutes providing these resources.

Source: Delhi government reports.

Box 12.9. **Mass transport through clean technologies: Delhi Metro**

India's first modern metropolitan rail transport project, Delhi Metro, was initiated in 2001 to cover a total distance of 413.83 kilometres in a phased manner. The Delhi Metro has made travelling easy and comfortable and has also had significant environmental and social impacts. A study conducted by the Central Roads Research Institute reveals that Metro railway has helped save 33 000 tonnes of fuel and prevented the creation of over 2 275 tonnes of poisonous gases.

It has also helped commuters in Delhi save 66 minutes per day, on average, commute time, and reduced road accidents and congestion. The Delhi Metro has become the first rail-based methodology to garner 90 000 voluntary carbon credits for improving the efficiency of power transmissions in the system. The introduction of the metro has resulted in the creation of a large number of jobs for engineers, drivers, station attendants, signal staff, ticketing, construction workers and maintenance staff, among others.

Source: CRRI.

The introduction of CNG and the Delhi Metro has resulted in greening existing occupations and created new occupations as well. The IIT, Delhi has initiated a course for Delhi Metro.

Skills sustainability: Skill needs, skill response and skill gaps

The above analyses indicate that different regions are responding to the climate change agenda in existing or newly emerging jobs using existing or new skills. It is also evident from the above case studies that local development initiatives undertaken in conjunction with low-carbon strategies have influenced employment generation particularly for young people, women, farmers, rural populations and slum dwellers. In other words, social sustainability and environmental sustainability are associated. The skill response varied from sector to sector.

It was further obvious from the studies that the community mobilisation, participation of the civil society, awareness generation, social dialogue, active government intervention in certain sectors (evident from government expenditure in some of the key areas) and policy coherence are necessary to accelerate the transition to a low-carbon economy. This places focus on the commitment to innovation, research, investment both in physical and human infrastructure as well as social cohesion and partnerships. It also emerges that the national goals of sustainable development can be achieved effectively with the involvement of all stakeholders, including state governments.

While the lower level skills sets such as masons, segregators, drivers, loaders, collectors, general mechanics, etc. were available locally, skills in relation to new green occupations, such as processors and managers, were not available. In certain sectors like energy efficiency in buildings, the Indian Green Building Council and the Bureau of Energy Efficiency are conducting training programmes for energy managers and a national certification examination for energy auditors.

The Bureau of Energy Efficiency provides energy efficiency related information regarding buildings, appliances, agriculture, industries, and small and medium enterprises, and is creating awareness among users about energy saving appliances and techniques. The Ministry of Road, Surface and Transport is also organising training programmes for drivers and conductors of the CNG buses. In addition, courses have been introduced to train mechanics for CNG buses. Training is also provided to the attendants at the CNG filling stations.

The national missions under the National Programme for Climate Change clearly specify the training requirements for capacity building in the energy sector. A large number of agricultural universities are offering degree courses in different agricultural related disciplines. There is training institute that provides training on plant protection, pest management and locust controls, etc. These types of skills are required for improving agricultural productivity and managing agricultural land and crops. The Indian Council of Agricultural Research arranges needs based training programmes in new and emerging areas, such as organic farming. In addition, Kisan Call Centres, Kisan Channels and Krishi Vigyan Kendras are providing timely information and advice to Indian farmers. Weather and weather based agricultural management plans are also available.

In the renewable energy sector, there are also a large number of sector-based training and research institutes, including in solar energy (Solar Energy Centre for Development of Solar Energy Technologies); wind (Centre for Wind Energy Technology); the National Institute of Renewable Energy; the Alternate Hydro Energy Centre, among others. These

institutions promote power generation and provide some training facilities. In addition, the government has set up an Indian Renewable Energy Development Agency which provides term loans for renewable energy and energy efficiency projects.

A Co-ordinated Action on Skill Development with a vision to create the infrastructure necessary to improve availability of a trained workforce for the growing economy has been put in place. The National Skill Development Policy envisions the creation of 500 million skilled workers by 2022. The focus is on developing skills so that the demographic dividend that India enjoys can be converted to the advantage of the economy. About 18 central ministries and departments are running various skill training programmes, some of which are specific to the requirements of the individual areas. Many of the ministries are covering the challenges of growth.

There are over 8 000 industrial training institutes and more than 3 500 polytechnics in addition to the engineering and other degree institutions (8 000) which provide training to different skill levels. The course curricula in ITIs are generally designed to provide basic skills in about 200 trades. Through World Bank assistance, the government of India has created 500 centres of excellence in specific trades. Efforts are also being made to improve the training and development of university faculties to increase the placement of trained graduates and to arrange on-the-job training. To address the skill needs of some of the activities, i.e. footwear, garments, electrical appliances and the automotive industry, in the unorganised sector, the Micro Small and Medium Enterprise Ministry is running training courses.

The private sector has also been involved in training efforts through the National Skill Development Corporation to train people according to the market's needs. The industry is thus directly involved in the creation of skilled manpower. The current training capacity (about 4.5 million per annum) is not sufficient to meet the skill requirements of the growing economy. The skill shortages in general, and for green jobs in particular, in India have emerged as a result of inadequate training capacity as well as estimates about the proposed growth of the various sectors linked to the green economy. In a country like India, where the dropout rate at secondary level is very high, the availability of skilled people in adequate supply is a big challenge. There is a need to co-ordinate between environmental, developmental and skill strategies.

Although India has developed a National Skill Development Strategy and a Co-ordinated Action Plan on Skill Development has been initiated, there is still no particular comprehensive strategy for promoting skills in green jobs. In fact, industry linkages with the training institutes for all skills are at a very nascent stage. Efforts are on to upscale the initiatives by setting up sector skills councils. The education and training system faces a number of challenges in meeting the skill requirements of the green economy, for example, important aspects include: the system needs to be flexible to respond to the changing market environment, have an adequate supply of quality teachers, continuously revise curriculum and upgrade teacher's skills.

Mechanism for anticipation, matching and monitoring of skills needs

The transition to a green economy has a differing impact on the different occupations and skills required in different sectors. The shortage of required skills impedes the growth of the sector. The employment effects of the transition to a green economy can be gauged in terms of the creation of new jobs, the emergence of new occupations in the existing jobs, the need for new skill sets in the same occupations to handle new technologies

necessitating training/retraining of workforce to meet the emerging demand. Training requires the creation of adequate training capacities. However, capacity building requires a sound knowledge base of the types of occupations, jobs and skill requirement. This is a big challenge (ILO, 2011).

The information on skill requirements helps policy planners to design appropriate policies, provide resources and frame qualification standards and enables training providers to modify course curriculum. However, it is not easy to identify and anticipate the skill requirements in a developing economy like India, where more than 94% of the workforce is in the unorganised sector, whose boundaries cannot be identified. The change in the technology/production process or demand pattern would change the occupations and skill contents. This may or may not be reflected in the national occupational classifications (2004).

In a growing economy, anticipation of skill needs is a continuous process and requires a system for identifying skills. The Labour Market Information System is a handy tool but the problem lies in assessing the needs of a low-carbon economy. In India, data about employment, the workforce and the labour force is available through the National Sample Survey Organisation, the Annual Survey of Industry and *ad hoc* services. However, these sources of information about the labour market do not give a holistic view. India neither has a labour market information nor national occupational standards for all jobs. There is a National Classification of Occupations, but it does not provide detail on all of the occupations of the green economy.

The government of India has initiated a Co-ordinated Action on Skill Development to create 500 million skilled workers by 2022 to turn the demographic dividend to the advantage of India. The median age of the working population in India was 25.3 in 2009. However, only 2% of the workforce has formal training and about 8% some training as per NSS 2004-05 estimates.

This leaves about 92% of population engaged in the unorganised sector, with little or no formal training. Furthermore, the dropout rate in India (as per midterm appraisal of the 11th Five-Year Plan) makes it difficult to implement a vocational skills development programme. Perusal of the skill training programmes indicates that most of the courses are available for middle/secondary school graduates. The Ministry of Labour and Employment has made a start through the Modular Employable programme to recognise the existing skills of unorganised sector workers irrespective of their education profile. The existing training infrastructure in terms of 8 000 industrial training institutes and more than 3 500 polytechnics by and large cater to the requirements of the "brown economy". The lack of anticipation in skill requirements for the green economy is hampering the creation of adequate training capacity.

The anticipation of skill needs requires effective interaction between industry and training institutes. The National Mission on Strategic Knowledge for Climate Change has emphasised the need for identification of skill gaps, capacity building in dedicated centres, international co-operation and the promotion of R&D, among others. The key Ministries of Labour and Employment and Human Resource Development are expanding training capacity in terms of opening new institutes in uncovered areas and taking up new course modules. The Ministry of HRD has also revamped its policies for vocationalisation of education to enhance training capacity. In addition, the Ministry of Agriculture and the Ministry of Micro, Small and Medium Enterprises, which have bearing on the green economy, are also expanding their training capacities' on the basis of sectoral surveys.

Policy implications for the way forward

India's low-carbon growth strategy envisaged in terms of promotion of energy efficiency, use of renewable energy, afforestation, mass rapid transport, etc. is likely to result in a climate friendly growth path on the one hand and the creation of millions of green jobs on the other. These positions cut across different sectors and require different skill sets and competency levels that may or may not be available in the current skill structure. For example, in the renewable energy sector, there are skill shortages in wind power. Mechanics or technicians with the required skill sets may not be available. The greening of the economy is generating a demand for new skills as new activities and new markets emerge. This also raises the demand for new competencies.

There are currently 17 central ministries working in the area of skill development, and some of them are making efforts towards greening the economy. However, although their initiatives have impact on each other, they are all working in silos. The transition to a green economy requires co-ordination among different stakeholders. This would not only result in efficiency in expenditure but it would also bridge the skill gaps. The key recommendations are:

- *Effective co-ordination among different central ministries/departments at all levels.* This will involve planning, project preparation, implementation, monitoring and evaluation and the engagement of state governments. This co-operation would help to properly assess the potential of green jobs and the associated competency level, thereby meeting the skill requirements appropriately. This requires complete policy coherence at all levels.
- *Setting up a robust labour market information system at national and state levels* so as to have a clear picture about the skill requirements. The two should be linked for better monitoring skills. This would facilitate creation of adequate capacity for training in relevant sectors.
- Creating awareness and sensitivity towards environmental concerns in different spheres of economic activities among different stakeholders. Educating workers, employers, civil society and policy planners would help in protecting the environment. Awareness generation can be created through media campaigns, street plays, artwork, school curricula, etc.
- Along with creating awareness, it is also necessary that *all social partners are actively involved in the transition to the green economy*. India has a sound tripartite system wherein workers, employers and the government discuss proposed changes in labour-related regulations. However, this needs to be strengthened, particularly in the unorganised sector, where the work processes and related issues are not well defined and the likelihood of violating the regulations related to green processes is very high. A large number of activities in the transition to a green economy are likely to be carried out in the unorganised sector. Therefore, effective dialogue at all levels to mobilise all stakeholders for a smooth transition and integrated policy response is urgently needed.
- *Restructuring of syllabi and curricula in training institutes to suit the green economy*. A start has been made with the implementation of the Modular Employable Skills. However, in the absence of detailed database on skill requirements, it has not been possible to design the curriculum for the skills required for green jobs.

- The administrative and legal framework should be strictly enforced.
- Investment in clean development and green jobs has been growing rapidly in India in recent years as is evident from the government expenditure in some of the key ministries responsible for promoting the green economy. Such investment in clean technology has also created employment in green jobs. However, there is a need to *increase the scale of such investment*.
- Strengthen the ability of local enterprises and local training providers to develop innovative solutions for filling skill gaps.

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Chapter 13

Climate change adaptation and local development: The new imperatives for green skills development

Krishna Rao Pinninti

This chapter offers a set of plausible new definitions of green jobs that are consistent with climate change governance, and identifies focus areas for new skills development based on both mitigation and adaptation activities. In line with this, the lists of projects and activities relevant at local development levels are then mapped into local as well as non-local skill development activities that enable: i) *effective transition to a low-carbon economy;* ii) *integration with the adaptation activities; and* iii) *alignment with local economic development strategies, including the promotion of job growth. The roles of transaction costs and public policies to assist an effective transition to the green economy via development of green skills are clarified.*

Besides providing a broad framework, this chapter offers a summary case study of the United States' green jobs policy approaches, scenarios and changes in skill requirements. The current "process"-based and "output"-based approaches (as per the Department of Labor) for defining green jobs in the United States are redefined to include climate change adaptation activities, and adaptation of capacity building and governance activities. The operations mandated by the Federal Directives on Adaptation are examined for their integration into: i) *broader green job assessment;* ii) *identification of newer requirements for skill development; and* iii) *integration with local economic development and job growth. Illustrative sample strategies for green jobs at state and federal levels are reviewed, following the existing approaches toward the green economy and green jobs. It is suggested that a more comprehensive public policy towards the green economy is required as an effective strategy for local economic development, green job growth, green skill development and climate change governance.*

Climate change governance, green economy and skill development

Climate change governance (CCG) comprises efficient design and implementation of climate change mitigation and adaptation policies as well as capacity development for improved governance of environmental and economic policies. CCG includes the design and implementation of policies, institutions and programmes for climate change adaptation (CCA) and climate change mitigation (CCM), and efficient governance of the same: separately and jointly. Creation of adaptive capacity (AC) is a pre-requisite in this governance process. AC is the ability of a system to adjust to climate change and its adverse effects as well as to take advantage of potential opportunities offered by change.

When it comes to green jobs, think global and act local is relevant. CCA possesses local dimensions of CCG whereas CCM applies largely at non-local levels. At the global level, the 2010 Cancun Adaptation Framework and the 2011 Durban Agreement under the UN Framework Convention on Climate Change (UNFCCC) focus substantially on CCA. The follow up activities in this context address local economic development, and integration with various local development plans. Article 6 of the UNFCCC addresses the role of capacity development. However, the relevant activities need to be stepped up across the world from their current limited focus. These activities possess considerable additional potential for skill development as well as the creation of green jobs, both in developed and developing countries. Developed countries can offer considerably more services in various skill-deficient countries, and in this process augment their own pools of green skills expertise.

Another important aspect of the integration of global and local economies with significant implications for green job growth arises from a possible successful culmination of decade-old negotiations for an Agreement on Environmental Goods and Services (EGS) under the World Trade Organization (WTO). Starting with the lack of an agreeable definition of EGS, the negotiations are bogged down. A meaningful definition needs to expand on the current limited set of technologies and services in order to address both CCM and CCA activities (Rao, 2012). If and when this is done, the creation of green jobs and the enhanced demand for green skills will expand rather significantly. It is also important to note that the Doha Round of Trade Negotiations under the WTO charter do not mention “climate change”. A revised approach that stays in tune with new knowledge on climate change enables a jump start to the process, augments trade in EGS, expands green job markets and enhances economic progress via green economic growth.

Many of the current concepts of green jobs fall short on encompassing these wide sets of activities around the world, as the focus has been mainly on jobs associated with carbon mitigation activities. CCA is largely complementary to CCM activities, with a greater focus on relatively shorter term horizons and local levels to cater to the on-going adverse impacts of climate change. Martinez-Fernandez et al. (2010) rightly pointed that “green” terminology needs to be applicable to activities that contribute to both CCM and CCA.

In addition, when broadened to include AC activities, the quality and quantity of jobs expand to cover a large set of economic development activities that belong to “greening” activities. A paradigm shift is called for in this regard: most definitions of green activities and therefore of “green jobs” fall short in relating to climate change but attempt simply to focus on the environment and carbon emissions (see below and also a summary in Martinez-Fernandez et al., 2010).

To be sure, we do not want to focus merely on a set of contributory factors but rather to gear up for the bigger and overarching phenomenon of climate change, its contributory factors as well as governance of the adverse impacts. Nothing in the desired paradigm shift will diminish the focus on CCM as it is being conventionally attempted as regards greening the economy or relating it to green jobs. Instead, we need to focus on the integrated framework that also facilitates cost-effective provision of resources, creation of more productive jobs in relation to CCG and seeks sustainable development at local and regional levels. There are hardly any estimates of "green jobs" when the integrated framework is adopted, however. This is because CCA mixes with a variety of local economic development activities cutting across almost all sectors of development. Thus, the road to developing an empirical estimation of relevant jobs will be lengthy for some time. Yet this approach broadens the narrow "clean energy" job perspectives of green jobs and enables eventually addressing CCG and sustainable development where the creation of green jobs remains an imperative for achieving both short-term goals and long-term objectives.

The ILO feature on the "Green Jobs Programme" (www.ilo.org) rightly argues that skill development and capacity building for workers, entrepreneurs and public entities is an important activity to address the imperatives of CCG. It is useful to include jobs related to CCA as part of green restructuring jobs. This expansion of the definition of green jobs is also seen in the ILO Programme on "Employment for Social Justice and a Fair Globalization".

As governments and private industry increase their efforts to take advantage of the economic opportunities offered by new low-carbon economies (Cedefop, 2010), the need to ensure the availability of skills is even more urgent when we add the imperatives for CCA which have a high priority for implementation. The urgency is further explained in a recent special report (SREX) of the Intergovernmental Panel on Climate Change (IPCC) on the expanded sets of extreme events possibly contributed by climate change (IPCC, 2011).

Various CCA activities may be classified in relation to the sectors, time-phases, institutional bases and so on. For the purpose of this chapter it is useful to recognise the categories: autonomous adaptation (the process as a spontaneous response to changes, taking place in private enterprises, households and individuals in response to climate change and its effects), and pro-active/planned adaptation (with interventions via public policy, anticipative measures in various entities, and related actions and plans for CCA). Investments and job training activities for green economies often belong in the arena of CCM but some overlap with either of the above CCA activities. The overlap is incidental rather than planned: detailed assessment of vulnerabilities, impacts and the design of policies for effective CCA constitute major exercises for pragmatic actions. These involve further expansion of green skills, toolkits and training activities for this purpose.

The mismatch of jobs and skills in job markets is more a normal feature than an exception in most scenarios. The key issue is the extent of the gaps between the demand supply of skills at any given point of time, and the role of public policy in reducing the gaps without excessively interfering in the smooth functioning and development of market institutions. The well-known phenomenon of "creative destruction" cannot be avoided, but the process of transition to new phases needs to be governed by local, regional, national and international policies for "adjustments with a human face". This is especially important and urgent to avoid social upheavals in light of large-scale unemployment. The transition to a green economy requires some of these approaches.

Combining policies that increase the AC of labour markets with measures such as unemployment insurance and in-work benefits ensures that the transition and adjustment toward green growth is not attempted at the expense of the income security of current workers (OECD, 2011).

An important pathway to promote green job growth is to incorporate it as an integral element of green growth policies. This route to economic development draws upon the synergistic links between skill development, provision of relevant resources and catering to the imperatives of CCG. Investments in CCA, preferably in public-private partnerships, enable new and expanded economic activity, thus supporting the expansion of green jobs in key sectors. Currently, much less attention has been paid to jobs that address various CCA and climate resilience (climate-proofing) measures that societies address in light of the adverse effects of climate change (UN Global Compact, 2011).

Local development

Local development strategies remain the focus for activities in the areas of climate resilience and CCA. These include, but are not limited to, low-carbon economies and available joint approaches to mitigation and adaptation aspects of CCG. An effective CCG requires integration of the relevant policy imperatives of CCA and those of green economic development in the regional context. Various indicators relevant for CCA and for a low-carbon economy can be deployed here to link to policy instruments and for measuring progress. In the process, job market implications for various skills and for workforce development, such as skills retraining, can be detailed for various locations, sectors and entities.

Public sector units, including public energy utility entities, should take on a stewardship role in local development, for the following reasons: their critical impact is significant, they possess human resources that can be quickly retrained, and goal setting is easier than in small and medium enterprises. Eco-innovation is better achieved in public-private partnerships, including via the role of research institutions. The roles of public entities in promoting job training and retooling tends to be better accomplished when area-specific entities pool their resources. In this process, they can reap the skill development benefits for their respective enterprises as well as create local public goods for the benefit of all. Functional area-based as well as sectoral policy approaches are relevant, simultaneously, in effecting the transition to a green economy at local and regional levels (Martinez-Fernandez et al., 2010). This approach takes on an additional dimension when incorporating CCA by prioritizing interventions that address the vulnerability of systems and segments of the population to the adverse impacts of climate change. The development of green skills needs to cater to these dimensions of inclusive sustainable green growth.

Embedding CCA in local development rather than as a special programme is important. However, separate goals may have to be set for CCA in view of some of the urgent measures required. Adaptation needs tend to be local and green jobs and green skills are thus factors that can enhance local employment potential (Harsdorff et al., 2011). If companies create shared values by sourcing from small and medium-sized enterprises, thus creating local jobs, local communities will have a better economic base and capacity for resilience.

Strengthening local institutions, co-ordination among agencies, and upgrading or retooling skills are among the known urgent tasks for local development. The barriers to their implementation are commonly observed in most OECD countries: limited co-ordination among administrative agencies at all levels, disproportionately small resource allocations to address CCG and for human resource development (including adaptive capacity). An effective strategy toward multi-level governance of the green economy and green jobs with a key role for the public sector maximises the potential of local green strategies (OECD, 2012). Cluster-based or agglomeration approaches toward technical innovations and diffusion of new technologies have been advocated in a recent report which also includes the role of CCA (OECD, 2012). The local strategies approach towards a green economy, green jobs and sustainable development is a high priority and remains consistent with the economic foundations summarised at the beginning of this chapter. In the next section reviews related applications in the US context, with a few pointers toward further development with an enhanced role for green skills.

Tools (see Eberts, 2011) relevant for analysing the green economy and skill requirements include input-output tables (local and national) and occupation-skills tables. These methods need to be complemented with relevant dynamic analytical models, assessments of plausible scenarios of changes in skill demand over time, sensitivity to technological and market uncertainties, and applications of stochastic as well as dynamic versions of input-output methods.

The lists of projects and activities relevant at local development levels can be mapped into local as well as non-local skill development activities that enable: *i)* effective transition to a low-carbon economy; *ii)* integration with the adaptation activities; and *iii)* alignment with local economic development strategies, including promotion of job growth.

The next section highlights the policy and implementation aspects of the United States' green jobs and CCA approaches. This is not an exhaustive survey but is rather an illustrative summary.

United States case analyses

The United States' situation in green jobs and green skills is a story still in the making as far as current policies and implementation are concerned. A largely decentralised autonomous and uncoordinated approach dominates the economic paradigm. Whenever an attempt has been made to steer these activities, it has been fragmented and feeble. A proactive role for the federal government has its own limits, given the relative roles of state, county and municipal governments. However, a more active and effective catalytic role for the federal government is desirable and feasible.

An assessment of green jobs may be attempted. A study by the Brookings Institution (Muro et al., 2011) concludes that the "green" economy employs 2.7 million workers and offers more opportunities for low- and middle-skilled workers than the aggregate economy; specialised industry clusters boost growth performance; and suggests scaling up the measures to promote green industry. The study observed that the green jobs growth rate lagged behind that total employment growth rates, and this suggests there are problems in the design of policies and their implementation. However, this study is limited in its scope by a narrow definition of green jobs.

We begin with the definition of green jobs, and this is subject to the same limitations of not including all jobs associated with CCG, discussed earlier in a general context.

The US Department of Labor (www.data.bls.gov) defines "green jobs" as:

- output approach jobs: jobs in entities that produce green goods and services or conserve natural resources
- process approach jobs: jobs associated with entities that use environmentally friendly production processes and practices or use fewer natural resources.

A revised approach is needed to reflect not only CCM-related activities and outputs but also CCA related activities so that the entire gamut of CCG is covered under the green jobs definition. This approach enables a better focus on the required capacity building activities in relation to the imperatives of CCG, skills development and supporting transitional phases in the relevant segments' job markets. Table 13.1 refers to the environmental goods and services categories, and is not necessarily inclusive of establishments focused on CCA. These often overlap with the entities listed in the table but are not necessarily classified in the relevant categories if they do not follow green practices.

Table 13.1. **Sectors classified for green goods and services in the United States**

Construction	820 700
Professional and business services	779 100
Other services (repair and maintenance, professional organisations)	183 300
Natural resources and mining	88 700
Information	77 000
Manufacturing	77 000
Trade, transport and utilities	49 300
Public administration	42 100
Education and health services	26 400
All other sectors	10 400
Total	2 154 700

Source: US Bureau of Labor Statistics, www.data.bls.gov.

The US Inter-Agency Task Force Reports on CCA and the follow up by the White House Council on Environmental Quality with directives to all federal agencies to formulate agency plans for CCA suggest a few multi-level actions but a number of links in their integration with local development and green jobs are missing.

The Task Force Reports offer a few important guidelines, such as adopting an integrated approach and prioritising the most vulnerable, but they offer few clues to the dovetailing of skills for the new activities (see also the Federal Agency Climate Adaptation Planning Instructions for Implementing Climate Change Adaptation Planning in Accordance with Executive Order 13514, www.whitehouse.gov/ceq). The Federal Agency Climate Change Adaptation Planning Support Document of 4 March 2011 does not go beyond asserting that "building awareness and skills will require education and training, enabling structures and leadership". The Department of Labor (DOL) does not appear to have a role yet in these sets of activities; it is not represented on the Inter-Agency Working Group on CCA.

The US Federal Directives on Adaptation need to be integrated into: *i)* broader green job assessments; *ii)* identification of newer requirements for skill development; and *iii)* local economic development and job growth. This is an exercise that needs priority attention.

The US Environmental Protection Agency (EPA) has been working on community and local sustainability actions and offering tools for possible adoption. However, there is little recognition of the availability of necessary skills or gearing up green jobs to cater to the new demands, besides falling short on catering to the CCA requirements. There is an obvious need for the EPA and DOL, as well as other agencies, to co-ordinate activities for green skills development. There is also a need to improve the conceptual and analytical bases for the green economy and green jobs approaches for both entities.

The EPA needs to expand and adopt the approaches relevant for CCG rather than merely focus on the "clean energy" sector for a green economy. Similarly, the DOL needs to move in tune with the imperatives of broader skills for green jobs to enable a green economy and sustainable development, with CCG as one of its modes for application in defining, creating and assessing green jobs. Summarised below are a few programmes of relevance in green skills development, green jobs and the low-carbon economy; however, none of these relate directly to the imperatives of activities that are urgently needed for CCA.

Both federal and state level approaches to the green economy are currently confined to clean energy and environmental governance rather than in relation to CCG. Among the exceptions to the current norms of defining and assessing green jobs, the state of Oregon expands its focus to include education, policy promotion and related services but again, only in the context of CCM.

- Training programmes and the Department of Labor: The US DOL supports a network of job training centres, many with a green skills focus, and offers a variety of grants (DOL Sustainability Plan, 2011). These include green capacity building grants (operating for three years with a range from USD 42 000 to USD 100 000), energy training partnership grants (25 awards of about USD 1 million), state energy sector partnership and training grants (34 awards from USD 2.5 million to USD 6 million), Pathways out of Poverty grants (38 grants in the range of USD 2.1 million to USD 8 million), and state labour market information improvement grants (30 grants from USD 765 000 to USD 4 million).
- WIRED: The US DOL has been carrying out a phased expansion of its major initiative called "Workforce Innovation in Regional Economic Development" (WIRED), based on the premise that successful regions are those which demonstrate the "ability to network innovation assets – people, institutions, capital and infrastructure – to generate growth and prosperity in the region's economy". The initiative was launched in 2006 and expanded to 39 regions in the country, which represents a very tiny part of the desirable coverage of regions. The grants are of the magnitude of USD 15 million for each region for three years. The focus of the WIRED Initiative is not necessarily on the green economy or green jobs, rather, it is an illustrative application of job training and local economic development with an agglomeration or cluster approach to foster innovation and technical development. A number of other policy initiatives have been initiated at federal and state levels from time to time, albeit at a very small scale. Illustrative examples are given below.

- Green Challenge i6: The Economic Development Administration Division of the US Department of Commerce launched the so-called i6 Green Challenge which involves federal support of investment to promote clean energy innovation and job creation, with the participation of the Departments of Energy and Agriculture, the EPA, the National Science Foundation and the National Institutes of Standards and Technology, among others. Six grants have been awarded so far and range from USD 1 million to USD 7 million each.
- Green Enterprise Zones (GEZ): Designed by the USDA Rural Empowerment Program (started in 1993), it created 57 zones, which are primarily community-based partnerships based on the adoption of principles of sustainable community development. Each zone focuses on manufacturing for the green economy, research and development for green companies, green service providers and green building design. The scale of operations is still small, believed to have created 28 000 jobs. Establishing a GEZ requires co-ordination between local and state level agencies. The state offers a set of incentives such as tax relief, workforce training grants and export assistance. Local agencies enable development permits, property tax reductions and other such incentives.
- Local development and cluster strategies: The Washington state government launched the Climate Change Challenge and prepared plans under the "Washington State Green Economy: A Strategic Framework" in 2009. In 2008, the State Workforce Education and Training Co-ordination Board, in its report "Skills for the Next Washington", suggested rightly that clusters of industry groups are "where economic growth is most likely to occur and where innovation is most likely to begin". The Governor directed the state economic and workforce development entities to develop a plan to support co-ordination at the state and regional levels, with a special emphasis on the key economic clusters. However, the approach cannot be effective without the assistance of the state in several forms, including provision of appropriate incentives and co-ordination. Recent reports (see the *2011 Green-Economy Jobs Report of the State*) show that the scale of green jobs declined by about 18% from 2009 to 2011. However, given the emphasis of the state on a range of CCA activities, the total number of green jobs – when defined in relation to CCG – are expected to have risen significantly.

Policy implications

It is useful to recall one of the suggestions made during the US-Canada-EC Trilateral Roundtable on the "Employment Dimension of the Transition to a Green Economy" (held at the Department of Labor, Washington, DC, in February 2011): adapting education systems and training programmes to the emerging skill requirements is needed, as well as support to workers affected by the transition to a green economy.

It is suggested here that green jobs be defined as: all jobs associated with the activities (planning, information gathering, information processing, implementation, co-ordination, monitoring and evaluation, and related research and development) of the creation of adaptive capacity, climate change adaptation and mitigation. In effect, jobs associated with the entire gamut of activities in relation to climate change governance should be termed as green jobs.

Public policy and resource allocation limitations constrain CCG and job creation. Limited resource allocation for training and skill development and a lack of awareness among decision makers are major obstacles that hamper the effective integration of

human resources and CCG. Green jobs are scarce wherever public policy is not sufficiently supportive, beyond peripheral efforts; multi-level co-ordination and policy coherence is required. Green skills are what we make of them; we need proactive approaches to develop and avail their roles in a sustainable society. To imagine waiting for the market to lead policy rather than the other way around, we need only to remind ourselves what could happen in light of the adverse effects of climate change and a lack of preparedness if we rely on the market factors.

Barriers to the expansion of green jobs and the development of green skills are similar to those that pertain to the areas of adopting a green economy, CCG in general and CCA in particular:

- lack of awareness about the full complexity and interdependencies of effective CCG
- limited co-ordination across several major departments and entities, across policy making and implementation agencies, and filtering to the local government as well as various public sector units
- lack of understanding of the critical minimum thresholds to realise efficiency gains and increasing returns to scale (endogenous growth potential)
- ineffective implementation of programmes due to co-ordination constraints
- lack of sufficient training in green skills and limitations of relevant workforce development
- scale of operations too small (in several cases in the United States) to depict positive gains that could motivate expansion
- economies of scope and of transaction costs make it imperative that the green economy and green jobs are assessed and corresponding policies designed with the CCG as an overarching framework rather than environmental governance alone
- path dependency of some of the administrative agencies in terms of lack of integration with relevant CCG aspects.

Key recommendations

- Increase the scale of successful programmes, with the use of cluster-based promotion of green businesses.
- Expand training and skill development mechanisms for the workforce as well as for employers (public and private) on a larger scale that augment adaptive capacity and enhance adaptive efficiency.
- Design green economic strategies with essential elements and their threshold magnitudes so as to reap the benefits of networking and endogenous economic growth.
- Ensure that climate change adaptation is embedded into green growth strategies and sustainable development.
- Formulate and implement win-win strategies for local sustainable development incorporating ingredients of CCG, skills development and an accelerated smooth transition to a green economy.

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Chapter 14

Lessons from the project "Employment Centres and Sustainable Development" in France

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In France, buildings consume more than 40% of all energy. Reducing this consumption is one of the main objectives of French climate change mitigation policies. This objective represents a major challenge for the construction sector, which needs to be ready to deliver buildings and renovations offering high energy performance. If current construction and renovation technologies are to deliver the expected results, they require specific skills that most building sector companies do not currently have. This skills gap is a strong obstacle to reaching the set objectives.

The project "Employment Centres and Sustainable Development", initiated by the French Environment and Energy Management Agency (ADEME) and the association Alliance Villes Emploi ("Cities' Employment Alliance", a national network of local authorities working on employment, inclusion and training issues), is based upon this assessment. The project initiated an innovative approach to trigger stakeholders' mobilisation in order to better anticipate the effects of climate change mitigation policies on employment and skills across 33 territories.

French context and objectives for promoting a greener economy: Focus on the building sector

National strategy in the building sector to contribute to the EU 2020 targets

The fourth biggest emitter of greenhouse gases (GHG) in France, representing 25% of national emissions, the building sector is the largest energy consumer, with 42% of the final energy consumption in the country in 2008 (65% for residential and 35% for tertiary use).

Despite the gradual strengthening of thermal regulations for new buildings since the 1970s and more recently for existing buildings, GHG emissions have grown steadily (+15% since 1990). This can be explained by the strong increase in the park (+41% over the last 30 years) and by higher electricity consumption accompanying the development and use of electrical and electronic equipment (household and office appliances).

The potential energy savings in this area are large, but require increasing awareness and training on how to use and apply new means of regulation.

According to these challenges, the "Grenelle Environment" process has provided France with a new planning law that establishes goals and measures for reducing energy consumption in the building sector. This law additionally gives a major role to local authorities for climate change mitigation policies, both in their skills and in their areas of influence.

The Grenelle Law, published in August 2009, establishes measures and targets for reducing the energy consumption of and GHG emissions from new and existing buildings. It relies on the Grenelle Building Plan, launched in January 2009 and mobilising most, if not all, of the relevant actors from the building sector (institutions, local authorities, social landlords, construction professionals).

The Grenelle Law 1 relies on three fundamental levers:

1. *The energy and thermal renovation of existing buildings* to reduce their energy consumption by at least 38% by 2020. To do this, the law has set the following targets:
   - the complete renovation of at least 400 000 homes per year from 2013
   - to reduce the energy consumption of state buildings and of its public bodies by at least 40%, and the GHG emissions from these buildings by at least 50% by 2020 (territorial communities are encouraged to take the same objectives)
   - the renovation of all social housing units, starting with the rehabilitation of the 800 000 most energy consuming ones, by 2020 so as to reduce their consumption of primary energy to 150 kWh/m^2/year.
2. The reduction of energy consumption in new buildings by a gradual strengthening of the thermal regulation:
   - the generalisation of low energy buildings, consuming on average 50 kWh/m^2/year of primary energy by 2010, in the case of public buildings, commercial buildings or housing as part of the ANRU (National Agency for Urban Renovation) programmes, and by 2012 for all other buildings

   - the generalisation of energy positive buildings, which produce more energy than they consume, by 2020 for all buildings.

3. The arrangement of necessary funding measures to support this work:
   - privileged loans envelopes
   - strengthening the tax credit for sustainable development.

National policies and strategies related to green skills and jobs in the building sector

In France, two main initiatives are framing the development of a green economy in the building sector:

- the "*Plan Bâtiment Grenelle*", which implements and co-ordinates the French government's programme to improve the energy performance of buildings
- the French "National plan for mobilisation of industries and territories towards a development of jobs and skills in a green economy" ("Green Skills Plan", 2009), developed by the French Ministry of Ecology, Sustainable Development, Transport and Housing.

These two plans work close together so that the expertise on green building can better serve the Green Skills Plan discussion about jobs and skills.

The "Green Skills Plan" identified 11 fields suitable for the development of a greener economy, representing half of the French working areas. One of these fields is the building sector. These strategic fields will have to face major changes in the coming years and therefore there is a strong need to anticipate and manage their transition to a greener economy.

In the building sector specifically, studies show that no massive job creation is to be expected from the transition to a greener economy. There will rather be a progressive and massive change in professional attitudes and skills, concerning all professions and activities, not only the ones related to the use of new technologies.

In renewable energy production in buildings, it was shown that skilled professionals are already lacking in the market, as are professors and trainers.

Consequently, a massive evolution has to take place in education and vocational training, as well as in policies for jobseekers, communication toward enterprises' management and other stakeholders, etc. In such a context, transversal skills will become crucial to allow jobseekers to skip more easily from a job to another. Nevertheless, professionals from the building sector are often reluctant to undertake/provide training and their current working habits will need to evolve substantially to allow buildings to achieve good energy performances.

The skills gaps

With nearly 1.5 million workers and a very heterogeneous structure, the building sector is one of the most important economic sectors in France and has a significant potential for job creation.

The changes brought about by new thermal regulation and new construction and energy performance targets strongly impact the sector's construction habits and trades. The quantitative and qualitative changes required to achieve energy performance in buildings are posing important challenges to the sector's professionals and training, both initial and vocational, appears to be one of the major challenge for the success of Grenelle commitments.

Professionals have to learn to work differently and to better co-ordinate their work on construction sites together in order to achieve the desired overall energy performance. More precisely, the sector's professionals themselves have identified three main skills gaps:[1]

- From a technical point of view, professionals have to get used to new construction materials and new technologies.
- Builders also have to learn to work differently on construction sites and better co-ordinate their work. There is a need to develop a common working culture in order to achieve the required final energy performance of buildings, which will soon become mandatory.
- Finally, craftsmen and entrepreneurs should develop transposable management skills to be able to position themselves for new tenders, including energy efficiency requirements.

Education and continuing vocational training in the building sector: Frame and current needs

Since 1971, continuing professional development in France is a national obligation and "continuing vocational training" (CVT) relies on the requirement, for an employer, to financially contribute to public funds used to finance training for each employee, as well as the right, for the employee, to receive training during his work time.

In the building sector, CVT is organised both at the national and regional levels. At the national level, it is managed by "Constructys" and "Pôle Emploi" (state organisation for employment). At the regional level, the requirements for professional training lay in the hands of the regional councils. The CVT can be delivered by private or public organisations such as the CAPEB Network, IFRB (*Institut de la Formation Régionale du Bâtiment*), AFPA, GRETAs, CCCA-BTP, or by in-house training services for large companies (e.g. Bouygues, Vinci, Eiffage, etc.).

A number of private initiatives have also been put in place to improve workers' skills in the building sector, among them:

- FEE Bat (training in energy efficiency for craftsmen and employees of building companies), a full training course developed by EDF, ADEME and professional federations (CAPEB, FFB, FN SCOP-BTP). It has trained 35 000 people over the last two and a half years.
- E-nergieBat, an online technical teaching resource centre dedicated to artisans and employees in the building sector set up by the CAH (*Club d'Amélioration de l'Habitat*) and ADEME. It provided technical information to several thousands of visitors.

- PRAXIBAT, a fieldwork-training platform for apprentices, designed by ADEME in some regions.

Increasing skills in this sector is also sought through enterprise qualification schemes, such as Qualit'Enr or Qualibat, which can be used by companies to promote the quality of their work among consumers and thus provide an interesting incentive for companies to train their workers.

Recent studies under the "Green Job Plan" estimate that 230 000 workers and craftsmen of the building sector need to be trained per year through 2020 if French environmental objectives are to be reached. This represents 130 000 working professionals and 100 000 new entrants (these figures were established by considering turnovers and changes in the sector's activity).

Innovative strategies for skills development and employment in France: The role of territories

In France, although employment is legally a state competency, local authorities have been involved for more than 20 years in the development of local employment strategies. This role was finally officially recognised in the Social Cohesion Planning Law of 2005.

Additionally, local authorities are also responsible for economic development and urban renovation and regions and departments play a crucial role in training and inclusion policies.

As such, locally elected representatives are accountable to their citizens for their territory's economic development, employment, training and inclusion opportunities. They also find themselves in a strong position to shape policies and schemes that are the best fit for their territory's needs and opportunities.

For these reasons, we believe the local level is the most appropriate one for bringing about the changes required to foster a greener economy.

As seen in the first section, these changes are huge and diverse and they require transversal and integrated approaches; a role that French Employment Centres have proven able to fulfil.

"Employment Centres": An effective collaborative tool to organise transitions in territories

Employment Centres (*maisons de l'emploi*) are local organisations under the presidency of locally elected representatives, acting at the local level to federate all local employment and labour market actors within a single structure and around a single local employment promotion strategy.

They act within "employment areas"[2] and cover several local government spheres. The French Ministry of Social Affairs, Labour and Solidarity defines employment areas as the geographical space where the majority of the working population lives and works and from which companies satisfy their workforce needs. Partners seeking to create an Employment Centre then collectively define the employment area.

The French national "Social Cohesion Plan", adopted in June 2004, and the Social Cohesion Planning Law, introduced in January 2005, renewed the French government's approach to employment policy. Both pieces of legislation recognised the importance of local authorities in the promotion of employment and designated them as one of the

three main pillars of employment, along with the state and the Public Employment Service (*Pôle Emploi*). In addition, this approach sought to modernise and reorganise existing employment partnership models and establish a single framework for local employment development at the local level.

Employment Centres were created out of the will to federate local employment actors within a single structure and around a single local employment promotion strategy. As a result, Employment Centres were established as a one-stop-service for jobseekers and employers gathering state public employment services, local governments and local employment development actors and partnerships under one roof. Through a bottom-up approach, partners elaborate employment promotion strategies adapted to the needs of their territories and populations.

Employment Centres were first piloted in 1989 in select territories. In 2004, the French government's "Social Cohesion Plan" decided to spread the initiative to the whole country. Today there are 196 Employment Centres in France, represented in almost every French region. They are represented at the national level by the "Alliance Villes Emploi" ("Cities Employment Alliance"), a network of local authorities focused on employment, inclusion and training.

At the local level, they deliver the following services:

- *Stakeholders' mobilisation:* Employment Centres are places where territorial dialogue on employment, inclusion and training can take place and where joint projects can be elaborated and steered.
- *Territorial integration and adaptation of policies and programmes:* Employment Centres also aim to integrate and co-ordinate, within their territory, all policies and programmes related to employment and social inclusion in order to ensure territorial consistency.
- *Territories' observation and monitoring* in order to identify and seize local opportunities or anticipate specific risks or evolutions.
- *Projects' engineering*, both technical and financial, to be able to set up specific actions responding to specific identified needs.
- *Expertise on social clauses in public tenders:* Alliance Villes Emploi is also promoting, through its network, the use of social clauses in public tenders. It provides training and resources to staff of Employment Centres on this topic.
- *Information, orientation and counselling:* Basic information on employment opportunities and mechanisms, as well as different resources are provided to job-seekers in some Employment Centres.

As such, Employment Centres can act locally as strong catalysts for mobilizing stakeholders and provide an appropriate framework in which to develop concrete and integrated solutions to territories' needs**.**

Building up integrated solutions for territories

With this array of skills, Employment Centres try to conceive territory-based responses to specific challenges, such as a factory closing down, the setting up of a new industry or the implementation of a new project in their territory, etc.

In order to meet these challenges, they try to organise local responses by: organising specific training sessions for jobseekers in order to meet recruiters' needs when a new project or industry plans to open in the territory; working closely with local enterprises and industries in order to anticipate economic evolutions and their consequences on jobs and skills locally; looking for conversion opportunities for employees after a factory closes down, etc.

This "provisional management of jobs and skills" (*Gestion prévisionnelle des emplois et des compétences*) is based on observations made by the territories, close relationships and a constant dialogue with all economic actors. It has proven to be a powerful means by which to anticipate and better manage economic transitions in territories.

The project "Employment Centres and Sustainable Development": Anticipating skills and employment challenges of environmental transitions in the building sector

Project methodology: Stakeholders' mobilisation and collective action at the local scale

Aware that the environmental objectives set by the "Grenelle" for the building sector will not be reached unless an appropriate transition towards a greener economy, skills and jobs takes place, the French Environment and Energy Management Agency (ADEME) and the association "Alliance Villes Emploi" decided in 2008 to work closely together in order to better anticipate these challenges.

The local arena was considered by both organisations to be the appropriate one to carry out such reflections and actions, for several reasons. Firstly, it is now recognised that, if climate change is a global concern, GHG emissions have to be reduced locally and territories have been recognised as being an important actor of climate change mitigation strategies.

It was also becoming obvious at that time that the "Grenelle" general objectives and measures needed to be adapted locally, but also, and most importantly, to be appropriated by local stakeholders. Local actors' involvement and mobilisation around these objectives seemed absolutely necessary for change to occur.

In other words, the top-town and centralised approach that prevailed in the Grenelle process in France (which proved to be very successful for launching a pro-active policy for climate change reduction and to set binding agreements in law at the national level) needed to be complemented by a bottom-up approach.

It was for these reasons that in 2008, ADEME and "Alliance Villes Emploi" decided to launch an initial experiment in three "employment development areas" (the cities of Bayonne, Nancy and Lille) to test an innovative methodology for mobilising stakeholders around Grenelle issues and the resulting consequences on jobs and skills. The project's approach and methodology was then extended in 2010 to 30 additional territories, with further extensions expected.

The project relies on Employment Centres and the regional directions of ADEME, with each playing the following roles:

- Employment Centres are responsible for mobilising stakeholders and participative consultation in their territory.

- Regional directions of ADEME provide the environmental and sector expertise in order to frame the work carried out by partners.

The first year of the project was dedicated to:

- Identifying and mobilising all relevant stakeholders and partners in the projects' territory.
- Setting up a vast and representative steering committee responsible for deciding and framing projects' local orientations.
- Carrying out a study on local markets, skills and employment options in the building sector (carried out by an external organisation), based upon a vast compilation of quantitative data on buildings, as well as on a qualitative survey of enterprises to better understand their current expectations.
- Organising participative meetings and working groups to share the study's results, to comment and discuss them in order to elaborate a shared diagnosis of the situation among local stakeholders.
- Based upon these shared diagnoses, elaborate a joint action plan to tackle skills and employment transitions locally.

Project's main achievements

This methodology gathered together all of the relevant stakeholders from employment, training and the building sector in order to work collaboratively and plan for upcoming challenges and ways to adapt skills and jobs to meet the Grenelle requirements. Additionally, they jointly planned concrete and relevant actions to tackle sustainable development issues locally.

Across the 33 territories, more than 1 300 people attended local participative working groups, bringing their specific expertise and professional cultures to enrich the project's analysis and action plans.

It also enabled participants to create linkages, synergies and working habits between actors from very different professional sectors. This newly built local partnership is an important added-value for the project locally and will enable them to better meet the anticipated challenges and opportunities.

Another important achievement of the project was to share diagnoses among stakeholders and encourage them to agree upon a common understanding of the situation. This forms the basis of collective actions and led to the elaboration and implementation of joint action plans in 33 territories.

Joint action plans to "green" local skills and jobs

Employment Centres and their partners in the 33 territories, representing approximately 500 local actions and acting at 4 main levels, are currently implementing 33 local action plans:

- **Awareness-raising and information campaigns** to communicate about jobs and skills evolutions in the sector, targeting: works contractors, companies and their employees, jobseekers and labour market institutions.

- **Adaptation and access to training** for these different actors, especially for companies' managers and craftsmen.
- **Support to enterprises'** development and organisation to progress towards improved services in line with energy performance or renewable energy businesses.
- **Promotion of local development strategies** around new activities to be found in the field of energy efficiency and renewable energy in buildings.

Implementation of these actions began in September 2011, led either by the local Employment Centre or one of its partners. Their follow-up and monitoring is being organised by "Alliance Villes Emploi". A national evaluation was carried out in 2012 by ADEME with the aim of assessing these projects' impact on accelerating the implementation of the Grenelle.

Some lessons can already be drawn from this project, in particular regarding the importance of local actions in the field of climate change mitigation and the role of local authorities in organising jobs and skills transitions towards a greener economy.

Conclusion and policy implications

First, this project shows that, in the field of climate change mitigation and sustainable development, national policies can only be effective through local appropriation and implementation by all relevant stakeholders. Local adaptation of national schemes has to be organised systematically.

Second, stakeholders' mobilisation is a key issue for the success of these policies and has to be effectively organised in territories. This can be highly facilitated by the existence, at the local level, of a strong political will and a legitimate organisation able to play this role. In the case of France, Employment Centres proved to be the appropriate actors to fulfil this mission.

The role of elected representatives to catalyse local mobilisation and gather very different stakeholders around a shared and meaningful project is also crucial. The shift towards a green economy will bring substantial changes for people and territories and the construction of a collective project is an essential condition for the transition's success.

Responsibilities should also be clearly assigned between the projects' partners to ensure the credibility of proposed actions. This is the role of a representative and neutral steering committee.

Finally, another success factor lies in the elaboration of a shared diagnosis among stakeholders. Based upon an objective study, professionals from very different fields discussed and jointly agreed upon common conclusions and shared views on current gaps and challenges ahead. This may seem very time consuming but is a very necessary step to unlock professionals' anticipations.

Notes

1. Observations made by the sector's workers during the project's participative phase.
2. In French: *bassin d'emploi*. Employment areas are defined by the French Ministry of Social Affairs, Labour and Solidarity as the geographical space where the majority of the working population lives and works, and from which companies satisfy their workforce needs. The precise definition of each employment area is collectively defined by the partners seeking to create an Employment Centre.

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Simonas Gaušas is Research Manager at the Public Policy and Management Institute. He has more than seven years of work experience in public policy research including on education (especially vocational education and training, adult learning, education financing issues) and labour market policies (especially issues related to the impact of climate change on employment, sector-based labour market trends; and anticipation of the skills needs of the economy). He has recently worked on the Eurofound project "Growth and Employment: Anticipating and Managing the Effects of Greening of Industries in the EU" (2011-12), the Cedefop study "Financing Training in Europe" (2010-12) and was a country group expert in the Cedefop project "Forecasting Skill Supply and Demand in Europe" (2009-12). Simonas holds an MA in European Public Administration from Vilnius University.

Andy Gouldson is Director of the Centre for Climate Change Economics and Policy at the University of Leeds. His work focuses on the influence of different forms of policy and governance on the relationship between the environment and the economy, and on the factors that are shaping the transition to a low-carbon economy. Most recently, he has worked on the economics of low-carbon cities through a series of city scale mini-Stern reviews. This work has led to the adoption of carbon reduction strategies in various contexts, and is part of a wider debate on stimulating investment in the low-carbon economy.

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Christine Hofmann has been working for the ILO Skills and Employability Department since 2006. She co-authored the book *Skills for Green Jobs. A Global View*, arising from a global policy-applied research project covering 21 countries world-wide, in collaboration with Cedefop. She also participated in research on early identification of skill needs for the low-carbon economy, a joint ILO/EC management agreement, resulting in two sector studies and a comparative analysis of methods. Apart from contributing to the ILO's Green Jobs portfolio, Christine has developed a resource guide on upgrading informal apprenticeship in Africa, delivers training and advises technical co-operation projects in countries in Asia and Africa. Before joining the ILO, she worked in political consulting and co-ordinated development projects for trade unions in Africa and Asia for a German labour foundation promoting social sustainability in national and international fora such as the UN CSD. She holds a degree in International Business and Area Studies.

Terence Hogarth is a Principal Research Fellow at the University of Warwick Institute for Employment Research where he leads a programme of research into employers' skill needs and investment in human resources. He also leads a programme of research on apprenticeships and has directed the "Net Costs and Benefits of Apprenticeships to Employers" study since the mid-1990s. He has a strong interest in the green agenda in general, and renewable energies in particular, and has worked with Cambridge Econometrics in analysing these issues in the United Kingdom and across the EU.

Pat Irving is a Principal of ICF GHK and has more than 20 years research and consulting experience gained within an EU and UK context. Pat has worked on research and evaluation studies across the spectrum of European employment policy, social inclusion and lifelong learning as well as vocational guidance. She is the Project Director for the European Employment Observatory and is working with DG Education and Culture (EAC) and DG Employment, Social Affairs and Inclusion (EMPL) on the EU Skills Panorama. Pat has managed assignments for the European Commission on the education and training 2010 targets, the implementation of national lifelong learning strategies and worked on the New Skills for New Jobs Commission Staff Working document. Subsequently she directed two studies delivered in co-operation with Chinese research institutes: "New Skills for New Jobs: China and the EU", in co-operation with the Chinese Academy of Social Sciences and the "Race for Skills" project for the DG EAC.

Nick Jagger is a Research Fellow at the Centre for Climate Change Economics and Policy funded by the Economic and Social Research Council at the University of Leeds. His research currently focuses of the skills requirements of the low-carbon transition. In the past, he has held research positions at the Science Policy Research Unit, the University of Sussex, and the Institute for Employment Studies in Brighton. He has over

20 years' experience of researching skills issues, in particular those surrounding scientists and engineers. He has developed and populated a range of international indicators for the OECD, the European Commission and UK bodies. He has undertaken research funded by a wide range of international and national bodies as well as acted as advisor to the UK's Roberts' Review, which examined the supply of, and demand for, science, technology, engineering and mathematics (STEM) skills.

Adeline Kroll works at the Directorate-General for Research and Innovation of the European Commission (DG RTD). Prior to this, she worked at the Joint Research Centre of the European Commission, Institute for Prospective Technology Studies (Sevilla, Spain) and DG Environment, mainly on the contribution of scientific research to policy development. Her fields of expertise include scientific monitoring of water protection and policy work on related environmental issues at the European level (e.g. Water Framework Directive, Environmental Regulation of Mine Waters Directive). She also worked on European and international research policies (*ERAWATCH database*). More recently, she co-ordinated an expert group on how to assess the quality of research performed by universities (Assessing Europe's University-Based Research). She now works in the "skills" unit of DG RTD on the basis for a European framework for professional development for researchers, the implementation of the principles for innovative doctoral training in Europe and on the implementation of a new European initiative, the European Research Area Chairs.

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Cristina Martinez-Fernandez is a Senior Policy Analyst on Employment and Skills, Green Growth and Southeast Asia at the Organisation for Economic Co-operation and Development (OECD), Local Economic and Employment Development (LEED) programme. She works on issues related to the challenges of skills and training systems for SMEs, entrepreneurial and innovation activities; industrial policy, climate change and the transformation of labour markets to the low-carbon economy; the challenges of demographic change and an ageing society for skills and employment development. Cristina also manages the OECD/LEED Initiative on Employment and Skills Strategies in Southeast Asia (ESSSA). Before joining the OECD she was a professor at the Urban Research Centre, University of Western Sydney in Australia where she led the Urban and Regional Dynamics programme, which analyses industry change, urban performance and socio-economic development within the frameworks of innovation, globalisation and the knowledge economy.

Joel Marsden is a Consultant at ICF GHK with over three years of experience in performing research and evaluation studies on environmental, labour market and skills policy, particularly focused on the linkages and interactions between these as well as the implications for training. Joel joined ICF GHK from Cedefop, where he conducted

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James Medhurst is an Economist and Director of GHK with over 20 years of senior experience. He is responsible for taking forward GHK's work in relation to economic and sustainable development and environmental policy, including work on policy evaluation, impact assessment and performance management. He has detailed experience of a wide range of assessment methods including MCA, CBA, SEA/SA and EIA. He has led numerous studies that explore the linkages between environmental policy and the economy. In recent work for DG Environment, he assessed and quantified the economic activity associated with the use of the environment, at both EU and member state level. He also examined the employment effects of environmental policy changes, including those relating to climate change. He has previously undertaken a wide range of EU studies, including projects covering environmental taxation and investment programmes and their economic and social impacts, including on skills and training.

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Costanza Pagnini has been Economist and Project Manager since 2008 at the Fondazione Giacomo Brodolini, Rome, Italy. She has managed and co-ordinated various programmes of applied research and policy analysis at the national and transnational level in the fields of gender, employment and social inclusion. Currently she is acting as expert/researcher in several evaluation activities in the fields of gender and employment, such as the thematic evaluation on equal opportunities and gender mainstreaming for the European Social Fund in the Emilia Romagna Region (2007-13) and the independent strategic evaluation of the European Regional Development Fund in the Liguria Region (2007-13) with a focus on equal opportunities.

Agnė Paliokaitė is a Research Manager in Public Policy and Management Institute and a PhD student at the ISM University of Management and Economics (Lithuania). She has 12 years of experience in public policy research and evaluation, especially in the fields of research and innovation systems, governance and policy strategies, industry development and restructuring, change management and prospective analysis. During her career, she has provided advice, training and support to the European Commission, national and regional governments in more than 30 research and evaluation projects,

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Mark Peacock is an economist with expertise in impact assessment, policy appraisal and market analysis covering a variety of economic and policy issues at the UK and European levels. He has worked on projects related to the low-carbon transition, green jobs and skills, and environment-economy linkages for over eight years. In addition to work on green jobs, he has also been involved in impact assessments and evaluations relating to the REACH Regulations, Water Framework Directive, proposals for an EU Environmental Technology Verification (ETV) scheme, GHS for the classification and labelling of chemicals, EU marine strategy and LIFE+.

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Hector Pollitt is an applied Economist and Associate Director at Cambridge Econometrics with extensive experience in the development and application of macroeconomic modelling tools for impact analysis. He holds overall responsibility for maintenance of the European Commission's European E3ME model and for the European Commission's development of the global E3MG model. Recent applications of these models include contributions to the European Commission's communication on the possibility to move to a 30% GHG target and to assessments of revisions to the EU's Energy Services Directive and Energy Taxation Directive. The models have also been used to assess carbon leakage and border mechanisms. He has also recently carried out detailed reviews of current state-of-the-art modelling approaches for policy analysis and led on the creation of the UNFCCC's model inventory and the most recent version of the European Commission's *IA Tools model database*.

Jo Pye is Senior Researcher at the Marchmont Observatory, Research and Knowledge Transfer, University of Exeter, with a research background in renewable energy technologies and environmental goods and services. She has provided research and information services for 30 years in both public and private sector organisations. Jo has investigated skills, employment and adult learning for Marchmont since 1999, designing and conducting impact evaluations and analysing national and regional evidence to inform policy initiatives in adult learning. She has a long history of active involvement with the European Union's Leonardo and Lifelong Learning Programme projects, developing guidelines and resources to encourage learning practices by European small businesses in a range of industry sectors.

Antonio Ranieri is Project Manager at Cedefop within the Research and Policy Analysis area. An economist by training, Antonio has taught regional and urban economics at the University of Roma. As Head of Area at CLES in Rome, an independent centre of studies on labour market and economic development issues, he co-ordinated research projects in the fields of policy design and evaluation of public investment. At

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Olga Strietska-Ilina is a specialist in skills policies and systems at the Skills and Employability Department of the International Labour Organisation (ILO). Her work is particularly focused on the identification and forecasting of skill needs, and related cross-country international research. She is also in charge of the skills agenda in the framework of the Green Jobs initiative. She started her career teaching at the Central European University in Prague in 1994-95. Between 1996 and 2003, she was Head of the Czech National Observatory of Employment and Training. From 2003-08 she provided her expertise to facilitate the development of a number of Cedefop's initiatives in the field of early identification of skill needs and the network Skillsnet. Olga has published extensively in the field of education and training, employment and labour market, social exclusion, cultural minorities, nationalism and European affairs. She holds degrees in Sociology, Political and Economic Sciences, and History.

Rob Wilson is a Professorial Fellow and Deputy Director of the Warwick Institute for Employment Research at the University of Warwick in the United Kingdom. He leads the institute's labour assessment and market forecasting work, although he has researched and published on many other aspects of labour market behaviour. He is an editor and contributor to various publications in this area including Working Futures for the

LSC/UKCES and various reports for Cedefop at a pan-European level. He leads the Cedefop Skillsnet project on producing medium-term forecasts of occupational skill needs and skill supply in Europe, which for the first time has presented a consistent and comprehensive assessment for the whole of Europe. Amongst his professional responsibilities, he is currently a member of the Migration Advisory Committee, set up to advise the UK government on where there are likely to be skill shortages that can be sensibly filled by migrants, and was previously a member of the UK Commission for Skills Expert Panel.

About the OECD

The Organisation for Economic Co-operation and Development (OECD) is a unique forum where the governments of 34 market democracies work together to address the economic, social and governance challenges of globalisation as well as to exploit its opportunities. The OECD's way of working consists of a highly effective process that begins with data collection and analysis and moves on to collective discussion of policy, then decision making and implementation. Mutual examination by governments, multi-lateral surveillance and peer pressure to conform or reform are at the heart of the OECD's effectiveness. Much of the material collected and analysed at the OECD is published on paper or online: from press releases and regular compilations of data and projections to one-off publications or monographs on particular issues; from economic surveys of each member country to regular reviews of education systems, science and technology policies or environmental performance. For more information on the OECD, please visit www.oecd.org/about.

About LEED

The OECD Programme on Local Economic and Employment Development (LEED) has advised governments and communities since 1982 on how to respond to economic change and tackle complex problems in a fast-changing world. It draws on a comparative analysis of experience from some 50 countries in the Americas, Asia, Australasia and Europe in fostering economic growth, employment and inclusion. For more information on the LEED Programme, please visit www.oecd.org/cfe/leed.

About Cedefop

Concerns over Europe's economic future and the pace of technological and social change make Europe's workforce and the quality of its skills more important than ever. Most of Europe's workforce acquires its skills through vocational education and training (VET). Consequently, VET in Europe must meet the highest standards. Cedefop (the European Centre for the Development of Vocational Training) is the EU's agency that provides evidence from research, statistical data, policy analyses and stimulates debate on learning and the labour market to find ways to improve VET throughout Europe. Cedefop's work seeks to strengthen European co-operation in VET and is used by the European Commission, member states and social partners to support their VET policy making. To find out more about what Cedefop does, please visit: www.cedefop.europa.eu.

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