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SKILLS FOR GREEN JOBS A GLOBAL VIEW



**SYNTHESIS
REPORT
BASED ON
21 COUNTRY
STUDIES**

Olga Strietska-Ilina • Christine Hofmann • Mercedes Durán Haro • Shinyoung Jeon

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Foreword

Climate change and environmental degradation are jeopardizing the sustainability of many kinds of economic activity around the globe. At the same time, moving towards a greener economy is creating opportunities for new technologies, investment and jobs.

This is the message of the *Green jobs* report (2008), which estimated that efforts to tackle climate change could result in the creation of millions of new “green jobs” in the coming decades.¹ This assessment was made as part of the Green Jobs Initiative, a joint effort launched by the International Labour Organization (ILO), the United Nations Environmental Programme (UNEP), the International Organization of Employers (IOE) and the International Trade Union Confederation (ITUC) to help governments and social partners turn this potential for decent work into reality by aligning environment and employment objectives.

As part of this Green Jobs Initiative, the ILO Skills and Employability Department defined a global research project to investigate skill needs for greener economies. A series of 21 country studies was conducted in partnership with the European Centre for the Development of Vocational Training (Cedefop), a European Union agency located in Thessaloniki, Greece.² The global synthesis of these countries’ experience was prepared by the ILO. Cedefop conducted the research on the six EU countries included in the study, and also published a separate summary of their findings.³

The analysis of countries’ experience revealed that skill shortages already constrain the transition to a greener economy — in terms of preparing for some new occupations and in terms of changing the skill profile of a large number of occupations. The research also documented the need to provide opportunities for acquiring new skills to those who are at risk of losing jobs in high-emissions industries. Countries’ experiences in adapting training provision to meet all of these needs vary. Some countries are developing innovative strategies and policies to proactively anticipate and address emerging skill needs; others adjust existing mechanisms and systems on a more ad hoc basis. The report has assembled case studies across a wide spectrum of challenges, documenting a broad array of approaches to promote the transition to greener workplaces with sustainable, productive and decent employment.

A number of examples of good practices demonstrate that public policy together with private initiatives can foster the green transformation and job growth. These policies focus on equipping young people entering the labour market and older workers mid-way through their careers with the ability to learn the skills required for adopting new technologies, meeting new environmental regulations and shifting to renewable sources of energy. National efforts are placing increasing emphasis on the core skills that enable workers to adapt to changing technologies, and are also

¹ UNEP, ILO, IOE, ITUC: *Green jobs: Towards decent work in a sustainable, low-carbon world* (Geneva, 2008), available at: http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/publication/wcms_098504.pdf

² The background country reports are available at http://www.ilo.org/skills/what/projects/lang--en/WCMS_144268/index.htm

³ Cedefop: *Skills for green jobs: European synthesis report* (Luxembourg, Publications Office of the European Union, 2010).

focusing on building up competencies in mathematics, engineering, technologies and science. Many countries and communities target training and employment measures to disadvantaged groups out of concern that the green transformation also be a socially just one.

This research project on skills for green jobs builds on earlier ILO research on how skills development can improve productivity, employment growth and development.⁴ Skills development systems need to go beyond matching training to labour market needs; they need to play a catalytic role in future economic growth and resilience by enabling enterprises and entrepreneurs to adapt technologies, compete in new markets, diversify economies and thus accelerate job growth. The broad availability of good quality education and training means having the capability to take advantage of opportunities and to mitigate the negative impact of change.

Propelling the transition to the green economy is a case in point. Environmental and climate change policies bring enormous employment opportunities but also the risks associated with structural changes. Countries need coherent strategies that bring together energy, environment, education and skills development objectives, policies and responsible ministries in order to adapt to climate change and shift to clean and sustainable production and consumption in ways that maximize creation of decent work and make it available to all. Countries that are succeeding in such a challenging task are placing a high premium on effective social dialogue, coordination among ministries and communication between employers and training providers. Labour market information systems, institutions for social dialogue and labour market mediation services are prerequisites for being able to anticipate future skill needs and to adapt skills development systems accordingly.

Every job can potentially become greener. Integration of sustainable development and environmental awareness into education and training at all levels, starting from early childhood education, is an important task. It will contribute to changing consumer behaviour and triggering market forces to push the greening agenda ahead.

The availability of workers and enterprises with the right skills for green jobs plays a critical role in triggering the green transformation and in facilitating transitions that are fair as well as efficient. Employers investing in new technologies need to be able to find workers with the right skills. Workers and communities that lose jobs in “brown” industries need opportunities for acquiring new skills and employment. This report documents both these needs and provides cause for optimism that the opportunity for job growth inherent in the green transformation will be seized, that it will not be lost for want of right-skilled workforces and that environmental sustainability will be well served by workers, employers and communities, who with confidence stake their future on new, cleaner economic activities.

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⁴ ILC: *Conclusions on skills for improved productivity, employment growth and development* (Geneva, 2008).

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List of background country reports

The full texts of the reports are available at: http://www.ilo.org/skills/what/projects/lang--en/WCMS_144268/index.htm

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- **United States:** W. Mass, P. Moss, M. Hopkins and M. Ross, University of Massachusetts Lowell, *Skills for green jobs in the US*, 2010 (ILO).
- **Europe:** Cedefop, *Skills for green jobs: European synthesis report*, Luxembourg, Publications Office of the European Union, 2010.

Executive summary

The growing importance of sustainable development and the shift to a low-carbon economy are increasing the pace of change in labour markets and skill needs. Economies moving towards greener production can seize this potential for job creation – which is particularly relevant for recovery from the current economic crisis – if they can deal effectively with the coming structural change and transformation of existing jobs.

In 2008, the ILO, the United Nations Environment Programme (UNEP), the International Organization of Employers (IOE) and the International Trade Union Confederation (ITUC) jointly launched the Green Jobs Initiative to help governments and social partners turn this potential for decent work into reality by aligning environment and employment objectives and policies.

Skills development is one of the keys to unlocking this job potential. The timely supply of relevant and quality skills is indispensable for successful transformations that boost productivity, employment growth and development.

Thus the ILO's Skills and Employability Department, in cooperation with the European Centre for the Development of Vocational Training (Cedefop), launched a global investigation of skill needs for greener economies. Investigations were carried out in 21 countries that represent 60 per cent of the world population, 59 per cent of global GDP and 49 per cent of global CO₂ emissions: Australia, Bangladesh, Brazil, China, Costa Rica, Denmark, Egypt, Estonia, France, Germany, India, Indonesia, Mali, the Philippines, the Republic of Korea, South Africa, Spain, Thailand, Uganda, the United Kingdom and the United States. These **21 country studies** form the core evidence base of this report.

In each country study, analysts started by identifying the drivers of transformation to a greener economy – changes in the physical environment itself and changes induced by government regulations, more efficient technologies and changes in consumer demand. Then they assessed the effect of these changes on employment, identifying areas of job growth and of job loss. Only then could researchers start to understand how skill requirements are changing and are expected to change in the future, and to examine how well national training systems are anticipating and responding to these new needs.

The transformation wrought by greening economies affects skill needs in three ways. First, the green transformation shifts activities in the economy, for example from those that are less energy efficient and generate higher CO₂ emissions towards those that are more efficient and less polluting. This type of transformation occurs at industry level, causing structural shifts in economic activity, and thus in employment, between and within industries. This is called **green restructuring**. Structural changes in turn decrease demand for some occupations and skill profiles and increase demand for others. An example of this source of change in skill requirements would be the growth of alternative and renewable energy sources, such as wind or solar power, and the relative decline in the production and use of fossil fuels. It calls for training to enable workers and enterprises to move from declining to growing sectors and occupations.

Second, structural changes, the introduction of new regulations and the development of new technologies and practices result in the emergence of some entirely **new occupations**. This process

is very much country specific. For example, a solar technician is often mentioned as a new occupation in those countries where solar energy is a new technology. Emerging occupations call for the provision of relevant training courses and the adjustment of qualification and training systems.

Third, new skills will be needed by workers in many existing occupations and industries in the process of *greening existing jobs*. For example, within the automotive industry, workers across a range of jobs from engineering design to the assembly line will have to work with new fuel efficient technologies. In another example, farmers in many parts of the world will have to adjust to more severe drought conditions, requiring them to learn how to grow new crops or new methods for producing the same crops. This source of change in skill requirements is the most widespread: in fact, it will be pervasive, and calls for a major effort to revise existing curricula, qualification standards and training programmes at all levels of education and training.

All three sources of change – shifts between industries, development of new occupations and changing skill profiles within occupations – alter the skill profiles of occupations and thus affect training needs and delivery. The scale and extent of these changes depend in turn on the speed and breadth of technological and market changes in the green transformation. Preparation for new occupations, or for growth in demand for some occupations at the expense of others, is particularly important in preparing young men and women entering the labour market. Workers already in the labour market, midway through their careers or older, will need access to retraining to enable them, and enterprises, not only to move from declining industries and occupations into growing ones, but also to keep their skills up to date with new technologies, market demand, government regulations etc. in their existing fields of work and business.

Thus the country studies undertaken for this report were intended to reveal whether the potential for new and better jobs in greener industries is being realized, and, if so, how countries have succeeded in adjusting their training provision to meet new demand; or whether skill gaps are delaying the green transformation and in turn causing economies to miss out on new sources of job creation.

Drivers of change: How skill needs shift as economies go green

Within the country studies, changes in employment, and hence in skills, were found to be the result of 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.

Changes in the physical environment – global warming, changing weather patterns, more extreme droughts, rising sea levels etc. – require adaptation measures. To the extent that these changes are already happening, humankind is obliged to adjust our consumption and production patterns to cope with them. These measures aim at reducing the social costs of adjustment and avoiding their being borne disproportionately by those already at economic and social disadvantage. In particular, the need for effective adaptation measures is becoming increasingly urgent in developing countries.

On the other hand, scientists give us encouragement that there is much that can be done to limit further environmental degradation. Changes in human activities can mitigate, or limit further, change. Reducing carbon emissions and expanding recycling efforts are examples of mitigation efforts.

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 also 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 encourage them to adopt new technologies that allow them to meet new consumer needs.

In spite of the growing influence of globalization, skill changes resulting from the transition to a greener and low-carbon economy remain very much country specific, largely determined by specific 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.

In this context, sharing information from these 21 country studies on the identification of skills for green jobs, on changes within existing occupations and the emergence of new ones, and on effective skills development strategies provides a relevant resource to other countries seeking to prepare themselves better for the changes ahead.

Policy context

The transition to a greener economy has enormous employment potential in the long run, creating millions of jobs both directly, and indirectly through supply chains. The challenge for environmental policy is to choose policy options that maximize productive and decent work, and the challenge for skills development policy is to integrate environmental awareness and the right technical training for green jobs into education and training provision. Thus policy objectives in the two areas are mutually supportive: without a suitably trained workforce the transformation to a greener economy will stall, and without the imperative of meeting environmental challenges the need for accelerated job growth may go unmet.

The country studies revealed that skill shortages already pose a major barrier to transitions to green economies and the creation of green jobs, a trend which is likely to be exacerbated in the future. Skill shortages for green jobs stem from a number of factors, including underestimated growth of certain green sectors, for example in energy efficiency in buildings; a general shortage of scientists and engineers – a problem shared by economies at all development levels; the low reputation and attractiveness of some sectors, such as waste management; and the general structure of the national skill base. Shortages of teachers and trainers in environmental awareness subjects and in fast-growing green sectors (e.g. renewable energy, energy efficiency) are reported in many countries, especially in developing economies.

However, in this important area of policy coordination, comparison across the countries studied revealed that coordination between environmental and skills policies ranges from comprehensive and well coordinated to fragmented or virtually non-existent:

- The skills response component in most of the documentation for adaptation and mitigation measures, policies, strategies, action plans and programmes initiated in response to climate

change and environmental degradation is either limited or non-existent. Lack of human and financial resources, unclear mandates of institutions involved and lack of awareness of training issues among environmental policy-makers are among the obstacles that hamper the integration of human resource development into environmental strategies.

- Moreover, mechanisms for identifying, monitoring, anticipating and providing skills do not usually include representation from environment ministries. Similarly, ministries, agencies and institutions concerned with education and training are typically not involved in developing environmental policies. And even where coordination mechanisms exist for policy design, coordination for implementation is weak.

The conclusion from the cross-country comparison is that sustained inclusion of skills development in strategies to speed the greening of national economies remains limited to isolated initiatives.

In addition to this specific problem of lack of policy coordination, many of the case studies also revealed a lack of enforcement of environmental regulations already adopted. This diminishes the incentive to invest in new skills, which in turn detracts from compliance capabilities and, in a downward spiral, further exacerbates the difficulty of implementing regulations.

Finally, policy rightly focuses on the quality, as well as the quantity, of the potential new jobs. Many jobs in waste management, recycling and agriculture, especially subsistence agriculture, are characterized by extremely poor working conditions. However, the limited information gathered on the quality of green jobs indicates that efforts to upgrade skills can be accompanied by efforts to improve working conditions in respect of safety and health in the work environment, working time, work organization and employment contracts. This is another important area of policy coordination: job creation and skills upgrading in greening the economy can benefit from active labour market policies, labour inspection and social dialogue in order to promote work that is green and decent. Indeed, the ILO's promotion of green jobs fully integrates the core elements of decent work: labour law compliance, access to social protection measures and participation in social dialogue.

Green structural change and implications for skills development

In countries whose economies are energy and emissions intensive, the transition to a greener and low-carbon future may incur potentially severe adjustment costs, both economic and social. Significant regulatory reforms and emissions targets can be expected to lead to restructuring and downsizing in emissions-intensive industries. The same regulatory changes will stimulate growth in renewable energies and activities to improve energy efficiency, for example. In addition, the transition from carbon-intensive to energy-saving and cleaner production and service patterns will cause restructuring and downsizing in some parts of manufacturing and construction.

Different estimates and scenarios generate various opinions on the medium- to longer-term employment effects of green restructuring, although most of them agree that the net effect will be positive. However, the prospects for achieving this positive net effect, and the duration and pain of the transition, are materially affected by the extent of comprehensive planning and coordinated policy implementation. Retraining and skills upgrading measures feature prominently in well-coordinated and proactive approaches.

The country studies highlighted many sectors where extensive restructuring is anticipated, and thus where training and other active labour market policies are most needed in order to

avoid long-term displacement. Agricultural production will be affected by growth of biofuels and organic farming. Fossil fuel energy generation will decline relative to growth in renewable energy sources and in consequence of new green technologies in, for example, carbon capture and storage. Emissions-intensive manufacturing, in particular the automotive sector and related supply chains, will shift focus to eco-friendly vehicles (hybrid, electric and hydrogen). In marine engineering and extractive industries, offshore oil production may decline relative to off- or onshore renewable energy, including the construction, supply and maintenance of off-/onshore wind turbines and wave and tidal energy infrastructure.

Although new job opportunities arising from greener production are estimated to offset job losses, those who will get “green” jobs are not necessarily those who will have lost their jobs in so-called “brown” industries. Retraining workers and upgrading skills are matters of urgency in facilitating a smooth and just transition to the low-carbon and green economy. Disadvantaged groups in the labour market need targeted assistance and preferential treatment to ensure their access to new and good quality green jobs. Low-skilled workers are especially vulnerable as it will be difficult for them to compete for new jobs.

Short and tailor-made courses, directly linked to specific job openings, have been found to be the most useful approach to retraining workers and upgrading skills in the context of restructuring measures. The ability of workers to take advantage of such training opportunities hinges on how prepared they are to learn new skills. Core skills for employability are of broad relevance rather than linked to specific occupations or technologies. They include competencies in literacy, numeracy, decision-making, teamwork, communication etc. Competencies in these areas affect the ability to learn, and thus materially affect the adaptability of workers and their occupational mobility. Opportunities to gain competence in these areas can be provided through both initial and continuing training. Such basic competencies as literacy and numeracy are acquired through early education, and many societies find a need to provide remedial education to adults who did not have the opportunity to go to school when they were young and who are faced with the challenge of learning new technical skills later in life.

Successful restructuring with efficient retraining measures can divert workers from long-term displacement and speed redeployment into new, greener industries and occupations. The key to success in such measures is shared responsibility by the government at all levels (national, regional, local), trade unions and employers. Organizing social dialogue at industry level is therefore an important prerequisite for efficiency in restructuring. Public employment services are an important delivery mechanism for active labour market policy measures, including retraining jobseekers and assisting enterprises in their restructuring.

Training activities, then, are not all that is needed to smooth transitions in the face of structural adjustments: labour market information systems, social dialogue and employment services are likewise critical assets. Ideally, mechanisms for workforce restructuring are incorporated in the overall system of active labour market measures, are informed by a well-functioning labour market information system, are delivered through efficient public employment services and are bolstered by social protection mechanisms and institutional mechanisms for social dialogue.

How occupations change as economies go green

The change in occupational skill needs is both quantitative and qualitative. Increased investments in a green sector and increased demand for certain occupations may not affect the skills composition of the occupation: for example, demand for railway workers may increase due to greater investment

in public transportation, but the skills needed to perform the job do not change. In such cases it is the number of jobs, and hence the quantity of training required, that may change. The level of occupational change depends on the degree of skills change: from none (the example of the railway worker) to high, when new occupations emerge (for example, that of solar energy technician). In the middle of this range are numerous established occupations whose content is altered with the adoption of new green technologies or of new green methods of production. These include engineers, managers, craftspersons or technicians who install and maintain new technologies or implement new energy efficiency standards. This type of skills change – greening existing occupations – is the most widespread and concerns the largest number of jobs.

Occupational change is taking place in both blue- and white-collar jobs. New and emerging occupations more often require higher-level qualifications, while changes in existing occupations happen more often at the low and medium-skill levels.

Taking as the starting point the principle that every job can become greener, not all of the new skill needs are technical. Skill needs also pertain to knowledge about regulation and the ability to adopt, adapt, implement and maintain skills. Innovation and new markets require management, design, planning and leadership skills. Clearly some sectors are more affected by occupational change than others, but all sectors generally need certain environmental competency levels in their workforce, such as skills in energy and resource efficiency, in compliance with environmental legislation and in the reduction of environmental pollution and waste. Core skills such as entrepreneurship, risk assessment or communication skills among many others are indispensable as economies move to greener solutions.

The country studies reveal some general trends on the gender implications of changing and emerging occupations. Most evident is a generally low representation of women in science and technologies related to green jobs. In developing countries in particular there is a disproportionate representation of women in low-end green jobs such as waste collection and recycling occupations. On the other hand, green jobs present a particular opportunity to break gender barriers as gender segregation is not yet deep-rooted in new occupations.

Having identified changes in skill requirements generated by changes across industries and within occupations, we ask: What responses are proving effective in meeting this current and future demand?

- Enterprise-level responses are the fastest and most effective in developing skills matched to current, company-specific needs. They are, however, rarely coordinated and have somewhat limited impact on the overall greening of the economy and no influence on the regular skills supply.
- Industry-level responses, through such bodies as industry skills councils or chambers of commerce, have already achieved considerable results in several countries. In France, for example, the main federations and business associations in the construction sector launched *Qualit'ENR*, a programme to develop training standards for the installation of renewable energy equipment. Since the creation of the scheme in 2006, training provision has considerably improved.
- At government level, training programmes may be delivered through the formal education and training system, involving ministries of education, manpower or labour and the universities or training centres related to the system. Responses can be designed under relevant line ministries – energy, agriculture, construction etc. – to address national, regional or local demand.

- Public–private partnerships, matching government resources to business’s hands-on knowledge of skill relevance and quality, have proven effective in many cases. The involvement of trade unions and employers’ associations in education and training through public–private partnerships can deliver effective training responses and trigger green transformation on a larger scale. Tripartite governance structures in vocational training in Denmark and Germany ensure that updated and new curricula take economic, social and environmental dimensions into account. In Spain, a public–private skills initiative in Navarre created a training centre for renewable energy (CENIFER) that contributed to the increase in electricity production from renewables from zero to 65 per cent in 15 years.

Countries with well-developed and responsive skills development systems are incorporating environmental considerations as cross-cutting issues in training programmes at all levels. In countries with less responsive education and training systems, companies usually account for the biggest share of skill provision. The principal deficiency reported in public systems is unresponsiveness to industry needs. This is variously attributed to poor communication channels between the training system and industry, or between the system and agencies responsible for implementing policies or programmes on greening; or to a lack of sufficient or sufficiently skilled teachers and trainers; or to institutions’ slow and cumbersome procedures to develop new skill programmes. By default, then, training takes place mostly at the enterprise level, or through NGOs, and although it may meet needs, its overall outreach and thus impact on the greening of industries and the economy remains limited.

Coherent multi-level skills development responses are seen as the most effective approach to greening economies, as they address both consumption and production patterns. They influence consumption by raising environmental awareness through general schooling or mass media; and they help production move to more environmentally conscious practices through training programmes, vocational, technical and higher education and training, and lifelong learning at enterprise level.

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. In any case, investment in skills without matching investment in related job creation is not productive, and vice versa.

Anticipation and monitoring of skill needs

It is broadly acknowledged that there is a paucity of data on the classification and incidence of green jobs. Most countries rely on qualitative methods for anticipating and monitoring skill needs, such as enterprise surveys, sectoral analyses, occupational research and job analyses, sometimes in combination with quantitative analysis. A more standardized and rigorous approach to identifying and monitoring green occupations and related skills would be very helpful. Widespread agreement was reported in the country studies on the need for more standardized and rigorous approaches for the preparation of taxonomies of green jobs and related occupations and for quantitative methods of analysis.

When it comes to anticipation and monitoring of skill needs, most developed countries enjoy well-established systems which they have been able to utilize for the analysis of skills for green jobs. These systems have previously reflected changes in environmentally driven competencies, leading to new qualifications and courses, and changes to established curricula.

To the extent that the pace of change allows, these systems might be expected to continue to reflect and animate responses to emerging skill needs.

Identification of current and future skill needs as the basis of skill development responses remains very challenging in most developing countries, both with a view to market relevance in general and with a particular focus on environmentally motivated change. Here the first priority is establishing social dialogue mechanisms in a systematic way to transfer labour market signals to mechanisms for updating training programmes.

Although sector-level analyses have proved very relevant and are widely used across developed, emerging and developing economies, in contexts where green activities cannot be categorized neatly into traditional sectors there is a great need for better coordination of labour market analysis and monitoring across sectors and occupations.

Ways forward

It is important to remember that skills are not a poor servant of the economy, expected merely to react and adjust to any change. The availability of a suitably trained workforce capable of further learning inspires confidence that in turn encourages investment, technical innovation, economic diversification and job creation.

Policies need to be informed, coherent and coordinated

When policies to green the economy and policies to develop skills are not well connected, skill bottlenecks will slow the green transformation, and potential new jobs will be lost. **Strategic, leadership and management skills** that enable policy-makers in governments, employers' associations and trade unions to set the right incentives and create enabling conditions for cleaner production and services are an absolute priority.

Environmental awareness as an integral part of education and training at all levels, introduced as a core skill from early childhood education onwards, will eventually push consumer behaviour and preferences and the market itself.

Labour market information for anticipating and monitoring skill needs for green jobs is the critical starting point for effective policy cycles. This enables governments and businesses to anticipate changes in the labour market, identify the impact on skill requirements, incorporate changes into the system by revising training programmes and introducing new ones, and monitor the impact of training on the labour market.

The country studies that told the most successful stories prove the value of **effective coordination among line ministries and social partners**, achieved by creating task forces for human resource development for a greening economy, or by incorporating training and skills issues into a council for environmental development. It is important that the platform for this dialogue has decision-making authority, can establish clear commitments among all those partners involved and allocate human and financial resources to them, and has agreed responsibilities not only for planning but for implementation. A win-win situation can only be achieved if environment, jobs and skills are discussed, planned and implemented in conjunction with each other.

Decentralized approaches can actually promote policy coordination and coherence at **sectoral and local levels**. Direct dialogue between national and regional governments and social partners can be translated into action when commitments and resource allocation occur at a smaller scale and where immediate dividends are obvious for all partners involved. A good

combination of top-down coordinated policy-making with bottom-up sectoral or local initiatives can support effective training-intensive green transitions.

Policies need to be targeted

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 growth dividend from greening the economy will be attained only if access to new training provided as part of green measures is made accessible to disadvantaged youth, persons with disabilities, rural communities and other vulnerable groups. Incentives to increase women's participation in technical training programmes will not only increase their participation in technology-driven occupations but also help solve the skill shortage problem in this segment of the labour market.

Green transitions affect the entire training system

Taking into account all three types of skills change – that resulting from employment shifts within and across sectors as the consequence of green restructuring, that associated with new and emerging occupations, and the massive change in the content of established occupations – it becomes clear that the whole training system must be mobilized. Adjusting training programmes to green changes in the labour market is a transversal task across levels and types of education and training.

So far, compulsory level and tertiary education have been catching up rather well, whereas technical and vocational education and training has been lagging behind in adapting to the needs of the green economy. Improving adjustment here can give new impetus to employment-centred and fair green transitions and requires the following key challenges to be met:

- ***putting basic skills high on the policy agenda***, as a foundation of flexibility and employability throughout the life cycle;
- ***matching classroom and practical training*** through apprenticeships, internships, job placements, projects on the job etc.;
- ***adjusting the length and breadth of training provision*** according to different types of skills change;
- ***equipping teachers and trainers*** with up to date knowledge on environmental issues and on green technologies – education and training which deals with preparation of teachers and trainers should be one of the first priorities in skills response strategies;
- ***enabling active labour market policy measures*** (ALMPs) to take into account green structural change and to provide access to relevant training and other employment activation measures; and
- ***deploying public employment services*** (PES), as important players in job matching and training, to raise awareness about green business opportunities and related skill needs.

The linchpin of effective skills development for greening the economy is *coordination*. The degree of coordination between public and private stakeholders and the degree of involvement of social partners are decisive. Concerted measures need to be undertaken by governments at different levels, including the community level, employers and workers, through institutional mechanisms of social dialogue, such as national or regional tripartite councils, sector or industry skills councils, public–private partnerships and the like.

Developing countries need special measures

Developing countries, and the workers and employers in them, have the least responsibility for climate change and environmental degradation but suffer their economic and social consequences disproportionately. Special measures that can speed their employment-centred green transformations include:

- capacity building for employers in the informal economy and micro and small enterprises to enter green markets in localities where they are most needed;
- entrepreneurship training and business coaching for young people and adults to start up green businesses in conjunction with microfinance projects;
- environmental awareness among decision-makers, business leaders and administrators as well as institutions of formal and non-formal training systems;
- capacity building of tripartite constituents to strengthen social dialogue mechanisms and to apply these to dialogue about accessibility of training for green jobs; and
- increased capacity of formal education and training systems and institutions to provide basic skills for all and to raise the skills base of the national workforce; this includes improving apprenticeship systems and building synergies with NGOs that provide education and training.

These measures can only be taken if resources are available. It is therefore recommended that not only national governments but also international partnerships in developing countries take these recommendations into account both in environment programmes and in skills development programmes.

Abbreviations

ANFA	National Association for Training in the Automobile Sector (France)
ANPE	National Agency for Employment (Mali)
ARRA	American Recovery and Reinvestment Act of 2009
BIBB	Federal Institute for Vocational Training (Germany)
BITC	Business in the Community (United Kingdom)
BLS	Bureau of Labor Statistics (United States)
CAD	computer-aided design
CCS	carbon capture and storage
CDM	Clean Development Mechanism
Cedefop	European Centre for the Development of Vocational Training
CER	certified emissions reduction
CFMEU	Construction, Forestry, Mining and Energy Union (Australia)
CIEA	Inter-University Environmental Education Commission (Costa Rica)
CNG	compressed natural gas
CRSP	Central Rural Sanitation Programme (India)
CSR	corporate social responsibility
DIHK	Chamber of Commerce (Germany)
EPI	Environmental Performance Index
EPWP	Expanded Public Works Programme (South Africa)
ESD	education for sustainable development
ETA	Employment and Training Administration (United States)
EU	European Union
GDP	gross domestic product
GHG	greenhouse gas(es)
GIS	geographic information systems
GJP	Global Jobs Pact (ILO)

GPS	global positioning systems
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (now GIZ: Deutsche Gesellschaft für Internationale Zusammenarbeit)
HDI	Human Development Index
HRD	human resources development
HSBC	Hong Kong and Shanghai Banking Corporation
HVAC	heating, ventilation and air conditioning systems
ICT	information and communications technology
IEA	International Energy Agency
ILC	International Labour Conference
ILO	International Labour Organization
IOE	International Organization of Employers
ISC	Industry Skills Council (Australia)
ISCO	International Standard Classification of Occupations
ISIC	International Standard Industrial Classification of All Economic Activities
ITUC	International Trade Union Confederation
LEED	Leadership in Energy and Environmental Design
LMI	labour market information
LMIS	labour market information system(s)
LO	Danish Confederation of Trade Unions
MSA	Manufacturing Skills Australia
MSEs	micro and small enterprises
NAPA	National Adaptation Programme of Action (under UNFCCC)
NGO	non-governmental organization
ODEP	Office of Disability Employment Policy (US Department of Labor)
O*NET	Occupational Information Network (United States)
PES	public employment services
PV	photovoltaic
R&D	research and development
RKMLP	Ramakrishna Mission Loksiksha Parishad (India)
SETA	Sector Education and Training Authority (South Africa)
SMEs	small and medium enterprises

SOC	Standard Occupational Classification
SSC	sector skills council
STEM	science, technology, engineering and mathematics
TAFE	technical and further education (Australia)
TERI	The Energy and Resources Institute (India)
TESDA	Technical Education and Skills Development Authority (Philippines)
TVET	technical and vocational education and training
UKCES	UK Commission for Employment and Skills
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICA	Brazilian Sugarcane Industry Association
VET	vocational education and training
WHO	World Health Organization

PART 1 | **Global synthesis report**

1. Introduction

The transition to a greener economy depends crucially on having the right skills available. The growing importance attached to sustainable development and the shift to a low-carbon economy is increasing the pace of change in labour markets and skill needs. Economies moving towards greener production have great potential for job creation – a benefit of particular significance as countries attempt to recover from economic crisis – but also face structural change and transformation of existing jobs. The timely supply of relevant and good-quality skills is indispensable for a successful transition that safeguards productivity, employment growth and development.

1.1 The origins of the project

In this context, in 2009 the ILO launched, in cooperation with the European Centre for the Development of Vocational Training (Cedefop), a global research project to investigate the skill needs of greener economies, focusing on structural economic changes, new and changing occupational profiles, and major constraints on the acquisition and development of relevant skills. The research also analysed responses to these needs, including both training and the systems and tools created to anticipate and monitor the skills needed for green jobs.

The research project has been part of the Green Jobs Initiative, a joint initiative of the United Nations Environment Programme (UNEP), the ILO, the International Organization of Employers (IOE) and the International Trade Union Confederation (ITUC), which analyses and promotes green and decent jobs as a consequence of policies developed to reconcile economic development with the protection of the environment. An earlier report produced in the framework of the initiative, entitled *Green jobs: Towards decent work in a sustainable, low-carbon world*, identified the lack of available relevant skills as a bottleneck in transition to the green economy.¹ The current research project has taken this work further, both by identifying skills needed for green jobs and by setting out to collect more evidence on the situation in different countries and to gather examples of good practice in responding effectively to these new skill needs.

The International Labour Conference (ILC) has identified climate change as one of the major global drivers of change, alongside technology and trade. Its *Conclusions on skills for improved productivity, employment growth and development* recognized skills development as part of an effective response to changing conditions, helping employers and workers alike to take advantage of new opportunities and helping to mitigate the negative impacts of change. It also specified identification and forecasting of skill needs, and the design of effective skills development mechanisms within national development strategies, as critically important in preparing workers and enterprises for new opportunities and adopting a forward-looking approach to dealing with change.² The current project was developed in line with these findings, collecting further evidence relating to the role of skills in taking opportunities and mitigating negative consequences of climate and environmental change.

¹ UNEP, ILO, IOE, ITUC: *Green jobs: Towards decent work in a sustainable, low-carbon world* (Geneva, 2008).

² ILC: *Conclusions on skills for improved productivity, employment growth and development*, Report to International Labour Conference (Geneva, 2008).

1.2 What are “green jobs”?

“Green jobs” are defined as jobs that reduce the environmental impact of enterprises and economic sectors, ultimately to levels that are sustainable. This definition covers work in agriculture, industry, services and administration that contributes to preserving or restoring the quality of the environment while also meeting the criteria for decent work – adequate wages, safe conditions, workers’ rights, social dialogue and social protection.³ It also covers activities related to both mitigation of and adaptation to climate change. This is a working definition. It implies in its inclusivity and breadth that every job can potentially become greener. As time goes on and the transition to a green economy intensifies, what is considered a green job today might not continue to be so regarded. The understanding of green jobs also varies from one country to another. Ultimately, countries will need to compose their own national definitions and set thresholds for practices considered green or non-green.

1.3 Hypothesis and methodology

The main hypothesis of the research project is that there are three main types of change relating to skills in the context of greening the economy:

- “green structural change” as a result of environmental changes, application of new green technologies and regulations, and new market opportunities, giving rise to displaced workers in need of retraining for employment in other sectors;
- the emergence of new occupations; and
- change in existing jobs as a consequence of the greening of many established occupations.

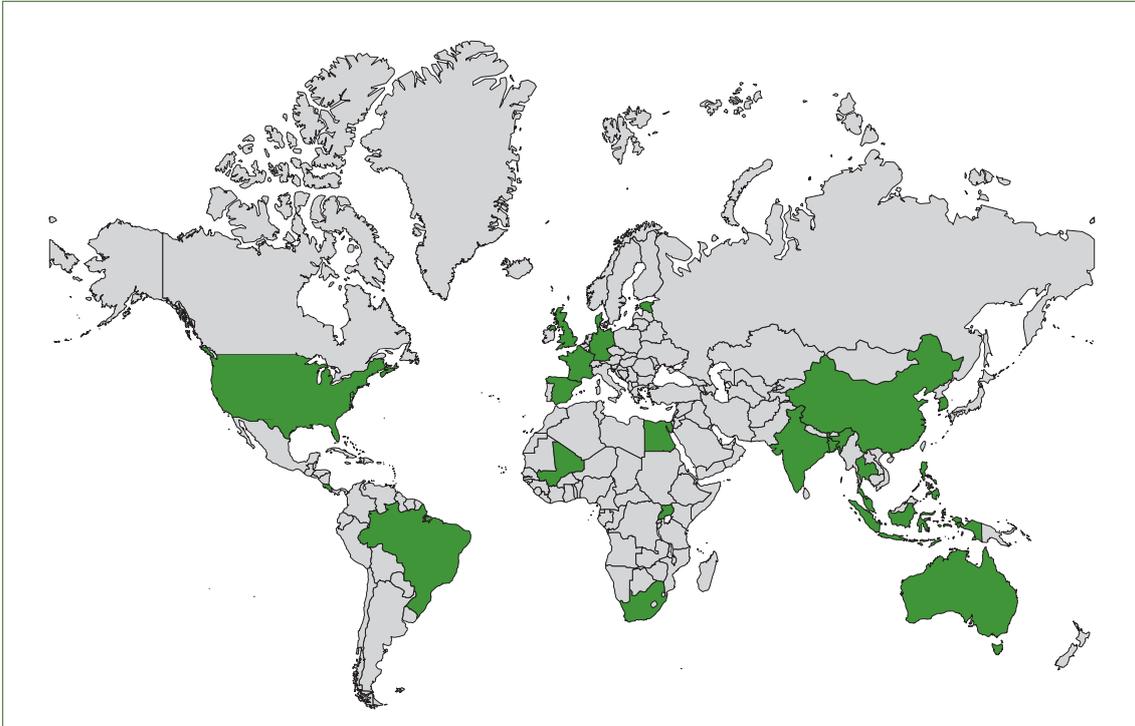
At the core of the research are 21 country studies (see figure 1.1), 15 conducted by the ILO (in Australia, Bangladesh, Brazil, China, Costa Rica, Egypt, India, Indonesia, Mali, the Philippines, the Republic of Korea, South Africa, Thailand, Uganda and the United States) and six by Cedefop (in the European Union Member States of Denmark, Estonia, France, Germany, Spain and the United Kingdom).

The initial selection of countries was made in a consultation process with green jobs specialists and ILO field offices. The subject attracted substantial interest at the national level and additional countries were welcomed on board. The final group of 21 represents 60 per cent of the world population, 59 per cent of global GDP (2008 figures) and 64 per cent of global CO₂ emissions (2006 figures). The available literature was also reviewed, broadening the scope of the report beyond coverage of these 21 countries.

All the country studies applied a standard methodology with a uniform template and research guidelines (see Annex 3). Consultants were asked to combine qualitative and quantitative research in proportions appropriate to the availability of data. Quantitative analysis was limited to national statistics already formulated, not requiring any major primary data collection. Qualitative analysis included a large variety of techniques ranging from structured interviewing and focus groups to workshops and small-scale questionnaire surveys. The study targeted national experts, policy-makers at various levels, trade unions, business associations, training authorities, sectoral organizations, public–private partnerships, enterprises and academic institutions. Country experts were asked to collect case studies which could shed light on how the three types of change

³ UNEP, ILO, IOE, ITUC: *Green jobs*.

Figure 1.1. Country coverage in the research project “Skills for green jobs”



identified in the project hypothesis were playing out and to present examples of good practice in response strategies. Accordingly, within the countries studied 148 case studies were collected (107 by the ILO and 41 by Cedefop). These focused on the skill needs specific to particular sectors and occupations, and on the strategies being adopted by countries in response to those needs.

A thorough validation process was undertaken to subject the draft report to expert review and comment. This included a validation workshop held in Geneva in May 2010 which brought together all the authors of the country studies, researchers, skills and labour market experts, environmental experts and policy-makers, along with representatives of international and European employers' and workers' organizations, other international organizations and European institutions.

1.4 The structure of the report

The structure of Part 1 of the report, the global synthesis report, is as follows. This introduction is followed by a second chapter which discusses the factors driving changes in skill needs in the transition to a green economy. The third chapter sets out the policy context of these changes, identifying key challenges for a green economy, including skill shortages, and reviewing policy responses to date from both the environmental and the skills perspective. The fourth chapter looks at green structural change, that is employment shifts within and across sectors, and its implications for retraining. The fifth chapter discusses change in skills requirements within occupations, providing an overview of both changing and newly emerging occupations, and reviewing the training responses being put in place, including the methods used, to provide the necessary skills. The

sixth chapter provides an insight into countries' approaches to anticipating and monitoring the skills they will need as their economies go green. Finally, the seventh chapter presents key findings and proposes ways forward.

Part 2 of the report comprises summaries of the background reports for all 21 countries, including brief description of case studies. The full versions of the country reports were published electronically and can be found at http://www.ilo.org/skills/what/projects/lang--en/WCMS_144268/index.htm.

This report is a first snapshot of current trends, shortcomings and good practices in skills for green jobs, based on 21 country studies. It makes no claim to draw an exhaustive picture of skills change in the green transition. Indeed, it has revealed many areas in which further work is required, among them green jobs statistics and monitoring and in-depth sectoral analysis. Nevertheless, as the first global research project of this kind, it has generated unique findings, marshalled valuable evidence of successful efforts to meet environmental and employment challenges simultaneously, and indicated the major role played by skills development in facilitating the transition to a green economy in parallel with the quest for decent work for all.

2. Drivers of change: How skill needs shift as economies go green

This research has identified four main drivers of change in skills requirements: physical changes in the environment itself; environmental policy and regulation; technology and innovation; and changes in prices, markets and consumer habits. These drivers, or forces of change, are interrelated but their relative importance differs among countries. In developed countries consumer behaviour and hence market forces have become a major driver of change, whereas in developing countries environmental changes and policy and regulation remain more important. Better-informed policy-making and more effective incentives for appropriate investment, business development and technology transfer may trigger the green transition in developing countries through a process similar to that which occurred in the earlier days of environmentalism in some industrialized countries.

The environmental movement did not start yesterday. In many developed countries these concerns, and attempts to make production and consumption patterns cleaner and more environmentally friendly, have been around for three or four decades. These processes have changed the skills requirements of both consumers (e.g. environmental awareness, knowledge about production patterns, labelling etc.) and producers, eventually affecting entire societies. What have been the main drivers of these developments? What can we learn from the past and from current trends? What are the skills implications for countries at different stages of economic development? This chapter attempts to answer these questions and to provide a framework for further analysis.

It is clear from the country reports that in the early days of environmentalism, in the 1970s and 1980s, changes in skill needs related to the environment were mainly driven by legislation. Nowadays, with evidence growing of damaging trends such as climate change, desertification, pollution and increasing scarcity of resources, concern for the environment has triggered numerous technological solutions and innovations and has generated a vibrant global market. Consequently, recent developments are driven by a combination of factors. Market pull is an important element, stimulating and stimulated by research and development, innovation and investment. Investments in turn are made both for enterprise creation and for R&D and innovation purposes.¹

Thus the research has identified four drivers of change currently at work. These are:

- changes in the natural or built environments;
- policy and regulation;
- technology and innovation; and
- markets for green industries and new consumer habits.

2.1 The changing environment

Changes in the natural and built environment directly influence economic processes affecting the very basis of production. Therefore the changing natural and built environment is at the heart of

¹ See e.g. Research2015 catalogue (2009), available at: <http://research2015.fi.dk/> (accessed 1 Apr. 2011).

environmental concerns. At the forefront of current environmental debates is climate change, which already affects farmers around the world and is likely to have profound impacts on people living in low-lying coastal areas and those in arid and semi-arid regions suffering from water scarcity. Increasing climate variability is responsible for natural disasters such as droughts and floods, and also affects biodiversity and the availability of natural resources. Agriculturists and pastoralists need the skills to enable them to adapt to changing weather patterns, to diversify in their choice of crops or livestock, and to prepare for and deal with the increasing risks associated with the climate. Policy-makers too need new skills to design appropriate policy responses to damage and disaster: for example, in flood-devastated areas such as parts of the Philippines, urban and rural developers need to consider what investment is necessary in preparing communities to withstand future such events.

Other disasters, such as earthquakes, have similarly severe and devastating effects on economies and will result in short- to medium-term changes in skill needs. Reconstruction of buildings will demand not only increased labour in the construction sector, but professionals with increased knowledge on statics and construction materials in order to design and erect buildings capable of withstanding future earthquakes.

The scarcity and depletion of resources needed for production such as fertile soils is another critical driver affecting economic patterns and skill needs at global, national and local levels. In this area both adaptation skills and mitigation skills come into play. The implementation of alternative energy solutions to avoid the damaging effects of fossil fuel use require not only installation and maintenance skills but also research and development skills, both to make the new technologies affordable and accessible for all and to replace scarce resources, such as the rare earth metals used for photovoltaic solar cells and many other electronic appliances. Increased emphasis on the re-use of materials adds to the importance of the recycling industry, with implications for a wide range of technical and managerial occupations both within and outside that industry. Depletion of marine resources affects occupations in the fishing industry.

Another type of change in natural environments is pollution caused by toxic substances, which affects a wide variety of occupations. To name just a few: pollution of waters concerns the fishing industry and increases the demand for skills in water treatment, in the form of both greater numbers of qualified technicians and higher levels of expertise; air pollution that causes respiratory diseases affects many who live in cities and/or near industrial sites and also those involved in medical treatments; and pollution of soils has impacts on farmers and foresters. Pollution is usually tackled through regulation: policy-makers ban certain products or resources, impose standards or thresholds, or introduce incentive-based instruments such as taxes or tradable permits, as in the case of CO₂ emissions trading. To be effective, this response requires, first, researchers such as biologists, chemists and economists with the skills to identify harmful substances and recommend appropriate measures to mitigate their effects; and second, policy-makers with the skills to evaluate research results and design and implement effective policy responses.

The changing natural and built environment will be discussed in more detail in Chapter 3, in the context of setting out the key challenges for a green economy.

2.2 Policy and regulation

The field of regulation encompasses all government policies that affect the environmental performance of a country's economy. These include on the one hand measures to reduce or prevent environmental damage, for example by restricting the use of certain materials, products or production processes, be it through trade barriers, bans or increased costs, and on the other hand

measures to promote and foster cleaner production. Cleaner production can be promoted through targets for reduction of CO₂ emissions or the dissemination of green technologies; incentive structures such as taxes, subsidies, rebates, emissions trading mechanisms or feed-in tariffs for renewable energy; industrial and technology policies to support green practices and sectors; and policies to promote research and development in pursuit of green innovation.

Governments thus play a crucial role in driving behavioural change on the part of both business and consumers, not only through legislative prohibitions but by providing both incentives and disincentives. In order to do so they require new skills first and foremost on the part of policy-makers and regulators, who need to be able to assess the environmental and policy impacts of various options and select the most appropriate policy instrument for prevailing circumstances. The policies adopted will in turn have widespread effects on skill needs across a broad spectrum of industries. Far-reaching policy directives alter the content of existing occupations and may also call into being entirely new occupations – not only in the production of environmental goods and services, but within other industries such as construction, tourism and transport, among others. This topic is explored in more detail in Chapter 5 of this report. Lack of enforcement of environmental regulation, which is often deplored by developing countries, can retard the necessary change and adaptation of the workforce; it can even damage the employability of those who have equipped themselves with new skills in response to the regulations.

Every country covered in the research provides numerous instances of national legislation necessitating skills changes in certain occupations. A good example comes from China, where seven central government departments and administrations jointly issued a Management Regulation on Pollution Control of Electronic Information Products. The regulation will gradually phase out the use of several hazardous materials in electronic products in order to control pollution at the source, forcing managers, engineers and product developers in domestic manufacturing firms to use greener designs.²

Changes in national skill needs can be brought about by international agreements as well as by national regulation. In Europe, EU directives take priority over much national legislation, frequently forcing skills change in the construction, manufacturing and transport sectors. The country report from the Philippines pinpoints new skills required of seafarers with responsibility for managing ship-based pollution to comply with the International Convention for the Prevention of Pollution for Ships.

By setting the right incentives, regulation can also influence the development and uptake of new green technologies.

2.3 Green technology and innovation

Technology is the knowledge of instructions or “recipes” on how to make things or supply a service.³ Technology includes all tools, machines, instruments and devices, and the skills by which we produce and use them.⁴ Technological innovation and change have always been drivers of skills change. Yet not every technological innovation contributes to the greening of economies.

² *Recycling Magazine*, 2009, cited in Chinese country report.

³ J. Mokyr: *Thinking about technology and institutions*, Paper presented at the Macalester International College Roundtable, “Prometheus’s bequest: Technology and change”, Departments of Economics and History, Northwestern University, 2002, available at: <http://faculty.wcas.northwestern.edu/~jmokyr/macalester3.PDF> (accessed 1 Apr. 2011).

⁴ R. Bain: “Technology and state government”, in *American Sociological Review* (1937), Vol. 2, Dec., p. 860.

Technologies that enhance productivity but increase carbon emissions do not contribute to greenhouse gas mitigation; improvements in agro-industry that yield better harvests at the cost of decreased resilience of soil or plants to climate shocks do not contribute to sustainable agriculture.⁵ Green technology is that which improves the resource or energy efficiency of production, ultimately to sustainable levels, reduces waste, and/or increases the use of non-polluting, renewable resources.

Green innovation is understood as improvements in products, processes, marketing methods, organizations or institutions that yield higher environmental benefit. Such innovation can be technological or non-technological.⁶ Skill needs triggered by innovation include demand for research and development skills, but also for entrepreneurship skills to commercialize and diffuse innovation as well as management and operational-level skills to translate it into practice.

New technology can be developed through innovation or it can be acquired and adopted. The appropriate skills and competencies for the development, dissemination and adoption of technology are crucial for the transfer of technology, either from firm to firm or from one country to another. While developed countries at the forefront of technological development need the skills to research and innovate, developing countries more often require the skills to adopt and adapt technologies. The first challenge developing countries face in seeking access to new technologies is often their protection through intellectual property rights.⁷ However, this is by no means the only challenge: successful green technology transfer also hinges on the process of adoption and the absorptive capacity of enterprises or countries.⁸ This capacity in turn depends on the acquisition within companies of the necessary skills to assess, select, apply and adapt new technologies, and within the national administration of the skills required to set up and manage institutions that support the uptake of technology.⁹ When new technologies are in place, in both developed and developing countries, further major skill needs arise to ensure their dissemination, implementation and maintenance: for instance, craftspeople need to be trained to market greener products and services, so that they can advise on, for example, energy-saving measures in houses.¹⁰ Such skills may be required in a wide variety of occupations, ranging from managers to developers, purchasing officers to engineers, salespeople to technicians.

Green technology and innovation are independent drivers of change in skill needs. They can influence demand for skills without necessarily being affected by regulation, consumer demand or changes in the natural environment.

As an example, several districts in India are benefiting from a technological improvement related to brickmaking. The vertical shaft brick kiln introduced in a World Bank project is much more energy and resource efficient than the traditional kiln, which involves high consumption of

⁵ J. Park and N. Roome: "Atom to bits: E-sustainability in the global economy", in J. Park and N. Roome (eds.): *The ecology of the new economy* (Sheffield, Greenleaf Publishing, 2002), pp. 10–19.

⁶ See also C. Martínez-Fernández, C. Hinojosa and G. Miranda: *Green jobs and skills: The local labour market implications of addressing climate change* (Paris, OECD, 2010).

⁷ J. H. Barton: *Intellectual property and access to clean energy technologies in developing countries: An analysis of solar photovoltaic, biofuel and wind technologies* (Geneva, ICTSD, 2007).

⁸ Wesley M. Cohen and Daniel A. Levinthal: "Absorptive capacity: A new perspective on learning and innovation", in *Administrative Science Quarterly* (1990), Vol. 35, pp. 128–52.

⁹ UN Department of Economic and Social Affairs: *World Economic and Social Survey 2009: Promoting development, saving the planet* (New York, 2009).

¹⁰ K. Hahne: *Skills and occupations in the area of sustainable use of energy and renewable energies* (Bundesinstitut für Berufsbildung, 2005), available at: <http://www.bibb.de/veroeffentlichungen/en/publication/show/id/2209> (accessed 1 Apr. 2011).

coal, firewood and other biomass fuels and generates high carbon emissions. The technicians who run the kiln need new skills to operate and maintain it. This example, as well as many others from the country reports, highlights the importance of collaboration between industry, government and other non-state actors in fostering both the development and commercialization of technologies and the related skills development.

The level of green technology is also determined by demand. Consumers' attitudes towards clean technologies influence their willingness to buy green products, such as low-fuel cars or other energy-efficient devices, and thereby both to support and to disseminate new technologies. The following section will discuss the relationship between green technology and markets, and the implications for skill needs, in more detail.

2.4 Green markets: Industrial and consumer demand

The market for greener products and services is itself driving change in skill needs. Devices to enhance energy efficiency sell on the market; regulations to promote renewable energies in various countries create market opportunities for producers of renewable energy technology worldwide. Making the most of these market openings requires staff with appropriate skills to develop businesses.¹¹ Companies also undertake initiatives that take their green performance beyond simple compliance with regulation, giving them a competitive advantage over others in conditions where climate change and other environmental risks impose costs on businesses.¹² International market linkages increasingly demand that supplying companies in developing countries comply with the environmental requirements of purchasing companies in developed countries.

New markets and business opportunities are often opened up by special incentives, such as those provided by green stimulus packages, and investment opportunities in countries with abundant and cheap labour. Outsourcing of supply in clean technologies and other green production and services, both onshore and offshore, has been on the rise over recent decades. The decisive factors in choosing where to invest or to seek suppliers include not only the cost of production but also the availability of relevant skills.

A thriving market for cleaner production provides opportunities for new business operations and models that require green managers and entrepreneurs. In Indonesia, where there is no legal requirement for individual consumers to manage their waste, the recycling industry emerged purely because it offered business opportunities. In an example of an innovative business model, companies move from selling products to leasing them, which enables them to reduce their material inputs by recycling used parts.¹³

Markets are driven by consumer demand and thus develop new skill needs in the wake of changing consumer preferences. Growing awareness of commercial practices that harm the environment has changed consumption patterns among certain consumer groups. Emerging preferences for good-quality organic food free of chemical fertilizers, or for "ecotourism" that does not harm ecosystems, have created entirely new industries requiring specific skills that

¹¹ World Business Council for Sustainable Development (WBCSD): *Annual Review 2009: The green race is on* (Geneva, 2010). In 2009 the WBCSD broadened the focus on capacity building to look strategically at issues around talent, skills and sustainability.

¹² HSBC Global Research: *Building a green recovery* (2009a).

¹³ W. McDonough and M. Braungart: *Cradle to cradle: Remaking the way we make things* (New York, North Point Press, 2002).

workers in the conventional food and tourism sectors do not possess. The organic farming sector in Uganda developed to meet demand from European and North American consumers for socially and ecologically responsible products. In Costa Rica, the occupational profile of corporate social responsibility (CSR) managers in companies has evolved in response to growing concerns about responsible business practices.

Alongside increasing demand for greener products and services in some consumer groups there has also been a degree of sceptical backlash (against, for example, the enthusiasm for organic food and ecotourism), while many consumers simply want more information. These circumstances create a strong demand for green advocacy work and awareness-raising. Workers in environmental education and the environmental information sector have a key role in disseminating knowledge about the environmental impacts of human activity, and thus in shifting consumer behaviour.¹⁴

2.5 Conclusions

Whereas in the early days of the environmental movement changes in skill needs were driven largely by policy and legislation, in recent years other drivers have become equally important. Increasingly urgent and more widely felt concern about the effects of human activity on the environment has triggered technological innovation and created vibrant markets. These drivers do not have equal force in all contexts. In the developed countries business opportunities and consumer preferences have become major drivers of changing skill needs, whereas in developing countries the chief drivers remain the changing environment and policy and regulation. Even so, it is clear that if policy and regulation continue to promote the green transition strongly with smart incentives for green and greening businesses, sooner or later the market will be sparked into action. It is therefore essential that policy-making and legislation in these countries are well informed and thoughtfully conducted in such a way as to foster this process.

Green technology is an important driver of change in skill needs in its own right, in both developed and developing countries. In the former, the highest demand seems to be for skills in research and development; in the latter, the emphasis is rather on skills in the adoption, implementation and maintenance of new technologies. However, these skills can come into play only after successful technology transfer and diffusion have been achieved, and here again the availability of relevant skills is decisive.

All four drivers discussed in this chapter imply a need for skills related to both adaptation to and mitigation of climate change, but the changing natural and built environment creates a particularly strong demand for adaptation skills. As the changing environment tends to loom largest in developing countries, the relative importance of adaptation skills is correspondingly greater there than in the developed world.

All the drivers of change discussed here are interrelated. A changing natural or built environment is the basis for policy decisions on environmental regulation. Regulation, in turn, can affect the development, availability and dissemination of technology. Regulation and also the availability of technology affect national and global markets. Consumer attitudes and preferences, and thus the demand for greener products, can affect the way companies do business and implement new technologies that allow them to meet new consumer needs.

¹⁴ See e.g. UNESCO: *Education for sustainable development*, available at: <http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/education-for-sustainable-development/> (accessed 1 Apr. 2011).

Eventually, these drivers of change will lead to changing mindsets among policy-makers, businesses and consumers. Changed ways of thinking and the changed patterns of behaviour that follow will then further stimulate green economic activities. This is why raising environmental awareness is crucial to encouraging a green transition, and why some countries have already placed it high on the national agenda. In Costa Rica, the government's stated objective to become carbon neutral prompted several enterprises to initiate voluntary programmes to reduce their emissions; in Thailand, the country's sustainable development strategy is based on the king's Sufficiency Economy Philosophy, which calls for environmental awareness in all circumstances as an integral part of the national way of life.

Although globalization is exerting a growing influence on all four drivers identified here, three of them – the changing environment, policy and regulation, and green technology – remain primarily influenced by the national context. Therefore the requirements for new skills in the context of transition to a greener economy remain very much country specific, depending above all on the particular environmental challenges faced by each country and on its national political and policy framework, including its system of rebates, feed-in tariffs, credits, tax exemptions and other incentives. This situation is, however, changing as more and more countries come to realize that the planet Earth is our common home, and that an environmental disaster in one country is a matter of global concern. International and supranational policy and legislation are already playing a greater role and are coming to drive change at national policy level. This trend will eventually accelerate the already vibrant global market and intensify business-driven technology transfer.

As a result of all these factors, the need for new and augmented skills will become increasingly widespread and increasingly pressing across countries and regions. Identifying the particular skills needed for green jobs in particular locations and sectors, pinpointing where occupations will change and where new ones will come into being, and working out effective strategies for developing skills in collaboration with other nations can all help countries across the world and across the development spectrum to prepare for the change ahead.

3. Challenge and response: The policy context

The key priority for a green economy is to combat climate change and environmental degradation and remove their negative environmental, economic and social impacts. The transition to a green economy depends crucially on coordination and policy coherence. Many countries, however, in spite of having formulated environmental policies, fall short in establishing skills development strategies that meet the green employment demand. The same deficiency often hampers the green components of economic recovery packages: few countries have allocated investment to complementary training measures. Coherence between environment and skills policies is not simply correlated with level of economic development: it depends on a complex combination of factors including institutional capacity, education and training systems, technological competitiveness and attitudes to innovation. Integration of the skills agenda into an overall development strategy, including technological, industrial, employment, trade and environmental policies, will help to promote policy coherence in general and that in the field of environment and skills in particular.

Human life depends on natural resources; natural resources depend on human behaviour. This reciprocity should inform countries' strategies in striving for economic growth, employment generation and decent work in healthy environments. In facing the challenges of climate change and environmental degradation, environmental policies will need to be bold and ambitious. It is important also to recognize in turn that these policies can only be implemented by people, and that those people have to be equipped with the necessary skills, knowledge and environmental awareness. Transition to a low-carbon, green economy will bring about large-scale change in the skills required of workers. It is therefore vital, in the common pursuit of a better life, to seek coherence between environmental and skills policies.

This chapter sets the scene for further analysis. Section 3.1 discusses the key challenges and priorities for a green economy identified by the 21 countries that participated in the research: namely, climate change and environmental degradation and their impact on economy and society; the challenge of providing decent work; and skills shortages. Section 3.2 reviews the range and coherence of environmental and skills policies countries have put in place to date, including both long-term policies and crisis response measures prompted by the recession and jobs crisis affecting many countries since 2008.

3.1 Key challenges and priorities for a green economy

3.1.1 *Climate change, environmental degradation, and related economic and social impacts*

Unsustainable consumption and production patterns such as overexploitation of resources in the developed world and rapid and high-carbon growth in the developing world are having damaging and dramatic effects on the environment. Above all, they are responsible for global warming.

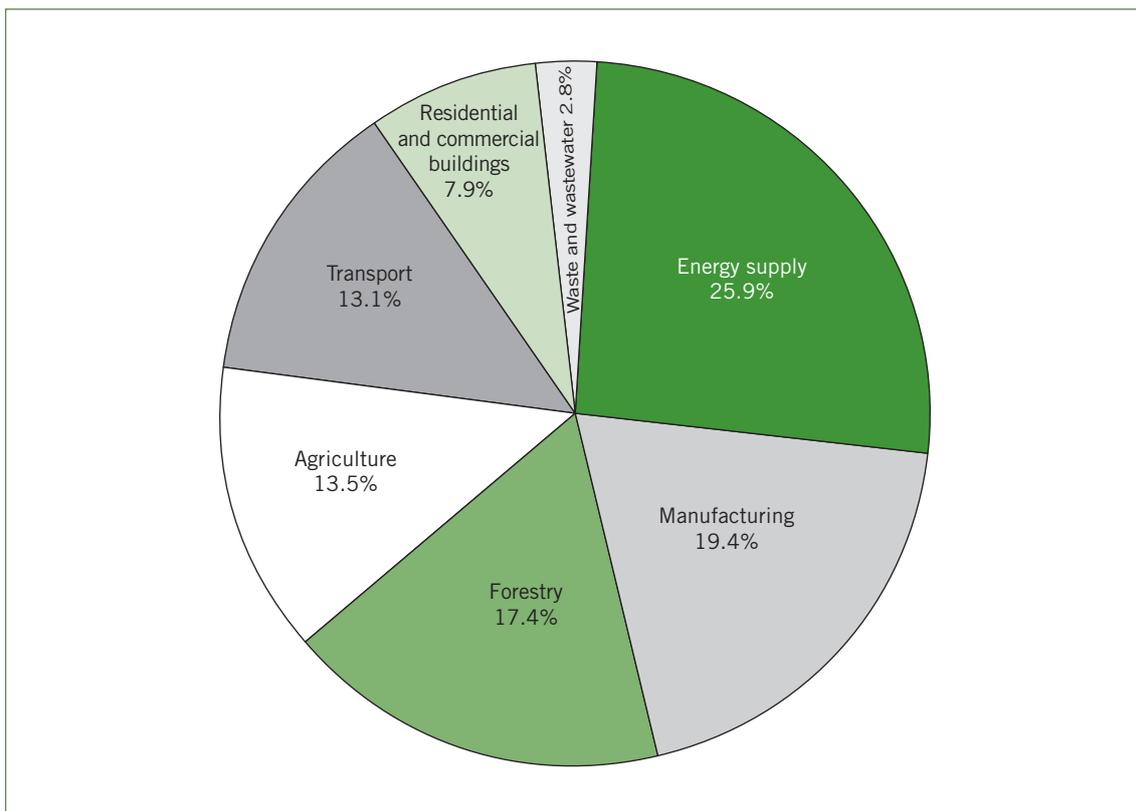
They also cause scarcity and depletion of resources, destroy habitats, cause biodiversity loss and the degradation and loss of arable land, increase the numbers of threatened species, change the migratory paths of animals and pollute the air, earth and water.

Global energy demand is expected to rise in the coming years, mainly due to an exponential increase in the world population. In addition, the price of oil is expected to rise, which will make it difficult for countries to ensure both electricity supply and food security. At the same time, the International Energy Agency (IEA) is warning that if the global economy is not made less dependent on carbon-based fuels the atmospheric concentration of greenhouse gases (GHG) could double by the end of the twenty-first century, leading to an eventual global average temperature increase of up to 6°C.¹

Sectors with the highest greenhouse gas emissions

The highest GHG emitting sector worldwide is energy generation, which releases 25.9 per cent of total emissions, followed by manufacturing at 19.4 per cent (see figure 3.1).

Figure 3.1. CO₂ emissions by sector



Source: IPCC: Climate Change: *Synthesis report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Figure 2.1 (Geneva, IPCC, 2007). © IPCC. Reproduced with permission.

¹ International Energy Agency: *World Energy Outlook 2008–2030* (Paris, 2008). Following the findings of the Intergovernmental Panel on Climate Change (IPCC), experts and policy-makers believe that the increase in global average temperature should be limited to a maximum of 2°C to avoid irreversible negative impacts.

The forestry sector is responsible for 17.4 per cent of CO₂ emissions; these result from both timber harvesting and low forest regrowth rates, inhibiting CO₂ absorption. In the Philippines, the proportion of land covered by forest has fallen from 70 per cent around 1900 to only 6 per cent today. In Bangladesh, Mali and Uganda, the use of charcoal and firewood creates immense pressure on forests, especially in the vicinity of towns. Because the forestry sector is an absorber (sink) of CO₂, as well as an emitter, the sector has a high climate change mitigation potential. Some countries, such as India, have implemented national forestry policies that aim to increase the proportion of national territory covered by forest as a way to offer environmental protection to the nation's society at large.

Agriculture is the largest employer in the world.² Worldwide, the sector is responsible for 13.5 per cent of GHG emissions, and the figure is considerably higher for emerging economies. In China, the agricultural sector emits 21 per cent of national GHGs, mostly as a result of rice cultivation, and in Brazil, agriculture emissions account for 57 per cent of the national total.³ Reducing these emissions will require the adoption of sustainable agricultural practices. Adaptation measures are already taking place in this sector, including training strategies for farmers all over the world.

Transport accounts for a rapidly increasing proportion of GHG emissions, reaching 13.1 per cent by 2007. For example, Costa Rica saw a 315 per cent increase in emissions from transportation between 1997 and 2006, compared to a 75 per cent increase in emissions from manufacturing for the same period. Greening the sector will involve an increased demand for low-carbon vehicles and the new technical skills required to design, assemble, repair and maintain them.

Residential and commercial buildings are responsible for 7.9 per cent of GHG emissions. Building is one of the sectors with the highest technical and economic potential to reduce emissions and create jobs in the process. High-performance buildings using technology already available, such as energy-efficient heating systems, renewable energy sources and insulation technology, can boast energy costs at least 80 per cent lower than those built using traditional practices.⁴ Many countries, such as the UK, have already introduced important policy measures for greening the building sector but have identified skill shortages in architecture, engineering and carbon consultancy as a major bottleneck in implementing them.

All these sectors, and others, will undergo significant structural changes as a result of policy interventions to reduce emissions. These will have substantial impacts on labour markets, setting in motion employment shifts within and across sectors and generating new retraining needs. These topics will be discussed in Chapter 4.

Food security in jeopardy

In some African countries, declining precipitation could reduce yields from rain-fed agriculture by up to 50 per cent by 2020. For this reason and others connected to climate change, agricultural production and access to food are likely to be severely compromised in many areas of the continent, endangering food security and exacerbating malnutrition.⁵

² UNEP, ILO, IOE, ITUC: *Green jobs: Towards decent work in a sustainable, low-carbon world* (Geneva, 2008).

³ <http://unfccc.int> (accessed 1 Apr. 2011).

⁴ UNEP, ILO, IOE, ITUC: *Green jobs*.

⁵ IPCC: *Climate Change 2007: Fourth assessment report* (Geneva, 2007).

The gravity of these effects is amplified by the high reliance of many countries on agricultural production, for both food and trade. In Mali, agriculture accounts for 40 per cent of GDP and provides the primary means of living for more than 80 per cent of the population. In India, where 60 per cent of the working population is engaged in agriculture, increases in global temperature are likely to change the patterns of the monsoon, with detrimental effects on agriculture. Countries such as Australia, Egypt and Spain are also likely to suffer from decreasing precipitation, reducing already limited water resources and inhibiting agricultural production. In addition, growing competition between land use for food and for biofuel production is likely to further jeopardize food security.

Endangered coastal areas

In Europe, North America, Australasia and small islands across the globe, coastal communities and habitats will be increasingly stressed by climate change impacts. Sea-level rise is expected to exacerbate flooding, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihood of people living and working in coastal areas.

In Egypt, the delta region already faces problems of possible flooding because of rising sea levels. Here and in other areas similarly threatened, skills in the installation and maintenance of innovative facilities more resistant to weather conditions will be required. Such skills have already been employed in the US city of New Orleans, where reconstruction after the devastation caused by Hurricane Katrina in 2005 has incorporated “smart” houses that would float if the city were to be flooded again.⁶

In Asia the areas at greatest risk will be the heavily populated megadelta regions of the south and east, with Bangladesh in particular peril.

Scarcity of resources, excess of waste

Rapid urbanization, industrialization and unsustainable economic development have led to rapid depletion of many natural resources, to the point where biodiversity is threatened and many substances needed to support economic production are severely depleted. In China in 1978 there were 193 cities, according to the national definition. In 2007 there were 661. Habitat destruction and loss of biodiversity, worrying trends in their own right, also have major impacts on the availability of resources. Traditional economic activities, such as woodcrafts, fishing and farming, may become impossible to pursue in their traditional forms or locations, forcing people to migrate in search of alternative employment.

At the same time as human activity across the world is consuming vast amounts of resources, so it is also generating vast amounts of waste. Some countries, such as Egypt, Thailand and Uganda, consider their waste management systems to be inefficient, acknowledging the scope for improvement in dealing with these unwanted outputs. In this context, the recycling industry has an increasingly important role to play. However, though it generates jobs that are green in the sense that their purpose is environmental protection, many of them are in the informal economy and of questionable quality. We shall return to this point when considering the interface between green jobs and decent work.

⁶ <http://www.makeitrightmola.org/> (accessed 1 Apr. 2011).

Risks to human health

Climate change and environmental degradation are likely to have damaging effects of varying severity on the health of millions of people. These include increased incidence of malnutrition; increases in deaths, diseases (diarrhoea, malaria etc.) and injury caused by extreme weather conditions; increased frequency of cardio-respiratory diseases as a result of higher concentrations of ground-level ozone in urban areas; increased vulnerability in some areas to certain infectious diseases; and illness, injury and death as a result of more frequent heatwaves and wildfires.⁷ In these circumstances initiatives directly related to population health, in fields such as education and public awareness, health care, public health, and infrastructure and economic development, will be of critical importance.

Water and air pollution also cause serious health problems. As noted in Chapter 2, efforts to combat pollution usually take the form of regulation, through prohibitions, thresholds, standards or incentive-based instruments.

Air quality is deteriorating in many parts of the world – to the point where most of India's metropolitan centres fall into the category of “polluted cities” according to standards set by the World Health Organization (WHO). The main causes of poor air quality are solid waste dumps, congested roads and obsolete transport infrastructure, dust and seasonal sandstorms, and emissions from heavy metallurgical industries, refineries, and cement and power plants.

Water shortages

In Africa and Asia, climate change is likely to increase water scarcity for millions of people. By 2050 water shortages are expected to be affecting 1 billion people in Asia alone, while changes in precipitation patterns and the disappearance of glaciers are projected to reduce significantly the amounts of water available for human consumption, agriculture and energy generation all over the world.⁸ In some places the trend is exacerbated by human activity: in Egypt, for example, per capita water share is expected to decline because of the unsustainable usage of the River Nile (in particular to dispose of solid and liquid waste from municipal and industrial sources).

In southern Europe, climate change is projected to lead to higher temperatures and greater incidence of drought in a region already vulnerable to climate variability. Reduced water availability here will affect hydropower potential, summer tourism and, in general, crop productivity.⁹ Spain, in the most southerly part of Europe, faces a particularly acute challenge, with higher temperature, lower rainfall and rising sea level all likely to diminish water resources. These challenges have given rise to a clear policy focus on the management of the country's energy and water resources.

Mountainous areas of Europe, meanwhile, will face glacier retreat, and the consequent reduced snow cover will affect winter tourism and threaten flora and fauna with habitat loss.

Displacement and other consequences of natural disasters

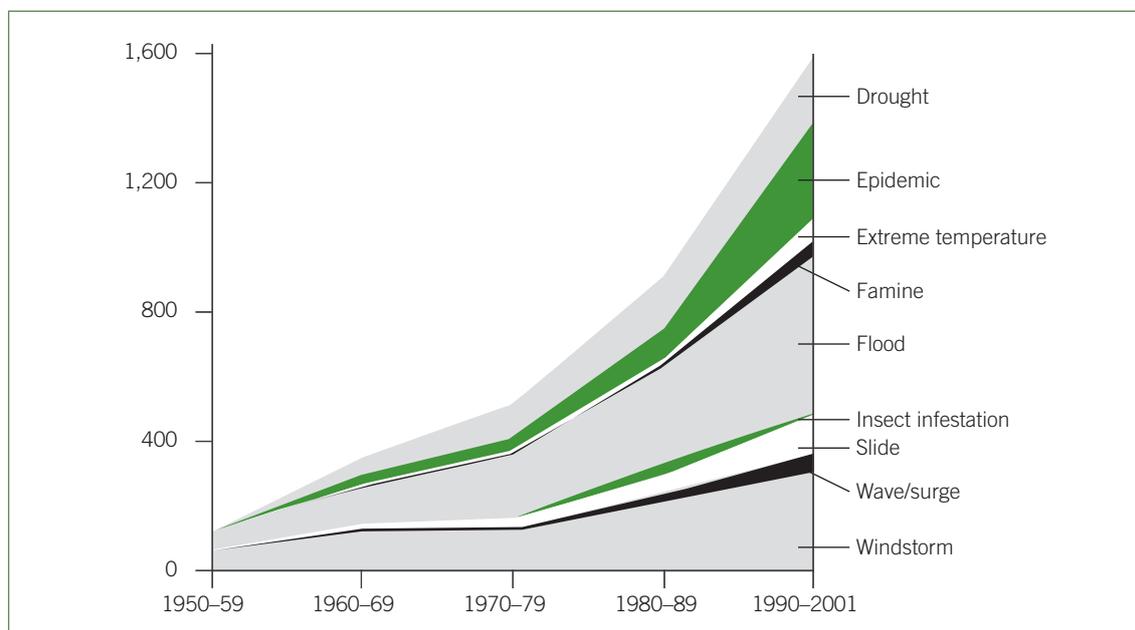
Floods, droughts and other weather-related disasters are growing more severe and more frequent as climate variability increases (see figure 3.2), with pronounced effects on biodiversity and the availability of natural resources. Every year between 2000 and 2004, 262 million people were affected by such events,¹⁰ and in 2009 alone nearly 9,000 people died or were missing as a result

⁷ IPCC: *Climate Change 2007*.

⁸ Ibid.

⁹ Ibid.

¹⁰ UNEP, ILO, IOE, ITUC: *Green jobs*.

Figure 3.2. Frequency of weather-related disasters

Source: J. Lash and F. Wellington: "Competitive advantage on a warming planet", in *Harvard Business Review* (March, 2007), based on data from Swiss Re. Reproduced with permission from Harvard Business Publishing.

of natural catastrophes. The hardest-hit region was Asia.¹¹ Particularly alarming is the case of the Philippines, 43 per cent of whose territory is likely to be affected by climate change induced droughts, floods and landslides in the years ahead.¹² These disasters, with their devastating effects on economies, will inevitably cause population displacements; countries affected will need people skilled in designing and implementing adaptation measures.

Many countries have adopted policies and passed environmental laws in response to these pressing issues, and many are now looking at implementation of such measures with a view to improving levels of compliance. Skills development plays a crucial role in improving enforcement mechanisms and so helping to implement strategies for greening.

The economic and social imperative

It is clear from this review of the major consequences of climate change and environmental degradation that these processes do not only damage the environment itself. The associated negative social and economic impacts are immense, posing huge and pressing challenges for policy-makers. The Stern Review estimated that climate change could reduce global GDP by at least 5 per cent and as much as 20 per cent by 2050.¹³ As noted above, the number of people forced to abandon their homes and livelihoods by floods, droughts and other weather-related events will increase over the next few years, while water shortages and malnutrition threaten to affect 600 million people by 2080.¹⁴

¹¹ Swiss Re: *Natural catastrophes and man-made disasters* (Zurich, 2009).

¹² Estimate by Dr Esteban Godilano (2009), who composed a climate change map for the Department of Agriculture in the Philippines. Information extracted from the Philippines country report.

¹³ Nicholas Stern: *The economics of climate change* (The Stern Review) (Cambridge and New York, Cambridge University Press, 2006).

¹⁴ UNEP, ILO, IOE, ITUC: *Green jobs*.

All the consequences of climate change and environmental degradation discussed in this chapter so far have potentially grave implications for employment and income generation (see table 3.1). Nor are the socio-economic impacts likely to be felt evenly. Climate change hits the poor hardest: countries and populations already struggling against poverty have less capacity to react and adapt to the effects of changes in their environments, so that malnutrition and health problems are likely to get worse, exacerbating joblessness and poverty and setting up a vicious circle of environmental and socio-economic decline. Many people will have to learn new ways of working simply in order to make a living. It is therefore imperative for policy-makers to include targeted skills development strategies in their policies for greening at all levels of education and for all types of employment (including vulnerable employment).¹⁵

Table 3.1. Environmental challenges and their socio-economic impact

Environmental challenges	Major features	Major areas of impact	Possible impacts on employment	Possible impacts on income
Climate change	Rising average temperature	Health, food security, water, resources	√	√
	Higher climate variability	Food security, water	√	√
	High incidence of droughts and floods	Food security, population displacement, resources	√	√
	Melting of glaciers	Food security, water	√	√
	Rising of sea levels	Coastal areas	√	√
	Loss of biodiversity	Food security, resources	√	√
Environmental degradation	Degradation and loss of arable land	Food security	√	√
	Habitat destruction	Resources, food security	√	√
	Loss of biodiversity, deforestation	Resources, food security	√	√
	Pollution of water, air, soil and organisms	Food security, water, resources, health	√	√
	Overfishing	Food security, coastal areas	√	√

Source: Authors.

For all these reasons, the economic and social policy agenda should have the transition from an unsustainable fossil-fuel economy to a green economy as its overriding aim.

3.1.2 Decent work and the labour market challenge

For many, the notion of a “green economy” carries high expectations. It is expected not only to help mitigate the pace of climate change and to stop environmental degradation but also help, by boosting inclusive green growth, to create more and better jobs in developing countries and thus fight unemployment and poverty.

¹⁵ Self-employed workers and contributing family workers have a lower likelihood of having formal work arrangements, and are therefore more likely to lack elements associated with decent employment, such as adequate social security and a voice at work. The two statuses together, therefore, are summed to create a classification of “vulnerable employment” (ILO: *Key Indicators of the Labour Market*).

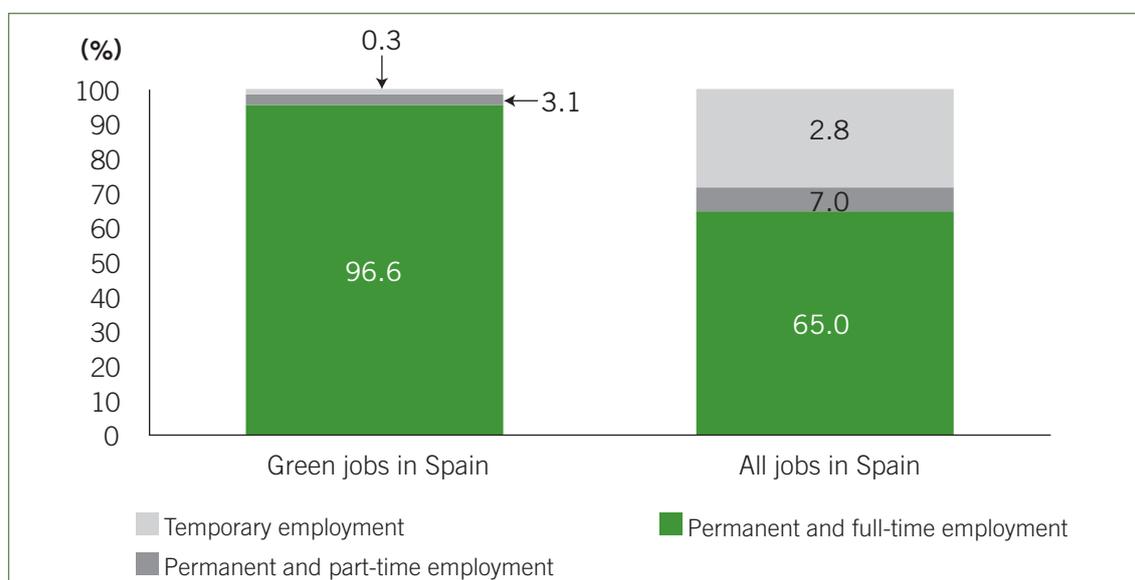
The transition to a greener economy has enormous employment potential in the long run, with capacity to create millions of jobs directly, indirectly and through induced effects.¹⁶ In realizing this potential for substantial job creation, the ILO is clear that the aspirations for decent work must be met. Green jobs can form part of strategies to put the brake on the race to the bottom in wages and working conditions, and halt the downward spiral in social cohesion. There is an important role in achieving this tough task for the development and upgrading of the skills required.

The promotion of green jobs is part of the ILO's Decent Work Agenda. Jobs are considered green only if they provide adequate wages, ensure safe working conditions and basic social protection, respect workers' rights, and are part of a process of social dialogue.¹⁷ Green jobs are also a critical requirement for economic recovery, inclusive growth and long-term sustainable development.

The *Green jobs* report of 2008 pointed out that there are millions of jobs that nominally support environmental goals – in, for example, the electronics recycling industry, waste management and agriculture – but whose day-to-day reality is characterized by extremely poor practices, exposing workers to hazardous substances that endanger their health and lives, and falling short with regard to freedom of association, social protection and other key aspects of decent work.¹⁸ The challenge here is to transform these environmentally constructive jobs into truly decent work.

According to a recent study in Spain, 99.7 per cent of green jobs in the country are permanent, compared to only 72 per cent in the whole Spanish economy (see figure 3.3). This contrast can serve as an indirect indicator of the improved quality of “greened” jobs.

Figure 3.3. The employment status of green jobs vs all jobs in Spain



Source: Fundación Biodiversidad and Observatorio de la Sostenibilidad en España: *Informe Empleo verde en una economía sostenible* (2010). Reproduced with permission.

¹⁶ Jobs are created directly through increased demand and output induced by environment-related expenditures, and indirectly through employment effects arising in supplier industries; induced job effects occur as wage incomes are spent generating demand in additional industries (UNEP, ILO, IOE, ITUC: *Green jobs*).

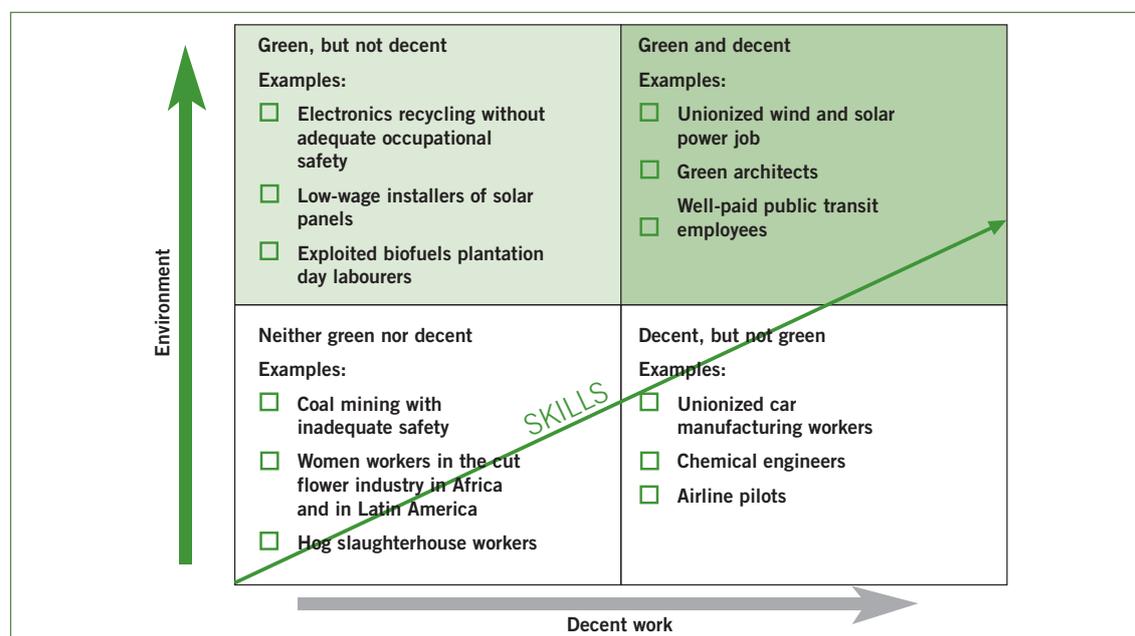
¹⁷ UNEP, ILO, IOE, ITUC: *Green jobs*.

¹⁸ Ibid.

A survey on job quality and skills conducted among companies in selected industries in Austria, Germany, the Netherlands, Spain and Sweden found that adoption of environmental protection measures as an integral part of work processes improved job quality in terms of working environment, working time, work organization and work contracts. Environmental legislation proved to have a positive impact on most industries, although job quality was particularly poor in waste management. The study also found out that in 75 per cent of companies “greening” generated a need for higher-skilled workers. These enterprises had to increase training provision, both internal (68 per cent of companies) and external (11 per cent of companies), to meet new skill requirements in operations and maintenance, organization, engineering and development, ICT and marketing.¹⁹

Greening jobs goes hand in hand with enhancing skills. The 2008 conclusions of the ILC on “skills for improved productivity, employment growth and development” identified skills development as a key factor both in stimulating a sustainable development process and in facilitating workers’ and enterprises’ transition from the informal to the formal economy.²⁰ A vicious circle of low-skill, low-productivity, low-wage and poor-quality jobs traps the working poor, excludes workers from productive employment and inhibits the competitiveness of enterprises. Improved quality and availability of training can stimulate a virtuous circle in which skills development fuels innovation, increased productivity and enterprise development, technological change, investment, diversification of the economy, and competitiveness – all factors that in turn sustain and accelerate the creation of more and better jobs.²¹

Figure 3.4. Green and decent jobs: Do skills matter? A schematic overview



Source: Adapted by authors from UNEP, ILO, IOE, ITUC: *Green jobs: Towards decent work in a sustainable, low-carbon world* (Geneva, 2008).

¹⁹ O. Fritz, M. Getzner, H. Mahringer and T. Ritt: *Umwelt und Beschäftigung: Strategien für eine nachhaltige Entwicklung und deren Auswirkungen auf die Beschäftigung*, Informationen zur Umweltpolitik 144 (Vienna, Bundeskammer für Arbeiter und Angestellte, 2001).

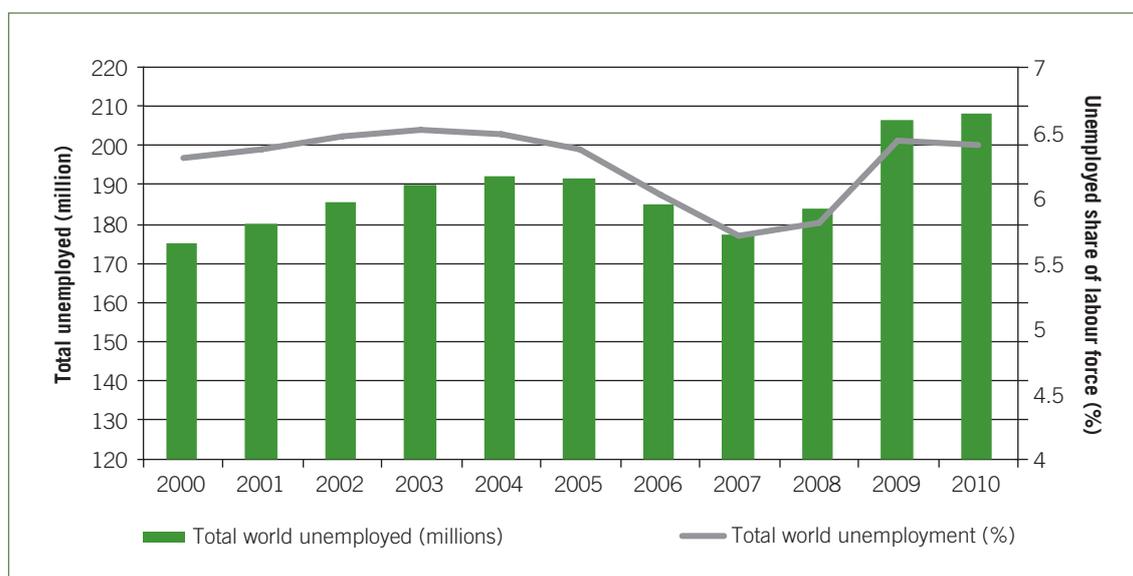
²⁰ ILC: *Conclusions on skills for improved productivity, employment growth and development*, Report to International Labour Conference (Geneva, 2008).

²¹ Ibid.

Skills do play an important role in the environment/decent work matrix (see figure 3.4). However, it is important to bear in mind that workers, enterprises and societies can only benefit from skills development and productivity gains if these are translated into decent work. Provision of skills will not solve the problem by itself. Targeted policies, including training, that focus on local development, the informal economy, micro and small enterprises, and disadvantaged groups such as the young, unemployed, low-skilled and poor, are needed if the twin challenges of decent work and the labour market are to be met.

From 2008 the world was confronted by a global recession that turned out to be the worst since the Great Depression of the 1930s. In this context, the greening agenda attracted increasing policy attention owing to its promise of new job opportunities. A slow economic recovery, beginning in 2010, was even slower in restoring job growth. Three years after the start of the crisis, high rates and long-term unemployment persist. Developing and emerging economies' labour markets are recovering somewhat faster than those of advanced economies, where employment is not expected to return to pre-crisis levels before 2015.²² The ILO estimates in the *Global Employment Trends* report of January 2011 show an increase in unemployment of some 32 million between 2007 and 2010 (see figure 3.5) and an increase in the number of unemployed youth worldwide of 10.2 million by 2009.²³

Figure 3.5. Global unemployment trends, 2000–10

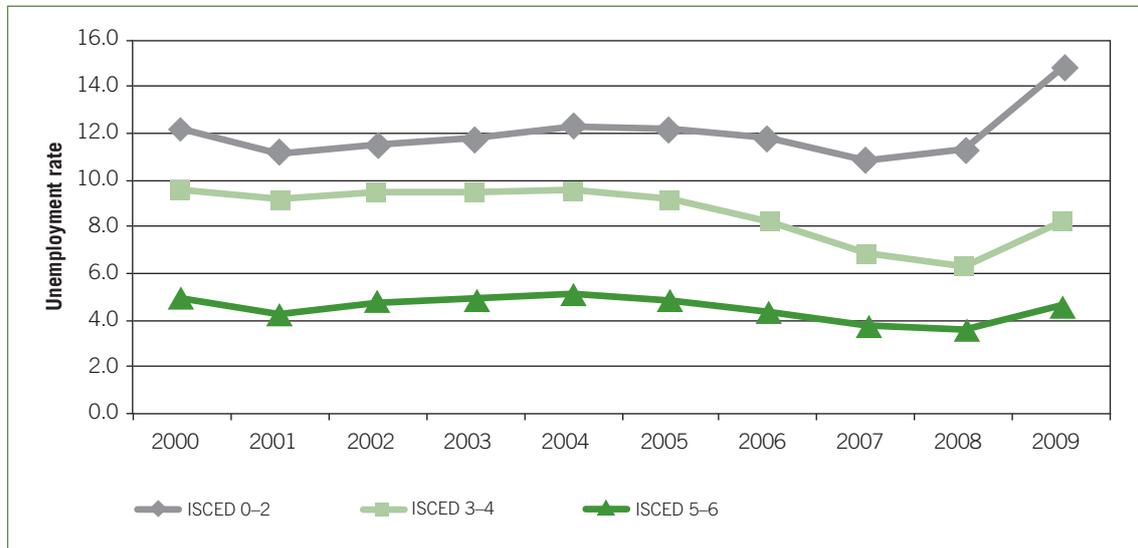


Note: 2010 is a projection.

Sources: ILO: *Trends econometric models* (April 2010); ILO: *Global Employment Trends* (January 2011).

²² ILO International Institute for Labour Studies (IILS): *World of Work Report 2010: From one crisis to the next?* (Geneva, 2010).

²³ Ibid.

Figure 3.6. Unemployment rate by level of educational attainment in the EU, 2000–09

Note: ISCED is the International Standard Classification of Education designed by UNESCO as an instrument to assemble, compile and present education statistics. Levels 0–2 cover education from pre-primary level up to lower secondary or second stage of basic education; levels 3–4 cover upper secondary education and post-secondary non-tertiary education; levels 5–6 cover first and second stages of tertiary education. Source: Eurostat database, 2009.

Over half the world's labour force is estimated to be in vulnerable employment.²⁴ As a result of the crisis, there were in 2009 around 40 million more working poor living on less than US\$1.25 a day than would have been expected on the basis of pre-crisis trends.²⁵

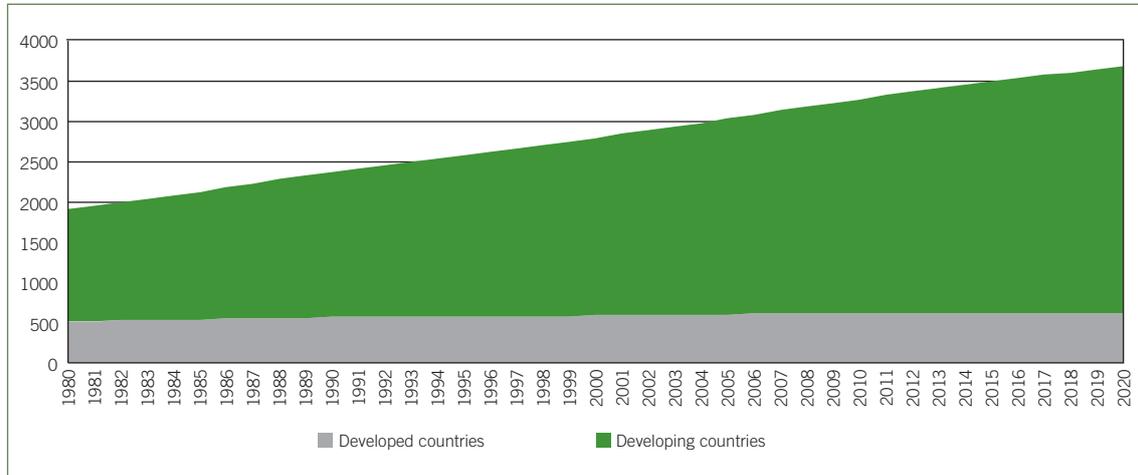
The crisis has affected each country differently, but across all countries those most affected by the job crisis have been young people, low-skilled workers, migrant workers and other vulnerable groups: for example, as figure 3.6 shows, the highest unemployment rate in the EU-27 throughout the past decade has been for the low-skilled. Growing poverty and unemployment tend to mean decreasing levels of private investment in education and skills, with detrimental long-term effects on any country's development potential. Growing unemployment leads to underutilization of existing available skills, and, if recession persists, to declining skill levels in the population as skills are not practised.²⁶

These effects of economic crisis have occurred against the background of longer-term labour market challenges. In developed countries, labour shortages associated with population ageing are expected in the years ahead; in developing countries, on the other hand, the economically active population is expected to increase over the coming years (see figure 3.7), which is a cause of anxiety when coupled with falling employment rates: new labour market entrants competing for scarce jobs will have a hard time finding work.

²⁴ ILO: *Global Employment Trends*, 2010a. See: http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_elm/---trends/documents/publication/wcms_120471.pdf (accessed 1 Apr. 2011).

²⁵ ILO: *Global Employment Trends*, 2011.

²⁶ ILO: *Global Employment Trends*, 2010a.

Figure 3.7. Economically active population, 1980–2020 (millions)

Source: ILO: LABORSTA database, 2009.

3.1.3 Skill shortages

According to the Solar Energy Society of Canada,

One of the reasons why Solar (Thermal) got a bad reputation is that during the last Solar boom of the 1970s and early 1980s, too many unqualified installers put up solar systems that never worked properly. While it is important that high-quality, certified equipment be installed, the best equipment may not operate if the installer has not been properly trained and demonstrated that he/she has the necessary competencies.²⁷

Many studies on green jobs highlight the risk that the large job creation potential of green industries might go unfulfilled because of prevalent skills shortages. The present research confirms that skills shortages do indeed exist in several occupations and sectors. These shortages already pose a major barrier to the transition to a green economy and the creation of green jobs, and this barrier is likely to become more pronounced in the future. In addition, the implementation of green policies relies directly on the skilled workforce available to enact change, and will be retarded if those skills are lacking. However, not all the country studies were able to obtain enough information to assess imbalances between the supply of and demand for green jobs and qualifications.

The term “skill shortage” refers to both quantitative (labour shortages) and qualitative (skill gaps) lack of skills.²⁸

²⁷ Solar Energy Society of Canada: *Report on ten features of successful solar policies*, Spring 2007.

²⁸ “Skill shortage” is defined as “a genuine lack of adequately skilled individuals available in the accessible labour market with the type of skill being sought and which leads to a difficulty in recruitment. A skill shortage characterizes the situation where employers are unable to recruit staff with the skills they are looking for at the going rate of pay. This could result from basic lack of people (when unemployment levels are very low), significant geographical imbalances in supply (sufficient skilled people in the labour market but not easily accessible to available jobs), or a genuine shortfall in the number of appropriately skilled individuals – either at new entrant level, or for higher level skilled occupations.” O. Strietska-Ilina: “Skill shortages”, in Cedefop: *Modernising vocational education and training. Fourth report on vocational training research in Europe: Background report*, Vol. 1 (Luxembourg, Office for Official Publications of the European Communities, 2008).

Some countries have established a system to assess skill shortages regularly. South Africa issues a yearly National Scarce Skills List, highlighting skill shortages across industries (see also Chapter 6). The Sector Education and Training Authorities (SETAs) – industry bodies convened by the Minister of Labour – undertake intensive consultation and research to develop sector-specific skills plans describing the skills development priorities for each sector over the next three to five years, which are then published. The sectoral scarce skills lists from each SETA are then amalgamated into the National Scarce Skills List. Skill shortages for green jobs become apparent through this process, although they do not receive particular attention, and consequently some of the emerging occupations are not yet captured. The list identifies national skill shortages in the following areas: environmental managers, urban and regional planners, civil engineers and technologists and quantity surveyors, environmental scientists, and occupational and environmental health professionals.

Other countries assess skill shortages for certain sectors on a more ad hoc basis when they begin to become apparent. An example is a study conducted on qualifications and employment estimates in the German renewable energy sector.²⁹ The study, based on surveys and interviews among enterprises and experts, identified expected skill shortages for each renewable energy sub-sector: wind, solar, hydro, geothermal and bioenergy. While industry representatives in the wind, solar and geothermal subsectors stressed skill needs for staff in research and development, those in the hydro and bioenergy subsectors expected shortages in plant engineering and maintenance.

Skill shortages for emerging green occupations and others that are going green are caused by various factors. In the first place, growth in some sectors, such as in the area of green technology, is underestimated, so that training systems are not able to respond quickly enough; second, a general lack of scientists and engineers hits technology-driven green sectors particularly hard; third, existing national skill structures do not always reflect the pattern of skill demand; and fourth, some sectors, such as waste management, fail to attract enough skilled candidates for further training owing to the sector's low reputation. These four factors are considered in more detail below.

Poor working conditions – low pay, unsocial working hours, hazardous health and safety conditions, and other features of poor-quality jobs – can also lead to labour shortage, rendering jobs unattractive to people with the appropriate skills.

The economic downturn that began in 2008, resulting in business closures and declining demand for skilled workers, is easing skills shortages in certain sectors such as construction and manufacturing. But even as unemployment rates remain high, skill shortages persist in many economies, pointing to structural imbalances in labour markets. Once economic recovery oils the wheels of employment growth, these skill shortages will intensify.

Underestimated growth rates in demand for environmental technologies, for example in the renewable energy sector, have led to skill shortages in these industries. The wind energy industry across Europe³⁰ and the wind, wave and tidal power industry in the United Kingdom face shortages in qualified electrical engineers, turbine technicians and project managers.³¹ In the United States,

²⁹ T. Bühler, H. Klemisch and K. Ostenrath: *Ausbildung und Arbeit für Erneuerbare Energien* (Wissenschaftsladen Bonn e.v., 2007), available at: <http://www.jobmotor-erneuerbare.de/download/Statusbericht-AA-EE.pdf> (accessed 1 Apr. 2011).

³⁰ European Wind Energy Association: *Wind at work: Wind energy and job creation in the EU* (2009), available at: http://www.ewea.org/fileadmin/ewea_documents/documents/publications/Wind_at_work_FINAL.pdf (accessed 1 Apr. 2011).

³¹ M. Boettcher, N. Peder Nielsen and K. Petrick: *A closer look at the development of wind, wave and tidal energy in the UK: Employment opportunities and challenges in the context of rapid industry growth* (London, Bain & Co., 2009).

skill shortages related to renewable energy are reported in manufacturing, construction and installation.³² Developing countries such as Uganda are experiencing skill shortages in assembling solar panels and skills for biofuel production.

The general lack of scientists and engineers in most developed, emerging and developing economies has detrimental effects on the design, development, deployment and delivery of green technologies. Shortage of skills in science, technology, engineering and mathematics (STEM) is particularly severe in some EU countries, which are failing to attract more students to these subjects. This skill shortage is particularly relevant for technical occupations. A lack of skilled technicians, managers and operators is reported, for example, in the biofuels industry in Brazil, in the renewable energy and environmental industry in Germany and the United States, and in the construction sector in Australia, China, Europe and South Africa.³³

The development paths of countries are determined in large part by their national skill structures. An unbalanced skill structure can give rise to skill shortages when economies become more environmentally conscious. In developing countries, for example, the number of university graduates is very small compared to the overall workforce. Therefore the specialized higher-level leadership skills required to manage processes of change in government or businesses are generally scarcer than in more developed countries.

The low reputation of certain industries relevant for the transition to a green economy deters students from acquiring qualifications in these fields. For example, there is a lack of skilled personnel in the waste management and recycling sector to fill technical, engineering and management positions in both commercial enterprises and the public sector. There is a similar recruiting problem in the areas of waste, sewage and sanitary, heat and air conditioning, whose poor image has led to a dearth of apprentices. Likewise, the chemistry sector faces skill shortages, in particular in toxicology and eco-toxicology. The environmental industries in the Republic of Korea suffer from a general perception of entailing hard working conditions and low pay. However, in some countries the opposite trend can be identified. The growing demand for energy-efficient and climate-friendly solutions in Denmark, for example, has changed the occupational profile for those working at waste treatment plants, and has increased the attractiveness of these jobs.³⁴

Apart from these four sources of skill shortages, a number of particular core skills appear to be lacking. Good and broad core skills are also central in coping with changing economies. These include knowing how to learn, how to work in teams and how to communicate effectively, and need to be learned at a young age. (For more on core skills see Chapter 5, section 5.3.) Language skills are critically important in accessing knowledge related to environmental change. In Mali, for example, most tools to improve the climate change resilience of rural populations are available in only French or English, which most people do not understand. In Costa Rica, a lack of English-language skills is reported to be hampering uptake of new green technologies such as precision agriculture.

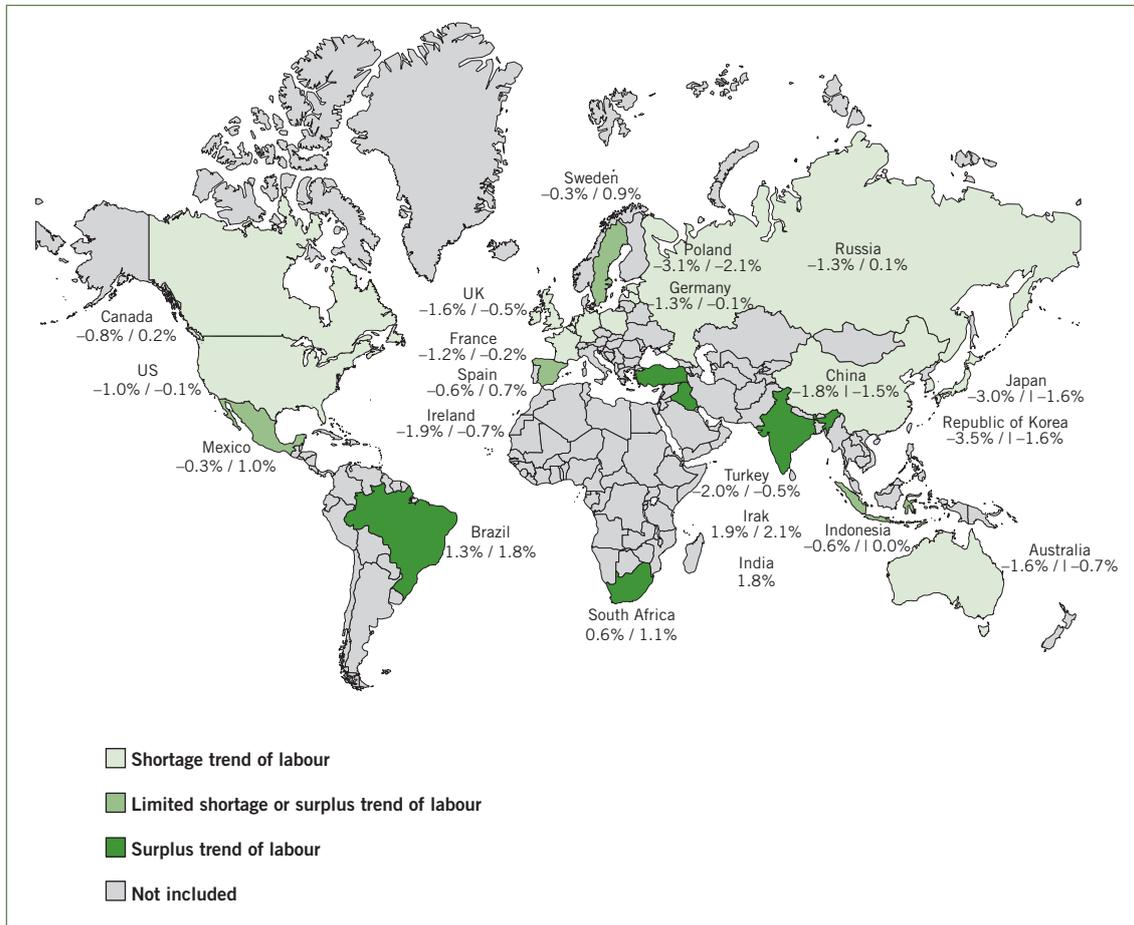
Multiskilling requirements seem to be particularly prominent in greener economies. Workers in the construction industry in France, for example, are increasingly required to be competent in interdisciplinary approaches and networking, as companies need to work across traditional trade

³² Apollo Alliance: *Green-collar jobs in American cities* (San Francisco, 2008).

³³ C. Hofmann, M. Duran and O. Strietska-Ilina: "Skills for the low-carbon economy", Paper prepared for the European Commission's workshop, "Emerging stronger from the recession to tackle the challenges of social cohesion and sustainable development", Brussels, 9 Sep. 2009 (unpublished).

³⁴ http://www.teknologisk.dk/_root/media/16060_629258_628597_Jobprofiler%20og%20kvalifikationskrav%20endelig%20udgave.pdf (accessed 1 Apr. 2011).

Figure 3.8. Projected gaps between labour supply and demand, selected countries, 2020



Note: Gap = Supply compound annual growth rate minus demand compound annual growth rate. Crisis impact is included in the calculation. The view presented is a solely quantitative view and does not reflect any qualitative issues (e.g. job mismatch, employability).

Source: Boston Consulting Group: *Stimulating economies through fostering talent mobility* (Cologne and Geneva, World Economic Forum, 2010).

boundaries, with simultaneous interventions by several trades; those working on non-domestic buildings also need to be well informed about the various challenges posed by poor fabric, poor environmental controls and low levels of energy awareness on the part of occupants. This finding is confirmed by an Irish study that calls for multidisciplinary apprenticeships in construction as skill needs cut across traditional craft boundaries.³⁵ People at supervisory level need technical skills related to the environment in addition to traditional management skills, so that, for example, fast-food store managers can tackle pollution control tasks. An OECD report has found that eco-innovations are becoming increasingly complex as they move towards systems incorporating processes on several levels that all need to be understood and managed as parts of a coherent

³⁵ Comhar Sustainable Development Council: *Skills and training for a green new deal* (Dublin, 2010).

whole.³⁶ Whether the need for multiskilling can be seen as a general feature of green jobs or whether it only applies to a certain number of jobs in converging sectors is an area for further research.

Some countries report specific national skill shortages. These include skills for biological pest control, organic farming and carbon auditing in forestry in Uganda; for trainers and teachers on sustainability-related issues in agriculture and the built environment in France; and for “eco-smart” electricians (electricians with skills in installation and maintenance of energy-efficiency and renewable energy systems) in China. Environmental consulting and auditing services seem to be in higher demand in emerging economies, whereas in developed countries this market was reported to be saturated. An EU report highlights the overall shortage of highly skilled and experienced green professionals in a number of European countries, including the Czech Republic, France, Ireland, Italy, Portugal, Turkey and the United Kingdom. By contrast, previous sustained investment in the green sector in Denmark has ensured that relatively little upskilling will be required.³⁷

When considering labour shortages in the medium to long term, demographic factors must be taken into account. Industrialized countries are faced with ageing and shrinking populations and are therefore likely to see skill shortages becoming more acute (see figure 3.8).³⁸ At the same time, many developing countries will continue to be confronted with oversupply of labour. Labour, skills and industrial policies will therefore need to respond appropriately. In developed countries, activation measures should be considered to increase the share of the population in productive work. In developing countries, policies should aim at enhancing labour mobility across borders, including fostering the core skills which stimulate labour mobility, and reaping the employment creation potential of green jobs. All countries will need to encourage investment in relevant and quality skills.

3.2 The policy response: In pursuit of coherence of environmental and skills policies

The 2008 ILC *Conclusions on skills for improved productivity, employment growth and development* call for policy coherence: that is, for governments, working with the social partners, to integrate education and skills development within broader growth, employment and development strategies, creating and sustaining links with labour markets and with the technology, investment, trade and macroeconomic policies that generate future employment growth. This imperative places a high premium on strong social dialogue, effective coordination among ministries, and improved communication between employers and training providers.³⁹ The next two sections of the chapter focus respectively on the interface between environmental and skill policies in general terms (section 3.2.1) and on responses to the current economic crisis with implications for skills and green jobs (section 3.2.2).

³⁶ OECD: *Eco-innovation in industry: Enabling green growth* (Paris, OECD, 2009).

³⁷ European Commission: European Employment Observatory review, The employment dimension of economic greening (2009), available at: <http://ec.europa.eu/social/main.jsp?catId=101&langId=en&pubId=541&type=2&furtherPubs=yes> (accessed 1 Apr. 2011).

³⁸ See e.g. World Economic Forum: *Stimulating economies through fostering talent mobility* (Cologne/Geneva, 2010).

³⁹ ILO: *Conclusions on skills for improved productivity, employment growth and development*.

3.2.1 Environmental and skills development strategies for greening: An overview

The international context

The UN Climate Change Conference in Copenhagen in 2009 brought together 115 Heads of State and Government. Never before has climate change featured so prominently on the international agenda. The parties to the Copenhagen Accord agreed that global mean temperature should not be allowed to rise by more than 2°C; other key provisions included pledges from developed countries to assist developing countries financially in their efforts to mitigate and adapt to climate change.⁴⁰

Overall, however, the Copenhagen Accord was rather disappointing, not least because the developed economies did not commit themselves to legally binding emissions reductions. Many of them made their GHG emissions reduction targets conditional on others taking similar action, while many developing countries made their pledges of action conditional on receiving further international financial or technical support. This conditionality adds to uncertainty over whether the decisions will be implemented.⁴¹ Some countries still seem to fear that the transition to a low-carbon economy will reduce jobs and growth prospects in certain economic sectors, even though others, among them Brazil, China and Germany, have already experienced employment growth as a result of investment in emissions reduction mechanisms. The present research demonstrates how timely, relevant and quality skills provision can help mitigate job losses and speed job gains in the transition to greener economies.

Besides the UN Framework Convention on Climate Change and the Kyoto Protocol, there are more than 200 multilateral environmental agreements that affect national environmental policies, of which the best known are the Montreal Protocol on substances that deplete the ozone layer, the UN Convention on Biodiversity and the UN Convention to Combat Desertification.

Apart from these, measurement of GHG emissions, the reporting and verification of country actions, and the Clean Development Mechanism (CDM) introduced in the Kyoto Protocol will have impacts on national actions and skills requirements. Some €20 billion is expected to be transferred from developed countries to developing countries by 2012 through CDM projects.⁴² Much of this activity will involve technology transfer, with a consequent impact on skill needs. Indeed, skill shortages have been already identified in the preparation of various CDM projects.

National policies

Countries are setting ambitious targets to cut their GHG emissions, reduce energy consumption and increase the use of alternative energy sources. For example, the Republic of Korea and South Africa are introducing energy-saving initiatives based on energy efficiency measures; Denmark, Germany and Spain are providing incentives for businesses and consumers to use energy from renewable sources. However, while much of the attention is focused on technology, the hard fact remains that without qualified entrepreneurs and skilled workers the available technology and investment resources cannot be used.

⁴⁰ International Institute for Sustainable Development: *A brief analysis of the Copenhagen Climate Change Conference*, available at: http://www.iisd.org/pdf/2009/enb_copenhagen_commentary.pdf (accessed 1 Apr. 2011).

⁴¹ <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/10/215&language=EN> (accessed 1 Apr. 2011).

⁴² See Karan Capoor and Philippe Ambrosi: *State and trends of the carbon market* (Washington DC, World Bank, May 2007).

The coordination of skills policies and environmental policies is therefore a key factor in any successful transition to a low-carbon economy. Many countries have implemented sound environmental policies but have fallen short of developing the necessary associated skills policies.

There is no formal definition of coherence in policy, and indeed it is difficult to provide a definition valid for all countries given the wide variety in country-specific conditions and requirements. With this caveat in mind, in this study, and for the purpose of the analysis of the policy response to the greening imperative, the following criteria are used:

- One policy should not contradict another. Coordination among policies is essential to avoid contradictions.
- Policies should have good coverage and be complementary. Policies should capture industry needs, both those of business enterprises and those of workers. The involvement of social partners in the decision-making process constitutes the basis of a successful policy in this respect.
- Policies should correspond to the needs of the (labour) market and take into account current and future challenges. Therefore policies should be informed by thorough research and (labour) market monitoring.
- There should be a clear link from policy pronouncements to actions, including finance. Lack of implementation and enforcement has been reported by countries as one of the most frequent hindrances to the greening process.
- There should be a monitoring and evaluation mechanism to follow policy implementation.

A mapping exercise was undertaken to assess the degree of coherence in governments' policy response to the greening imperative. The findings, based on information provided in the background country reports, were discussed at the validation workshop in Geneva in May 2010 and the exercise was followed by a round of comment from participants and observers.

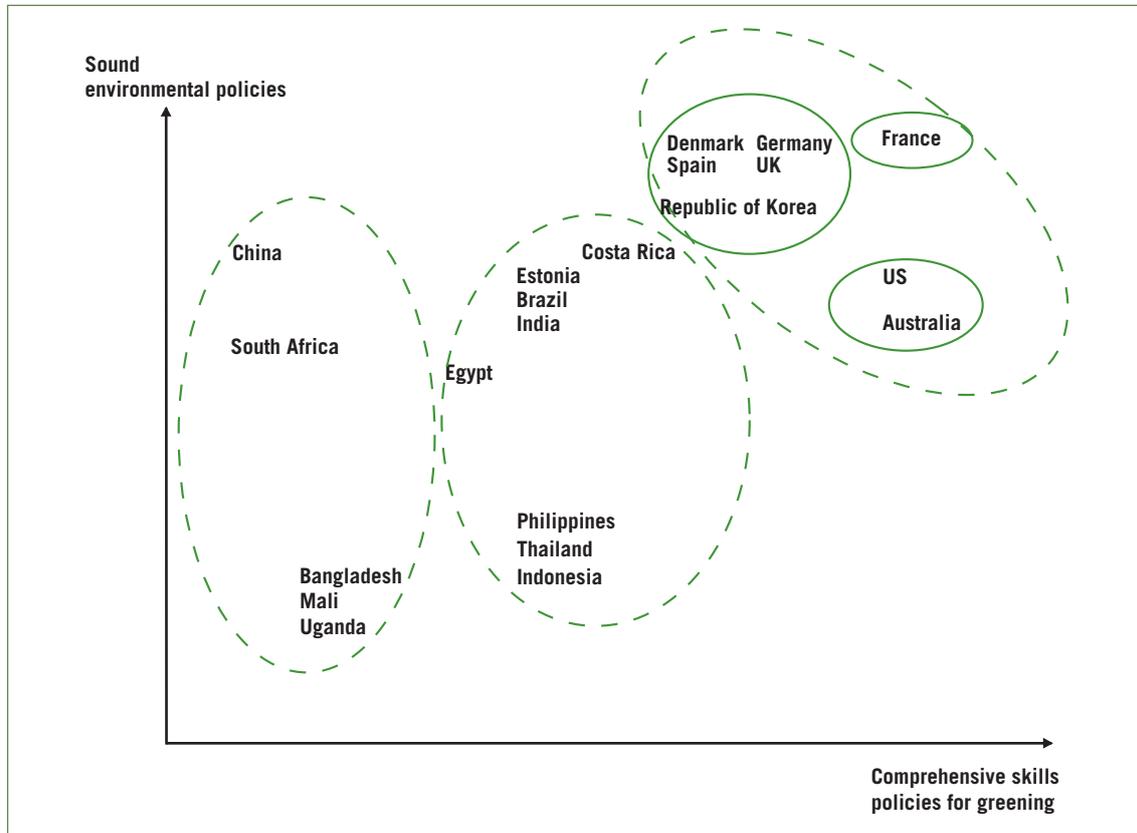
In the course of this exercise, countries' policy responses were grouped into three broad categories:

- ***sound and comprehensive policies*** in countries where policies for the environment and/or skills are internally sound and comprehensive but not always well aligned;
- ***fragmented policies*** in countries where policies for the environment and skills are somewhat weaker and generally not well aligned; and
- ***policies under development*** in countries that do not have either a well-developed environmental policy or skills development policy for a greener economy.

The intention behind this mapping exercise was *not* to rank countries on their performance of environmental and skills policies for greening, but rather to arrive at an idea of what it takes to achieve policy coherence. To arrive at that point, represented by a position in the top right-hand corner of figure 3.9, countries will need to incorporate the key features of policy coherence set out above into new or existing environmental and skills policies for greening.

We can see from a glance at figure 3.9 that the top right-hand quadrant is dominated by the EU countries, with France in the lead: these are countries that enjoy sound environmental policies and comprehensive skills development policies for greening. Europe has long been at the forefront of the environmental policy agenda, while Australia and the United States perform especially

Figure 3.9. Coherence between skills and environmental policies



Source: Authors' grouping based on qualitative analysis (country reports).

well in relation to training responses related to greening. It is important to note that whereas all countries do have environmental policies (of varying degrees of soundness), there are countries where environmental policies do not intersect effectively with skills policies.

Sound and comprehensive policies

Sound, comprehensive and well-coordinated policies

These combine a sound environmental policy and a comprehensive skills policy for greening that together build an effective green strategy consciously designed to avoid skill gaps in achieving environmental goals, and seeing in the transit to the low-carbon economies opportunities for new jobs and new skills.

The key to achieving policy coherence lies in designing the right institutional apparatus to ensure that policies are coordinated between different line ministries, and between ministries, social partners and other stakeholders. The French strategy for sustainable development, with its Environment Round Table and Mobilization Plan for Green Jobs, provides an illustrative example of how this coordination can be achieved, and is therefore outlined below. However, it remains to be seen how successfully the strategy is implemented. Therefore even the unique position of France in this group is conditional.

The French strategy for sustainable development

France has established a comprehensive policy framework fostering cross-agency collaboration and bringing together networks of stakeholders to address skill development for a green economy holistically, and in coordination with the national environmental strategy.

The new National Strategy for Sustainable Development 2009–12 aims at providing a structure to ensure consistency across the range of actions and measures implemented in France. The consultation process that underlay its formulation involved various stakeholders, including ministries and social partners, NGOs and civil society. The Interministerial Committee on Sustainable Development bore responsibility for the final approval of the strategy.

The strategy is organized around challenges in nine key areas, following the EU's Sustainable Development Strategy:

- **Climate change and energy:** observing patterns of consumption, development of renewable energy sources, adaptation of territories to the changing climate, and mitigating its effect on vulnerable people and activities.
- **Sustainable transport and mobility:** working towards complementarity between public and private means of transport, encouraging less polluting means of transport, and developing innovative systems.
- **Sustainable consumption and production:** acting on the entire lifecycle of products and services.
- **Sustainable management of biodiversity and natural resources,** based on a better understanding of their contribution to human life and the health of the planet, and drawing on eco-innovation in the economy, urbanization and organizations.
- **Public health, and the prevention and management of risks to it,** paying attention to the quality of the social environment and potential social inequalities.
- **Demography, immigration, poverty and social inclusion:** fighting against exclusions as a result of, for example, age, poverty, lack of education etc.
- **International challenges:** supporting sustainable development and the reduction of poverty across the world within the framework of international governance.
- **Knowledge society:** the development of information, training, lifelong learning and access to culture.
- **Governance,** conducted in such a way as to make adaptation to change easier and support the evolution of society, while cooperating with stakeholders.

The orientation of the strategy reflects the conclusions reached and undertakings made during the deliberations of the Environment Round Table (Grenelle de l'environnement) from 2007 onwards, including economic and social dimensions.

The Environment Round Table brought together for the first time Government, unions, employers, NGOs and local authorities to discuss France's environmental policy. Among the first measures adopted as a result of its work was a skills development strategy for greening called the Mobilization Plan for Green Jobs, launched in 2009 (see box 3.1).⁴³

⁴³ Plan de mobilisation des territoires et des filières sur le développement des métiers de la croissance verte.

Box 3.1. France's Mobilization Plan for Green Jobs

The Mobilization Plan is an illustration of collaborative work between stakeholders at all levels: ministries, regional authorities, training providers, advisory bodies, social partners and employment agencies. The steering group includes stakeholder representatives from bodies concerned with training and employment (Pôle emploi, Alliances villes emploi, Conseil national des missions locales, AFPA, Agence de l'Environnement et de la Maîtrise de l'Energie). It also includes representatives of local authorities (Association des régions de France), social partners, economic actors, relevant ministries (Sustainable Development, Education, Higher Education and Research, Employment) and the Centre d'analyse stratégique (CAS).

The objective of the Mobilization Plan is to update existing training programmes and qualifications in the light of environmental challenges and create new qualifications where necessary. This process is intended to support the creation of 600,000 green jobs by 2020, as announced by the Environment Round Table (Grenelle de l'environnement). These jobs should include employment accessible to those with all levels of qualifications.

The plan is structured around four themes:

- **Identification of relevant professions.** This includes setting up a national observatory to gather information about relevant fields and new professions and assess their size and scope.
- **Definition of training needs and establishment of training and qualification pathways.** On the basis of the professions identified, the plan aims to describe pathways to complement training currently available so that it meets the skills needs expressed by employers. This will also mean introducing new training courses.
- **Matching sustainable development jobs and skills.** This includes actions to help jobseekers meet the requirements of the numerous jobs which are currently on offer but cannot be taken up due to lack of skills.
- **Promotion and development of professions for green growth.** In early 2010 a national event on green professions was organized, announced by the French President. During this event green growth was explained and the national observatory on green employment and occupations was created.

Eleven sectoral committees (comités de filières) were set up, representing the sectors considered most promising in terms of green jobs creation: these included the automobile industry, building, tourism and renewable energy sectors. Their mission is to carry out a quantitative and qualitative analysis of each sector's needs in terms of skills needs, training and employment policy.

Following publication of the findings of the sectoral committees set up under the Mobilization Plan, the Ministry of Ecology, Energy, Sustainable and Maritime Development, Green Technologies and Negotiations on Climate Change (MEEDDM), created in 2007 by fusing the functions of several ministries, announced the next step of the plan, namely adopting the necessary measures to ensure that the education and training system adequately responds to the needs identified.

Sound environmental policy but somewhat fragmented skills policy for greening

A number of countries have been quite successful in developing sound environmental policies, but without fully coordinated skills policy measures to accompany them. Thus overall a coherent and holistic approach is lacking.

Denmark, Germany, the Republic of Korea, Spain and the United Kingdom belong to this category. In Germany and Spain, for example, the National Sustainable Development Strategy

acts as an umbrella for plans and initiatives involving the three main pillars of sustainable development – social, economic and environmental – including a National Climate Change Strategy as well as other environmental strategies. The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety calls for an “ecological industrial policy” for innovation, growth and employment that cuts across different sectors. Specifically, this means strengthening the leading green markets of the future, fostering technological innovation, progress and uptake, helping industries to adjust to resource scarcity, and changing the material base of the economy to renewable resources.

In Denmark and the United Kingdom a broad response to environmental challenges has been under way for many years. Both countries have in place a sound environmental strategy, addressing not only climate change but also other environmental degradation issues.

At the same time, in Denmark, Germany, Spain and the United Kingdom several skills development strategies for greening the economy coexist. Despite the fact that these programmes are interrelated and some of them are coordinated, they are not fully aligned and embedded in an overall policy framework.

An example is the “Environment creates perspectives” programme in Germany, which brings together the Ministry of Environment and the Ministry of Education and Research, the Chamber of Commerce (DIHK) and the Federal Institute for Vocational Training (BIBB). This programme exists in parallel with other initiatives such as the research and development project conceived by the Ministry of Education.

In Spain, the Renewable Energy Plan 2005–10 identifies new skill needs for renewable energy installers and maintenance workers. At regional level, government training initiatives are targeting unemployed people with a view to drawing them into the green building sector. In parallel, the Spanish Public Employment Service, through its Observatory of Occupations (Observatorio de las ocupaciones), has been conducting research on environmental occupational profiles and how these are reflected in the labour market, focusing in particular on the renewable energy sector. Environment-related programmes in higher education are also progressively being developed. However, there is no explicit national skills development strategy for a green economy.

In the Republic of Korea, the Green New Deal links green growth initiatives with the urgent need for new jobs triggered by the global economic crisis. The government focus has been on the development of green technologies and the highest impact on skills is in this area. The country enjoys an otherwise comprehensive skills development system at all levels of education and training, but so far this system has not been adjusted to accommodate the green growth agenda. However, government agencies are conducting research on skill needs for a green economy, and the Government has announced support for research into green technologies.

Comprehensive skills policy for greening but somewhat fragmented environmental policy

The Australian and US governments have launched interesting initiatives. Australia has put in place a number of policies and programmes at both state and national level with a view to establishing a long-term skills strategy, involving civil society, that will contribute significantly to the country’s endeavour to move towards a low-carbon economy. At national level, the Government pursues strategic activities to build up appropriate institutions, industry-based partnerships, skills and competencies for a greener economy. Regional initiatives (in New South Wales and Queensland) provide funding for training providers to increase the delivery of green training, facilitate online resources, and explore business opportunities, skills gaps and training solutions in green markets (see box 3.2).

Box 3.2. Devising skills strategies for green jobs in Australia

At national level, the Government is pursuing strategic activities on three fronts to build up institutions, skills and competencies for a greener economy:

- First, it passed two national action plans: an Action Plan for Education for Sustainability, which reorients the education system to sustainability, fosters sustainability in business and industry, and harnesses community spirit to act; and a National Vocational Education and Training Sector Sustainability Policy and Action Plan (2009–12), which includes measures ranging from embedding sustainability topics in all training products and building the capacity of trainers and assessors to developing standards of certification of registered training organizations and articulating paths between the education and training sectors.
- Second, it created national “education for sustainability” structures to undertake more systematic knowledge creation, to oversee knowledge sharing and to provide expert advice. These are the National Advisory Council; the National Education for Sustainability Network Initiative; the Australian Sustainable Schools Initiative; and the National Education for Sustainability Research Programme, which aims to recommend new approaches to achieve enduring, system-wide change.
- Third, it set up an Education for Sustainability Grants Program which provides funding for sustainability education and training projects; for activities that enhance national coordination of existing education for sustainability programmes, policies or institutions; and for new and innovative education and training approaches.

As part of the broader skills strategy for green jobs, the Prime Minister of Australia announced in 2009 that 50,000 new green jobs and training opportunities for young people, in particular the long-term unemployed and apprentices, would be created. This implies reforming Australia’s training system to produce high-quality “green” skills to meet the growing demand for energy-efficient homes and buildings, and to power the industries of the future.

In addition to these strategic activities, in 2008 the Government launched an open civil society dialogue, the **Australia 2020 Summit**, to help shape a long-term strategy for the nation’s future. The final report of the summit called for the introduction of “a world-class climate change education program that includes developing applied science capacity, green economy skills and training, a clean energy corps, and ‘eco-education’ embedded in school curricula”. The Government’s response endorsed the critical importance of skills for the transition to a low-carbon economy.

At the regional level, the **NSW Green Skills Strategy** was adopted in New South Wales in 2008. It provides funding for training institutions to increase the delivery of green training courses (including, for example, courses to encourage green small business and energy efficiency training for tradespeople and professionals as well as training in green skills) and to provide online resources such as a Green Business Guide for small and medium enterprises (SMEs) and an online green course finder to help businesses to access suitable training courses for their staff. The strategy also funds and collects demonstration projects to explore business opportunities, skills gaps and training solutions in green markets. One example is the EnviroPainter Training Program, which trains painting and decorating contractors in environmentally friendly products and practices, including how to reduce trade waste, water consumption and exposure to levels of volatile organic compounds, and how to minimize the environmental impacts of the materials used. New courses were developed and piloted, including learner and trainer resources, a national qualification and an industry accreditation scheme. The programme is implemented by the industry association, Master Painters Australia NSW Association Inc.

Sources:

<http://www.environment.gov.au/education/publications/pubs/national-action-plan.pdf> (accessed 1 Apr. 2011).

<http://training.qld.gov.au/information/vet-sustainability/policy-action-plan.html> (accessed 1 Apr. 2011).

<http://www.environment.gov.au/education/programs/index.html> (accessed 1 Apr. 2011).

http://www.australia2020.gov.au/docs/government_response/2020_summit_response_full.pdf (accessed 1 Apr. 2011).

In the United States, a Green Jobs Framework for Action⁴⁴ launched in 2007 has since assumed more importance in the context of the subsequent economic crisis. Significant steps regarding skill development have been undertaken in response to the crisis with, for example, the creation of regional forums on green jobs and the introduction of education grants for green careers. Taking a longer-term perspective, the Department of Labor conducted research on identifying and anticipating skill needs for new green-collar jobs and greening existing occupations in collaboration with the occupational information network O*NET.

As far as environmental policies are concerned, the Bush–Cheney administration was heavily criticized for insufficient regulation. Nevertheless, states have adopted a very large number of complementary regulatory and financial incentive policies. The 2008 Energy Improvement and Extension Act and 2009 American Recovery and Reinvestment Act provided for the extension and creation of significant federal outlays which have since flowed into numerous direct and indirect investments in renewable energy, energy efficiency, and green production and technology.

Fragmented policies

The countries that belong to this group have successfully developed a number of environmental and skill policy initiatives, but in the absence of a general coordinating framework have not achieved policy coherence between the two.

Brazil, Costa Rica, Egypt, Estonia, India, Indonesia, the Philippines and Thailand belong to this category. Estonia launched a National Strategy for Sustainable Development – Sustainable Estonia 21 – in 2005, but this is still considered in its initial stages. It runs in parallel with the Estonian Environmental Strategy 2030 and further initiatives to protect the environment and mitigate climate change. The Action Plan for Environmental Education 2008–13 had not been approved by the Government at the time the country report was prepared.

Costa Rica has a long record of environmental policies. With the aim of becoming a carbon-neutral country by 2021 it has developed several important initiatives, including skills development strategies. The Peace with Nature initiative proposes the inclusion of environmental education for sustainable development in the public education curriculum. The Strategic Framework for Environmental Education, developed by the Ministry of Education, is the main structure for implementing skills development strategies for greening. However, most programmes are linked to higher and graduate-level education, with very few targeting vocational training. So far, Costa Rica's National Climate Change Strategy sets out only general principles to be considered on the educational level, and although interministerial coordination exists, there is no real coordination mechanism between academia as a whole and the public and private business sectors which could facilitate a better adaptation of curricula to the demands of sustainable development.

Although Brazil has no formal obligations to limit or reduce its GHG emissions, a National Plan on Climate Change containing mitigation and adaptation measures has been issued by the Inter-Ministerial Committee on Climate Change, which includes among its members representatives of the Ministries of Environment and Education, as well as of civil society.⁴⁵ According to

⁴⁴ http://www.doleta.gov/pdf/No_Workers_Frame_0306.pdf (accessed 1 Apr. 2011).

⁴⁵ The membership of the Inter-Ministerial Committee on Climate Change is drawn from: The House of the Presidency of the Republic; Secretariat of Strategic Affairs; Ministry of Agriculture, Livestock and Food Supply; Ministry of Science and Technology; Ministry of Defense; Ministry of Education; Ministry of Finance; Ministry of National Integration; Ministry of Health; Ministry of Cities; Ministry of Foreign Affairs; Ministry of Mines and Energy; Ministry of Agrarian Development; Ministry of Development, Industry and Foreign Trade; Ministry of Environment; Ministry of Planning, Budget and Management; Ministry of Transportation; the Brazilian Forum on Climate Change; and civil society.

the World Resources Institute, the plan is “fairly comprehensive but still falls short of identifying specific action-steps and implementation strategies”.⁴⁶ According to the country report, implementation strategies are in place in relation to cleaner energy production, energy efficiency and biofuels. The Brazilian Ministries of Environment and Education established the National Program for Environmental Education in 2003. Several initiatives have been undertaken aimed at raising environmental awareness, upgrading teachers’ environmental skills and introducing climate change into educational curricula at all levels.

India has a comprehensive research and development programme on climate change. It is also on the path to launching its own satellite to monitor GHGs in the atmosphere. In 2008 the country released its National Action Plan on Climate Change, developed by a special council with stakeholder involvement. The plan identified eight missions: solar power, energy efficiency, sustainable habitat, water, the Himalayan ecosystem, green India, sustainable agriculture and strategic knowledge. Under the last heading it suggests strategic skill development actions that have not yet been taken. As in the case of Brazil, in India other skill development activities related to greening the economy already exist but are not embedded in an overall policy framework.

In general, the national climate change strategies of emerging economies such as Brazil, India and China (which is covered in the next subsection) indicate national adaptation needs and priorities, but fall short of providing concrete procedures and strategies for meeting adaptation needs and mitigation goals.⁴⁷

In Egypt, the National Environmental Action Plan covers the period 2002–17 and addresses key environmental issues, such as water quality, air quality, management of land resources, desertification, protection of the marine environment, solid waste management, biodiversity and biological safety. The plan includes activities addressing training needs, such as integrating environmental and development issues, as promoted by educational institutions, into existing training curricula and promoting the exchange of methodologies and evaluations; and supporting training programmes to help businesses, especially SMEs, to build capacity/skills pertaining to environmental auditing, technology, best practices and environmental services markets. However, to date none of these activities has been implemented. A National Committee on Climate Change has been created in Egypt, aiming at the elaboration of a national strategy on climate change.

In the Philippines and Thailand and the some isolated environmental programmes have been implemented, for example to restore forests and soil, and promote the sustainable use of natural resources and renewable energies. In Thailand, the Government’s policy on natural resources, environment and energy includes a 15-year Alternative Energy Development Plan (2008–22) which promotes electricity generation using renewable energy, especially biofuel. In the Philippines, a Climate Change Commission has been created, but is not yet operational. In both countries there is no specific strategy on skill development for greening, but several formal and informal initiatives exist, set up by public and private organizations for different educational levels and target groups. In the Philippines a national environmental education initiative was launched in 1992, but its success was reportedly limited by resource constraints.

In Indonesia, the Government has developed programmes for greening the economy, but none is broadly implemented. The country has also established the Climate Project initiative under the Climate Change National Body to address issues of adaptation and mitigation. The Indonesia

⁴⁶ World Resources Institute: *National climate change strategies: Comparative analysis of developing country plans* (June 2009).

⁴⁷ Ibid.

Climate Project is one of the most active and advanced in the country in terms of providing education related to climate change issues.

Policies under development

The countries that fall into this group (Bangladesh, China, Mali, South Africa and Uganda) have benefited from important initiatives in the environmental field at strategic level but lack implementation mechanisms, including implementation of training responses to improve skills for greening the economy. Their policy has yet to develop a comprehensive and coordinated approach.

In South Africa, the National Climate Change Strategy dates back to 2004, yet no plan has been set up for its implementation. The strategy recommends that activities related to climate change should be incorporated into education at all levels to increase public awareness of the issue, and also that industries should produce their own in-house training programmes which could then be shared through industry bodies and associations. This has happened in certain industries but the practice is by no means widespread throughout the country. The Long-term Mitigation Scenarios Plan (2008) contains an ambitious mitigation strategy but lacks an adaptation supplement. South Africa is now in the process of developing a national response to climate change including adaptation measures.

Sustainable development is a national strategy in China, and many policies and measures introduced under this umbrella – on energy efficiency, renewable energy, reforestation, and soil and water conservation – yield benefits in respect of climate change. China's Action Plan on Climate Change addresses mitigation and adaptation, science and technology, public awareness, institutional reform, coordination across agencies and international cooperation. Yet China still lacks a national skill development strategy for greening the economy.

Box 3.3 shows the relative prevalence of conditions needed to create green jobs in 13 Asian countries, including the availability of skilled labour. The results obtained by the Asia Business Council confirm our country grouping – except for the case of China. According to the Asia Business Council, “China possesses the most favorable conditions overall for green job creation.” The size of many green industry sectors, such as renewables (solar for China), the potential for carbon reduction and the number of university graduates provide great market opportunities for green jobs in China. However, no skill development strategy for greening the economy was reported.

Bangladesh, Mali and Uganda fall into the category of least developed countries and qualify for support under the National Adaptation Programmes of Action (NAPAs) introduced by the United Nations Framework Convention on Climate Change (UNFCCC). NAPAs are policy documents designed to help prioritize urgent and immediate climate change adaptation needs.

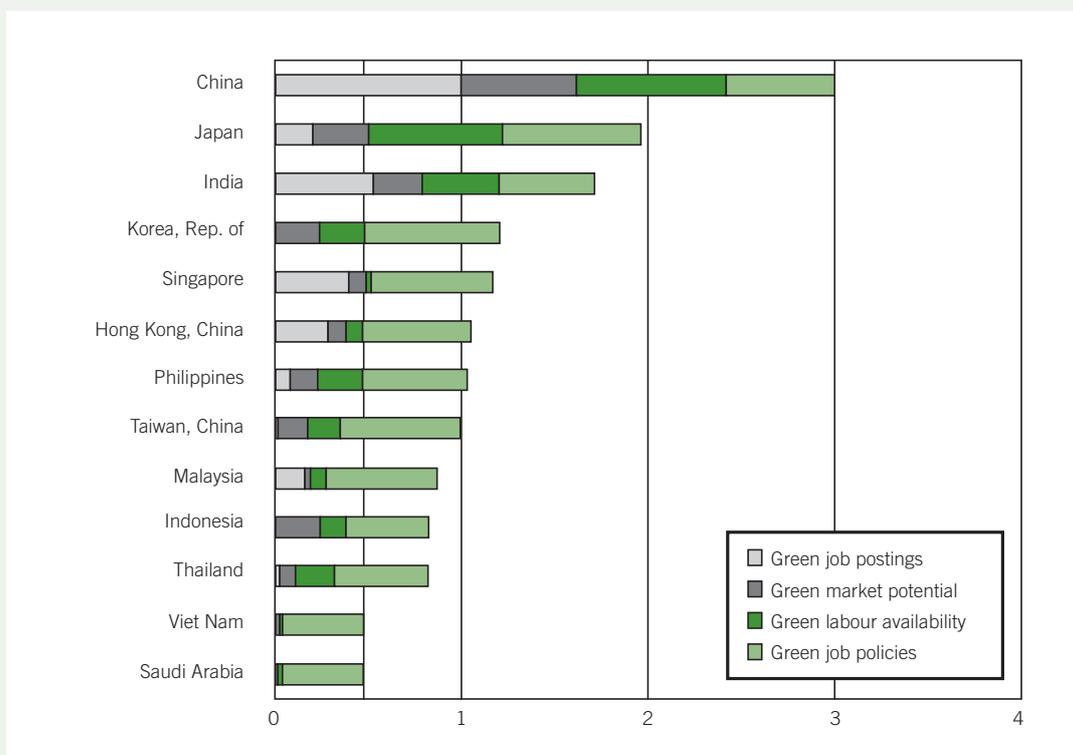
Bangladesh has seen more strategies and plans from the NAPA implemented than Mali or Uganda. In the case of Mali, so far, only one project (concerning food security) identified in the NAPA is being considered by the Global Environmental Facility (GEF) for financing. In Uganda, the NAPA has not yet been implemented due to lack of resources.

The NAPAs include skills-related measures in water resource management, techniques for sustainable land management and restoring soil fertility, and extending hydro-agro-meteorological services to crop and livestock farmers. For example, in Mali, the development of an adaptation training package for rural communities is included. However, a major obstacle to progress is the lack of involvement by ministries of labour in developing these plans, which cannot be put into practice without considering the labour force required to bring them to fruition. Further obstacles to successful implementation of the plans are posed by lack of capacity and resources.

Box 3.3. The Asia green jobs index

To examine the conditions in Asia that are needed to create green jobs, the Asia Business Council compiled a green jobs index that compares 13 Asian economies where the Council has members or conducts activities in several dimensions crucial to green job creation. The index is composed of four equally weighted dimensions. Two of them measure green job market demand: green job postings, indicating current employment needs; and green market potential, identifying the main industry segments that can create green jobs. The other two dimensions measure green job enablers: green labour availability, gauging the number of environmental programmes offered by top universities, as well as the number of science and engineering graduates and managers in private and public enterprises with potentially transferable skills; and environmental performance according to key international standards, along with government policies to prepare the economy for green jobs.

Index scores range from 0 to 4; a higher score means more favourable conditions for green jobs.



The results suggest that China possesses the most favourable conditions overall for green job creation, followed by Japan and India. In the cases of China and India, the sheer size of many green industry sectors, such as renewables (e.g. wind for India and solar for China), and the scale of potential for carbon reduction, as well as the number of university-educated job candidates, provide market opportunities and human capital that can enable green development. Japan's high rank in areas including university environmental programmes and national environmental performance reflects the economy's longstanding focus on developing green expertise and policies, dating from well before environmental concerns gained widespread global attention.

In terms of green job policies, China lags slightly behind Japan and the Republic of Korea. China and India have room for improvement in terms of green job enablers relative to green job market demand, whereas the Republic of Korea has more proactive enablers than it has demand. Out of all the economies measured, Japan has struck the best balance.

Source: Asia Business Council, report on *Addressing Asia's new green jobs challenge*, 2009. Reproduced with permission.

Further exploration of coherence between skills and environmental policies

The previous section looked at the information in the country case studies to see to what extent countries are including issues on skills development in their environment policy planning and implementation. The countries with such evidence are indicated in the top right-hand quadrant of figure 3.9. The relative ease of building policy coherence may be affected by the environmental context, productivity and competitiveness, and other development factors.

This section looks for associations between policy coherence and a number of indicators.⁴⁸ Policy coherence in countries presented in figure 3.9 (captured on a metric scale from 0 to 10) was correlated with GDP per capita, the Human Development Index (HDI), the Global Competitiveness Index and the Environment Performance Index (EPI).⁴⁹ Looking for statistical correlation between policy coherence and these indicators does not address the question of causality, nor does this analysis extrapolate the empirical findings to a wider set of countries. It simply provides an interesting extension of the investigation of coherence between environment and skills policies in the 21 studied countries (see figure 3.10).

It comes as no surprise that economic development (measured by GDP per capita at purchasing power parity) correlates positively with coherent environmental and skills policies for greening: the more advanced the economy, the higher the policy coherence, which is in accord with the findings depicted in figure 3.9. Interestingly, the correlation of policy coherence with the HDI is somewhat stronger than one with GDP per capita. HDI, in addition to including an indicator of per capita income, also includes indicators on education and health and thus captures not only some indication of economic but also of social development.

The Competitiveness Index, which also correlates positively with policy coherence, comprises a range of indicators not only on productivity but also social performance, including access to and quality of education, local availability of research and training services, legal and administrative frameworks of the institutional environment, technology availability and firms' technology absorption.

⁴⁸ See Annex 2 for the data on the indicators described below.

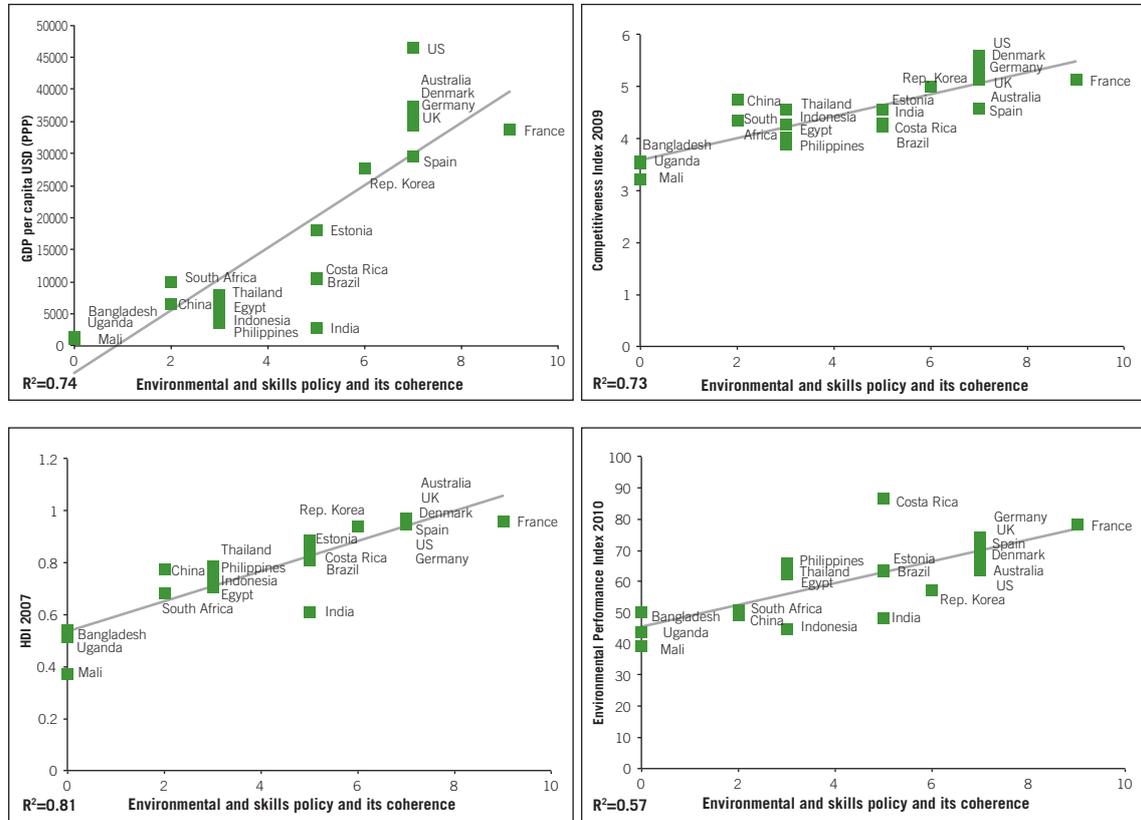
⁴⁹ The Human Development Index (HDI) is a composite statistic used to rank countries by level of "human development" as a frame of reference for both social and economic development. The index is composed from national data on health (life expectancy at birth), education (mean and expected years of schooling) and standard of living (GNI, Gross National Income per capita). It is collected by the UNDP. See <http://hdr.undp.org/en/statistics/hdi/> (accessed 1 Apr. 2011).

The Global Competitiveness Index compiled by the World Economic Forum is a way of measuring competitiveness defined as "the set of institutions, policies, and factors that determine the level of productivity of a country". The competitiveness index includes, among others, indicators on institutions, macroeconomics, education, health, labour markets, financial markets and business sophistication, technological readiness and innovation. See <http://www.weforum.org/pdf/GCR09/GCR20092010fullreport.pdf> (accessed 1 Apr. 2011).

The Environmental Performance Index (EPI) is a method of quantifying and numerically benchmarking the environmental performance of a country. It is prepared by Yale University and Columbia University. See <http://sedac.ciesin.columbia.edu/es/epi/downloads.html> (accessed 1 Apr. 2011).

The soundness of environmental policy and the comprehensiveness of skills policy for greening were each classified on a scale of 0–3 in respect of extent (0 = no policy, 1 = little policy, 2 = some policy and 3 = fully developed policy) and alignment between the two, and coherence was likewise classified on a scale of 0–3 (0 = no coherence, 1 = little coherence, 2 = some coherence, 3 = fully coherent). The three scores were summed to yield a composite score for each country that does not differentiate between environmental and skills policies and converted into a position on a scale from 1 to 10.

Figure 3.10. Correlation of coherence between environmental and skills policies with selected indicators



Note: R² values: the closer the value to 1, the stronger positive linear correlation between variables. All computed values are significantly different from zero, where zero means no correlation.

Source: Authors' analysis and relevant country indicators (see Annex 2).

The EPI, which measures 25 performance indicators across ten policy categories covering environmental public health and ecosystem vitality, demonstrates positive correlation with coherent environmental and skills policies for greening. Although we cannot state any direction of causality, this evidence is consistent with the findings from the country studies that paying attention to skills development is important for meeting the objectives of environment policies.

The institutional structures of advanced countries and the financial capacity to develop, implement and monitor coherent policies seem to facilitate the adoption of coordinated policies for greening. Also, strong international competition in the field of technology, including in renewable energies and energy efficiency, helps drive investment in research and environmental technologies, which in turn increases investment in skills development. Effective education and training systems at all levels – from primary to tertiary – provide the foundation for technological development and innovation.

In developing and emerging economies, the lack of financial resources and institutional capacity hinders the successful implementation of skills development strategies in general; a problem which is then manifested in the relatively little attention paid to skills development within national environmental and climate change policy agendas in particular. Some companies

within global value chains may gain access to training in new technologies through their headquarters, and this may lead to the adoption, and then adaptation, of innovations. But in general, the transition to the green economy will require developing the capacity of national training institutions, investment in education and training at all levels, and integration of the skills agenda into the overall development strategy, including technological, industrial, employment, trade and environmental policies.

3.2.2 *The green response to economic crisis*

The recent recession and the deep jobs crisis that followed it posed a major challenge to the policy agenda. Faced with the prospect of a prolonged global increase in unemployment, poverty and inequality, and the continuing collapse of enterprises, the ILO adopted a Global Jobs Pact (GJP) designed to guide national and international policies aimed at stimulating economic recovery, generating jobs, and providing protection to working people and their families (see box 3.4). The GJP calls for action to boost economic recovery and job creation while at the same time preparing for a greener, more balanced, fairer and sustainable global economy. It offers a wide range of crisis response measures that countries can adapt to their specific needs and situations.⁵⁰ Such measures are complex and integrated, combining skills development with job creation, social security, employment protection, support to vulnerable groups, an enhanced role for employment services and improved social dialogue. So complex a mix of policy measures presumes a high degree of policy coherence at national and international levels.

At the national level, many governments designed crisis response packages to stimulate economic recovery, restore employment growth, and increase social protection and employment services to help workers and enterprises. Some have included green policies aiming to mitigate and offset the immediate impact of the crisis by creating new jobs and new markets while also working towards the longer-term goal of promoting the transition to a low-carbon economy. This approach calls for strong coherence between employment, skills, economic, climate change and environmental policies. This section will therefore analyse policy coherence using the example of green components of economic stimulus packages.

Investment in job creation through green components of economic stimulus packages is aimed at helping to generate employment in green sectors: for example, jobs in infrastructure and carbon-neutral building, retrofitting, renewable energies and energy efficiency.⁵¹ As a result, labour markets will require different skill profiles from job applicants. Measures to stimulate activity in new energy sectors, water and waste management, and energy efficiency, including green building and retrofitting, will also have major implications for employment and skills.

⁵⁰ “ILO adopts ‘Global Jobs Pact’ aimed at creating jobs, protecting workers and stimulating economic recovery”, press release, 19 June 2009b.

⁵¹ ILO: *The financial and economic crisis: A decent work response*, Governing Body, 304th Session, Geneva, March 2009c, GB.304/ESP/2; R. Kyloh and C. Saget: *A common economic crisis but contradictory responses: The European experience 2008–2009*, Working paper no. 93, Policy Integration Department (Geneva, ILO, 2009), available at: http://www.ilo.org/wcmsp5/groups/public/---dgreports/---integration/documents/publication/wcms_108647.pdf (accessed 1 Apr. 2011).

Box 3.4. The Global Jobs Pact: Key extracts

At the 98th session of the International Labour Conference in June 2009, a Global Jobs Pact was agreed by representatives of governments, employers' associations and trade unions to guide national and international policies aimed at stimulating economic recovery, generating jobs, and providing protection to working people and their families. The Global Jobs Pact underlines the important contribution of skills provision and of green jobs to an effective recovery strategy implemented through active labour market policies and employment services. The text includes the following key passages:

7. *Our response should contribute to a fair globalization, a greener economy and development that more effectively creates jobs and sustainable enterprises, respects workers' rights, promotes gender equality, protects vulnerable people, assists countries in the provision of quality public services and enables countries to achieve the Millennium Development Goals. . . .*
9. *Action . . . involves the following principles: . . .*
 - (2) *enhancing support to vulnerable women and men hit hard by the crisis including youth at risk, low-wage, low-skilled, informal economy and migrant workers;*
 - . . .
 - (5) *increasing equal access and opportunities for skills development, quality training and education to prepare for recovery; . . .*
11. *. . . we agree to put the aim of full and productive employment and decent work at the heart of the crisis responses. These responses may include: . . .*
 - (2) *helping jobseekers by . . . (iii) implementing vocational and entrepreneurial skills programmes for paid and self-employment;*
 - (3) *investing in workers' skills development, skills upgrading and re-skilling to improve employability, in particular for those having lost or at risk of losing their job and vulnerable groups;*
 - . . .
 - (10) *increasing investment in infrastructure, research and development, public services and "green" production and services as important tools for creating jobs and stimulating sustained economic activity.*
12. *Sustainable social protection systems . . . address social hardship, while also helping to stabilize the economy and maintain and promote employability. . . .*
 - (1) *Countries should give consideration, as appropriate, to the following: . . . (iv) ensuring that the long-term unemployed stay connected to the labour market through, for example, skills development for employability;*
 - (2) *All countries should, through a combination of income support, skills development and enforcement of rights to equality and non-discrimination, help vulnerable groups most hard hit by the crisis. . . .*
22. *For many developing countries, especially the least developed, the global recession exacerbates large-scale structural unemployment, underemployment and poverty. We recognize the need to: . . .*
 - (3) *provide vocational and technical training and entrepreneurial skills development especially for unemployed youth.*

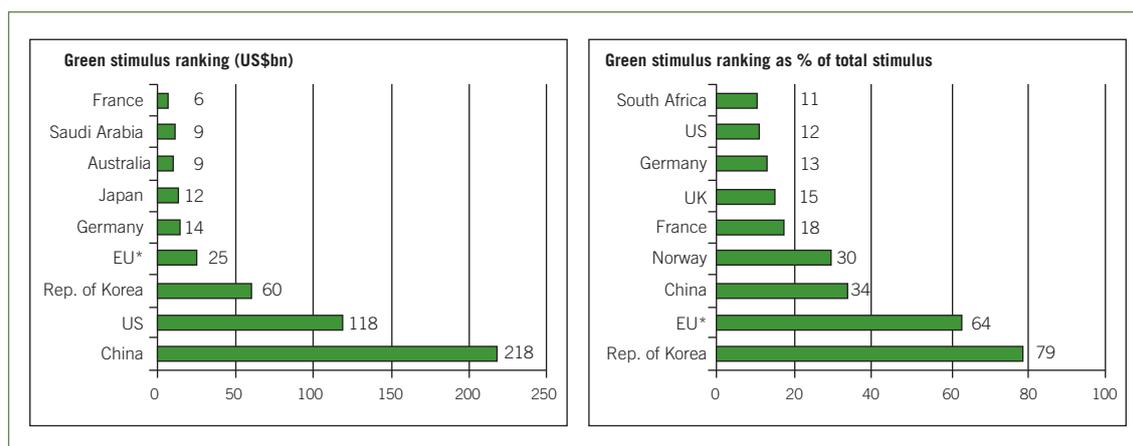
Source: ILO: *Recovering from the crisis: A Global Jobs Pact*, International Labour Conference 2009a (Geneva, 2009), available at: http://www.ilo.org/public/libdoc/ilo/2009/109B09_101_engl.pdf (accessed 1 Apr. 2011).

Green components of economic stimulus packages at a glance

According to a Hong Kong and Shanghai Banking Corporation (HSBC) study on green stimulus packages, around 16 per cent of the US\$3,100 billion in fiscal measures disbursed globally since the beginning of the financial crisis in 2007–08 can be associated with climate change investment themes. This includes more than US\$512 billion with expected multiplier effects, as total spending now tops US\$1,000 billion.

According to the HSBC research, China and the United States dominate the green stimulus landscape in absolute terms. The Republic of Korea, however, has allocated the highest proportion of its stimulus package to environment-related themes, followed by the EU and China (see figure 3.11).

Figure 3.11. Green stimulus packages ranked by size and proportion



* Includes the EU central recovery plan; EU Member States listed separately.

Source: HSBC Global Research: *A global green recovery? Yes, but in 2010* (2009c). Reproduced with permission.

Geographically, Asia is at the forefront of green stimulus spending, led by China, Japan and the Republic of Korea: over the region as a whole, more than 20 per cent of stimulus spending is dedicated to environment-related areas. In Europe, the stimulus in general, and the green stimulus in particular, is smaller than in other regions, a discrepancy partly explained by the existence of automatic fiscal stabilizers such as social security systems.⁵²

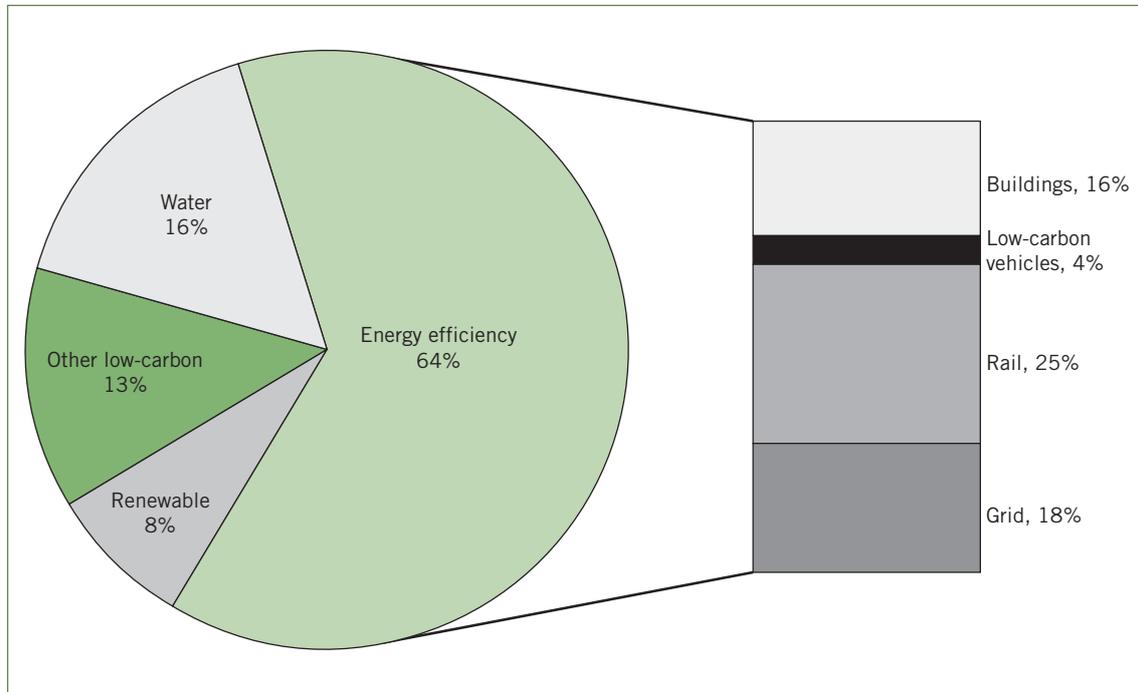
In terms of timing, most of the green stimulus spending entered the economy in 2010. China's stimulus plan is already starting to have an effect, and the first clean energy projects in the United States have been agreed.

Thematically, the largest proportion of the green stimulus is allocated to energy efficiency, with large-scale infrastructure investments in rail, power distribution grids and energy-efficient building (see figure 3.12). Water and waste come next, followed by renewable energy and other low-carbon power sources – largely carbon capture and storage.⁵³

Timely identification of skill needs in the targeted sectors is important in order that training can be provided for workers in renewable energy, water/waste management, infrastructure, energy efficiency, grid expansion, building efficiency (weatherproofing of housing, retrofitting), rail transportation, low-carbon vehicles and other low-carbon power sources. Well-timed and well-aligned training provision will help to avoid skills shortages, gaps and mismatches, delays in implementation of recovery packages, or even failure in achieving the packages' goals.

⁵² HSBC: *A climate for recovery: The colour of stimulus goes green* (2009b).

⁵³ Ibid.

Figure 3.12. Thematic allocation of green stimulus (US\$512bn)

Source: HSBC Global Research: *A global green recovery? Yes, but in 2010* (2009c). Reproduced with permission.

Also, getting the most out of the recovery packages for the economy and society without compromising the environment will smooth the path towards the longer-term goal of a greener economy.

Research demonstrates that even in those countries where there is no systematic shortage of skills for a low-carbon economy, shortfalls have been identified and are expected to widen in fast-growing markets such as renewable energy and building refurbishment. Green recovery measures have revealed hidden skills deficiencies and systemic failure to react to the new demand in a fast and flexible way.

Jobs and skills in green stimulus packages

Well-tailored green components of recovery packages create jobs and stimulate the economy while achieving the wider objectives of cleaner production and energy savings. The United States estimates that, on average, for every US\$1 billion invested in green recovery, 30,000 jobs could be created and savings made of up to US\$450 million per year on energy costs.⁵⁴

Legislative developments in the United States include the proposed Waxman–Markey American Clean Energy and Security Act of 2009, which includes a cap-and-trade GHG reduction plan. Combined with the American Recovery and Reinvestment Act of 2009 (ARRA), this could create an estimated 1.7 million new jobs.⁵⁵

⁵⁴ Peterson Institute for International Economics, World Resources Institute, policy brief 09-3, Feb. 2009.

⁵⁵ R. Pollin and Heidi Garrett-Peltier: *Building the green economy: Employment effects of green energy investments in Ontario* (Amherst, MA, Political Economy Research Institute (PERI), 2009). Reported figures from 2009 and 2010 show that PERI estimates are quite accurate.

Experts in China estimate that for every US\$100 billion of green investment, GDP would grow by US\$143 billion, tax revenues by US\$1 billion and household consumption by US\$60 billion, and 600,000 new jobs would be created.

In addition to the stimulus package in France, the commitments of the Grenelle de l'environnement strategy up to 2020 represent over US\$600 billion in further green measures. It is expected that this investment will generate more than 500,000 jobs and an annual return of about US\$30 billion.

In Germany, an estimated 13 per cent of the total stimulus package of US\$105 billion was expected to create 25,000 jobs in manufacturing and construction for retrofitting buildings to improve energy efficiency. Renewable energy accounted for 280,000 jobs in 2008, and planned investments, some of which will be financed out of the stimulus package, are expected to create more. This will include 30,000 jobs in the construction of offshore wind parks.

The energy conservation and green building investments that form part of the Republic of Korea's Green New Deal amount to 0.5 per cent of 2009 GDP, and the full low-carbon strategy accounts for 1.2 per cent of GDP. These strategies are expected to create 181,000 and 334,000 jobs, respectively.

It is important to note that green technologies tend to generate proportionately more jobs than their CO₂-intensive counterparts.⁵⁶ A green stimulus, however, is not a replacement for a sound policy to fight environmental degradation and climate change. The most successful programmes complement rather than replace longer-term climate and energy policy. Such complementary policies aim at comprehensive coverage of the social and economic dimensions, including human resource development measures to ensure the skills supply is adequate for their implementation. Skills development measures also help disadvantaged groups to gain access to and benefit from green recovery.

An overview of some green stimulus packages is presented in table 3.2.

While the overall pattern of green responses to the crisis has been analysed by HSBC, the focus of the present research has been on the role of skills development as an integral component of this response, an aspect which merits particular attention. The majority of countries have allocated little or no funding to human resource measures to identify what skills are needed to implement the stimulus plan and ensure they are available – a gap that sounds a loud note of warning. This is the case even in respect of such large green packages as those drawn up by China and the Republic of Korea.

In the United States, skills measures accounted for 0.6 per cent of the funding allocated under the ARRA, in the form of US\$600 million for training green-collar workers. The range of jobs that will benefit from the ARRA stimulus include occupations in the construction industry and the renewable energy industry, specifically solar energy and wind. Energy auditors will play an important role in distributing the US\$12 billion that is to be spent supporting energy efficiency initiatives and green construction. A significant portion of the stimulus is also related to supporting job creation and growth among America's youth and the economically disadvantaged – a highly diverse group. For example, in the construction industry, training will be given both in construction skills and how to work with new, greener and more efficient construction materials and methods.

In Germany a matching package to the value of €6.5 billion, supporting the stimulus although not part of it, promotes education and educational infrastructure, with particular emphasis on energy-efficient research and reconstructing schools and universities. In Australia, the Prime

⁵⁶ ILO: *The financial and economic crisis: A decent work response*.

Table 3.2. Overview of some green stimulus packages (information gathered in 2009–10)

Country	Package	Total fund and % of investment devoted to greening	Composition	Comment
Australia	Nation Building and Jobs Plan (Feb. 2009)	US\$26.7bn 9.3%	Energy efficiency, renewables, carbon capture and storage, and rail	Includes “Clean Sustainable Skills Package”, a US\$94 million investment which provides training opportunities for emerging green jobs
	Budget 2009–20	US\$17.1bn 39.8%		
Brazil	Stimulus package (2009)	US\$20bn		Includes the programme “Minha Casa, Minha Vida” aimed at providing training for workers in the construction sector to minimize the industry’s environmental impact
Canada	Economic Action Plan (Jan. 2009)	US\$31.8bn 8.7%	Renewable, carbon capture and storage, energy efficiency, rail, grid, waste and water sector	
China	NDRC ¹ stimulus package (Nov. 2008)	US\$586.1bn 34.3%	Energy efficiency, low-carbon vehicles, rail, grid, water, waste and renewables	Biggest stimulus package in the world, with largest absolute amount dedicated to climate-related themes
	Budget 2009	US\$63bn 27.3%		
Denmark	Stimulus package (June 2009)	€3bn (tax cuts); n/a		Based mainly on tax cuts
European Union	Economic Recovery Plan (only EU level) (Nov. 2008)	US\$38.8bn 63.7%	Renewables, carbon capture and storage, energy efficiency, low-carbon vehicles and grid	
France	Economic revival plan (Dec. 2008)	€26bn 21.2%	Energy efficiency (buildings); low-carbon vehicles (scrappage bonus, premium for low-carbon cars; investment in high-speed rail); renewables; grid infrastructure	Highest proportion of package allocated to climate-related themes in the EU
Germany	Twin stimulus packages (Nov. 2008, Jan. 2009)	€81bn 13.2%	Energy efficiency (buildings); low-carbon vehicles (scrappage bonus, loans to develop low-carbon engines, emissions-based vehicle taxation scheme); public transport systems	Biggest stimulus package with largest absolute amount dedicated to climate-related themes in the EU A matching package (€6.5bn) promotes education, in particular for energy efficient research and reconstructing schools and universities
Indonesia	Stimulus Plan (Jan. 2009)	US\$5.9bn 1.6%	Renewables and rail	
Ireland	Pact for Stabilization, Social Solidarity and Economic Renewal (Jan. 2009)		Increased provision of training opportunities, particularly for laid-off construction workers, in energy efficiency and renewable energy sources; measures to facilitate completion of apprenticeships	
Japan	Package to “safeguard people’s daily lives” (Dec. 2008)	US\$486bn 2.65%	Renewables, carbon capture and storage, energy efficiency, low-carbon vehicles	
	Countermeasures to economic crisis (Apr. 2009)	US\$154bn 15.3%		

Table 3.2. Overview of some green stimulus packages (information gathered in 2009–10) *(Continued)*

Country	Package	Total fund and % of investment devoted to greening	Composition	Comment
Mexico	Agreement for Home Economics and Employment (Jan. 2009)	US\$7.7bn 9.7%	Energy efficiency	
Republic of Korea	Green New Deal (Jan. 2009)	US\$76.1bn 78.8%	Renewables, carbon capture and storage, energy efficiency, low-carbon vehicles, rail, water and waste	Highest proportion of package allocated to environment-related themes in the world
Saudi Arabia	Budget 2009 (Dec. 2008)	US\$126.8bn 7.5%	Water and waste management measures	
South Africa	Budget 2009/10 (Feb. 2009)	US\$75bn 10.7%	Rail	
Spain	Stimulus package (Nov. 2008)	€11bn 5.8%	Water/waste infrastructure	
Switzerland	Stabilization measures (June 2009)			US\$14m for workforce training (solar panel installation training, insulation and retrofitting training in the construction sector)
UK	Recovery Plan (Nov. 2008) and additional support for automotive industry	£22.1bn 6.9%	Energy efficiency (buildings; new carriages; British waterways network; low-carbon vehicles; scrappage scheme); extension of Renewables Obligation from 2027 to 2037; flood defence funding	
US	Emergency Economic Stabilization Act (Oct. 2008)	US\$185bn 10.1%	Renewables, carbon capture and storage, energy efficiency, low-carbon vehicles, rail, grid, water and waste	The ARRA contains the broadest-based stimulus of any country package
	American Recovery and Reinvestment Plan (ARRA) (Jan. 2009)	US\$787bn, 12%		Skills measures constitute 0.6% (US\$600m) of the ARRA

Note: In cases where no reliable data were available, blanks have been left.

¹ National Development and Reform Commission.

Sources: HSBC studies; European Synthesis report; country reports; ILO Cedefop research.

Minister has announced the “Clean Sustainable Skills Package”, a US\$94 million investment which provides training opportunities for emerging green jobs.

The recovery package in Switzerland set out by the Federal Council includes measures to establish a greener economy. Human capital investment is a crucial element in the third, implementation, phase of the package. The programme “energiwissen.ch” developed by SuisseEnergie describes a skills development action plan for 2009–12 which will allocate CHF15 million (approximately US\$15 million) for workforce training.⁵⁷ The measures mainly focus on training in solar panel installation, insulation and retrofitting in the construction sector.

⁵⁷ SuisseEnergie is the Swiss programme on energy efficiency and renewable energy. Its strength rests on close collaboration and partnership between the Confederation, cantons, municipalities and numerous partners from the economy, environment, consumer associations, public agencies and private businesses.

In Brazil, the Government's stimulus package to address the financial crisis includes an initiative to build 1 million homes equipped with solar panels for low-income residents. This initiative is part of the programme "Minha Casa, Minha Vida" (My house, my life) which, among other things, plans to provide training for workers in the construction sector to minimize the industry's environmental impact. The ILO is conducting research to provide advice on the employment component of the production, installation, repair and maintenance of these solar panels, including addressing skills shortages and how they can be tackled, and ways to plan the production and installation of the panels.

In general, the (non-green) skills component of national crisis response packages is complex, incorporating a variety of approaches and measures in both employment and social policy, such as employment retention incentives, support to enterprises, protection of employed workers and special support for migrant workers, to name just a few. Our research has revealed that the skills response with a green focus is often less complex, frequently consisting largely of straightforward training measures in particular sectors to support green investment and job creation. The case of the United States shows a broader approach and will be dealt with in more detail below (see box 3.5).

Types of human resources measures included in green components of economic stimuli

Disadvantaged groups need special attention in a recovery period. Therefore it is imperative that recovery packages include measures targeting unemployed and low-skilled people, youth at risk and women, as well as paying attention to social dialogue processes and policy coherence. Human resources measures analysed in green recovery packages include vocational education and apprenticeship training geared to making green jobs attractive to young people. Below are some examples of such measures.

Labour market information investments

Through the ARRA, the US Department of Labor received funding to support activities related to green jobs. State Labor Market Information Improvement Grants to the value of approximately \$50 million were made to the workforce agencies of the 50 states (see box 3.5).

Measures targeting disadvantaged groups

In Ireland, the Government and the social partners concluded the Pact for Stabilization, Social Solidarity and Economic Renewal, which provides the framework for economic recovery, in January 2009. A key document is *Building Ireland's smart economy*,⁵⁸ which seeks, among other measures, to aid restructuring of the construction sector. The National Training and Employment Authority (FÁS) increased the provision of training opportunities, particularly for laid-off construction workers, in new skill areas such as installation of equipment and material to increase energy efficiency or to take advantage of renewable energy sources.

In Malaysia, the Government is responding to the jobs crisis by implementing sector-specific measures. The Sarawak Corridor of Renewable Energy (SCORE) is a major infrastructure project designed to attract investment to and create employment opportunities in the Sarawak region.⁵⁹ It is one of the five corridor development projects under the Ninth Malaysia Development Plan,

⁵⁸ http://www.taoiseach.gov.ie/eng/Publications/Publications_2008/Building_Ireland's_Smart_Economy.html (accessed 1 Apr. 2011).

⁵⁹ <http://www.sarawakscore.com.my/> (accessed 1 Apr. 2011).

Box 3.5. Large and complex workforce development programmes as a major focus of recovery measures in the United States

The **US American Recovery and Reinvestment Act (ARRA)** foresees a US\$600 million stimulus package for training of green-collar workers administered by the Department of Labor. The whole recovery package is nominally worth US\$787 billion, of which more than US\$100 billion is devoted to green measures. The training response therefore constitutes 0.6 per cent of the green stimulus. A green jobs framework for action summarizes the activities.

The green workforce training consists of a number of different grant programmes aiming at (i) improved strategic planning processes at government level; (ii) training and placement services for workers, including (iii) disadvantaged groups; and (iv) improved labour market information related to energy efficiency and renewable energy industries:

- (i) The largest share goes to the 50 state Workforce Investment Boards, which receive funds to encourage a **strategic planning process** to align employment strategies with state energy policies and local and regional training activities that lead to employment in targeted industry sectors.
- (ii) **Training and placement services** for energy efficiency and renewable energy industries are funded through grants, as is training directed at workers whose jobs are affected by national energy and environmental policy and automotive-related restructuring (US\$250 million altogether). In addition, organizations that provide training for entry-level positions in the energy efficiency and renewable energy industries benefit from capacity-building grants.
- (iii) The Federal Government also designed **targeted programmes for disadvantaged groups** such as economically challenged youth, mainly covering green-collar job training for careers in the automotive, construction and manufacturing industries. Course topics include knowledge of sustainable building products, solar panel installation and weatherproofing techniques.
- (iv) **State Labor Market Information Improvement Grants** fund all state workforce agencies to collect, analyse and disseminate labour market information, and to enhance the labour exchange infrastructure to deal with careers within the energy efficiency and renewable energy industries.

Apart from these measures, the green stimulus package also features **knowledge sharing** and **research** activities. A web page for sharing information on green jobs was established and a community of practice focused on green jobs is being launched. Additionally, regional forums were organized to focus on immediate and effective implementation. These forums paid significant attention to green jobs, recommending that partnerships be established between the state, organizations in the local labour system, and employers' and workers' organizations, to identify available training programmes and skills gaps, and to establish standards for green job skills and translate them into training curricula.

making use of the abundance of hydropower and other natural resources. As part of this project, the state provides initial training programmes, including a training scheme to prepare unemployed graduates for green jobs worth 300 million Malaysian ringgits (approximately US\$84 million).

Economically challenged youth in the United States benefit from the green measures of the ARRA, mainly covering green-collar job training for careers in the automotive, construction and manufacturing industries (see box 3.5). Also in the United States, a group of unemployed women who previously worked in a broad spectrum of industries are participating in a new "Women Going Green" project. This new programme, developed by the Atlanta Regional Office of the US Department of Labor and funded by the Department's Women's Bureau, is providing unemployed women with the opportunity to secure better working and living conditions through training in green small businesses, and/or high demand non-traditional green careers. Part of their training included a study tour to Southface, an organization that promotes sustainable homes, workplaces and communities through education, research, advocacy and technical assistance training.⁶⁰

⁶⁰ <http://www.dol.gov> (accessed 1 Apr. 2011).

Vocational education and training, and apprenticeship

In the United States, on 24 June 2009 the Department of Labor Employment and Training Administration announced a series of grants, to be awarded through competition, for worker training and placement in green jobs totalling US\$500 million.

In Australia, the Green Skills Agreement between the Australian Government and the state and territory governments seeks to build the capacity of the vocational education and training sector to deliver the skills for sustainability required in the workplace and to enable individuals, businesses and communities to adjust to and prosper in a sustainable, low-carbon economy. On 30 July 2009 the Prime Minister announced the “Clean Sustainable Skills Package”, a US\$94 million investment which provides apprenticeship and training opportunities for 50,000 young or disadvantaged Australians to acquire the skills and training they will need for emerging green jobs. This programme is an example of how targeted measures for young and unemployed people can be combined (see box 3.6).

Box 3.6. Australia’s Clean Sustainable Skills Package

The Clean Sustainable Skills Package announced in 2010 includes the following elements:

- 30,000 apprentices will graduate over the next two years with qualifications that include clean and green skills;
- 10,000 unemployed 17- to 24-year-olds will be able to access a 26-week environmental work experience and training programme through the National Green Jobs Corps initiative;
- 4,000 training opportunities will be made available for insulation installers upon completion of their employment in this field; and
- 6,000 new local green jobs will enable unemployed Australians to contribute to environmental sustainability in priority local communities.

In Ireland, the report *Building Ireland’s smart economy* recognizes the special difficulties faced by apprentices who are being laid off as the result of restructuring in the construction sector. To address the issue, the National Training and Employment Authority (FÁS) and the Institutes of Technology are working together to help apprentices finish their apprenticeships. Additionally, FÁS and the Department of Enterprise, Trade and Employment identified scope for approximately 30,000 additional places (predominantly in training for the unemployed, but also including some apprenticeships) in 2009.

3.3 Conclusions

The key priority in a green economy is reducing the negative environmental, economic and social impacts of climate change and environmental degradation, ultimately to sustainable levels. The key challenge in making the transition to a low-carbon economy is how to change unsustainable production and consumption patterns. Growing awareness of environmental issues, such as climate change, moves environmental policies up the political agenda.

Skills are playing an important role in improving the quality of jobs, and a green economy can contribute to the fight against poverty and unemployment, both aggravated by the financial crisis, as well as creating more and better work. These challenges – environmental, economic

and social alike – can only be met if comprehensive, coordinated and targeted policies are in place. Skills shortages already pose a major barrier to transitions to green economies and the creation of green jobs. Effective mechanisms for timely identification and provision of skills are therefore central to meeting these challenges.

Skills policies and environmental policies are still often dealt with in isolation. The same applies to green components of crisis recovery packages: only a few countries have included such measures as investments in labour market information systems, measures targeting disadvantaged groups, and vocational education and apprenticeship training.

The country mapping exercise has revealed different levels of coherence between environmental and skills policies, ranging from sound, comprehensive and well-coordinated policies to fragmented or virtually non-existent ones.

Overall, three broad policy-related difficulties confronting countries in their attempts to move to a low-carbon economy can be identified:

- **Lack of enforcement of environmental regulations** already adopted, sometimes along with a need for more detailed and elaborate legislation to protect the environment. Weak enforcement of environmental laws and consequently lax implementation reduces the demand for the new skills needed to comply with them.
- **Limited awareness and capacities** of policy-makers to integrate a skill dimension into policy responses to manage environmental risks. Most of the documentation on adaptation and mitigation measures, policies, strategies, action plans and programmes initiated in response to climate change and environmental degradation refers only very briefly to the skills implications of these measures, and lacks any, or any substantial, skills response component. Lack of human and financial resources, unclear mandates of institutions involved and lack of general environmental awareness are some of the obstacles hampering skills development strategies.
- **Weak coordination of efforts between ministries and other governmental agencies.** Mechanisms established for identifying, monitoring, anticipating and providing skills do not usually include representation from environment ministries. Similarly, ministries, agencies and institutions concerned with education and training are mostly not involved in developing environmental policies. This lack of reciprocity clearly reduces the prospects for coordinated approaches. In other cases, even if interministerial coordination is undertaken successfully, coordination for implementation may be weak, and as a result policies to include a skills response in greening remain limited to isolated initiatives.

The factors conducive to environmental and skills policy coherence derive from complex development issues, including economic development, institutional structures and capacity, technological competitiveness and innovation, and effective education and training systems. Integration of the skills agenda into the overall development strategy, including technological, industrial, employment, trade and environmental policies, will help to promote both policy coherence in general and that in the field of environment and skills.

4. Green structural change and retraining needs

Transition to a greener economy as part of broader long-term structural change may incur severe economic and social adjustment costs if efficient and socially responsible restructuring measures are not in place. Sectors likely to be acutely affected include extractive industries and fossil fuel energy generation, emissions-intensive manufacturing and agriculture. On the other side of the equation, the move to renewable energies, energy efficiency, green building, clean energy, green manufacturing and organic farming will generate jobs. However, those who get the new jobs will not necessarily be the people who have lost their old jobs. Disadvantaged groups need targeted assistance, but retraining and skills upgrading will be crucial for everyone. The key to success is the assumption of shared responsibility by governments, employers and workers, achieved through social dialogue. Public employment services and active labour market policies are effective delivery mechanisms for training, and for matching skills with jobs.

This chapter analyses the notion of “green structural change” in the economy and its implications for employment. It focuses on the likely major employment shifts between sectors, taking into consideration the situation of sectors which are expected to lose jobs as well as those with high employment potential, and on the consequent needs for retraining and skills upgrading. The final section presents examples of good practice in socially responsible restructuring, with a particular focus on related skills measures, at national, regional, sectoral and enterprise levels.

4.1 What is green structural change and where is it happening?

In all economies, patterns of enterprise and employment shift continually as changes in markets and technologies open up new opportunities and weaken conventional businesses. This is the process of innovation in market economies that Schumpeter described as “creative destruction”.¹ Structural change – the rise of new industries and the decline of old industries – results in some workers finding their skills in high demand while others may find their skills redundant.

In a well-functioning labour market and with steady economic growth, workers move into new occupations, industries and areas, following signals given by employment and wage growth, preferably moving from economic activities with lower productivity to ones with higher levels of productivity.² However, if the labour market in a community or region is not functioning well or economic growth stalls, then these changes in markets and technologies can lead to worker displacement. This is what economists refer to as structural unemployment – resulting from fundamental changes in the real economy rather than from cyclical downturns.

¹ Joseph A. Schumpeter: “The process of creative destruction”, in *Capitalism, socialism and democracy*, ch. 7 (New York, Harper, 1942), pp. 82–85.

² C. Evans-Klock, P. Kelly, P. Richards and C. Varga: *Worker displacement: Public policy and labour–management initiatives in selected OECD countries*, Employment and Training Papers 24 (Geneva, ILO, 1998).

Table 4.1 Greening the economy: Types of employment effects

Type of effect	Observation
Positive and negative employment effects	<ul style="list-style-type: none"> Green policies and business practices can create new jobs or preserve existing ones On the other hand, environmental regulations can, in theory, have negative job consequences (by raising costs, reducing demand, or rendering a factory or company uncompetitive); this, however, has proven to be an exceedingly rare outcome
New job creation and job preservation	<ul style="list-style-type: none"> To some extent, green jobs will be created through the development of new technologies and the emergence of new industries (wind turbines, solar photovoltaics, fuel cells, biofuels etc.) As established firms and industries green their operations, existing jobs may be transformed and thus preserved against possible loss (implying changes in work methods, retraining)
Direct and indirect employment effects	<ul style="list-style-type: none"> Jobs are created directly through increased demand and output induced by environment-related expenditures Indirect employment effects arise in supplier industries Induced job effects occur as wage incomes are spent generating demand in additional industries
Temporary and long-term jobs	<ul style="list-style-type: none"> Construction and installation jobs (for instance, of a wind turbine) are usually of a temporary nature (as are jobs that are supported by a specific policy measure or programme) Manufacturing and maintenance jobs, on the other hand, are in principle of a longer-lasting nature

Source: Adapted from OECD: *Environment and employment: An assessment*, Report of the Working Party on National Environmental Policy (Paris, 17 May 2004), pp. 9–10; and from UNEP, ILO, IOE, ITUC: *Green jobs: Towards decent work in a sustainable, low-carbon world* (Geneva, 2008), p. 44.

From a broad conceptual perspective, the *Green jobs* report produced by UNEP, ILO, IOE and ITUC in 2008 identified four ways in which employment will be affected as economies are redirected towards greater sustainability. First, additional jobs will be created. Second, some employment will shift – for example from fossil fuels to renewables, or from truck manufacturing to railway rolling stock manufacturing, or from landfilling and waste incineration to recycling. Third, certain jobs may be eliminated without direct replacement. Finally, the jobs of many existing workers (for example, plumbers, electricians, metal workers and construction workers) will simply be redefined as day-to-day skill sets, work methods and profiles are greened.³ (See table 4.1.)

Two sources of structural adjustment linked to climate change and environment were identified:

- (1) Destruction of natural habitats, natural resources and ecosystems leads to decline of income-generating opportunities. As explained in the previous chapter, economic changes are wrought by flooding, contamination of land and water, deforestation, loss of biodiversity etc.
- (2) New markets, technologies, policies and regulations lead to the decline of certain economic sectors and rise of others. *Green* structural change is induced through environmental regulations and policies, such as carbon taxation, cap-and-trade schemes and emissions targets. Likewise, green structural change is led by economic forces, as businesses take advantage of new market opportunities and develop and apply new green technologies.

Both types may cause job losses. The first source of structural change requires active adaptation measures and diversification of income opportunities. The second source requires a proactive restructuring approach at enterprise, community and national level to alleviate the negative consequences for the labour market and to realize the potential of these structural changes for economic growth and decent work.

³ UNEP, ILO, IOE, ITUC: *Green jobs: Towards decent work in a sustainable, low-carbon world* (Geneva, 2008), p. 43.

Green structural change is not a discrete, independent sequence of events but part of a longer-term and complex process of economic restructuring. The degree to which a country experiences green structural change depends not only on pro-environment policy and legislation but also on its stage of socio-economic development. Our research among 21 countries demonstrated a very strong relationship between stage of development and presence of green structural change.

Australia, Denmark, France, Germany, the United Kingdom and the United States recognize that green restructuring is occurring as part of a gradual process that began over 30 years ago and has been driven by a combination of automation, relocation to reduce costs, developments in labour market policies, major changes in the composition of the industrial sector, the growth of the services sector and an increase in service intensity in other sectors.⁴ This wider restructuring process included growth in environmental goods and services, initially driven mainly by regulation and an active use of fiscal policies to promote green behaviour among enterprises and consumers. The continuation of this process today is far more focused on innovation and growth, with the market active as an important driver of green structural change.

In **Costa Rica, Estonia, the Republic of Korea, South Africa and Spain** green structural change, although influenced by technological and market factors, is still mainly policy driven. These countries recognize that to a certain extent they are at the beginning of the greening curve towards a low-carbon economy and in many respects are yet to experience a significant structural shift in their economies and their labour markets.

The background reports on **Egypt, the Philippines and Thailand** judge that their economies are not yet undergoing any major green shift. This is also likely to be the case in **Bangladesh, Brazil, China, India and Indonesia**. As the Philippines country report puts it, “the green initiative of a score or so enterprises, even if they are big, does not mean the economy is now going green”. A larger-scale green structural change in these countries will take time and will largely depend on policy development and implementation, law enforcement, and successful embracing of green technologies. Nevertheless, there is in these countries already a recognition that new skills will be needed to meet this challenge – and that this need will grow if policy development and implementation are hastened, broadened and deepened by their governments.

In **Mali and Uganda** green structural shifts are yet to be seen, with green policy and regulation still in the embryonic stage. In these countries, as in other developing countries, much depends on awareness raising, diffusion of green technologies, international environmental regulations and support through donor activities. Some labour market adjustment will be unavoidable in the face of lost income opportunities as a consequence of climate change and destruction of natural ecosystems.

4.2 Workforce restructuring and adjustment

Enterprise restructuring is defined as “the deliberate modification of formal relationships among organizational components. It involves redesigning work processes, delayering, eliminating structural elements through outsourcing, spinning off, selling off, and divesting units, activities or jobs. Restructuring is not a synonym for downsizing or reengineering but is a much broader and more inclusive concept.”⁵

⁴ *Serviceinnovation – dynamikker og konsekvenser i forhold til den fremadrettede virksomhedsnære innovationsstrategi i Danmark*, Background working paper to the Danish national innovation strategy by the Agency for Research and Innovation (2008).

⁵ ILO and EBBF: *Socially responsible enterprise restructuring*. A joint working paper of the ILO and EBBF (1999), p. 12.

Socially responsible restructuring takes into account the interests of all actors involved in the process – managers/owners/shareholders of the enterprise, workers and the wider community.⁶ Efficient enterprise restructuring helps to avoid lay-offs and to introduce changes conducive to thriving business enterprise and continued employment.

To prepare for the possibility of job losses, it is important at regional/community level to know which industries will be viable, which sectors will be expanding in the local economy and what skills will be needed. Equally, knowing which industries are in danger of decline and likely to undergo structural change is part of an early warning system which helps to prevent job losses in certain sectors and regions and/or to equip the workforce with skills to take up new opportunities.

Therefore, the following aspects are especially important in the restructuring process:

- (1) knowledge of current and expected structural change in the labour market and recognition of the problems this may cause; and
- (2) a proactive, integrated and coherent approach towards solving the problem by all concerned.

As the UK country report states, “job losses are not inevitable but the requirement for companies to be less carbon intensive is”.⁷ The Philippines report rightly points out that job losses are not an unavoidable consequence of green restructuring: a decision by an enterprise to go green is more likely to save jobs and even create new ones than to displace existing workers.

Much depends on an integrated and timely response supported by active labour market policy measures, based on labour market information and built up in collaboration between enterprises, governments, public employment services and social partners.

When it comes to knowledge of current and expected structural change (aspect (1) above), many countries have attempted to identify the sectors in decline where jobs are in danger and identify the new environmental products and services with good labour market prospects, including the occupations for which demand is rising. To varying extents this is true of almost all the developed countries involved in the study as well as of Brazil, the Republic of Korea and South Africa.

When it comes to a proactive, integrated and coherent response to the problem (aspect (2)), however, the record is patchy. Responses to restructuring in the countries examined are often ad hoc, opportunistic and largely company-specific reactions to new market demands reflected in changing skills requirements. The most successful responses are built around the regeneration efforts of particular regions, localities or sectors and include public–private partnership and social dialogue. Even in the few exceptional cases where national strategies exist, as for example in the automotive sector in France, Germany and the United Kingdom, there is still a reliance on regional or company-level initiatives to design skills responses.

Ideally, mechanisms for workforce restructuring are incorporated in the overall national, regional or sectoral system of active labour market policies, including retraining, and based on the established labour market information system. In Denmark, for instance, before the global economic downturn, the flexicurity model was hailed by many as effective in tackling structural

⁶ G. B. Hansen: *A guide to worker displacement: Some tools for reducing the impact on workers, communities and enterprises*, update 2009 (Geneva, ILO).

⁷ UK House of Commons Environmental Audit Committee: *Green jobs and skills*, Second Report of Session 2008–09, Dec. 2009.

imbalances, including those linked to green structural change. This approach assumes, however, the existence of a social protection framework, public employment services and institutional mechanisms for social dialogue.

The large size of the informal economy in a number of developing countries (Uganda 83 per cent, the Philippines 77 per cent, Thailand 72 per cent, Indonesia 68 per cent, India 57 per cent, Mali 56 per cent, Brazil 46 per cent, Egypt 44 per cent, Costa Rica 37 per cent)⁸ means that even if measures to ensure efficient and socially responsible restructuring exist, a considerable proportion of the population has no access to them. At the same time, the informal economy employs the highest proportion of low-skilled workers with the poorest prospects of gaining alternative employment. In India, for instance, it is estimated that 23 per cent of men and 40 per cent of women in the unorganized sector do not have even primary-level education. The informal economy also consists predominantly of micro and small enterprises, which are in greatest need of public assistance in restructuring.

Even when it comes to formal employment, in many countries active labour market policy measures to cushion workers against the effects of transition to a greener economy have not been identified. This is especially true of developing countries. In the absence of active restructuring measures by enterprises or communities, workers take whatever action they can to protect their own livelihoods in changed conditions. For instance, in countries where farming is the main means of livelihood, and where climate change and environmental degradation have diminished income opportunities in already very poor areas, in the absence of any efficient restructuring and diversification of production at community level, people flee to urban areas or other countries. This “passive” adaptation to climate change has occurred, for example, during the increasingly prolonged dry season in Mali. Such measures, taken in desperation, may have serious negative consequences, in this case resulting in the temporary or permanent loss of the most capable young people – the very people on whom communities most rely to thrive and develop.

“Passive” adaptation occurs in many sectors and in many attempts to adjust to an appalling economic situation linked to restructuring in the absence of any clear policy for mitigation of climate change. For instance, in Mali a large proportion of useful waste (e.g. metals, hard plastics) is collected in deprived communities by people who simply take their chances earning their living from waste. At the same time only about 10 per cent of the 17,000 tonnes of plastic waste generated each year is recycled. A strategic restructuring approach at community level could have provided many more people with jobs. Many other developing countries see strong potential for employment growth in waste collection and recycling. Tapping this potential while also introducing skills development measures in a socially responsible way could go a long way towards helpfully restructuring labour markets in economically deprived areas.

In the absence of efficient labour market measures, job-matching services or retraining opportunities, skills development is often self-organized and ad hoc. The situation of women and vulnerable groups, such as people with disabilities, and disadvantaged young people, is particularly alarming: without targeted public support, they stand little chance of gaining access to training or job opportunities.

⁸ “Employment in the informal sector”, *Key Indicators of the Labour Market* (KILM) 6th edn (Geneva, ILO, 2009a), using the most recent data available for each country; for the Philippines, the data source is the Employers Confederation of the Philippines. In most of the countries the actual share of the informal economy is likely to be much higher. Data for Indonesia, the Philippines and Thailand relate to the whole economy; all other countries exclude agriculture and paid domestic workers. In India workers in the electricity, gas and water sectors are also excluded; in Uganda the data cover only urban areas and exclude the electricity, gas, water and communication sectors.

4.3 Employment effects

With growing acceptance of the urgent need to arrest climate change and environmental degradation, and with the introduction of new targets in cutting CO₂ emissions, countries are likely to face a sizeable employment challenge in the future, if indeed they are not doing so already.

A number of forecasts have indicated that the overall impact on employment of the transition to a low-carbon economy will be positive. This assessment is based on two main assumptions:

- (1) that strengthened regulation to combat climate change will lead to expanded production of environmental goods and services; and
- (2) that many green sectors tend to be more labour intensive than “traditional” fossil fuel based industries.⁹

The 2008 *Green jobs* report predicts that as a result of the increasing interest in alternative energy sources 2.1 million jobs will be created in wind energy production, 6.3 million in solar/photovoltaic and 12 million in biofuels-related agriculture and industry. The European Renewable Energy Council argues that increasing the share of renewable energy in Europe to 20 per cent of consumption levels by 2020 will create the potential for over 2 million jobs.¹⁰

Investment in greener economic activities generates jobs not only directly, for example in solar panel production, installation and maintenance, or in hybrid car manufacturing, but also indirectly in the supply chain – for instance, in steel production for wind turbines. In addition, investment in environment-friendly industries generates induced employment in the form of jobs generated by consumer spending.

Our country findings largely conform with the assessment that on balance job gains will outnumber job losses. To anticipate a likely net gain, however, is not to deny that declining sectors could see negative effects in the short term. Some countries (e.g. Australia) project slightly lower short-run growth in gross output in transition to the low-carbon economy, which may result in a temporary decline in employment. Falls in employment tend to reflect falls in production in emissions-intensive sectors. In the medium term, employment is projected to return to base levels with the potential for further growth – depending, crucially, on the retraining of workers.

Other studies warn that the predicted effects on labour markets will vary significantly over time.¹¹ In the short term jobs will be lost in directly affected sectors and new ones created in replacement industries. The expected net job creation in this phase, however, is likely to tail off as low-carbon technologies become more competitive and mature. Consequently, it will not be possible to sustain the initial employment gains over a 10–15-year time span. In addition, skills gaps in emerging sectors may cause structural unemployment. In the longer term still, as behaviour changes and value chains adjust, the impact on employment will depend strongly on external

⁹ That is, that investments in environment-friendly economic activities support more jobs per unit of expenditure. See UNEP, ILO, IOE, ITUC: *Green jobs*; C. Martinez-Fernandez, C. Hinojosa and G. Miranda: *Green jobs and skills: The local labour market implications of addressing climate change* (Paris, OECD, 2010).

¹⁰ UNEP, ILO, IOE, ITUC: *Green jobs*; Martinez-Fernandez, Hinojosa and Miranda: *Green jobs and skills*; M. Renner, M. Ghani-Eneland and A. Chawla: *Low-carbon jobs for Europe: Current opportunities and future prospects* (Brussels, World Wide Fund for Nature, June 2009), p. 10.

¹¹ S. Fankhauser, F. Scheiler and N. Stern: “Climate change, innovation and jobs”, in *Climate Policy* (2008), Vol. 8, pp. 421–29; Martinez-Fernandez, Hinojosa and Miranda: *Green jobs and skills*.

factors; but it is expected that innovation and the development of a new generation of green technologies will create a virtuous cycle of opportunities for investment and growth. This implies that, as the green economy grows, there will be an increased demand for highly skilled and qualified labour with up-to-date capability in new technologies and working practices.¹²

The overwhelmingly favourable conclusions about the positive net employment effects of transition to the low-carbon economy should not obscure the significant slowdown in growth and contraction in jobs likely to occur in carbon-intensive sectors such as coalmining, oil and gas, utilities and heavy manufacturing. New jobs created may not be in the same locality as old employers, so some communities may experience a net loss of jobs and structural unemployment.

The employment challenge associated with the goal of cutting CO₂ emissions is significant. The *World of Work Report 2009* estimated the employment effects of “green policies” designed to support low carbon intensive sectors. On the basis of its review of earlier evidence, the report suggested that the overall effect could be neutral or slightly positive, but that much depends on how revenues from taxing and pricing mechanisms are used.¹³ For instance, carbon taxes or cap-and-trade schemes would generate government revenues, which, if used to reduce taxes on labour, would in turn stimulate demand for labour. As with any other structural change, the transition to a greener economy will be more or less successful in any particular country depending on that country’s characteristics, such as the labour intensity of adversely affected sectors, the extent to which workers’ skills match the new job requirements, the speed of technology diffusion, and the availability of well-designed labour market policies to support workers and businesses in their move to a greener economy.

The *World of Work Report 2009* shows that if a price were put on CO₂ emissions, through taxes or emissions trading schemes,¹⁴ and if the resulting revenues were used to cut labour taxes, then employment would rise by 0.5 per cent by 2014. This is equivalent to 2.6 million new jobs in developed countries and over 14.3 million new jobs for the world economy as a whole. These results, which are consistent with evidence from other studies, rest on the assumption that green policies are adopted in a coordinated manner.¹⁵

It is important to note that, even if the overall employment effect were positive, not everybody would gain from it: there would also be losers, some temporary and some permanent. New jobs are not necessarily created in the same sectors, regions and communities where old jobs have been lost, or open to people with the same qualifications. Poor farmers, coastal communities, women and migrant workers may not get access to new employment opportunities in green and decent jobs if efficient policies targeting vulnerable groups are not in place.

A report by the Australian Treasury suggests that countries that defer action on climate change face longer-term economic costs, because global investment (and therefore employment growth) will be directed to less emissions-intensive countries and industries.¹⁶ A proactive stance in restructuring is therefore crucial both to attract investment and to mitigate the consequences

¹² Martinez-Fernandez, Hinojosa and Miranda: *Green jobs and skills*; Fankhauser, Seheiler and Stern: “Climate change, innovation and jobs”.

¹³ International Institute for Labour Studies (IILS): *World of Work Report 2009: The global jobs crisis and beyond* (Geneva, 2009).

¹⁴ In the empirical studies carried out for the *World of Work Report*, the simulation corresponds to a decrease in CO₂ emissions by 4.6 per cent.

¹⁵ IILS: *World of Work Report 2009*.

¹⁶ Australian Treasury: *Australia’s low pollution future: The economics of climate change mitigation* (Canberra, 2008).

of structural change. To pursue “business as usual” with no attempt to abate climate change would be not only ecologically but also economically disastrous. Ignoring the fact that green structural change may bring unemployment for certain groups, domains of work and areas will only delay an adequate response and worsen the employment situation.

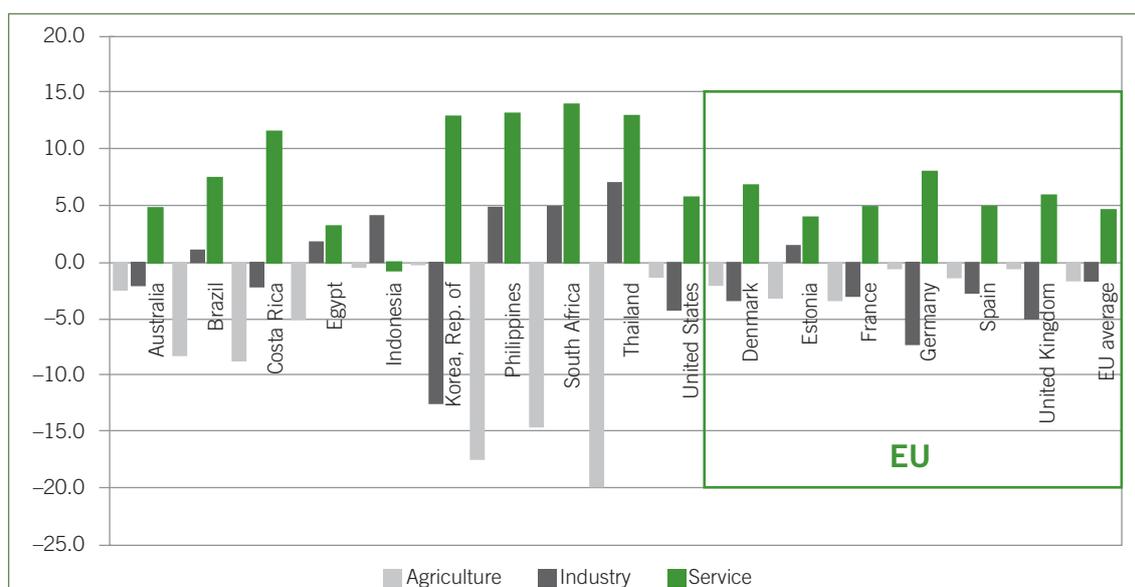
The recent economic downturn is likely to hasten and exacerbate the longer-term structural problems; at the same time, in prompting green stimulus measures and support for investment in environmental products and services, it is also likely to accelerate and intensify green structural change.

4.4 Sectors most affected by green restructuring

The decline of energy and emissions intensive agriculture and manufacturing, and the commensurate rise of less energy-intensive services, has been taking place in the developed world for some decades. This restructuring process, of course, is not driven solely by the environmental agenda and the shift to a green economy. Other factors, such as changes in demand for products, new market opportunities, global competition, outsourcing to cut production costs, technological change and innovation, have played an equally important role. Nevertheless, the structural shifts in employment already taking place as a result of all these factors are likely to be exacerbated by the transition to a carbon-constrained future (figures 4.1 and 4.2).

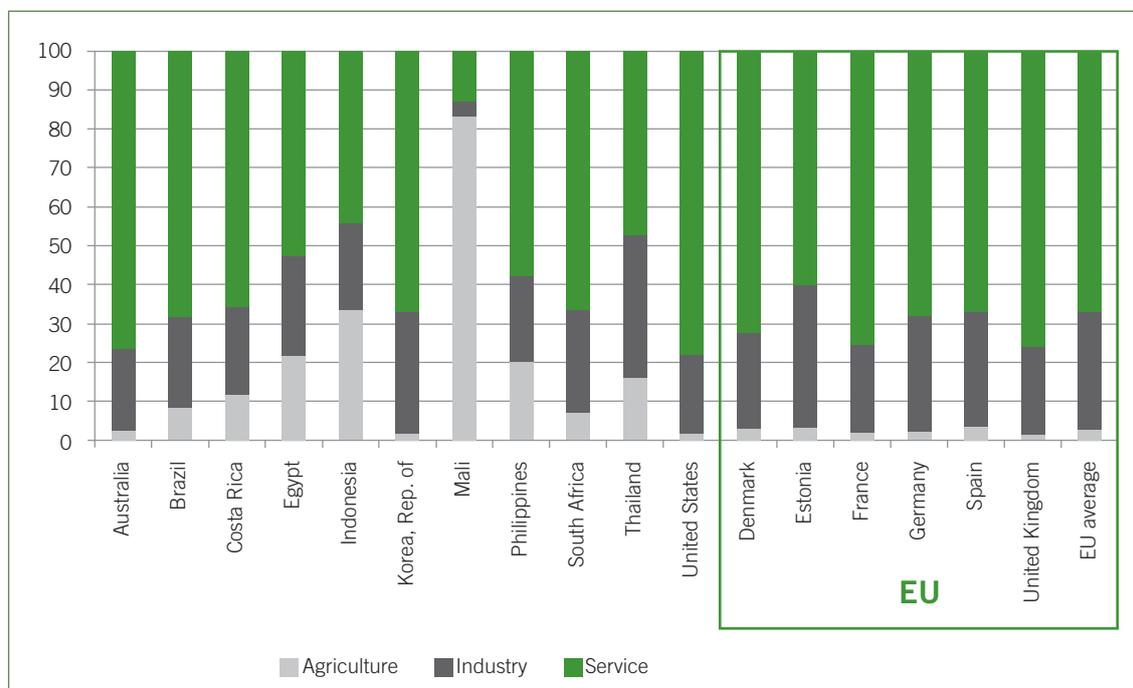
In developing countries, structural change is driven not only by government policy, new environmental regulations and emissions targets, but also by adoption and adaptation of new technologies, including cleaner technologies, and new business opportunities. Trade and industrial policies have a role to play in this process. However, environmental pressure itself is also driving change, often prompting spontaneous adaptations in response. Shifts to a greener economy remain

Figure 4.1. Employment change by major economic sector between 1995 and 2008 in selected countries (%)



Note: No data are available for Bangladesh, China, India, Mali and Uganda.

Source: Authors' own calculations based on ILO LABORSTA database, Table 1C, “Economically active population, by industry and status in employment (thousands)”.

Figure 4.2. Composition of employment by major economic sector in selected countries, 2008 (%)

Note: No data are available for Bangladesh, China, India and Uganda.

Source: Authors' own calculations based on ILO LABORSTA database, Table 1C, "Economically active population, by industry and status in employment (thousands)"; Mali data are from the country report (from *Strategic Framework for Growth and Poverty Reduction (GPRS II)*, 2007–11).

weak owing to inadequate policy formation, institutional support and implementation measures. Agriculture continues to play an important role in the economy and trade of developing countries, in spite of the continuing shift towards services and manufacturing. According to India's country report, over 60 per cent of the country's working population is engaged in agriculture. In Mali 83 per cent of the workforce looks to agriculture for some or all of its income. Restructuring processes in agriculture include the move to organic farming and the adoption of more sustainable farm and land management practices. Employment in agriculture is steadily declining, although it is likely to remain the backbone of the economy in some less developed countries.

In developing countries still undergoing the process of industrialization, employment in the manufacturing sector continues to grow. The employment shift towards carbon-intensive sectors represents a major challenge for the sustainable development agenda, especially in emerging economies with high growth rates. To adapt to climate change, mitigate its negative effects and environmental degradation, and sustain economic growth and development all at the same time, these countries will need to adapt new energy production and energy efficiency practices.

In fact, positive examples from early starters in the environmental transformation demonstrate that a trade-off between growth and environmental agendas is not inevitable. The Danish economy, for instance, has grown by 78 per cent in the last three decades, while energy consumption has remained more or less constant and CO₂ emissions have been reduced. Overall annual job losses have for several years totalled around 250,000, marginally lower than the number of jobs created. Similar successes are also reported at sectoral level: the German chemicals industry, for instance,

has increased production by 38 per cent since 1990 but at the same time reduced its energy consumption by 27 per cent and its GHG emissions by 46 per cent.¹⁷

Nevertheless, the immediate consequences of green structural change could be severe and their impact on employment should not be ignored. In China, it is estimated that since 2006 about 7,000 small power plants have been closed down, involving 400,000 employees in small- and medium-sized energy-intensive enterprises (see box 4.1).¹⁸

Box 4.1. Environment versus employment: Thorough policies are needed to address employment of dislocated workers in China

Closing down small coal-fired power plants will help improve the environment in neighbouring areas and reduce health problems caused by air pollution. Hebei province is one part of China where this has been done. The National Development and Reform Commission of China approved the thermal power project for Xuanhua, Zhangjiakou, in February 2009. Zhangjiakou has very cold winters, and people there need heating for more than five months a year. The project involves building two 300,000 kilowatt coal-fired thermal power plants with a total investment of 2.76 billion renminbi and closing small plants producing some 239,400 kilowatts. When the new plants are put into operation, it is estimated that SO₂ emissions will decline by 15,000 tonnes a year and soot discharges by 4,000 tonnes a year – a considerable improvement both to the environment and to the quality of life in Zhangjiakou and nearby Beijing.

However, the closure of over 7,000 small power plants in China has also meant the loss of many jobs. It is estimated that around 400,000 people have been affected. A power generation company in Shanxi, for example, has had to shut down 15 power plants with a total capacity of 800,000 kilowatts to build two new 600,000 kilowatt plants. The two new plants need only about 380 workers, but the laid-off workers from the 15 closed plants number 3,600, which means that over 3,200 people have become unemployed. Although the central government has allocated RMB 2 billion to remote provinces for restructuring enterprises, supporting laid-off workers and providing job training, according to the most recent report by the United Nations Development Programme (UNDP) no policies have been launched to address the employment of dislocated workers.

Source: UNDP: *China Human Development Report 2009/10. China and a sustainable future: Towards a low carbon economy and society.*

Across the countries studied in this research, green restructuring to date has been limited in scale. Environmental pressures have contributed somewhat to the decline of certain industries, although they have by no means been the main causal factor. In both developed and developing countries the following energy and emissions intensive industries have been identified as facing declining markets and beginning to reorientate their production models and processes to take advantage of markets driven by environmental priorities:

- Agriculture, forestry and fisheries are refocusing on organic food markets and on the production of biofuels, alongside significant shifts across subsectors and within the food/wood processing industry (for example, to sustainable forestry or new kinds of aquaculture), with related retraining needs.

¹⁷ *Towards a new understanding of "green jobs"*, Discussion paper from German employers, Mar. 2009, available at: http://www.ioe-emp.org/fileadmin/user_upload/documents_pdf/globaljobscrisis/documentsfrommembers/Towards_a_new_understanding_of_green_jobs_a_discussion_paper_German_employers_BDA.pdf (accessed 1 Apr. 2011).

¹⁸ UNDP: *China Human Development Report 2009/10. China and a sustainable future: Towards a low carbon economy and society.* (New York, 2010).

- Extractive industries and fossil fuel energy generation are making the transition to greater energy and resource efficiency, using new green technologies, clean coal,¹⁹ and carbon capture and storage; workers are also being diverted into renewable energies, again creating a need for retraining.
- Emissions-intensive manufacturing is making similar adjustments; in particular,
 - the automotive sector and related supply chains are refocusing on eco-friendly vehicles (hybrid, electric, hydrogen) capable of reducing GHG emissions and meeting other customer demands;
 - shipbuilding and related marine engineering activities are refocusing on offshore renewable energy activity, including the construction, supply and maintenance of offshore (and onshore) wind turbines and wave and tidal energy; and
 - the cement industry is taking measures to shift to more energy-efficient ways of production.

Table 4.2 provides a more detailed picture.

Table 4.2. “Green” restructuring: Industries likely to be adversely affected and associated retraining needs¹

Industry	Employment effect	Type of restructuring	Countries affected ²	Training needs
Agriculture, forestry, including food/wood processing	Some jobs lost, but organic farming is estimated to have high growth potential	• Employment shift towards manufacturing in developing countries and towards services in both developed and developing countries	AUS, BGD, BRA, CHN, CRI, DEU, EGY, EST, FRA, GBR, KOR, IDN, IND, MLI, UGA	Retraining for new farming practices, crop diversification and organic farming
	Some food-processing industries are stable or gaining in employment, also absorbing agricultural workers			Retraining in biofuel production and for new technologies
	Biofuels expected to absorb some displaced agricultural workers	• Intra-industry restructuring		Retraining of farmers as forestry workers
	Re-/afforestation projects expected to have positive impact on employment in forestry but negative impact of conversion of cropland			Retraining for eco-, rural and forest tourism
Fisheries	Some job losses; some fisheries stable or gaining in employment, also absorbing agricultural workers	• Employment shift towards manufacturing in developing countries and services in both developed and developing countries	BGD, CRI, MLI	Skills upgrading: sustainability skills; climatology/meteorology skills; eco-counselling; entrepreneurial skills for farmers
		• Intra-industry restructuring		Complex use of timber and new technologies in wood processing
		• Absorbing land-based farmers		Retraining for jobs in marine natural parks
				Retraining of agricultural workers
				Skills upgrading (sustainable fish/seafood farming, aquaculture)

¹⁹ Clean coal technologies aim to reduce the environmental impact of energy generation from coal by increasing production efficiency and reducing emissions of CO₂ and other pollutants (Wikipedia, Wikinvest).

Table 4.2. “Green” restructuring: Industries likely to be adversely affected and associated retraining needs¹ (Continued)

Industry	Employment effect	Type of restructuring	Countries affected ²	Training needs
Extractive industries and fossil fuel energy generation	Stable or losing jobs; projected to lose jobs in medium to long term	<ul style="list-style-type: none"> Intra-industry restructuring Employment shifts towards other industries 	AUS, BRA, CHN, DEU, EST, GBR, IDN, IND, MLI, PHL, USA, ZAF	Retraining (into e.g. renewable energies) Skills upgrading (sustainable practices, energy and resource efficiency, new green technologies, clean coal, carbon capture and storage)
Emissions-intensive manufacturing	Losing jobs	<ul style="list-style-type: none"> Intra-industry restructuring Employment shifts towards other industries 	AUS, BRA, CHN, CRI, DEU, DNK, EGY, FRA, GBR, IDN, PHL, USA	Skills upgrading: core/portable skills; training for specialized sustainability skills Training for compliance with environmental regulations Environmental impact assessment Change in production processes (energy and resource efficiency, recycling, treatment of hazardous waste)
Automotive	Affected by economic crisis: job losses; may stabilize in medium term	Intra-industry restructuring into production of eco-friendly cars (hybrid, electric, hydrogen); increase in use of biofuels	DEU, DNK, ESP, FRA, GBR, KOR, THA, USA	Skills upgrading for car mechanics, technicians and engineers Training on design, maintenance and recycling, fuel efficiency
Shipbuilding	Losing jobs	Employment shifts towards other industries and market opportunities	DNK, GBR	Retraining for other heavy industries, including installations for off/onshore wind turbines and wave and tidal energy
Cement	Losing jobs	Employment shifts towards other industries and market opportunities	CHN	Retraining Skills upgrading (energy efficiency)

¹ This table is not exhaustive: it does not take into account information from other sources.

² AUS = Australia, BGD = Bangladesh, BRA = Brazil, CHN = China, CRI = Costa Rica, DEU = Germany, DNK = Denmark, EGY = Egypt, ESP = Spain, EST = Estonia, FRA = France, GBR = the United Kingdom, IDN = Indonesia, IND = India, KOR = Republic of Korea, MLI = Mali, PHL = Philippines, THA = Thailand, UGA = Uganda, USA = the United States, ZAF = South Africa.

Source: Authors. Based on the information from country reports.

The training response to restructuring needs to include not only retraining, especially in cases where employment shifts between industries, but skills upgrading. Skills upgrading is especially important for those industries where employment is stable at present but is expected to shrink in future, and in those where restructuring is being undertaken to make production processes, goods and services greener. However, even in shrinking industries skills upgrading remains important, especially when it comes to core, portable skills, sustainability skills and environmental awareness.

The subsections below take a more detailed look at restructuring in the key energy and emissions intensive industries identified as negatively affected by green structural change. An analysis of changing and emerging skills and occupations in major economic sectors is presented in Chapter 5 (section 5.4).

4.4.1 Restructuring in agriculture, fisheries and agrifood

Restructuring in agriculture is happening in a great variety of ways. Most of the country case studies indicate that many farmers are repositioning themselves both within the sector and in other sectors, prompted by the inability to make enough profit to live on from agriculture, the development of machinery and technology, and climate change.

Agriculture is a large consumer of water and one of the main carbon emitting sectors in the world economy (see Chapter 3, figure 3.1). The sector will face increasing pressure from the need to adapt to and mitigate climate change. Countries are already moving away from the excessive use of chemical fertilizers, pesticides and artificial irrigation, all of which are harmful

Box 4.2. The shift to organic farming

In **Bangladesh**, organic farming is as profitable as conventional farming: production costs are higher, but products command premium prices. Although it is still on a largely experimental footing (accounting for only 2 per cent of the country's total cultivable land and 1 per cent of farmers), the Ecological Agriculture Program (EAP), run by a national NGO with support from international donors, is expected to involve around 0.8 million farmers in organic cultivation across 0.22 million acres of land by 2020. The involvement of farmers in organic farming through training programmes, mostly provided by NGOs, spans over 16 districts and over 100,000 farming families. Both Department of Agriculture staff at local level and NGOs have identified skill needs in organic farming, and there is an urgent need for systematic skill development among agricultural workers.

Organic agriculture is also rapidly growing in **Egypt**, where around 500 organic farms cultivate approximately 24,500 hectares of land. Although this is still a negligible proportion of the total agricultural area of the country, the potential for further growth is very high. Here too, development of the skills needed in organic farms is primarily met through NGOs such as the Egyptian Biodynamic Association (EBA) which provides regular training seminars, workshops, farm visits and field trips. The training materials are prepared, planned and introduced by an array of national and international experts working in the field, and by researchers in Egyptian universities and research centres. The EBA also offers farmers on-the-job training in the form of technical assistance and expertise during the successive stages of cultivation, especially on how to apply biodynamic methods. The technical support also covers farm management and documentation, areas in which competence is essential if farms are to meet inspection, auditing and accreditation requirements.

In **Uganda**, according to the National Organic Agricultural Movement (NOGAMU), 200,000 farmers are currently practising organic farming. NOGAMU has identified the skills needed to build capacity in the production and processing of organic products, and also the training needs for farmers and individuals interested in organic farming. The latter cover such areas of organic production as management of pests and diseases, soil fertility management, post-harvest handling of crops, weed management, and processing and marketing of products. NOGAMU offers a range of services in the areas of training, research and extension services. Uganda Martyrs University has offered an organic farming degree programme since 2005, targeted at applicants who have already undergone initial training in agriculture.

In **France** the Grenelle de l'environnement (Environment Round Table) has set targets for organic agricultural production as follows: 20 per cent organic production by 2012; 10 per cent of products certified as HVE (high environmental value) from 2012; HVE certification for 50 per cent of farms by 2012; and all secondary school farms to be HVE certified by 2012. It has also specified the introduction of modules on biodiversity, the environmental effects of inputs and soil function into secondary school farm curriculum, and stipulated that 20 per cent of farmers should be trained in new environmental techniques (e.g. low-input farming methods), also by 2012. The Grenelle measures are expected to lead to the creation of around 10,000 jobs in the agriculture sector by 2020, 7,600 of them in organic farming and in local supply. These policy measures will require higher skill levels on the part of both farmers themselves and those in associated occupations. For example, new technical skills will be needed in techniques for reducing the use of fertilizers and chemicals, and in understanding how to meet environment-friendly objectives in practice. Significant upgrading of existing training programmes will be necessary, and training trainers (there are 20,000 teachers in the agricultural school system) will be an important issue.

to the environment. The move to organic cultivation is driven not only by health concerns but also by the imperative to increase or at least sustain soil fertility and by new market opportunities. It is, however, important to note that the demand that drives the organic food market does not exist locally in developing countries; here, organic products are one of the main export commodities serving primarily external markets.

Most countries that are highly dependent on agriculture are ill prepared for the structural change brought about by a combination of green and economic factors, and are facing problems of rural poverty and a haemorrhage of population to the towns and cities without any clear solution, and specifically without any of the necessary skills provision. The most severely affected groups are poor small-scale farmers – but these are also the first to stop the excessive use of costly chemicals, which they often simply cannot afford, and to move on to new methods of farming (as reported in e.g. Bangladesh). Thus there is an increasing potential to reverse the exodus and halt the slide into further poverty through organic farming, integrated farming, biomass fuels, agrometeorology and other agricultural activities. Organic farming is considered much more labour intensive than conventional farming and thus may provide new income opportunities within rural communities. However, although organic farming normally generates 20–30 per cent more jobs than conventional farming, the impact on employment in developing countries is not so straightforward. In developing countries, switching from low-productivity conventional farming, where farmers often cannot afford pesticides and fertilizers, to organic farming sometimes involves adoption of new technologies which, over time, generate higher yields and better productivity with potentially lower labour input.

Box 4.3. Restructuring in agriculture: Moving into biofuel production

In the face of energy shortages and in the global rush for alternative energy solutions, a move from agricultural food production to biofuel on a massive scale is affecting both developed and developing countries in many regions. The emerging biofuel industry is growing fast and is estimated to be providing as much as 25 per cent of the world's energy by 2030. Biofuel production arguably helps reduce poverty by creating rural jobs and at the same time mitigates climate change. However, while there are certainly many benefits, among them income generation opportunities for farmers, additional electricity supply, diversification of energy sources, greater energy security and rural development, there are also costs that need careful consideration from the social, environmental, ethical and economic points of view.

The net energy benefits of biofuel production are still questionable: considering the entire fuel cycle and taking into account the use of natural gas, water and fossil fuels in biofuel production, overall the effect of biofuel use on total energy consumption is less positive than it may at first appear. The production process not only involves socio-economic costs (rising food prices, land appropriation and high energy subsidies from the public sector) but also risks causing environmental damage (deforestation, monocultures). A movement away from food production by crop diversion or land conversion is also problematic, leading to price rises not only in food but also in energy markets, where the higher costs of production can push up overall energy prices. Biofuel production is not entirely economically viable under current conditions and so is strongly supported by subsidies and protection mechanisms, which create price distortions on global markets and affect food security in various parts of the world. Even in Brazil, whose uniquely favourable conditions for sugarcane cultivation have made it the world success story of bioethanol production, sustained government support through direct subsidies was required until recently. The United States uses about 20 per cent of its maize crop to produce bioethanol, but only with the help of tax incentives and subsidies. The economies of scale involved in biofuel cultivation and the subsequent concentration of landholdings may also reduce smallholders' access to land. A recent (2007) UN-Energy report on biofuels concluded that the benefits to farmers are not assured, and may come with increased costs: "biofuel programs can also result in a concentration of ownership that could drive the world's poorest farmers off their land and into deeper poverty".

Turning agricultural land over to biofuels production does, however, create employment and income generation opportunities for those farmers who are forced to stop food farming for economic and environmental reasons. So, while biofuel jobs may not be truly green jobs for some time yet, pending further technological advances

and skills development, investments in biofuels and the related restructuring process should certainly be subject to balanced policies, thoughtful planning and careful management now. Retraining is important, both in restructuring from traditional agricultural crops into biofuel and in adapting to change within both fuel and food production.

Brazil is the world's largest producer of biofuels, thanks to its low-cost production of sugarcane which is responsible for more than 1 million jobs. Using about half its sugarcane to produce ethanol today, Brazil has the longest history of ethanol production (dating back to the 1930s). However, the expected further expansion of the ethanol industry will be accompanied by the mechanization of sugarcane production, which is expected to cause a major restructuring and downsizing. The Brazilian country study shows that the provision of timely retraining to sugarcane cutters to equip them for other jobs, as, for example, drivers, machine operators and maintenance workers, electricians, mechanics, beekeepers and reforestation workers, prevents their displacement and increases their employability in other capacities. Certainly, in Brazil, ethanol production created many jobs both directly in the industry and, through multiplier effects, more widely in the agricultural sector. However, here as in South Africa and other parts of Latin America, the industry is dominated by low-skilled migrant labour, and requirements for skilled labour are likely to increase as the industry grows. Therefore farmers and farm workers will need better skills to thrive in the new environment, and investment in biofuels should be integrated within a broader context of rural development and human capital formation.

In **Kenya**, the cultivation of jatropha (a type of succulent plant found in tropical and subtropical areas of Africa, Asia and America) for biofuel production has been judged not viable for smallholder farming, despite its promising potential and good reputation elsewhere. This is partly because of the current methods of cultivation (monoculture or intercrop plantation rather than natural growth with very few inputs), but mainly because of a lack of agronomic support, awareness raising and skills development, which has led to low levels of production and unpredictable profits. Skills matter in determining cultivation conditions, methods and inputs, and in assessing timeframes and profitability. In this context it is important to improve delivery of effective extension services to farmers, to raise awareness about negative aspects of jatropha such as toxicity and invasiveness, to improve research on the crop, and to ensure adequate skills development provision for jatropha farmers. A similar situation prevails in respect of other biofuel crops, with at least some of the negative consequences of cultivation susceptible to solution through training and awareness raising.

Sources:

UN-Energy, 2007: *Sustainable bioenergy: A framework for decision makers*.

World Bank, 2008: *World Development Report 2008: Agriculture for development*.

Brent D. Yacobucci and Randy Schnepf: *Ethanol and biofuels: Agriculture, infrastructure, and market constraints related to expanded production*, Congressional Research Service (CRS) Report for Congress, 16 Mar. 2007.

German Technical Cooperation (GTZ), 2009: *Jatropha reality check: A field assessment of the agronomic and economic viability of Jatropha and other oilseed crops in Kenya*. Nairobi.

Rural communities in coastal areas are also severely affected by restructuring. In Bangladesh, land-based farmers are moving into shrimp cultivation because of a labour surplus in agriculture and the need to seek higher incomes. There is an urgent need for retraining in sustainable and environment-friendly practices in shrimp production, processing and export.

Most of the country studies reported that the key to successful restructuring in agriculture lies in the efficient and timely provision of retraining to help farmers adapt to changing circumstances. This will enable them to apply new skills and techniques in converting and/or diversifying their income-generating activities.

In Europe, governments take a proactive role in leading green structural change in the sector, resulting in an increasing and accelerating demand for higher skills, as France and the United Kingdom reports stated. This would not be possible without the EU Common Agricultural Policy, which provides funding for the pro-environmental shift.

In Australia, restructuring of the sector is addressed through Agrifood Skills Australia, one of the country's 11 Industry Skills Councils, which assesses demand for and supply of skills and subsequently reviews the units of competency, the training packages required and the corresponding qualifications.

In the least developed countries (Bangladesh and Mali among those studied), the main support comes from international donors and NGOs, which try to provide job opportunities, particularly for women to help them become independent.

4.4.2 Restructuring in extractive industries and fossil fuel energy generation

The 2008 *Green jobs* report indicated that employment in global mining and quarrying experienced an average decline of more than 20 per cent between 1995 and 2005.²⁰ In Romania and Slovakia, employment in mining fell by over 50 per cent between 1996 and 2006, and in China and South Africa by over 30 per cent.²¹ In South Africa, total mining and quarrying employment declined from 603,000 to 398,000 between 1999 and 2005, while coal production grew by about 10 per cent over the same period. In the United Kingdom today there are about 5,500 miners, compared to 229,000 in 1981; some 4,000 former miners have found jobs retrofitting homes to make them more energy efficient, but about 100,000 remain long-term unemployed.²² Productivity gains and rising coal imports in Germany translate into a projected decline in employment from 265,000 in 1991 to less than 80,000 by 2020. Employment in the quarrying and mining sectors in China – the world’s largest coal producer – has also fallen steadily, with a total loss in jobs of 31 per cent between 1997 and 2002 as modern plants employ fewer workers per megawatt.

Employment prospects in the coal industry in Australia and South Africa are surprisingly good even in the light of the need to mitigate climate change, mainly due to a growing demand for energy, rising electricity prices and the construction of coal-fired power stations. South Africa’s vast reserves of coal have given it some of the cheapest electricity in the world, and 90 per cent of its electricity capacity comes from coal-fired plants. Australia is the world’s largest exporter of coal, shipping about 30 per cent of the world total, which generated an estimated US\$24.8 billion in export income for Australia in 2008.²³

Box 4.4. Restructuring in copper mining in the Philippines

In the Philippines, Asia’s biggest producer of copper in the 1960s and 1970s, the Philippine Associated Smelting and Refining Corporation (PASAR) was the target of a number of complaints about pollution-causing illnesses; it also had to meet the high costs of wastewater disposal, exacerbated by the obligation to comply with clean water requirements and standards introduced in the early 1990s. After going bankrupt and subsequently being privatized in the mid-1990s, PASAR invested in an environmental transformation programme involving the import of expensive pollution abatement facilities (e.g. acid plant to convert sulphur dioxide into sulphuric acid, dust-removing equipment and wastewater treatment facilities). The total environment-related investment reached around US\$50 million. The introduction of the pollution abatement facilities required the retraining of machine operators, which was provided by the foreign contractors who supplied the technology. It also prompted the company’s Environmental Protection Department to institute the environmental processes needed to acquire the ISO-14001 certification, which entails additional environmental training for employees.

²⁰ ILO: *KILM*, 5th edn (Geneva, 2007), available at: <http://www.oit.org/public/english/employment/strat/kilm/download.htm>. (accessed 1 Apr. 2011).

²¹ UNEP, ILO, IOE, ITUC: *Green jobs*.

²² Numbers of long-term unemployed coal miners from UK Department of the Environment, Farming and Rural Affairs and Trade Union Sustainable Development Advisory Committee; numbers of miners employed in home retrofits from UNEP, “Statement at the Governing Body of the International Labour Office’s 300th Session”, 12 Nov. 2007, available at: <http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=522&ArticleID=5704&l=en.m>. (accessed 1 Apr. 2011).

²³ Australian Coal Association, 2009: see http://www.australiancoal.com.au/the-australian-coal-industry_coal-exports.aspx (accessed 1 Apr. 2011).

Box 4.5. Restructuring in oil shale mining in Estonia

In Estonia, where 90 per cent of all electricity production is derived from shale oil, rising prices for crude oil on the world market have increased interest in alternative fuels, including shale oil and diesel fuels produced from shale oil. All shale oil producers in Estonia are therefore investing in the development and implementation of new, more efficient and more environmentally friendly technologies to increase the production of shale oil and products derived from it. These include environmental technologies needed to remediate the damage caused by decades of extensive and non-sustainable development of the energy sector, in particular the oil shale industry, in Estonia. Particular concerns are the rehabilitation of opencast mines, the protection of ground-water and air against further pollution with semicoke and ashes, and the neutralization of dangerous wastes.

According to an Estonian labour force forecast of 2009, the total number of jobs in the oil shale industry is estimated at approximately 1,850 and predicted to rise to 2,350 in 2016. The majority of the jobs predicted to be available in the sector in 2016 are for operators (1,200): the remainder are divided among managers (250), specialists (500), skilled workers (200) and unskilled workers (200). The qualification level of the workforce will remain unchanged until 2016: 54 per cent with secondary level qualifications and 38 per cent with tertiary level qualifications.

However, it is anticipated that mechanization and modernization of coal-fired power plants will translate into fewer jobs and lower demand for skills in fossil fuel energy generation in these countries too, presenting them with the challenge of responding to the dislocation of workers no longer required in the sector. In South Africa, the recent power crisis and increasing cost of the plants provides an economic imperative for diversification of the highly centralized energy supply, while in Australia, the question of managing the structural change imposed by the imperative to reduce GHG emissions is a critical one, given the importance of the energy and mining industries to the country's economy. New initiatives are changing the skills demand for the coal industry as pressure for restructuring grows.

Currently, most restructuring within the sector involves the introduction of sustainable production practices, energy and resource efficiency, new green technologies, clean coal, and carbon capture and storage. These changes require significant skills upgrading. The sectoral workforce is also expected to feed into the labour-hungry renewable energy sector, with associated needs for retraining.

4.4.3 Restructuring in the automotive industry

The traditional, fuel-intensive automotive industry has been in decline in the developed world since the 1990s.²⁴ Its global growth was sustained until 2007, mostly thanks to growth in production and sales in emerging markets. Thereafter the financial crisis hit the industry hard, and its worldwide production and sales dropped by 20–30 per cent. In the United Kingdom, the automotive manufacturing sector has been undergoing significant restructuring since the 1990s. In France, where automobile production fell by 9.3 per cent and its added value dropped by 15.4 per cent in 2008,²⁵ 8,000 jobs were lost due to falling production of the internal combustion engine in 2009;²⁶ a further 107,000 jobs in the French automobile industry could be lost in the drive to meet the target of a 30 per cent reduction in CO₂ emissions by 2020.²⁷

²⁴ J. Humphrey and O. Memedovic: *The global automotive industry value chain: What prospects for upgrading by developing countries?* Sectoral Studies Series (Vienna, UNIDO, 2003).

²⁵ Institut national de la statistique et des études économiques, *L'économie française, comptes et dossiers, Édition 2009. L'industrie automobile en France depuis 1950: des mutations à la chaîne* (Paris, 2009).

²⁶ Data from the sectoral committee for automobiles.

²⁷ Renner, Ghani-Eneland and Chawla: *Low-carbon jobs for Europe*, p. 7.

The few exceptions to this declining trend were concentrated in emerging markets (notably China and India).²⁸ Fewer cars are being sold, leading to factory closures and job losses. In high-income countries the industry is projected to continue on a downward trend or at best to reach a plateau, with growth expected to be confined to emerging economies.²⁹

A recent paper produced by the OECD envisages that higher prices for automotive fuels, driven by increasing demand for oil and policy interventions to reduce CO₂ emissions, are likely to require significant restructuring to realign production capacity with changing patterns of demand. This will accelerate the trend towards smaller, more fuel-efficient cars which command lower profit margins. Furthermore, the bulk of demand will be in the rapidly growing emerging markets where the demand for smaller cars is predominant.³⁰

The measures taken in response to the financial crisis include a number aiming to make the automotive industry more environmentally sustainable, such as tax and duty reductions for vehicles with lower CO₂ emissions, special tax incentives and other fiscal green measures to promote purchases of eco-friendly cars, subsidies for purchases of particularly energy-efficient cars, scrapping schemes for eco-cars and a pilot programme for the production of electric cars. These measures, varying combinations of which have been introduced in Australia, Belgium, the Czech Republic, India, Japan, Luxembourg, the Netherlands, Spain and Sweden,³¹ intensify restructuring processes already under way within the industry and create a need for retraining.

Low-carbon vehicles (LCVs), such as battery-powered, electric, highly energy efficient or rechargeable hybrid cars, offer the industry a new opportunity for weathering the recession and going on to future growth.³² Consumers are becoming increasingly interested in LCVs because of greater environmental awareness, environmental regulations imposed on vehicle production and incentives to purchase.³³ France estimates that about 250,000 jobs were directly created in 2008 by production of the Pacte automobile,³⁴ and that in all between 15,000 and 30,000 jobs will be created by 2025–30 as a result of electric and hybrid vehicle production. The Grenelle de l'environnement gives the least-polluting vehicles a competitive advantage through a yearly “bonus–malus” green disc system.³⁵ The bonus–malus scheme, by which cars with lower fuel consumption benefit from lower taxes, while higher rates are levied on high-consuming models, has made it possible to maintain around 5,000 jobs in the automotive industry.³⁶ The UK Government has also identified ultra-LCVs (ULCVs) as an area of economic and job growth in its Low Carbon Industrial Strategy.³⁷

²⁸ OECD: *The automobile industry in and beyond the crisis*, Working paper no. 745 (Paris, 2010).

²⁹ Ibid.

³⁰ Ibid.

³¹ Ibid.

³² NB: Although the emission levels of LCVs are much lower than those of conventional vehicles, all partially or fully electricity-dependent vehicles are only as green as the electricity supply they rely on (e.g. greener if from a renewable energy source).

³³ GHK for DBIS: *Identification of expertise and excellence in new industry and new jobs (NINJ) industrial technologies* (2009).

³⁴ <http://www.gouvernement.fr/gouvernement/le-pacte-automobile>.

³⁵ Grenelle de l'environnement, Summary report on discussions, Oct. 2007.

³⁶ Estimate by the Commissariat général au développement durable. Ministry of Ecology, Energy, Sustainable Development and the Sea (in charge of green technology and climate change negotiations), Annual report to the National Assembly on implementing France's commitments under the Grenelle de l'environnement, Oct. 2009.

³⁷ UK Department for Business, Innovation and Skills /Department of Energy and Climate Change: *The UK's low carbon industrial strategy* (London, July 2009).

The automotive industry tends to serve as a major employer in certain localities, so that plant closures have severe social and economic consequences for local communities. The role of regions in cushioning the effects of restructuring, including retraining measures, is very important, especially in the context of the current economic downturn (see box 4.6).

Box 4.6. Restructuring in the automotive industry: The role of regional institutions

In 2008, the **Poitou-Charentes region of France** invested in the technology required to produce cheap electric cars. The automobile industry is prominent in the region, with 2,801 companies and 13,478 employees working in the sector, 1,941 companies and 10,305 employees in sales and maintenance. A convention for securing professional pathways in the framework of a recovery plan was signed between the Heuliez group, the state, the region, the Union des industries et des métiers de la métallurgie and Bernard Krief Consulting in order to finance employee training and maintain jobs. Public authorities and social partners also joined in the effort to improve skills and staff employability. Social partners mobilized €50 million to fund remuneration for staff in training through their main training body, the Organisme paritaire collecteur agréé des industries de la métallurgie. In September 2009 Heuliez established a training plan, in close collaboration with the trade unions, within which training programmes were provided by the employer and partly financed by the region (maintaining salaries, training costs etc.). Training was offered to workers as an alternative to displacement. Although the skills required to produce electric cars are not widely different from those involved in the production of traditional cars, some adaptations have to be made: it was particularly important to upgrade skills in relation to electricity. In addition, the skills of most employees required upgrading more generally.

In the **north-east of England**, a new battery assembly plant for Nissan's electric vehicles is creating employment opportunities which require new skills from the workforce. The battery manufacturing facility is expected to create 350 jobs and potentially many more in the supply chain. Nearly half of the workforce (48 per cent) is at technician level and the skills are acquired through apprenticeship programmes jointly run by employers and further education colleges and funded for the most part by the state. The North East Regional Development Agency, or One Northeast, assisted skills projects aimed at factory workers for meeting the demand in the LCV design and production. One Northeast, through the North East Low Carbon Economic Area, built a strong skills base for LCVs in cooperation with employers, trade unions, public and private training providers, and research centres involving universities and businesses. For instance, the National Training Centre for Sustainable Manufacturing was a joint project run by Gateshead College, Nissan Motors UK, the NA Group (a private training provider) and One Northeast to build a state-of-the-art green collar training centre on a site adjacent to the Nissan car and battery plant. The centre will be equipped to retrain existing and train future workers on all aspects of ULCVs (manufacture, charging, storage and handling of batteries and fuel cells, and vehicle maintenance). It is expected that at least 60 businesses, including large manufacturers, supply chain firms and SMEs, will access the centre to obtain training for their staff at apprentice and higher level. The NA Group also collaborates with Nissan to offer a green collar pre-employment training course aimed at unemployed people seeking employment in the automotive industry.

Sources:

ANFA, *La branche des services de l'automobile: Convention-cadre de Financement de la sécurisation des parcours professionnels des salaires relevant du plan de reprise de Heuliez S.A.*, Sep. 2009.

<http://www.wk-rh.fr/actualites/detail/10418/des-fonds-d-urgence-debloques-pour-la-formation-des-salaires-au-chomage-partiel.html> (accessed 1 Apr. 2011).

Background country reports for France and Germany.

4.4.4 Restructuring in shipbuilding

As the demand for ocean liners declined with the emergence of the aviation industry and shipyards producing cheaper vessels, countries where the industry had played a major role (among those studied here, Denmark and the United Kingdom in particular) had to restructure their shipbuilding sectors. Between 1988 and 2007 Denmark's share of the global shipbuilding market fell from

3.2 per cent to 1.45 per cent and shipbuilding's share of total Danish industrial turnover from 2.33 per cent to 0.76 per cent,³⁸ with a drop in employment of around 40 per cent.

Shipbuilding and related marine engineering functions were refocused on offshore and on-shore renewable energy activity, including the construction, supply and maintenance of wind turbines and wave and tidal energy installations. Restructuring in this industry therefore involves retraining to equip workers for jobs in these other heavy industries.

Box 4.7. Restructuring in the shipbuilding sector in Denmark and the United Kingdom

The Lindoe shipyard in southern Denmark is due to be closed by February 2012, when all remaining employees will be laid off. The Confederation of Danish Industry fears that 8,000 jobs may be lost as a result of the closure. With a view to providing replacement jobs, offshore renewable energy was identified as one of the most promising sectors in terms of employment growth potential with a minimum of retraining needs. Lindoe is well equipped to undertake this shift by its existing facilities, which include docks, production and storage facilities, cranes and lifting facilities, and heavy transportation equipment.

The existing competencies of Lindoe's employees in functions such as welding, surface treatment and outfitting are also highly relevant. The actual skills response is still being planned, with the focus on retraining programmes at the public training centres and at the Lindoe Offshore Renewable Centre (LORC), which was established in January 2010 by major Danish companies in the energy sector, together with local, regional and national policy-makers, in partnership with the Lindoe Forum. Training and the continuing identification of skills needs in the offshore renewable energy sector are among LORC's main activities. Local municipal authorities took the formal responsibility for identifying skills needs in relation to Lindoe's employees through public employment services and followed this up by retraining for work in the offshore renewable energy sector.

Information gathered by LORC should be passed on to the public authorities as well as the vocational education and training system. In the local area there are currently no retraining activities on offer directly focused on employment in the offshore industry. However, the vocational training system is quite flexible, and when jobs start to materialize retraining programmes will be implemented accordingly.

Harland & Wolff Heavy Industries (H&W), one of the United Kingdom's largest shipbuilding companies, had to cut 2,400 jobs and diversify into offshore oil and gas markets at the beginning of the millennium. Using shipbuilding skills and experience in areas including not only shipbuilding but design engineering, ship repair and conversion, vessel recycling and recovery, and renewable energy technologies, H&W now produce a range of renewable energy products such as turbines for offshore wind farms and wave and tidal energy devices, as well as decommissioning ships at the end of their lives in an environmentally sustainable manner.

The restructuring process and the diversification strategy have led to a reduction in the workforce, partly because renewables projects have considerably lower work-hour requirements than shipbuilding. Reskilling and upskilling of workers were inevitable. Low-skilled workers such as labourers and mechanical fitters had to learn how to use new equipment through training provided by the equipment's manufacturers. A company-wide training programme also allowed their engineers and designers to update their knowledge of the new DNV classifications* and adapt to the classification codes, although the classifications for the design and construction of offshore wind turbines and offshore oil and gas platforms are very similar. In order to avoid skills gaps, H&W asked the trade union – which acts as an employment agency with a pool of temporary workers – to provide only workers who have been certified to the required standards. On occasion the company has funded a training course to recognize and certify the skills of workers who possess relevant experience but no required certification. They also subcontract skilled workers from engineering companies who have experience in the renewables sector. H&W have two wave power generators at the prototype stage, which implies new skill needs and need to develop skills further in this sector in the future.

*Classification set by DNV (Det Norske Veritas), an independent foundation whose core competency is to identify, assess and manage risk in the maritime environment. DNV provides specifications for offshore wind turbines. See <http://www.dnv.com> (accessed 1 Apr. 2011).

Sources:

The Lindoe Forum: *Udkast til Væksplan, 2010*, available at: <http://www.lindoeforum.dk> (accessed 1 Apr. 2011).
<http://www.lorc.dk> (accessed 1 Apr. 2011).

Claire Harrison, *Belfast Telegraph*, Monday, 2 June 2008.

³⁸ Data from the Danish trade association Danish Maritime's web page, available at: <http://www.danskemaritime.dk/uk> (accessed 1 Apr. 2011).

4.5 Industries with high employment potential

Green activities where demand is rising are likely to absorb some workers from declining industries. The reported environmental challenges are similar across all countries, dominated by the need to mitigate and adapt to climate change. This focus is resulting in a very strong emphasis on policies that promote the production and use of clean energy. This in turn is likely to have positive effects on employment in the related industries. The industries that will gain from this shift and the associated restructuring processes are summarized in table 4.3 and in the text below. A detailed analysis of changing and emerging skills and occupations in these sectors is provided in Chapter 5 (section 5.4).

Table 4.3. “Green” restructuring: Industries likely to gain and associated retraining needs¹

Industry	Employment effect	Type of restructuring	Countries affected ²	Training needs
Renewable energies: wind, wave and tidal power, solar, hydro, biomass, geothermal	Gaining, though job losses in solar expected in DEU	Absorbing workers from other industries	AUS, BGD, BRA, CHN, DEU, DNK, EGY, ESP, FRA, GBR, IDN, IND, MLI, PHL, THA, UGA, USA, ZAF	Skills upgrading: energy efficient solutions, management and entrepreneurship skills, incl. project management skills Retraining from manufacturing Retraining as engineers, installers, technicians, operation and maintenance specialists
Green building and retrofitting	Stable or gaining	Restructuring within construction industry and through the value chain (energy, suppliers of materials etc.)	AUS, BRA, CHN, DEU, DNK, EGY, ESP, EST, FRA, GBR, MLI, THA, USA, ZAF	Skills upgrading: energy efficiency, green technologies, new materials, energy auditing/certification
Transport	Stable or gaining; taxi drivers lose jobs as countries move to mass public transportation	Intra-industry restructuring	AUS, BGD, BRA, EST, FRA, MLI, UGA, USA	Retraining and skills upgrading into various public transportation jobs
Telecommunications	Gaining	Intra-industry restructuring	BGD	A target to cut CO ₂ emissions by 30% by 2015 Skills upgrading for new green technologies (including renewable energy power generation network facilities) (Re)training of network engineers and technicians
Recycling and waste management	Gaining	Intra-industry restructuring	BGD, BRA, CHN, DEU, EGY, MLI, PHL, USA	Retraining from waste collection to recycling; skills upgrading in methane and energy recover
Water	Gaining	Intra-industry restructuring	ESP, EST, FRA, IND, USA	Skills upgrading: water resource management, water conservation and efficient use, wastewater treatment

¹ This table is not exhaustive: it does not take into account information from other sources.

² AUS = Australia, BGD = Bangladesh, BRA = Brazil, CHN = China, CRI = Costa Rica, DEU = Germany, DNK = Denmark, EGY = Egypt, ESP = Spain, EST = Estonia, FRA = France, GBR = the United Kingdom, IDN = Indonesia, IND = India, KOR = Republic of Korea, MLI = Mali, PHL = Philippines, THA = Thailand, UGA = Uganda, USA = the United States, ZAF = South Africa.

Source: Authors. Based on the information from country reports.

4.5.1 Renewable energy

Renewable energy is the sector reported by all countries studied as one of those with the highest potential for employment and for the creation of jobs.

According to the American Solar Energy Society (ASES), in the United States wind energy alone accounted for 17,300 jobs directly and 39,600 overall, including indirect and induced effects, in 2007. The ASES also created three scenarios predicting the growth of the US renewable energy industry up to the year 2030. The three scenarios, labelled advanced, moderate and base, predicted the creation of 7,328,000, 2,846,000 and 1,305,000 jobs respectively. The report indicates that under the assumptions of the advanced scenario the wind industry alone would create nearly 1,040,000 jobs (257,000 in the moderate scenario and 66,200 in the base scenario).³⁹ In Europe, estimates for total employment in the wind energy sector indicate over 108,000 jobs across Europe in 2007.

In Australia, over 1,200 people are currently permanently employed in the operation and maintenance of clean energy facilities, which also support over 7,300 indirect jobs. The country study further indicates that over 2,400 jobs are likely to be created by existing, committed and planned clean energy projects, with a further 25,000 jobs being generated indirectly and in associated construction by 2020. In Germany, renewables are expected to create between 400,000 and 500,000 jobs, both directly and indirectly, by 2020. Similar numbers are expected in the United Kingdom by 2015. France anticipates 316,000 new jobs by 2020. In the Republic of Korea, the ambition is to create 950,000 new jobs by 2030. In South Africa, 150,000 direct and indirect new jobs are expected by 2020.

The high employment potential of renewable energy is not restricted to high-income countries and emerging economies but also applies to developing countries. There the potential is especially strong where the central electricity grid does not extend to rural and remote areas, so that off-grid electricity generation solutions using renewable energy technology are already economically viable.

Table 4.4. Estimated employment potential in renewable energies in selected countries: Projected job creation by 2020 (unless otherwise indicated)¹

AUS	BGD	DEU	DNK	FRA	GBR	IND	KOR	USA	ZAF
27,400 new jobs	100,000 new jobs in solar energy in 2009	400,000–500,000 new jobs	10,000–20,000 new jobs by 2015	316,000 new jobs	410,800 potential new jobs by 2015	100,000 trained personnel for solar by 2022	950,000 new jobs by 2030	1,305,000–7,328,000 new jobs by 2030	150,000 new jobs

¹ The information in the table is indicative only. The methods of calculation differ across countries and are not entirely comparable. AUS = Australia, BGD = Bangladesh, DEU = Germany, DNK = Denmark, FRA = France, GBR = the United Kingdom, IND = India, KOR = Republic of Korea, USA = the United States, ZAF = South Africa.

Source: Based on the information from country reports.

³⁹ Roger Bezdek: *Green collar jobs in the U.S. and Colorado*, American Solar Energy Society, Jan. 2009.

Across the globe, the pace of both private and public investment in renewable energy businesses, and the changing regulatory environment, indicate substantial growth potential. The sector is, however, heavily dependent on subsidies and this makes its position very vulnerable. In Germany a well-established renewable energy sector (worth 1.8 million jobs), with prospects for a further expansion of the market as a result of policy decisions, may find itself compelled to restructure. Rapid growth in solar photovoltaic (PV) generation has led to excess supply and a big drop in prices in recent years. The price decline in turn has resulted in considerable financial losses and enormous additional costs to the Government in implementing the Renewable Energy Law, which fixed the feed-in tariff at a high level. The consequent cut in subsidies will probably lead to production being outsourced to China and consequent job cuts, especially in eastern Germany, where the solar sector has been established as a major industry. Policy-makers missed the opportunity to attach conditions to the subsidies and now a correction of former development seems unavoidable. The solar sector is thus likely to experience a restructuring process with a shift away from production and towards more knowledge-intensive work.

The jobs created in renewable energy have the potential to absorb redundant workers from many other sectors. For instance, in the United States companies involved in wind energy generation are expected to retrain and re-employ many workers displaced from the construction sector in the wake of the housing boom. Manufacturing jobs in the wind industry require knowledge similar to that used in automobile assembly. Growth in wind energy could also help counteract the unemployment seen as a result of the recession's effect on the manufacturing base in the Midwest.

4.5.2 Energy efficiency

Well over half of the countries studied (Australia, Brazil, China, Denmark, Egypt, Estonia, France, Germany, Mali, South Africa, Spain, Thailand and the United States) estimate very high employment potential in energy efficiency improvements in the energy-hungry commercial and residential building sector. The building sector ranks high in terms of both energy consumption and CO₂ emissions (in the United States it is estimated to account for 40 per cent of both). The construction sector has also been severely hit by the current economic downturn. The employment potential in energy efficiency and green building therefore implies considerable restructuring within the construction sector.

A study in 2009 by the Washington State (US) Employment Security Department identified four core areas of direct green employment in construction: energy efficiency, renewable energy, pollution reduction, and pollution clean-up and mitigation.⁴⁰ The Australian country report points out that the situation is likely to be similar in most developed economies: buildings have been identified as a dominant consumer of emissions-intensive electricity generation, and accordingly initiatives have focused on performance measurement of commercial and residential buildings and on energy-efficient design and construction.

⁴⁰ 2008 green economy jobs in Washington State (Olympia, WA, Washington State Employment Security Department, 2009).

Box 4.8. Retraining existing skilled craft workers as photovoltaic installers in the United States

The PV industry has been a major focus of renewable energy initiatives by US policy-makers since the turn of the century. In recent years the growth rates of residential installation have increased exponentially nationwide, and even more steeply in those states with aggressive green legislation. At a federal level, the American Recovery and Reinvestment Act includes an allocation of US\$40 billion for energy efficiency and renewable energy programmes, a large proportion of which is going into the PV industry. The American Solar Energy Society estimates that this public funding will generate a demand for photovoltaic installers amounting to between 200,000 and 700,000 jobs. A substantial investment in training of PV installers will thus be necessary to meet the growing demand. This presents an opportunity for existing skilled craft workers such as electricians, line workers, roofers, and heating, ventilating and air-conditioning workers to expand their skill set to include PV installation. In the short run, as a result of the housing bubble bursting, there is at present a surplus of these workers available to meet the industry's growing demand; in the long run, however, it will be necessary to focus on providing complete training in PV installation for people with no experience in relevant fields.

A wide variety of trade organizations is working with the Federal Government on standards and programmes for training, certification and licensing of PV installers. For example, a partnership programme between the Department of Labor and Education and the Department of Energy called the Solar Instructor Training Network was launched in October 2009 to set up a network of training centres for solar installation across the United States. These efforts will also ensure that there are sufficient trainers and installation instructors in PV technology and disseminate the best industry training practices.

Translating the potential of both renewable energy and energy efficiency into production and employment growth will depend heavily, at least initially, on consistent policy support and continued technological innovation. In developing countries it will also depend on successful technology transfer, which is still limited. Where technology transfer has occurred alongside an opportunity to produce technological goods and spare parts and an efficient training component for production, maintenance and sale of green technology goods, the impact on both economic growth and employment has been positive (an example is the work carried out by the NGO Grameen Shakti in Bangladesh: see box 5.8 in Chapter 5). Such initiatives are especially successful when they take place in conjunction with local economic development and microfinance projects, since poor people in less developed countries cannot afford green technology equipment without such assistance.

4.5.3 Other industries

Other industries which are likely to have a positive employment outlook and be able to absorb part of the workforce from declining economic activities are public transport, recycling and waste management, and water management. Recycling and waste management have a high employment potential (see also Chapter 5, section 5.4), especially in developing countries, but the quality of jobs in this sector is often poor. These jobs will need to fulfil the requirements of decent work before they can be considered green. In Bangladesh, telecommunications is another growing sector which is going green, with targets for significant CO₂ emission cuts.

Box 4.9. Improving public transport in Uganda

The Ugandan Government is implementing a plan to remove motorcycle taxis (bodaboda) and commuter taxis from the streets of Kampala and introduce a city bus service. The aim is to reduce congestion in the city and cut down emissions, since each bus can carry more people than a commuter taxi. So far a couple of bus routes have been established linking the city centre with the major suburbs of Mukono, Bweyogerere, Gayaza, Luzira and Entebbe. The number of buses is still low relative to the numbers of people needing to travel, especially at busy times of the day. Nevertheless, even this level of provision has created competition and forced some commuter taxi owners to abandon routes served by buses. The Government has encouraged taxi owners to set up cooperatives and purchase buses; it has also encouraged the remaining taxis to switch to routes not covered by the bus service to reduce congestion. Many of the workers who lost their jobs when buses were introduced have become ticket-sellers and conductors. The commuter taxis' main organization, the Uganda Taxi Operators and Drivers Association, has taken the initiative in opening up other income-generating opportunities for drivers who have lost their jobs, such as buying up large areas of land and making them available for farming. There is no relevant training on offer to those people whose livelihood is based on motorcycle and commuter taxis and, once buses are fully operational in the city, they may have to relocate to other areas.

4.6 Retraining and skills upgrading

Apart from the growing renewables industry, where restructuring involves retraining workers absorbed from other industries, most industries experience restructuring as an internal process. Here too, of course, workers may need to be retrained for new occupations as a result of shifts within the industry. In all growing industries, however, there is a need to upgrade skills within jobs, and this type of training is widely practised.

Most countries report that increased demand for green jobs, at least in the short to medium term, is expected at all skill levels, but that demand for labourers and skilled workers is particularly strong and is growing most rapidly. At the same time, skills upgrading is expected to form a significant part of restructuring within industries to meet the new demands for greener practices in production and services.

While a number of sectors are declining as a result of green structural changes, among other reasons, hardly any skills are becoming entirely obsolete. The country studies unanimously confirmed that even where certain activities or tasks cease, for example when production of certain materials is banned for environmental reasons, skills related to those tasks do not become redundant but can be applied, sometimes by the same individuals, in other sectors and occupations, provided skills are upgraded as necessary.

Not only is skills upgrading a priority in meeting the demands of restructuring within industries, it is also a key element of retraining. What is needed across all industries and sectors is a large pool of workers well informed on green issues and in possession of enhanced skills and capabilities in new, cleaner and greener production processes, goods and services, including knowledge of green technologies for installation, operation and maintenance. To this end, efforts are best concentrated on using the available skill base as much as possible and grafting on to it the new and complementary skills that are required. In this context, the presence of foundational skills becomes of pre-eminent importance.

The skill base of jobs relating to environmental products and services differs greatly across sectors. In the EU, while the proportion of people without a learning certificate is 42 per cent in waste management (waste collection and handling and recycling pick-up tasks), it is only 1 per

cent in eco-consulting.⁴¹ (On the skills situation in waste management see also Chapter 5, box 5.5.)

Countries with a shortage of skilled workers in the national labour pool will find it harder to make the most of growth and employment prospects in the new green industries. From this perspective it is important that countries address the overall level of their skills base. Those countries with high levels of educational attainment are better prepared to cope with structural change in the economy, whether driven by greening or other factors.

The Indian country report, for example, recognizes that if the country is to make the best use of emerging employment opportunities, while also minimizing the social costs and dislocation associated with restructuring, it is of critical importance to address the level and quality of skills that the nation possesses. An oversupply of highly skilled workers may also impede efficient restructuring and cause unemployment. In the Republic of Korea, for instance, many environment-related jobs require only low levels of skill and offer only a poor working environment, and so do not attract skilled workers. The country suffers from an oversupply of highly skilled workers qualified for jobs where demand is currently low, and an undersupply of semi-skilled and skilled workers with specialist technical and vocational skills in areas where demand is high.

Retraining and skills upgrading are likely to become more important in both developed and developing countries not only because of the pace of change in technology and innovation but also as a result of demographic trends. In developed countries – the EU states, Australia, the United States – and also in the Republic of Korea, the focus will be on upgrading the skills of an ageing workforce. In many developing countries, on the other hand, where the working population is weighted towards the younger cohorts, the challenge will be twofold: to strengthen the provision of initial education and training, including universal primary education, and to (re)train the existing young workforce to help them keep up with structural change and new skills demands.

In the context of the economic crisis that has afflicted many parts of the world since 2008, with a growing pool of skilled, semi-skilled and unskilled labour, the imperative to retrain for emerging jobs is particularly acute. For example, Spain reports considerable growth of interest in training courses related to green-collar work since economic conditions began to worsen after 2007. These circumstances pose a twofold challenge: first, to achieve better coordination of the bodies involved in training; and second, to identify which sectors can most realistically and appropriately be targeted as destinations for the labour requiring retraining.

Most of the jobs lost in the recession of 2008 and after were in the male-dominated manufacturing and construction industries, and so the rise in unemployment has been disproportionately marked among male workers. This phenomenon is sometimes referred to as “manception”. In fact, men have always been overrepresented in highly cyclical sectors and that is why historically they have been hit harder than female employees by recession. It is therefore fairly common for stimulus packages in technology-related and manual occupations to offer more employment opportunities for men than for women. At the same time, women’s access to these jobs tends to be limited by their low participation in science and technology education and in technical and vocational training (for more on the gender implications of skill needs in the green transition, see Chapter 5, section 5.5). The transition to a low-carbon economy offers an opportunity to redress existing inequalities, such as gender segregation of occupations and exclusion of disabled people, minorities and disadvantaged young people from the labour market. To this end, training measures need to be targeted and accessible, and linked to more complex affirmative action projects. A

⁴¹ Cedefop: *Future skill needs for the green economy* (Luxembourg, 2009).

proactive approach is required, drawing on public, private and civil society sector initiatives and pursued through partnership.

In South Africa, formal programmes to help displaced workers to find new employment are not uncommon when bigger organizations restructure. These programmes typically result from consultation and negotiation between businesses, trade unions and workers and include personnel counselling, financial counselling, job matching and career counselling, further training and entrepreneurial development. The Government has also focused strategies and training programmes on developing portable skills, empowering workers to transfer their skills across industries and sectors, thus diminishing the risk of unemployment.

Core skills are especially valuable in improving employability and will accordingly need to become an integral component of retraining. Such skills are portable across occupations and sectors, and therefore equip individuals with a certain level of employment security. Core skills are considered lacking among the workforce in both developed and developing countries, but more acutely in the latter, and especially in the least developed countries, where education and training systems often do not provide even the basic foundational skills. (For more on core skills, see Chapter 5, section 5.3.)

Retraining will be necessary to equip workers displaced from declining sectors to take up employment opportunities in occupations created by the growth of the green economy. Most of the countries studied agreed green restructuring would have the most severe impact on people with low and medium levels of educational attainment, notably those in occupations directly linked to agricultural and manufacturing production.

Retraining needs may be specific to sectors or to particular occupations. Retraining for new green jobs may be preferentially directed at those who have lost jobs in similar sectors of the labour market or whose existing skills and abilities overlap substantially with those required in the new jobs. For instance, it has proved to be fairly simple to find an adequately skilled workforce for biofuel production in the Philippines because the processes used in ethanol distilleries are similar in many respects to those used in sugar milling. Similarly, many of the skills required for operating cogeneration machinery in, for example, South Africa are transferable from the mining sector and from heavy industry more generally.

The feasibility of retraining in any particular instance depends on the characteristics of both the existing and the potential job. In some cases retraining may be comprehensive, as in the retraining of bricklayers as solar panel installers within the construction sector. The restructuring process within this sector has the potential to assist the development of the renewable energy sector by providing labour already equipped with some of the skills required, such as electricians, plumbers or installers and especially solar panel installers. Certain technical skills are needed to ensure correct handling of PV and thermal solar panels, but these can be learnt relatively quickly through training courses.

In this context Spain has interesting sector synergies which could reduce skills gaps and ease training responses. The construction sector, automotive industry and renewable energy enjoy such synergies, for example, with electric vehicles requiring increased power production and buildings becoming a usual location for solar energy generation. An integrated approach to retraining and outplacement could help to close skills gaps. The case study of Mali provides another example, with a strategy to integrate energy and transport with agricultural production. It seems that, in seeking growth in green jobs within the restructuring context, countries are looking for institutional mechanisms and other solutions that go beyond sectoral arrangements.

Most countries agree that short, intensive vocational training courses, tailored to the specific needs of employers, are the most successful way of delivering retraining for specific new job

opportunities. Such retraining has to occur locally, in rural areas if this is where the jobs are: ideally, it should be linked to the job opportunity and should not detach participants from existing work or from the job market. For instance, in rural areas it is even more difficult for women than for men to participate in training outside their local village. Thus there is a need for local training facilities, including trained trainers and teachers. The Philippines country report refers to the import of a green technology that is not yet available in the domestic market: this means either sending Filipinos appointed to manage and maintain the technology overseas for training or importing foreign experts to train Filipinos in its use.

4.7 Effective and equitable restructuring: Good practices by public and private sector actors

Effective public policies and socially responsible private sector actions can minimize negative consequences of structural change in the economy. This section discusses examples of good practice in restructuring, particularly of skill-related measures, implemented at different levels – national, regional, sectoral and enterprise – and delivered through different channels – via government-supported services, trade unions, employers’ associations, sectoral skills councils, NGOs, public–private partnerships and training institutions, as well as collaborative efforts.

The effectiveness of restructuring measures in any country depends on many factors, including its institutional and fiscal arrangements and the relative prominence of the informal economy. Consequently, even the most outstanding examples of good practice are not necessarily transferable from one country to all others. Certain practices are good only in certain contexts and might not be relevant for other countries. At the same time, certain prerequisites for equitable and effective restructuring – a mix of different policy measures and the presence of certain institutional structures and mechanisms – create a favourable environment. We hope, therefore, that the following discussion can serve to inspire if not to instruct in specific detail.

4.7.1 Government-supported services

In many cases, government support to workers and enterprises in the process of restructuring will be essential. The elements of the ILO Just Transition framework include guidance for enterprises shifting to more sustainable development modes, with an emphasis on constructive social dialogue to ease social tensions, encourage cost-sharing and achieve effective allocations of resources.⁴² Workers and groups adversely affected by the transition need adequate protection through, for example, proactive labour policies, income guarantees, retraining and capacity building; attention also needs to be focused on the nurturing of entrepreneurship and investment in diversifying local economies and creating new jobs. One primary role of government-supported services in this context is to ensure equal access of all demographic groups, and especially the disadvantaged, such as people with disabilities, young people, ethnic minorities and the low-skilled, to productive and good-quality jobs. Public programmes need to take into account the ways that gender exacerbates existing patterns of disadvantage or discrimination and then take steps to promote gender equality.

⁴² The ILO Just Transition framework calls for workers’ rights, decent work, social protection, social dialogue and sustainable businesses (UNEP, ILO, IOE, ITUC: *Green jobs*).

A number of interesting experiences have been collected through country and case studies. For instance, in India the National Rural Employment Guarantee Act of 2005 introduced a job guarantee scheme that provides a legally binding guarantee of 100 days of employment in every financial year to adult members of rural households below the poverty line willing to do public manual work at the statutory minimum wage of 60 rupees per day. The scheme offers the unskilled workforce job opportunities, although some of the work on offer is criticized as mere drudgery. Discussion is under way on ways to improve the scheme to provide better-quality jobs. The scheme has a strong natural resource management component and has recently included afforestation projects. People (both men and women) employed through the scheme to plant and preserve trees acquired their skills either through traditional channels or through informal training in the field.

In South Africa, the Expanded Public Works Programme (EPWP) has provided over 1 million work opportunities since its inception in 2004. The EPWP focuses on infrastructure, economic, social and environmental programmes. The environmental section deals with important ecosystem functions and provides training to all types of employees. The programme particularly targets vulnerable population groups.

Box 4.10. Jobs created by “Working for Water” through the Expanded Public Works Programme in South Africa

The “Working for Water” programme 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 South Africa’s water security and the sound functioning of natural ecological systems by diverting enormous amounts of water from more productive uses. Integral to the programme are the development of people as an essential element of environmental conservation and the provision of sustainable, decent jobs. Short-term contract jobs are created in the clearing activities, with the emphasis on endeavouring to recruit women (the target is 60 per cent), young people (40 per cent) and people with disabilities (5 per cent). The programme provides various jobs, including:

- Working for Water contractor
- chainsaw operator
- brushcutter operator
- herbicide applicator
- plant identification
- health and safety representatives, peer educators, first aiders.

Thailand, like many other developing countries, points to the role of line ministries in providing support for those affected by economic restructuring. Here the Ministry of Agriculture has organized training courses for rural farmers in how to produce and use bio-fertilizers based on renewable organic material rather than on chemicals or oil, and the Department of Alternative Energy Development and Efficiency has adopted an action plan to train people who have lost jobs in rural areas in the production, installation and maintenance of alternative energy sources (making biomass, and installing and maintaining solar, hydro and wind energy technology).

In Denmark, the flexicurity model mentioned in section 4.2 above and the comprehensive coverage of vocational training programmes have supported the occupational changes consequent on several phases of restructuring and will continue to play a significant role in “green” restructuring. The success of these arrangements has much to do with the tripartite governance

mechanisms in operation here, which make the training programmes very responsive to changes in the labour market. Without such efficient collaboration between public services, businesses and workers through career guidance and job matching linked to retraining, the model would not increase employment security by easing transitions between jobs. In addition, the short duration and the adaptive character of the training programmes allow any individual's training to be tailored to the acquisition of competencies necessary to fulfil specific new functions in the labour market. The training certification furthermore counts towards credit in the ordinary skills development system.

In France, a tool used by an increasing number of companies to accompany staff retraining and redeployment is the validation of experience procedure (VAE).⁴³ This allows any person in the active workforce to earn a partial or full credit towards a diploma, vocational certificate or other professional qualification on the basis of his or her working experience. This can be a remunerated or volunteer experience and must last at least three years.⁴⁴ The VAE system has been implemented across a number of companies undergoing restructuring in sectors affected by major employment shifts, particularly in the automobile industry. France is also working on a fully fledged skills development strategy, drawing on the work carried out by the sectoral committees of the Mobilization Plan for Green Jobs and including actions related to restructuring. The Government announced that €369 million would be dedicated to training for green jobs.

Plant closures and mass lay-offs in consequence of structural changes can have devastating effects on regions and localities. This is particularly true when the closure or lay-off is very large, dislocating thousands of workers, or where the community is relatively small and the enterprise is the major or only employer.⁴⁵ In such circumstances, the speed with which the community can react to the structural change has a direct impact on the local economy and the well-being of the population. Early warning mechanisms, including labour market information on changes in demand and supply of skills, and rapid response in readjustment services for dislocated workers, are crucial to a successful response. For this to happen, it is essential that national and local governments and agencies work closely together and in conjunction with employers and trade unions. Meaningful response also requires a well-developed vision of local economic development and active labour market measures linked to new job and business opportunities.

Regional economic planning, and coherent retraining and social measures, are crucial in mitigating the consequences of structural unemployment. Regional-level public-private partnerships have proved very successful in economic restructuring. The comparison across EU countries set out in the European synthesis report revealed that regions are increasingly important actors in identifying skill needs and in organizing the provision of training relating to green jobs.⁴⁶ This can be seen especially in France, Spain and the United Kingdom. The autonomous regions in Spain have been proactive in identifying skill needs for new green occupations and the greening of existing occupations. In particular, the Extremadura and Navarre regions have both been cited as "front runners" in this respect, and are regularly approached for advice on the development of training responses. The experience of Navarre in organizing a major expansion of training provision for the renewables sector is especially noteworthy (see box 4.11).

⁴³ Law no. 2002-73 of 17 Jan. 2002 relating to social modernization.

⁴⁴ Cedefop: *Vocational education and training in France* (Luxembourg, 2008).

⁴⁵ Hansen: *A guide to worker displacement*, update 2009.

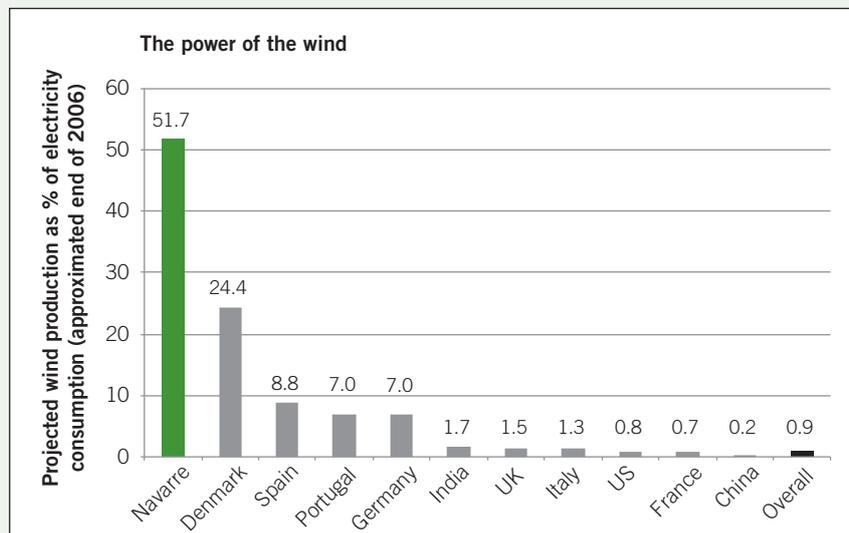
⁴⁶ http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_143855.pdf (accessed 1 Apr. 2011).

Box 4.11. Green restructuring in Navarre: A successful shift to renewable energies

In the 1980s and 1990s, the Spanish region of Navarre suffered from a severe economic downturn when high oil prices impaired the competitiveness of its single large industrial employer, a Volkswagen car plant. Unemployment soared to a peak of 13 per cent in 1993. The regional government responded with active industrial policy measures, including worker retraining, to expand the renewable energy sector. A rapid and successful development of a wind power industry followed, facilitated by the favourable geographical and climatic conditions of the region alongside a clear corporate and public strategy. The region expanded the share of its electricity production derived from renewable sources to 65 per cent, with an eventual target of 100 per cent. This small region of Spain, with a population of just 620,000, is now Europe's sixth largest producer of wind power.

From 2002 onwards Navarre has been implementing its Environmental Training Plan. In cooperation with the Confederation of Entrepreneurs of Navarre and the Navarre Industry Association, the regional government identified the main skills shortages in the region through a project entitled "Strategic talent in the renewable energy sector", and on the basis of its findings set up CENIFER, a public training centre for renewable energies, which became a major training provider for the sector. In 2006, the country's first graduate programme for electrical engineers in wind and solar electricity was launched at the Public University of Navarre.

Between 2002 and 2006, employment in renewable energies across Navarre increased by 183 per cent. In 2007 alone, 100 companies and over 6,000 jobs in renewable energies were created. Unemployment dropped to 4.76 per cent. Even in the economic and employment downturn of 2009 Navarre maintained the lowest unemployment levels in Spain. This achievement bears witness to the success of a policy mix which incorporated environmental and skills measures in a proactive response to an economic crisis with a view to long-term dynamic development.



Sources: D. Fairless: "Renewable energy: Energy-go-round", in *Nature*, Vol. 447 (2007). Reproduced with permission from Macmillan Publishers Ltd.

Gobierno de Navarra: *Navarre: Renewable Energies*, 2009.

Figure: US Department of Energy.

Box 4.12. Aquitaine: A prominent role in restructuring plans for regional authorities

The French region of Aquitaine provided funding for employee training in the automobile engineering company First Aquitaine. A German industrial company took over a former Ford Aquitaine site with plans to diversify its activities into wind energy. The region's first priority was to increase employee competencies by upgrading skills in traditional automobile industry occupations (e.g. welders and electricians). The second step will be training staff for wind turbine production, which begins in 2011. Following the restructuring plan, in which the regional authority has been prominently involved, the region looked at the potential for creating an eco-parc that would gather together companies involved in renewable energy, including production of wind turbines, blades and solar panels. The project was recently adopted, and already the job creation potential is estimated at 2,000. The eco-parc will include a training centre focusing on wind energy and eco-construction.

It is difficult to overstate the importance of public employment services (PES) in socially responsible restructuring. They offer many services to jobseekers, employers, and workers in enterprises undergoing restructuring, among them initiating and/or facilitating the creation of early warning systems and rapid response committees, performing counselling and job matching functions based on labour market information, and implementing labour market measures. In Spanish regional success stories, such as that of Navarre described in box 4.11, national and regional PES played an important role in identifying potential employment trends and related skill needs and providing training at a local level. Active labour market measures delivered through the PES network, including education and training responses to industrial restructuring, are well developed in all EU Member States and in the United States, where they are used, especially in the United States, to foster green jobs and related training.

Box 4.13. The US round table on “Strategies for Including People with Disabilities in the Green Jobs Talent Pipeline”

In December 2009 the Office of Disability Employment Policy (ODEP) in the US Department of Labor hosted a round table, in conjunction with the National Technical Assistance and Research Leadership Center, entitled “Strategies for Including People with Disabilities in the Green Jobs Talent Pipeline”. The event brought together experts to develop recommendations to ensure that opportunities to train for and gain work in the emerging energy efficiency and renewable energy sectors are open to people with disabilities and to identify promising federal, state, regional and local mechanisms by which people with disabilities can be encouraged towards these green jobs. The findings of the round table and the active steps it identified are being used to provide guidance to the nation'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 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.

Source: <http://www.cvent.com/EVENTS/Info/Summary.aspx?e=05f55e59-f803-42a4-820b-98d10cf55ece> (accessed 1 Apr. 2011).

Active labour market measures in developing countries are still limited and often subject to funding availability and capacity development in the PES network. But there are examples of these measures being particularly focused on training for green jobs. In Mali, the National Agency for Employment (ANPE) has been active in job creation in sectors of the economy, in particular agricultural sectors, with the potential for direct or indirect greening as well as expanding employment opportunities. One example is the cultivation of jatropha, often used for biofuel production, where the focus is on creating jobs for young people in rural areas; another is support for fisheries, with the reforestation of river banks to prevent erosion and reduced water levels, thus protecting fish stocks. For this and other activities ANPE provides special kits, with all the necessary tools including training.

4.7.2 Trade unions

There are numerous examples at both national and international levels of unions taking a proactive position and even a leadership role on the issue of combating climate change and mitigating the costs of transition to a low-carbon economy. Such a proactive stance is not only conducive to a socially responsible restructuring process but also stimulates sustainable growth. Involvement of workers in the restructuring process encourages the adoption of measures which target pro-environmental change at workplace level with respect to equity, workers' rights and access to retraining. However, when industries face a major employment challenge, such as new competition or restructuring pressures, unions in these industries sometimes adopt a defensive position, seeking to protect industry conditions and employment. Such an approach may slow down, delay or postpone responses to climate change. What is preferable is the promotion of pro-employment transitions to a greener economy described in many of the examples above.

In South Africa trade unions play an important role in the identification of retraining needs. They are often the only common denominator between declining and emerging industries and therefore are well placed to play a role in coordinated skills development and retraining. They

Box 4.14. Australia's Construction, Forestry, Mining and Energy Union takes the lead in transition to a low-carbon future

In Australia, the Construction, Forestry, Mining and Energy Union (CFMEU) has taken a proactive stance on climate change policies in relation to its industries and workers. The CFMEU is balancing its commitments to reduced greenhouse gas emissions and the welfare of its workers by advocating the deployment of carbon capture and storage (CCS) technologies. It has enlisted the support of the Federal Government, which has committed 100 million Australian dollars (AUD) in funding for the Global CCS Institute (established in September 2008), with the objective of commercializing and deploying CCS technologies. CCS represents a new industry stream with new skill demands. CCS plants will be vastly more sophisticated than conventional coal-fired power stations. It has been estimated that less than half the engineers with the skills and experience needed to build and run CCS power stations are yet available. For instance, the CCS Zerogen project will cost AUD 4.3 billion and involve 2,000 construction jobs. The pipeline construction tasks associated with CCS will also involve new skills and new jobs. The civil construction industry will have to upskill and retool to do the work. At this stage it is difficult to quantify the likely employment shifts and overall employment effects, bearing in mind that CCS is highly capital intensive. The potential skill implications will depend on the speed at which CCS is adopted. It is, however, clear that CCS will have a significant impact on the Australian mining industry, and that both miners and mining unions are actively taking up the challenge.

are also well linked into government policy-making and target-setting processes with repercussions for the country's labour market.

Major Danish workers' organizations – notably the Danish Confederation of Trade Unions (LO), the Danish Metalworkers' Union (Dansk Metal) and the union for unskilled workers (3F) – have publicly tried to draw attention to the implications of economic greening for employment and job creation. The debate became particularly intense when the closing of the last big shipyard in Denmark, Lindø Skibsværft, was announced in 2009, to take effect in 2012. Union representatives advocated that the shipyard be turned into a knowledge, innovation and education centre for green technologies and jobs. The Danish Engineering Confederation and the LO have hosted a number of events with a focus on climate change to discuss the impacts on engineering and other professions. Dansk Metal and 3F have called for actions to stimulate job creation in clean technologies and other green areas with growth opportunities and to support the retraining their members may need to qualify for those jobs. Dansk Metal have developed specific recommendations which they estimate would create up to 50,000 new jobs in the energy sector.⁴⁷

In many countries around the world, in particular developing countries, trade unions need capacity development in responding to climate change challenges, the need for change in production and consumption models, the related consequences for workers and the prospects for green jobs. This will enable them to make full use of their unique position to engage workers in the issue and to organize their own, and lobby for broader retraining efforts for greener production opportunities. Sustainlabour is a global, multi-stakeholder, non-profit-making organization which supports trade union efforts to support sustainable work and workplaces around the world. Among other activities, it facilitates training and technical assistance for trade union organizations.⁴⁸ However, trade unions' efforts will have only limited effect in countries where a large proportion of the population works in the informal economy.

4.7.3 *Employers' associations and sector skills councils*

Although national and sectoral business associations sometimes take a conservative attitude towards the greening of industries, concerned that it may be a brake on business, employers who take a proactive stance on green restructuring perceive greening as an engine for growth. Employers' associations, chambers of commerce and industry skills councils are key players in identifying employment potential and retraining needs, and in providing access to training opportunities for their membership.

The Industry Skills Councils (ISCs) in Australia are instrumental in identifying and responding to retraining needs. The ISCs foster close relationships between business enterprises, industry organizations, and the education and training system. Typically, they conduct annual "environmental scans" which document industry-wide trends and concerns regarding the retraining requirements of the workforce. For example, Manufacturing Skills Australia (MSA) has recognized

⁴⁷ See the strategy by Danish Industries (DI), the Danish Society of Engineers (IDA), the Danish Energy Association and the Danish Metalworkers' Union (Nov. 2009), *Energisatsning til gavn for klima, vækst og beskæftigelse*, available at: http://ida.dk/omida/laesesalen/Documents/analyse_og_rapporter/energisatsning-web.pdf (accessed 1 Apr. 2011); also the Danish Metalworkers' Union's policy recommendations: *50,000 jobs in the energy sector* (2009).

⁴⁸ <http://www.sustainlabour.org/> (accessed 1 Apr. 2011).

that the introduction of a carbon pricing mechanism will have a strong impact on manufacturing industry, which has the third highest carbon emissions of any sector in Australia.⁴⁹ MSA recognizes the need to develop both generic and specialized skills in relation to more sustainable manufacturing practices, to be delivered through the existing vocational education and training system. Through a rigorous process of industry research that stimulated relationships with manufacturing enterprises, industry organizations and educators, MSA has developed units of competency relating to sustainable manufacturing which embody skills to be accredited and incorporated within the national qualifications framework.

Box 4.15. Retraining of sugarcane cutters by the Brazilian Sugarcane Industry Association

Brazil is the world's largest sugarcane producer and is quickly becoming the world's largest producer of biofuels. Around 200,000 workers have seasonal jobs cutting cane at harvest time. However, despite the expected expansion of ethanol production using sugarcane, many of the cutters' jobs are doomed to vanish as a result of mechanization and environmental rules that prohibit the burning of sugarcane (traditionally done to remove poisonous animals, such as snakes, and enable the cutters to increase yields). In 2007 the Brazilian Sugarcane Industry Association (UNICA) and the environment department of the state of São Paulo signed a protocol that anticipates burning coming to an end in 2014. When this happens, a significant proportion of sugarcane cutters, most of whom are men and whose families have worked in the industry for many generations, will have to relocate to other activities.

UNICA is the largest organization in Brazil representing sugar, ethanol and bioelectricity producers. The industry has already developed several initiatives to retrain these workers, providing better job opportunities within their own plants or in other segments of the economy. UNICA has also created a programme to retrain up to 7,000 sugarcane and ethanol workers every year in a variety of occupations including drivers, farm machine operators, harvester operators and electricians, tractor mechanics, beekeepers and reforestation work.

Sources: UNICA: Sugarcane workers requalification program, 2008; Milton Maciel (former Brazilian Secretary of Agriculture): *Sufferings of Brazilian sugar cane workers*, interview, <http://www.oilcrisis.com/BR/SugarCaneWorkers.htm> (accessed 1 Apr. 2011).

The French National Association for Training in the Automobile Sector (ANFA) was created in 1952 to collect and distribute a levy for skills development. ANFA's training policy focuses on increasing qualifications and ensuring continuous employee adaptation to technological advances within the sector, including those linked to the production of eco-friendly vehicles. ANFA's responsibilities include:

- anticipating skills needs;
- investigating professions and jobs in the sector;
- analysing the training system;
- implementing appropriate training measures for trainers, tutors and apprenticeship masters;
- updating state diplomas;
- managing branch certificates;
- developing requalification systems for employees; and
- providing support for training institutions.

⁴⁹ Manufacturing Skills Australia: *Sustainable manufacturing – Manufacturing for sustainability* (Sydney, 2008).

ANFA is currently implementing measures to support both workers and companies in the automobile sector, with the specific aims of raising staff competency levels and alleviating the effects of restructuring on workers.

4.7.4 Enterprises and value chains

The case studies show how important on-the-job training at the level of the individual enterprise has been in meeting the demand for skills retraining into green jobs. Especially in developing countries and rapidly growing emerging economies, where change is happening fast, formal training systems take time to catch up with events in the real economy and to develop training capacity. In such circumstances, systematic support from public and sectoral bodies is often limited or non-existent. Especially in the absence of efficient active labour market policy measures through public employment services in the formal economy, and of tripartite or bipartite mechanisms at industry level in the informal economy, enterprises bear the heaviest burden of restructuring in trying to adjust to new demands, including those in skills.

While training organizations and educational institutions are developing capacity and expertise, enterprises focus on internal training, in forms varying from mentoring to structured information sessions, to keep abreast of the changing business environment. In both developed and developing countries, most companies that have undertaken internal training along these lines have been successful in equipping their employees to adapt to new green practices, products and services.

In Germany, retraining in response to green restructuring is mainly delivered through the education and training system and the smaller-scale initiatives by firms are seen as marginal. However, in the renewable energy sector the situation is somewhat different. Here, firms often prefer to recruit workers who have already undergone initial training rather than to offer dual apprenticeship courses (combining workplace training with courses in vocational schools). There are two reasons for this: first, the sector has experienced very high growth rates, and dual apprenticeship programmes take time to become established; second, there is no dual apprenticeship programme particularly designed to cater for renewable energy, which means that even qualified recruits have to be trained further to meet firms' own internal needs.

In the Philippines, some businesses have set up "green committees" within their personnel management and training divisions to take a green perspective on management and the factory environment. These committees, which consist of representatives from each division or production line, propose training plans to address identified skill needs within the enterprise, including details of the training courses, the qualifications required of instructors and where the training is to take place (whether in-house or at an external location).

In South Africa, the private renewable energy sector seems to be expanding to the point where it can finance its own training programmes, so that the skills development levy paid by all employers can be effectively used in demand-driven skills development; up to 70 per cent of the levy can be reclaimed for just this kind of training.

The employment generation potential in environmental goods and services has a multiplying effect across supply chains. For instance, wind energy generates jobs directly not only in clean energy production but also in the production of turbine towers and blades, often manufactured near the point of use (e.g. in Egypt). In Denmark, where the construction industry has lost approximately 30,000 jobs since 2008 as a result of the economic downturn, the Danish Construction Association has supported the development of energy-efficient renovation and

managed to create 5,000 new jobs. In April 2009 the Danish Government adopted a strategy to reduce energy consumption in buildings and an interministerial committee and a working group were set up, with members drawn from relevant business organizations, educational institutions and public authorities, to thoroughly assess the skills requirements for various occupations related to the construction sector and the value chain of energy efficiency in building with the view of agreeing an action plan for skills development. Identification of skill needs and the provision of retraining and skills upgrading right through the value chain are a crucial element of successful restructuring and support employment generation in affected sectors.

4.7.5 Other institutions and partnerships

Other actors with a role to play in effective and equitable restructuring include academic educational establishments, education and training institutions, training authorities, NGOs, national and international donors, and public–private partnerships.

In Costa Rica and Uganda, universities have played a proactive role in identifying retraining needs and delivering training for green industries. A recent survey among higher education institutions in Costa Rica demonstrated that private universities have been the most active in offering courses for green jobs, and that demand has been highest for shorter retraining courses.

Public–private partnerships can play an important role in pushing national policy agendas forward. In the United States, the Apollo Alliance and other “Blue–Green” partnerships were created to bridge the gap between creating and sustaining employment opportunities on the one hand, and promoting policy and regulatory changes in pursuit of greener economic outcomes on the other. Such public–private partnerships bring the economic and community development objectives together by uniting the interests of private business, workers, environmental and community NGOs, and public authorities. For instance, the Apollo Alliance developed a Green Manufacturing Action Plan aimed at revitalizing the shrinking US manufacturing sector (see box 4.16).

Box 4.16: The Apollo Alliance’s roadmap for revitalizing the US manufacturing sector

The Apollo Alliance is a coalition of labour, business, environmental and community leaders in the United States whose goal is to spark a clean energy revolution that will provide a new generation of good-quality green-collar jobs. The Apollo Alliance promotes investments in energy efficiency, clean power, mass transit, next-generation vehicles and emerging technology, as well as in education and training. One of its initiatives has been a roadmap for revitalizing the shrinking US manufacturing sector. The proposed Green Manufacturing Action Plan calls for investments in domestic clean energy manufacturing and for greater energy efficiency in manufacturing, and addresses the poor employment situation in manufacturing, most of which is concentrated in the 20 states hit the hardest by the recession. It proposes the reversal of outsourcing in the manufacture of clean energy products, such as wind turbines and solar components, bringing production back to the United States to make use of the country’s robust manufacturing infrastructure and skilled workforce. The Plan includes measures to enable clean energy manufacturers to retool their facilities and retrain their workers, and to develop skill standards for clean energy manufacturing.

Source: *Make it in America: The Apollo Green Manufacturing Action Plan*, March 2009, available at: <http://www.apolloalliance.org> (accessed 1 Apr. 2011).

Box 4.17 Goodwill Industries International: Tackling barriers to employment

Goodwill Industries International is a global non-profit-making NGO which has worked successfully for over a century to help people in need to reach their fullest potential through the power of work, including jobs in recycling and other environment-friendly activities. There are currently 165 Goodwill organizations in Canada and the United States and 14 affiliated organizations in other countries around the world (among them Costa Rica, Mexico, the Philippines, South Africa, Thailand and Uruguay). Goodwill works closely with a wide range of local stakeholders to promote its model of self-sustainability. The social enterprises created and developed on this model provide skills training and job placement activities for people who experience barriers to employment, for example disabled people, immigrants, people with a criminal record, young people and unemployed people. Goodwill works closely with local businesses to learn where jobs are becoming available and what skills are needed to fill them, and provides tailored training.

Source: <http://www.goodwill.org/> (accessed 1 Apr. 2011).

In developing countries the efforts of enterprises to cushion the effects of restructuring and avoid displacing workers are sometimes supported by NGOs and assistance from aid donors. These groups are especially active in addressing the needs of disadvantaged groups in both developed and developing countries, but the longer-term effectiveness of this type of assistance depends on its becoming part of a systemic and sustainable response mechanism.

4.8 Conclusions

Comprehensive planning is essential to mitigate the potentially severe adjustment costs, both economic and social, that may accompany the transition to a low-carbon future in energy and emissions intensive economies. Especially vulnerable to such effects are those economies with high emissions per capita and a high reliance on traditional extracting industries.

Significant regulatory reforms and emissions targets will have important implications for emissions-intensive industries, where downsizing and restructuring can be expected. Employment in these industries will shrink, while employment opportunities will open up in newly emerging industries such as those associated with renewable energies and energy efficiency. At the same time internal restructuring and adjustment, including important retraining measures, can be expected in many industries, especially in manufacturing and construction, to assist the transition from carbon-intensive to energy-saving operations.

Estimates and scenarios differ as to the medium- to longer-term employment effects of “green” restructuring, although most agree that the net effect will be positive. In the short term, however, the process may cause unemployment as a result of the decline in carbon-intensive industries, if efficient restructuring measures accompanied by retraining are not put in place. In agriculture, forestry and fisheries, these measures will refocus on the market for organic food, the production of biofuels and significant shifts between subsectors, with particular emphasis on the food/wood processing industries. Extractive industries and fossil fuel energy generation will need to move towards energy and resource efficiency, using new green technologies, clean coal, and carbon capture and storage, and substantial numbers of displaced workers will be redirected into renewable energies. Emissions-intensive manufacturing, in particular the automotive sector and related supply chains, will refocus on eco-friendly vehicles (hybrid, electric, hydrogen) with lower GHG emissions and other green features now in demand among customers. In the ship-building and related marine engineering industries, activity will shift into offshore and onshore

renewable energies, including the construction, supply and maintenance of wind turbines and wave and tidal energy machinery. In all these sectors and activities, these and other restructuring changes will bring with them significant retraining needs.

Although new job opportunities arising from new low-carbon markets are expected to offset the unemployment arising from the contraction of older, more carbon-intensive industries, the new green jobs will not necessarily go to those who have lost their old jobs. Disadvantaged groups in the labour market will need targeted assistance and preferential treatment to ensure their access to new and good-quality green jobs. Retraining and skills upgrading are thus crucial to a successful, smooth and equitable transition to the low-carbon and green economy. Low-skilled people are especially vulnerable as it will be difficult for them to compete for many of the new jobs.

Short, tailor-made courses are considered the most efficient means of delivering retraining. Skills upgrading is at least as important as retraining – in fact, it is the route most often taken in responding to employment shifts both within and between industries. Common to all sectors and occupations is a reliance on basic skills as the foundation for training measures. The starting point must therefore be equipping the workforce with those basic skills, delivered through initial education and training. Portable skills become especially valuable as they increase workers' adaptability and occupational mobility. These are provided through both initial and continuing training, including retraining measures.

Successful restructuring with efficient retraining measures can prevent workers being displaced and/or successfully retrain displaced workers for employment in new, greener, industries and occupations. The key to success in this endeavour is the assumption of a shared responsibility on the part of government (in the form of national, regional, local or community administration), trade unions and employers. Organizing social dialogue at industry level is therefore an important prerequisite for efficiency in restructuring. Public employment services are an important delivery mechanism for active labour market policy measures, including retraining jobseekers and assisting enterprises in their restructuring.

Ideally, mechanisms for workforce restructuring are incorporated in the overall system of active labour market measures, including retraining, and based on an established labour market information system. This assumes, however, the presence of social protection mechanisms, public employment services and institutional mechanisms for social dialogue.

5. How occupations change as economies go green

The degree of change in the skill composition of occupations when economies go green will determine whether established occupations will become greener or entirely new occupations will emerge. The evidence from the case studies is that the predominant demand for skills in greening the economy is in changing existing occupations rather than in creating new ones. This actually creates a much bigger challenge. It requires a pervasive response across all skill levels and all segments of the education and training system, rather than narrowly targeted changes. Successful skills development measures depend in the first instance on the general responsiveness of education and training systems. But they also require many actors and mechanisms to bring about the specific changes needed. Enterprises are usually the first to react to the immediate changes in skill needs, but effective responses commensurate with the scale of change anticipated require skills development initiatives at industry level, public–private partnerships, and multilateral responses on the part of a variety of stakeholders.

The previous chapter looked at skill needs in the transition to a greener economy from the perspective of industries: which industries might shed jobs, which industries are likely to create new ones, and what this structural adjustment implies for skill needs. This chapter examines similar questions of transition but from the perspective of occupations. It looks at the changing composition of occupations, and what this means for training systems. It provides detailed analysis of the types and trends of skill change within and across occupations, of changing and emerging occupations in major economic sectors and of the gender implications. Finally, it reviews the various actors and mechanisms involved in the response to these changes, at enterprise, industry, national and regional levels, and evaluates their effectiveness.

5.1 Types of change in occupations and their skill requirements

An occupation is defined as a grouping of jobs which have a common set of main tasks and duties in whichever sector they occur. For reasons of classification, occupations are grouped together into occupational groups on the basis of similarity in the type of work done. The idea of occupation is closely linked to that of specialist skill, and in consequence occupations are often accepted as a proxy for skills. The International Standard Classification of Occupations (ISCO), last updated in 2008,¹ classifies skill specialization in terms of four conceptual areas: (1) the field of knowledge required; (2) the tools and machinery used; (3) the materials worked on or with; and (4) the kind of goods and services produced.²

¹ <http://www.ilo.org/public/english/bureau/stat/isco/index.htm> (accessed 1 Apr. 2011).

² A. M. Greenwood: *Updating the International Standard Classification of Occupations*, ISCO-08 (Geneva, ILO Bureau of Statistics, 2008).

Applying this framework in the context of greening, we can identify the corresponding four dimensions where new skills will be required: (1) knowledge, covering technical knowledge in a particular field and also knowledge about, for example, environmental regulations and resource efficient production processes, and general environmental awareness; (2) environmentally friendly tools and machinery and green technological developments; (3) understanding of sustainable (or banned) materials and how they are produced and handled; and (4) the production of green and environmentally friendly goods and services.

Table 5.1 provides an overview of the levels of skill and occupational change involved in moving towards green jobs. It takes as its starting point the degree of skill change required on the labour market, matches this with the corresponding type of occupational change, specifies the typical skills response required and gives examples for each level.

Table 5.1. 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: Authors. Based on the information from country case studies.

The table shows that there will be both quantitative and qualitative changes in skill needs. Environmental policy, for example, may increase the number of practitioners needed in certain jobs – for example, if the Government expands protected areas of territory, more national park rangers will be needed. The occupational profile of a national park ranger, however, and the skills needed to perform the work, remain the same; so this would be an example of purely quantitative change. Some jobs might become greener without changing the skills content of the occupation – for example, a bus driver switching to vehicles using compressed natural gas (CNG) will not need any new skills (as long as they are not involved in repair and maintenance work).³ This again represents only quantitative change: these occupations do not change in their content, though the number of jobs available may change under certain conditions – for example, increased investment in related industries, changes in legislation or increased commitment to lowering GHG emissions. This report will pay no particular attention to occupations subject only to quantitative change, as this does not involve a demand for new or altered skills.

By contrast, technological progress that allows for more energy-efficient ways of producing goods and services will alter the content of jobs of engineers, managers, craftspeople and technicians who install, use and maintain the new technology. This introduces qualitative change: occupational profiles will change, new skills and competencies will come into being and old skills may become obsolete.

³ There is nevertheless a growing debate about reskilling drivers to change driving behaviour and style, which can reduce fuel consumption by 10 per cent. See e.g. J. N. Barkenbus: “Eco-driving: An overlooked climate change initiative”, in *Energy Policy* (2010), Vol. 38, Issue 2, pp. 762–69; *The impacts of climate change on European employment and skills in the short to medium term: Company case studies* (London, GHK, 2009).

New skill needs prompt changes in occupations. Many of the green occupations discussed in this report, and the skills required to pursue them, are in a developmental stage. New and changing skills may result in entirely new occupations or the updating of existing occupations, depending ultimately on decisions taken by industries and training institutions as well as on education and skills policies. Occupational directories listing a country's occupational profile are usually developed at national level, administered by public employment services or labour observatories, and used by national statistical offices. Many of these directories refer to ISCO, but while ISCO attempts to make national classifications comparable internationally, considerable differences remain in the skills content of classifications from one country to another.

Every national database is regularly updated, and some green occupations have already entered national classifications, for example in the United States (see also Chapter 6, box 6.1).⁴ The Spanish public employment service coordinated a study which identifies and describes 82 environmental occupations, some of which are new, with a view to updating the national occupational directory.⁵ The Korean employment information service has published a list of 55 new occupations, 19 of which belong to the green technology industry (see box 5.1). However, the list is not yet included in the current national occupation standards, and statistical data on the numbers and distribution of these jobs are not yet available.

Box 5.1. New occupations in the green technology industry in the Republic of Korea

- solar photovoltaic researcher and developer
- marine bio-energy researcher
- geothermal system development engineer
- wind power researcher and developer
- carbon capture and storage researcher
- greenhouse gas auditor
- seawater desalination researcher
- advanced water treatment researcher
- LED device engineer
- LED lighting system engineer
- LED thermal protection system engineer
- hybrid fuel cell researcher and developer
- hybrid power system developer
- maritime environmental regulation specialist
- developer of alternative fuels for ships
- eco-friendly ship designer
- U-city (“ubiquitous city”) planner
- U-city infrastructure operator
- building energy consultant

⁴ D. Rifkin, P. Lewis, E. C. Dierdorff, J. J. Norton, D. W. Drewes and C. M. Kroustalis: *Greening of the world of work: Implications for O*NET®-SOC and new and emerging occupations*, Paper prepared for US Department of Labor Employment and Training Administration, Washington, DC (North Carolina State University and National Center for O*NET Development, 2009).

⁵ INEM: *Perfiles de las ocupaciones medioambientales y su impacto sobre el empleo* (Madrid, 2008).

However, since many of the activities related to greening economies are fairly new, in most countries many newly emerging occupations will not yet have been officially classified. This research took an explorative approach and left it to the judgement of consultants and national stakeholders to decide whether a certain job profile could be considered a new occupation or not.

Nevertheless, in order to summarize trends across countries, it is helpful to have common criteria that can help determine if an occupation is to be classified as emerging or changing. New green occupations usually:

- are or will be included in the national catalogue of occupations; or
- include a significant degree of new skills for unique work and worker requirements different from that performed by incumbents of other occupations; or
- can be learnt through existing education/training programmes/institutions offering credentials for the new occupation; or
- require licensing, registration or certification by states/authorities in order to be practised; or
- have a professional association that caters to their particular needs.

A new occupation may be entirely novel or may be “born” from an existing occupation. Also, as noted earlier in this chapter, an occupation may remain the same but its skill profile change in one or more specialist areas. A plant mechanic still installing heat systems but having to take into account energy conservation is working in an established occupation which has become greener. Conversely, a solar energy technician is working in a new occupation, as the specialization in this field did not previously exist and the occupation focuses on the production of a new product, solar cells. Green occupations can also be country specific: for example, tree farmers involved in trading carbon emissions and possessing the ability to estimate carbon sequestration of forests exist only in the countries eligible for Clean Development Mechanism (CDM) projects or other voluntary programmes to offset carbon emissions.⁶

Another variant worth mentioning is the hybrid occupation which appears in the context of greening economies. Hybrid occupations build a new job profile by uniting various specialist areas. For example, in the course of increasing efforts to adapt to climate change in developing countries, the occupation of agricultural meteorologist has emerged, combining expertise in both meteorology and agricultural sciences.⁷ Hybrid occupations pose a particular challenge for education and training systems because of their disciplinary mix.

In pursuit of policy objectives, some countries are developing a specific taxonomy for green occupations. An example from Australia is set out in box 5.2. An extensive listing provided by the Californian Employment Development Department displays all green occupations identified in various studies in Canada and the United States showing the wide variety of occupations concerned.⁸ Although the list includes hundreds of occupations, most of them are well-established traditional occupations which are either performed in a green industry or have become greener with adjustment of the occupational profile.

⁶ C. Watson: *Forest carbon accounting: Overview and principles* (Addis Ababa, UNDP–UNEP, 2009).

⁷ S. Walker: “Role of education and training in agricultural meteorology to reduce vulnerability to climate variability”, *Climatic Change* (2005), Vol. 70, pp. 311–18.

⁸ <http://www.labormarketinfo.edd.ca.gov/contentpub/GreenDigest/Green-Occupations-Summary.pdf> (accessed 1 Apr. 2011).

Box 5.2. Taxonomy of green occupations in Australia

A current research project proposes an Australian taxonomy for “green jobs”, based on existing occupational (ANZSCO), industry (ANZSIC) and skill (VET Certificate I through to university degree) classifications, and introducing a distinction between the environmental and sustainable aspects of “green” work.

While no standard classification or regular data collection has yet been embraced, the Australian Bureau of Statistics has expressed interest in designing a methodology and delivering a dataset which will profile the Australia-wide green workforce.

The following table sets out some examples of occupations classified according to the proposed system.

“Green job”	Environmental/ sustainable	Occupational group	Skill level	Industry	Combined classification
Electrical engineer with a university degree working for a power utility on policy issues	S	3	1	D	S31D
Construction worker helping build a government-funded solar power facility for a remote community	E	8	5	E	E85E
Director of an environmental consultancy advising organizations on lowering their carbon footprint	ES	1	1	M	ES11M
Sustainability manager helping senior management in a credit union devise an environmental strategy	S	2	2	K	S22K
Sustainability manager helping to transform the culture of the organization to become more sustainable	S	2	2	Depends on industry	S22x
Lawyer specializing in sustainability and/or environmental issues	S	2	1	M	S21M
Journalist writing about environmental issues for a major newspaper (or an Internet newsletter)	ES	2	1	J	ES21J
Manufacturer’s or retailer’s technician installing solar panels or insulation in homes	E	3	4	M	E34M
Market researcher analysing green issues for corporate clients	S	2	1	M	S21M
Transport company’s occupational health and safety officer confirming compliance with environmental standards	S	3	2	I	S32I
Dairy farmer struggling with reduced water allocations and climate change	E	1	3	A	E13A
High school teacher teaching students about green issues	ES	2	1	P	ES21P

Notes:

Environmental/sustainable: S = predominantly sustainable; E = predominantly environmental; ES = both environmental and sustainable.

Occupational group: 1 = managers; 2 = professionals; 3 = technicians and trades workers; 4 = community and personal service workers; 5 = clerical and administrative workers; 6 = sales workers; 7 = machinery operators and drivers; 8 = labourers.

Skill levels: 1 = degree; 2 = diploma; 3 = certificate III with experience or certificate IV; 4 = certificate II or III; 5 = certificate I or semi-skilled.

Industry: A = agriculture, forestry and fishing; B = mining; C = manufacturing; D = electricity, gas, water and waste services; E = construction; F = wholesale trade; G = retail trade; H = accommodation and food services; I = transport, postal and warehousing; J = information, media and communications; K = financial and insurance services; L = rental, hiring and real estate services; M = professional, scientific and technical services; N = administrative and support services; O = public administration and safety; P = education and training; Q = health care and social assistance; R = arts and recreation services; S = other services.

Source: Connection Research: *Who are the green collar workers? Defining and identifying workers in sustainability and the environment* (2009), available at: <http://www.eianz.org/sb/modules/news/attachments/71/Green%20Collar%20Worker%20report%20Final.pdf> (accessed 1 Apr. 2011). Reproduced with permission.

It is clear from the country reports that the number of existing occupations that will change and update their skills content by far exceeds the number of new occupations that will emerge, and will affect more jobs than the latter (see figure 5.1). This finding corresponds to the results of other studies.⁹ The greening of established occupations implies incremental changes in qualifications. New skills are needed because specific competencies are currently lacking, some existing skills relating to job tasks that become obsolete cease to be used, some tasks require global or interdisciplinary approaches, and sustainable development constraints are increasingly taken into account. This may lead to the diversification of existing occupations (for example in management, with increased environmental management responsibilities) or to increased specialization of occupations (for example in the waste sector, as technologies and operations become more advanced).

The research also enquired about the nature of the occupations involved in the change. As all jobs can become greener, both blue- and white-collar jobs are involved in the change. Blue-collar occupations in areas such as construction or maintenance are as instrumental in greening economies as white-collar jobs in services or administration. Decisions and measures taken at the white-collar level may be implemented by blue-collar personnel. The same holds true for new green occupations, which emerge in the areas of manual, blue-collar occupations (e.g. solar energy technician) as well as in traditionally white-collar fields (e.g. eco-consultant). The Spanish country report finds that blue-collar occupations tend to be more energy intensive than white-collar activities; hence the potential “greening gap” between established skills and new green skills is wider for blue-collar workers than for white-collar workers.

What qualifications, levels of educational attainment and spread of competencies are required for the new green-collar occupations all depend on the type of occupation and industry. Two German studies looked at the structure of qualifications in different green industries (see table 5.2). The share of low-skilled workers is highest in recycling, the share of master craftspeople/technicians is highest in sewage industries and the share of university graduates is highest in air pollution control, reflecting the use of sophisticated and specialized technologies in this industry.

Table 5.2. Structure of green industries by qualification in Germany (%)

Industry	Low-skilled	Skilled worker (apprenticeship)	Master craftsman/technician	University of applied science	University
Air pollution control	3.5	20.7	12.3	22.3	41.2
Recycling	16.0	47.4	11.4	10.2	15.0
Sewage	4.4	24.9	14.8	23.1	32.8
Control systems and metrology	3.4	24.4	14.1	18.6	39.5
Noise control	3.8	25.8	12.3	20.0	38.2
Renewable energies	5.0	41.0	8.0	27.0 ^a	19.0 ^b

^a For renewable energies, this category refers to “commercial clerks”.

^b For renewable energies, this includes graduates of both universities and universities of applied science.

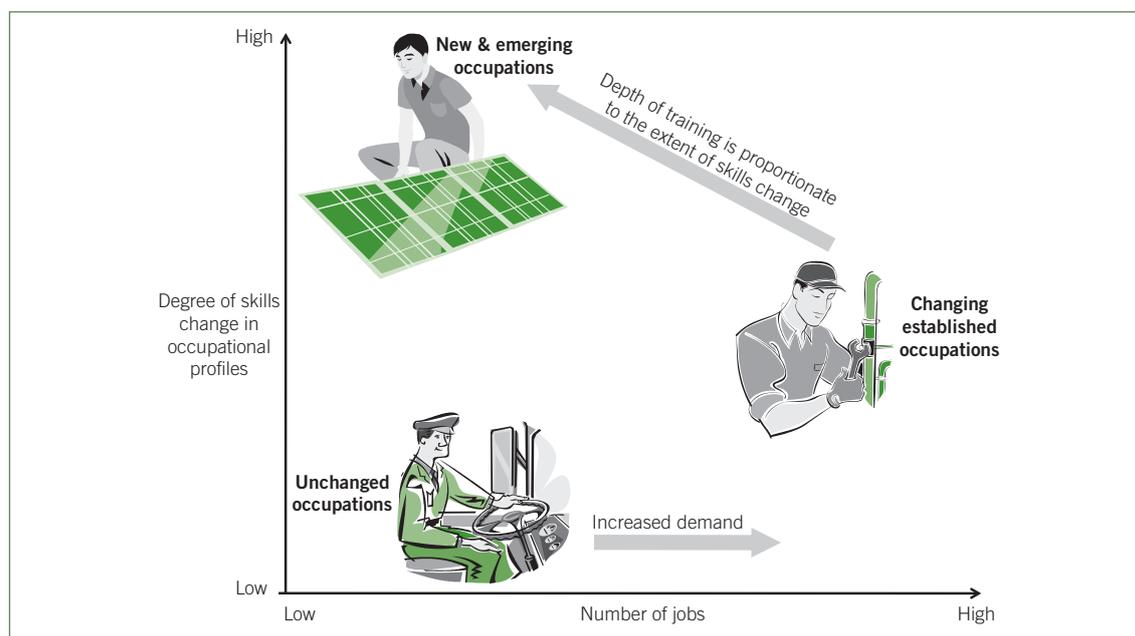
Sources: For all industries except renewable energy: J. Wackerbauer: “Arbeitsplätze durch ökologische Modernisierung: Auswirkungen des Umweltschutzes auf Niveau und Struktur der Beschäftigung”, in *WSI-Mitteilungen* (1999), Vol. 52, No. 9, pp. 632–38. For renewable energy: T. Bühler, H. Klemisch and K. Ostenrath: *Ausbildung und Arbeit für Erneuerbare Energien* (Wissenschaftsladen Bonn e.v., 2007), available at: <http://www.jobmotor-erneuerbare.de/download/Statusbericht-AA-EE.pdf> (accessed 1 July 2010). Reproduced with permission.

⁹ C. Briggs, M. Cole, J. Evesson, K. Gleeson, J. Buchanan, G. Larcombe and H. Saddler: *Going with the grain? Skills and sustainable business development* (University of Sydney, 2007); UNEP, ILO, IOE, ITUC: *Green jobs: Towards decent work in a sustainable, low-carbon world* (Geneva, 2008).

The country reports indicate that new occupations tend to require high-level qualifications. This can be explained by the fact that they are strongly linked to expertise in new technologies (e.g. engineer or technician in measurement and metrology), or to organization and coordination (e.g. manager of transport flow, logistic chain optimization, or major buildings projects), or to diagnosis, auditing and consulting. There are also emerging occupations that require vocational qualifications at upper secondary level, such as those dealing with the use and maintenance of technology: wind turbine operator, wastewater treatment technician or cooling technician. This analysis seems to hold true in developing, emerging and industrialized countries alike, and echoes other findings that emerging occupations commonly require initial technical and vocational training at upper secondary level or university education, as a broad set of new skills needs to be acquired.¹⁰

Changes in existing occupations tend to be concentrated in low- to middle-skilled occupations where traditional skills will need to be complemented by new skills through continuing training or on-the-job upskilling (see figure 5.1).¹¹ For example, in the United States most new green jobs are projected to be in occupations requiring professional certification, an apprenticeship, or one or two years of post-secondary education. These jobs fall into the “middle-skilled” category, meaning they require some post-secondary education or training, but less than a four-year post-secondary degree.¹² However, some occupations that require higher-level skills, such as business or public management, also need new types of expertise and thus will also see their occupational profile change.

Figure 5.1. The dynamic of change in skills, occupations and related training needs



Source: Authors, based on information from country reports.

¹⁰ See also C. Martinez-Fernandez, C. Hinojosa and G. Miranda: *Green jobs and skills: The local labour market implications of addressing climate change* (Paris, OECD, 2010).

¹¹ Michigan Department of Energy, Labor and Economic Growth (DELEG): *Michigan Green Jobs Report 2009: Occupations and employment in the new green economy*.

¹² J. R. Stone III: “It isn’t easy being green, or is it?”, in *Techniques: Connecting Education and Careers* (2010), Vol. 85, No. 3, Mar., pp. 42–46.

The French country report developed a table that sets out the qualifications and educational level required in new green occupations in key sectors of the economy (see table 5.3). It confirms that new green occupations require a relatively high level of qualification.

Table 5.3. New green occupations in key sectors of the French economy

Sector	New green occupation/field	Qualification/educational level required
Renewable energy	Quality control, diagnostics, auditing	Managerial
	Project developer	High qualification level
	Engineer	
	Consulting and research	
	Coordinator	
	Maintenance technician (wind energy)	
	Sales and marketing	
	Legal expert	
Built sector	Company organization or project management (e.g. in construction)	High qualification level related to green technologies or complex project management
	Works coordination and planning before commissioning	
	Diagnosis, control and performance measurement related to regulatory requirements (e.g. energy performance, air quality, acoustic measurement)	
	Interdisciplinary skills (e.g. regulatory impacts of low currents, metrology and software)	
	Renewable energy systems (solar, wind, geothermal)	
Energy efficiency	Engineer (<i>ingénieur thermicien</i>)	Medium and high qualification levels
	Auditing and consulting	
Waste	Waste prevention management	Medium and high qualification levels
	Recycling industries operators	

Source: French country report.

The country reports from developing and emerging economies state that the educational background required to enter new occupations can vary from one company to another and depends to a large extent on individual firms' hiring practices. This is particularly the case in contexts where education and training systems have not yet adapted to new skills requirements, or where skills certification is not widespread.

A US study that looked at the relationship between qualifications and pay levels concluded that green investment generates not only significant numbers of well-paying jobs with benefits but also a relatively high proportion of lower, entry-level jobs that offer low-paid workers a step on to a career ladder and the chance of moving into better employment positions over time.¹³ It found that the average pay for green jobs is about 20 per cent less than the average for those connected to the oil industry. However, a green investment programme is estimated to create roughly triple the number of decent jobs as the same level of spending within the oil industry.

¹³ Political Economy Research Institute, University of Massachusetts: *Green recovery: A program to create good jobs and start building a low-carbon economy* (2008), available at: http://www.peri.umass.edu/fileadmin/pdf/other_publication_types/peri_report.pdf (accessed 1 Apr. 2011).

5.2 Do “green skills” exist?

Over the past few years, a considerable body of literature has grown up on defining and determining green jobs and green skills. While in some countries the term “green skills” enjoys wide popularity among politicians, scholars and practitioners, in other countries experts are more reluctant to define a group of skills as green.

The OECD classifies skills in three groups: basic skills; advanced/knowledge-intensive skills; and converging skills. The last of these, converging skills, itself includes two types of skills: entrepreneurial skills and green skills. The latter are defined 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.¹⁴

Green skills feature prominently in debate in Australia, where the Federal Government has, among other measures, negotiated a Green Skills Agreement with the states and territories designed to ensure that Australia’s vocational education and training (VET) system delivers the skills for sustainability that will enable individuals and businesses to contribute to a sustainable, low-carbon economy. Green skills, or skills for sustainability as they are also called, are defined as the “technical skills, knowledge, values and attitudes needed in the workforce to develop and support sustainable social, economic and environmental outcomes in business, industry and the community”.¹⁵

In the United Kingdom, a substantial green skills checklist was developed within the framework of a report for the UK Government on the skills implications of the transition to a low-carbon and resource-efficient economy. The list includes ten broad groups of skills (tier 1), relevant across sectors, which are broken down into general skills categories (tier 2) and more specific skills (tier 3) (see table 5.4).

It is clear both from this checklist and from the definitions of green skills quoted above that in order to reduce negative impacts and increase positive impacts on the environment, any economy has to have at its disposal a broad range of knowledge and of technical, managerial and conceptual skills. Many of these are specific new skills such as knowledge of sustainable materials, carbon footprinting skills or environmental impact assessment.¹⁶ It is also clear that some of these skills are not necessarily green per se, but only as green as the context in which they are applied: for example, knowledge of building regulations only leads to more energy-efficient buildings if the right regulation is in place; impact assessment skills only belong to a green job when the results of the assessment lead to a more resource-efficient product or way of production. Building skills may be green only when they are applied in the green building industry. However, this does not make building skills as such irrelevant for green jobs.

The essential point is that skills are possessed by individuals, who can apply them in different contexts – green or non-green. A green context may call for different skills, but will not necessarily do so; and even if it does, it will also use elements of skills which could also be applied in a non-green context. Green jobs need plumbers, roofers, engineers and chemists with a full range of technical skills, reaching way beyond specific sustainability or green skills.

¹⁴ OECD: *Entrepreneurship, SMEs and innovation* (Paris, 2010).

¹⁵ The Green Skills Agreement can be found at <http://www.deewr.gov.au/Skills/Programs/WorkDevelop/ClimateChangeSustainability/Documents/GreenSkillsAgreement.pdf> (accessed 1 Apr. 2011).

¹⁶ See also ECORYS: *Environment and labour force skills: Overview of the links between the skills profile of the labour force and environmental factors*, Report for the European Commission DG Environment (Rotterdam, 2009).

Table 5.4. Green skills checklist (United Kingdom)

Tier 1	Tier 2	Tier 3
1. Design skills	Eco-design	Design for disassembly, design for recyclability, design for the environment, design for effective energy use, legislation and regulatory compliance
	Green manufacturing	Legislation and regulatory compliance, integration of process waste
	Materials specification	
	Life-cycle assessment/costing	
2. Waste skills	Waste quantification and monitoring	Waste production calculations, mass balance, waste audit
	Waste process studies	Material/substance flow analysis, resource utilization mapping, life-cycle assessment
	Waste management systems	Objective setting, legislative and regulatory compliance, collection systems, segregation, waste cycle management, 3R implementation (reduce, reuse, recycle), hazardous waste management, landfill requirements, communications/implementation campaigns
	Waste minimization	Industrial symbiosis, integration of process waste
	Waste technologies	Recycling, waste-to-energy
3. Energy skills	Energy minimization	Energy reduction programmes, heat recovery and re-use, energy-efficient technologies, energy-efficient practices, communications/implementation campaigns, enhanced capital allowance technologies and schemes
	Energy management systems	Objective setting, legislative and regulatory compliance, energy base loads and variable loads, energy audit, energy review, communications/implementation campaigns
	Energy quantification and monitoring	Monitoring targeting and reporting, use of half-hourly data, use of sub-meters, computer-based data logging and energy management systems, energy data manipulation software systems
	Energy costs and trading	Energy markets and pricing, carbon trading schemes, climate change levy agreements, energy price trends, enhanced capital allowances, peak oil and impact on energy supplies and prices
	Renewable energy (RE) technologies	Solar, wind, biomass, combined heat and power, photovoltaic, ground source heat pump, air source heat pump, hydro, hydrogen, fuel cell, integration into energy supply
	Non-renewable technologies	Nuclear, incineration with energy recovery, clean fossil fuel technologies, carbon sequestration, waste-to-energy
4. Water skills	Water use minimization and water re-use	Grey water, water harvesting, wastewater recovery, recycling, cascading, waste/water recovery, effluent treatment, sludge/slurry dewatering, leak detection
	Water management systems	Objective setting, legislative and regulatory compliance, water audit, water consumption review, communications/implementation campaigns
	Water quantification and monitoring	Sub-metering, data collection, water use calculations
5. Buildings skills	Building energy management	Monitoring targeting and reporting, use of half-hourly data, use of sub-meters, computer-based data logging and energy management systems, energy data manipulation software systems, building energy assessment
	Integration of renewable energy	Photovoltaic, solar, wind turbines, combined heat and power, fuel cell
	Energy-efficient construction	Insulation (cavity wall, loft, paperwork), regulatory compliance, passive heating, building regulations
	Facilities management	Building energy management systems, management and maintenance of water, waste management
	Calculating building energy efficiency and carbon ratings	U value calculations, building energy assessment, carbon rating

Table 5.4. Green skills checklist (United Kingdom)

(Continued)

Tier 1	Tier 2	Tier 3
6. Transport skills	Transport impact minimization technologies	Hybrid vehicles, biodiesel, electric vehicles, fuel-efficient vehicles
	Transport impact minimization processes	Alternative transport strategies, communication/implementation campaigns, car-sharing schemes, public transport planning, public transport implementation, cycle network planning, cycle network implementation, transport modelling
	Transport management in business	Transport modelling, route planning and management, distribution and collection system
7. Materials skills	Sourcing	Sources of low-energy materials, sources of low-mileage materials, recyclates (secondary materials), energy-efficient raw material extraction, industrial symbiosis, transport mileage
	Procurement and selection	Use and properties of low-energy materials and of recyclates, industrial symbiosis, low-carbon and resource-efficient procurement, cost impact of climate change on material procurement
	Material use and impact quantification	Material usage calculations, life-cycle assessment and costing
	Management systems	Material use planning, material flow process design and implementation, energy-efficient process design and implementation
	Impact and use minimization	Life-cycle assessment and costing, energy-efficient process implementation, material flows analysis
8. Financial skills	Investment models	Energy technologies investment models, carbon derivatives investment models, calculation of payback/return on investment
	New/alternative financial models	Carbon trading, EU Emissions Trading Scheme, UK Emissions Trading Scheme, enhanced capital allowances
	Quantification of climate change impacts	Impact assessment of climate change on business finances, impact of climate change on materials availability and cost, carbon neutrality and associated cost/opportunities (costs of doing nothing), risk/opportunity assessment models for adaptation and mitigation, insurance risks/opportunities of a low-carbon economy
	Principles of low-carbon and resource-efficient economies	Polluter pays principle, externalities
	Tools of low-carbon and resource-efficient economies	Climate Change Levy agreements, enhanced capital allowances, cost – benefit analysis, low-carbon and resource-efficient procurement
9. Management skills	Impact assessment	Energy use calculations, water use calculations, waste production calculations, carbon footprinting calculations, emissions measurement
	Business planning	RE planning, low-carbon planning, integration of RE and low carbon into business planning cycles, climate change risks, climate change adaptation and mitigation responses (as part of business risk management), understanding low-carbon and resource efficiency skills requirements and long-term planning
	Awareness raising	Communication/implementation campaigns
	Opportunities management	Identification of low-carbon and resource efficiency opportunities, cost–benefit analysis
	Risk management	Identification of low-carbon and resource scarcity risks, cost–benefit analysis
	Day to day management	Low-carbon and resource-efficient procurement, integration of low-carbon and resource efficiency skills, due diligence, management systems, low-carbon and resource efficiency skills requirements for recruitment
10. Policy and planning skills	Built environment master planning and implementation	Low-carbon spatial planning, zero waste planning, resource-efficient planning, low-carbon and resource-efficient urban design, building regulations, public transport planning and implementation, cycle network planning and implementation
	Strategy development	Impact assessment and modelling, principles of low-carbon and resource efficiency
	Strategy implementation	Understanding of skills needs for HR managers, low-carbon and resource-efficient material sourcing and procurement, awareness raising/communications skills

Source: Pro Enviro: *Skills for a low-carbon and resource efficient economy (LCREE)*, Report for DEFRA (2008). Reproduced with permission.

Neither the UK list nor the Australian definition includes core skills. Only the OECD definition is broad enough to encompass both technical and core skills. As core skills are critical skills for green jobs, they are discussed in more detail in the next section of this chapter. Again, these skills are certainly not “green” in themselves, but are in high demand as occupations become greener.

5.3 Core skills for green occupations

Changes in an economy’s structure driven by regulation, innovation, the natural environment or markets commonly call for a set of core skills. Many of these skills figure repeatedly in reports about skills demand in changing societies: communication and management skills, for example, and innovation and entrepreneurial skills. However, others are of particular importance in economies shifting to more environmentally conscious forms of production and consumption. Among these are environmental awareness, leadership skills (to drive change), risk analysis (to define options) and consulting skills (to select the best option).

Box 5.3. Core skills for natural resource managers in Costa Rica

Costa Rica has 56 universities and 74 vocational schools including the National Training Institute (INA). Of these, 25 offer 166 educational programmes related to natural resource management. Specific technical knowledge and skills regarding management of particular natural and environmental resources make up a large proportion of the curricula. However, these specific skills are complemented by core skills to strengthen the students’ ability to perform in a green economy.

Core skills in the following areas feature in many of the programmes:

- organization and planning;
- political, legal and ethical aspects of sustainable development;
- gender sensitivity in natural resource management;
- quality of environmental management;
- corporate social responsibility;
- leadership in non-profit-making contexts;
- entrepreneurialism, innovation and environment;
- system dynamics;
- social networks;
- statistics and data analysis;
- negotiation and mediation in environmental intervention;
- use of new technologies;
- community participation in natural resource management;
- management decisions and communication;
- political analysis;
- project development and evaluation; and
- fundraising for sustainable development.

The following list summarizes the main core skills necessary for green jobs identified in the country reports:

- strategic and leadership skills to enable policy-makers and business executives to set the right incentives and create conditions conducive to cleaner production, cleaner transportation etc. (see box 5.4);
- adaptability and transferability skills to enable workers to learn and apply the new technologies and processes required to green their jobs;
- environmental awareness and willingness to learn about sustainable development;
- coordination, management and business skills to facilitate holistic and interdisciplinary approaches incorporating economic, social and ecological objectives;
- systems and risk analysis skills to assess, interpret and understand both the need for change and the measures required;
- entrepreneurial skills to seize the opportunities of low-carbon technologies;
- innovation skills to identify opportunities and create new strategies to respond to green challenges;
- communication and negotiation skills to discuss conflicting interests in complex contexts;
- marketing skills to promote greener products and services;
- consulting skills to advise consumers about green solutions and to spread the use of green technologies; and
- networking, IT and language skills to perform in global markets.

Box 5.4. Leadership skills: The biggest challenge in transition to a low-carbon economy in the United Kingdom?

The Business in the Community (BITC) group, a network of responsible businesses committed to building a sustainable future, conducted a survey among 700 business leaders. The ensuing report, *Leadership skills for a sustainable economy*, found that 70 per cent of businesses thought a shortage of sustainable business leadership skills would represent one of the most pressing challenges facing UK firms over the next five years as they attempt to develop new low-carbon business models. The report also revealed that 90 per cent of firms needed to boost their efforts to prepare employees for the transition to a sustainable economy.

BITC is teaming up with a number of its members, including EDF Energy, Marks & Spencer and LloydsTSB, to launch a new task force that will work to develop a guide to best practice in sustainable leadership for a wide range of employees including senior managers, middle managers, customer-facing staff and general workforce. The group considers leadership skills critical at every level of business in taking action on climate change and preparing for a sustainable economy. Key leadership skills needed include the ability to develop a long-term vision of how the organization will contribute to a sustainable economy, the ability to inspire a broad range of people internally and externally, and the ability to work collaboratively with different stakeholders.

Sources:

<http://www.bitc.org.uk>; <http://www.businessgreen.com/bg/news/1805120/blue-chip-firms-warn-green-skills-crisis> (accessed 1 Apr. 2011).

Since a considerable share of green innovation is technology-driven, many country reports stress an increased need for skills in science, technology, engineering and mathematics (STEM).¹⁷ These skills are in high demand and yet science courses and studies remain rather unpopular among applicants, with enrolment rates low and drop-out rates high. As noted in Chapter 3 of this report, this disparity between demand and uptake has led to a shortage of practitioners in certain professions (e.g. engineering). But it has also broader implications for core skills. A great deal of work in the green economy demands such skills as the ability to reason and identify the source of problems; the mathematical, scientific or technological knowledge to solve those problems; the research and science skills to break down a complex system into smaller parts, to recognize cause and effect relationships, and to draw conclusions; the mathematical skills required to make calculations and measurements and record data; and the ICT skills needed to stay up to date on appropriate software and equipment.¹⁸

Literacy and numeracy skills remain basic requirements in both developed and developing societies. While being environmentally sensitive or living in harmony with nature in a traditional sense might not require literacy and numeracy skills, participation in a green economy that relies on a wide range of modern technologies to shift current ways of production and consumption to more sustainable forms certainly does, at all levels – from reading product labels and understanding manuals and other written instructions to calculating prices and costs, documenting knowledge and planning green investment. Basic literacy and numeracy skills are also a foundation for further learning and attaining technical competencies. Developing countries with high levels of illiteracy and/or innumeracy in the population can therefore take a substantial step in facilitating the transition to a green economy by tackling this challenge.

5.4 Changing and emerging occupations in major economic sectors

Skills for the green transition are needed in all sectors of the economy and in all industries. This section of the chapter attempts to capture the most prominent changes in occupations, but makes no claim to be exhaustive. It assembles experience gathered in different countries and tries to highlight both commonalities and differences.

Some occupations feature in several sectors: for example, welders may work in the manufacture of wind turbines in the renewable energies sector as well as in assembling cars for the transport sector. Moreover, all sectors include a range of service and support workers, such as accountants, office clerks, human resource managers and cashiers, in jobs whose skills content in many cases might be entirely unaffected by greening processes in the industry.

The degree of new skill needs in an occupation determines the training response. Where appropriate, this section will point to different tendencies in skills responses, differentiating between informal on-the-job skills acquisition, continuing training inside or outside firms, and initial vocational training or higher education degrees. Section 5.6 on the mechanisms for changing skills and occupations will provide a more comprehensive overview of this subject.

It is important to note that a sectoral approach to analysing the greening of occupations does not capture occupations in converging sectors or even some hybrid occupations. A study on job

¹⁷ See also DELEG: *Michigan Green Jobs Report 2009*.

¹⁸ On “soft” STEM skills and on high-demand STEM careers, including those in green industries, see e.g. the Minnesota careers, education and job resource: <http://www.iseek.org/careers/stemcareers.html> (accessed 1 Apr. 2011).

functions in “clean technology” companies published by the Danish Ministry of Education confirms that some emerging green occupations straddle the boundaries between existing industries.¹⁹ The profile of building service technician, for example, represents an occupation that includes tasks pertaining to both service and technical occupations.

5.4.1 Agriculture and forestry

More people across the world work in farming than in any other single occupation.²⁰ Most current change in farming skills is driven by changing environmental conditions, such as climate change, soil degradation and desertification. The challenges of adaptation to climate change are most severe in arid and semi-arid developing countries where a high proportion of the population live in rural areas. Here in particular, farmers need new farming techniques and skills: for example, they need to know how to cultivate varieties or species of crops that will thrive in changing conditions. When profits from traditional crop production decline, additional and different sources of income are crucial to prevent people leaving the countryside for the towns. These include vegetable and fruit cultivation, adding value to production by processing local raw materials, small-scale commerce, animal husbandry, energy crop farming, tree planting and tree nurseries. These skill changes concern mostly people working in small-scale farming. Skills are mainly acquired on the job or through agricultural extension workers.

Research skills are required, mostly at university level, to develop crop varieties that can withstand the vagaries of climate change as changing environmental conditions jeopardize agricultural yields. Demand for soil scientists, plant and animal breeders, and pathologists will increase. Agricultural research has become more multidisciplinary, calling for new competencies and research profiles. At vocational education and training level, **agricultural technicians** will be in demand to undertake work related to crop diversification and the application of improved machinery to reduce energy consumption and GHG emissions. These technology-driven skills, needed also to improve agricultural productivity while conserving soil quality, affect agricultural workers on medium or large farms and plantations.

A new occupational field in this area is **precision agriculture**. Specialists in this technology provide the appropriate methods to calibrate applications of herbicides, pesticides, irrigation and fertilizers to avoid over- or under-use. In Costa Rica, only large-scale farmers and transnational companies utilize this technology, since small and medium-sized farmers lack the capital and skills to apply it effectively. The skills it requires include the ability to apply remote sensing, geographic information systems (GIS) and global positioning systems (GPS). Professionals require a university degree in agricultural engineering.

Irrigation specialists will be in demand to identify appropriate irrigation technologies that improve water conservation, conduct market studies to ensure the technologies are applied effectively, and impart skills in using and maintaining the technology to end users. This is particularly important as climate change and variability increase water scarcity. The need for these skills can be fuelled by regulation, by consumer demand or by technological advance.

¹⁹ Brøndum & Fliess: *Erhvervs- og efteruddannelser i et cleantechperspektiv* (2009).

²⁰ <http://www.fao-ilo.org/> (accessed 1 Apr. 2011).

Agricultural meteorology is a new occupation created in response to increasing weather variability. These professionals apply meteorological information to enhance crop yields and reduce crop losses caused by adverse weather. They combine knowledge of plant physiology and pathology, meteorology and agronomy, common agricultural practices and remote sensing techniques. They collect satellite images and remote sensing images, including vegetation indices from centres that monitor the evolution of rainfalls, and make projections about weather, river flows and pest infestations. In South Africa, an agricultural meteorologist is referred to as a climate change adviser in agriculture.

Driven by international markets and consumer demand, standards for organic (e.g. cotton, bananas) or fair trade (e.g. shea butter, cashew nuts, mangos) produce affect skill needs. Most of the **organic farmers** in the Philippines and Uganda are small-scale farmers. The majority of people working in organic farming have no formal education, but have received basic training on organic principles. By contrast, some managers receive additional training in marketing and other techniques, such as natural pest/parasite and disease control approaches (for example, the use of natural predators on pests), increased use of organic matter in cultivation, organic waste management and soil functions. The skills needs for organic farming are similar in developed and developing countries, with the difference that some smallholders in developing countries face fewer skill changes as established agricultural practices are closer to organic ways of producing than in developed countries where farming has become reliant on the use of chemicals. Additional occupations affected by spreading organic farming practices are those of land care coordinator, soil conservation technician, land management specialist, farm supervisor and pesticide operator. Linked to the farming sector is the production of organic seeds and fertilizers, an area in which existing occupations require new skills.

Eco-adviser in agriculture for sustainable development and eco-certification is another emerging occupation. These experts advise farms of all sizes from agribusinesses to smallholders in sustainable practices and existing certification mechanisms and standards.

In the forestry sector, numbers of **foresters or tree farmers** are expected to rise when governments invest in reforestation to mitigate negative impacts of climate change, restore soils and conserve biodiversity. Tree farmers in countries such as Uganda need additional skills to become involved in selling the carbon sequestered by their forests on the voluntary and CDM markets. To date, as the country does not have adequately skilled people to estimate the amounts of carbon sequestered by different forest ecosystems, its tree farmers have had to rely on international experts.

5.4.2 Waste and water management, recycling and materials management

These are key sectors for green jobs. As already mentioned in Chapter 4, these sectors are becoming increasingly important as natural resources become scarcer: in France, they represent nearly half of all green jobs (between 400,000 and 450,000 jobs). In developed countries, the traditional activities in this area such as treatment of wastewater and the collection and elimination of waste by storage or incineration will be slowly reduced. The jobs lost as a result will, however, be more than compensated for by the emergence and development of new activities – detection of leaks, quality of sanitation, measure of flows, closing of loops and education of consumers – which will require a higher level of training. Other new occupations that have emerged in the waste management area include those of **waste prevention manager** and **operators in recycling industries**, employed by local authorities or waste management companies.

While employment in the recycling industry in developed countries belongs to the formal economy, many people employed in recycling in developing countries work in the informal economy. The sorting of plastic bags, bottles and other valuable components of the waste is mostly done by women and children **waste collectors**. As noted earlier in this report, many of these jobs cannot be considered decent since they often involve health hazards and are very poorly remunerated. New skills for waste collectors include separating organic waste so that it can be used for composting. Other innovative uses of organic waste also require new skills, such as the manufacture of charcoal briquettes from the residues of carbonized stalks of cotton, millet, maize and tiph (a wild herb). A new occupation in developing countries – often under hazardous working conditions – is **recycler of electronic waste**, mostly employed within specialized MSEs.

Occupational profiles of **plant managers** will change as plants switch to new processes, for example waste to energy, or other materials recovery tasks. Process engineering and technical staff, such as **chemical engineers**, **industrial chemists** and **lab technicians**, are involved in analysing hazardous waste and in developing recycling procedures to ensure product standards are met and to monitor plant emissions.²¹

In Europe, occupational profiles in the waste management sector are more complex, each including several of the duties that seem to be spread among different occupations in developing countries. More advanced technologies in the industry also determine occupational requirements. For **operators in the recycling industry**, initial training programmes provide the specialized skills required to classify waste, collect material to be transformed into raw material, control and monitor recycling processes, and maintain machinery and equipment.²²

Box 5.5. Occupations in the solid waste management sector

Waste collectors collect waste and/or classify recyclables from refuse. In most developing countries they work in the informal economy without proper technical knowledge of collection or recycling methods. This causes health and safety problems, particularly for hazardous waste including medical and industrial waste.

In China, about 1.3 million people are employed in the formal waste collection system and an additional 2.5 million are estimated to work in the informal economy as waste collectors; the whole industry of recycling, reuse and remanufacturing employs as many as 10 million workers, 90 per cent of whom work in very small, often family-based, workshops. In Germany, around 55,000 people (of which only 3 per cent were women) worked in waste disposal and street cleaning in 2007: 55.9 per cent of them held a qualification through the dual apprenticeship system and only 0.7 per cent the Abitur (university entrance diploma). Forward Scotland's study of the waste management sector in Scotland suggested that in 2005 approximately 70 per cent of the labour force in the sector fell into the semi-skilled/low-skilled category, with 5 per cent in the professional/technical/managers category and the balance divided across administrative and skilled trade categories.

Plastic and paper recycling is undergoing a boom, as country reports from Brazil, China, Mali, the Philippines and Uganda make clear. Metal Wealth, one of the largest plastic recycling firms in the Philippines, employs 150 people, one-third of whom are medium- to high-skilled (supervisors, recycling machine operators, quality inspectors and maintenance technicians) and two-thirds low-skilled (plastic pickers, collectors, classifiers and sorters). Its activities have also created hundreds of indirect jobs in waste collection and trading of plastic wastes (junk and waste dealers, junk shop operators). Other specialized occupations in recycling include the dismantling of electronic waste, the composting of organic waste (e.g. in Bangladesh or Mali), or that of the "waste artisan" who crafts new objects out of the waste (for example, toys and tools from waste metal, baskets from plastic bags).

²¹ See also Forward Scotland: *Skills for the waste management sector in Scotland* (2005), available at: <http://www.futurebalance.org.uk/prevprogs/ejs/documents/skillsforwastemanagementreport.pdf> (accessed 1 Apr. 2011).

²² <http://www.cndp.fr/archivage/valid/brochadmin/bouton/b065.htm> (accessed 1 Apr. 2011).

In developed countries, regulation plays a very prominent role in changing skill needs in the waste management sector.²³ In developing countries, by contrast, change in the sector is driven primarily by income opportunities. In emerging economies, increased regulation on materials management, in particular the introduction of independent waste management systems based on segregation of hazardous waste from municipal waste streams, has led to job creation and an increased need for **public monitoring officials**.

In many developing or emerging countries, open-air defecation still poses a major threat to human health, causing water-borne diseases that kill especially infants and young children. Environmental pollution is also an issue as water quality deteriorates. Urban slum areas are most affected, but the same problems are prevalent in some rural areas.

The Indian country report classifies **water and sanitation related occupations** in three major categories. The first category deals with the production of hardware – that is, the construction of wells, tube-wells, filters, low-cost latrines, hand pumps and sanitary pans – and requires **masons, artisans** and **mechanical fitters**. The second is responsible for the operation, maintenance and monitoring of the wells, tubes and toilets, which is done by masons, mechanical fitters and **care-takers**. The third category includes **trainers** and **motivators** to raise awareness among local populations, informing and communicating in order to stimulate demand. This is crucial as the task of implementing sanitation programmes requires change not only in people's habits, but in their mindsets. In areas of water scarcity, dry toilets or composting toilets will be in increasing demand. To design, build, install and maintain these requires not only plumbing and masonry skills but knowledge of horticulture and agriculture to use the right locally available plants.²⁴

Box 5.6. Occupations related to water management

Occupations related to water management cover a wide spectrum of activities.

For instance, engineer in water industry is a new occupation in Australia. It entails technical skills in hydrogeology, water-sensitive urban design, flood-plain assessment and aquifer storage and recovery, management skills, knowledge of water trading, management of environmental flows, emerging and future water quality issues, salinity solutions and so on. Skills for wastewater management are also included. In China, the occupation of wastewater treatment engineer in urban areas is likely to grow in the wake of a government programme on water pollution control.

Water resources managers in Brazil mostly work in various parts of the manufacturing sector, for example those producing rubber goods, food and beverages, chemical products, textiles, cellulose and paper. They need knowledge and skills in hydrology, water basins and dealing with biotic elements, as well as a good grasp of the legislation and capacity to address socio-economic conflicts around water resources. This occupation conforms to that of water resource analyst in South Africa, who improves monitoring and verification of water usage and conservation.

A new occupation in Spain is that of desalination plant maintenance and operation manager, who oversees the process of turning seawater into fresh drinking water.

Managing materials in a green way implies not only recycling but looking at the composition of materials themselves. Materials science and in particular **green chemistry** is a growing area where new skills are emerging as technology advances. With cleaner and healthier materials, consumers would be protected against adverse effects of toxic substances in the products they use; there would be less floating non-biodegradable debris, helping marine life and making beaches cleaner; and fewer landfills and hazardous waste sites would be needed. The scientific and technical workforce for this aspect of a green economy requires highly skilled technicians, laboratory

²³ Forward Scotland: *Skills for the waste management sector* (2005).

²⁴ See e.g. <http://www.drytoilet.org/>, <http://www.compostingtoilet.org/> or <http://www.worldtoilet.org/> (all accessed 1 Apr. 2011).

workers and other employees who can apply green chemistry principles in their jobs.²⁵ The O*NET taxonomy update in the United States, for example, lists **biochemical engineer** as an emerging green occupation; other related occupations where skills are likely to change include those of **chemical engineers, chemical equipment operators and tenders, chemical plant and system operators, chemical technicians and chemists.**²⁶

5.4.3 Tourism

Eco-tourism is developing in many countries and regions as consumers demand services that do not harm the environment. Large tourism businesses appear still to be avoiding major “greening” of their production processes in the face of ambivalent consumer demand; however, smaller, specialized operators are emerging and have already created a vibrant market. Nature-based tourism is one of the booming industries in Latin American and Asian countries such as Costa Rica or Thailand. Governments also play a role in the push for more sustainable tourism as many of the natural resources needed for tourism are essentially “common pool” resources and thus require special protection.²⁷ The growth of eco-tourism requires **tourist guides, hotel managers, resort operators, souvenir shop assistants, clerks in tourist offices** etc. to be knowledgeable about environmental concerns and be able to incorporate issues such as biodiversity, forest rehabilitation, and climate change adaptation and mitigation measures into their daily business. This means that existing occupational profiles change. Skills are mostly acquired through continuing or on-the-job training.

5.4.4 Renewable energy

Renewable energy not only has a high potential for employment generation (see Chapter 4, section 4.5) but also represents the most dynamic labour market segment for newly emerging green occupations, such as **renewable energy engineers, consultants, auditors, quality controllers, and installation and maintenance technicians.** These occupations are widely considered new since their skills content differs considerably from their counterparts in other sectors, albeit with some overlap. These occupations are all characterized by high added value and middle to high qualification levels. Others that may develop in the future include **lawyers specializing in renewable energy legislation.** In Spain, 76 per cent of new green jobs created in the renewable energy sector are in construction, installation, manufacturing and maintenance, the other 24 per cent in management, commercialization or engineering occupations. Half of all renewable energy occupations have a technical profile.²⁸

²⁵ California Environmental Protection Agency: *California Green Chemistry Initiative: Final report* (2008), available at: http://www.dtsc.ca.gov/PollutionPrevention/GreenChemistryInitiative/upload/GREEN_Chem.pdf (accessed 1 Apr. 2011).

²⁶ See <http://www.onetcenter.org/green.html?p=2> (accessed 1 Apr. 2011).

²⁷ A common pool resource is a natural or human-made resource whose size or characteristics make it costly, but not impossible, to exclude potential beneficiaries from obtaining benefits from its use. Unlike pure public goods, common pool resources face problems of congestion or overuse because they can be depleted: examples are fishing grounds, forests, water or pastures. See P. Williams and I. Ponsford: “Confronting tourism’s environmental paradox: Transitioning for sustainable tourism”, in *Futures* (2009), Vol. 41, pp. 396–404.

²⁸ ISTAS: *Employment in renewable energy and auxiliary industries in Spanish SMEs* (Ecoinformas, 2006).

Box 5.7. Solar energy technicians

Solar energy technicians install solar energy systems on a variety of structures (residential, commercial or industrial) in compliance with site assessment for sun intensity. They measure, cut, assemble, adjust and attach framing and solar modules, and perform electrical work. They also set up, maintain, repair, operate and test solar energy systems and large- or small-scale solar power plants for electricity generation or water heating. These technicians require skills in electrical and electronic components, PV electricity systems, roof installations and business management.

While the general features of the occupational profile are comparable internationally, different countries use different names for the same occupation, or define narrower occupations that cover only parts of the profile described above. The following table lists occupations within the family of solar energy technicians, and related occupations with narrower specialization or higher levels of skill requirements.

Occupations with narrower specialization	Occupations with skills similar to solar energy technician	Occupations with higher-level skills
Solar PV installer PV system installer Solar thermal installer/technician Solar sales assessor Boilermaker Solar water heater manufacturing technician Maintenance technician Installation helper	Solar panel installer Solar power installation technician Solarteur Solar power plant technician Solar electric installer Solar panel maintenance and repair technician	Green building architect Solar commercial installation electrician or foreman Solar energy installation manager Solar engineer Environmental construction engineer Solar energy production technician System integration engineer PV power systems engineer PV solar cell designer Solar operations engineer Commercial green building and retrofit architect

Countries also apply different educational requirements for these jobs. Usually, however, those in existing occupations such as plumbers, carpenters, roofers, sheet metal workers, line workers, electric installers/electricians and heating, ventilating and air conditioning installers can be trained to work as solar energy technicians. This is the case across American, European, African and Asian countries.

Educational requirements also vary according to the level of technology used. In South Africa, there are two types of solar water heating systems: low-tech units targeted at low-income housing and more high-tech units. There is a substantial difference between the levels of skills needed to install these two types of system. Solar engineers commonly require university degrees, as they are involved not only in installation but in design and production of solar energy technology. However, in Bangladesh and India illiterate women are trained to become solar engineers in rural areas, installing PV lighting systems, and also fabricating locally applied technology such as circuits and solar lanterns, solar lamps, charge controllers, choke coils and transformers, and solar cookers.

Some countries have introduced accreditation schemes for solar energy technicians to exercise quality control. So far, only a small proportion of the workforce has been covered by these schemes. In Australia, 2,000 solar PV installers are accredited by the Clean Energy Council. In China, 2,000 solarteurs out of a total of around 2 million have acquired certificates. In the United States, the North American Board of Certified Energy Practitioners has certified 4,000 PV installers, while the states of California and Florida have also introduced licensing schemes.

As the solar energy market is vibrant and growing rapidly, demand for solar energy technicians will continue to increase. The majority of the 100,000 or so green jobs expected to be created in solar energy in Bangladesh by 2014 will be for solar energy technicians, engaged in expanding solar home systems. In Brazil, the demand for solar energy technicians (called solar panel installers) stems from a government programme called "My house, my life" which provides access to affordable housing with solar panels for low-income families. Skill shortages are already reported in many countries and are likely to become even more acute.

Demand for the various renewable energy occupations varies across countries. Research and development and large shares of the production of renewable energy technologies are concentrated in developed countries, and also in China and India. Accordingly, while **solar energy production technicians** are mostly employed in Australia, China, Europe and the United States, **solar energy technicians** capable of repairing and maintaining the technology can be found in all countries involved in the research. Managers, engineers, craftspeople and technicians in hydro, geothermal, wind, biomass or biofuel power plants are also spread across most countries. By contrast, occupations related to rural off-grid electrification through renewable energies are restricted to countries where rural populations do not yet enjoy electricity supply.

Box 5.8. Training provision for solar energy technicians

The research identified a broad variety of skills responses to the need for trained solar energy technicians, ranging from short courses, often provided by universities or international experts, to continuing training initiated by business associations, ministries, public employment services or international donors. Training by NGOs is often targeted to specific disadvantaged groups and initial training provided through the technical and vocational education and training (TVET) system, sometimes in collaboration with private companies, universities or research institutes.

Short courses in Bangladesh or Uganda for graduates in science or engineering, architects, policy-makers or economists are provided by universities (e.g., respectively, the Renewable Energy Research Centre at the University of Dhaka and Makerere University). In Uganda, staff of registered solar energy companies hold qualifications in business management, electrical engineering or technical trades. Most have been trained in skills related to the assembly, installation and repair of solar energy panels by international consultants. The Ministry of Energy and Mineral Development in Uganda, in partnership with Makerere University, has launched continuing training programmes for local technicians on panel fitting and maintenance.

In France, continuing training has adapted to new needs faster than initial training. Short programmes have been created to train architects, engineers and installers, partly through the Qualit'ENR scheme, a key initiative set up by the main federations and business associations in the sector which started to develop training standards for the installation of renewable energy equipment in 2006. However, stakeholders have expressed concern about the multiplication of training programmes by private providers and the associated risk to the quality of training, and about the relevance of "green" training courses to labour market needs.

Initial training in France has been addressed by the Agency for Environment and Energy Management and the National Institute for Solar Energy, which since 2006 have supported training of trainers on solar energy in vocational secondary schools. However, the sector expects a skills shortage since the number of trained trainers is not sufficient to meet the anticipated demand for trained technicians.

Among longer training programmes, France's professional skills certificate for installation and maintenance of solar systems (involving 1,050 hours of training) is targeted at existing professionals, such as roofers, heating engineers and electricians. In the United States, community colleges have initiated new programmes in solar panel fabrication and installation where demand is high. Since the German dual system decided not to offer a separate apprenticeship programme for solar energy technicians, a private company launched a three-year dual bachelor of engineering in solar techniques course in cooperation with the University of Applied Sciences in Köthen and the Fraunhofer Centre for Silicon and Photovoltaic. The course follows the dual training mode of the German apprenticeship system, with the theory being taught at university and the practical experience acquired in the company, with which students are required to enter into a contract.

NGOs play an important role in training in developing countries, where they particularly address disadvantaged groups such as illiterate women. In India, the Barefoot College has trained illiterate people, building on traditional knowledge and imparting modern skills, and has also extended its services to international participants. One course trained women from Bolivia, Cameroon, the Gambia, Mali and Sierra Leone, who then returned to introduce solar-powered electricity into villages in their respective countries. In Bangladesh, Grameen Shakti has trained more than 1,000 women technicians through 20 Grameen Technology Centres to install, maintain and assemble components of solar home systems, as well as 10,000 students and 5,000 women users. The NGO received technical support from several donors including USAID, the World Bank, GTZ and ADB.

The training provided is delivered on the job with little coordination nationally. One exception is a current pilot project by the ILO in Bangladesh, aiming to link the training provided by Grameen Shakti to formal training centres run by the Bureau of Manpower, Employment and Training. This public-private partnership aims to standardize the curriculum, introduce formal certification of the course and mainstream it through the ILO's community-based training programme.

Tables 5.5 and 5.6 show occupations in the renewable energy sector in, respectively, the Philippines and Indonesia.

Table 5.5. Jobs in renewable energy in the Philippines

Area of employment	Job opportunities	Area of employment	Job opportunities
Rural electrification	Sales/planning/project engineers	Government	Energy managers/officers
	Renewable energy (RE) technicians/installers/repairers		Energy auditors
	Community organizers		RE planners/engineers/researchers
	RE resource assessors		RE technicians/inspectors
	RE component fabricators		Rural development officers
	Village electricians		Community organizers
	Micro-financiers		Trainers
	RE project monitors		
Industry	Energy managers	Academia	RE professors/teachers
	Energy auditors		Researchers
	RE planners/engineers/researchers		Trainers
Manufacturing	Designers/engineers/draftspeople	Livelihood/agriculture	RE technicians
	Metalworkers/tinsmiths/welders		Mechanics, electricians, welders
	Electricians		Researchers
	Mechanics		

Source: Institute for Labor Studies: *Green jobs: Working with climate change* (Manila, DOLE-ILS, 2008).

Table 5.6. Changing and emerging occupations in renewable energy in Indonesia

Area of sector	Company scale		Location		Ownership		Occupations
	Large	SME	Rural	Urban	National	Joint venture/ multinational	
Geothermal	√		√		√		Geothermal engineer Electrician
Big hydro	√		√		√		Hydro engineer Electrician
Small or micro hydro		√	√		√		Hydro engineer Electrician
Solar panel retail		√		√	√		Electrician
Wind power	√			√	√	√	Wind engineer Electrician
Biogas	√	√	√	√	√		Biogas engineer Electrician
Biofuel	√	√	√		√		Biomass/waste engineer

Source: Indonesian country report.

There remain certain reservations about sustainable biofuel production, as noted in Chapter 4 (see box 4.3). Related occupations that will experience changes in skill needs include those of farmer, agronomist, environmental officer and seed developer. Newly emerging occupations in this area are biofuel engineers in biofuel distillation or processing, machine and distillery operators, mechanical engineer and maintenance engineer. The use of jatropha oil as biofuel requires technical competencies to convert engines to run on this type of oil, and to operate pressing and filtering systems, creating a new occupational profile of **jatropha technician**.

In the wind energy sector, jobs are likely to be highly skilled and to require a range of engineering and project management skills.²⁹ In India, new occupational profiles include **wind energy operations manager**, **wind energy engineer** and **wind turbine service technician**. In Denmark, a recent study carried out among clean technology companies suggests that a new converging occupational profile should be created, targeting not only wind energy but also solar energy and wave energy enterprises, with the title of **climate designer**. A study among offshore wind energy companies revealed the range of qualifications required across the industry: they include skills in planning, development, finance and insurance; foundation technology and tower construction; mechanical engineering and plant construction; fibre composite technology; electrical engineering; assembly and logistics; service, maintenance and repairs; and maritime construction.³⁰

Policy-makers need new skills to accelerate the adoption of renewable energy and to integrate it into national development strategies in agriculture, forestry, poverty alleviation, energy and rural electrification. Government officials in ministries or agencies need to coordinate activities in the field of renewable energy; provide information; issue technical standards to assure quality; and provide a platform for exchange between national and international partners. While general objectives for the promotion of renewable energy are similar among all countries, particular strategies and instruments can vary widely between developing, emerging and developed economies.

5.4.5 Transport and logistics

Logistical services are at the heart of globalized economies, enabling international trade in products and services. At the same time, individual car ownership continues to be on the rise, in particular in emerging economies where private vehicles represent aspiration and new economic success. Although significantly affected by the economic crisis in 2009, as noted in Chapter 4 (section 4.4), the automotive industry is still an important employer in both developed and developing countries. Thus changes in occupational profiles within it will affect a considerable workforce.

Markets, technology and regulation all have impacts on skill needs in the transport sector. As oil prices increase, new and more energy-efficient engines are developed, requiring new design, engineering and technical skills. The new EU regulation on CO₂ emissions from cars is leading to investment in low-carbon vehicle research and development, requiring designers and engineers to innovate.³¹ Regulation in China limiting fuel consumption had similar impacts on vehicle

²⁹ European Wind Energy Association: *Wind at work: Wind energy and job creation in the EU* (2009), available at: http://www.ewea.org/fileadmin/ewea_documents/documents/publications/Wind_at_work_FINAL.pdf (accessed 1 Apr. 2011).

³⁰ G. Hammer and R. Röhrig: *Qualification requirement analysis offshore wind energy industry* (July 2005), available at: http://www.offshore-power.net/Files/Dok/final_report_qrs.pdf (accessed 1 Apr. 2011).

³¹ Regulation (EC) No. 443/2009 of the European Parliament and of the Council, 23 April 2009: see http://ec.europa.eu/environment/air/transport/co2/co2_home.htm (accessed 1 Apr. 2011).

production.³² Conversion of the government fleet in Bangladesh and public transport in New Delhi to compressed natural gas (CNG) technology sparked a demand for CNG-related knowledge and skills, specifically a need for **fuel retrofitting and conversion technicians, supervisors and workshop technicians**.

In many countries, green solutions not only lower fuel consumption but also replace some fossil fuel engines with hybrid electric and electric vehicles and increase the use of biofuels or of CNG. Besides **engineers, developers and craftspeople** such as **welders** who need to incorporate principles of eco-design into their work (see section 5.4.7 below on manufacturing), the main occupation to become greener is that of **car mechanic**, or **car mechatronic** as the revised occupation in several European countries is called. High-level problem-solving skills and technical diagnostic skills will be needed to meet new requirements. New fuels will affect the skills profile of fuel station workers and of those included in the fuel production chain (see section 5.4.4 above on renewable energy).

Apart from new green technology, organizational or institutional innovations can also contribute to reducing the environmental impacts of the transport and logistics sector. Increased use of car leasing schemes, thereby reducing scrapping of old cars, leads to higher demand for **car leasing clerks and managers**. Car pooling also requires the institutional apparatus to set up the appropriate arrangements and managers, website administrators or clerks to run them. Extending public transport systems will require more **bus drivers, train conductors and public transport managers**. New systems such as Galileo satellite navigation, radio frequency identification (RFID) or the Rapid Urban Flexible (RUF) system demand new skills of the workers applying them.³³

The **aerospace industry** occupies an important place in efforts to green the transport sector, given its high emissions and the increasing popularity of flying. Ways of reducing the aviation industry's carbon emissions will be rooted in technological development, which can be stimulated by governments. According to country reports, the skills response linked to this work is at an early stage. **Research and development skills** are crucial to identify greener solutions, such as lighter fans that reduce fuel consumption, which will then need to translate into **manufacturing and repair skills** for technicians and engineers. Carbon offsetting to compensate for flights taken requires new skills related to **project selection, carbon accounting and marketing**.

The transport and logistics sector does not seem likely to create many new occupational profiles but will be affected by considerable skill change within existing occupations.

5.4.6 Building

As noted in Chapter 4, energy used in buildings for heating or cooling purposes constitutes a substantial share of overall energy consumption in countries all over the world. A considerable body of literature has described the energy-saving potential in this sector through improved insulation, heating and cooling systems, building materials and use of renewable resources.³⁴ Greener building technologies (for windows, doors, materials, insulation and heating, and mon-

³² D. V. Wagner, A. Feng and C. Wanga: "Structure and impacts of fuel economy standards for passenger cars in China", in *Energy Policy* (2009), Vol. 37, No. 10, Oct., pp. 3803–11.

³³ European Foundation for the Improvement of Living and Working Conditions: *Trends and drivers of change in the EU transport and logistics sector: Scenarios* (Dublin, European Monitoring Centre on Change, 2008), available at: <http://www.eurofound.europa.eu/pubdocs/2008/40/en/1/ef0840en.pdf> (accessed 1 Apr. 2011).

³⁴ See e.g. <http://www.unep.org/sbci/index.asp> (accessed 1 Apr. 2011); UNEP: *Green Economy Report. Buildings investing in energy and resource efficiency* (2011).

itoring and central systems) are becoming increasingly readily available and increasingly demanded by clients. In France, out of 4 million jobs in the sector, 260,000 craftspeople now work with eco-materials and integrate energy efficiency techniques into the construction and maintenance of sustainable buildings. The California Employment and Development Department has assembled a list of green construction jobs including both new and traditional occupations (see box 5.9).

Box 5.9. Green construction jobs in California

Air-quality auditor	Facilities manager
Appliance installer	Fuel cell test technician
Architect	Geothermal analyst
Building materials specialist/sales rep (green/sustainable building materials)	Geothermal heat pump installer
Buyer and purchasing agent/manager	Glazier
Carpenter (green building)	Hazardous materials removal worker
Civil engineer	HVAC ² salesperson
Concrete machine operator	HVAC service technician and installer
Construction labourer	Insulation worker
Construction manager	Landscape architect
Construction supervisor, first-line	Pipefitter
Cost estimator	Plumber
Customer service representative	Refuse and recycling material collector
Drafter, CAD ¹ technician	Roofer
Drywall and ceiling tile installer	Sales representative
Electrical and electronic engineering technician	Sheet metal worker
Electrical engineer	Solar installation manager or project foreman
Electrician	Solar photovoltaic installer or technician
Energy auditor	Solar thermal installer or technician
Energy engineer	Steamfitter
Engineering manager	Truck driver
	Welder
	Wind energy technician

¹ Computer-aided design.

² Heating, ventilation, air conditioning.

Source: California Employment and Development Department: *Green building. Construction in California: Job training for an emerging industry*, available at: <http://www.green-technology.org/greentech-report-june09r.pdf> (accessed 1 Apr. 2011).

While the use of eco-materials is mainly driven by market demand, the major driver of change for energy efficiency in buildings appears to be legislation. The European Energy Performance of Buildings Directive³⁵ and the Indian Energy Conservation Building Code are examples of measures that set standards to reduce energy consumption in buildings.

In the EU, anyone selling a home or other building has to obtain an Energy Performance Certificate that defines the energy consumption of the building. EU countries need to specify which group of specialists is entitled to issue this certificate. **Energy audit** and **energy consultancy in building** are usually considered newly emerging occupations. Auditors and consultants, including energy efficiency specialists, may work independently, in construction sector consulting firms, or in companies responsible for the construction, maintenance, refurbishment or energy contracting of buildings.³⁶ These occupations also emerge in countries where energy consumption of buildings is not regulated, because of the great potential for cost saving through energy saving in the building sector. They require a mix of competencies, some traditional and others new, as set out in box 5.10.

Box 5.10. Energy auditors and consultants in building

Energy auditors and consultants in building assess the energy consumption of buildings and its average cost. Auditors are licensed to prepare audit reports in relation to certain standards, such as the globally recognized Leadership in Energy and Environmental Design (LEED) standards, or Energy Star in the United States, without providing further advice. Energy consultants (or energy auditors who are not hired to do an audit) are asked to propose measures to control energy consumption, with recommendations on energy-efficient renovation work and use of energy-efficient technology. Both occupations carry out energy efficiency assessments, apply new calculation methods or techniques, perform inspection of and techno-economic analysis for different sub-systems of the building (heating, sanitary, ventilation, air conditioning, solar PV etc.), and present the results in a report. In some countries, energy auditors or consultants are also referred to as domestic energy assessors (the United Kingdom), energy performance experts (France) or consumer advisers (Germany).

In the United States, where energy auditors have been active for over 30 years, the occupation has not yet been included in the Standard Occupational Classification (SOC). The occupation of energy auditor was proposed for inclusion but, after reviewing the request in 2009, the SOC Policy Committee considered the tasks performed by energy auditors not sufficiently unique compared to several existing occupations. Energy auditors perform similar tasks and draw on the same skills as building inspectors, farm and home management advisers, construction and building inspectors, cost estimators, energy audit advisers and environmental engineering technicians, whose qualifications vary between associate and bachelor's degree or higher.

The workforce of energy consultants and auditors is drawn from established occupations and includes civil engineers, architects and craftspeople including carpenters, masons, plumbers, building surveyors (experts in handling lead, asbestos or termites, for example), heating installers, roofers, electricians and so forth. The new competencies they need range from renewable energy, new materials and retrofitting to climate change effects, regulatory frameworks, and risks and safety. As the skills needed supplement existing knowledge, they can generally be acquired through continuing training. On the basis of research into new occupations in the context of greening,³⁷ O*NET identified energy consultancy as a new and emerging occupation and attributed a new SOC code in 2010. In Germany, the role of energy consulting has been incorporated into an existing occupation: chimney sweeps must now integrate environmental supervisory and consultancy tasks into their work. In the United States, the Residential Energy Services Network and the Building Performance Institute have developed certification standards for energy auditors and between them have accredited over 350 training providers to teach and certify potential employees in occupations related to energy auditing.

³⁵ COM 2002/91/EC: Directive on the Energy Performance of Buildings, available at: http://ec.europa.eu/energy/efficiency/buildings/buildings_en.htm (accessed 1 Apr. 2011).

³⁶ “Energy contracting” means that an investor retrofits a building and is repaid by the saving on energy costs – until the investment is recovered. From that point on, the owners benefit from the reduced energy bills.

³⁷ E. C. Dierdorff, J. J. Norton, D. W. Drewes, C. M. Kroustalis, D. Rivkin and P. Lewis: *Greening of the world of work: Implications for O*NET-SOC and new and emerging occupations*, Paper prepared for the US Department of Labor, Employment and Training Administration, Office of Workforce Investment, Division of Workforce System Support, Washington, DC, Feb. 2009.

Once energy auditors and consultants have identified the potential for energy efficiency improvements in buildings, **construction workers** need the knowledge and skills to carry out retrofitting. A study conducted by the French Environmental Agency concluded that the following occupations will be significantly affected by this requirement: **carpenter** (insulation work), **plumber** (installation of solar water heating), **heating engineer**, **painter** and **plasterer** (insulation, roofs and walls), **roofer** (solar PV and thermal installation) and **electrician**. In Denmark, the occupation of **building service technician** provides consulting services and is able to apply green technology in buildings.

New skills requirements in building include:

- knowledge of new materials, technologies and energy efficiency adapted technical solutions;
- cross-cutting knowledge of energy issues;
- understanding of other occupations related to building renovation;
- client counselling/advice to meet new market demands; and
- building techniques adapted to risks of natural disasters such as earthquakes.

5.4.7 Manufacturing

The manufacturing sector has a huge potential for greening. Production processes become green when green technology and improved materials are applied, outputs of waste and inputs of energy and resources are reduced, and account is taken of products and materials throughout their entire life. Occupations affected by these changes vary from one industry to another, but across the sector include those of **executive manager**, **researcher/developer**, **engineer**, **industrial technician** and **machine operator**.

Changes in occupations in manufacturing are driven by markets, technology and regulation. Regulation now requires **leather tanners** in India, for example, to acquire new skills to reduce the use of water and of hazardous chemicals and to treat the wastewater, and **lead smelters** in Egypt to acquire the skills needed to reduce pollution. Regulation also requires **refrigeration mechanics** to be familiar with new techniques to replace appliances that generate CFC gas with others that do not harm the ozone layer. **Pollution control officers** in companies as well as in public administration monitor compliance with legislation.

An emerging occupation in manufacturing is **eco-design**. Eco-designers also work in the building sector, energy production, agribusiness, the hospital sector, local authorities and consulting services, which shows the cross-sectoral nature of this new occupation. The occupational profile is described in more detail in box 5.11.

The Danish clean technology sector highlighted the need to revise existing competency goals for vocational training in manufacturing across a wide variety of occupational profiles: auto mechanic; technical insulation; electro technician; supply technician; cooling technician; plastics technician; metal technician; process technician; wind technician; industry technician; industry operator; industry electrician; electrician; and automation technician.

Box 5.11. The emerging occupation of eco-designer

Eco-designers aim to reduce the environmental impact of products, including their energy consumption, throughout their entire life-cycle. They integrate environmental issues from the initial design stage, assess environmental impacts using various tools and methodologies, and minimize those impacts by identifying adequate measures (e.g. introducing closed-loop systems, use of different materials, energy efficiency and recycling). Eco-designers improve the technical, energy, ecological and economic performance of products, while minimizing negative environmental impacts and reducing risks. They also evaluate consumption habits and ensure that the environmental added value of products is transparent for consumers. They can work as freelance consultants or be employed by companies to improve production processes in a wide range of sectors.

Eco-designers are commonly drawn from existing occupations such as those of product design engineer, energy consultant or waste manager. Apart from eco-design as a self-standing occupation, there are also existing occupations that include eco-design skills, such as engineer for quality, safety and environment, environmental auditor, project manager, financial analyst and communication manager.

In Europe, demand for the new skills of eco-design is prompted not only by changing consumer demand but also by the European Eco-design Directive (2005, updated 2009), which established a framework of requirements for environment-friendly product design.

5.4.8 Business and financial services

Business consulting services and the finance sector are also undergoing change in skills requirements. Existing occupations in this sector are becoming greener, and a number of new occupations are emerging. Change is driven by regulation and by market opportunities in areas such as carbon trading.

The most prominent and widely referred to emerging occupation in this field is **environmental consulting**. Environmental consultants help make environmental improvements to businesses. They provide advice on improving production efficiency in terms of energy, water and resources, minimizing waste, improving cross-sector resource efficiency and commercial trading of materials, and sharing assets, logistics and expertise. Environmental assessments may be carried out in any sector and in both developed and developing countries, adapted to national legislation and requirements. In Egypt or Uganda, for example, environmental impact assessors systematically identify and assess the potential environmental impacts of a proposed project, evaluate alternatives, and formulate appropriate mitigation, management and monitoring measures in the form of an environmental management plan.

In contrast to environmental consultants, **environmental auditors** assess the environmental performance of businesses for compliance with legislation and standards (e.g. ISO 14001), review the effectiveness of environmental management systems, or assess a particular subject (e.g. waste minimization); however, in order to preserve their neutral position they do not provide advice.

Carbon consulting may also be part of an environmental consultant's tasks. Occupations in the carbon finance sector are set out in detail in box 5.12, and the skills response in box 5.13.

Established occupations in the finance and banking sector will also undergo changes as a result of climate change mitigation and adaptation needs. **Managers, loan officers, investment bankers and venture capitalists** need to factor in and assess the climate risk attached to their credit portfolio.³⁸ Moreover, they need knowledge of the risks and returns associated with financing new green technology projects in order to minimize initial investment risks. **Commercial lawyers** need new skills to offer legal advice on projects with an environmental focus, and **technical and financial back-office clerks** need additional skills to comply with new regulations.

³⁸ S. Dupressoir: *Climate change, the environment and jobs in UNI Europa's sector* (Brussels, European Trade Union Institute, 2009).

Box 5.12. Occupations in the carbon finance sector

Flexible mechanisms introduced in the Kyoto Protocol included international carbon trading, which led to a number of new green occupations.

The United Kingdom carbon finance sector employs over 21,500 staff in 2,500 companies, including emissions traders, environmental lawyers, carbon auditors and CDM project investors. Financial brokers who once traded fossil fuels are now buying, selling and trading current and future carbon emissions. The new occupational profile requires the skills of the existing occupation plus additional specialized knowledge of new green markets.

Demand for carbon consultants is growing in developing countries such as Indonesia, where the number of consulting firms providing services related to CDM projects has increased from 1 in 2005 to 20 in 2009. Carbon consultants are hired to assist project owners in meeting national and international criteria to qualify under the CDM. They help prepare the necessary documentation, develop the additionality argument (i.e. proving the added value of the project in terms of potential for real and verifiable emissions reduction), and generally assist in the project's design and processing until it is eligible as a CDM project. A combination of technical and financial skills is needed to perform these tasks. Technical skills required include the capacity to calculate the emissions reduction potential using methods defined by the international CDM governing body. Financial skills required include the capacity to undertake financial analysis of the project.

The country reports for Mali and South Africa both deplore a shortage of carbon consultants in the country. Project developers, even if they are aware of opportunities under the CDM, face problems finding expertise at national level. In addition, staff in financing institutions may be unaware of the CDM's provisions and thus reluctant to provide finance for projects, or regulations may make it difficult for local authorities to access carbon credits.

Box 5.13. Skills provision for the carbon finance sector

Emissions traders in the **United Kingdom** gain new skills through in-house training or through an industry-led continuing training programme. In-house training includes specialist technical training, coaching, mentoring and team work. The industry-led response is offered by the European Climate Exchange, a marketplace for trading carbon emissions, including futures and options on allowances and certified emissions reductions. The short courses of up to two days cover the principles of carbon trading, the CDM, voluntary markets, carbon offsetting and carbon price drivers, among other topics. Training in trading software is also provided. The United Kingdom Government also prompted skills development by establishing a prototype emissions trading scheme to prepare firms for the European trading scheme. This allowed employers and employees to acquire skills in measurement, verification and the design of a working registry to track the transfer of emissions allowances.

In **Indonesia**, carbon consultants are trained on the job. New recruits receive in-house training on CDM procedures and methodologies. No courses are provided by the Government or international agencies. However, carbon consultants benefit from two international professional associations: the global Project Developer Forum, which assists carbon consultants in sharing knowledge and coordinating efforts to improve CDM-related policies; and the Carbon Market Investor Association, which sustains CDM markets by fostering dialogue between carbon investors, policy-makers and other stakeholders.

The first internationally accredited training course for carbon auditing in **South Africa** was run by a private company, the Global Carbon Exchange. The company offers three-day courses on carbon footprint analysis for carbon consultants, and carbon literacy courses for managers and executives.

5.4.9 Administration and management

As the *Green jobs* report has highlighted,³⁹ greening economies are faced with a substantial management challenge. This challenge consists of developing awareness, new perspectives and managerial capacities to implement change in processes, rules, products and services. **Managers** in enterprises, public administration and NGOs at all levels need skills for responding to climate and other environmental changes. Drivers of skills change among managers and administrators are first and foremost changes in the natural and built environment, such as resource scarcity or pollution, with the addition of market opportunities in the case of enterprises. Administrators and managers in government need skills to devise regulations in response to environmental challenges. These new regulations then become additional drivers of change for business managers.

Administrative and management positions related specifically to environmental protection include those of **forest areas manager**, **protected natural reserves manager** and **public environmental inspector**. Posts in these occupations are likely to increase in number when environmental legislation is strengthened. The occupational profile, however, is likely to remain unchanged, unless legislation revises protection rules and standards.

The capacity of government administrators is crucial in the management of responses to natural disasters. Institutional constraints and weaknesses can impede management of, for example, floods or food shortages, as a case from Bangladesh illustrated.⁴⁰ Skills in preparation for disaster and risk management are paramount for managers in disaster-prone areas.

5.4.10 Retail

The retail sector, while also subject to environmental regulation, will need to equip its workforce with new skills mainly in response to changing consumer demand. Greening in the retail sector also involves ensuring that supply chains for goods meet environmental or, more broadly, sustainability criteria.

Businesses are increasingly recruiting **sustainability managers** to control certain aspects of production and distribution processes and monitor activity in supply-chain partners. In South Africa, this occupation is frequently found in multinational corporations and those relying on EU or US export markets with higher consumer awareness of green issues. Sustainability managers need knowledge of carbon and water footprinting and of sustainable agriculture and sustainable labour practices, plus strong operational knowledge of their businesses to enable them to monitor sustainability criteria and identify improvements in practice.

Growing demand for local products driven by the environmental awareness of consumers, referred to as the relocalization of supply, can affect entire national food industries. Within these supply chains, new marketing skills will be required to assist small producers to sell their products in supermarkets and to be in contact with consumers, a practice long abandoned in global value chains. For example, Tesco recently announced that it was going to open six new purchasing centres for this purpose.⁴¹

³⁹ UNEP, ILO, IOE, ITUC: *Green jobs*.

⁴⁰ S. Huq, Z. Karim, M. Asaduzzaman and F. Mahtab: *Vulnerability and adaptation to climate change in Bangladesh* (Dordrecht, Kluwer Academic, 1999).

⁴¹ Dupressoir: *Climate change, the environment and jobs*.

Box 5.14. Store managers in the food retail sector: The case of Jollibee Foods Corporation

Jollibee Foods Corporation is the Philippines' leading fast-food chain with 600 stores countrywide. In order to comply with regulation on water effluents and solid waste management, the company developed a greening initiative implemented by two new units: the Environment and Safety Unit and the Energy Management Unit. Under this initiative, each step in the production and service process needs to apply the concept of "cleaner production" within the existing standards of speed, service and cleanliness.

Store managers, who are experts in restaurant management, require new skills to ensure the implementation of the company's environmental initiative at store level. They need to know about energy-saving technologies and to be able to monitor energy consumption and supervise compliance with environmental regulations. They act as the stores' pollution control officers, and are responsible for training the service crew.

New skills are provided by the two new units in the form of three-day training programmes on energy management and pollution control, run in cooperation with the central government Department of Environment and Natural Resources and the regional government Laguna Lake Development Authority.

5.4.11 Education and training services

The education and training sector is of critical importance in the green transition, disseminating basic knowledge about environmental changes and affecting the behaviour of individuals in matters of environmental sustainability. The skills required in the sector itself are also changing, as teachers, trainers, instructors, school managers and public administrators adapt to change in the demand for their services brought about by technological change and innovation, climate change and environment, greening policy and regulation in specific teaching fields, and labour markets.

The increasing demand for core skills (discussed in section 5.3 above) may be changing how these skills are imparted. Pedagogical methods are being reconsidered with a view to finding new ways of mainstreaming core skills in a wider variety of courses. For instance, teaching skills in leadership, networking, negotiating and communications requires a great deal of pedagogical innovation. Foreign languages are taught at all ages from early childhood, requiring quite different teaching methods for different age groups. Environmental awareness is becoming widely recognized throughout the world as one of the essential core skills; however, it is critical that environmental awareness and sustainability skills are inculcated from early childhood, and as yet they are not sufficiently embedded in teaching programmes at pre-primary and basic education levels.

Whereas compulsory and general education have been relatively successful in integrating core sustainability skills and environmental awareness into the curriculum, this remains to be achieved in the case of informal, non-formal and vocational training. Technical and vocational education and training (TVET) is crucial in producing a skilled workforce capable of adopting and maintaining clean technologies, introducing further innovation, and implementing policies and regulations in various green and greening industries. The urgent need for closer links between training and the world of work poses a significant challenge for teaching and training staff and their own hands-on skills.

Teaching and training personnel in all education systems and at all levels need command of the necessary skills and methods to impart environmental knowledge, to create awareness and to react flexibly to ever-changing labour market needs. In addition to these skills challenges, there is a general shortage of teachers and trainers in many countries. In developed countries, population

ageing is intensifying the shift from initial to continuing training. Reports from developed countries point to achievements already made at the initial level of education and training, and state that occupations related to environmental education and awareness have experienced considerable growth and diversification. The future prospects for this sector are seen as stable, without expected rises in demand for these occupations.⁴² However, many developed countries have registered a shortage of trainers for the adult population, further aggravated by the fact that the population of teachers and trainers is itself ageing.⁴³ Developing countries, meanwhile, have insufficient numbers of well-trained teachers and trainers to satisfy the need to update the skills of large and in many cases still growing workforces, including a need to incorporate environmental course content and update curricula at primary, secondary, tertiary and adult training levels.

5.5 Gender implications

Environmental changes and their repercussions in the world of work and skills needs are not gender neutral. Women are reported to be more vulnerable than men to the effects of climate change because they represent the majority of the world's poor, are proportionally more dependent on threatened natural resources, and are more severely affected by natural disasters.⁴⁴ In addition, women in the agricultural sector in developing countries have less access to credit or agricultural inputs such as irrigation, most of which are administered by men; they generally also have a lower education level than men and are thus less likely to be reached by extension services.⁴⁵ Stereotypical attitudes of extension officials pose another challenge. Additionally, skills needs for adapting farming practices differ between men and women, as men are often involved in cash-crop cultivation while women farm food crops.⁴⁶ However, the picture is slightly different for organic farming in Uganda, where the female proportion of organic farmers is reported to be higher than that of men.

Technology-driven emerging and changing occupations remain dominated by men. Women are vastly underrepresented in science and technology studies at both secondary and tertiary levels of education and in the overall technical workforce.⁴⁷ Although women receive more than half of university degrees in the OECD area, they account for only 30 per cent of degrees in science and technology – and only 12 per cent in countries such as Japan and the Republic of Korea.⁴⁸ Occupations in the renewable energy sector confirm this trend: men are generally overrepresented.⁴⁹ In South Africa only one-third of climatologists, a highly skilled occupation working with climatic models, are female.

⁴² ECO EMPLEO: *Current state and trends of environmental employment in Spain* (Valencia, 2008).

⁴³ ILO: *Teachers and trainers for the future: Technical and vocational education and training in a changing world*, Report for discussion at the Global Dialogue Forum on Vocational Education and Training (Geneva, 2010b).

⁴⁴ ILO: *Green jobs: Improving the climate for gender equality too!* (2009e), available at: http://www.ilo.org/wcmsp5/groups/public/--dgreports/--gender/documents/publication/wcms_101505.pdf (accessed 1 Apr. 2011); E. Enarson: *Gender and natural disasters*, Working paper no. 1 (Geneva, ILO, 2000).

⁴⁵ Y. Lambrou and G. Piana: *Gender: The missing component of the response to climate change* (Rome, FAO, 2006).

⁴⁶ FAO: *People-centred climate change adaptation: Integrating gender issues* (2007), available at: <http://www.preventionweb.net/english/professional/publications/v.php?id=2706> (accessed 1 Apr. 2011).

⁴⁷ OECD: *Science, Technology and Industry Scoreboard 2007: Innovation and performance in the global economy* (Paris, 2007).

⁴⁸ OECD: *Gender and sustainable development: Maximising the economic, social and environmental role of women* (Paris, 2008).

⁴⁹ See e.g. G. Thielmann: *Frauen im Bereich der Erneuerbare Energien Wirtschaft* (Frankfurt, Genanet, 2005), available at: http://genanet.de/uploads/media/genaS_6_EEWirtschaft.pdf (accessed 1 Apr. 2011).

Box 5.15. 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 Labor 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 both women workers and workforce professionals with 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 resumé (CV) writing, interview preparation, computer skills and financial education.

Source: <http://www.dol.gov/wb/media/Greenhome.htm> (accessed 1 Apr. 2011).

A prominent exception to this trend, however, can be observed in some developing countries such as Bangladesh and India, where NGOs are deliberately focusing on training women as solar energy technicians and engineers. In rural areas of many developing countries, lack of energy services mainly affects women, since they are usually responsible for providing energy for the household, such as heating and cooking. These women help to install and maintain thousands of solar home systems in rural communities.

In the area of recycling, waste collection and reuse of materials, country reports from developing and emerging economies confirm that women are strongly represented, often organized in cooperatives or associations. This gender bias might be connected with the low social status of these occupations.

Some country studies, however, highlight an increasing interest among women in environmental education and in gaining access to opportunities in natural resource management, tourism, education and other fields. In Thailand, according to the country report, there are already more women than men in occupations related to eco-tourism. This suggests that new green jobs in areas where gender stereotypes have not yet developed provide excellent employment opportunities that break gender barriers and ensure that existing discrimination is not replicated or entrenched.

5.6 Pathways of skills development: A review of players and practice

Action can be taken at various levels to address skills gaps and bottlenecks arising from the transition to a greener economy and to prepare the workforce for a greener future. This section analyses how countries deal with the growing demand for new skills, what channels are used to deliver those skills, and how effective they are. It covers both initial and continuing training, and examines institutional frameworks, systemic provisions, financing mechanisms and a range of different providers.

Just as different countries face different types and degrees of skill challenges and shortages, so their respective education and training systems are embedded in very different institutions and traditions. These will determine the starting point and delivery of skills responses. However, new skills challenges can trigger innovative approaches and new training solutions, including strategies for non-formal and informal learning.

The report distinguishes five different levels of response: enterprise; industry, including sectoral bodies and enterprises within one industry; government (national, regional or local); educational institutions, such as universities, training providers and research institutes; and finally, non-state actors and international development partners.

5.6.1 Enterprise level

Skill needs for greening are usually first identified at the level of the individual enterprise. New regulations and technologies affect specific jobs within the enterprise that require new skills. Business opportunities arising from new markets or consumer demand might modify production processes and thus trigger change in the entire workforce. The introduction of an environmental management system is also likely to demand new skills from most employees.

In many countries and sectors, training organizations do not yet have sufficient capacity and expertise to meet demand from companies for new skilled employees. In these circumstances, enterprises moving to greener production and service delivery have largely focused on internal training solutions instead of recruiting new staff. In developing and emerging countries, certain skills and know-how are sometimes not readily available, for example those of windmill operators or geothermal exploration engineers. In such cases companies either import skilled workers or send their national experts for further training overseas.

Table 5.7 categorizes enterprise-level training responses according to the type and degree of skill needs. Skills can be acquired informally on the job, with or without the help of colleagues or mentors. A more structured approach includes non-formal in-company information sessions, mainly related to general environmental awareness, climate change, or energy and resource efficiency. If companies require more specialized skills, they commonly provide in-company short courses. These courses and information sessions are usually run by in-house experts (in the case of multinational enterprises, these may come from other offices) or by external specialists from training providers, academia, other private companies (such as foreign suppliers of machinery) or parent companies. Examples are short courses on fuel-efficient take-off and landing for pilots of Virgin Atlantic or on fuel-efficient driving for Menzies fleet drivers.⁵⁰ Assembly-line workers at Heuliez in France producing electric vehicles were trained in electricity competencies. Training workers on new policies and regulations usually also takes place in-house.

To provide a structured response to the need for more complex skills and competencies for green jobs, a number of large enterprises at the forefront of green innovation and technology have opened their own training centres. Siemens SE, for example, established its own training centre in Bremen, Germany, to increase the supply and quality of service staff for its wind power turbines and wind power plants. Gamesa has created a corporate university to provide training and development opportunities for its staff, both to counter poaching from other wind energy companies and to provide career advancement.⁵¹ The Juwi Group, one of the world's leading companies in the renewable energy sector with a focus on solar, wind and bioenergy, opened a training academy in Wörrstadt, Germany, offering basic specialized modules in wind, solar and bioenergy for all new employees.

⁵⁰ GHK: *The impacts of climate change on European employment and skills in the short to medium term: Company case studies* (London, GHK, 2009).

⁵¹ E. Garcia Gerboles: *Skills gaps and shortages for a greener economy: A company perspective – Gamesa*, Presentation at validation workshop on Skills for Green Jobs, 17–18 May 2010, Geneva.

Table 5.7. Skills response at enterprise level

Skill need	Skill response	Training setting	Trainer	Example
Skills for simple tasks	Learning by doing	On the job	None, colleague	Crop diversification by mentor farmers in areas affected by climate change in Mali
General environmental awareness, climate change, resource efficiency	Structured information sessions	In company	In-house experts, external specialists	Fujikura's workers in Thailand receiving green awareness training
Specialized skills	Short courses	In company	In-house experts, external specialists	Coca-Cola training packaging designers to develop lighter packaging
More complex skills and competencies	Continuing training	Company's own training centre	Company trainers	ANCC-COOP training head of sale points in recycling, energy saving and management

Source: Authors.

There is a tendency for more structured responses to skill needs to take place mainly in large national or multinational enterprises, for example Japanese companies in Thailand such as Fujikura or Canon. Most training at the enterprise level is taken on the employer's initiative to update the skills of employees. Often, enterprises agree on training plans with staff or staff representatives, tailoring training to match the skill needs of the company. Employees in France can also take individual training leave on their own initiative.⁵²

Apart from skills upgrading for particular posts and new jobs within companies, it is crucial that companies consider overall processes and procedures that depend not on individuals but on the collaborative effort of the whole organization. Enterprises need to learn to take environmental concerns into account, to change modes of thinking and to challenge standard procedures and rules. These adaptation processes take longer than training of individual employees because they may imply changes in business culture.

The most widespread tools used in greening enterprise processes are environmental management systems such as ISO 14001 that require holistic assessments of production processes and outputs. These tools contribute to enterprise learning and skills upgrading of employees at a wide range of different levels, including management, administration, clerks, engineers, technicians and operators.

The human resources department plays a crucial role in the greening process of companies. In the Philippines, the human resources department in some companies serves as the principal translator of the company's green vision and mission into green human resources development programmes, in close collaboration with environmental departments or managers. In Thailand, companies have established green committees to improve energy and resource efficiency in production. These committees also propose training plans for staff.

Most training at enterprise level is funded by the enterprise; however, in some countries, enterprises are eligible for public support to fund continuing training of staff to achieve greener

⁵² French employers are not required to train their employees, but they are legally obligated to contribute funds to continuing vocational training, providing a strong incentive. Cedefop: *Vocational education and training in France* (Luxembourg, 2008).

work practices. In countries with levy funds financed by the private sector, such as Brazil, France, the Republic of Korea and South Africa, companies can claim back their contributions to support continuing training of staff. Public or private training providers may be involved. These measures are part of the national skills development system.

5.6.2 Industry level

Skill needs for greener production and service delivery are felt not only by single enterprises but by entire industries. Industry associations, sector skills councils, or chambers of commerce or industry can all act as drivers of joint skills responses. Throughout the research, industry-level responses were found more frequently in developed countries, where industry collaboration is traditionally stronger than in developing or emerging economies. As one of the earliest industry initiatives, starting as long ago as 1987, the chemical industry in Germany has played a leading role in integrating environmental aspects into apprenticeship training.

Initiatives by industry associations

Industry associations can play a key role in identifying skill needs and developing their own training responses. Instead of preparing training programmes themselves, they address requests to the education and training system, for example in France, where demands from industry associations led to a new qualification for renewable energy technician.

In the United Kingdom, the Royal Institute for British Architects has set up a Sustainable Futures Group to inform its members about developments in sustainable building design. The group also helps update curricula for architecture schools and continuing professional development, as well as contributing to professional standards to ensure that skills for designing low-carbon buildings are disseminated into the occupation. In Australia, the Master Plumbers organization and the Mechanical Services Association have designed a GreenPlumbers training programme jointly with the Plumbing Trades Employees Union which is being rolled out across the industry. This programme was also extended into New Zealand and North America. Plumbing industry associations in China have also developed green initiatives, supported by funding from provincial government, which assist plumbers to become trained and accredited in household water and energy efficiency.

Initiatives by sector skills councils

Sector skills councils are usually owned and led by employers, but their activities are co-sponsored by the State. Their objectives are to reduce skills gaps and shortages, improve the industry's productivity, boost the skills of their sector workforces and improve skills supply.

Some skills councils already have sectoral or subsectoral strategies to address skill needs for low-carbon economies, based on projected future labour force needs. In Wales, sector skills councils together with the Welsh Assembly Government identify skill needs for low-carbon energy generation, focusing on areas where Welsh industries have a strategic comparative advantage (e.g. in technology or innovation) or where there are untapped resources (e.g. in waste and resource efficiency).⁵³ Other councils review and update existing qualifications, or devise new ones. The

⁵³ Department for Economy and Transport: *Capturing the potential: A green jobs strategy for Wales* (Cardiff, Welsh Assembly Government, 2009).

Australian skills council for rural and food processing industries, AgriFood, reviewed the food-processing industry's training package for animal care and management. The United Kingdom council Construction Skills, together with the Institute of the Motor Industry, has set up a body to develop a qualification in hybrid technologies in response to demand from particular car manufacturers. Manufacturing Skills Australia has designed "units of competency" that are included in different qualifications (see Chapter 4, section 4.7.3).

The green agenda has also sparked coordinated efforts among skills councils. A number of United Kingdom sector skills councils have convened to form the Renewable Energy Skills Group.⁵⁴ The group provides a forum for coordinating a Renewable Energy Skills Strategy which aims to take account of requirements across the supply chain from initial research, through installation and maintenance, to disposal at the end of a product's life.⁵⁵ In South Africa, the skills response for solar water heating involves two sector training authorities, as both electrical skills and plumbing skills are needed for this new occupation.

In the Republic of Korea, two new sector skills councils have been created: a Sector Council Human Resource Development for New Renewable Energy, and one for Green Finance. Both councils provide short training courses, the first on solar energy technology and the CDM, the second on green industry trends, risk analysis, green finance and social accounting, and sustainability assessment.

Initiatives by chambers of commerce or industry

Chambers of commerce or industry also make important contributions to the greening of sectors by devising and running programmes for continuing training. The training institute of the Costa Rican Chamber of Industries, for example, provides courses for auditors so that they can award companies sustainability certificates, such as the Certificate in Sustainable Tourism in Costa Rica.

In Germany, different chambers have initiated cooperation in the area of energy efficiency and renewable energy and have designed continuing vocational training courses offering qualifications including Specialist in Environmentally Compatible Energy Techniques, Specialist in Solar Thermal Energy, and Building Energy Consultant.

Joint initiatives at industry level

A number of joint initiatives within particular industries have led to comprehensive skills responses in pursuit of the green agenda at sector level, including the creation of industry training centres.

For example, an initiative to develop skills for the production of low-carbon vehicles in the United Kingdom was discussed among employers, trade unions, research centres at university and industry level, and training providers. This dialogue resulted in cooperation between Nissan Motors United Kingdom, a college, a private sector training provider and a regional development agency. This consortium created the National Training Centre for Sustainable Manufacturing, which serves around 60 businesses in providing training for their staff at apprentice and higher levels. In northern Germany, the Federal Association of Wind Energy, the employment agency in Husum, the local chamber of industry and commerce, and local manufacturers and operators of wind energy facilities established a building centre for renewable energy. Workers in the fields of electrotechnology and machine building can train here to qualify as service technicians for wind turbines.

⁵⁴ AssetSkills, Cogent, ConstructionSkills, ECITB, Energy and Utility Skills, Lantra, SEMTA and SummitSkills.

⁵⁵ United Kingdom House of Commons: *Green jobs and skills*, Second Report of Session 2008–09 (London, Environmental Audit Committee, 2009), available at: <http://www.publications.parliament.uk/pa/cm200910/cmselect/cmenvaud/159/159i.pdf> (accessed 1 Apr. 2011).

Public–private partnerships

Public–private partnerships play a prominent part in the skills response to environmental challenges, as well as in shaping the policy agenda at industry level and across traditional industry boundaries. This is achieved by sharing costs and commitments in implementing strategies related to skills development, and by strong engagement of businesses with the public decision-making process.

Sometimes the incentive comes from governments. For instance, the Government of the Republic of Korea encourages green skills alliances between large enterprises, universities, and small and medium-sized businesses, and sponsors facilities, equipment and trainers for the provision of training in green technology. An example of government support for company training relevant for wider societal outreach in Bangladesh is provided in box 5.16.

Box 5.16: A public–private partnership: Dhaka’s Recycling Training Centre

Waste Concern Group is a social business enterprise comprising both profit-making and non-profit-making enterprises in the waste management sector in Bangladesh. It established a Recycling Training Centre at Dhaka with financial support from the Ministry of Environment and Forests and the United Nations Development Programme (UNDP). Target groups for training are local governmental officials, NGOs and community-based organizations. Courses focus on community-based solid waste management and resource recovery. The centre also trains trainers to help farmers to improve composting and use of the compost produced. The training is provided by both in-house and foreign experts.

In other cases, the initiative comes from industry and businesses. In the United Kingdom, the Aldersgate Group was set up in 2006 as a broad coalition of businesses, NGOs, professional bodies, MPs and others.⁵⁶ The group engages actively with Government and other key decision-makers, presenting objective evidence with the aim of contributing to the future development of the country’s economic, environment and sectoral policies. The group prepared a report entitled *Mind the gap*, analysing the skills situation in the context of the transition to a low-carbon economy and coming to the conclusion that the United Kingdom lacked the necessary skills to make the transition happen.⁵⁷ The report called for strong alignment between skills, industrial and environmental policies, with a corresponding skills strategy, to ensure success in the transition process.

5.6.3 Government responses at national, regional or local level

Governments are involved in skills responses to the demands of greening economies in a variety of ways. First, they coordinate the updating of national qualifications and curricula and finance skills provision. This includes the revision of existing qualifications and the creation of entirely new ones, taking into account changes in general education and the need for teacher training. Second, governments devise active labour market measures to cushion the effects of green structural change and to ensure disadvantaged groups have access to the labour market. Examples of these measures are included in Chapter 4, section 4.7.1. Third, they provide a number of initiatives

⁵⁶ Aldersgate Group: *Skill needs for green jobs in the United Kingdom*, Presentation by Andrew Raingold, Deputy Director, at the technical validation workshop on Skills for Green Jobs, 17–18 May 2010 (Geneva, ILO).

⁵⁷ Aldersgate Group: *Mind the gap: Skills for the transition to a low carbon economy* (2009), available at: <http://www.aldersgategroup.org.uk/reports> (accessed 1 Apr. 2011).

through line ministries and other bodies, including industrial and innovation policies. And fourth, regional and local-level governments are best positioned to provide hands-on and flexible responses to local demand and changing labour market situations. Examples of these different types of response are set out below.

The formal training system: Updating existing courses

Changes in training systems and the qualifications and certifications offered through them are determined by the systems' established mechanisms. Systems that have a strong tradition in updating qualifications and curricula, such as Australia, Denmark, France and Germany, follow existing pathways to include skills for green jobs. Some countries have been involved in this process of change for many years. However, many developing countries' institutions still lack general awareness of climate and environmental changes and related skills challenges. In India, hardly any of the 4,650 vocational training institutes (500 of which are government-run industrial training institutes) provide training in green technologies or related areas. Such countries with less established pathways will need to create new measures and procedures to craft appropriate skills responses within and outside their existing training systems. Clearly, future technological developments, improved legislation and enforcement, and additional market drivers will continue to require further updates and changes in skills provision.

Country reports show that there are two general approaches to including skills content for greener occupations in existing curricula: first, including a standard module relevant across a group of occupations; and second, updating the content of specific initial or continuing training courses by adding new material to augment or replace existing content.

Standard modules may contain, for example, training on environmental safety (mainstreamed throughout all national curricula for initial vocational and educational training in Estonia); knowledge about organic farming in agricultural education (in France, promoted as an element in existing curricula by the Formabio network); and skills for waste recycling, energy efficiency and conservation, and avoidance of pollution (included within the German dual apprenticeship system for occupations outside the environmental sector). In the Philippines, the Technical Education and Skills Development Authority (TESDA) plans to include an environmental component in all training courses.

Initial training courses are updated when skills demand on the labour market changes, driven by markets, technology or policy. The German course leading to qualification as plant mechanic for sanitary, heating and air conditioning systems, for example, was modernized to enable mechanics to operate modern heating, ventilation and air conditioning (HVAC) systems with minimal energy inputs. Moreover, they may now work for companies that also install solar photovoltaic (PV) and thermal technologies, which can be linked into the HVAC system to provide a low-carbon energy source. In the Philippines, mechanics, service technicians, transporters and retrofitters in service shops, and employees of companies dealing with refrigeration and air conditioning, received a joint update of skills when in 2004 TESDA developed a code of practice for refrigeration and air conditioning, targeted at workers in these areas, to adjust the handling of refrigerants in accordance with the Montreal Protocol on the reduction of ozone-depleting substances.

The formal training system: Creating new qualifications

While changing skill needs in existing occupations lead to updates of existing qualifications, new occupational profiles have led to the creation of new initial or continuing training courses and qualifications. Several countries emphasized that modernizing existing qualifications is prioritized

over creating new ones because it is faster and avoids overspecialization of occupations. Nevertheless, countries opt for different approaches: in the agricultural sector in France, organic farming will be integrated into existing training courses, while the Estonian Qualifications Authority has created a new qualification of “farmworker in alternative agriculture”.

In the waste and recycling sector, several new vocational qualifications have been created, for example in waste management in Australian technical and further education (TAFE) institutes; as recycling centre operator at the Costa Rican National Training Institute; as operator of recycling industries in France; and as waste management assistant in Estonia. The German dual apprenticeship system split the existing apprenticeship for provider of waste management services into four new occupations, mainly because of increasingly complex technological developments that created a need for further specialization in the waste and recycling sector. The four are: recycling and waste management technician; water supply engineering technician; sewage engineering technician; and pipe, sewer and industrial service technician.

New skills needs in renewable energy have often translated into new initial training courses or qualifications. In Estonia, an occupational standard for renewable technology technicians is currently under development, including technical skills related to new technologies as well as core skills like teamwork, communication, learning and entrepreneurship. In the United Kingdom, apprenticeships and foundation degrees in wind power are being developed. In South Africa, three national standards related to solar water heating have been designed: two, on installing and maintaining solar water heating systems, are offered as options within training in either electrical engineering or plumbing; and the third, on mounting solar water heating systems, is a core unit of the National Certificate of Hot Water System Installation.

In the building sector, the Australian TAFE institutes offer courses in sustainable building design, and the Estonian qualification system has incorporated a new qualification of energy auditor authorized to issue energy certificates for buildings. In France, requests for new qualifications in the construction sector mostly concern the creation of degree courses at university level.

General education and teacher training

New and additional skills are imparted not only through training systems but also as part of general schooling and tertiary education. The latter will be covered separately in section 5.6.4 below, as skills responses at university level, in contrast to public compulsory education, usually enjoy a degree of autonomy and are not determined by government.

Several countries have mainstreamed environmental education throughout the educational system and have adjusted curricula to cover themes such as energy efficiency, climate change and waste avoidance. Some European countries started to include environmental concerns in general schooling as early as the 1970s, triggered by debates about acid rain and environmental pollution. These initiatives are implemented by ministries of education, often in collaboration with ministries of environment or related departments (as for example in Uganda). Some countries launched additional activities through various means: Internet networking sites offering resources and learning material for teachers or virtual learning (e.g. in Denmark⁵⁸); teacher education projects (e.g. in Costa Rica); and physical spaces for interactive activity, including information, education, training and environmental action, within schools or other educational institutions (e.g. the Green

⁵⁸ <http://www.klimaundervisning.dk>; <http://www.emu.dk/tema/klima/> (accessed 1 Apr. 2011).

Room Project in Brazil). Efforts to raise environmental awareness and increase the attractiveness of science subjects are also used to entice more students into science and technology studies after compulsory education (e.g. in Denmark and Estonia).

The UN Decade on Education for Sustainable Development (ESD) has spurred further initiatives in this field and developed a wide resource base assembling good practice examples from all around the world.⁵⁹ ESD seeks to integrate the principles, values and practices of sustainable development into all aspects of education and learning. It has achieved some progress at international, regional and national levels, but needs to work on identifying ways to translate general themes into particular applications responsive to local needs.⁶⁰

Initiatives by government ministries and bodies

In addition to the responses to skill needs made by ministries of education and/or labour, other skills development initiatives have been made by ministries or other public bodies that play an important role in the transition to a greener economy. Some but not all are regarded as part of national training systems. The main actors mentioned in country reports are ministries of environment, agriculture, energy, tourism and public utilities, and their initiatives range from ad hoc and small-scale training provision to more systematic training with broader outreach.

Thailand provides some interesting examples of training in specific skills for an entire sector. The Ministry of Energy launched an initiative to train technicians at industry and village level, jointly with training instructors, in energy management and technology, end-use systems in companies and buildings, and the production process. It also constructed an eco-efficient house as a showcase for training purposes and to encourage technology transfer. Also, the Ministry of Tourism and Sports organizes training courses on eco-tourism in selected villages in which villagers learn the skills they need to work as tour guide, tour operator, environmentalist, wildlife and environment conservationist or hotel manager.

In the absence of a national curriculum in renewable energies, as a rather ad hoc training measure the Egyptian National Renewable Energy Agency provides on-the-job training in the operation and maintenance of wind energy technology.

The country reports also identified response strategies from ministries in cooperation with institutions of formal training systems. In Indonesia, the Ministry of Environment in cooperation with the Ministry of Labour launched an initiative in environmental competency in 2009. Aiming for broad outreach, it established standards for production processes and for professions in the environmental service sector such as retrofit and recycle technician, environmental impact assessor, environmental laboratory worker and water pollution manager. In Thailand, engineers of the Electricity Generator Authority in cooperation with the Department of Skills Development installed solar generators in remote villages and trained villagers as solar electricity technicians to undertake repair and maintenance.

In countries without national qualifications systems, such as the United States, the skill content of occupations is regulated by state licensing requirements administered by state authorities, mostly in collaboration with business associations. With regard to solar energy installation, for example, a range of competing standards across states has emerged, with varying impact on the industry's development and skills provision.

⁵⁹ <http://www.unesco.org/new/en/unesco> and <http://www.desd.org/> (accessed 1 Apr. 2011).

⁶⁰ UNESCO: *Review of contexts and structures for Education for Sustainable Development* (2009), available at: <http://unesdoc.unesco.org/images/0018/001849/184944e.pdf> (accessed 1 Apr. 2011).

Industrial and innovation policy

Governments can be directly involved in training provision, or they can provide incentives for skills development. Industrial and innovation policies, including publicly funded research as well as subsidies and incentives for research undertaken in the private sector, are powerful government tools that play a critical role in advancing clean technology sectors and fostering research and development. Some countries have established a national system of innovation, including a strong partnership between public and private institutions promoting technological development.⁶¹

Industrial investment strategies in Estonia and the United Kingdom focus research and development in globally significant technologies and sectors, including low-carbon industries. For the biotech industry, the United Kingdom Government established an Industrial Biotechnology Innovation and Growth Team to provide strategic leadership and guide skills development. This team recommended that the Government develop the United Kingdom's world-leading science base in several specialized areas, including plant science and marine organisms.

Box 5.17. A skills strategy for the Danish construction sector's value chain

Denmark is developing a coherent and strategic skills development response for the construction sector's value chain. The response is based on the Government's strategy for reduction of energy consumption in buildings (April 2009), which highlighted the new skills needs associated with energy efficiency in buildings, stressed the need for further education at all levels – from engineers and architects to electricians and blue-collar workers – and stated that existing education and training programmes should be revised to ensure that all future employees have solid basic skills in energy-efficient construction.

The skills response is organized through a process involving all stakeholders, and is being followed up by an interministerial committee. A working group was formed, with members drawn from relevant business organizations, educational institutions and public authorities, to thoroughly assess the skills requirements for different occupations, such as engineer, architect, plumber, electrician and bricklayer, and low-skilled workers, as compared to existing provision. The outcome of the process will be an action plan describing the existing supply of skills for the sector and its value chain and presenting new initiatives and recommendations. Since the government-led process was initiated fairly recently (October 2009), the effectiveness of the proposed measures remains to be reviewed in the future.

Box 5.18 The Energy Regional Innovation Cluster in the United States

President Obama's Administration created the Energy Regional Innovation Cluster (E-RIC) initiative to boost energy efficiency research. The initiative will award US\$129.7 million over five years to create a regional energy efficiency research centre that will develop technologies for energy-efficient building systems. Seven federal agencies, including the Department of Energy, Department of Labor, Department of Education and the US Small Business Administration, support the initiative. The cluster will bring together a multidisciplinary team of researchers to solve priority technology challenges that span work from basic research through engineering development to commercialization readiness. It will disseminate new technologies into the local marketplace and share best practices with the public and private sectors, working with local partners to provide the necessary workforce education and training. By linking researchers with local businesses and supporting specialized training in the local area, the initiative will create an economically dynamic region focused on building efficiency technologies.

Source: <http://www.dol.gov/opa/media/press/opa/OPA2010JR.pdf> (accessed 1 Apr. 2011).

⁶¹ UN Department of Economic and Social Affairs: *World Economic and Social Survey 2009: Promoting development, saving the planet* (New York, 2009).

In the building sector, two governments have launched promising initiatives. In Denmark, a multi-stakeholder initiative looked at the horizontal and vertical supply of skills for the entire building sector's value chain in order to determine if adjustments are needed within the education and training system (see box 5.17). In the United States, seven federal agencies created the Energy Regional Innovation Cluster – one of three proposed by the Administration and funded by Congress – to foster innovation for energy-efficient building and link it with skills development systems (see box 5.18). It is hoped that this investment in innovation and research will create the conditions for major technological breakthroughs to make technologies affordable and commercially attractive. Disseminating new technologies to local markets is expected to boost economic development and employment.

Regional and local responses

Governments at regional or local level are crafting responses to skill needs independently of central government. These activities may arise out of a particular need, such as high regional unemployment or regional skill shortages; out of legal obligation, for example in France, where regions are responsible for providing continuing training; or in order to promote certain sectors with growth potential.

Regions are key actors in the provision of continuing vocational education and training in France as they define, implement and fund the regional vocational training policy for young and adult learners. The Ile de France region, for example, designed a regional programme of vocational training in environmental matters for 2010 which includes courses on ecological land use and agriculture, pollution and nuisance prevention and reduction, waste management, application of standards and social and environmental corporate responsibility, energy efficiency and renewable energy development and management.

In order to respond to growing demand for renewable energy specialists in Extremadura, Spain, the regional government introduced skills training programmes for solar energy installation. Funding comes from the Extremadura regional employment body and the programme is managed by a public regional enterprise, FONAMA (Promotion of Nature and Environment). The training is targeted at employed and unemployed workers in the construction sector, in trades including plumbing, electrical services and heating installation.

Community-level responses tend to be related to challenges directly affecting community life, such as environmental degradation or waste disposal. In the Philippines, community organizers associated with NGOs and local government units apply a “participatory resource appraisal” in order to raise collective awareness about the state of the village economy, identification of local resources that need to be safeguarded, employment and so forth. Climate change awareness still needs to be incorporated into the appraisal process at local level.

Career guidance and counselling is another measure that can be applied in a decentralized fashion to meet skill needs. The Republic of Korea is providing green career guidance to students after higher secondary education to inform them about job and career prospects in green sectors.

5.6.4 Universities, training providers and research institutes

Educational institutions, private or public, devise their own skills responses to new demands from industry, changes in environmental legislation or advances in technology. Public institutions often follow government initiatives, but can also set their own agendas if new skills needs are identified. Private institutions follow market demand. In Costa Rica, for example, 60 per cent of courses in

environmental subjects are offered by private universities (most of them are postgraduate courses of two years or less). Yet in the absence of clear quality standards in many countries the multiplication of private training courses sometimes raises concerns about their quality.

Universities and training providers may update existing courses and qualifications and/or create new study fields to address skill needs to meet environmental challenges, sometimes with the direct involvement of industry. Many of these courses are tailored towards new occupations not yet included in national occupational classifications, such as environmental chemistry or energy-efficient design (architecture) in Germany. Research institutes can also be involved in skills provision, as they have at their disposal specialists in green technology and related fields who are not often available elsewhere.

In some countries, educational institutions are faster than government policies in adjusting the training they offer to current needs, for example where governments fail to put action plans into practice. This is the case in the Philippines, where a law requiring that environmental education be integrated at all levels of education has not been translated into concrete action: meanwhile, a number of universities have launched environmental courses and degrees.

In other countries, governments play an important role in coordinating skills responses among different educational providers. In Costa Rica, government-owned universities are coordinated through the National Rector Council (CONARE), comprising several bodies including the Inter-University Environmental Education Commission (CIEA). For the past 15 years, CIEA has been active in incorporating environmental concerns into university activities, developing curricula, proposing specific educational methodologies and conducting research on environmental issues across disciplines. Private universities in Costa Rica do not possess a similar coordinating body.

Updating existing and creating new courses and degrees

Universities and TVET institutions have updated existing courses with new content related to environmental awareness and climate change. Courses on agrarian sciences in Germany, for instance, now include a mandatory module on environmental and resource economics in which students learn to interpret environmental problems, policies, targets and instruments from an economic perspective. Polytechnic colleges in the Republic of Korea plan to revise and update 20 per cent of their curricula over the next five years with a view to training technicians and technologists capable of meeting the skill needs of the green economy.

The country reports highlight a large number of new university courses, supporting the research finding that new occupations seem to be more concentrated in high-skilled fields. Educational institutions in all the countries studied have already devised courses in environment-related fields, ranging from renewable energies and energy efficiency to organic farming, city planning and water management. In particular, there is considerable growth in technology courses covering energy and environment. In some areas (e.g. organic farming in Uganda, or renewable energy in Bangladesh), universities are offering both short courses and degrees, reflecting varying skill needs within one sector.

In renewable energy, the University of Aalborg in Denmark is offering a master's programme targeting people working in the wind energy sector with an engineering qualification. In Uganda, a master's degree programme in renewable energy was designed at the Faculty of Technology at Makerere University. This programme, developed with input from both local and international stakeholders, trains students in the use of renewable energy, including technology appropriate to local circumstances, such as solar lamps that replace the traditional kerosene lamps. In Germany alone there are 257 degrees at different universities related to renewable energy.

Some new skills demands have led to the creation of new university departments. In Egypt, for instance, the Faculty of Agriculture at Al-Azhar University established the Department of Environment and Organic Agriculture in 1997, where formal education began in 1999/2000. Likewise, the Faculty of Agriculture at Ain Shams University established the Department of Organic Agriculture, taking enrolments from 2005/06.

In developing countries, although universities are responding to new skills challenges arising from greening economies, the number of graduates is still low considering the market demand. This is the case, for example, with graduates in renewable energy in Uganda. Quality issues are also highlighted in a number of countries, in particular in relation to the calibre of teaching personnel. As skills for green jobs are newly emerging, many countries do not possess sufficient numbers of national experts to staff their educational institutions. Therefore, developing countries often need to rely on experts from other countries to fill the gap.

Educational institutions collaborating with companies

In order to align the provision of training closely with the demand for skills from industry, educational institutions enter into partnerships with private companies. The Engineering Faculty of Cairo University has linked up with the Holding Company for Water and Wastewater, which provides scholarships for students of the bachelor's programme in water and environment. The programme aims to produce engineers who are capable of monitoring water projects and are familiar with appropriate technologies in this field. Universities in Uganda consult private sector stakeholders when curricula are updated in order to match market demand. In Estonia, universities and vocational training centres are involved in continuing training of employees in Eesti Energia AS (see box 5.19).

Box 5.19 Eesti Energia AS: An energy company's cooperation with universities in Estonia

Eesti Energia AS is an Estonian state-owned company engaged in the production, sale and transmission of electric and thermal power, and in the construction and maintenance of energy systems. Structural change, EU and national regulations, technological innovation and the company's new business strategy have created the need for employees in several new green occupations: wind and hydro power plant operators and managers, electricity and heat co-production plant operators and managers, fluidized bed combustion plant operators and managers, energy auditors, persons authorized to issue energy certificates for buildings, technology developers and technology managers, intellectual property managers, and technology transfer project managers.

In order to respond to this need, Eesti Energia AS has hired graduates from and concluded cooperation agreements with universities and training providers such as the Estonian University of Life Sciences, Tallinn University of Technology, Virumaa College at TUT and East-Virumaa VET Centrem.

The cooperation covers three areas. First, Eesti Energia AS offers apprenticeship placement opportunities for students. Second, the company organizes structured training for employees, such as weekend university courses including excursions to sites where they can see the technology in operation (six thematic modules over six months, including production of electricity and heat, and power distribution). Third, the company and universities have jointly designed specific training courses for different target groups within the company (skilled workers, technicians, line managers, engineers, dispatchers, heads of department, analysts). These courses cover energy certification for buildings, (chartered) energy auditing, heat accumulation and green energy.

Research institutes disseminating knowledge and skills

Environmental research institutes employ specialists with the most up to date knowledge who may provide training in new technologies. They may also go on to work in key positions in industry and apply their research results in greening existing jobs and creating new green jobs, both for themselves and for other employees.

Research institutes are active in a wide range of sectors. Their work contributes to identifying and promoting solutions for greener production and addressing climate change. In order to strengthen adaptive capacity in the face of climate change in Mali, an agro-meteorological division was created within the National Weather Service, and agents were trained in data processing, transmission and storage to improve weather observation. In the effort to cut pollution in India, the Central Leather Research Institute offers training programmes at academic and vocational level as well as specialized short-term programmes targeting executive staff from the leatherwork industry. Also in India, The Energy and Resources Institute (TERI) provides training programmes on biomass gasification for manufacturers, technicians, local service providers and state nodal agencies.

In Bangladesh, the Renewable Energy Research Centre promotes solar thermal and PV applications and maintains the only solar energy dissemination park in the country at the campus of the University of Dhaka. The centre organizes research activities in the field of solar, wind and other alternative sources of energy; encourages research projects; trains, coordinates and establishes links between students, scientists, engineers, stakeholders and policy-makers; and supports students in their research. Training courses have been initiated as a response to the country's energy crisis and include courses in on-grid and off-grid PV systems and training of trainers for installing solar home systems.

5.6.5 NGOs and international development partners

NGOs also contribute to skills provision for green jobs, often with the support of international development partners. In developing and emerging economies, international development partners play an important role in funding skills development for new green activities, occupations or sectors, or in providing training for new skills unavailable in the country. They usually work in partnership with national authorities, institutions of the formal training system, businesses or other stakeholders.

NGOs often operate where formal training systems are absent or weak. In India, the Barefoot College has become increasingly involved in skills provision for renewable energy. Working as a non-formal training provider in a number of Indian states, it organizes training in solar technology for illiterate or semi-literate women from villages. They apply an innovative methodology, combining traditional knowledge and modern skills (see boxes 5.7 and 5.8 above). In Thailand, the NGO Border Green Energy Team trains villagers and local government technicians in the operation and maintenance of solar power systems (including removal and recycling of dead batteries), micro-hydro systems and bio-digesters. As courses only take a couple of days, skills provision is basic but sufficient for standard maintenance work. In Egypt, NGOs are involved in community-based solid waste management, supplementing government intervention at local level.

In Brazil, an international development agency provided technical input to make existing occupations greener. The Ministry of Mines and Energy and the Ministry of Development, Industry and Commerce, in association with manufacturers and retailers, launched the Programme of Replacement and Promotion of Access to Efficient Refrigerators. The programme's objective is

Box 5.20. Providing sanitation skills in India: An NGO success story

Defecation in the open has been identified as the biggest cause of poor water quality and rampant water-borne disease in India. A national NGO, Ramakrishna Mission Loksiksha Parishad (RKMLP), initiated the country's first demand-driven sanitation strategy in Midnapore district in 1990, in collaboration with international organizations and local government. The Midnapore sanitation strategy has been recognized as a role model in promoting the Central Rural Sanitation Programme (CRSP) in India.

RKMLP organized training for master masons, village masons, artisans and mechanical fitters in the production of sanitary hardware, and for village masons, mechanical fitters and caretakers in project operation, maintenance and monitoring. New skills needs were met: for example, women involved in hardware production required training in masonry, which was delivered on the job; and village people hitherto involved in constructing latrines for individual households had to learn the different skills involved in manufacturing sanitary pans. RKMLP worked with village youth clubs and other NGO partners in Midnapore district at grass-roots level in planning and implementing the sanitation programme and in delivering follow-up services. In order to stimulate demand and change mindsets, the training emphasized local communication and awareness raising as a means of changing habits.

As a result of this campaign, the proportion of households with toilets rather than latrines in Midnapore district increased from 4.47 per cent in 1991 to 100 per cent in 2007.

to replace 10 million obsolete refrigerators within the next ten years, preventing more than 7 million tonnes of CO₂ emissions and removing 5 million tonnes of CFCs. SENAI, the largest vocational training provider in Brazil, supported by the German development agency GTZ, developed training courses for refrigeration mechanics in new techniques, including alternatives to CFCs that do not damage the ozone layer.

5.7 Conclusions

Occupational change depends on the degree of skill change taking place. If the skill changes needed are small or moderate, the skill profile of existing occupations will change. If the skill changes needed are considerable and new specializations become necessary, new occupations may emerge. In addition, increased investment can lead to increased demand for existing occupations with unchanged skill sets.

Occupational change is taking place in both blue-collar and white-collar jobs, as well as at all skill levels. There seems to be a tendency for emerging occupations to require higher-level qualifications, while changes in existing occupations happen more often at the low and medium skill levels. A clear finding is that jobs in existing occupations facing skill changes will by far outnumber jobs in newly emerging occupations.

Taking as the starting point the assumption that every job can become greener, environmental aspects have to be considered in all mainstream activities, not only in eco-industries. Clearly some sectors are more affected by occupational change than others, but all sectors generally need certain environmental competency levels in their workforce, such as skills in energy and resource efficiency, knowledge of environmental legislation, and awareness of how to reduce environmental pollution and waste.

Skills responses to meet current and future demand occur at different levels and through a variety of different channels and mechanisms, from company-level training through initiatives by industry associations and sectoral skills councils to national and local government programmes, tertiary educational institutions and non-formal NGO activity. Two general patterns of activity can be identified.

Countries with well-developed and responsive skills development systems are incorporating environmental considerations as cross-cutting issues in training programmes at all levels. To update occupations they use existing mechanisms. For some new occupations, they have created new initial or continuing training programmes to target specific skill needs. In these countries, company initiatives in environmental training are less frequent, though larger companies offer company-based continuing training as a vital supplement to formal training. Responses of training systems have become more comprehensive over time. Initially, isolated or optional add-on courses were offered to supplement existing skills training for a small group of occupations, firms or industries. Today, courses tend to be offered across several occupations or industries, implying that the long-term importance of climate change abatement and greening is being recognized by a number of national training systems.

In countries with less responsive education and training systems, companies usually account for the biggest share of skill provision. A lack of sufficient or sufficiently skilled teaching personnel is often addressed by bringing in expertise from parent companies. In addition, procedures for developing skills programmes within training systems are often slow and cumbersome. In developing countries, NGOs are key providers of non-formal skills provision for green jobs in certain sectors and activities, with a particular focus on vulnerable groups and rural areas. International development agencies also provide funding and expertise. Training responses are often isolated and sporadic, and their impact on the greening of industries and the economy as a whole remains limited.

Throughout all the country reports, experts expressed a general difficulty in assessing the effectiveness of skills responses. Many initiatives are too new to evaluate and have trained only one or two generations of students. Even in Australia, where a comprehensive skills development agenda is being promoted across many occupations and industries, few data are available on the uptake and completion of green skills education and training courses. Moreover, the impact of the financial and economic crisis since 2007–08 may distort the picture.

Mainstreaming environmental topics across compulsory education is seen as effective in creating overall environmental awareness. Turning that awareness into career opportunities requires TVET systems that are more responsive to the new demands of the green economy. Courses offered at university level that range across a wide array of subjects also tend to be evaluated positively.

There are, however, a number of observations that can be made about effectiveness. In brief, an effective skills response depends on the selection of the appropriate instrument for the degree and type of skill needed; on effective implementation of the response; on economic and social conditions in the country concerned; and, probably most importantly, on the current state of the national skills development system. Across all development levels, the factor often identified as critical is coordination, and this in turn requires good communication channels between industry and the training system on occupations and training needs, and between government bodies responsible for policies and programmes on greening and those responsible for training.

Generally, but particularly in developing countries, women are under-represented in science and technology related green jobs, and disproportionately strongly represented in low-end green jobs in, for example, waste collection and recycling. On the other hand, green jobs offer a particular opportunity to break gender barriers as gender stereotypes in new occupations do not yet exist.

A high level of educational attainment is not in itself a sufficient response to the needs of a greening economy. A shortage of training in vocational and technical skills can still impede the green transformation.

Skill needs for green jobs have triggered some innovative training solutions. These include joint initiatives by social partners at sectoral or regional level; collaboration between companies and training providers or universities; research institutes reaching out to undertake community-level training; and proactive approaches by international professional associations and NGOs involving training of trainers and projects in areas out of reach of formal training provision.

Three types of responses were rated as most effective across countries: industry-level responses; public–private partnerships; and multilevel responses involving all stakeholders.

- Industry-level responses have proven ability to supply skills matched to current demand, in both quantitative and qualitative terms.
- Involvement of social partners in education and training, and in particular public–private partnerships, has generated effective training responses and triggered green change on a larger scale.
- Coherent multilevel skills development responses are most effective for greening economies, as they address both consumption and production patterns. They influence consumption by raising environmental awareness through general schooling or mass media; and they help production move to more environmentally conscious practices through training programmes, vocational, technical and higher education and training, and lifelong learning at enterprise or industry level.

For effective and targeted responses, then, the close involvement of all stakeholders concerned is key. Where this is achieved, it is likely to constitute a most effective contribution to the transition to a greener economy.

6. Anticipating and monitoring skill needs

A uniform statistical definition of green jobs does not exist. This creates difficulties in measuring green jobs and related skills, and complicates their incorporation into occupational and industrial classification systems. Anticipation of skill needs remains in need of improvement not only in respect of environmentally driven skill needs but across whole economies. Countries which enjoy long-established systems for the early identification of skill needs and elaborate labour market information systems (LMIS) certainly benefit from those, but still require additional means of detecting new needs resulting from the transition to a low-carbon, greener economy. Where LMIS are not developed, countries rely on ad hoc surveys and one-off initiatives, often supported by donor organizations and with no or limited sustainability. The most effective approaches to anticipating and monitoring needs for green skills are those that are built on social dialogue at sectoral or grass-roots level. There is also a need for greater coordination across economic sectors.

Evidence from numerous countries around the world suggests that ambitious policies to green current production patterns, including national targets for cuts in GHG emissions, frequently fail for lack of a qualified workforce. Timely identification and provision of the skills needed to ensure a smooth and just transition to the low-carbon, green economy are therefore crucial. To this end, there is an urgent need for accurate information on the current and expected quantity and quality of relevant skills.

This chapter discusses countries' existing approaches to defining and measuring green jobs, and to identifying and anticipating the skills needed to perform them. It then goes on to describe new tools and approaches that can be used to detect demand for skills in a greening economy.

6.1 Measuring and classifying green jobs and related skills

In order to measure anything, it is necessary to delineate what is to be measured. Measuring employment and skills is no exception, requiring clear concepts and boundaries. However, since the concept of “green jobs” is a relatively new one and still very much under development, it is a moving target which is hard to capture. Green jobs are not easy to define: many countries came up with multiple definitions but none of them seem to be satisfactory as a basis for measurement at occupational, sectoral or skill level. Nor is there any uniform definition at international level which would be easy to use for measurement and monitoring purposes.

According to the ILO definition (see Chapter 1 above), work that contributes to preserving or restoring the quality of the environment, and which meets the principles of “decent work”, can be considered green.¹ This definition is deliberately broad, incorporating an assumption that

¹ UNEP, ILO, IOE, ITUC: *Green jobs: Towards decent work in a sustainable, low-carbon world* (Geneva, 2008).

every job can become greener. From a policy perspective, such a definition is totally justifiable. But the dynamic and inclusive nature of the green jobs concept confronts us with an immediate problem in respect of measurement: how to set up boundaries when the definition deliberately does not imply them?

One attempt to introduce a statistical definition across countries, specifically for data collection purposes, was made by Eurostat. Its data collection handbook,² which builds on earlier work with the OECD,³ serves as a complete reference tool for developing a data collection system on the environmental goods and services sector in the EU Member States. It introduced the following definition of the environmental goods and services sector: “For statistical purposes, only technologies, goods and services that have been produced for the environment (‘environmental purpose’) are included in the scope of the environmental sector.” Environment-related activities are defined as those that “measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes cleaner technologies, goods and services that reduce environmental risk and minimize pollution and resource use.”⁴ The definition is appropriate for the environmental sector and it does demarcate statistical boundaries, but it does not capture the full spectrum of the green economy. It is not entirely clear whether it covers all those jobs for which demand increases as economies become greener but which do not change in nature (e.g. bus drivers, railway workers), or those jobs whose processes reduce environmental impact but do not use clean technologies and do not produce goods and services that themselves can be defined as intrinsically “environmental” per se.

Some countries have introduced their own definitions specifically for measurement purposes. For instance, the US Bureau of Labor Statistics (BLS) is using the following definition for measuring green jobs:

- A. *Jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources.*
- B. *Jobs in which workers’ duties involve making their establishment’s production processes more environmentally friendly or use fewer natural resources.*⁵

The definition therefore includes both *output* and *process* aspects of green jobs. However, it does not resolve the challenge of defining the boundary between green and other jobs.

Given the pace of technological change and innovation, the objective reality of which jobs are green and to what extent will be constantly changing, influenced in addition by green policies, regulations, investment decisions and market forces. Anticipating this change is as desirable as it is difficult: it takes time to adjust the supply of skills and therefore a forward-looking approach is necessary; however, in the absence of reliable information on the quantity and quality of green jobs currently available, anticipating future demand for skills becomes an almost impossible task.

The skills themselves are not easy to measure either. Competencies, for example, can be assessed only by directly observing their application: a process so resource- and time-consuming

² Eurostat: *The environmental goods and services sector: A data collection handbook* (Luxembourg, European Commission, 2009).

³ OECD and Eurostat: *The environmental goods and services industry: Manual for data collection and analysis* (Paris, 1999).

⁴ Eurostat: *The environmental goods and services sector*.

⁵ <http://www.bls.gov/green/> (accessed 1 Apr. 2011).

that it is almost impossible to implement systematically across industries and occupations. Measurement therefore usually relies on proxies for skills, such as occupations, qualifications, fields of activities, fields of training etc.

We are therefore confronted with the double challenge of measuring two moving targets – skills and jobs – in a continuing process – the transition to a greener economy.

The lack of a uniform statistical definition of green jobs is partly to blame for the difficulties in updating occupational and industrial classifications to reflect greening processes. At the international level, the International Standard Classification of Occupations (ISCO) and International Standard Industrial Classification of All Economic Activities (ISIC) do not yet include officially defined green occupations and industries. These classifications are deliberately not too detailed to make them internationally applicable. Many ISCO occupations include both some green and some “brown” (environmentally polluting) jobs and tasks: only a small group of occupations could be considered entirely green, while some tasks and occupations might be green or brown depending on the context in which workers operate. The situation is similar in respect of industry definition in ISIC. Cross-tabulations of ISCO and ISIC may be helpful, but do not solve the problem as their use produces only rough estimates owing to lack of detailed data.⁶

Several national reviews of occupational classification systems have investigated whether the green economy is adequately captured by current definitions. The most rigorous and systematic is the US system of occupational research for the O*NET database. O*NET monitors evolution of occupations regularly, using standard procedures, and presents occupational descriptions online for purposes of career guidance and human resources development. Within this context, the task of identifying green occupations was not a one-off exercise but part of a well-established system. O*NET investigated the impact of green economy activities and technologies on occupational requirements and on the development of new and emerging occupations. (See box 6.1.)

A 2009 study by the Washington State (US) Employment Security Department found that green jobs are concentrated in industry classifications and occupational titles which “promote environmental protection and energy security”.⁷ The study obtained responses from 9,500 employers in relation to directly employed “green” employees, their job titles and associated qualifications, and identified four core areas of direct green employment – energy efficiency, renewable energy, pollution reduction and pollution clean-up and mitigation. The study sorted green jobs in these four areas according to the North American Industry Classification Standards, and found that 86 per cent of all green jobs existed in just six industry classifications:

- specialized trades associated with residential, commercial and industrial construction;
- professional, technical and scientific services – a group dominated by law, engineering, accounting, advertising and architectural firms;
- crop production;
- building construction;
- waste management and remediation services; and
- agricultural and forestry support activities (crop-harvesting services).

⁶ Based on results of ongoing research in the framework of the joint EC–ILO project “Knowledge sharing in early identification of skill needs” (2010–11).

⁷ 2008 *Green economy jobs in Washington State* (Olympia, WA, Washington State Employment Security Department, 2009).

Box 6.1. Greening occupational descriptions: The O*NET research in the United States

The Occupational Information Network (O*NET) is being developed under the sponsorship of the US Department of Labor/Employment and Training Administration (USDOL/ETA) through a grant to the North Carolina Employment Security Commission which operates the National Center for O*NET Development.

The Center recently investigated the impact of green economy activities and technologies on occupational requirements in an effort to determine their impact on current O*NET-SOC (Standard Occupational Classification) occupations and the development of new and emerging occupations as potential candidates for inclusion in the O*NET-SOC system. Its report, *Greening of the world of work*, which uses the O*NET-SOC updating methodology and draws on current research on greening in the world of work to examine 12 different sectors of the green economy, has important implications. Its systematic process includes identifying three types of occupations: (i) existing O*NET-SOC occupations; (ii) new and emerging occupations identified from previous research which are undergoing “greening”; and (iii) new and emerging candidate occupations newly identified in the green economy. The methodology consists of the following steps: literature review; identifying, compiling and sorting job titles; clustering titles to identify occupations and occupational sectors; determining overlap with current O*NET-SOC occupations; identifying potential green economy new and emerging occupations; researching potential green economy new and emerging occupations; building and consolidating evidence for final determination of new and emerging occupations; and finally, compiling and reporting new and emerging evidence.

Occupations already existing in the 2006 O*NET-SOC taxonomy that are experiencing an increase in employment demand but no significant changes in job tasks are designated green increased demand occupations. Those already existing in the 2006 O*NET-SOC 2006 taxonomy where the essential purpose of the occupation remains the same, but tasks, skills, knowledge and other such elements have been altered by the impact of green economy activities and technologies, are designated green enhanced skills occupations.

In summary, a total of 64 O*NET-SOC occupations from the 2006 taxonomy were identified as green increased demand occupations and 60 O*NET-SOC occupations as green enhanced skills occupations. In addition, 45 O*NET-SOC new and emerging occupations previously identified through research on in-demand industry clusters and 46 newly identified new and emerging occupations in the green economy qualified as “green new and emerging” occupations. Related occupational profiles were described according to a common set of factors. These findings are now reflected in the O*NET-SOC system and the result will be continuously updated.

Sources: <http://www.onetcenter.org>; O*NET: *Updating the O*NET-SOC taxonomy* (Mar. 2006); O*NET: *New and emerging (N&E) occupations methodology development report* (Apr. 2006); Dierdorff et al.: *Greening of the world of work: Implications for O*NET-SOC and new and emerging occupations* (2009), available at: http://www.onetcenter.org/dl_files/Green.pdf (accessed 1 Apr. 2011).

Within these results, 53 per cent of “green jobs” were identified as being within the energy efficiency sector, with almost half of those falling in the specialized trades classification. Over 30 per cent of “green jobs” related to the reduction of pollution, with strong representation in the crop production occupational category.

In Australia, the taxonomy for green jobs set out in Chapter 5 (box 5.2) was derived from existing occupational, industry and skill classifications and introduced a distinction between the environmental and sustainable aspects of green work.⁸ The Australian Bureau of Statistics plans to design a methodology and a dataset which will cover the national green workforce.

In France, one of the objectives of the Mobilization Plan for Green Jobs (see Chapter 3, box 3.1) is to identify green occupations. Pôle emploi, the national employment agency, has produced a document mapping out green growth occupations.⁹ The inventory, based on a similar approach to that of O*NET in the United States, distinguishes three occupational categories:

⁸ W. Ehmcke, G. Philipson and C. Kold-Christensen: *Who are the green collar workers? Defining and identifying workers in sustainability and the environment* (St Leonards, Connection Research, 2008), available at: <http://www.eianz.org/sb/modules/news/attachments/71/Green%20Collar%20Worker%20report%20Final.pdf> (accessed 1 Apr. 2011).

⁹ *Présentation par Pôle emploi d'un outil de cartographie des métiers de la croissance verte*, Rapport final du comité de filière énergies renouvelables (Jan. 2010).

- green occupations (i.e. “new” occupations);
- greening occupations (i.e. established occupations that will evolve to take account of environmental factors); and
- occupations that will not be modified, but that will be impacted by green growth dynamics.

In Spain, the Observatory of Occupations of the National Public Employment Service has developed profiles of environmental occupations and their impact on employment. The study was based on a questionnaire survey conducted among enterprises in green sectors. The list of profiles included occupations with modified content as well as new occupations and related skill needs. (See box 6.2.)

In the Republic of Korea, the Ministry of Labour analysed the current National Standard of Industry and National Standard of Occupation to identify green industries and green occupations. From a total of 169 industries (at 3-digit level), 47 industries were identified as related to the green economy, as were 53 out of a total of 139 occupations (4-digit level). The inclusion of indirectly related green sectors would bring another 73 industries and 114 occupations into the green category. From this categorization, it is estimated that in 2007 there were 320,000 green jobs and 1,070,000 green-related jobs in the country.

Box 6.2. Identification of green occupations by the Observatory of Occupations of the National Public Employment Service in Spain

The process of identifying green occupations in Spain’s economy has been under way since 2002, when an initial study proposed their inclusion in the national occupational classification. In 2006 the Ministry of Labour initiated more specific research on environmental sectors and occupations, using the OECD’s 1999 definition of environmental activities as a starting point. It determined that some green jobs were already recognized in its classification system while a few others were not. This project made recommendations to create new occupations and disaggregate some existing occupations.

In 2008 the Observatory of Occupations prepared a report which was coordinated by the Spanish Public Employment Services Agency in cooperation with the Ministry of Labour, Ministry of the Environment and regional authorities. The report classified the following ten sectors as green: sewage water treatment; waste treatment and management; renewable energy production; management of nature reserves; forestry management; environmental services; environmental education and information; eco-agriculture and eco-cattle-farming; internal environmental protection activities within companies; and public employment in environmental affairs.

The report took into account environmental policies at international, national and regional levels, employment trends, new technologies in use and occupational profiles. It was based on a literature review of previous studies, analysis of existing data, and a questionnaire survey and telephone interviews conducted among enterprises and key external informants. The questionnaire covered occupational profiles, modifications in occupational content, innovation and technology, new occupations detected, employment trends and training needs. The qualitative research revealed 82 occupational profiles in the ten sectors, giving for each its title and definition, educational profile (including levels of qualification and specific skills required), and a list of related technologies, innovations and tools.

Sources: E. Cuevas Riaño: *The Spanish occupational observatory (under PES) and their occupational research for green jobs*, Presentation at the technical validation workshop on “Skills for Green Jobs”, Geneva, 17–18 May 2010.

Ministerio de Trabajo y Asuntos Sociales (MTAS): *Estudio Marco sobre sectores y ocupaciones medioambientales* (Madrid, Observatorio de las ocupaciones del servicio publico de empleo estatal, 2006).

MTAS: *Perfiles de las ocupaciones medioambientales y su impacto sobre el empleo* (Madrid, Observatorio de las ocupaciones del servicio publico de empleo estatal, 2008).

OECD and Eurostat: *The environmental goods and services industry: Manual for data collection and analysis* (Paris, 1999).

Brazilian researchers, through consultations with experts, identified a group of occupations that would be affected by national environmental legislation and by the diffusion of some cleaner technologies. They distinguished between occupational groups in industries with great opportunities for reducing emissions; jobs in green economic activities; and occupational groups associated with green economic sectors representing greater growth potential than other sectors for the next five years.

It is broadly acknowledged in all 21 country studies included in this research that there is a paucity of data on the classification and incidence of green jobs. The available data tend to be estimates and/or partial snapshots based on ad hoc surveys. Time series of rigorously and systematically collected observations across industries are so far absent. Most countries, confronting the challenge of measuring and classifying green jobs and skills, agree that any formal quantitative approach is likely to yield only rough estimates, and that therefore a holistic approach which explores both the volume and the characteristics of the jobs and skills (or their proxies) is to be preferred. A more standardized and rigorous approach, with guidance on how to prepare a taxonomy of green jobs/occupations and related skills, is widely sought.

6.2 Identifying skill needs: Evaluating existing systems and tools

6.2.1 Well-established systems for early identification of skill needs

There are well-established systems for timely identification of skill needs in a number of the countries studied, namely **Australia, France, Germany, the United Kingdom and the United States**, and to a certain extent **South Africa**. These systems apply a combination of quantitative forecasting, qualitative needs assessments, institutional social dialogue mechanisms and regular information flows to education and training systems. They are implemented at national, sectoral and regional levels, and include provision for analysis of changing occupations and qualifications.

These countries manage the translation of policy decisions and regulatory requirements into skills demand relatively well. They also try to reflect the changes in skills needs in the education and training provided. The latter task, recognized to be difficult, is addressed through attempts to apply systemic coordination mechanisms and continuous information exchange. The complexity of systems to identify skill needs, involving multiple layers of information and multiple stakeholders, often leads to a lack of transparency. Some countries seek to overcome this problem by establishing one central point into which information from different levels is fed and from which the collection of information is coordinated.

This is the case in France and also in the United Kingdom, where the system is under reform. The United Kingdom is developing a new institutional framework which relies on sector skills councils (SSCs) in order to better understand the needs of industry. The United Kingdom has established the United Kingdom Commission for Employment and Skills (UKCES) with a brief including an annual Strategic Skills Audit and a clear mandate to identify what green skills are required by employers in priority sectors – reflecting the focus of central government on “priority industries”. The Alliance of Sector Skills Councils, the collective voice of the SSCs – the employer-driven organizations that seek to ensure that skills taught are relevant to the world of work – is responsible for coordination across sectors and works in a collaborative partnership with

¹⁰ <http://www.sscalliance.org> (accessed 1 Apr. 2011).

UKCES. The identification of skills for a low-carbon economy is one of its cross-sectoral activities.¹⁰

In France the system is characterized by the existence of a broad network of observatories for employment and training, which brings together the various players in the labour market with the aim of reaching a common diagnosis of skill needs. Some of these research and monitoring centres work at sectoral level (industry observatories), others at regional level (regional observatories); all combine macroeconomic projections and quantitative surveys with qualitative information. The new Mobilization Plan for Green Jobs included the establishment of a new observatory for emerging environmental professions, which is now in its pilot phase. This network of observatories complements national-level forecasts and studies (carried out through the General Planning Commission and the Development Agreement for Employment and Skills).

All of the countries noted above have some form of system for medium- to long-term forecasting of future occupational needs, which serves as the basis of state-driven investment in new qualifications and related education and training provision. These systems employ a mixture of quantitative and qualitative assessment of labour market and occupational changes, supported by contributions from employers and trades unions. Indeed, there is wide agreement across many of the country studies, shared by the present authors, that a built-in social dialogue mechanism is the strongest feature of their institutional arrangements.

When attempting to respond to a specific change in skill needs, such as one related to the greening agenda, quantitative forecasts have proven to be inefficient. The weaknesses of national forecasting in terms of accuracy and the level of detail provided are acknowledged in many countries. This general weakness is exacerbated by the presence of major and rapid changes in competencies and skills needs. Moreover, in the present context quantitative forecasting depends heavily on the availability of a trustworthy statistical definition of green jobs, well translated into occupational and industrial classifications. In the absence of these tools, countries rely on well-established methods of identifying skills at sectoral and regional levels. At the same time, most of these countries also recognize the limited capacity of sectoral analysis in the context of green jobs, as every sector offers only a partial picture. A more flexible framework, allowing for both sectoral and cross-sectoral studies, is preferred.

Another question to consider is to what extent the standard systems will be able to cope with analysis of demand in non-standard situations, for example when a large-scale investment in renewable energies and energy efficiency projects triggers structural changes that occur at an unpredictable pace. In the event of a particularly abrupt change, conventional methods will not always work. This possibility calls for new analytical tools, a need recognized in all the countries in this group. For instance, a US study provides an estimate of the number and types of jobs that would be created through a US\$100 billion green recovery programme. The study used input-output modelling complemented with the qualitative “construction” of synthetic industries (e.g. a synthetic representation of the biomass industry, which consists of a combination of assigned relative weights in farming, forestry, wood products and refining). The analysis was augmented by identification of the occupations “most affected” by green economy strategies in key green sectors.¹¹ (See box 6.3.)

¹¹ R. Pollin, H. Garrett-Peltier, J. Heintz and H. Scharber: *Green recovery: A program to create good jobs and start building a low-carbon economy* (Amherst, MA, Political Economy Research Institute, 2008).

Box 6.3. Estimating demand for green jobs in the United States

A report prepared by the Center for American Progress and Political Economy Research Institute estimated that around 2 million new green jobs (935,200 direct jobs, 586,000 indirect jobs and 496,000 induced jobs) would result from a US\$100 billion green recovery programme focusing on six sectors: building retrofitting, mass transit/freight rail, smart grid (a form of electricity network using digital technology, with potential to save energy and reduce costs), wind power, solar power and advanced biofuels. This compares with an estimated 1.7 million jobs created through spending the same amount on promoting household consumption and 542,000 jobs created through spending the same amount on the oil industry.

The direct and indirect employment effects were calculated through input–output analysis. Since input–output tables are structured according to sectors which do not reflect green economic activities affected by the recovery programme, the authors of the report constructed “synthetic” industries: for example, a synthetic representation of the biomass industry is arrived at by assigning relative weights to each of its sub-industries according to their respective contributions to producing biomass products.

The 496,000 jobs created through induced expenditures are estimated, on a conservative basis, as about one-third of direct and indirect jobs. Given that green recovery programmes are designed to have large induced employment effects, the authors argue that the actual number of induced jobs may be as high as double the number of direct and indirect jobs, giving a total of about 3 million jobs.

To complement this report, Pollin and Wicks-Lim used input–output analysis (2005 tables) to evaluate which occupations would witness the largest job gains from a given volume of investment for the same six green economy sectors. The results are shown in the table below, which lists 45 “representative” occupations varying widely by type and education requirements. Across the United States, 14.3 million people were employed in these occupations in 2007, equivalent to 9 per cent of the US workforce. In sum, the results of the study suggest that the employment benefits of a green jobs strategy would be wide-ranging in terms of the number and type of jobs created.

Destination sector for green economic investment	Representative jobs
Building retrofitting	Electricians, heating/air conditioning installers, carpenters, construction equipment operators, roofers, insulation workers, carpenter helpers, industrial truck drivers, construction managers, building inspectors
Mass transit	Civil engineers, railtrack layers, electricians, welders, metal fabricators, engine assemblers, production helpers, bus drivers, first-line transportation supervisors, dispatchers
Energy-efficient automobiles	Computer software engineers, electrical engineers, engineering technicians, welders, transportation equipment painters, metal fabricators, computer-controlled machine operators, engine assemblers, production helpers, operations managers
Wind power	Environmental engineers, iron and steel workers, millwrights, sheet metal workers, machinists, electrical equipment assemblers, construction equipment operators, industrial truck drivers, industrial production managers, first-line production supervisors
Solar power	Electrical engineers, electricians, industrial machinery mechanics, welders, metal fabricators, electrical equipment assemblers, construction equipment operators, installation helpers, labourers, construction managers
Cellulosic biofuels	Chemical engineers, chemists, chemical equipment operators, chemical technicians, mixing and blending machine operators, agricultural workers, industrial truck drivers, farm product purchasers, agricultural and forestry supervisors, agricultural inspectors

Source:

Table from R. Pollin and J. Wicks-Lim: *Job opportunities for the green economy: A state-by-state picture of occupations that gain from green investments* (2008). Courtesy of the Political Economy Research Institute, University of Massachusetts, Amherst. Reproduced with permission.

Similarly, in Germany input–output analysis was complemented by a qualitative survey among more than 1,100 companies in two renewable energy subsectors (manufacturing, and operation of systems for the use of renewable energy).¹² The survey, carried out in 2005 and published the following year, included information on skills in the current workforce as well as expected requirements up to 2010. The methodology is particularly useful as the study looked at net job creation, taking into account jobs that would disappear as well as those created. It remains to be considered how this methodology could be further adapted to incorporate more information relating to skills and competencies.

The experience to date is that even countries with well-established national systems for anticipating skill needs still rely on ad hoc initiatives at regional or local and sectoral or company levels for information on change occurring and skill needs arising within specific groups of occupations. Such initiatives sometimes grow into well-defined holistic strategies at regional or sectoral level that complement national systems. An example is the New South Wales State Government Green Skills Strategy (Australia), whose implementation plan identifies nine priority industries on the basis of their contribution to carbon emissions, key environmental challenges and opportunities, vocational training related occupations and specific environmental targets.¹³ The Strategy details the underlying “units of competency” to be delivered through training packages, or learning modules, by registered training organizations. Within the framework of the Strategy the New South Wales Government also contributed to the improvement of labour market information by establishing an online Business Guide and Course Finder to help businesses identify strategies and resources to develop a greener workforce.

No matter how well established a system is, countries still seek information at grass-roots level where change is actually happening. From this point of view, Denmark and Germany are interesting examples.

In Germany, notwithstanding a multilayered system of forecasting and identification of skill needs, most updating of qualifications and training provision is based on information derived from the well-established dual apprenticeship system of both workplace-based and school-based learning, which manages to transfer labour market signals into the system on a continuous basis. According to the Vocational Training Act of 1969 (updated in 2005), a specific skill need has to be identified in the economy to justify a modernization of an existing apprenticeship/qualification or the establishment of a new one. In 2006, the Federal Environment Ministry launched an educational initiative entitled “Environment creates perspectives” in cooperation with firms from the environmental technologies/renewable energy sectors and business associations. As a result of this initiative, which aims to identify the trades, skills and competencies required by the environmental sector, 6,000 additional apprenticeship positions were created in 2009.

In Denmark, no correspondingly elaborate system of skills identification exists and relatively little information (statistics, analyses etc.) is available regarding the implications of the greening economy for Danish occupational structures and skill requirements. However, the training system has proved flexible and able to cope well with changes in the labour market. The trade committees and their corresponding councils that monitor occupational changes can call for development or

¹² German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: *Renewable energy. Employment effects: Impact of the expansion of renewable energy on the German labour market* (2006).

¹³ The nine industries are manufacturing; electricity and gas supply/generation; water; construction; agriculture, forestry, fishing and land management; wholesale and retail trade; transport and storage; property and business services; and government.

adaptation of qualifications and certificates within the tripartite governance framework. In support of this endeavour, the trade committees are also active in anticipating skill needs at occupational level in “families of occupations”.

As a follow-up to the recommendations of the Danish Globalization Council set up by the Government in 2005,¹⁴ a unit was created to complement tripartite collaboration by commissioning a dynamic identification of changing skills and occupational demands resulting from the growth of new industries, convergence of sectors and development of technology.¹⁵ This unit conducted a study focused specifically on 79 clean technology companies.¹⁶ It included an in-depth analysis of ten companies characterized by impressive growth and innovative abilities, and representative of the types of convergence of occupational profiles that have emerged as a result of new market opportunities arising from eco-friendly products and services. Using a functional job analysis, the study also analysed new and changing occupational demands for skilled workers.

South Africa has a well-developed framework for identifying skill needs, although it does not seem to have added references to greening of the economy and green jobs yet. It is designed to work through a demand-led process with industry to identify skills gaps, and then formulates education and training programmes to facilitate capacity building to fill those gaps.

The aspect of the South African system particularly relevant for identification of skills for green jobs is the National Scarce Skills List (mentioned in Chapter 3, section 3.1.3). This list gives an idea of the extent to which economic growth and development are constrained by the country’s limited human resource capital. In consultation with the Sector Education and Training Authorities (SETAs) and drawing on data set out in their sector skills plans, a structure is created through which each economic sector identifies its projected skills shortages. The National Scarce Skills List can also be used to gauge which occupations should be priority targets for training, education and restructuring policies with a view to the green economy of the future. Figure 6.1 shows those occupations that can be considered the top priorities on the basis of:

- magnitude of scarcity;
- direct importance to the green economy; and
- potential green knock-on effect.

The two top-priority groups are engineering professionals, and natural and physical science professionals (which would include environmental scientists).

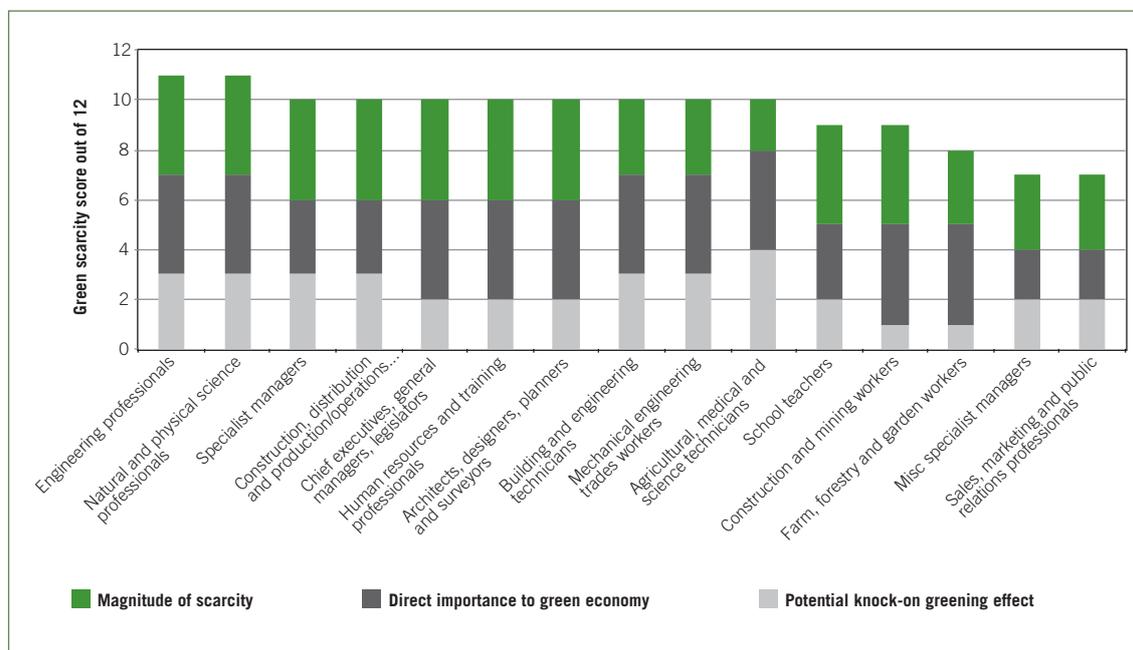
Trade unions and employers’ associations are important players in the process of identifying skill needs at virtually any level in these countries. A formalized social dialogue and institutionalized structures, such as sector skills councils, trade committees or observatories, are complemented by informal dialogue within the framework of individual undertakings.

¹⁴ For more detail, see <http://www.globalisering.dk/page.dsp?area=52> (accessed 1 Apr. 2011).

¹⁵ The call for tenders is managed by the Danish School of Education in collaboration with the consultancy firm KUBIX. The Danish Technological Institute is responsible for identifying and disseminating useful studies and promising practices, with a particular emphasis on supporting the work of the social partners.

¹⁶ Brøndum & Fliess: *Erhvervs- og efteruddannelser i et cleantechperspektiv* (2009), available at: <http://www.uvm.dk/Uddannelse/Erhvervsuddannelser/Om%20erhvervsuddannelserne/Nyheder/Erhvervsuddannelser/Udd/Erhvervs/2009/Dec/091217%20Flere%20kompetencer%20til%20cleantech-branchen.aspx> (accessed 1 Apr. 2011).

Figure 6.1. Priority occupations for the green economy, South Africa, 2008



Source: South African country report, based on figures from the National Scarce Skills List, South African Department of Labour (2008).

6.2.2 Systems for early identification of skill needs under development

In **Brazil, China, Estonia** and the **Republic of Korea**, systems for identifying skill needs are still in the process of development. These countries rely on their occupational forecasting and qualification systems and their institutional mechanisms for identification of skills needs; however, the existing systems have proved to be of only limited value in responding to the effects of greening on the labour market.

In the Republic of Korea, a comprehensive system to identify skills change and training needs does not currently exist. Labour demand and supply forecasts at the national level have been drawn up every two years, focusing on the projected number of jobs available, but this exercise provides limited information about the level and/or type of skills needed. To address this gap, national and regional skills surveys were launched, comprising surveys in five regional labour markets with a subsequent aggregation of results to national level. Additionally, sector human resources development councils were established from 2003 to identify and monitor skill needs in selected industries. Since the country has not enjoyed a strong culture of partnership between industries and training providers, most of the sector councils have yet to achieve their full potential in providing comprehensive and concrete information on skills needs.

Brazil relies on a combination of qualitative and quantitative occupational forecasting and consultation with experts (as mentioned in section 6.1 above). The quantitative element of the forecast is produced by means of econometric modelling that includes an input–output matrix. The qualitative component is based on technological foresight and impact analysis of the repercussions for occupations and skills. The forecast provides only limited information on imbalances

of demand and supply owing to the limited statistical significance of the disaggregated data. Also, formal quantitative forecasts are of limited value in measuring change in occupational profiles and specific skill needs. The consultation process with specialists and others active in the world of work compensates for these limitations to some degree. To improve the situation, Brazilian experts are seeking to establish a regular skills survey and to deepen and strengthen dialogue with the world of work.

China and Estonia rely on econometric projections, which they plan to develop further, and some ad hoc surveys. On the positive side, these countries already have in place a number of institutional frameworks which could potentially be used for skill needs analysis, such as a network of public employment services and advisory mechanisms for national qualification standards. However, whether existing systems will be effective in identifying the skills needed for green jobs remains to be seen.

These countries are confronted with a double challenge: to continue developing their systems for early identification of skill needs, and to adjust these systems to specific policy challenges and labour market needs, such as those related to the greening economy.

6.2.3 Emerging or non-existent systems for early identification of skill needs

Some of the countries which participated in this research do not possess a well-elaborated system for anticipation and monitoring of green jobs. In these countries it is generally difficult to obtain reliable labour market information (LMI); a greater focus on green jobs simply adds another layer of complexity for governments and other institutions in their attempts to address skill needs. Such countries rely on ad hoc surveys organized by NGOs, international donors and, in some cases, national line ministries and universities. Often such exercises occur in the framework of particular studies or activities and therefore have a limited lifespan, lacking the sustainability that is so desirable in establishing elements of an LMIS. There is no evidence that, even with the support of such one-off project initiatives, any comprehensive research has to date been conducted on skills for green jobs. Our research programme has been ploughing a new furrow in a largely uncultivated field.

In some countries, such as the **Philippines**, governments use very basic forecasting methods, making the simple assumption that every job created in, for example, agriculture is a green job. These rough estimates are not, however, an adequate basis for a skills demand analysis. Many countries are receptive to a critical review of new methodological approaches and to capacity development to assist efforts in this area by their governments and other institutions. For example, simple input–output modelling is assumed to be feasible in developing countries.¹⁷ It remains to be seen, nevertheless, whether these countries' statistical databases are sufficient for the task, and whether such modelling efforts could be translated into anticipation of skills demand in these countries.

One of the reasons why developing LMIS and analyses of skill needs are not considered matters of particular urgency in these countries is that they have a labour surplus. The abundance of people on the labour market gives the impression of there being no labour shortage. To accept

¹⁷ Jarvis, A., Varma A. and J. Ram, forthcoming: *Assessing green jobs potential in developing countries: A practitioner's guide* (Geneva, ILO).

this impression at face value, however, would be very short-sighted, since the shortage of skills is not directly linked to the size of the workforce: indeed, many developing countries are reporting increasing shortages of skilled workers in particular.

In the absence of a system for monitoring change in skill needs, enterprises bear the burden of trying to adjust to the changing situation on their own. Some of them identify the training needs of their existing personnel and new recruits using a variety of approaches deriving variously from the nature of their products and services, the green technologies in use and their production arrangements. What form the process takes in each case is determined by the specific human resources needs and circumstances of each company. Skills gaps are also identified through a process of benchmarking, by which companies (e.g. in **Thailand**) compare themselves with their counterparts within the country and overseas.

6.2.4 General findings on systems for early identification of skill needs: The imperative of coordination

It remains uncertain to what extent the established systems and their institutional frameworks will be able to cope with the new tasks associated with identifying skill needs for green jobs, which are hard to measure, in the rapidly changing and heterogeneous context of the green transition. There is, however, no doubt that the presence of such systems and mechanisms for social dialogue is helpful. Part of the challenge rests in avoiding duplication of activities and the building of a system within a system. Additional activities using alternative tools need to become complementary to the established system rather than simply overlaying it or competing with it.

We did not find many examples of specific coordination mechanisms in relation to identification of skills for green jobs; the few exceptions included some in non-traditional sectors which cut across industry boundaries (e.g. renewable energy), for example the United Kingdom Alliance of Sector Skills Councils in its work on low-carbon skills, and the French Observatory's analysis of the development of environmental professions. If more such mechanisms appear – and they probably will, as there is a widely expressed demand for them – it will be a challenge to articulate them with the existing structures.

Those countries that have less developed systems for anticipation and monitoring of skill needs, or no systems at all, are seeking to establish comprehensive systems, with particular emphasis on creating sectoral, branch or trade mechanisms. Conversely, and somewhat ironically, those countries that already have well-established systems, including mechanisms at sectoral level, are seeking to move beyond those structures, reasoning that a purely sectoral approach to the analysis of green jobs will be misleading as it measures the emergence of specialized industries but not the importance of increasingly greener or cleaner production. Similarly, an occupational approach indicates the specialization of workers on environmental issues rather than the full range and scope of green activities in the economy. Since environmental aspects have to be considered in most, if not all, activities, a cross-sectoral or cross-occupational perspective is considered more fruitful.

Irrespective of how well developed their LMIS are, countries are seeking to improve their handling of green jobs. For instance, the American Recovery and Reinvestment Act (ARRA) provides funding for LMI improvement through 30 grants awarded to 30 states, in all worth US\$47 million. These grants are intended to assist states with green technology impact studies, occupational needs studies for renewable energy and energy efficiency industries, and the posting of jobs to online job banks, with the intention, among other things, of trying to connect local

workers to local jobs.¹⁸ It is clear from these aims that policy challenges linked to climate change are even more demanding in the context of economic crisis, where many look to the greening agenda for help in accelerating job creation. This expectation imposes an additional burden on LMIS. Countries that do not possess LMIS, and where data collection and monitoring systems are underdeveloped in general (as is the case in most developing countries), find themselves in a particularly difficult situation. These countries might usefully learn from those (such as Denmark and Germany) that have not relied on LMI alone but have responded to signals from the labour market by introducing changes in education and training through mechanisms for grass-roots social dialogue, so that direct links between businesses and training institutions compensate for the shortcomings in LMI.

Having said that, the role of social dialogue in updating occupational profiles, curricula and training programmes is weak to non-existent in developing countries (see table 6.1). Similarly, employers' organizations and trade unions are not yet fully integrated in the process in these countries: sectoral studies are mostly organized by line ministries and donor organizations, and even if they involve social partners this does not lead to a systematic collaboration. In addition, identification of skill needs in developing countries tends to be centralized, with no input from the regional level; and yet it is at regional and local levels that identification of skill needs can be most cost-efficient and most practical, in terms of both organizing the process and using its findings. There is therefore a need for systems for early identification of skill needs in developing countries to be reformed, or, where they do not exist, established, to incorporate a greater role for social dialogue and more decentralization at the same time as more systematization.

6.3 Conclusions

It is broadly acknowledged by all countries participating in this research that there is a paucity of data on the classification and incidence of green jobs. Experience with taxonomy and measurement of green jobs and related occupations is still scarce and no standardized methodology is available. Most countries rely on qualitative methods, such as enterprise surveys, sectoral analyses, occupational research, job analyses and consultations with experts. All the country reports point to the urgent need for a more standardized and rigorous approach and for guidance on how to prepare a taxonomy of green jobs/occupations and related skills.

From an institutional perspective, the role of statistical departments of ministries of labour (Australia and the United States) and public employment services (France and Spain) in updating occupational taxonomies and in collecting relevant data on green occupations is very important. These institutions are well placed to take the initiative at national level in those countries where green occupations are still to be defined and taxonomies updated.

Most developed countries enjoy well-established systems for anticipating and monitoring skill needs which they have been able to use to analyse the skills particularly needed for green jobs. These systems have already reflected past changes in environmentally driven competencies, leading to new qualifications and courses and changes to established curricula. To the extent that the pace of change allows, these systems might be expected to continue to reflect and animate the need for new skills responses.

¹⁸ US Department of Labor Employment and Training Administration: Notice of Availability of Funds and Solicitation for State Labor Market Information Improvement Grants, 24 June 2009 (v 74, n 120), SGA/DFA PY 08-17, available at: <http://edocket.access.gpo.gov/2009/E9-14930.htm> (accessed 1 Apr. 2011).

Table 6.1 Institutional frameworks and other mechanisms for identification of current and future skill needs in the countries studied¹

	AUS	DEU	DNK	ESP	FRA	GBR	USA	ZAF	BRA	CHN	EST	KOR	BGD	CRI	EGY	IDN	MLI	PHL	THA	UGA
National-level studies/line ministries	x				x	x	x	x	x	x	x	x		x		x		x		x
Observatories				x	x										x		x			
Sectoral/industry/trade	x		x		x	x		x				x				x		x		
Occupation		x	x				x					x						x		
Enterprise	x			x	x	x							x					x		x
Value chain																				
Regional/local	x	x		x	x	x	x					x								
Social dialogue	x	x	x		x	x	x	x	x		x									
Public-private networks/partnerships	x	x			x	x	x													
Trade unions			x					x												
Employers' associations				x	x										x					
Public employment services				x	x				x											
Training providers/universities				x										x						x
NGOs/donors				x									x	x	x		x			x
Do levels meet somewhere?					x	x	x	x												

¹ Based on the information from country reports. The countries are organized in subgroups according to the narrative (section 6.2).

AUS = Australia, BGD = Bangladesh, BRA = Brazil, CHN = China, CRI = Costa Rica, DEU = Germany, DNK = Denmark, EGY = Egypt, ESP = Spain, EST = Estonia, FRA = France, GBR = the United Kingdom, IDN = Indonesia, IND = India, KOR = Republic of Korea, MLI = Mali, PHL = Philippines, THA = Thailand, UGA = Uganda, USA = the United States, ZAF = South Africa.

The role of social partners in trade committees and skills councils has been of key importance in the successful continuous transfer of labour market signals to the vocational education and training system. It plays a particularly strong part in support of the German apprenticeship system and the simple but flexible system pertaining in Denmark. In many countries, despite the presence of elaborate systems, information is still gathered through ad hoc arrangements at grass-roots level. Additional activities using alternative tools need to be made complementary to the established system without duplication of functions.

Improvement is still needed in the identification of current and future skill needs as the basis for skills responses. This is true both for environmentally driven skills needs and for the whole economy, especially in developing countries and emerging economies where systems for monitoring skill needs are under development, emerging or even non-existent. Here, the first priority is to establish systematic social dialogue mechanisms to translate labour market signals into updated training programmes. It appears to be both practical and efficient in these countries to identify skills at regional and local levels.

Whereas in developed countries there is a need to look beyond established structures and levels of analysis to map out a bigger picture of green jobs in the overall economy, in developing countries and emerging economies it is more useful, and feasible, to focus on industry-level analysis and the establishment of relevant institutional mechanisms for social dialogue. Nevertheless, in the context of green employment, where green activities do not always fit within traditional sectors and value chain analysis is important, in both developed and developing countries greater coordination of analyses and labour market monitoring across sectors and occupations is needed.

7. Key findings and ways forward

This report, based on research conducted in 21 countries across the world, offers a snapshot of the skills needed for green jobs. To our knowledge, it is the first global study of the kind, and naturally it is far from being exhaustive. In-depth analysis of the skills requirements of green sectors and more focused thematic analyses, for example on the measurement and identification of green jobs and skills, are still needed. Nevertheless, our research has yielded a number of important findings which have implications for policy and action.

7.1 Change in skill needs for green jobs is real and requires action

All the country studies in the research concur that overcoming the negative environmental, economic and social impacts of climate change and environmental degradation is the key priority for a green economy. The challenge goes beyond climate change alone and involves the whole range of environmental changes. The response measures needed require complex skills and environmental knowledge.

Green jobs are seen as a real solution to not only environmental but also economic and social challenges, providing real income generation opportunities. Green jobs have become central in the policy agenda. The 2008 *Green jobs* report suggested that a central feature of the next Great Transformation, after Karl Polanyi's "market society", will be green jobs.¹ Without entering into the debate here, we would like to point to the fact that this suggestion was made before the financial crisis hit the world economy and resulted in a global recession and jobs crisis. Green jobs offered governments and workers alike the hope of a double dividend: fighting climate change and environmental degradation, and creating employment opportunities for millions of unemployed people and for millions more trapped in jobs with low productivity and limited career prospects. Since the *Green jobs* report was published, green jobs have become more central to the policy agenda than ever before. The rate at which investment and stimulus funding are being directed at green activities suggest that the greening agenda is not likely to diminish in importance any time soon.

The power of the greening economy agenda will translate into skills change. The research project identified **four drivers of skills change: environmental changes; policy and regulation; green technology and innovation; and markets and consumer habits**. These drivers are often mutually dependent: regulation is based on current or expected changes in the environment; technology and markets may depend on regulation or on resource scarcity and also interact with each other; consumer behaviour mainly affects markets, but also influences the uptake of technologies.

Of particular importance is how these drivers of change have evolved. Markets and consumer behaviour are a defining driver 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. Policy, regulation and the market all helped change people's mindsets, encouraging them to acknowledge the business case for green innovation.

¹ UNEP, ILO, IOE, ITUC: *Green jobs: Towards decent work in a sustainable, low-carbon world* (Geneva, 2008); Karl Polanyi: *The Great Transformation: The political and economic origins of our time* (Boston, Beacon Press, 2001).

Developing countries, emerging economies and those industrialized 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. Therefore the highest priority for these countries must be capacity development, specifically the creation of strategic, leadership and management skills to enable decision-makers in governments, employers' associations, trade unions and business to set the right incentives and create enabling conditions for cleaner, greener production and service delivery. Another high priority must be the inculcation of environmental awareness as an integral part of education and training at all levels. Preferably introduced as one of the core skills from early childhood education, this will eventually drive change in consumer attitudes and behaviour and thus in the market itself. This is where skills come into play as a driver of change in their own right, capable of providing new impetus to green evolution.

Furthermore, as the green market becomes a more powerful driver worldwide, and national environmental challenges and regulations diminish in relative weight, skills change will become increasingly uniform across countries and skills will become less country-specific than they are at present. This means that changes in demand for, and in the content of, skills in certain occupations among the front-runners in the greening process can inform policy decisions and training responses in other countries. There will thus be a need for more information on core, changing and emerging occupations and their skills content at a global level.

Which drivers of change are most prominent in particular contexts does not necessarily affect the route chosen to deliver the skills response. Skill needs arising from green innovation and technological change, from new markets and new regulations, can be tackled at company level, in formal training systems or by non-formal training providers. What determines the way in which skills are delivered is not so much the particular drivers of change at work but rather the degree and urgency of skill needs together with the quality and responsiveness of existing institutions.

The key point here is that the green transition and related skills change are already under way and require action if existing bottlenecks in skill and labour supply are to be cleared. Already, shortages of skilled workers are preventing countries from implementing policies, regulations and green stimulus packages.

Skill shortages for green jobs stem from a number of factors, including underestimated growth in certain green sectors (e.g. energy efficiency in buildings), a general lack of scientists and engineers (common across countries), the low reputation and attractiveness of some sectors (e.g. waste management), and the general structure of the national skill base. Science, technology, engineering and mathematical (STEM) skills, much needed for green occupations, are in constant low supply as too few young people choose to study these subjects. Many countries, especially developing economies, report shortages of teachers and trainers in subjects related to environmental awareness and in fast-growing green sectors such as renewable energy and energy efficiency. Multiskilling is increasingly needed as tasks and industries converge and the development of solutions to new challenges requires systemic thinking. A multidisciplinary approach in vocational training for green jobs is thus required at all levels, including apprenticeship training.

To avoid future skill shortages, countries will need to devise strategies based on well-informed policy decisions. Labour market information, anticipation of skill needs for green jobs, and the continuous translation of labour market signals into updated training provision need to become integral elements of such strategies. It is also important to remember that skills are not a mere servant of the economy, solely reactive in the face of change. Every policy – industrial, techno-

logical, restructuring, taxation, emissions-reducing – can tap the power of skills to promote change, if skills are considered an important function of the planning and implementation processes.

7.2 Policy coherence is crucial: How is it to be achieved?

The policy response to changing skill needs to be **bold and ambitious but also coherent**. Skills policies and environmental policies are still often dealt with in isolation. The country comparison revealed different levels of coherence, with environmental and skills policies ranging from the comprehensive and well coordinated to the fragmented or virtually non-existent. Skills policies often do not reflect environmental concerns and vice versa. Implementation of existing policies is often weak, with no clear human and financial resource allocation and no clear institutional accountability. Sometimes, policy documents and government strategies related to the environment do highlight shortcomings in skills supply and call for training responses, but do not set out concrete steps to close the skills gap and are not followed up by joint decision and action on the part of ministries and other stakeholders on both sides. Some public programmes and policies that include skills components for green jobs do not emphasize their contribution to environmental protection but stress only the economic and employment objectives. This is especially common in developing and emerging economies, but applies in developed countries too.

These shortcomings are attributable in part to **divergent priorities** but mainly to **lack of coordination** among the responsible government ministries. Procedures established for identifying, monitoring, anticipating and providing skills often do not include mechanisms for dialogue with representatives from other line ministries, including ministries of environment; and, for the most part, ministries and other institutions concerned with education and training are not involved in developing environmental policies. This clearly reduces prospects for coordinated approaches. In other cases, if interministerial coordination for policy formation is undertaken successfully, coordination for policy implementation is weak. The same result occurs where policy-makers lack sufficient awareness or capacity to integrate a skills dimension into policy responses to environmental risks.

Where might a solution to this key difficulty lie?

First, our analysis demonstrated that **policy coherence is closely linked to the level of a country's development** – not just economic development, but a more complex phenomenon involving institutional, educational, social, health and technological aspects. Institutional maturity and thus policy-making capacity among key players, including social partners, support policy coherence. It is also important in seeking to boost green jobs and skills that policy coherence is sought across the policy spectrum – including trade policy, technological development, industrial policy, fiscal policy and so on. Just as environment and climate change should feed into all these separate agendas, so skills and training should too.

Second, **more coordination among line ministries and social partners** would help. This could be achieved by setting up a task force for human resources development for a greening economy, or incorporating training and skills issues into an existing forum, such as an HRD council or a council for environmental development. What is important is not the roof under which the dialogue occurs so much as the real decision-making power it exercises. This requires that the forum for the dialogue can establish clear commitments common to all those partners involved, allocate human and financial resources, agree on responsibilities in the implementation plan, and then take on these responsibilities and continue working to bring the decisions into life. Failure to implement a given environmental policy or to enforce a certain environmental regulation translates into reduced need for the skills planned to implement those policies and regulations

and may result in a surplus of skills and increase of joblessness. Failure to provide the skills required to implement the planned policy results in skill shortages. A win-win situation can only be achieved if skills and jobs are discussed, planned and implemented in timely fashion and in conjunction with each other.

Third, a **more decentralized approach** can actually promote policy coordination and coherence at **sectoral and local levels**. Direct dialogue between national and regional governments and social partners can be translated into action through commitments and resource allocation on a smaller scale and in a down-to-earth way where immediate dividends are obvious 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 coordinated policy-making and such bottom-up initiatives, with skills playing an important role, can support the green transition.

7.3 How skills are changing and what works in response strategies

Our research assumption was that at least three types of skills change occur in the context of a greening economy: (1) **green structural change**, requiring retraining; (2) **emergence of new occupations**; and (3) **alteration of skills content in established occupations**. Was the assumption confirmed? We may answer this question by setting out four key findings, which lead into a review of the most effective skills responses.

First, the regulatory environment and green policies, such as carbon taxation, cap-and-trade schemes and emissions targets, along with the development and application of green technologies and the take-up of new market opportunities in greener businesses, are indeed responsible for *green* structural change. However, green transition occurs as part of a longer-term structural change driven by a combination of automation, cost-driven relocation, sectoral employment shifts and other factors. Green structural change has been further exacerbated by the recent economic crisis.

Green regulations and emissions targets will have important implications for emissions-intensive industries such as fossil fuel energy generation, agriculture and the automotive sector, where downsizing and restructuring can be expected. Conversely, employment opportunities will grow in newly emerging and expanding industries, such as renewable energies and those relating to energy efficiency. At the same time, internal restructuring and adjustment can be expected in many industries, especially in manufacturing and construction, to assist the transition from carbon-intensive to energy-saving and cleaner production and service patterns. The interesting feature in this process is that while certain jobs will disappear, the skills associated with them will not become obsolete: they will serve as the foundation for the skill set required in new jobs and the basis for retraining and skills upgrading measures, the latter being at least as important as the former. Portable skills acquire special value in the restructuring context, enhancing both employment security and inter-occupational and geographical mobility.

Second, the change in occupational skill needs is both quantitative and qualitative. Where investment in a green sector increases, demand for certain occupations may increase with no influence on the skills composition of the occupation: for example, additional investment in public transport may increase demand for railway workers without changing the skills they need to perform their jobs.

In the case of a qualitative change, the level of occupational change depends on the degree of skills change required, which may range from nil (as in the case of the railway worker) to high.

Where the degree of change in skills composition is highest, new occupations come into being (e.g. that of solar energy technician). Between the two extremes are numerous established occupations whose content is altered as a result of new green technologies or new green patterns of production. These include the occupations of engineers, managers, and the craftspeople or technicians who install and maintain new technologies or implement new energy efficiency standards. This type of skills change is the most frequent and concerns the largest number of jobs.

Third, new and emerging occupations tend to require higher-level qualifications than changes in existing occupations, which happen more often at the low and medium skill levels. Whether the occupation is green or greening is up to each country to decide depending on the national context, the stage of greening in the economy, the level of detail in its occupational classification, and the presence of related qualification profiles and training programmes. For instance, in France organic farming is not a new occupation, and training for the job is integrated into existing training courses, while in Estonia a new qualification of farm-worker in alternative agriculture has been created.

Fourth, core skills are at least as important as technical skills for the green economy. This chapter has already mentioned strategic and leadership skills, and environmental awareness; of equal importance are entrepreneurial, innovation and communication skills, to name just a few.

What do these findings mean in terms of skills response strategy?

- (1) Since skills upgrading is the measure most frequently taken in restructuring both within and across sectors, and given the number and importance of established occupations that are greening, countries need to put **basic skills** high on the policy agenda. Basic skills are the foundation on which the individual can go on building a skills profile throughout his or her working life. In providing basic skills, initial education and training play a crucial catalysing role. It is therefore essential that systems of initial vocational training strengthen cooperation between training providers and the formal training system on the one hand, and enterprises, industry associations or sector skills councils on the other. Enhanced social dialogue and more practical training (apprenticeships, internships, job placements, practical training in enterprises, projects on the job etc.) will help to build up foundational skills relevant to business needs and to increase the employability and productivity of workers. Upgrading or greening such skills will be easier than training a workforce with no hands-on experience or capacity.
- (2) **Portable skills** should be an important element of both initial and continuing training as a means to employment security. Portable skills are skills which can be transferred and used productively in different jobs, occupations and industries and thus include not only core skills but also many technical and vocational skills. Core skills, including environmental awareness, should be considered a cornerstone of every curriculum at any level of education and training. A good deal of innovative pedagogy is needed to translate core skills into effective teaching and assessment methods. Portability of skills is dependent on their assessment and recognition. This requires transparent systems and credible sources of information.
- (3) **The appropriate length and breadth of courses will vary** according to the type of skills being taught. In the context of restructuring measures, the most useful retraining and skills upgrading courses are short and tailor-made. These can be provided on or off the job, but to be most effective need to be linked to a specific job opening. Retraining and skills upgrading measures in the context of restructuring are delivered through various channels including

standard active labour market policies. It is therefore important that such policies take into account the green structural change and contain relevant training and other activation measures.

When it comes to greening established occupations, suitable training may vary between learning by doing on the job and longer continuous training courses.

New and emerging occupations may require a new initial training course, university degree or longer continuous training.

Taking into account all three types of skills change, it is clear that the whole training system is affected. It is essential that both the formal education and training system and its institutions, and alternative training providers outside formal education and training systems, are adequate in respect of both capacity and quality. The revision of training programmes to adjust to green changes on the labour market is a task for the whole training system. So far, compulsory level and tertiary education have been catching up rather well, whereas technical and vocational education and training has been lagging behind in adapting to the needs of the green economy.

- (4) The availability of **teachers and trainers** with up to date knowledge on the environment and green technologies is crucial for all types of training. Education and training of teachers and trainers should therefore be addressed as one of the first items in any skills response strategy.
- (5) From the institutional point of view, the key to success lies in **concerted measures** undertaken by governments from national to community level and by employers and workers, through institutional mechanisms of social dialogue, such as national or regional tripartite councils, sector or industry skills councils, public–private partnerships and other similar arrangements. Such measures may occur within the framework of existing institutional structures or may require the creation of new ones, depending on the context. Certainly, the presence of such institutions as sector skills councils covering green sectors assists the effectiveness of such measures. The degree of coordination between public and private stakeholders and the degree of involvement of social partners are decisive.

Given the importance of multidisciplinary approaches at all levels and in all types of training for green jobs, mechanisms to devise appropriate skills responses often need to be cross-sectoral. A good combination of national coordination and sectoral approaches implies institutional mechanisms conducive to effective identification of skill needs and responses at sectoral level and effective articulation with national priorities and with cross-sectoral coordinating bodies.

In the context of restructuring measures, public employment services (PES) with well-developed networks and good coverage have an important role to play in job matching and training. Establishing or developing PES and their networks in developing countries, and raising their awareness about green business opportunities and related skill needs in all countries, is of central importance in this context.

7.4 A green and just transition, not just a green transition

Different models and estimates of the overall employment effects of greening the economy provide different scenarios, for both the short and the long term, but most of them agree that overall jobs created will offset those lost. The new jobs, however, will not necessarily be in the same sectors, occupations and localities as those lost, and those who get the new jobs will not necessarily be

the same people who have lost their old jobs. In particular, **disadvantaged groups**, such as people with disabilities, those who are low-skilled and/or illiterate, vulnerable young people, members of minorities and ex-offenders, might find it hard to get access to new green and decent jobs. Research has also demonstrated that **gender segregation of occupations** persists in the green jobs market.

In this context, it is essential not only that **socially responsible restructuring measures** are provided to protect those who lose their jobs but also that **targeted assistance and affirmative action** are in place for women and disadvantaged groups. Green growth provides an opportunity to make new good and green jobs accessible for all and to address social inequalities. Since newly emerging occupations do not yet have a history of gender stereotyping and segregation, they offer the chance to break existing gender barriers. Such inclusive growth, however, can only be achieved if **access to green training measures** is granted to, indeed targeted on, disadvantaged groups. Incentives to increase women's participation in technical training programmes teaching STEM subjects will not only increase their participation in technology-driven occupations but also help to solve the skill shortage problem in this segment of the labour market.

Developing countries bear least responsibility for climate change but are hit hardest by its consequences. The alteration of natural habitats, loss of biodiversity, droughts, floods and other consequences of climate change and environmental degradation all have grave repercussions for traditional ways of life and livelihood. In countries heavily dependent on farming, fishing and traditional crafts, such as wood carving, people deprived of these sources of income rapidly fall below the poverty line. Consequently these communities have an urgent need for adaptation skills; however, so far skills development strategies are rarely included in national adaptation plans. In addition, the prominence of the informal economy and the lack of social dialogue, social protection and other institutional and systemic mechanisms exclude large segments of the population in developing countries from efficient and socially responsible restructuring measures.

In this context, developing countries require special measures to address these particular challenges. These may include capacity building for micro and small enterprises and within the informal economy to enable green jobs to be created in localities where they are most needed; the provision of entrepreneurship skills for young people and adults, in conjunction with microfinance projects and continuing business coaching, to enable them to establish and maintain green businesses; capacity development and environmental awareness raising among decision-makers, business leaders and administrators as well as institutions of the formal and non-formal training system; capacity development among tripartite constituents to strengthen social dialogue mechanisms and to extend that dialogue to address the accessibility and availability of green jobs and related training for all; building on synergies with NGOs that already provide skills for green jobs, mainstreaming these mostly uncoordinated and fragmented training programmes within the system; and last but not least, increasing the capacity and level of formal education and training systems and institutions to provide basic skills for all and enhance the skills base of the national workforce.

These measures can only occur if funding is available. It is therefore recommended that not only national governments but also donors in developing countries take these recommendations into account.

7.5 From monitoring and anticipating skills change to stimulating green transition

Monitoring and anticipation of skills for green jobs is a cornerstone of an effective skills development system. Once change in the labour market is anticipated and the necessary skills identified, training programmes can be revised and new ones introduced to take account of the change; the success of the amended training provision can then be assessed by monitoring the labour market. If skills

are updated and changed *before* change in the labour market occurs, they can serve as a powerful promoter of change, including green change. This implies the need for both quantitative and qualitative approaches in the monitoring and anticipation of skill needs.

All the countries that participated in the research have been challenged by the **lack of a statistical definition of green jobs**, which is necessary for quantitative measurement of the jobs and skills needed on the greening labour market. In addition, in the absence of a uniform statistical definition of green jobs, updating occupational taxonomies becomes impossible. Some countries (e.g. the United States) have found a solution in introducing their own green jobs definition to be used for statistical purposes and have updated their occupational classifications on this basis. But such efforts are still only desultory, and an international statistical definition of green jobs, with guidelines on how to translate it into occupational and industrial taxonomies, could be helpful. Guidelines on establishing green jobs and skills indicators for their subsequent development at national level are also needed. Locating green jobs in current international classifications is another long-term task. UN statistical bodies, the ILO, Eurostat, the OECD and other international actors need to come together to address these tasks.

Our research also demonstrated that **established systems of labour market information and early identification of skill needs** are helpful but not sufficient. In the current circumstances of rapid change, with massive investments in renewable energy and energy efficiency programmes, additional research tools and institutional mechanisms are being introduced. In this context, the only reliable methodological approach to the identification of skills for green jobs combines both quantitative and qualitative elements. Identification of skill needs at sectoral level is also very helpful where institutional arrangements permit – that is, where sectoral or industry skills councils and/or sectoral observatories are in place. Nevertheless, given that many green sectors and activities straddle the borders of established sectors, strong cross-sectoral coordination needs to accompany such sectoral approaches. Such coordinating mechanisms are to date scarce and frequently absent altogether.

Countries with no effective labour market information (LMI) systems and no standard procedures for identification of skill needs face a double challenge. Already facing difficulty in identifying skill needs for the labour market in general, they now face in addition environmental policy challenges and the requirements of the greening agenda, which add another layer of uncertainty in the process of establishing and revising training response programmes. This is the situation of most developing countries and emerging economies. These countries need to combine **decentralized approaches** – at sectoral, regional and local levels – with **systematization of their LMI and skills identification at national level**. There is a great need in these countries for capacity building and technical assistance in modelling and LMI development.

Our research also demonstrated that existing systemic mechanisms of social dialogue in education and training work efficiently without any adjustment specifically for green jobs purposes. This finding applies to all countries – developed, emerging and developing.

7.6 Further research

Almost every piece of research terminates with a number of issues identified for further research, and this project is no exception. Our study of skills for green jobs has merely opened the door on a vast and under-researched area. Much needs to be done, through analyses at international, national and sectoral level.

At **international level**, there is a pressing need, as noted earlier in this chapter, for clarification of the statistical definition of green jobs, along with the corresponding adaptation of international

taxonomies of occupations and industries, and their interface with skills. Other priorities are in-depth analysis of methods and models which can be used to identify current and future skill needs for green jobs, and their applicability to various economic contexts: developed, emerging and developing. Elaboration of international indicators on green jobs and skills may promote research and statistical monitoring at national level.

Comparative cross-country research into core occupations and their skills composition will generate findings that could be invaluable for those countries where occupational research is not well developed. Adaptation and subsequent translation of these findings into national qualification standards and training programmes will assist the development of education and training provision for the green jobs market.

Another fruitful research enterprise would be closer examination of global trends to investigate the mobility of green jobs and skills across countries and through global value chains. The green labour market will become increasingly global and a deep understanding of the processes behind its development will help countries prepare better, avoid damaging consequences and tap both domestic and foreign skills potential.

At **national level**, developing national LMI systems and adjusting them to identify skills for green jobs is a hard task, especially for developing countries. These activities need to be accompanied by capacity development mechanisms providing support in statistical development and monitoring, including the application of both quantitative and qualitative methods, the development of national taxonomies in general and their adaptation to the needs of the green economy in particular.

Systematic occupational research at national level is still very scarce, even in countries with well-established LMI systems. Here the best way forward may be to learn from the experience of other countries, such as the United States. A peer review approach might be a suitable instrument in approaching this.

Identification of current and potential skill bottlenecks – both quantitative (labour shortages) and qualitative (skill gaps) – especially in connection with specific policies, regulations and investments, is a research priority to help avoid delay in the implementation of ambitious policies and targets, and to support investment in and transfer of new clean technologies.

At **sectoral level**, the many research options include a closer look at the development of occupational content – tasks and skills – in specific sectors, identification of changing and emerging occupations in sectoral value chains and related training needs, detection of current and future sectoral skill shortages, and the nature of core skills requirements both for green jobs in particular sectors and across jobs and sectors. Furthermore, sectoral level analysis is also suitable for seeking a deeper insight into restructuring processes within the sector, estimation of employment impact (downsizing or hiring) and identification of related training needs to support socially responsible restructuring. It is, however, important that sectoral research allows for cross-sectoral analyses (e.g. expected employment shifts across sectors and retraining needs identification) and for capturing the change in non-conventionally defined sectors, such as renewable energy. This is only possible through cross-sectoral collaboration and coordination mechanisms.

Crucially, countries will also need to meet the challenge of **incorporating research on green jobs and skills into established systems and structures** to avoid building a parallel and separate structure. Once the initial impetus in this fast-developing and in many respects still novel research area has passed, it will be the task of existing systems of research and analysis to monitor continuing skills change. It is essential to recognize that climate and other environmental change is and will continue to be part of a wider range of global drivers of change, including technology, trade, demography and others, and that it needs to be taken into consideration not only in research targeted specifically at skills for green jobs, but in all national and sectoral research on skills.

8. Glossary

active labour market policies (ALMPs): Policies that provide labour market integration measures to those looking for jobs, usually the unemployed, but also the underemployed and even the employed who are looking for better jobs. ALMPs typically include labour market training, job creation in the form of public and community work programmes, programmes to promote enterprise creation, and hiring subsidies. ALMPs are usually targeted at specific groups facing particular labour market integration difficulties: younger and older people, women and those particularly hard to place such as the disabled. (ILO: GB.288/ESP/2, 2003)

affirmative action: Measures targeted at a particular group and intended to eliminate and prevent discrimination or to offset disadvantages arising from existing attitudes, behaviours and structures. (ILO Thesaurus)

apprenticeship: A system of training which usually combines on-the-job training and work experience with institution-based training. It can be regulated by law or by custom. (ILO: *Glossary of key terms on learning and training for work*, 2006)

barefoot college: Non-formal training provider run by a non-governmental organization. (www.barefootcollege.org)

basic skills: Skills that are fundamental for further learning or for performing in a job. (ILO: *Glossary of key terms on learning and training for work*, 2006)

cap-and-trade: A design for emissions trading systems under which total emissions are limited or “capped”. Tradable emissions allowances corresponding to the total permitted volume of emissions are allocated to participants either free or by auction. Examples are the EU Emissions Trading System (ETS) (see below), the US Regional Greenhouse Gas Initiative (RGGI) and international emissions trading under the Kyoto Protocol (see below). (Point Carbon)

carbon capture and storage (CCS)/carbon capture and geological storage (CCGS): Process by which CO₂ from industrial and energy-related sources is separated from other outputs, transported to a storage location and held in long-term isolation from the atmosphere. CO₂ may be stored underground in old oil and gas fields, non-commercial coalfields and saline aquifers. It may also be injected into the ocean. (Point Carbon)

carbon offsetting: A financial instrument aimed at reducing greenhouse gas (GHG) emissions. GHGs are measured in terms of CO₂ equivalent. In compulsory markets such those regulated by the Kyoto Protocol (see below), companies, governments or other entities buy carbon offsets – in effect, compensatory reductions of GHG emissions – in order to comply with caps on the total amount of CO₂ they are allowed to emit. In the much smaller voluntary market, individuals, companies or governments purchase carbon offsets to mitigate their own GHG emissions from transportation, electricity use and other sources. For example, an individual might purchase carbon offsets to compensate for the GHG emissions caused by personal air travel. (Adapted from Wikipedia)

clean coal: An umbrella term used primarily to describe technologies that aim to reduce the environmental impact of coal energy generation by increasing its production efficiency and reducing emissions of CO₂ and other pollutants. (Wikipedia, Wikinvest)

Clean Development Mechanism (CDM): A mechanism introduced by the Kyoto Protocol (see below) to encourage project-based emissions reduction activities in developing countries (“non-Annex B countries”). Certified emissions reductions (CERs) are generated from projects that lead to certifiable reductions in emissions that would otherwise not occur. (Point Carbon)

climate change: The slow variation of climatic characteristics over time at a given place. Usually refers to the change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is, in addition to natural climate variability, observed over comparable periods. (UNEP)

compressed natural gas (CNG): Gas stored in a high-pressure container. It is used mainly as an alternative fuel for internal combustion engines (such as automobile engines) and generates low hydrocarbon emissions, but a significant quantity of nitrogen oxide emissions. (<http://www.businessdictionary.com>, accessed 1 Apr. 2011)

continuing vocational training: Further vocational training, undertaken by those who have already completed basic or initial training, in order to supplement acquired knowledge or skills. (ILO Thesaurus)

core skills/core employability skills: Non-vocational, non-technical skills or competencies that are needed to perform at work and in society. They apply to work generally, rather than being specific to an occupation or industry. Core employability skills include the ability to work with others and in teams; the ability to solve problems and use technology; communications skills; and learning-to-learn skills. Core skills are also called generic skills, key competencies, key skills, portable skills, soft skills and transferable skills. (ILO: *Glossary of key terms on learning and training for work*, 2006)

decent work: A term that sums up the aspirations of people in their working lives – their aspirations for opportunity and income; rights, voice and recognition; family stability and personal development; and fairness and gender equality. Ultimately these various dimensions of decent work underpin peace in communities and society. Decent work is captured in four strategic objectives: fundamental principles and rights at work and international labour standards; employment and income opportunities; social protection and social security; and social dialogue and tripartism. (ILO: *Decent work*, Report of the Director-General, International Labour Conference, 87th Session, Geneva, 1999)

desertification: The transformation of arable or habitable land to desert, usually as a result of a change in climate or destructive land use. (<http://www.thefreedictionary.com>, accessed 1 Apr. 2011)

direct employment effects: Creation (or loss) of jobs directly through increased (or reduced) demand and output, which in the context of green jobs is stimulated by environment-related expenditures. (UNEP, ILO, IOE, ITUC: *Green jobs: Towards decent work in a sustainable, low-carbon world*, Geneva, 2008)

economically active population: All persons of either sex who furnish the supply of labour, usually comprising all employed and the unemployed, for the production of goods and services during a specified time-reference period. (ILO: LABORSTA)

emissions trading: A market-based approach to controlling greenhouse gas emissions by providing economic incentives for achieving reductions in the emissions of pollutants. Also known as “cap-and-trade” (see above). (Wikipedia)

employability: Possession of portable competencies and qualifications that enhance an individual’s capacity to make use of the education and training opportunities available in order to secure and retain decent work, to progress within the enterprise and between jobs, and to cope with changing technology and labour market conditions. (ILO: *Glossary of key terms on learning and training for work*, 2006)

environmental impact assessment (EIA): The critical appraisal, both positive and negative, of the likely effects on the environment of a proposed project, development, activity or policy. (UNEP)

Environmental Performance Index (EPI): A method of quantifying and numerically benchmarking the environmental performance of a country’s policies. The EPI was preceded by the Environmental Sustainability Index (ESI) (see below). Both indices were developed by Yale University (Yale Center for Environmental Law and Policy) and Columbia University (Center for International Earth Science Information Network) in collaboration with the World Economic Forum and the Joint Research Centre of the European Commission. (Yale University; for further information see: <http://epi.yale.edu/>, accessed 1 Apr. 2011)

Environmental Sustainability Index (ESI): A composite index tracking 21 elements of environmental sustainability covering natural resource endowments, past and present pollution levels, environmental management efforts, contributions to protection of the global commons, and a society’s capacity to improve its environmental performance over time. The ESI was developed to evaluate environmental sustainability relative to the paths of other countries. It was published between 1999 and 2005 by Yale University’s Center for Environmental Law and Policy in collaboration with Columbia University’s Center for International Earth Science Information Network and the World Economic Forum. (Yale University)

Environmental Vulnerability Index (EVI): An index designed to be used with economic and social vulnerability indices to provide insights into the processes that can hinder the sustainable development of countries. The EVI was developed by the South Pacific Applied Geoscience Commission, the United Nations Environment Programme (UNEP) and their partners, through consultation and collaboration with countries, institutions and experts across the globe. The three vulnerability indices aim to provide a rapid and standardized method for characterizing vulnerability in an overall sense, and identifying issues that may need to be addressed within each of the three pillars of sustainability, namely environmental, economic and social aspects of a country’s development. (For further information, see: <http://www.vulnerabilityindex.net/>, accessed 1 Apr. 2011)

European Union Emissions Trading System (EU ETS): Carbon-trading scheme within the European Union, launched on 1 January 2005. The scheme is based on Directive 2003/87/EC, which entered into force on 25 October 2003. Phase I (2005–07) was much criticized on the

grounds of oversupply of allowances and their method of distribution (via free allocation or “grandfathering” rather than auctioning). Phase II (2008–12) links the ETS to other countries participating in the trading system established under the Kyoto Protocol (see below). In Phase III (2013–20) the share of auctioning will increase. In 2013 at least 50 per cent of the total amount of allowances will be auctioned, and this share will increase as free allocation is phased out towards 2020. (Point Carbon)

flexicurity: A balanced policy of flexibility and security for enterprises and for workers by providing new training opportunities to improve employability, job search assistance, income support and social protection. Critical elements in balancing flexibility with security are tripartite social dialogue in the framework of broader national macroeconomic strategies, collective bargaining and respect of labour legislation. (ILO: Conclusions of the Seventh European Regional Meeting, Budapest, 2005)

Global Competitiveness Index (GCI): A highly comprehensive index which captures the microeconomic and macroeconomic foundations of national competitiveness used by the World Economic Forum since 2005 in the competitiveness analysis of countries. (World Economic Forum; for further information, see: http://www.weforum.org/pdf/GCR09/GCR20092010_fullreport.pdf, accessed 1 Apr. 2011)

green economy/greening the economy: The process of reconfiguring businesses and infrastructure to deliver better returns on investments of natural, human and economic capital, while at the same time reducing greenhouse gas emissions, extracting and using fewer natural resources, creating less waste and reducing social disparities. (UNEP)

green innovation: Improvements in products, processes, marketing methods, organizations or institutions that yield higher environmental benefit. Innovation can include technological and non-technological change. (C. Martinez-Fernandez, C. Hinojosa and G. Miranda: *Green jobs and skills: The local labour market implications of addressing climate change*, Paris, OECD, 2010)

green technology/clean technology: Technology that improves the resource or energy efficiency of production, ultimately to sustainable levels, reduces waste and/or increases the use of non-polluting, renewable resources.

greenhouse gas (GHG): Greenhouse gases are the gaseous constituents of the atmosphere, both natural and artificial, that absorb and re-emit infrared radiation and are thereby responsible for global warming. The most important GHG, CO₂, is rapidly accumulating in the atmosphere as a result of human activities. (UNEP)

Human Development Index (HDI): A composite statistic used to rank countries by level of “human development” as a frame of reference for both social and economic development. The index is composed from data on health (life expectancy at birth), education (mean and expected years of schooling) and standard of living (gross national income per capita) collected at national level. (UNDP)

indirect employment effects: Creation or loss of jobs in supplier industries and through the value chain. (UNEP, ILO, IOE, ITUC: *Green jobs: Towards decent work in a sustainable, low-carbon world*, Geneva, 2008)

induced job effects: Creation of jobs as wage incomes are spent generating demand in additional industries (or their loss as decreasing expenditure reduces demand). (UNEP, ILO, IOE, ITUC: *Green jobs: Towards decent work in a sustainable, low-carbon world*, Geneva, 2008)

informal economy: Forms part of the market economy in that it produces (legal) goods and services for sale or other form of remuneration. It covers informal employment both in informal enterprises (small unregistered or unincorporated enterprises) and outside informal enterprises. Informal entrepreneurs and workers share one important characteristic: they are not recognized or protected under existing legal and regulatory frameworks. The informal economy excludes the criminal economy and the reproductive or care economy. (ILO Thesaurus)

informal learning: An unstructured learning process that takes place outside the formal education and training system. It can result from daily activities related to work, family or leisure. Informal learning is in most cases unintentional from the learner's perspective. (ILO: *Glossary of key terms on learning and training for work*, 2006; Cedefop: *Terminology of European education and training policy*, 2008)

initial training: Pre-employment training in the fundamentals of an occupation. It may qualify a learner for a job or provide the basis for specialization. (ILO: *Glossary of key terms on learning and training for work*, 2006)

job: A set of tasks and duties carried out, or meant to be carried out, by one person for a particular employer, including self-employment. (A. M. Greenwood: *Updating the International Standard Classification of Occupations, ISCO-08*, Geneva, ILO, Bureau of Statistics, 2008)

Kyoto Protocol: The outcome document of the third Conference of the Parties to the UN Framework Convention on Climate Change (COP-3), held in Kyoto, Japan, in December 1997. It specifies developed countries' obligations to reduce emissions and defines the three so-called Kyoto flexible mechanisms: Joint Implementation (JI), the Clean Development Mechanism (CDM) and emissions trading. It entered into force on 16 February 2005. (Point Carbon)

labour market information system (LMIS): A system that provides information, for the benefit of employers, workers and jobseekers, on the location and types of jobs available and forecasts of changes in the labour market, skill composition of the current labour force and prospective changes over time. (ILO Thesaurus)

National Adaptation Programmes of Action (NAPAs): Documents prepared through a process established by the United Nations Framework Convention on Climate Change to enable the least developed countries to identify priority activities that respond to their urgent and immediate needs to adapt to climate change. The aim is to pinpoint areas in which further delay would increase vulnerability and/or costs at a later stage. (UNFCCC)

non-formal learning: Organized and systematic learning activity conducted outside the formal education system. (ILO: *Glossary of key terms on learning and training for work*, 2006)

occupation: A grouping of jobs which have a repeating set of main tasks and duties across industries. For reasons of classification, occupations are grouped together into narrowly or broadly defined occupational groups on the basis of similarity in the type of work done. (A. M. Greenwood:

Updating the International Standard Classification of Occupations, ISCO-08, Geneva, ILO, Bureau of Statistics, 2008)

oil shale: Shale, rich in organic matter, which yields substantial quantities of oil (normally referred to as shale oil) and combustible gas through heating and distillation. The organic material in oil shale is called kerogen, from which liquid hydrocarbons can be extracted. Kerogen requires more processing than crude oil to render it usable, which increases its cost as a crude-oil substitute both financially and in terms of its environmental impact. (*Australian atlas of mineral resources, mines, and processing centres*, Geoscience Australia, 2010; Wikipedia)

on-grid and off-grid systems: Systems to supply energy to the end user either through a central electrical interlocking system of transmission lines and power stations (on-grid) or through decentralized power supply solutions (off-grid), such as solar home systems. (Adapted from <http://www.off-grid.net>, accessed 1 Apr. 2011, and Wikipedia)

on-the-job training: Training undertaken in the workplace which uses the tasks of the job as the basis for training and practice. (ILO: *Glossary of key terms on learning and training for work*, 2006)

organic farming: The process of producing safe and healthy food naturally by avoiding the use of synthetic chemical fertilizers and genetically modified organisms, and protecting the earth's resources. (Adapted from <http://www.living-organic.net>, accessed 1 Apr. 2011)

portable skills/transferable skills: Skills which can be introduced in a different socio-cultural or technical environment, or which can be used in other occupations. (ILO Thesaurus)

precision farming/precision agriculture: An agricultural concept that responds to the changing demands of agricultural land for inputs such as water, pesticides and fertilizers. It uses new technologies, such as global positioning devices (GPS and DGPS), sensors, satellites or aerial images, and information management tools (GIS), to assess and understand variations. (Wikipedia)

public–private partnerships: Collaborative arrangements among government, private enterprises and educational institutions for the provision of a public service or the promotion of research and development. Such partnerships may include trade unions and business representatives, NGOs, environmental and community organizations and leaders. (Adapted from ILO Thesaurus)

restructuring: The deliberate modification of formal relationships among organizational components. It involves redesigning work processes, delayering and eliminating structural elements through outsourcing, spinning off, selling off and divesting units, activities or jobs. Socially responsible restructuring takes into account interests of all actors involved in the process – managers/owners/shareholders of the enterprise, workers and the community. Efficient enterprise restructuring helps to avoid lay-offs and to introduce changes that enable the enterprise to continue to operate its business and employ its workforce. (ILO and EBBF: *Socially responsible enterprise restructuring*, Joint working paper, Geneva, 1999)

skill: Ability to carry out a manual or mental activity, acquired through learning and practice. The term “skills” is used throughout this document as an overarching term for the knowledge,

competence and experience needed to perform a specific task or job. (Adapted from ILO: *Glossary of key terms on learning and training for work*, 2006)

skills development: Understood in broad terms to mean basic education, initial training and lifelong learning. (ILO: *Conclusions concerning human resources training and development*, adopted by the ILC, 88th Session, 2000)

skills levy/training levy: A tax imposed on enterprises, the proceeds from which are used to finance training activities. (ILO: *Glossary of key terms on learning and training for work*, 2006)

sustainable agriculture: A way of farming, especially to produce food, that “is healthy for consumers and animals, does not harm the environment, is humane for workers, respects animals, provides a fair wage to the farmer, and supports and enhances rural communities”. Examples include no-till farming, crop rotation, and prevention of runoff or leaching of fertilizers and pesticides. (Quotation from: <http://www.sustainabletable.org/intro/whatis/>, accessed 1 Apr. 2011)

sustainable development: Development activity that meets the needs of present generations without jeopardizing the ability of future generations to meet their own needs. The concept offers a vision of progress that integrates immediate and longer-term objectives and local and global action, and regards social, economic and environmental issues as inseparable and interdependent components of human progress. Sustainable development will not be brought about by policies only: it must be taken up by society at large as a principle guiding the many choices each citizen makes every day, as well as the big political and economic decisions. This requires profound changes in thinking, in economic and social structures, and in consumption and production patterns. (European Commission)

taxonomy: The practice and science of classification. The word is also used as a count noun: a taxonomy, or taxonomic scheme, is a particular classification (“the taxonomy of . . .”), arranged in a hierarchical structure. Typically this is organized by supertype–subtype relationships, also called generalization–specialization relationships or, less formally, parent–child relationships. In such an inheritance relationship, the subtype by definition has the same properties, behaviours and constraints as the supertype plus one or more additional properties, behaviours or constraints. For instance, the International Standard Classification of Occupations is an example of a hierarchical scheme or taxonomy of occupations. (Wikipedia)

technical and vocational education and training (TVET): Initial and continuing education and training provided by schools, training providers or enterprises that imparts the skills, knowledge and attitudes required for employment in a particular occupation, or group of related occupations, in any field of economic activity. (Adapted from ILO Thesaurus)

vulnerable employment: Self-employed workers without employees (own-account workers) and contributing family workers have a lower likelihood of having formal work arrangements, and are therefore more likely to lack benefits associated with decent employment, such as adequate social security and a voice at work. The two statuses are therefore put together to create a classification of “vulnerable employment”. (Adapted from ILO: *Key Indicators of the Labour Market*)

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10. Annexes

Annex 1. Distribution of the 21 countries included in the study by stage of development

Developed/advanced economies	Developing and emerging economies	Least developed countries
Australia	Brazil	Bangladesh
Denmark	China	Mali
Estonia	Costa Rica	Uganda
France	Egypt	
Germany	India	
Spain	Indonesia	
United Kingdom	Philippines	
United States	Republic of Korea	
	South Africa	
	Thailand	

Note: Countries grouped according to UN classifications.

Annex 2. Relevant country indicators

Country	Population, 2010 (000) ¹	% of world population	GDP, 2008 (US\$ million) ²	GDP per capita, PPP, 2009 (US\$)	GDP annual growth, 2000 (%)	GDP annual growth, 2005 (%)	GDP annual growth, 2007 (%)	CO ₂ emissions, kg/\$1 GDP, 2006 (PPP) ³	CO ₂ emissions, per capita, 2006 (tonnes)	CO ₂ emissions, 2006 (000 tonnes)	CO ₂ emissions, 2006 (% of world emissions)
Australia	21 512	0.3	1 015 217	37 302	4	2.8	3.3	0.59	19	390 436	1.4
Bangladesh	164 425	2.4	78 992	1 470	5.9	6	6.4	0.24	0.27	41 609	0.1
Brazil	195 423	2.8	1 612 539	10 456	4.3	3.2	5.7	0.21	1.86	352 524	1.2
China	1 354 146	19.6	4 326 187	6 546	8.4	10.4	13	1.03	4.62	6 103 493	21.3
Costa Rica	4 640	0.1	29 834	10 572	1.8	5.9	7.8	0.19	1.79	7 854	0.0
Denmark	5 481	0.1	342 672	36 725	3.5	2.5	1.8	0.31	10.6	58 925	0.2
Egypt	84 474	1.2	162 818	6 147	5.4	4.5	7.1	0.47	2.25	166 800	0.6
Estonia	1 339	0.0	23 089	18 051	..	9.2	6.3	0.65	11.9	15 972	0.1
France	62 637	0.9	2 853 062	33 744	3.9	1.9	2.2	0.21	6.7	408 686	1.4
Germany	82 057	1.2	3 652 824	34 219	3.2	0.8	2.5	0.33	10.7	880 253	3.1
India	1 214 464	17.6	1 217 490	2 932	4	9.4	9.1	0.56	1.31	1 510 351	5.3
Indonesia	232 517	3.4	514 389	4 149	4.9	5.7	6.3	0.45	1.46	333 483	1.2
Mali	13 323	0.2	8 740	1 167	3.2	6.1	2.8	0.05	0.05	568	0.0
Philippines	93 617	1.4	166 909	3 536	6	5	7.1	0.26	0.79	68 328	0.2
Republic of Korea	48 501	0.7	929 121	27 791	..	4	5.1	0.44	9.89	475 248	1.7
South Africa	50 492	0.7	276 764	9 961	4.2	5	5.1	0.99	8.59	414 649	1.4
Spain	45 317	0.7	1 604 174	29 527	5	3.6	3.8	0.29	8.2	359 627	1.3
Thailand	68 139	1.0	260 693	7 998	4.8	4.6	4.9	0.58	4.3	272 521	0.9
Uganda	33 796	0.5	14 529	1 203	5.6	6.3	8.6	0.09	0.09	2 706	0.0
UK	61 899	0.9	26 45 593	35 165	3.8	1.8	3	0.28	9.2	557 855	1.9
US	317 641	4.6	14 204 322	46 443	3.7	3.1	2	0.47	19.7	5 975 096	20.8
Total	4 155 840	60.2								18 396 984	64.1

¹ Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects, 2008.

² World Bank and International Monetary Fund databases.

³ UNSD, Millennium Development Goals, 2009 country data (UNFCCC).

Annex 2. Relevant country indicators (Continued)

Country	Human Development Index, 2007 ⁴	Size of informal economy as % of total economy ⁵	Employment in informal sector as % of total employment ⁶	Labour force participation rate, 2008 (%) ⁶	Unemployment rate (latest year available) ⁶	Environmental Sustainability Index, 2005 ⁷	Environmental Performance Index, 2010 ⁷	Environmental Vulnerability Index, 2005 ⁸	Global Competitiveness Index, 2009/10 ⁹
Australia	0.97	15.30		65.3	4.2 (2008)	13	51	At risk	5.15
Bangladesh	0.543	35.60	10.00	70.6	4.3 (2005)	114	139	Highly vulnerable	3.55
Brazil	0.813	39.80	46.60	70.7	7.9 (2008)	11	62	Vulnerable	4.23
China	0.772	13.10		73.8	4 (2007)	133	121	Highly vulnerable	4.74
Costa Rica	0.854	26.20	39.90	63.5	4.6 (2007)	18	3	Highly vulnerable	4.25
Denmark	0.955	18.20		66.1	3.3 (2008)	26	32	Highly vulnerable	5.46
Egypt	0.703		44.40	47.8	8.7 (2008)	115	68	Vulnerable	4.04
Estonia	0.883			61.5	5.5 (2008)	27	57	Vulnerable	4.56
France	0.961	15.30		56.3	7.4 (2008)	36	7	Highly vulnerable	5.13
Germany	0.947	16.30		59.8	7.5 (2008)	31	17	Highly vulnerable	5.37
India	0.612	23.10	55.70	57.8	5 (2004)	101	123	Extremely vulnerable	4.3
Indonesia	0.734	19.40	62.70	68.3	8.4 (2008)	75	134	Highly vulnerable	4.26
Mali	0.371	41.00	41.30	51.8	3.2 (2004)	41	156	Resilient	3.22
Philippines	0.751	43.40	17.30	63.8	8.8 (2008)	125	50	Extremely vulnerable	3.9
Republic of Korea	0.937			60.8	7.4 (2008)	112	94	Extremely vulnerable	5
South Africa	0.683	28.40	13.80	55.3	22.9 (2008)	93	115	Highly vulnerable	4.34
Spain	0.955	22.60		58.6	11.3 (2008)	76	25	Highly vulnerable	4.59
Thailand	0.783	52.60	72.10	73.2	1.4 (2008)	73	67	Vulnerable	4.56
Uganda	0.514	43.10	83.70	84.5	3.2 (2003)	57	119	Vulnerable	3.53
UK	0.947	12.60		62.2	5.6 (2008)	65	14	Extremely vulnerable	5.19
USA	0.956	8.80		65.4	5.8 (2008)	45	61	Vulnerable	5.59

⁴ http://hdrstats.undp.org/en/buildtables/rc_report.cfm (accessed 1 Apr. 2011).

⁵ http://rru.worldbank.org/Documents/Papers/Links/informal_economy.pdf (accessed 1 Apr. 2011).

⁶ ILO: Key Indicators of the Labour Market.

⁷ Center for Environmental Law and Policy, Yale University.

⁸ <http://www.vulnerabilityindex.net/> (accessed 1 Apr. 2011).

⁹ World Economic Forum.

Annex 3. Template for the country reports

Abstract (150 words maximum)

Executive summary (2 pages)

1. Introduction (2 pages)

Describe briefly the objectives of the study as defined by the ToR, specific methods used to conduct the research, institutions and experts consulted, difficulties faced and research limitations to take into account, etc.

2. Policy context

2.1 Key challenges and priorities for a green economy (1 page)

This subsection should provide *very concise* contextual information which should serve as a starting point for further analysis. It should point out *major* environmental issues which should drive the green policy response in your country and which affect the economy, employment and the labour market.

Describe *briefly* the main challenges and priorities of the country for mitigating and adapting to climate change and in response to environmental degradation. Provide *concise* information on how the country's green economy is developing. You may build your analysis on a limited number of key indicators *relevant to your country*, such as:

- numbers and trends on ecological footprint (see GEO);
- energy production per capita and per GDP (see IEA);
- electricity consumption per capita and per GDP (see IEA);
- composition of energy use/production;
- waste production per capita (see GEO);
- CO₂ per capita (see UNFCCC or IEA);
- rate of land degradation/agricultural soil degradation/desertification;
- rate of deforestation;
- R&D related to energy and to renewable energy (see IEA);
- share of R&D budget/expenditures (public/private) on environment-related issues, new technologies and innovations in relation to the overall R&D budget/expenditure;
- use of fresh water per capita and per GDP;
- programmes in place for the protection of biodiversity (CBD), etc.

Some useful resources:

GEO: <http://geodata.grid.unep.ch/results.php>

IEA: <http://www.iea.org/Textbase/country/index.asp>

UNFCCC: http://unfccc.int/ghg_data/ghg_data_unfccc/items/4146.php

2.2 *The response strategy (2–3 pages)*

2.2.1 *General environmental strategy*

This subsection should *briefly* outline the general country strategy, the adaptation and mitigation measures in response to climate change and environmental degradation, referring to key strategic, political and programming documents of the country.

What are the strategic development responses of the country to prevent environmental degradation, contain and adapt to climate change and answer the global call for greening economies? Do these strategies have skills implications and do they include a skills development component?

2.2.2 *Green response to the current economic crisis*

This sub section should *briefly* outline the greening components of the country strategy in response to the current economic crisis.

Does the country's response to the current economic crisis include greening economic practices and does it target greening investments and stimuli, such as greener infrastructure and renewable energies? Which skills implications does this convey? Does the crisis response strategy include a skills development component?

2.3 *The skills development strategy in response to greening (4–5 pages)*

This section deals with the skills development strategy as a part of a coherent country policy response to climate change and environmental degradation. It focuses on policy coherence, complementarity, relevance and coordination.

Are response strategies incorporated into a larger greening policy agenda? How? Is there a coherent national strategy/policy targeting the skill needs for greening the economy? What is the main driver for the national HRD strategy in the provision of skills for green jobs – market adaptation or greening policy agenda? That is, is the national HRD strategy market-driven or environmental policy-driven? What is the role of skills identification in the strategy development?

In the context of greening the economy, are skills development policies and strategies coordinated with and linked to industrial, trade, technology, macroeconomic and environmental policies? If so, how? What kind of coordinating mechanisms are in place (e.g. inter-ministerial coordination, labour market intelligence/information system, local feedback mechanisms between employers and training system, value chains, clusters and industry networks) and how do they work?

What is the role of social dialogue in skills development for greener economies?

What are the biggest institutional roadblocks that hamper skills development for a transition to green economies?

Which level and types of education and training are considered crucial in promoting green skills among the population: compulsory level education, initial secondary general type of education, initial technical and vocational education and training (TVET), continuing vocational training (CVT), higher education (HE)? What is the role of business management education and training in promoting sustainable entrepreneurship? How important are generic skills, such as leadership, communication, problem solving etc., in the skills provision for green jobs? Does the education and training system follow a strategy to “mainstream” sustainability and environment protection issues within the education and training system?

3. Anticipation and provision of skills

3.1 *Green structural change and (re)training needs (7–10 pages + case studies)*

This section and all its subsections deal with *(re)training needs* which derive from:

- major employment shifts within and across sectors and economic activities due to climate change and demands for greening the economy, i.e. green structural change (e.g. in construction, agriculture, energy); and
- identification of skills, trades and occupations that become obsolete as a result of *green structural changes* on the labour market (e.g. in fisheries, coal mining, oil and gas production).

3.1.1 *Green restructuring and its impact on the labour market*

This subsection deals with employment shifts and trends due to green structural change. It will identify sectors and economic activities with major employment growth potential and will identify trades and related skills in declining sectors/economic activities.

Identify sectors/economic activities with major employment growth potential for green jobs *most relevant for the economy of the country of your study*.

Identify trades and related skills in declining sectors/economic activities that will or have become obsolete in the context of environmental degradation, climate change or environmental policies (e.g. in fisheries, coal mining, oil and gas production). What is the origin of the decline – why does demand for these trades and skills decline? Is the change driven by policy, by technology implementation, by innovation or by environmental pressure?

Analyse current and estimated future employment shifts and trends due to the green structural change. While assessing employment potential, take into account direct and indirect employment, and disaggregate by occupation/trade and sector/economic activity. Wherever possible, provide quantified trends analysis.

3.1.2 *Identification of (re)training needs*

This subsection deals with *(re)training needs* based on identification of major employment shifts (current and anticipated) and the green structural change as outlined in the previous subsection. It also covers approaches and tools for identification of *(re)training needs*.

Outline current and future (re)training needs due to major employment shifts and green structural changes as analysed in the previous subsection. How have these (re)training needs been identified? Which methods and approaches to skills anticipation and assessment were used?

Explain both quantitative and qualitative approaches and levels of identification, i.e. national, sectoral, regional, company, training provider etc. Specify methodology, explain modelling, provide tools – e.g. questionnaires etc. Specify whether the methodology sought to identify the immediate skill needs or the mid- or long-term needs. Does it address particular target groups (youth, women, rural population etc.)?

Explain which institutions/systems were in charge of skill needs identification (e.g. LMIS, specific research and/or data collection institutions, departments of ministries, regional or sectoral bodies etc.)

3.1.3 *Skills response*

This subsection analyses effectiveness and organization of the skills response (retraining, TVET) to meet the challenge of the green economic restructuring, paying specific attention to active labour market policy measures, planning of initial and continuing training, institutional frameworks, systemic provisions, delivery channels, ad hoc versus anticipated skills responses, and skills response by different actors and providers.

Are there special skills development programmes to cushion the effects (displaced workers, need for skills upgrading etc.)? What are their delivery/provision channels? How are these programmes funded? Since when and for how long are these programmes in place?

How many people have been trained and in which fields? How many have found a job or could be kept in their old job?

3.1.4 *Case studies (2 cases × 3–4 pages each)*

Please provide illustrative case studies on retraining as part of active labour market policy measures for the workers who became redundant as a result of green structural change on the labour market. You could also select retraining as part of the green crisis response. Please try to follow the above structure of section 3.1 and its subsections.

3.2 *New and changing skills needs (10–15 pages + case studies)*

The section and its subsequent subsections deal with skill needs for *newly emerging green-collar occupations* and with *new and changing skills requirements for existing occupations* (skill gaps) in the context of greening the economy. In the skill needs identification and analysis and in the case studies it is necessary to distinguish between skills needed for (i) reactive and remedial environmental measures, and (ii) proactive measures.

3.2.1 *New green-collar occupations*

This subsection deals with *green-collar occupations* which emerge *newly* as a result of adaptation to climate change and mitigation of its negative impacts. Such occupations are new on the labour market, meaning that the actual change has occurred recently or is occurring now, no matter whether such occupations have already been listed in the national catalogue of occupations or

may be considered for the inclusion in the catalogue in future. These could be new as well as “hybrid” occupations (e.g. agricultural meteorologist, solarteur, bioenergy technicians, energy assessors, green accountants).

Where are these new green-collar occupations concentrated? Which sectors, companies (SMEs vs larger companies, rural vs urban, national vs foreign/multinational), regions etc? If possible, provide an estimate of the volume (absolute and relative) of the workforce involved in such occupations now and how this is expected to change in the future.

What is the role of technological change and innovation for new occupations demands? What are the qualifications and levels of educational attainment expected?

Which new green-collar occupations are most demanded in the country in terms of greening the economy?

In the analysis consider which existing occupations and qualifications could supply the workforce for new green-collar occupations. Which technical and generic skills and competencies are required? Discuss gender composition of new green-collar occupations and implications.

If the list of new occupations is available, please provide the list in the Annex. If occupational profiles are available – please provide in the Annex.

3.2.2 *Greening existing occupations*

This subsection deals with *new types of skills, competencies and skill gaps* which need to be incorporated into existing occupational profiles (i.e. greening existing occupations, e.g. advisory services in craft and retail, green procurement, new skills for improved energy efficiency and lifecycle analysis). In order to delimit the analysis and for the benefit of a better focus it is advised to address skills gaps among key occupations in the major economic sectors with the highest greening potential in the country.

Which existing occupations tend to become greener? What is the outlook for the future – which occupations are expected to become greener? Which sectors and companies (SMEs vs larger companies, rural vs urban, national vs foreign/multinational) are they concentrated in? Which workers tend to acquire the green collar – blue- or white-collar workers? Which qualifications and levels of educational attainment are expected? Are skills levels expected to be higher, the same or lower? What is the role of technological change and innovation for new skills demands? Which technical and generic skills and competencies are required? Discuss gender composition and implications.

Where are the greatest skills gaps in the country in terms of greening the economy? Shortage in the supply of which skills and qualifications is responsible for the labour market bottleneck in greening the economy? If possible, provide an estimate of the volume (absolute and relative) of the shortage workforce now and how this is expected to change in future.

If the list of new occupations is available, please provide the list in the Annex. If profiles are available – please provide in the Annex.

3.2.3 *Identification of skill needs*

This subsection deals with the methods, approaches, systems and institutional responsibilities in identification of current and future skill needs for the green jobs labour market.

How are new occupations and new skills requirements identified? Please describe the methods in detail, and provide a description of the assessment and modelling methods and related diagrams, questionnaires and other tools used in the Annex. Identify which methods and approaches to skills

anticipation and assessment are in use to ensure the skills provision correspondence to current and future labour market demand for green-collar workers both quantitatively and qualitatively and at different levels, i.e. national, sectoral, regional, company, training provider.

Explain which institutions/systems were in charge of skill needs identification (e.g. LMIS, specific research and/or data collection institutions, departments of ministries, regional or sectoral bodies etc.). Do labour market information systems take green jobs into account? If yes, how?

What are the systemic and institutional arrangements for early identification of skills needs and for the transfer of the findings into occupational profiles, curriculum design and education and training provision for new green occupations? What are institutional roles and responsibilities? Which actors are involved? What is the role of government (e.g. Ministry of Labour, Ministry of Education, interministerial bodies), businesses and social partners in the process?

3.2.4 *Skills response*

This subsection analyses effectiveness and organization of the skills response in relation to the challenge of greening the economy with a specific attention to planning of initial and continuing training, institutional frameworks, systemic provisions, delivery channels, ad hoc versus anticipated skills responses, and skills response by different actors and providers.

How does the education and training *system* react to the identified skills needs? Have new courses/occupational standards been developed? In which fields of studies? How do education and training providers deal with curriculum development?

What are the main channels of current response in skills provision: initial TVET, CVT, training measures within active labour market policy implementation, on-the-job training or other forms of training supported by enterprises etc.? Who provides the skills required? Do mainly businesses organize skills-upgrading courses or do private/public training providers also offer courses for these skills? In which fields of training?

Given the estimate of future training needs, is the education and training capacity to meet the needs sufficient? Do companies find the training offered satisfactory for their needs to upgrade/prepare the workforce for the green production processes, services and products?

What are the mechanisms applied to respond to these new skill needs? Are feedback mechanisms between business and the education and training systems in place? How do they work? How are future changes in skills requirements communicated and translated into timely supply of relevant skills?

Who are the actors involved? (Ministries, labour market observatories, skills councils, business associations etc.)

How effective is the skills development response? How many people have been trained? How many have found a job? Are businesses satisfied with the education/training programmes available?

3.2.5 *Case studies on new green-collar occupations (2–3 cases × 3–4 pages each)*

Please provide illustrative case studies on new green-collar occupations respecting the following structure:

- Select an example of a new green-collar occupation.
- Describe the origin and the situation of the occupation (sector, type of companies, region, number of the current workforce involved in this occupation and its composition by age,

gender and qualification/level of educational attainment, estimate of future growth in the demand for this occupation etc.).

- Analyse skill gaps for the new occupation.
- Describe how and by whom the need was identified (method, institutional responsibilities, information flows etc.).
- Analyse provision of skills and the potential of the education and training system for skills provision for this occupation (which curricula and training programmes could be adopted?).
- Analyse the skills policy response to the situation (specify the policy/legal framework and level of decision-making). Assess the adequacy of the policy response.
- Describe the skills provision in response to the identified need. Assess the effectiveness of the process.

3.2.6 Case studies on greening existing occupations (3 cases × 3-4 pages each)

Please provide illustrative case studies on greening existing occupations respecting the following criteria for the selection of occupations:

- greening potential in terms of reducing greenhouse gas emission or non-renewable resources;
- contribution to adaptive capacity of communities;
- skills development record; and
- contribution to national economy and as source of employment.

Please follow the following structure for each case study:

- Select an example of an existing occupation which typically undergoes “greening” in reaction to the demands of the economy.
- Describe the origin and the situation of greening this occupation. (Is this a massive process? Does greening concern a large proportion of existing occupations? What is the role of technological change and innovation? What are sectors, types of companies, regions? Specify where possible the number of the current workforce already performing a greener version of this occupation, and its composition by age, gender and qualification/level of educational attainment; estimate the volume of the workforce expected to transit into a greener version of this occupation in the coming years etc.)
- Analyse skill gaps for greening the occupation.
- Describe how and by whom the need was identified (method, institutional responsibilities, information flows etc.).
- Analyse provision of skills and the potential of the education and training system for skills provision for greening this occupation (which curricula and training programmes could be adopted?).
- Analyse the skills policy response to the situation (specify the policy/legal framework and level of decision-making). Assess the adequacy of the policy response.

- Describe the skills provision in response to the identified need. Assess the effectiveness of the process.

4. Conclusions (2–4 pages)

The conclusions should be drawn on the basis of the whole body of research for the country study, i.e. literature review, data analysis, empirical research including interviewing, focus groups, case studies etc.

4.1 Main “greening” shifts in economies and labour markets

4.2 Skills implications and development

4.2.1 Anticipation and identification of skill needs

4.2.2 Response policies and programmes

4.2.3 Effective delivery mechanisms

5. Recommendations (2–4 pages)

5.1 Policy recommendations

5.2 Recommendations for education and training

5.3 Recommendations for further research and data collection

PART 2

**Summaries of country
studies**

The responsibility for opinions expressed in country studies rests solely with the authors of country studies.

Publication does not constitute an endorsement by the International Labour Office of the opinions expressed in them.

Australia

Policy context

Key challenges and priorities for a green economy

Australia is the eighth largest player in the world's energy markets, accounting for 2.4 per cent of global energy production, with two-thirds of production exported to world markets. Coal and uranium dominate this energy production and, consequently, a move towards a green economy will substantially alter Australia's energy production mix, leading to displaced industries and workers, but over a reasonably long time frame.

Australia's industrial history plays a large part in its high carbon emissions per capita, underpinned by energy and emissions-intensive agricultural and resource markets and a dominance of coal in electricity generation. This is illustrated by UNEP statistics,¹ which show an increase in GHG emissions of 2.5 mega tons (Mt) to over 19Mt between 1990 and 2004, compared to an average of 10Mt across all OECD countries.

The last decade in Australia has been characterized by a lack of a nationally coordinated and coherent environmental sustainability agenda. Whilst environmental sustainability has been tackled in a number of ways by federal and state governments, including emissions reduction and energy efficiency, initiatives have on the whole been innovative yet poorly integrated and coordinated, leading to confusion amongst parties interested in the climate change agenda.

Even in the absence of strong top-down leadership, there are many interesting initiatives within Australia, initiatives that might be understood as bottom-up in nature. In democratic countries like Australia, social and economic change is always a complex mix of top-down and bottom-up initiatives, so finding bottom-up initiatives is not surprising.

The environmental response strategy and the role of skills development

General environmental strategy

The sustainability agenda has been undergoing a "green shoots" transitional period culminating in the introduction of legislation on the Carbon Pollution Reduction Scheme to the Australian Parliament in 2009.² The legislation proposed a national cap and trade emissions trading scheme as the primary mechanism for delivering on Australia's commitment in 2000 to reducing GHG emission levels by 5 per cent by 2020.

However, in April 2010, the Australian Government announced that, in light of the continued absence of Parliamentary support for the Carbon Pollution Reduction Scheme, it would not move to legislate the Scheme until after the end of the current commitment period of the Kyoto Protocol, and only when there is greater clarity on the actions of major economies, including China, India and the United States. This means that the Government will not move to submit the Scheme legislation before the end of 2012, and will only do so if there is sufficient international action during this time.

¹ UNEP/ILO/IOE/ITUC, 2008.

² The information provided on Australian Government policy in this report is current to 16 July 2010. On this date, the Prime Minister requested that an election be held on 21 August 2010.

The Australian Government, however, remains committed to tackling the challenge of climate change and, in the short term, will boost existing investments in clean and renewable energy, and support greater energy efficiency measures in order to bring down GHG emissions.

A recent report³ proposed an Australian taxonomy for “green jobs” based on existing occupational, industry and skill classifications. It introduced distinctions between the environmental and/or sustainable nature of “green work” and suggested that this could be extended to other industry and occupational classification schemes. Currently, no standard classification has been embraced, but the Australian Bureau of Statistics has expressed interest in designing a methodology and delivering a dataset to profile the green workforce in Australia.

Green response to the current economic crisis

The Australian Government’s response to the current economic crisis was to target environmental abatement, including green jobs and skills. On 30 July 2009, the Australian Government committed to the development of a Green Skills Agreement⁴ with the state and territory governments to build the capacity of the Australian VET sector to deliver sustainable skills, competencies and knowledge. The Agreement was endorsed at the 7 December 2009 Council of Australian Government meeting in Brisbane. The four objectives of the Agreement are:

- develop national standards in skills for sustainability within the requirements of the national regulatory framework;
- “upskill” VET practitioners so they can provide effective training and facilitation in skills for sustainability;
- review and revise Training Packages to incorporate skills for sustainability; and
- implement strategies to “reskill” vulnerable workers in the transition to a low-carbon economy.

The Australian Government allocated AUD 5.3 million across four financial years in the 2010–11 Budget to implement the Agreement as noted by the Ministerial Council on Tertiary, Education and Employment at its June 2010 meeting.

On 30 July 2009, the Australian Government also announced the National Green Jobs Corps initiative,⁵ which will provide 10,000 unemployed 17 to 24 year olds with access to a 26-week environmental work experience and training programme, designed to provide job-ready skills.

The skills development strategy in response to greening

Until recently, the policy framework for skills and green workforce development has lacked coherence, characterized by fragmented state and national initiatives. This incoherence has led to an inadequate analysis and coordination of the demand for, and supply of, green skills in the Australian economy.

³ W. Ehmcke, G. Philipson and C. Kold-Christensen, 2009.

⁴ The Green Skills Agreement can be found at: <http://www.deewr.gov.au/Skills/Programs/WorkDevelop/ClimateChangeSustainability/Pages/GreenSkillsAgreement.aspx>

⁵ For more information please see: <http://www.deewr.gov.au/Employment/JobsandTraining/Pages/newgreenjobs.aspx>

Nationally, the Green Skills Agreement aims to ensure that training in, and delivery of, skills for sustainability are an inherent part of the VET system and relevant to industry through government working with employers, higher education systems and community organizations. A goal of the agreement is that the skill sets required for transition into a low-carbon economy are available when needed.

In June 2009, the National VET Sector Sustainability Action Plan was endorsed, and the goal of the Plan is to assist in coordinating and supporting “green” workforce development initiatives at state and industry levels. The Plan aims to build capacity whilst facilitating innovation and technology diffusion, working through collaboration with education sectors, industry and employer associations, Industry Skills Councils and governmental agencies. More specifically, it seeks to promote activity, including embedding sustainability topics across training products and building the capacity of trainers and assessors.

Initiative development has been particularly prevalent in New South Wales (NSW), with the “Green Skills NSW Strategy” prioritizing green workforce development and business opportunities, including a AUD 340m Climate Change Fund, including AUD 20m earmarked for energy efficiency training for workers involved in a particular trade and professionals.

The 11 Industry Skills Councils also play a key role in the development of skills policy in Australia. The ISCs support the development, implementation and continuous improvement of training and workforce development products and services including Training Packages, and provide advice to Skills Australia, industry and government on the workforce development and skills needs of their respective industries. The Industry Skills Councils work with educators, industry groups and other stakeholders to try to meet the changing industry landscape with the skills required through the VET system at a national level. Consequently, these Councils collectively have played a large part in examining current impacts of environmental sustainability on their industry sectors and implemented activity and initiatives to address both current and emerging priorities. Each Council is, however, a product of the collaborative arrangements within each industry sector, and while some Councils have been able to pioneer a range of innovative approaches to green skills, others have been much less impressive.

The Industry Skills Councils will play a key role in the implementation of the Green Skills Agreement. Under the Agreement, ISCs are expected to revise relevant Training Packages to embed skills for sustainability principles. In March 2010, each Council completed a review of relevant Training Packages to identify gaps in sustainability skills, knowledge and competencies. The revision of Training Packages to address these gaps will be substantially completed by December 2010.

The Industry Skills Councils have identified three core principles which must underpin all VET activity in skills for sustainability. Skills activity must be:

- **industry specific:** environmental sustainability should be tackled in a way which is specific to the needs of the job and industry worked in;
- **appropriately timed:** environmental sustainability skills will take different time scales to emerge depending on the industry; and
- **value adding:** environmental sustainability skills must add weight to skills already possessed without adding unnecessary burdens to enterprises.

The field of skills for environmental sustainability is emerging and it has been identified that best practice should be shared to assist the growth of green industries in Australia.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

The movement of the Australian economy away from energy and emissions-intensive industry to less energy-intensive services industries requires a coordinated and consistent policy response, with acknowledgement that if action on climate change is deferred, countries will face longer term economic costs and global investment will choose to focus on less emissions-intensive countries and industries.

The Government has committed resources to facilitating the retraining of workers and regional planning. A CSIRO report⁶ states that the transition to a sustainable economy will have little adverse impact on employment in Australia; indeed it is estimated that there will be 230,000 to 340,000 new jobs in transport and construction, above the usual levels if climate change abatement is tackled.

Sectoral employment shares are expected to remain stable, based on accounts of aggregate jobs growth of 2.5m to 3.3m between 2005 and 2025. It has been anticipated that the impact of green restructuring and employment in Australia is likely to be neutral to positive. Furthermore, it is estimated that mitigation costs are small relative to the costs forecast of unabated climate change, with a relatively small cumulative fall in GDP growth over the period 2010 to 2030 of around 2 per cent.

The predicted decline in manufacturing and agriculture in Australia is likely to be made worse by the transition to a carbon constrained future, especially given the pressure of global demand shifting towards low-emissions goods and services, which will impact negatively upon employment in emissions-intensive industries (manufacturing, agriculture and energy production).

Skills response

The skills response to carbon abatement has taken a number of paths at different levels of governance (national, state, regional and industry), but it is moving, at different speeds and in different ways, towards serious engagement with the skills challenge, and through integration of abatement policy into a wide range of policy areas.

At the enterprise level, focus has been on internal training varying from mentoring to more structured information sessions, to maintain awareness of the changing business environment. The expectation is that as policy-making becomes more aware of the benefits of facilitating business exchanges and engagement with the environmental agenda, dissemination of best practice will become a priority.

At the industry level, including Industry Skills Councils, innovative approaches to skills formation have been visible through integrating green skills into all elements of training rather than just acting as an add-on.

Changing and emerging occupations and related skill needs

New and emerging occupations

New green-collar occupations are a central element of environmental change, yet just as many technologies and regulatory regimes are in their infancy, occupations and underlying skills are

⁶ The Treasury, 2008.

also in a developmental stage. Regulatory certainty and consistency in driving market demand, the role of government incentives to drive behavioural and business change, industry and government collaboration to foster development and commercialization of technologies, and design and delivery of training courses are vital in ensuring that these green-collar occupations and skills continue to develop.

Despite a slow-down in venture capital investment as a result of the global financial crisis, the proportion of funding for green industry still increased from 1.6 to 11 per cent between 2003 and 2008. Given a supportive policy context, Australia is deemed to be well positioned to take advantage of the global growth in demand.

In a 2008 report by the Australian Council of Trade Unions (“Green Gold Rush”), six industries were identified as representing areas in which Australia was well positioned:⁷

- renewable energy due to high wind capacity locations, long sunlight hours and a long coastline;
- energy efficiency due to high electricity consumption of commercial/residential buildings. Energy efficiency advances would yield substantial results;
- sustainable water systems due to geography and recurring droughts. Australia has a strong history of water innovation in the water sector, particularly water use efficiency;
- biomaterials, whilst a fledgling industry, benefits through growth given Australia’s expertise in agricultural production and natural resource management;
- green buildings due to commercial/residential energy consumption. Strong emissions reductions can be made through retrofitting and the introduction of higher energy standards for new builds; and
- waste and recycling due to its current competition for waste and recycling contracts. The sector is poised for strong growth.

These sectors will include a mix of greening existing jobs and creation of new roles and industries.

Greening established occupations

A stock-take of Australia’s green skills and workforce capabilities is still forthcoming. A number of themes, however, were drawn from case studies, including:

- regulatory consistency and stability on which technology and training investment can pivot is very important;
- dissemination of current and ongoing legislative requirements is still in need of further action; and
- green skills education and training coordination is already visible at industry and regional levels.

⁷ S. Hatfield-Dodds, G. Turner, H. Schandl and T. Doss, 2008.

The 11 Industry Skills Councils manage the revision of Training Packages to meet skills development needs, forming networks between businesses, unions and training sectors to drive changes in the VET system through continuous review of competency units, curricula and qualification structures. The presence of Councils has helped to prompt better national sector-based identification of skills needs. The Green Skills Agreement will further facilitate re-skilling and up-skilling of workers in sustainability skills and enable the adjustment to a low-carbon economy.

Despite a lack of Australian research relating to green skills, a snapshot of Washington DC illustrates indicatively through current educational qualifications of “green employees” that:⁸

- between 1 and 4 years’ vocational training was required by 27 per cent of green employees; and
- a degree of higher qualification was required by 13 per cent of employees.

Skills response

Whilst Australia’s advancement of a sustainability agenda has been characterized by fragmented skills policies at state and industry level, some state governments have more comprehensive and coherent approaches, including Victoria, Queensland and New South Wales. Although it is recognized that the supply of green skills is in some respects secondary to establishing stable and supportive policy settings for the growth in demand for green skills, a strong framework with ongoing enhancement and improvement will be instrumental in meeting the growing demand.

There has been an uneven evolution of green skills. The initial phase was the preserve of a small group of occupations, firms and industries primarily at state level, as an add-on to existing skill training, and often conducted in-house by the leading firms in the industry. However, more recently “green skilling” has moved towards a more comprehensive agenda across more occupations and industries, becoming embedded in training, both through on-the-job and more formal approaches. This signifies a realization of industry and training sectors of the longer-term significance of climate change abatement in work practices.

Whilst currently there are multiple government initiatives targeting energy efficiency and supporting renewable energy markets, the demand for skills to drive these developments will be a key focus of skills policy and delivery. Formal training is likely to play a larger part over time, with comparable training standards developed.

Anticipation and monitoring of skill needs

Opportunities in Australia have been identified in areas including the energy-intensive commercial and residential sectors, and growth in renewable energies sectors, but these will be dependent upon policy support and innovation. The historic issue within Australia has been the highly fragmented nature of progress in green skills development with some examples of best practice, but with no consistent overarching approach. It is important that a more connected approach be realized.

At the sectoral level, Industry Skills Councils have been instrumental in identifying changing skills needs as a response to the greening of the economy through conducting annual “environmental scans” to indicate the industry-wide skills requirements.⁹ The identification of skills needs is typically derived through ongoing stakeholder consultation and research from training authorities

⁸ K. Lee, G. Weeks, M. Ayala and A. Hardcastle, 2009.

⁹ Industry Skills Councils, 2009.

and service providers to employers which allows a more sector-based approach on a national scale. The dynamism around sustainability policies means this process is difficult; the networks of consultation are active and representative of a broad range of stakeholders. Furthermore, the institutional structures for taking the next steps already exist. Consequently, more coordinated systems of skill formation and training are likely to emerge over the next few years, providing the capacity to enable the green skilling of the Australian workforce to take place quickly.

Summaries of case studies

Case study 1. Coal miner, Australia Coal mining industry

The Construction, Forestry, Mining and Energy Union's (CFMEU) Mining and Energy Division has taken a proactive stance on the threat to the mining industry and its workers since 1990, when it led the Australian union involvement in the Government's Ecologically Sustainable Development Working Groups. The CFMEU is balancing commitment to reducing GHG emissions and its workers' welfare through advocating the deployment of carbon capture and storage (CCS) technologies.

Despite the demands of climate change on the coal industry, employment prospects in the Australian coal industry are good, with a shortage of skilled labour. The mining workforce is set to grow through creation of new mines and expansion of those already existing. CCS also provides a new industry stream and new skill demands due to being vastly more sophisticated than a conventional coal-fired power station.

To build the first new CCS plants there will be major demand for appropriately qualified technical and professional staff; if Australia can get 2–4 of the world's first plants there will also be huge demand for Australian expertise, because it has been estimated that there are less than half the engineers with the skills needed to build and run CCS power stations. Engineering and science faculties therefore need improvement. The pipeline construction task associated with CCS will also involve new skills sets and new jobs, with 5,000km of pipeline and up to AUD 30bn investment anticipated. The pipes will need to be greater than 24 inches in diameter, a size Australia last constructed in the 1980s, requiring the civil construction industry to up-skill and retool the workforce.

The skills implications of CCS technologies will depend on the speed at which it is to be implemented, but it will undoubtedly have a significant impact on the Australian mining industry with acknowledgement from miners and unions that the task is huge and will require huge investment in new jobs and skills, with planning for training only at a rudimentary stage.

Case study 2. Cotton farming, Australian Cotton Industry Best Management Practices (BMP)

Australia is known globally as a reliable supplier of high quality cotton, generating in excess of AUD 1 billion in a non-drought year in export value. The Australian Cotton Industry BMP is an example of a continuous improvement programme developed as a voluntary, self-regulated approach to protecting resources and environmental management: providing self-assessment mechanisms and practical tools for auditing processes in order for cotton to be produced with best practice across focus areas which include greenhouse gases and carbon.

Individual growers implement BMP with support from Cotton Australia staff and investment from the Cotton Research and Development Corporation and Cotton Catchment Communities. The programme led to guidelines which award BMP accreditation to farm properties on the basis of environmental and sustainable production criteria.

In 2007, the Australian Government funded a cotton industry initiative to map skills and learning which has led to development of formal qualifications – the Diploma of Agriculture – and an industry award – the Certified BMP Farm Manager.

The programme continues to evolve and more recently has been extended to include more topics and encompass previous module material and updated standards. Focus is on the implementation of research and development by farmers to grow the business, with new topics including greenhouse gases and carbon, soil health and natural assets and quality to be released to industry later in the year. The programme allows the practical implementation of agricultural science to producing cotton with the least environmental impact, with a Farm Manager award acknowledging and setting standards for future producers to meet the evolving BMP principles.

Case study 3. Business analyst, Victorian Advanced Resource Recovery Initiative (VARRI)

The VARRI is a AUD 10m Victorian State government initiative to improve organic waste recovery in metropolitan Melbourne, which will facilitate the introduction of new “Advanced Resource Recovery Technologies” (ARRTs) to process Melbourne’s municipal solid waste.

The establishment of up to eight facilities¹⁰ is aiming to create 250 permanent jobs over the next five to ten years with additional indirect jobs. Once operational, the workforce for each facility will include low-skilled workers through to specialized engineers and business operations managers. The first stage of the process is the development of a business case to explore ARRT options from a financial, environmental and community perspective, and following the business case, the State Government will work with local government to seek tenders to incorporate the first two resource recovery facilities. However, the skills required for a business case are complex and dynamic, requiring an understanding of government objectives, private investment priorities and waste processing technologies. Currently, the business analyst workforce is made up of degree-qualified staff with specialized knowledge gained on the job from project to project.

Numerous Technical and Further Education (TAFE) and Registered Training Organizations (RTO) institutions in Australia deliver waste management qualifications ranging from Certificate II to IV in Asset Maintenance (Waste Management). At university level, a number of institutions offer undergraduate specializations or post-graduate degrees within engineering faculties, including the Masters of Water, Wastewater and Waste Engineering at the University of New South Wales School of Civil and Environmental Engineering. The confluence of skills required to construct a business case at VARR requires knowledge of engineering and waste processing systems, business valuation and forecasting, advanced and new technologies and government service provision. The delivery of these skills sets is invariably through the university sector, although it is difficult for targeted training to be provided due to the dynamism and diversity of knowledge required and ,consequently, skills are largely learnt on-the-job using existing experts and mentors.

Case study 4. Technician, Infinity Solar

Infinity Solar is a firm specializing in solar energy; it was established in 2007 and is based in Queensland. It provides solar and wind energy solutions to domestic and commercial clients, designing and installing solar energy systems and distributing wind turbines.

The current workforce consists of 30 employees, who are divided between managers/professionals, technicians/trade workers and sales staff with qualifications ranging from degree level to qualifications in electrical trades. The majority of staff are Clean Energy Council accredited installers, a process which involves recognition of skills and competencies relating to design and installation of renewable energy systems for electricians and electrical engineers.

Skills requirements are currently met through a combination of vocational courses and on-the-job training at TAFE institutes and RTOs, with modularized training packages forming the basis of skills acquisition within an extensive qualifications framework. Many of the TAFEs and RTOs offer the modules necessary to attain both Clean Energy Council accreditation and full courses which culminate in Certificates up to Advanced Diplomas in Renewable Energy specializations.

The business recognizes that demand for skills is embedded in market demand for their services and renewable energy, and highlighted to government that regulatory certainty and R&D support was inherent. Growth in the sector will be highly dependent on a strong platform for R&D investment and protective measures to support the industry in its infancy. The skills response remains fragmented due to a lack of regulatory uncertainty, the fast pace of technological change and a need for ongoing coordination between industry, educators and government. Despite this, the potential for education and training systems to supply the renewable energy sector with skills is great.

¹⁰ As per the Metropolitan Waste and Resource Recovery Strategic Plan, 2009.

Case study 5. Engineer, Clearmake

Clearmake, established in 1993, is a water treatment and recycling service provider that designs, manufactures, installs and services more sustainable water usage systems, employing 21 full-time employees. Demand for the company's services is driven by regulatory standards for water pollution, consumption and access. Consequently, the stability of the regulatory environment is of critical importance and the company stands to benefit from increased emphasis on sustainability delivery and Australia's longstanding priority to optimize its water management and consumption.

Employees at Clearmake represent a variety of qualifications including ten degree-qualified staff (management and engineers) and eight vocationally trained staff (electrical trades). Skills requirements range from generic sales and finance to specific competencies relating to technical electrical trades and engineering. Whilst the foundations of knowledge are primarily from TAFE or university, a large proportion of water management related skills are acquired on-the-job due to an absence of targeted training. However, the potential for the education sector to cater for water system management skills needs is significant, as is the scope to engage the vocational and higher education sectors in specific training in design of water treatment and consumption systems. There also lies opportunity in developing the learning pathways embedded in either vocational education and leveraging skills of the electrical trades, or the higher education sector through more highly skilled engineering schemes.

Capability gaps were identified in the sector in 2005 including technical hydrogeology skills, water-sensitive urban design, wetland design and floodplain assessment amongst others. Whilst within the VET sector, elements of water system management are present in conservation and sustainability courses more broadly, there is also more specific training such as the Water Operations Training Package, to be reviewed by the ISC at the end of 2010. At the higher education level, four leading universities (Queensland, Griffith, Monash, Western Australia) have joined together to design and deliver a postgraduate programme in Integrated Water Management integrating scientific, economic, environmental and regulatory understanding of managing water systems delivered through a full-time Masters. Whilst the course is in its infancy, it is supported by a strong network of universities.

Case study 6. Consultant, Ernst and Young

Seven per cent of Australia's workforce is employed in the professional, technical and scientific services sector.¹¹ Ernst and Young are a private professional services firm which has built a specialized Climate Change and Sustainability Services team based in and around Australia. There are currently 40 members of the team across a range of disciplines including engineering, science, law, accounting, economics, social science and business with a minimum of a Bachelors degree qualification, with many holding postgraduate qualifications. Consultants require a detailed understanding of the technical elements of regulation and the practical ways they impact upon clients.

Skills are acquired primarily on-the-job; whilst emerging university courses contain sustainability and climate change content, they are deemed too broad in scope and there is an absence of training courses advanced enough in demonstrating the knowledge required by the firm's consultants. Training is mostly delivered internally by experienced employees through lectures, with external training used if it is mandatory for a certain service (e.g. NSW Greenhouse Gas Abatement Scheme Auditor training). Whilst the company acknowledge the useful training and skills on offer by training organizations, regulatory programmes etc. the primary method of upskilling staff remains internal training.

Ernst and Young acknowledge that the potential for education and training systems to "green" the professional services industry are limited but important. The policy response to the "greening" of the professional services industry has been very limited, tending mostly to creating measurement, reporting and auditing standards relating to energy usage and greenhouse emissions. The skills policy response to developing the workforce which is necessary to administer standards has been limited to training programmes which do not necessarily address the complexity of the relationship between business decisions and climate change/sustainability; furthermore, given the breadth of expertise required within the professional services firm, it is difficult to envisage a skills framework that would comprehensively meet all skills needs.

¹¹ ABS, Cat. No. 6291.0.55.003.

Case study 7. WPC Group GreenSkills initiative

The WPC Group GreenSkills initiative seeks to address skill shortages and deficiencies facing business and government agencies providing environmental goods/services or to meet government policy. The programme is the first group training programme which targets the “green economy”.

The WPC Group includes 500 apprentices who are working in 200 host employers across a breadth of industries. The aim is to create opportunities for apprentices and trainees in the green economy such that they develop skills necessary to understand the impacts they are having on the environment, whilst giving them the capacity to work more sustainably.

The programme targets areas which have high visibility in the green economy including those with an active sustainability policy and a professional/public commitment to sustainability through, for example, industry standards. Apprentices generally have vocational qualifications at a Certificate III level, relating to business services, waste management, construction and horticulture, with additional focus required for electrical and engineering fields and employers ranging from renewable energy providers to construction firms.

A new TAFE NSW development has led to at least one unit of sustainability education being included in all traineeships and apprenticeships, providing the opportunity to overcome the difficulty of not having customized “green” versions of traineeships and allowing the integration of sustainability modules into broader scopes of learning.

Case study 8. GreenPlumbers initiative

GreenPlumbers® is a joint initiative between the Master Plumbers and Mechanical Services Association of Australia and the Plumbing Trades Employees Union which seeks to enhance plumbers’ skills and knowledge about the environmental considerations of their work. It is a post-trade training programme delivered through a joint employer–union training enterprise through workshops. The opportunities place plumbers in a better position to advise and inform consumers on topics including the benefits of energy efficiency and water conservation. Approximately 7,300 plumbers representing 3,700 businesses have completed at least one training session which enables a tradesperson to be certified as a GreenPlumber following completion.

The programme has recently expanded into New Zealand and North America as governments have learnt to appreciate the importance that plumbing can play in creating a more environmentally sustainable future.

Case study 9. Ecotourism operator, Hidden Valley Cabins

Hidden Valley Cabins was established in 1982 as a family-run resort around 100km from Townsville, Queensland. The area does not use grid power and operates using self-generated electricity. In 2007, the resort commissioned a self-sufficient solar energy system to replace diesel generators. Carbon audits were undertaken and carbon credits were purchased to attain a carbon neutral accreditation.

In conjunction with Tropical Energy Solutions, Hidden Valley Cabins are leveraging their own experience to deliver training workshops on site to other tourism operators with a desire to make it easier for other operators to undertake similar transitions. Workshops encourage renewable energy usage by providing a platform of working knowledge demonstrated through their own operating energy system. The resort’s experience indicates that Australia possesses strong advantages comparatively due to solar radiation levels and natural resources, compared to other developed economies. The greatest impediments to growth are perceived as regulatory and policy settings, particularly the abolishment of incentives or disincentives for activity.

The experience from Hidden Valley has indicated a lack of experienced installers and dispersion in costing quotes because whilst vocational and higher education sectors have been active in designing courses in renewable energy training or solar and wind energy systems (including those at Swinburne University of Technology’s Certificate IV in Electrotechnology Renewable Energy), little data is available on the uptake of courses. The emergence of courses will gradually increase the supply of quality solar installers and reduce problems experienced at Hidden Valley (i.e. lack of trained solar energy system installers at a predictable price).

The Hidden Valley workshop provides targeted training to a niche market where operators are not connected to grid power. The Clean Energy Council have quantified that over 70 per cent of solar photovoltaic installations are off-grid. However, the workshop does demonstrate a functional, commercial scale and self-sufficient operation which could be translated across the tourism industry. Furthermore, operators believe Hidden Valley are better placed to deliver practical training in such a niche market than government-delivered courses, highlighting that industry-situated or collaborative training is important, but only within a stable regulatory setting, possibly with stronger incentives to drive changes to business practices to more sustainable options.

Conclusions

The trajectory of Australia's emissions reduction policy, evolving economic and regulatory structures and key responses from key informants and case studies demonstrate that:

- Australia is an energy and emissions-intensive economy in its current form, with the highest emissions per capita of any country in the OECD due to the historical structure of industrial activity. The move to a carbon constrained economy means that comprehensive mitigation planning is critical. However, the country's energy consumption provides a short-term opportunity for carbon abatement through existing energy efficiency technology;
- a number of policy initiatives, including the Renewable Energy Target, investments in clean and renewable energy and support for greater energy efficiency measures, aim to drive the transition to a sustainable, low-carbon economy. The reforms will encourage the uptake of clean energy and boost demand for emerging industries such as solar energy installation;
- there is much debate over the direction that Australian climate change abatement should take;
- Australia is well positioned to take advantage of growth in demand for goods and services with lower emissions, due to an abundance of solar radiation and wind resources and strong traditions in land and water management systems;
- regulatory reform will be a key driver across industries affected by the development of the green economy, be it those traditionally emissions-intensive or emerging industries of occupations, which will be reshaped by green skill requirements; and
- the supply of green skills has been fragmented along state and institutional lines but there is little data on the update and completion of green skills education or training to quantify how fragmented or sector based it has been.

Recommendations

Climate and skills policy

- A key policy issue facing Australia is the emissions abatement framework legislation, which will drive both the pace and scale of emissions reductions.
- There is a need to continue harnessing innovations at the industry and state government level and to streamline industry and state-based initiatives into national equivalents.
- Institutional mechanisms linking industry, businesses and workers are key to the success of green skilling in Australia, with Industry Skills Councils playing a pivotal role. Funding arrangements should be better targeted or possibly made conditional on embedding green skills into industry training to develop training to meet the changing demand.
- It may be time for a formal evaluation of existing funding for green skills and its relationship to skill development to be developed, as part of any broader evaluation process.

Education and training

- Greater industry collaboration is required, particularly in new green industries as technologies change.

- Whilst much of the initial training demand was met through on-the-job training, it is now being picked up by formal training systems through evolving course design; however, curricula need to be mapped to quantification frameworks, accreditation schemes and industry quality standards.

Further research and data collection

- The concept of green jobs is complex and will continue to evolve. Once the understanding of the work entailed is made more certain, there is a need to standardize the definition and taxonomy of green jobs and allocated resources to allow data collection.
- Training capacity is being built around green skills, but the numbers of employees successfully using these skills in the workplace is less certain, as is the number of employees likely to use these skills in the future and the effect the skills will have on promoting sustainable outcomes in the workplace. Analysis on the uptake and appropriateness of green skills courses available currently may be useful in guiding policy.
- The story of skills for climate change abatement in Australia is one of both top-down and bottom-up initiatives. However, the collapse of the Copenhagen negotiations internationally and carbon trading legislation nationally suggests that current bottom-up initiatives are leading the way in Australia. More research is needed on how to promote these current initiatives, and to create space for more initiatives. In the absence of coordinated international leadership, this is a finding for potential use in many other democratic countries.

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Bangladesh

Policy context

Key challenges and priorities for a green economy

Despite being a minor contributor to global GHG emissions, Bangladesh is suffering from climate change impacts. Environmental degradation is happening through soil erosion, deforestation, increased water salinity and water body pollution. The National Adaptation Programmes of Action revealed that the most damaging effects of climate change in Bangladesh were floods, salinity intrusion, and droughts that have been drastically affecting crop productivity almost every year. This is critical to the economy of Bangladesh, which relies predominantly on agriculture.

Mass deforestation is occurring, including burning forests to clear land. In addition to the effects that deforestation has on climate and geography, burning forests releases significant amounts of CO₂ into the atmosphere. In tropical areas such as Bangladesh, deforestation accounts for up to one-third of total anthropogenic CO₂.¹²

Bangladesh's per capita energy consumption is relatively low compared to India, Pakistan and Sri Lanka. Energy production and use are both estimated to have grown at a rate of 4.1 per cent annually,¹³ whilst carbon emissions have grown 6.6 per cent annually between 1980 and 2006.¹⁴

Gas is the main source of commercial energy where the share of biomass in total primary energy consumption is around 60 per cent.¹⁵

The environmental response strategy and the role of skills development

General environmental strategy

The 1996 National Environmental Management Action Plan prioritizes 57 programmes aimed at improving management of scarce resources and reversing present trends of environmental degradation.

The Sustainable Environment Management Programme (1999) is the national umbrella programme executed by the Ministry of Environment and Forests, which implements projects involving policy and institutions; participatory ecosystem management; community-based environmental sanitation; advocacy and awareness; and training and education.

Bangladesh became a signatory to the United Nations Framework Convention on Climate Change in 1992 and has undertaken GHG inventories and vulnerability and adaptation analyses, and is currently preparing its second National Communication and participating in the CDM. Bangladesh has involved local communities in forest protection and regeneration, for example through the Social Forestry Programme. In addition, the Coastal Islands Development and Settlement Programme is being implemented in collaboration with the Water Development Board, the Forest Department, the Local Government Engineering Department and the Department of Agricultural Extension.

¹² Bangladesh Centre for Advanced Studies, 1998.

¹³ Mondal et al. 2010: Table 2.1, pp. 5–6.

¹⁴ Data sources: Zurbrugg, 2002 (Quoted in Chowdhury, 2006); GEO: <http://geodata.grid.unep.ch/results.php>; IEA: <http://www.iea.org/Textbase/country/index.asp>; UNFCCC: http://unfccc.int/ghg_data/ghg_data_unfccc/items/4146.php; World Development Indicator, 2008.

¹⁵ Al-muyeed and Shadullah, 2010.

The Department of the Environment (DOE) headed by the Director General under the Ministry of Environment and Forests was established in 1989 and is the regulatory body responsible for enforcing the Environmental Conservation Act of 1995 and the Environmental Conservation Rules of 1997. Through this structure, the DOE manages problems such as industrial pollution. However, the DOE exercises no strict regulations or enforcement, and has no supervision by the Government of Bangladesh.

The Renewable Energy Policy of Bangladesh (2008) states that renewable energy will play a vital role for off-grid electrification in the country. The main renewable energy resources in Bangladesh are biomass, solar, wind and hydro power. The Government decided that all new public buildings must use solar power. Currently, renewable energy sources contribute less than 1 per cent of total electricity generation but the Government is aiming to increase this to 5 per cent by 2015 and 10 per cent by 2020.¹⁶

Green response to the current economic crisis

The impact of the current global economic crisis on the Bangladesh economy is still not as visible as one would expect. Information on the amount of green investments and the total amount allocated to the crisis response strategy is not available.

The greening components of the national strategy in response to the current economic crisis relate primarily to improvement of the national energy situation. At the moment, demand for power exceeds supply and the Government has undertaken certain policy measures to mitigate the power crisis. These include offering duty and tax benefits on the import of environmentally friendly energy technology and increasing the implementation of hydro and wind power plants.

The Government's crisis response strategy does not include any skills development component. However, it has skills implications for developing new green-collar occupations in response to increasing demand for renewable energy and also for greening existing occupations.

The skills development strategy in response to greening

Bangladesh does not have a national policy or skills development strategy in response to climate change and environmental degradation nor is a skills response strategy incorporated into a larger greening policy agenda. The national HRD strategy¹⁷ does not include identification or provision of skills for green jobs. The National Skills Development Council established in 2008 under the Prime Minister's Office is expected to fill that gap.

The National Capacity Self-Assessment (NCSA) for Global Environmental Management is a strategy that aims to identify priority capacity needs in the environmental sector in the context of the three Conventions relevant for the NCSA: the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change and the United Nations Convention for Combating Desertification.¹⁸ The NCSA strategy has skills implications mainly for climate change analysts, environmental restoration planners, environmental certification specialists, environmental economists, industrial ecologists, water resource specialists, water/wastewater engineers and geospatial information scientists and technologists.

¹⁶ Ministry of Power, Energy and Mineral Resources, 2008.

¹⁷ Ministry of Planning, 2008.

¹⁸ International Union for Conservation of Nature and Natural Resources, 2006.

Skills in transition to a greener economy

Green structural change and retraining needs

In the context of greening the economy, skills development policies and strategies in Bangladesh are not aligned or linked to industrial, trade, technology, macroeconomic and environmental policies. Although the ongoing TVET Reform Project is trying to establish a training network between the public sector training institutions and the industrial employers, there is no focus on developing skills for green jobs. The project aims to meet needs for skills dictated by the market.

The promotion of greener technology has implications for creating and developing skills for green jobs; however, no estimate on the number of green jobs that are going to be created as a consequence of these measures is available.

Currently there is no nationally coordinated strategy for skills training for a green economy. Much of the training is carried out informally, for example the Solar Energy Programme of Infrastructure Development Company Limited.

Green restructuring and its impact on the labour market

The structural transformation that is taking place in Bangladesh is derived not only from economic growth but also from spontaneous green structural change. However, current and future employment shifts and trends are likely to take place due to anticipated green structural change, notably in the renewable energy and waste management sectors, as well as in manufacturing, construction, transport, telecommunication and trade.

As a response to the impacts of climate change, there is a shift towards a greener economy and labour market, which is evident in initiatives from both private and public actors, on national and local levels. However, although these greening shifts are very apparent in the energy sector, they have remained rather weak in materials management, telecommunications and transport. This is primarily due to inadequate policy and institutional support. With the right policies, institutional framework, commitment and immediate reinvestment, it is possible to bring about the needed changes for greening the economy.

Skills response

The skills response to meet the challenges of restructuring due to greening of the economy remains limited. There are no active labour market policy measures or planning of initial and continuing training. There are insufficient institutional frameworks, delivery channels and ad hoc skills responses. Training is often undertaken by individual organizations, for example Infrastructure Development Company Limited or compressed natural gas or waste management companies.

There are no special skills development programmes to cater for displaced workers or for the upgrading of skills. This type of training is usually provided through on-the-job training by organizations such as Rahimafrooz Renewable Energy Limited, Grameen Shakti and Waste Concern, and is funded by NGOs with donor assistance.

Changing and emerging occupations and related skill needs

New and emerging occupations

Carbon traders, solar energy engineers and technicians, mechanical engineers and CNG conversion technicians have been identified as new green-collar occupations as a result of adaptation to

climate change and mitigation needs. New green-collar occupations are concentrated in the energy and transport sectors. The workforce involved in such occupations is now quite sizeable and is expected to increase substantially in future.

There is still a skills gap regarding carbon trading, not only because carbon trading is still in its infancy in Bangladesh, but also because emerging companies feel that their existing workforce does not have the necessary skills and competence levels to meet the requirements.

New renewable energy technologies such as wind turbines, geothermal systems and solar power are gaining increasing importance – leading to a need for solar energy and renewable energy technicians. In the CNG industry new skills are needed in relation to CNG technologies including more mechanical engineers, gas cylinder engineers and toolkit makers.

Greening established occupations

Existing occupations that are experiencing a green skills shift are in the waste, agricultural, construction and manufacturing sectors. A new approach to waste collection is emerging where traditional waste dumping is being replaced by community-based waste management coordinated by private enterprises and NGOs. NGOs are also involved in helping to train farmers to shift from traditional agriculture to organic farming practices.

The construction industry has also been targeted for greening, where architects, town planners, civil engineers, supervisors and masons are being trained to green their design approaches.

In the brick making and tannery sectors, mechanical engineers, supervisors, managers, accountants and workshop technicians aim to become greener in the areas of environmental conservation and the use of green technology.

Skills response

The organizations involved in skills response primarily include Waste Concern, Grameen Shakti, Infrastructure Development Company Limited and the Bangladesh Council of Scientific and Industrial Research. Coordination of the skills response needed for greening the economy remains weak. The existing education and training system has not responded to the need for green skills; hence there has been little curriculum development, and few new courses and occupational standards have been developed.

Anticipation and monitoring of skill needs

At the policy-making level, there is inadequate appreciation of the need for policy targeting the development of skills for green jobs. Although Bangladesh has embarked on several policies and programmes for adaptation to climate change and mitigation of its adverse impact, it has no policy for the formation and development of skills for greening the economy. In this regard, isolated and sporadic efforts are taking place with very little impact on greening the economy.

No labour market information service is in place in Bangladesh to collect information on retraining needs for green jobs. For this report, retraining needs were identified by researchers in consultation with organizations and enterprises initiating and/or dealing with greening the economy. The Bangladesh Bureau of Statistics conducts a Labour Force Survey at intervals of 4–5 years; however, the existing indicators could be further split into existing green and non-green occupations, as well as prospective green occupations across sectors. This would enable the collection of future information regarding green skills in the labour force.

Summaries of case studies

Eight case studies illustrate the anticipated change and provision of skills in various occupations.

Case study 1. Refuse/waste collectors and dumpers – Waste Concern

Community-based waste management is becoming a popular alternative to traditional waste dumping. Waste Concern is a private enterprise, which also runs training workshops on solid waste management, recycling and composting. According to an estimate by Waste Concern's not for profit research and development arm, the number of untrained people involved in the waste sector is rising by 1 per cent annually; however, many potential health risks are involved with having untrained people in this sector.

Waste Concern is providing a training programme targeted at municipal and local government officials, and at NGOs and community-based organizations. Furthermore, the organization is preparing a Solid Waste Management Plan for 19 towns in Bangladesh, and developing supporting training materials such as manuals. To promote the conversion of waste into resources, Waste Concern established a Recycling Training Centre at Katchpur, Dhaka. This was formed under the Sustainable Environment Management Programme implemented in 2006 by the Ministry of Environment and Forests with support from the United Nations Development Programme.

Waste Concern started a community-based composting project in 1995 to promote the “4 Rs” – reduce, reuse, recycle and recover waste – in urban areas. The organic content of Dhaka's household waste accounts for more than 70 per cent of total waste, and can be efficiently converted into valuable compost. This reduces disposal costs and prolongs the lifetime of landfill sites. It also reduces the harmful environmental impact of landfill sites, because organic waste is generally responsible for groundwater contamination and methane gas emissions. By turning the organic waste into compost, the soil in urban areas can be improved.

Waste Concern facilitates projects for small-scale waste management enterprises and assists in establishing local waste management committees. Government provides land, water and electricity, and the private sector markets the compost and recyclables. Rickshaws have in some cases been modified to collect household waste. Households will pay up to 20 to 35 cents per month to have their waste collected.¹⁹

Case study 2. Agricultural workers and inspectors in organic farming

The agricultural sector is the main livelihood strategy for the vast majority of the rural people in Bangladesh. It contributes about 20.6 per cent of the country's GDP and provides about 48 per cent of its employment.²⁰ Thus, in order to reduce rural poverty, it is necessary to boost agricultural production.

Commercial organic farming has emerged in Bangladesh as an alternative, highly profitable farming enterprise. A three-year-long economic analysis of Forschungsinstitut für Biologischen Landbau (a research institute of organic agriculture) on organic and conventional farms has shown that, due to high premium prices, organic farming is as profitable as conventional farming.

Many potential employment opportunities exist in organic farming, including: agriculture extension specialists, soil conservation technicians, and sustainable agriculture specialists. Although these occupations exist in Bangladesh, people trained in these occupations are in short supply, as they require extensive training.

PROSHIKA, an NGO offering educational and training programmes for human development, has an Ecological Agriculture Programme, which is the leading programme in the country. Since 1978 PROSHIKA has been promoting ecological practices among its group members by growing varieties of seasonal vegetables. According to PROSHIKA, its Ecological Agriculture Programme is expected to involve around 0.8 million organic farmers in organic cultivation across 0.22 million acres of land in the next ten years. PROSHIKA has also introduced an organic vegetable marketing project to promote the consumption of organic vegetables. Currently, one of PROSHIKA's marketing channels is selling eco-friendly produce to the public in the Mirpur area of Dhaka City and mobile vans are used to sell organic vegetables in some areas. The involvement of farmers in organic farming through training programmes provided by PROSHIKA or UBINIG (a policy and action research organization) is increasing and today spans over 16 districts and over 100,000 farming families (with an average of five members per family).²¹

¹⁹ Enayetullah, 2005; Zhu et al., 2008.

²⁰ Bangladesh Bureau of Statistics, 2007.

²¹ Forschungsinstitut für Biologischen Landbau, 2004; PROSHIKA, 2002.

Case study 3. Carbon trading: Carbon credit trader from composting waste

A carbon credit trader is an example of a new green-collar occupation.

Waste Concern is a non-profit organization that partnered with a private Dutch company to trade carbon under the CDM. WWR Bio Fertilizer Bangladesh Ltd is a Bangladesh and Dutch joint venture company (Waste Concern and World Wide Recycling of the Netherlands), which sells high quality organic fertilizer produced from fruit and vegetable waste from the markets of Dhaka City. It has launched a bio fertilizer into the market and has given the first compost to local dealers and farmers. The bio fertilizer is produced in the organic waste composting plant at Bhulta (Narayanganj), which has a processing capacity of 711.23 tonnes/day and produces 50,802.35 tonnes of compost per year with GHG reduction of 90,428.18 tonnes of CO₂ emissions annually (Waste Concern, 2009). This is expected to benefit more than 3.6 million people annually and equate to mitigating CO₂ emissions by an estimated 568,986.32 tonnes over the next six years.²²

Including the revenue from carbon credits, annual financial savings amount to USD 7,218 for a 3.05 tonnes/day capacity plant. Composting all organic waste in Dhaka would create new jobs for 16,000 people from lower socio-economic backgrounds, especially women, with the promise of robust growth in employment in the future.²³

The plant is the first of its kind in the country with such a large capacity. The project aims at setting up two more plants by 2010 to have a total capacity of handling 700 tonnes of waste from the Dhaka City Corporation markets on a daily basis. This is a model that can be replicated in any city and several other companies are also planning on incorporating carbon credit trading.

Case study 4. Solar energy engineers/technicians

Various skills are required in the solar home system (SHS) industry: branch manager, service engineer, financial assistant and solar energy technician. The appropriate skills for solar energy technicians are crucial for the expansion of an SHS industry.

According to the estimates of Infrastructure Development Company Limited²⁴ and Grameen Shakti, currently about 622,000 SHSs have been installed in different regions of the country. More than 3 million people currently benefit from this SHS. There are about 15,000 jobs related to solar energy, most of which are solar energy technicians. By 2014, it is expected that the total number of SHS installations will be more than 2 million. In this situation, there is a huge demand for solar energy technicians to gear up the expansion of SHSs. The ever-growing renewable energy industry is expected to provide jobs for at least 100,000 persons by 2014, according to expert estimates.

The rural electrification board introduced a solar energy programme in the rural areas in 1993. Grameen Shakti is a rural renewable energy company, which started operations in 1996 with a view to supplying solar electricity in the rural areas through SHS. Its workforce has grown so rapidly that Grameen Shakti is exporting this workforce to the Middle East and Africa.

Between 2005 and 2008, with technical support from the United States Agency for International Development Bangladesh, Grameen Shakti trained more than 1,000 women technicians to install and maintain SHSs, at 20 green technology centres. The women also learned to assemble crucial components of the SHSs. This programme has trained 10,000 students, 5,000 women users of SHS, and 300 engineers/technicians.²⁵

²² Climate Leadership Group, 2010.

²³ Ibid.

²⁴ Based on Sharif, 2009.

²⁵ USAID Bangladesh, 2008.

Case study 5. Mechanical engineers and CNG conversion technicians

Compressed Natural Gas (CNG) technology contributes to greening the economy. It is one of the most viable alternatives to traditional fuel energy for the automotive industry. CNG is economical, low in pollutants, high in calorific value and heat yield, and available in abundance in Bangladesh. CNG is considered an ideal environmentally friendly fuel, causing minimum pollution and GHG effect compared to other conventional vehicular fuels.

The CNG sector needs occupations such as workshop managers, field officers, supervisors and technicians. According to the Secretary General of the Bangladesh CNG Filling Station and Conversion Workshop Owners Association, the CNG sector currently employs 10,000 people with an investment of Tk.20,000 million. In the near future, employment in the CNG sector will increase to 16,000 because another Tk.12,000 million investment is in the pipeline.

The current demand for CNG conversion technicians is high and the number of CNG technicians is growing. Between 1983 and 2000, only one conversion centre was in operation and only 1,379 vehicles were run on CNG. By 2008–9, the number of authorized CNG conversion centres had increased to 138 and the total number of CNG vehicles had reached 166,672. According to the Bangladesh Road Transport Authority, the total number of vehicles (both CNG and non-CNG) at present is 1,054,057 with a growth rate of 51 per cent. These statistics indicate high potential for CNG conversion workshops as well as for employment of CNG technicians and other staff. However, currently there is no formal institution for training CNG technicians in Bangladesh, and the majority of training is carried out by suppliers of foreign equipment.

Case study 6. Architects, civil engineers, designers and masons in greening Buildings

To promote green jobs in the construction sector, the DOE introduced the Green Building initiative in 2008. A National Workshop on Eco-housing/Green Building was jointly organized by the DOE, Ministry of Environment and Forests, the Housing and Building Research Institute and UNEP – Regional Resource Centre in Asia and the Pacific. This national workshop has set a green skills development strategy for those who require retraining as a result of green structural change on the labour market due to a shift from traditional to newly emerging green building technology. The green skills development strategy for workers entails short, on-the-job, “green” training courses for existing construction workers: awareness campaigns among real estate developers, contractors and building dwellers; and forming green jobs skills development committees representing workers’ union and employers’ associations.

A contest titled “Holcim Green Built Bangladesh” organized by the cement maker Holcim Bangladesh in Dhaka in 2009 included speeches from the Finance Minister putting emphasis on the need for green construction to save resources and urging young professionals to come up with new ideas to make construction eco-friendly and sustainable. The competition stressed the importance of adequate training in green construction and aimed to encourage architects, engineers and students to strive to build a green Bangladesh.

Case study 7. Greening tanneries

Since almost all tanneries are located along rivers, most of the waste (toxic water and solid waste) is disposed of directly into the river. However, there are currently no effluent treatment plants in the tanneries, so the introduction of such plants into tannery units could play a vital role in greening the tannery process.

Greening processes do not currently feature in the tannery industry; however, the potential for greening existing jobs in this sector has been identified. According to an estimate by the Bangladesh Tanners Association, about 20,000 workers are employed in the tannery manufacturing sector, with about 2,000 people involved in the process of collecting raw hides and skins for tannery units.

The main jobs in a tannery are supervisors, machine operators and machine maintenance technicians. Most tannery workers are not trained in environmental issues and are unaware of the environmental impact of tannery production. This indicates a need for raising awareness about environmental problems related to pollution produced by tanneries, and for training workers in ways of reducing this. Employees showed a keen interest in receiving training on environmental conservation and pollution control, and were disappointed by the indifference of tannery owners to these problems.

Case study 8. Brick manufacturing: HHK technology and carbon credits – Brickfield managers

Brick making in Bangladesh is a highly energy-intensive and high carbon-emitting activity and is one of the largest sources of GHG emissions in the country. According to the Industrial and Infrastructure Development Finance Company, the brickfields in Bangladesh emit around 87.5 million tonnes of CO₂ every year, accounting for 30 per cent of the country's air pollution. Total annual brick production is about 12 billion and the industry is growing at more than 5 per cent annually. Bangladesh has begun making bricks using new technology that cuts carbon emissions by almost half and creates a scope for earning foreign currency through selling carbon credits.

The new technology is known as HHK (Hybrid Hoffman Kiln) technology, imported from China. HHK design combines a highly efficient kiln technology using wet clay and pulverized coal. The HHK uses 50 per cent less coal than regular brick kilns, and the smoke produced is trapped and used for drying raw bricks, thereby reducing GHG emissions and other air pollutants. A single kiln that runs on HHK technology will produce 15 million bricks and cut carbon emission by 5,000 tonnes in a year. The project involves a community benefit plan, providing social improvement for the employees in the brick making sector with first aid rooms, sanitary facilities and safety equipment.

The new technology is expensive – a single unit brickfield of modern technology costs about Tk.100 million (approximately USD 1.4 million)²⁶ – as opposed to Tk.10 million (approx. USD 0.14 million) required for a traditional brickfield machine. However, selling related carbon credits presents a revenue opportunity. The World Bank and Denmark will buy 189,000 and 60,000 emission reductions respectively. Such deals will pave the way for purchasing GHG emissions reductions from 20 energy-efficient HHK factories at various stages of production and construction.

The Bangladesh Brick Manufacturing Owners' Association estimates that more than 200,000 people are engaged in brick manufacturing. The main occupational categories in the brickfields are: brick field manager, cleaner (mainly female), machine operator for blending mud, brick dryer and brick burner. The skill gaps in brick making occupations primarily include brick making technologists and supply chain managers responsible for the production and marketing of bricks and overall management of the brickfield. The manager plays the key role in running the brickfield, maintaining a network with the owner, brick buyer and the labourers. There is no formal training arrangement for brickfield managers who conventionally learn the job through experience. In order to ensure greener brick making, managers need to be trained in environmental conservation, the use of green technology and the CDM process.

Conclusions

In the absence of any policy agenda and support, the delivery mechanisms of the existing institutions for developing skills for green jobs remain weak. Shortage of skills and expertise largely explains the weak delivery mechanisms of these institutions. Generally, training in skills for green jobs takes place only informally. In Bangladesh, no system or institutional responsibilities exist for identification of current and future skill needs for any kind of jobs – non-green or green – in the labour market. Companies identify their own skill requirements and provide on-the-job training for blue-collar jobs, and recruit trained people from the open market for white-collar jobs.

The existing education and training system including general schooling does not follow a strategy to “mainstream” sustainability and environment protection issues within the education and training system. However, although there is no explicit policy in place, the Government has introduced several chapters on environmental issues in pollution, adaptation and mitigation in the Grade III to Grade VIII syllabi in the general schooling system. In addition, the Government is planning to widen the base of environmental education on a higher level. The ongoing TVET

²⁶ Assume 1 USD = 70 Tk (http://coinmill.com/BDT_calculator.html#BDT=70).

Reform Project is trying to establish a training network between the public sector training institutions and the industrial employers, but there is no content on developing skills for green jobs.

The biggest institutional barrier to skills development for a transition to a green economy seems to be the lack of a clear policy agenda for developing skills for greening the economy. In addition there is a lack of awareness and engagement from various government departments, including the Department of Technical Education, the Bangladesh Technical Education Board, the Bureau of Manpower Employment and Training and, above all, the Ministry of Education and Ministry of Labour and Employment in addressing the shift to a greener economy.

Recommendations

Bangladesh's efforts to combat climate change require a combination of actions including investing in renewable energy, rewarding conservation, innovation and mitigation efforts, developing domestic and non-fossil energy sources and improving energy efficiency. Furthermore, establishing minimum green building standards and a standardized labelling scheme for appliances are programmes that have immediate results and are very cost effective. Market-based instruments such as national emissions trading schemes, renewable energy feed in tariffs and waste levies also need to be considered.

A coherent policy for the formation and development of skills for green jobs should be formulated and put in place within the overall framework for HRD. For greening the economy, the policy should target the implementation of programmes for meeting existing skills needs for green jobs (as identified by the present study). The policy should incorporate green skills into occupational profiles, curriculum design and education and training provision – both for greening existing occupations and for developing emerging and new green occupations. The policy should embody strategic interventions and adequate guidelines for overcoming critical skills gaps for green jobs. Simultaneously, feedback mechanisms between business and the education and training systems should be put in place.

Existing education and training policies have inadequate provisions for environmental education at all levels. At the primary level, environmental education should be made mandatory. Synergy among the existing policies and institutions (both public and private) for greening the economy is virtually non-existent. The existing TVET system has virtually no environment-driven curriculum and courses targeted towards establishing and improving the skill base for green jobs.

There is a growing momentum for green jobs, particularly as a component of mitigation response. The possibility of “jobless growth” (i.e. improving energy efficiency, but “losing” jobs) needs to be prevented. A green jobs development strategy that pursues a sustainable, low-carbon, low-waste economy will contribute strongly to meeting government targets for sustainable development and environment and stimulate the growth of the environmental goods and services sector.

In order to improve ongoing policies and programmes relating to greening HRD, further research and regular data collection should be undertaken with a view to updating knowledge and monitoring progress in greening the economy. To this end, there is a need for capacity building in research for greening the economy and skill development for green jobs.

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Brazil

Policy context

Key challenges and priorities for a green economy

The Inventory of Anthropogenic Emissions of 1994 illustrates that renewable energy sources represent 45.8 per cent of the total Brazilian energy supply, compared to a global average of 12 per cent, emphasizing the country's clean energy sector. The primary sectors for emitting CO₂ in 2005 were forestry and agriculture, accounting for four-fifths of CO₂ emissions.²⁷

The emissions and characteristics of energy supply sources point towards four primary environmental challenges:

- decreasing the net loss of forest area;
- implementing incentives for adoption of agro-forestry systems, no till-farming, energy efficiency, waste management and clean production measures;
- encouraging the replacement of fossil fuels by biodiesel and ethanol for countrywide transportation; and
- actively participating in the Clean Development Mechanism.

The environmental response strategy and the role of skills development

General environmental strategy

Brazil's National Plan on Climate Change was the result of national and international development and debates around climate change. The plan includes policies and programmes to mitigate and adapt to climate change, emphasizing mitigation due to its potentially significant impact on green jobs. Seven objectives are identified:

- **To encourage the economic sectors to efficiently improve their performance through the continuous search and implementation of best practices:** focus upon government action to support economic sectors and consequently decrease CO₂ emissions per GDP and improve the competitiveness of Brazilian products. This includes:
 - the Brazilian Program for the Development of GHG Inventories–GHG Protocol;
 - a national Policy for Solid Waste Management; and
 - a national Plan for Logistics of Transportation.
- **To maintain a high level of participation of renewable energy sources in the total energy supply in Brazil, preserving the country's position in the international rankings:** although Brazil benefits from a clean energy sector, the growing demand for electricity threatens this.
 - The National Energy Policy Plan seeks to mitigate the impact of increased electricity consumption through promotion of energy efficiency, a plan based upon strategies to expand the generation, transmission and distribution of hydroelectric and alternative energy sources.

²⁷ Ministry of Science and Technology, 2009.

- The Incentive for Alternative Sources of Energy Program established a new strategy for the integration of alternative energy sources through contracting 144 power plants in 19 states via Elektrobrás, a major Brazilian power utility company, in 2005. The programme created 3,299 MW of installed power capacity through wind farms, small hydroelectric plants and biomass power stations. By 2009, 150,000 jobs had been created nationwide.
- **To foster the sustainable use of biofuels for transportation and to build an international market for sustainable biofuels:** Brazilian biofuels (including ethanol and biodiesel) generate income for rural areas, with their usage displacing fossil fuels that impact on climate and air quality.
 - The National Alcohol Program (PROALCOOL) began in 1975 and is the largest global programme targeting the replacement of fossil fuels with renewable energy. By 2007, the domestic production of ethanol reached 22 billion litres, up one-fifth from the previous year. Some 3.5 billion litres of this was exported. Since the inception of the programme, the use of pure ethanol and ethanol blended with gasoline for transportation has contributed to the avoidance of 800 million tonnes of CO₂ being emitted.
- **To support the sustainable reduction of deforestation levels in its four-year period average in all Brazilian biomes, until zero illegal deforestation is attained:** there are a number of programmes in place to reduce deforestation levels including:
 - an Action Plan for the prevention and control of deforestation in the Amazon, which seeks to monitor and control deforestation, promote sustainable production activities and establish partnerships amongst government bodies, non-governmental organizations and the private sector. Its primary objective is to reduce deforestation by 40 per cent between 2006 and 2010 and 30 per cent more in each of the subsequent two four-year periods, thereby avoiding emissions of 4.8 billion tonnes of CO₂ between 2006 and 2017.
- **To eliminate net loss of the Brazilian forest cover by 2015:** to double the area of planted forests from 5.5 million to 11 million hectares in 2020 and eliminate net loss. Forest carbon sequestration is of vital importance to reduce emissions:
 - The National Forestry Plan is organized in two parts:

The first relates to the economic use of forests and involves activity to create and implement agencies for the conservation and sustainable use of forests, restore degraded areas, provide incentives for reforestation and agroforestry practices, and support local and indigenous populations and the production, processing and marketing of forest products.

The second includes actions related to laws and regulation, including updates of the Forest Code to support forest monitoring and control, support the national forest information system and expand the forest management through investment in human resources, training and education and science and technology.
 - The National Qualifications Plan, Agroextractivism Program, was launched to support the development of vocational training in agroextractivism to local communities threatened by the impacts on the environment that have been generated by the construction of the North–South railway. A total of 2,532 people will benefit from the programme, primarily agricultural workers of indigenous origin, the self-employed, the unemployed and minority groups.

- **To strengthen intersectoral actions to reduce the vulnerability of populations:** focus is being put on identifying those who are not yet ready to face the consequences of climate change and to promote actions which will reinforce their resilience. A series of actions have been emphasized, including incentives to undertake studies and research to enhance the level of knowledge of climate change impacts on human health, strengthening environmental sanitation measures, strengthening communication and environmental education actions, identifying threats, vulnerabilities and resources, stimulating and increasing the technical capacity of the National Health System professionals and creating an information and indicators panel to monitor weather events and their impact on public health.
- **To identify the environmental impacts from climate change and foster R&D to support strategies to minimize the socio-economic costs of the country's adaptation to climate change:** implies actions to increase the production of scientific knowledge related to climate change. The Ministry of Science and Technology's Action Plan (2007–10) is geared towards the definition of initiatives, actions and programmes to enable science, technology and innovation to play a more decisive role in the country's sustainable development including R&D, innovation and energy from other sources.

Green response to the current economic crisis

The response to the economic crisis included credit expansion, increased government spending as well as waiving taxes to increase demand and production. Direct measures targeted the construction sector, including the programme “My House, My Life”, created by the Provisional Measure No. 459 in March 2009. The programme is a partnership with local government and the private sector, facilitating the construction of 1 million homes for those on low-income to boost the economy through the creation of jobs and thus societal benefits.

As part of the programme, a number of measures are being implemented relating to green skills:

- **construction quality assurance** to increase the quality of construction companies, suppliers, building systems and components through training, quality management technologies/processes/products and conformity assessment;
- **use of prefabricated construction systems** to promote investments in alternative materials of low cost, fast delivery, low environmental impact and improved construction quality. It also provides funding to upgrade and expand existing prefabricated houses, and for developing prefabricated construction systems, technical training and machinery and equipment acquisition; and,
- **environmental licences** to decrease the time needed to provide environmental licences for projects up to 100 hectares to 30 days, to preserve environmental areas under permanent protection, to locate projects away from hazardous areas and to commit to investment in water infrastructure and sewage.

As part of construction quality measures, the Ministry of Environment and a Federal Bank is facilitating the use of solar panels in projects for low-income families which will increase demand for solar panel installation workers. It has been estimated that, between 2009 and 2010, 7,000 solar panel installers and 800 project managers will be required.²⁸

²⁸ ABRAVA. Geração de empregos verdes no setor de aquecimento solar.

The skills development strategy in response to greening

Since 1999, Brazil has had a National Policy for Environmental Education, which filters changes in environmental policy and labour market demands into the educational system. In 2003, the Ministries of Environment and Education ran the national Program for Environmental Education.

Climate change is a subject tackled by schools through the National Conference on Environment for Youth (CNIJMA), leading to study-related topics in the curriculum. For the second CNIJMA in 2005/06, climate change was chosen as a focal topic. Over 940,000 students, teachers and school communities debated the subject across almost 3,000 districts. A Letter of Responsibilities was handed to the President and Ministers of Education and Environment, listing the regional actions necessary to address climate change. In 2008/09, the third conference was held discussing research into options for global environmental change and the Plan on Educational Development, to discuss improvements in the quality of teaching–learning processes and solutions which could help keep students at school.

Brazil's vocational education system is responsive to labour market demand and dedicates attention to the environmental sector. The main actors in this process are the Ministries of Environment and Education:

- Environmental education is seen as a set of processes which build social values, knowledge/skills, attitudes and skills aimed at environmental conservation which are essential to the country's quality of life and sustainability. It is an essential and permanent part of the national education system and must be present at all educational levels, both formally and non-formally. Educational actions established by the Ministry of Environment include:
 - COLECIONA (2008), a collection of specialized information on environmental education and educational communications available on the website of the Department of Environmental Education;
 - a National Strategy for Environmental Communication and Education aiming to broaden social participation in public policies relating to protected areas and environmental education;
 - the Green Room Project supporting the development of interactive spaces for information, education, training and environmental action within educational institutions, including funding of environmental publications; and
 - training programmes for County Managers which elaborate orientation manuals to the municipalities and offer support on the methodology required to study greenhouse gas emissions and elaborate on a plan of action related to climate change.
- The Ministry of Education establishes guidelines for general and formal education through the General Coordination for Environmental Education, part of its Department for Continuing Education, Literacy and Diversity. It is proposing to implement sustainable educational programmes in retrofitted schools and university buildings, integrate them into teachers' training and to introduce climate change to the curriculum. Environmental education in elementary schools rose from 72 per cent to 95 per cent between 2001 and 2004;²⁹ this included projects, special subjects and the introduction of environmental education as a subject in its own right. Formal education guidelines and a number of programmes are coordinated by the committee for the National Environmental Educational Policy, including:

²⁹ A. Veiga, E. Amorim and M. Blanco, 2006.

- the CONPET Schools Program, which develops projects in schools to promote rational use of energy to create a generation aware of natural resources;
- the PROCEL Schools Program, aimed at primary and secondary level and at universities (and benefiting 18 million students between 1995 and 2006). The programme focused on the “Nature of Landscape – Energy” for lower educational levels and “Energy Conservation” as a discipline for those at university; and
- a National Strategy for Communication and Environmental Education aiming to increase social participation in public policies related to environmental education.
- Actions related to vocational education include:
 - a National Environmental Policy targeted at all education levels to incentivize participation in environmental protection and ensure that ecology is a mandatory subject. It also supports the implementation of sustainable educational spaces in retrofitted buildings and inclusion of climate change in the curriculum;
 - a National Forest Policy supporting development of forest management research projects and studies and training resources for environmental-related occupations;
 - a National Water Resources Plan which focuses training to meet demands including those from the National Council for Water Resources, including the promotion of training for occupations in water resources management and training to traditional and indigenous communities in water resources conservation;
 - a National Policy on Solid Waste which supports training for occupations in waste management such as “agents for the environmental management of urban solid waste” as well as providing support to ensure the continuity of public services related to urban cleaning; and
 - the Brazilian Space Agency Program in Schools, which aims to provoke school children’s interest in science and technology and develop future vocations.
- Technical and vocational educational training is offered publically and privately in Brazil. The environmental sector qualifications are distributed across vocational education institutes; private vocational institutes include the National Industrial Training Service (SENAI), the National Commercial Training Service (SENAC) and the National Transportation Training Service (SENAT). The private vocational educational institutions have developed management actions ensuring the continuous monitoring of labour market demands and demands from technological changes.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

Brazil is in transition from a “carbon” economy to a “low-carbon” economy, with the focus of green economic activities being on the use of end-of-pipe technology and cleaner technologies. However, the European Commission has highlighted that it is likely the continued ability of end-of-pipe technologies to reduce carbon emissions has reached a plateau and that its contribution

to reduction of emissions is likely to decline by the end of the decade.³⁰ Investments are necessary to generate and make cleaner technologies available or invest in preventive technologies to prevent environmental damage rather than rectify damage caused. To make the changes required, changes in the institutional framework are necessary to regulate and support economic activity. The redesigning of education policies and integration with environment policy is also necessary.³¹

Identifying the impacts that environmental legislation causes is inherent for labour market analysis and to identify the skills that will be required. Some industrial activities have substantial opportunities for mitigation, due to the large amount of greenhouse gases they emit. The National Plan on Climate Change states that opportunities are apparent in the following sectors:

- energy: through improving the efficiency of supply and distribution of energy, replacing carbon-intensive fuels with lower carbon and capturing and storing carbon;
- transport: through the use of efficient vehicles and railway systems;
- construction: through use of efficient appliances and solar power and adoption of an integrated planning system allowing efficiencies of energy use; and
- industry: through use of efficient equipment, adoption of recycling practices, and capture and storage of carbon.

It is likely that the greatest impact of end-of-pipe and cleaner technology implementation will be on low and medium level skills, with occupations directly linked to production highly affected. Impacts on higher-skilled professions and middle level technicians will also be noticed, with the incorporation of green qualifications within their job profiles.

Skills response

The training responses to the greening of the economy vary. Primarily, the tendency is for companies to identify business needs alongside the training institutions to develop programmes to retrain employees rather than employ new staff.

It is possible to foresee a growth in groups of occupations related to green economic activities, depending on government investment, with educational activity developing to create skills sets amongst the young which embody the skills required by future industry. However, some retraining is likely to be required following the movement of workers to more green economic activities. It is likely that some occupations created as a result of green economic activity growth will be filled by displaced workers following the dissemination of cleaner technologies, with priority given to those with similar mobility or skills sets to be retrained to augment their skills to meet the requirements of the new tasks.

Changing and emerging occupations and related skill needs

New and emerging occupations

Long-term, green economic activities are likely to converge from technologies such as nanotechnology and biotechnology, with a belief that many occupations will be transformed or disappear.

³⁰ C. Hewett and J. Foley, 2000.

³¹ R. Kemp and L. Soete, 1992.

The recycling industry in Brazil is exhibiting high growth levels as a result of the environmental legislation and is organized nationally and internationally as an economic activity. Primarily, the processes required within the sector are low-skilled such as garbage collection, or more complex occupations such as recycling specialists and designers of recycling vehicles. The best outlook for growth of recycling as an economic activity lies in the automotive industry and in end-of-life vehicles, where there is a useful range and quantity of material. Whilst the sector has been consolidated globally due to external pressures from legislation and social responsibility, quality is still poor and therefore a new chain based on reverse logistics needs to be realized. The skills profile for the automotive industry requires continuous innovation to produce cleaner processes and materials and, consequently, the “eco-conceived vehicle designer” can be seen as a new green occupation with growth potential in the labour market.

Greening established occupations

Environmental legislation is the primary driver of both direct and indirect impacts on occupations and skills in Brazil, with direct impacts such as legislation pointing directly to occupations that require vocational educational training processes and indirect impacts through adoption of end-of-pipe and cleaner technologies in some activities, which creates new occupations and skills.

Some activities have a greater potential for mitigation, such as the implementation of programmes to expand houses built with solar panels within the building industry. The use of solar heating has also been emphasized in discussions over low-income housing. Such technologies are reinforced by the “My House, My Life” programme which includes energy efficiency and rational use of water within its remit, which is likely to lead to an intense period of job creation in the manufacturing, installation and maintenance of solar panels and heating, which will demand vocational education training for new workers and the development of new skills for a set of occupations already in existence in the building sector.

Skills response

The need for skills is divided two-fold: those required as a result of environmental legislation and those which are a consequence of the demand perceived by training institutions.

The provision of skills related to environmental legislation which work to prepare professionals to work in environmental control and monitoring are supported by the Human Resources National Development and Training Centre, linked to the Brazilian Institute of the Environment and Renewable Natural Resources, and the National Support Centre for Forest Management, linked to the Brazilian Forest Service.

The skills supply for sustainable forest management activities is vital to the sustainability of the Amazon and reducing deforestation and the creation of conditions for sustainable use of forest resources. This supply is coordinated by the National Centre for Support to Forest Management and aimed at strengthening forest management through actions which support and enhance the training of local leaders, public administrators etc.

The skills provided by vocational education training institutions such as SENAI, SENAC and other similar institutions depend upon the mechanisms used by institutions to identify those needs. At times, these educational institutions are called to participate in certain activities such as the Replacement and Promotion of Access to Efficient Refrigerators Program, aiming to replace 10 million obsolete refrigerators over the next ten years. The programme stems from the formation of refrigeration mechanics that removes pipes of chlorofluorocarbon (CFC) gas.

Furthermore, another 29 occupational groups belonging to “green economic activities” provide scope for growth over the next five years, leading to retraining or training to satisfy the skills required by the economy.

Anticipation and monitoring of skill needs

The anticipation and monitoring of skill needs is primarily undertaken by vocational training institutions, looking at the labour market and changes to regulation. For example, SENAI has developed a Foresight Model to identify changes in the profiles of industrial workers over ten years; those identified so far will cause the displacement of workers from their duties – namely production workers who will need to be retrained (including those working in shoemaking and foundry activities). Further retraining will be required due to the mechanization of processes and the spread of robotic systems to reduce waste and speed up processes.

The National Plan on Climate Change defined economic activities which were most likely to take advantage of opportunities to mitigate their environmental impact, which were reemphasized in the McKinsey report (2008). Based on such sectoral analysis, industries can be focused upon to estimate where skills will be required and which sectors require emphasis in terms of training provision to re-skill or train human capital.

Summaries of case studies

Case study 1. Sugar cane cutters

Changes to the law have indirectly led to changes in the sugar cane labour market, as formerly manual work has been replaced by mechanized processes of planting and harvesting sugar cane, as a consequence of the law prohibiting sugar cane burning by 2014, leading to a need for many rural workers to migrate to different activities.

The Sugar Cane Manufacturers Organization has created a programme to retrain sugar cane workers, including sugar cane drivers, harvester-operator electricians and tractor mechanics, in beekeeping and reforestation. Whilst the increase expected in ethanol production will require increased amounts of sugar cane being produced, restructuring of the labour force has been predominantly brought about by advances in mechanization.

A sugar cane processing plant director contacted SENAI to develop a training programme to assist with their need for qualified professionals to work within the increasingly mechanized process of sugar cane production, given the difficulties in finding highly skilled labour; particularly the operation of tractors, trucks and vehicle maintenance and to a lesser extent extraction and vessel operators. The company chooses to promote job opportunities internally to staff prior to looking for external resources, offering opportunities for the staff to retrain and upskill to work in the mechanized processes.

Case study 2. Shoe finishing workers

Technological development in the footwear sector has reflected growth of environmental requirements, with the addition of cleaner technologies both as part of the process through recycling and waste treatment, and on the final products, such as using cleaner inputs in footwear. The largest impact is on the shoe finishing phase of the process, with displacement through unemployment.

Companies are involved in the Ecoshoe Project to make the manufacturing process and materials environmentally friendly and ensure standards are adhered to. The project was funded by the Brazilian Research Support Agency with technology developed through three companies. The company interviewed had introduced computer-aided design to reduce waste as well as use of water-based adhesives and thermo-transfer in the bonding phases. Whilst no employee lost their job through the introduction of technologies, the company offers training and workers are permitted to relocate, with a focus being placed on employees who can undertake a number of tasks.

Case study 3. New-green-collar occupations

Designer of an eco-conception vehicle

The engineering of eco-friendly vehicles is a highly skilled job requiring a variety of knowledge developed on the basis of material engineering. Whilst the Brazilian educational system possesses excellent teachers, doctorate and post-doctorate degrees and pure research, it does not provide the industry with the skills required for applied research to develop and fuel innovative activity. The gap is likely to be filled once regulation and legislation around eco-vehicles is made more concrete and a desire for eco products within the consumer market has developed.

Recycling specialist in waste paper trading

There is no formal training for the role as a recycling specialist, but the job requires education in the environment and marketing knowledge, as well as skills in identifying the quality of waste as to its worth. Material is received by the company and classified manually to separate waste most efficiently, a knowledge which comes with practice and experience. Those who sort the waste are proficient in materials separation and nimbleness, as well as having received training on technology of paper and the recyclable fibres industry. It is vital that such specialists have an up-to-date knowledge of recycling and in-depth knowledge of the quality of materials in order to maximize the value of waste.

Case study 4. Environmental protection professionals

At least three of the seven objectives of the National Plan on Climate Change will impact on the environmental protection professional. The current “denomination” of the position is an environment analyst, who is responsible for regulation, control, inspection, licensing, environmental auditing, management, protection and environment quality control to comply with national environment policy.

Primarily, this role is undertaken by those who are forest and environmental engineers (90 per cent), with the remainder made up of biologists and geographers. In the past, such advisers had little schooling and had no formal preparation for the position’s duties; instead knowledge resulted from practice. Today, those who enter the sector are educated at the National Centre of Development and Empowerment of Human Resources, linked to the Brazilian Institute of Environment and Renewable Natural Resources.

Case study 5. Solar panel installers

Courses which teach Solar Heating Systems Installation have been running schools for vocational training since 1998. The installation and use of equipment has become more prevalent since legislation, which states that 30 per cent of consumed energy in each household has to be from an alternative source as well as there being a general increase in awareness, technological advancement and reductions in the cost of equipment.

Installers require skills in hydraulics, knowledge of how to use auxiliary support systems and skills in soldering, as well as knowing issues of safety due to the location in which many panels are installed. The skills set is becoming increasingly important as legislation and targets become more progressive and the technology is installed as an increasingly common aspect of building development.

Case study 6. Refrigeration mechanics

The National Plan for Suppression of CFC has established a system of regeneration of CFCs through recollection, recycling, regeneration and reuse. This sees a requirement for new skills for refrigeration mechanics through vocational education training. Furthermore, a government initiative includes regulations which will support manufacturers of white goods to invest more in products that consume low energy and use no CFCs.

Conclusions

Environmental legislation, government mechanisms which value natural resources, consumer pressures and international agreements are driving forward the adoption of cleaner technologies. The transition of Brazil towards a low-carbon economy is mainly driven by environmental legislation at international and national levels. Brazil's legislative structures are largely developed to implement the transition towards a low-carbon economy, with mechanisms in place to mitigate major emissions through use of lands and forests and laws and programmes presiding over other economic sectors.

Environmental legislation leads to direct and indirect effects on the demand for green occupations and skills. Directly, occupations are related to control and inspection to ensure that laws are adhered to, as well as indirectly, through companies changing procedures and adopting new technologies to meet legislative requirements and subsequent changes to occupations and skills.

The study has not acquired sufficient evidence to indicate an imbalance between supply and demand for green jobs in Brazil. However, to overcome any imbalances that exist between the supply and demand for qualifications, vocational training institutions implement long-term parameters to anticipate demands over ten-year periods in labour markets. The demand for green occupations is increasing and it is anticipated that this is at all skills levels.

There are a variety of actions taking place at the Government and private sector level to formulate plans and programmes in the environmental area; however, there is a need to strengthen the exchange of knowledge that takes place to maximize results and optimize resources.

Recommendations

Environmental legislation

- Create a mechanism for monitoring national and international environmental legislation to identify economic activities which provide the greatest opportunity for mitigation, technologies and procedures that can be easily adopted by firms and impacts on occupations resulting from the diffusion for technology.
- Follow up trends in the application of the Clean Development Mechanism and the Reduction of Emissions by the Deforestation and Degradation Mechanism.

New estimates for green jobs

- Undertake more in-depth studies to understand how skills will be modified, by an analysis of technological impacts and procedures introduced through production processes.
- Identify end-of-pipe and cleaner technologies that could spread in the economic activities with the greatest mitigation opportunity and then develop strategies to facilitate the diffusion of these technologies. Anticipate the impact technologies will have on the need for skills within existing and new job profiles to ensure training processes are put into practice.
- Discuss the definition of green economic activity to accelerate the transition process as well as specific skills/qualifications relating to activity.

Qualifications supply

- Prioritize occupations that satisfy core competencies of activity that are likely to grow more to accelerate transition to a low-carbon economy.
- Amplify the offer of engineers, technicians, installers etc. by focusing on their work, which can impact on the environment due to the potential for mitigation activity.
- Expand the skills offered at professional training institutes through attracting and retaining professional teachers targeting the environment.
- Set up a training strategy for designers of eco-conception vehicles and recycling specialist occupations.
- Look to existing workers to fill jobs generated by growth of green economic activity due to the similarity in sets of knowledge and abilities, which could be augmented.

Reducing imbalance between the skills supply and demand

- Map out the green skills offered and regularly update the skills offered within Brazil.
- Identify the impact that prospective studies may create and create alert mechanisms for professional training institutes.

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China

Policy context

Key challenges and priorities for a green economy

China is currently the world's second biggest emitter of greenhouse gases, behind only the United States, with emissions primarily produced by burning fossil fuels. China is anticipated to overtake the United States in the near future to become the biggest emitter globally. China has seen a surge in steel output in recent years, but lags behind other major producers in terms of energy efficiency, carbon emissions and waste production. Current industries need to be analysed to identify opportunities for greening as a priority, including not just non-wood pulp and paper production but also new industries such as alternative energy.

The shift towards a greener economy in China will require workers to develop new green skills, requiring an adjustment to skills development strategies and training programmes. A major part of the challenge will need to be realized in the vocational training sector, which provides training to 80 per cent of occupations. University qualifications provide only part of the solution, as much of the work in green enterprise and industry is expected to be undertaken by non-university educated workers. Vocational training will therefore be critical in creating a labour force which can meet immediate business needs and provide pathways to higher level qualifications in green jobs.

Green occupations are a new concept in China and therefore few professional qualifications have been adopted. China needs to ensure that green jobs offer adequate wages and opportunities to workers, as some nominally environmental roles such as electronics recycling are characterized by poor practices and exposure to hazardous substances. There is an inherent need for more extensive research and data collection to anticipate the future skills demands of the labour market and for existing mechanisms which anticipate skills needs to be strengthened.

The environmental response strategy and the role of skills development

General environmental strategy

There are over 300 pieces of environmental legislation affecting Chinese businesses, primarily under the overarching objective of promoting sustainable development but which have positive impacts on climate change, including environmental protection and energy conservation. The pursuit of sustainable development is primarily consistent with climate protection. The Chinese State Council has voluntarily announced that China is going to reduce the intensity of CO₂ emissions per unit of GDP by 40–45 per cent of 2005 levels by 2020.

The Clean Development Mechanism Fund provides technical assistance to ministries and local government; it is also increasing public awareness of climate change and developing policy through research with government agencies.

In 2007, China established the National Leading Group to Address Climate Change which aims to:

- cut energy consumption per GDP by 20 per cent between 2005 and 2010;
- increase the use of renewable energy to 10 per cent of total energy consumption by 2010; and
- increase forest cover to 20 per cent by 2010.

China's energy efficiency has been increasing, with energy consumption reducing by almost 50 per cent between 1990 and 2005 per unit of GDP. The current target is for China to generate energy from coal with "near-zero" GHG emissions within the next decade. There are estimated to be several hundred years' worth of coal resources, which will continue to be used for energy security reasons. To facilitate national and international low-carbon development and help China reduce its energy intensity, the World Wildlife Fund has helped develop a Low Carbon City Initiative which is to be introduced over the next five years.

Green response to the current economic crisis

The economic crisis led to sharp reductions in industrial production in China. The resulting stimulus package from the Chinese Government included investment in measures towards a green economy. In November 2008, USD 51 billion was designated to biological conservation and environmental protection as part of a wider package of investment (of USD 585 bn); the Ministry of Environment Protection announced that the finance was to be spent on renewable energy and pollution-controlled industries. During the recovery, the Government focused on energy efficiency, expanding mass transit/freight rail, constructing a smart electrical grid transmission system, wind power, solar power and biofuels. The primary focus was on public infrastructure, public building retrofitting and public transportation due to the possibility for quick delivery.

It is hoped that the fiscal expansion, if properly executed, can frontload spending to launch a green energy economic development programme based on renewable energy and energy efficiency proposals. The boost in spending would be financed as part of the transition to a low-carbon economy through a balance of public and private spending.

It is hoped that investment in the green economy will provide employment opportunities across a breadth of occupations (such as roofers, accountants, welders, scientists), whilst strengthening career ladders and allowing workers to move from low-paying to higher-paying green jobs across all regions of China, as well as reducing the number of unemployed. Whilst not all areas of the country are equally capable of benefiting from technologies, for example solar and wind power, they are all able to make investments to improve energy efficiency through retrofitting buildings and transportation.

The skills development strategy in response to greening

Chinese vocational education and training (VET) is delivered at three levels: junior secondary, senior secondary and tertiary. The VET system provides most of the skilled workers required by the green jobs sector.

Approximately 50 per cent of secondary school students attend vocational and technical schools, which aim to equip graduates with practical job skills, whilst the remaining half of graduates attending general secondary schools gain skills for general employment and further education. VET secondary schools provide opportunities for enrolment on shorter courses in addition to full-time courses of between two and four years in length, providing service training and specialist pre-employment training.

VET training is provided by the Ministry of Education through technical schools, vocational schools and technical colleges for pre-service training, whilst the Ministry of Human Resources and Social Security oversees skilled workers schools providing training at secondary level. Whilst technical schools are largely engineering trade schools related to technical bureaux, secondary vocational schools are financed by local education bureaux, with graduates finding employment

in the emerging labour market. Whilst the assignment of graduates from technical schools and skilled workers schools to state-owned enterprise employment is being abolished, those graduates who are sponsored by state-owned enterprises and local governments are committed to employment under terms of agreement between schools and either the enterprise or government. Increasingly, however, graduates find employment independently.

Vocational training is seen as possessing a critical role in supporting China's transition to a carbon-neutral economy, particularly given that 80 per cent of occupations are covered by vocational training and are competency-based, as well as delivered and audited against national standards. It is also realized that the majority of changes to daily operational practice required in the move to the low-carbon economy will be undertaken by those who are not university educated. Emerging training in sustainability needs to include full qualifications and more targeted skills sets to meet business needs, as well as providing pathways into full or higher level qualifications. Skills should be included in vocational qualifications at a range of levels in both long-term and stand-alone courses undertaken before employment or as part of professional development. National training packages provide an ideal framework to integrate sustainability skills and knowledge into a practical vocational framework which is specific to sectors and occupations. As the term "green occupation" is a new concept, there are no green jobs standards in China, although the China Enterprises Foundation, alongside industry, recognize that a new model for training packages including environmental considerations in every unit of competency is a necessity.

China has rapidly moved towards the development of renewable energy sources, producing 16 per cent of electricity from renewable sources in 2006. Researchers have estimated that China could meet all its electricity demands from wind power by 2030. Following a boom in low-carbon enterprises, the need for green skills is huge but there is no specific training in place for green jobs, and there are still no national initiatives for training curricula in green occupations despite a realization by the Government of a need for green skills.

China's main challenges relating to skills are threefold:

- greening of existing jobs to meet the current demand for retrofitting and re-tooling of industry, particularly in sectors with a high environmental impact such as construction, energy, transport and agriculture;
- training new workers in appropriate skills to meet the demand for employees with the right skills set in renewable industries and new green technologies; and
- anticipating the future demand for green skills in emerging industries, as current approaches to green skills are grossly inadequate, with no systematic data collection.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

Greening of the labour force will be felt most in the energy-intensive industries. In the coal and cement industries, unemployment is already visible as plants downsize, although hopefully this will be counterbalanced by growth in the forestry, wind power, solar power and recycling sectors, and the retraining of workers in downsizing sectors to help them become re-employed.

Declining industries are likely to lead to a loss of a significant number of jobs in the move to a low-carbon economy, including for example the closure of small coal-fired power plants,

which is anticipated to affect over 600,000 workers between 2003 and 2020.³² Furthermore, the very labour-intensive cement industry is likely to lead to job losses of around 584,000 between 2005 and 2020, depending upon the intensity of closure. As China moves towards a green economy, such industries which have been historically sources of employment for millions will become obsolete, requiring vocational training and skill upgrading of workers.

The development of low-carbon industries including the desulphurization industry, however, is likely to create over 1 million jobs between 2005 and 2020. The state sustainability strategy has identified six areas for future green investment including:

- building retrofitting (electricians, heating/air conditioning, construction equipment operators, insulation workers);
- mass transit/freight rail (civil/electrical engineers, welders, metal fabricators, locomotive engineers);
- smart grid (computer software engineers, electrical engineers, technicians, machinists, team assemblers);
- wind power (environmental engineers, steel and iron workers, millwrights, machinists, industrial production managers);
- solar power (electrical engineers, electricians, industrial machinery, welders, metal fabricators); and
- advance biofuels (chemical engineers, chemists, chemical equipment operators, agricultural workers, agricultural/forestry supervisors and inspectors).

Skills response

China has reported skills shortages and gaps, requiring adaptations to training new workers and retraining efforts for those who want to make the transition from older, polluting industries to new ones.³³ The existence of the right skills is a prerequisite to ensuring that the transition to a greener economy happens. There are currently skills gaps in a number of sectors including renewable energy, energy and resource efficiency, building renovation, construction environmental services and manufacturing.³⁴

The skills response to restructuring needs to be undertaken by a variety of actors; government, business, trade unions, individuals and NGOs and businesses should work with government to ensure that appropriate skills responses exist that enable them to minimize their ecological footprint and comply with state/national legislation.

For companies characterized by low-carbon emissions, business commitment to changing practices needs to be developed through education to achieve incremental change in business operations, as sustainability is currently a low priority. The skills response to green jobs needs to look further than exclusive reliance on legislation and base level compliance and to look to enable innovative practices to be promoted. This, however, requires the Government to emphasize

³² IUE/CASS, 2010.

³³ UNEP, ILO, IOE and ITUC, 2008.

³⁴ MOHRSS, 2009.

best practice and provide strong incentives, particularly if centrally funded training is not available, so that behavioural change takes place.

In response to changing skill requirements, the educational system has been transformed to prepare workers for new occupations, and schools have added courses in practical subjects to the curriculum. Whilst there is a role for classroom modes of delivery, these are less likely to appeal to employers due to the loss of productive staff time on-the-job. Consequently flexible learning delivery models, including online, workbook or CD-ROM based resources, will play a critical role in supporting greater business uptake.

Changing and emerging occupations and related skill needs

New and emerging occupations

The impact of green jobs in terms of employment is significant in new industries, in particular wind, solar PV, solar thermal and biomass. China employed over 50 per cent of the estimated employment in the renewable energy sector in 2006. This is particularly due to the employment of approximately 600,000 in the solar thermal energy sector with an estimated 624,000 being employed globally in the sector.³⁵ The China Solar PV report from 2007 projects that 100,000 people will be employed in the sector in 2020 and possibly 5 million by 2050.

The development of wind power in China has been significant with growth of over 100 per cent in 2006 alone and 120,000 employed in the industry in 2008. Green-collar occupations in industries such as renewable energy and clean energy have high potential for job creation.

Greening established occupations

To create a greener economy, a number of occupations can also be “greened”, including the automotive, construction and recycling industries.

- The auto-industry employs 1.6 million in China. A concerted international fuel-efficiency strategy is required to create large numbers of greener jobs through energy targets, mechanisms for technology diffusion and incentives for consumers to purchase the cleanest models.³⁶
- Through retrofitting and energy efficiency measures, green skills are required in the construction industry. Over the next 20 years, 300 million Chinese are projected to move into urban areas requiring two billion sqm of new construction per year and requiring growth in the building sector of 7 per cent per annum. Energy-efficient measures related to construction lead to direct, indirect and induced jobs.
- Through greening the recycling industry, technology and skills would need to be upgraded, providing better work opportunities for workers. It is estimated that 70 per cent of global e-waste (or waste electrical and electronic equipment) is received by China, undertaken by smaller firms and families. In Giuyu alone, 60,000 workers dismantle over 1.5 million tonnes of electrical waste annually, providing around 90 per cent of the local fiscal income.

³⁵ NB: for countries where data was available, as illustrated in UNEP, ILO, IOE and ITUC, 2008.

³⁶ UNEP, ILO, IOE and ITUC, 2008.

Skills response

The Ministry of Human Resources and Social Security and the Ministry of Education have begun to address the need for VET to accommodate green skills and knowledge through the development of:

- a basic training system for green job skills: developing green jobs by all means, and establishing standards for skills for green jobs, qualifications for workers and training for trainers on green job skills;
- entrepreneurship training on green job skills: including green skills in business start-up training, encouraging the set-up of green enterprises, and adding the green enterprise skills category into the entrepreneurship training offer;
- infrastructure improvements for training for green job skills: establishing courses and training for green skills, and producing textbooks and related guidance and publicity on skills for green jobs; and
- support systems: including subsidies for workers participating in training for green jobs, and micro credits and taxation breaks for those involved in green entrepreneurship training.

Anticipation and monitoring of skill needs

The Chinese Government have used surveys to identify future skills demands as well as using quantitative projections of employment based on econometric models. Looking forward, the public employment service could identify skill needs in the labour market as the system is country-wide and could provide the opportunity to match supply and demand in the labour market through provision of services to employers and jobseekers. Currently, however, the public employment service is providing jobseekers with guidance and placements which can assist workers in meeting skills and training needs also providing training and retraining to jobseekers. The system could play a pivotal role in detecting and addressing skills shifts and demands through information it already collates.

Summary of case studies

Case study 1. Low carbon cities

Chinese cities are characterized by heavily polluting energy consumption, low energy efficiency and growing CO₂ emissions. This has led to a need for a clear vision for urban functions being set, in light of the potential that cities can play for environmental sustainability. The city aims to contribute to the national target of a 20 per cent reduction in energy density through decoupling economic development and rising CO₂ emissions, and promotion of the positive effects of clean, sustainable technologies.

City government is best placed to promote best practice on regulation and policy, low emission technologies and business expansion, and raising awareness amongst the general public. In addition, integrated public transport systems, green building technologies and clean production technologies will be promoted. Some cities have already begun low-carbon development including Baoding, Beijing and Shanghai. Baoding has become a solar energy demonstration city in China, establishing an industrial park of wind and solar technology and releasing a low-carbon urban construction paper hoping to develop low-carbon living and behavioural characteristics. Furthermore, it has a low-carbon development plan, with promotion of low-carbon into city planning and industrial park construction.

In setting up low-carbon cities, it is hoped governments can guide enterprises towards developing green industry, improving resource energy efficiency and achieving environmental protection and economic growth.

Case study 2. Forester

A forester inspects forests, takes measures to prevent forest fires and protects the resources that the forest provides. Such activity has helped China to achieve 54 million hectares of man-made forest with 35.1 per cent green coverage in urban areas. The minimum educational level required is junior middle school qualifications, with the syllabus determined by the vocational schools in which students are taught. At the primary level, 120 hours of training are required, with a further 100 hours for middle level and 80 hours to achieve the advanced level.

Many areas have embraced training programmes for foresters and many foresters have been retrained from their roles as lumberjacks. It is estimated that, in 2010, there are 2.5 million foresters, with training promoted by vocational or technician schools and supported by local forestry bureaux of local governments.

Case study 3. China's energy industry

The energy sectors in China have significant amounts of training activity, with some national standards in place, such as workers in solar energy or small wind power generation. Many advanced technologies remain too expensive for China as it continues to develop; however, China is working hard to achieve breakthroughs in R&D on energy development, energy conservation and clean energy technology to speed up the pace of commercialization of advanced technologies and enhance the technological capacity of the agricultural, water conservation and forestry sectors. Ageing production facilities in 13 industries are being phased out in the latest Five-Year Plan period to 2012, with heavily polluting plants in papermaking, chemicals, printing and dyeing ordered to close down. The expansion of energy-intensive industries is gradually being slowed down.

China is determined to accelerate the development of wind power, biomass energy development and utilization, nuclear power, carbon capture and storage and clean coal utilization. As part of developments, training includes topics relating to: energy planning; project design and management; system design; specification and purchasing of components installation services; maintenance services; business skills for renewable energy implementation; and finance of renewable energy systems.

Case study 4. Small wind power worker

The micro wind power worker installs, adjusts, operates, manages and maintains micro wind power, of less than 10KW per turbine, and can be employed at five levels: Primary (NQL5), Middle (NQL4), Advanced (NQL3), Technician (NQL2) or Advanced technician (NQL1). They possess abilities of observation, understanding, judgement and expression, and could potentially have computer skills and map reading skills.

Trainees are taught basic knowledge of wind power generation, knowledge of reading and drawing graphics, basic theories, safety and relevant laws and regulation.

Although it is a new occupation, trainees are expected to increase dramatically in number as government support for clean energy increases. Approximately 120,000 small wind power workers were employed in China at the end of 2008, with 200 workers passing an examination and receiving certificates that year. The number of technical workers with certificates is likely to increase following improvements to the clean energy strategy.

Case study 5. Solarteur

A solarteur installs, constructs, adjusts, maintains and manages solar and PV equipment. The occupation has five levels including: Primary (NQL5), Middle (NQL4), Advanced (NQL3), Technician (NQL2) or Advanced technician (NQL1). They possess abilities of observation, understanding, judgement and expression, and could potentially have computer skills and map reading skills.

Trainees are taught basic knowledge on utilization of solar energy, reading and grading graphics, basic knowledge on theories, safety knowledge and laws and regulations.

It is estimated that 2 million solarteurs were employed in China at the end of 2008, which is expected to rise in number following the advancement of new technology. In 2008 trainees gained a new qualification in being a solarteur, with providers of education mainly being vocational and technical schools and colleges.

Case study 6. Recycling occupations

Recycling is a global industry, and China is the largest importer of the world's waste materials to relieve China's problem of resource shortage. Many rural migrants are reliant upon the network of reclaiming waste that exists in China. The training of garbage collectors is mainly undertaken by garbage companies with initiative standards for rubbish classification, recyclables and unrecyclables, with other companies training workers in the identification of useful materials. Training often takes around one week.

In China, laws and regulations relating to the recycling industry are insufficient and therefore people and enterprises are doubtful as to the development of the industry. Resource recycling technologies lag behind other countries due to insufficient emphasis and investment. Therefore, there is a large gap between the reality and requirements regarding the integrated utilization of resources and environmental protection.

Furthermore, 4.9 million employees in the reuse element of the recycling industry are informal (98 per cent of the total) and primarily working as individuals or as part of small companies. There is no national standard for an occupation in recycling, but the Government is expected to establish a job profile shortly. Training programmes that currently exist are inadequate and only cover part of the garbage collector's role in garbage classification.

Case study 7. Jobs in wastewater treatment

Whilst the Chinese wastewater treatment industry is growing rapidly, it is still at the primary development stage. For example, although the volume of wastewater treatment is increasing year by year, the industry capacity is not able to keep up with the rapid expansion of water use, nor can the development of the infrastructure required (pipe network, sludge treatment) keep up. China needs to improve the policies and regulations of wastewater treatment, establish a supervision system, create a rational wastewater treatment charge system, support the development of the domestic environmental protection industry and promote the industrialization of wastewater treatment. During the 11th Five-Year Plan period, 300 billion Yuan is being invested in promoting the wastewater industry, which should promote the sector's rapid development.

Another issue in China is the lack of sewage treatment plants. China has one sewage treatment plant per 1.5 million urban and suburban dwellers, in comparison with one per 10,000 in the United States. The Government have set targets for the sewage treatment rate to be over 60 per cent in all urban areas by 2010, resulting in a need for a comprehensive construction effort. Some 10,000 new treatment plants are required to achieve just a 50 per cent treatment rate at current discharge rates.

Case study 8. Biogas jobs in rural areas

By the end of 2010, 40 million households will be using biogas digesters according to the National Rural Biogas Construction Plan, with 4,700 biogas plants built on husbandry farms. However, this plan highlights the shortages in skills and expertise possessed in the Chinese economy:

- Biogas technicians require a qualification to construct and maintain digesters. The number of existing certified technicians would not be able to meet the demand for digesters set out in the National Plan; therefore poor quality digesters with a short life expectancy are expected.
- The significant contributions made by rural biogas technology have not yet been recognized. Biogas projects increase farmers' income, improving their living standards, whilst social and environmental benefits are external.
- The majority of poor farmers and small farms cannot afford to build a digester due to financial issues.

Investment in biogas has increased dramatically, with annual investment of over 1 billion Yuan since 2003 and over 2.5 million in 2007, with financial support accelerating biogas development. In order to meet the shortage of technical capacity for biogas digesters, 40 training courses were held and, by 2005, 4,000 people had gained their National Biogas Professional Technician Certificate, illustrating the proactive support for job creation through adaptation and mitigation measures.

Case study 9. Car manufacturing – Occupations to become greener

The National Commission of Reform and Development has publicized its support for new energy vehicles, launching a pilot programme in 13 cities to subsidise the use of new energy cars in the public transport system. China is set to become the largest producer of environmentally friendly cars in ten years through the Government's backing and the desire of car manufacturers to push electric vehicles. The aim is for an annual production of 500,000 units per annum by the end of 2011.

Skills for these car-related jobs are in strong demand, with a need for an upgrade in skills relating to battery technology and support infrastructure before electric vehicles can progress. As well as creating a world-leading industry, China hopes to reduce urban pollution and decrease its dependence on oil. Due to the greening of car manufacturers, training is booming. The car producer BYD (build your dreams), for example, has 300,000 employees and 5,000 auto-engineers in China with its own technical schools in each location, with additional relationships with local vocational schools and universities. Annually, one-third of employees receive training for new technologies, plus pre-employment training takes place for new employees. This latter training takes place over one month and involves understanding company regulations, basic knowledge about work safety and mechanical principles. After joining the company, new workers will have an additional 3–6 months' training. For those who enter the electric car manufacturing process, an additional 3 months' retraining is required to gain new skills. The vocational schools within the company provide most training, with some key employees and engineers sent to university for further training.

Case study 10. Agricultural technical instructor

Whilst the agricultural technical instructor is an existing occupation, the role is becoming increasingly green through use of green technologies. Biological pesticides are likely to replace chemical pesticides over time, and the bio-pesticide industry will therefore have the opportunity for expansion and a booming sector for greening jobs. The adjustment of policies on the structure of the national pesticide industry will be pivotal in influencing the future labour market trends.

As of 2008, there were 300,000 agricultural technical instructors. Each year, 75,000 trainees receive training on new agricultural technologies, including bio-pesticide use and other environment-friendly methods. However, the number of qualified technicians is still inadequate, with only 31,500 qualified instructors. It is likely that the number of qualified instructors will increase significantly with support provided by government and business.

Conclusions

Greening shifts in labour markets

China is planning a significant increase in its use of wind and solar power over the next decade. The belief is that its economic recovery programme and fiscal measures will lead to more efficient use of resources and an increased demand for renewable energy, as enterprises show an increased enthusiasm for clean energy generation. The renewed focus on green energies requires green skills for both new occupations and the retraining of existing occupations towards more green objectives.

Green jobs require new skills among workers, and China will need to focus training on environmental management and protection skills in eco-friendly technologies, including those which support renewable energy sectors, energy efficiency and recycling. This will require:

- surveys of employees and employers on green skills;
- quantitative projections of employment based upon appropriate econometric models; and
- foresight qualitative analysis of green skills.

Skills implications

To ensure continued economic growth, individual and business behaviour needs to change. Skills gaps and shortages exist in all sectors: both generic skills which relate to green jobs in all sectors and those specific to individual jobs. Whilst some training is taking place, it is not on the scale required to ensure that gaps are filled and that targets for renewable energy are realized.

- China needs to ensure that its energy policy is efficient and that the targets set are achievable and sustainable. The shape of its investment in policy will determine energy use patterns and carbon emissions.
- Worker skills need to be upgraded at vocational, technical and managerial levels to reduce GHG emissions and ensure that the transition to low-carbon economies is achieved.
- For new technologies to be developed China needs to ensure that high-level skills for research and development in new technologies, technical skills related to installation, operation and maintenance and the core skills required to support the implementation of reforms and changes are being provided.

Supportive policies will promote green development and strengthen the institutions and governance systems which nurture enterprise. Furthermore, human, financial and natural resources will need to be combined to achieve innovation in green technologies efficiently, which will require cooperation between government, business, labour and society more generally.

Coordination with ministries and agencies involved in policy design and implementation is required to ensure that national education and skills development can equip workers with skills required by emerging green industries and jobs, and national capabilities are built to manage the transition between declining and growing sectors and occupations. Without measures in place, skills gaps will remain and there will be high individual and social adjustment costs, with further missed opportunities through loss of productivity and employment growth.

Recommendations

Policy recommendations

- China needs to promote social dialogue and partnership to enable life-long learning through the State, social partners, individuals and other stakeholders.
- Strong coordination amongst employers will lead to knowledge and trust being built up over time;
- Strong employer associations and industry-level bargaining may reduce poaching of skills and help the diffusion of best practice to ensure the skills requirements for green jobs are met.
- Trade associations should be independent and represent the interests of workers through putting pressure on employers to invest more in training.
- The Chinese State should have a more active role in vocational training issues.
- Further coordination of occupational qualification certification with the preparatory training system will enable national qualification standards for all green-collar occupations. This is necessary for the establishment of the labour market and a smooth flow of skilled workers.

- Levels of investment in VET training should be increased for all people, linked to low-carbon economic and employment growth strategies.
- Targeted education programmes should seek to ensure equal training opportunities for groups sometimes “missed out”, including young people, women and people with disabilities.

Education and training

- Training should match the needs of the labour market and be defined through skill sets and units of competency.
- The use of new technologies, new manufacturing processes and new modes of work for the green economy have led to skill intensification of the national economy and an increase in the demand for skills. The most significant shortage is in skilled labour at management and technician levels, felt most acutely by those operating in international markets. The education and training system is still geared mostly towards traditional industries and is struggling to keep up.
- Training systems need to be more flexible in the courses they offer. There is potential for links to be created and enhanced between enterprise and education to deliver knowledge which is more grounded through workplace-based skills. The training system needs to be more rapid in its response to green skills.
- Business uptake of training should be supported through marketing of the economic and business benefits, innovative case studies and good practice solutions.

Further research and data collection

- Further research should focus on the national qualification standards for green jobs and skills, and data on relevant green jobs (including number of employees, skill level and future needs) should be collected.

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Costa Rica

Policy context

Key challenges and priorities for a green economy

Costa Rica has been a pioneer in the production and use of clean energy, with the Costa Rican Energy Institute shifting to hydropower in the 1950s, later adding eolic and geothermal energy. Costa Rica is therefore less reliant upon fossil fuels than many of its neighbours. However, despite this, Costa Rica has continued to see a growth in its CO₂ emissions, with the industrial sector seeing growth in CO₂ emissions of 75 per cent between 1997 and 2006³⁷ and an increase in transportation of 315 per cent across the same period. There is a need for some of Costa Rica's sectors therefore to be greened. Currently, Costa Rica utilizes fossil fuels for its transportation energy needs, worsened by the heavy dependence on private vehicles.

Costa Rica faces a challenge to define its short to long term goals and to promote the population's active participation through dialogue and implementing plans. There is also an active campaign to green public administration throughout Costa Rica. The greening of human capacity development is deemed to be one of the most important challenges to ensuring that the adequate training and skills structure is in place for jobs and careers in a green economy to be created. Knowledge transfer to different members of society through education channels is necessary for changes in attitude and behaviour to take place and to enable greater awareness of issues to provide politicians, legislators, the private sector and consumers tools to develop a green economy.

The environmental response strategy and the role of skills development

General environmental strategy

The protection of the environment has been a priority for the Costa Rican Government for decades due to the social importance of the country's resources and a need to utilize resources in a way which promotes sustainable development.

Preservation of wildlife dates to 1945 when the first National Park was designated: an area known as Robledales along the Inter-American Highway. In 1955, the land around all volcano craters in the country became designated National Parks. In 1969, a Forestry Law established the Department of National Parks, creating national parks, biological reserves, protected zones, wildlife refuges and one national monument. In 1977, the National Parks Service was created to strengthen the establishment of protected wildlife areas and, in 1988, the National Parks Service was placed under the Ministry of Natural Resources, Energy and Mines (MINETREM). Areas of Conservation were created to facilitate the management of wildlife areas and to protect biodiversity and therefore integrate protected wildlife areas into a national system of regional units.

By 1995, Law 7554 on the Environment united the Forestry Department, Wildlife Department and National Parks Systems and also converted MINETREM into the Ministry of Environment and Energy (MINAE) which later incorporated Telecommunications and was known as MINAET. In 1998 the Biodiversity Law established the current National System of Conservation Areas (SINAC).

³⁷ OLADE, 2007.

MINAET oversees a number of systems in addition to SINAC, including the following:

- The Department of Environmental Quality Management, created in 2002 to implement/design tools to define strategy and public policy in the area of environmental quality, focuses on the protection, mitigation and reversal of degradation of water, air and soil.
- The National Environmental Technical Secretariat oversees, studies, analyses, monitors and evaluates the environmental impact studies of productive activities.
- The Environmental Administrative Tribunal, created by the Environment Law No. 7554 and Executive Decree No. 25084-MINAE, ensures compliance with legislation.
- The National Commission for the Management of Biodiversity, created in 1998, consolidates a national technical authority to dictate conservation policies, sustainable use of resources and the restoration of biodiversity.
- The National Climate Change Strategy seeks to respond to the global issue of climate change nationally through active participation from public and private sectors with five points of action: (1) mitigation; (2) vulnerability and adaptation; (3) metrics; (4) capacity development and technology transfer; and (5) education and awareness.
- The Peace with Nature Initiative is an initiative of President Oscar Arias to confront degradation and help the coordination, implementation and follow-through of intervention processes in environmental and sustainable development issues, including:
 - measures to make Costa Rica a carbon neutral country by 2021;
 - the development and execution of Environmental Management Plans in all government bodies;
 - the promotion of increased forestry cover and the protected areas system; and
 - the inclusion of Environmental Education for Sustainable Development in the public education curriculum.

The “C-Neutral” seal was established to differentiate Costa Rica’s production of goods and services through a certification system in order to contribute and strengthen competitiveness, demonstrating a commitment to the environment.

The stimulation of renewable energy use is seen as of importance. Sixty-six per cent of the energy consumed is from imported petrol, with 75 per cent of hydrocarbons use being for the transportation of people or merchandise. Forty-four per cent of fuel consumed in Costa Rica is diesel, with gasoline representing 33 per cent;³⁸ the remainder is used by large companies and industries to generate electricity. The National Strategy for De-Carbonization of the Economy is promoted by the national government to reduce the dependency on fossil fuels and promote the electrification of land transport, modernization of transport for people and goods, and the use of multimodal transport and energy-efficient policy for industry and general consumption. This includes use of biofuels through sugar cane and palm oil surplus and the development of incentives to plant producers who do not compete with food cultivation, as well as providing new agricultural zones which have previously been unable to support thriving agricultural products, thereby improving social and economic circumstances.

³⁸ Energy Sector Unit – MINAET.

A second wave of biofuel production is being developed by the Government, entrepreneurs and research centres to develop biomass materials, including algae and pineapple waste, derived from wastage from agro-industrial processes. As part of the national strategy, the Government will implement a national campaign on efficient energy management, modify fuel taxes and double the tax on imported luxury vehicles which use diesel. A tax-break on more fuel-efficient or hybrid/electric vehicles and limits on imported vehicles over 5 years old are also being promoted.

Green response to the current economic crisis

The Protection Plan was announced in January 2009 in response to the international crisis, focusing on social protection and economic stimulus; however, there were no specific “greening components” within the stimulus package.

The skills development strategy in response to greening

A number of laws explicitly incorporate environmental education into all levels of schooling in Costa Rica, including the Organic Environmental Act and the Biodiversity Act. One of the five core pillars of the Regional Climate Change Strategy relates to education, through creating individual awareness and developing public sensitization to enhance the understanding and knowledge of nature and the impact of climate change on all elements of society, including the role each part of society must play in mitigating, adapting and reducing vulnerabilities.

Focus on education is also included in the:

- Regional Agro-Environmental and Health Strategy 2009–24;
- Central American Sustainable Energy Strategy 2020;
- Central American Water Management Strategy 2010–20 and its Action Plan 2010–12;
- Central American Environmental Plan 2010–14;
- Regional Integrated Risk Management Strategy;
- Multi-Year SICA 2010–12 Program.

The Organic Environmental Act (No. 7554) encourages the inclusion of environmental issues in formal and informal education, to lead to a more environmentally aware culture and sustainable development. The National Climate Change Strategy proposes citizen involvement in climate change decision-making and implementation through instruction and public sensitization. The strategy also promotes the need for specific environmental university curricula and corporate social responsibility (CSR) programmes at varying levels.

A Strategic Framework for Environmental Education was developed in 2004 by the Public Education Ministry (2004) for Costa Rica’s first and second basic education and focused on:

- *Institutional Environmental Management*: involving decision-makers and those implementing decisions made in the design of institutional management practices;
- *Teacher Education*: development of training and continuous education and updates of teaching staff through experts from major universities;
- *Environmental Education Projects*: taking action at school level with civil society players to develop environmental education projects and strengthen the value of the environment within individuals; and

- *Sustainable Development Culture*: fostering and promoting environmental action through education.

A number of technical, professional and college-level education programmes in public and private universities were developed following the Earth Summit in Rio, including environmental management and impact evaluation, protected area management, sustainable local development, waste management, water, coast and basin management, tourism, legislation etc. Of Costa Rica's 130 universities and vocational schools, only 25 offer educational programmes relating to natural resource management; however, these institutions offer a total of 166 educational programmes between them. Courses are in higher and graduate education, with few technical or independent courses.

Whilst education is a core element of the Regional Climate Change Strategy, the National Climate Change Strategy only provides general principles to be considered at the educational level, with emphasis on the country's infrastructure and experience over the past few decades in protecting and taking advantage of the sustainable use of natural resources. No statement regarding specific educational requirements for every level of the country is made, nor how educational requirements are to be met. Environmental topics are included as key aspects in a range of basic education curricula, including the sciences, geography, history and civic education.

Only a small number of vocational schools or programmes relate to the environment, but at the university and technical college level, a variety of such courses and degrees are offered. Government-owned universities are coordinated by the Inter-University Environmental Education Commission, which works to incorporate the environment into university activities and to enhance the incorporation of environmental education and the environment more generally into government-owned universities. Private education is regulated by the National Higher-Education Council but there is no initiative similar to the Inter-University Environmental Education Commission to promote the integration of environmental issues into university curricula. There is no information system collating information on the labour market related to natural resource management but some statistical data is collected on graduates in the field of natural resources.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

The environmental approach has been promoted by private initiatives, supported and led by active regulation. In the 1960s, changes in the economic structure and national agricultural policy accelerated the process of deforestation, with the largest impact visible in the mid-1980s through a 41 per cent loss of forests.³⁹ The decline was particularly prevalent due to population increase, expansion of agriculture and incentives for cattle ranching for beef exports, which led to contamination of the water supply due to use of pesticides. The expansion of livestock up to 1986 was stopped due to a decline in meat prices and advances in forestry programmes and conservation of natural resources. In the 1990s, there were a number of changes which impacted on the country's green economic history. This led to an intense participation of the environmental NGO sector in

³⁹ Estado de la Nación (XV report) presents the results of the nation's forest cover changes at provincial and national levels. Losses nationwide were 35,000 ha/year between 1960 and 1979 and 39,000 ha/year between 1979 and 1986. Recovery rates were 17,000 ha/year for the period 1986–2000 and 26,000 ha/year for 2000–05.

the productive use of natural resources, waste and pollution; support to government institutions through consultancy; and resource technicians, with a positive impact upon the labour market. In the private sector the beginnings of a market for “green products” are visible, with an increasing appreciation of the differences between conventional and green products.

Whilst “greening” has negatively impacted upon some sectors, others have seen its potential, including the energy, construction, manufacturing, transportation, agriculture and forestry sectors. Careers with the greatest potential for green jobs include administration in recycling, energy conservation, agribusiness, architecture and construction, eco-banking (related to green projects), biotechnology, educators (to prepare people for green jobs), energy, food technologies, forestry, product design, technology, tourism, waste management, transportation and health with environmental specialization. Given the variety of jobs, green issues must be included at all levels of the education system and, more specifically, universities must take charge of the specialization of professionals.

Educational indicators do not currently take account of the quality of education or deficiencies within the labour market and instead focus upon coverage and material requirements. The National Training Institute identifies the needs of the economic sectors, which include the design and delivery of training programmes, establishing teaching enterprises and offering technical assistance regarding training to institutions and companies.

Education policies are developed by government under the Ministry of Public Education. The Board of Higher Education authorizes curricula and teaching programmes for different levels and types of education which vary according to the conditions and needs of Costa Rica. Whilst the ministry’s focus is on the learning and progress of science according to labour market needs, the National Training Institute takes “action” as the most important part of retraining. Universities also identify training needs, particularly CONARE, which coordinates the country’s public university high education and the Superior Education Planning Office.

A lack of institutional capacity and insufficient skills for decision-making in the environmental sector have been associated with deficiencies in the implementation of policy and strategy to improve the degradation of natural resources. Other visible signs of an apparent need for retraining include:

- institutions focusing training on current themes without forward thinking, or multidisciplinary response;
- lack of awareness of the responsibility of professionals;
- a reduced number of institutions with short-term thinking; and
- a lack of outreach between universities and professionals.

For some companies it has already been necessary to hire new staff and to position themselves in the green market, whilst others have retrained employees to implement their new, greener programmes.

Skills response

Public education is free and compulsory in Costa Rica. The majority of private schools are bilingual and offer programmes such as Advanced Level and International Baccalaureate. Schools and colleges with international certification can also be found. Costa Rica has sufficient educational institutions, but the education system requires more structure and changes to teaching methodologies.

Competence in the English language has been identified as a critical skill for general and green jobs, including within tourism, export, banking and telecommunications. A multilingual programme was launched in 2008 by the Ministry of Public Education, the National Training Institute, CONARE, CINDA and the National Competitiveness Program of the Ministry of Foreign Trade, to improve English proficiency, heighten personal development and provide better education opportunities. Other organizations have also recognized the role they can play in strengthening the skills demanded by green changes, including:

- the Chamber of Industries of Costa Rica: providing training courses and training for industry;
- the Venture Program of the Government of Costa Rica: to facilitate the enrolment of students in education through scholarships which reward students' performances, which may increase the number of those remaining in the formal education system, allowing training in new skills for green jobs; and
- the National Training Institute: to offer more tailored Call Centre and Plan Operators courses in Environmental Management.

Changing and emerging occupations and related skill needs

New and emerging occupations

New green-collar occupations continue to emerge in the labour market in sectors historically involved in environmental issues and new areas. This has led to both new employment opportunities in manufacturing, construction and transportation as well as creating and expanding opportunities in traditional environmental areas such as agriculture, energy and environmental management.

Many new green positions are filled by those who have received conventional training, but due to skills needs of new positions can transfer their current skills and acquire new ones to carry out the job functions. Occupations include Natural Resources Manager, Corporate Social Responsibility Manager, Environmental Consultant, Energy Efficiency Consultant etc.

New green-collar jobs cut across industries, companies and geographies. However, due to the cluster of industries in the Greater Metropolitan Area, there could be a concentration of positions. Academia is one of the sectors in which positions are being developed, particularly in tertiary institutions to address natural resource management, climate change and energy efficiency issues, in addition to R&D and curriculum development required to meet current and projected needs in society. Many of the existing wind farms and areas scouted for further wind farm development are in a rural part of north-west Costa Rica, with eco-tourism activities situated throughout the country due to the country's extensive forestry cover and other natural features.

Whilst many of the new innovations are currently made outside of Costa Rica (e.g. solar panels), Costa Rica is increasingly making advances in technology and innovation. Costa Rica is ranked 55 out of 133 countries globally in 2009, compared to 59 in 2008,⁴⁰ with improvements due to high rankings in R&D, alliances between universities and the private sector and availability of professionals in the country. Although there is potential for innovation in the renewable energy sector, the Government monopoly on energy production has limited the scope and reach of independent power producers who wish to pursue opportunities for clean energy production. There is scope for the Government to lead development in clean technologies in the transportation sector.

⁴⁰ WEF, 2009.

Those with extensive training in the sciences, geography, engineering, communications, information technology, education and the services were considered to have the skills required for new green-collar occupations. The fundamental skills for greening of the economy already exist, but a deeper knowledge of issues, processes and innovations is required, which will need a more coherent skills approach from academic and training institutions.

Greening established occupations

Existing occupations in Costa Rica are becoming greener as the economic climate demands a change towards greener products and services, and therefore jobseekers are taking previous knowledge and applying it to existing or newly created green job opportunities. The demand for socially and environmentally responsible products from Europe and America has also driven industries to augment their practices. Costa Rican consumers are becoming more conscientious.

Skills which seem to be in particular demand include the understanding and calculation of carbon footprints, energy efficiency measures, natural resource management, project financing and feasibility and fluency in a foreign language, with both blue- and white-collar jobs involved in the change. Blue-collar manual labour in construction and maintenance, for example, are as instrumental and necessary as those jobs deemed white-collar. Education is necessary at all levels, for example through environmental issues at primary level, with development of skills and career paths to green existing occupations or new jobs encouraged in secondary and tertiary education. However, these skills also need to be multidisciplinary so that synergies can be created.

Skills response

Education and training responses to identified skills needs are continually being developed by different actors but are ad hoc due to a lack of documentation of current and future training needs. Academic institutions have responded through creating new courses and training programmes. Training is also being developed by different companies and business associations to respond to skills needs and changing occupational standards. There are also opportunities for TVET, continual VET, on-the-job training programmes and external training programmes supported by companies and ministries to meet skills needs.

There is no organized coordination mechanism between academia and the public and private sectors to respond to the skills needs for becoming carbon neutral or creating a green economy. However, the inclusion of environmental education in basic education has created a foundation for a skills response. Universities, including INCAE, have explored different ways to provide students with transferrable skills in industry, business administration and natural resource management. Furthermore the National Training Institute has responded to the skills need by working with the Ministry of Health and other companies to create and design new courses to respond to the organizational need, including courses for Recycling Centre Operators and incorporation of environmental management into all courses.

Continual VET provides training to adults active in the labour market, which focuses on strengthening and developing vocational skills and competencies. Different certification programmes exist which prepare people in the public and private sectors to meet environmental management and sustainable development standards including ISO 9001 and ISO 14001.

The Peace with Nature Initiative Teacher Education Project began in 2007, seeking to retrain all teachers at primary and secondary level regarding environmental issues in waste management, recycling, water management, energy and other issues. The overarching objective is to

provide teachers with hands-on knowledge regarding climate change which can be integrated into teaching. Whilst there are a number of academic initiatives in existence, a comprehensive system between economic sectors and academia looking into the skills need of Costa Rica does not exist. Such a system would enable the evaluation of effectiveness of the available national-level education to ascertain whether it would meet the country's skills needs.

Anticipation and monitoring of skill needs

Due to the incipient nature of green jobs in Costa Rica, new occupations and skill requirements are identified in an ad hoc manner in response to needs as they are identified.

Efforts to identify skill needs are not restricted to individual companies, and increasingly business associations (including the Chamber of Industries of Costa Rica) are identifying the implications of climate change and sustainable development for its members. For example, the Chamber of Industries of Costa Rica carries out training and capacity building for members in response to identified needs and, in 2009, conducted a study on the Industrial Strategy for Climate Change in which it makes several recommendations for education and technology transfer for its members, where training and education needs for members were identified. Other initiatives inadvertently identify skill needs through examination of policy and best practice, including through alliances and workshops.

Summaries of case studies

Case study 1. Steps towards carbon neutrality

Costa Rica is one of the four leading countries with the aim of being carbon neutral by 2021. Carbon neutrality goals have inspired a number of companies in the transportation sector to act in a more environmental manner. Purdy Motors, distributors of Toyota in Costa Rica, analysed the varying options for implementing environmental changes in their company following government goals and those of the company to position themselves as "green leaders". An expert consulting group was hired to measure the financial impact and potential market in offering customers the opportunity to neutralize emissions.

Whilst green jobs have not been officially introduced in the company, environmental awareness is a core value of part of their CSR policy. The company believes government and educational institutions should encourage people to increase their awareness and knowledge on green topics regardless of their profession. The Toyota Prius is the only vehicle which uses Hybrid Synergy Drive, and as part of the car's introduction, a small group of people were trained by experts from the company's Japanese HQ, in sales and parts, to provide assistance to customers.

The Eastern Operating Consortium SA provides services on six routes in eastern San Jose, with a corporate goal to become the first carbon neutral company in the Costa Rican transport sector. Since 2006, they have implemented biodiesel for 30 per cent of their units as well as owning farms dedicated to conservation, reforestation and cultivation of timber to offset their CO₂ emissions.

The Eastern Operating Consortium SA hired an environmental services technician holding a BA degree in Environmental Services to lead programmes to reduce emissions and solid waste, prevent risks associated with hazardous waste storage and water efficiency, implement strategies for cleaner production and pollution prevention, ensure employees are trained in environmental performance and communicate the company's environmental policy to customers, suppliers and the public more widely. The Operations General Manager's role is to run the biodiesel programme which seeks to convert all their vehicles to 100 per cent biodiesel use; the manager requires skills in engineering and mechanics to respond to changes in technology and communication skills to participate in meetings held by the National Biofuels Commission. The company offers training in waste management, energy savings and "healthy habits" to enhance environmental programmes, leading to a reduction in their operation costs and additional income from recycling.

The Costa Rican labour market offers well-trained personnel to respond to carbon neutrality, with both companies hiring employees who have a strong knowledge of green topics. Existing personnel were also provided training to achieve and promote other sustainability-oriented goals including the promotion of energy use and waste management.

Case study 2. PRUGAM and the environmental sustainability of Costa Rica's Greater Metropolitan Area

Financing for the *Plan Regional Urbano de la Gran Area Metropolitana* (PRUGAM) was secured in 2003, following an agreement between Costa Rica's Government and the European Union. PRUGAM's aim was to improve the urban system of the main economic region of Costa Rica (Central Valley) through the reduction of environmental, social and environmental costs which were the result of an irrational and unsustainable land use model.

The Greater Metropolitan Area is home to 57 per cent of the country's population, but represents only 4 per cent of the national land mass. It is responsible for 70 per cent of national GDP. The most important outputs of the plan thus far have been:

- a regional urban park covering 1,760sqm which seeks to functionally integrate the territories;
- design, update and approval of 31 county master plans; and
- execution of demonstrative works and motivation programmes to municipal officials and establishment of the Greater Metropolitan Area information service including digital mapping.

To achieve goals, PRUGAM requires a multidisciplinary team possessing skills in: architecture, urban design, geography, GIS, sociology, administration, hydrology, civil engineering, housing, road infrastructure and public transportation. Training and experience amassed by PRUGAM workers allow the creation of tools which are applied and transferred to those working in the municipalities through training; however, most municipalities do not have a multidisciplinary team, leading to skills gaps related to planning. However, the qualified personnel required to integrate PRUGAM teams into the municipalities are available; professionals take further courses to complement their skills and, in some cases, public universities offer consultative services.

Formal education in public and private universities and training institutions are supplying enough professionals and technicians to meet current labour needs in the area required, but more specific and complex elements of sociology, urban design and urban economy require training, often only available in countries with advanced experience. The greening of existing jobs is a fundamental element in accomplishing PRUGAM goals.

Case study 3. INCAE Business School, Coordinator for Internal Projects on Energy and Natural Resources

INCAE Business School was founded in 1964 with campuses in Nicaragua and Costa Rica. Its focus is on research and education on business administration, competitiveness and sustainable development. INCAE is a recognized leader in sustainability issues for business and has made advances in on-campus environmental management over the last four years including energy savings and efficiency, recycling, water management and engagement with studies. Due to increased awareness and concern for climate change globally, INCAE seeks to establish a leadership position regarding its GHG emissions profile.

In 2008, the university's president proposed to reduce INCAE's net GHG emissions to zero by 2012, with the creation of a specific post – Coordinator for Internal Projects on Energy and Natural Resources. The coordinator regularly carries out surveys and inventories of INCAE's campuses and possesses an MA in Industrial Engineering and knowledge of operations management, simulation, industrial administration, process design, economic engineering, environmental management, climate change as well as recycling SME operations. In addition, new skills in the management of electrical systems and equipment, calculation of carbon footprint and mechanisms for incentivizing energy savings were required. The coordinator is also undertaking a technical training programme in Energy Management Leadership, financed by the German Government as part of development cooperation between Germany and Latin America. The employee will receive training in Germany and spend four months doing technical training followed by four months as an intern at an energy services company. At the end of the course, the coordinator will apply the acquired knowledge at INCAE.

The people who work or are involved with the institution are critical to INCAE's environmental performance mission, and training programmes are therefore an important way through which sustainability can be achieved. INCAE are committed to the idea that leadership positions in private companies and public institutions will have a strong environmental component, through new positions and the transfer of existing skills sets into new roles.

Case study 4. Dole Costa Rica: Ten years of responsibility

Dole is a leading company in the agricultural sector, involved in the production and packaging of fresh fruits and export. They were the first global agricultural company to be ISO 14001 certified and have integrated management systems into their agricultural and operational practices. They also possess ISO 14001, ISO 9001, Global GAP, GMP, Rainforest Alliance and SA 8000.

Climate change policy has been part of management systems since 2007, including reduction of their carbon footprint, development of a compensation bill and lock-chain partnership on mitigation, motivated by the national desire for Costa Rican products to be differentiated in competitive markets. The first green jobs emerged ten years ago when a corporate strategy in environmental management systems was established. Whilst initially focused on environmental practices at the field level, they were later expanded to areas including occupational health, product safety and social and labour issues. Environmental management has become an integral management system with training to all staff members as well as to local families and schools located close to Dole's operations.

To properly implement management systems, training programmes on target standards are required and Dole employed 15 people to help manage the process including occupational health specialists and technicians, engineers, environmental auditors, agricultural engineers and technicians with diplomas in agriculture or environmental management. Several of the roles did not exist ten years ago and Dole has been a leader in the industry in creating new green-collar job positions. When Dole first began to implement environmental management systems, there was no formal education in place and training was limited. The education system (private and public) currently graduates professionals with, at least, a basic knowledge on sustainability and Dole have built alliances with academic institutions offering internships for students and so, generally, Costa Rica's education system provides the trained personnel required to meet new job demands.

Case study 5. Management of solid waste in Costa Rica's Greater Metropolitan Area

Costa Rican municipalities are obliged to collect, manage and dispose of solid waste in their communities. However, in rural areas where services are not provided, people throw solid waste into rivers and waste land areas, contaminating the environment and creating a health risk for surrounding populations.

Thirty per cent of Costa Rica's 4,500 tonnes of solid waste generated in residential areas each day is dumped into rivers, empty lots and public areas,⁴¹ made worse by only four landfills serving the whole country. The Greater Metropolitan Area lacks a Solid Waste Integral Management Plan and Costa Rica nationally lacks the sustainable goods production facilities which may help reduce the volume and composition of biodegradable solid waste.

The Costa Rican Solid Waste Plan is a national effort by institutions and sectors, which arose from an urgency to solve the issue of poor waste management and the wider implications it poses for the environment and society. Thirty-one strategic actions were defined, grouped into five areas of action including administrative-legal, technical, education and awareness, institution-organizational and economic.

One of the primary issues highlighted is that Costa Rica's human resources are insufficiently trained to resolve issues related to waste management. New opportunities for waste management (including new technologies) are emerging in the private sector. Due to the size and increasing importance of the national waste management sector, the Government needs to address regulation more proactively, which has led to a poor demand for environmental professionals. When regulation is developed, skilled professionals at all levels will be required.

⁴¹ Asociación Terra Nostra, 2008.

Case study 6. Precision agriculture in Costa Rica

Historically, detailed knowledge in agriculture has been difficult to acquire but, more recently, advances in technology and communications have removed barriers. Sensors and microprocessors, integrated software, mobile power sources and satellite communications allow farmers to collect significant amounts of geo-referenced data.

Precision agriculture technologies being developed can sense micro-site specific conditions in real time and automatically adjust treatments to meet each site's unique needs. Investment in training engineers and related professionals in the field of sustainable agriculture is key; currently only 10 per cent of Costa Rica's agriculture is organic. Whilst large-scale farmers and transnational companies utilize precision agriculture in Costa Rica, small and medium-sized farmers lack the capital and skills required to effectively apply the technology (which includes remote sensing, GIS and GPS). There is a need for training to be given to farmers and operators to interpret information received through high technology devices. For a professional position in precision agriculture, an employee is required to have an MSc, be an Agriculture Engineer and possess knowledge of soil science and statistics. They must also have experience of agricultural machinery and GIS, fumigation equipment and application techniques as well as business administration. However, a maximum of only five individuals are working as specialized professionals in precision agriculture in Costa Rica at present.

AGRIPRESA offer training in precision agriculture as a global concept to large-scale farmers and TNCs and have established pilot programmes to farms to demonstrate the benefits of technology in crops which include sugar cane, rice, grasses, banana, pineapple, coffee and oil palm. In 2008, EARTH University began a Precision Agriculture course due to increasing student demand, but only 55 students have completed the elective class and, due to the international background of the university, only ten have stayed within Costa Rica. Whilst precision agriculture is in its infancy in Costa Rica, it offers several tools to reduce cost, increase productivity and comply with environmental concerns. Few highly specialized professionals work in the field and only large farms are willing to take on this type of skilled worker.

Case study 7. Ramada Herradura Hotel: Becoming an environmentally sustainable operation

Hotel Herradura is aware of national and international environmental problems and the role that the private sector and public at large should play. The hotel's daily operations focus on developing an environmentally sustainable entity. As part of a restructuring process, the hotel looked to change focus and has invested in a number of green skills including:

- a Certificate in Sustainable Tourism Level 3, granted by the Ministry of Tourism due to its policy of social and energy transformation,
- the Corporate Social Responsibility Program (Award for Merit in Tourism 2009–10 of the National Chamber of Tourism); and
- the hotel's general manager has an MA in the Administration of Natural Resources with training in administration of protected areas, energy and natural resource administration, sustainable economic development, natural resource economics and contaminations, project evaluation and environmental impact and natural resource policy, legislation and planning.

The company wishes to recruit a manager to supervise CSR and sustainability issues, but there is a lack of skills in Costa Rica and the hotel has to find their own team of experts to succeed in the sustainability market. The hotel has agreements with universities for internships and professional practice, giving them access to those interested in pursuing careers in sustainability and hotel services. The Government, whilst promoting policy on sustainability initiatives, provides no policy on incentives to promote cleaner or more efficient technologies. The hotel sector demands human resources with knowledge of sustainability and has launched a web site with certified sustainable tourism products; however, for the sector of sustainable tourism to fully develop, human resources will need to change their profiles and personal skills.

Conclusions

Main greening shifts

The greening of the Costa Rican economy is unmistakably under way. The nation's efforts, whilst at the outset of their development, are targeted at renewable energy development, ecotourism and natural resources management, paving the way for more widespread efforts in other industries and sectors. International consensus of the need to act against climate change has led to national movement through policy and strategies to make the country carbon neutral by 2021, including initiatives such as Peace with Nature and the National Climate Change Strategy.

Skills implications

A patchwork of individual greening efforts is visible, but in a way which lacks a cohesive or integrated strategy. Opportunities for new green jobs and the greening of existing positions take place, but have not been specifically identified, with anticipation and identification of skills needs ad hoc and a more macro response at the national level needing to be developed. More co-ordination and involvement from the Ministries, for example, to establish a systematic information exchange across sectors regarding employment opportunities and skills gaps, needs to take place.

There is a strong history of environmental policy in Costa Rica related to sustainable development, but the response to the creation of green jobs needs to be made more concrete and ought to include the creation of a national, overseeing body to report data on greening, job creation, skills needs and progress. National indicators must also monitor and record the country's efforts. An appropriate national curriculum needs to be developed to educate across educational levels. International interest in climate change provides new opportunities to seek cooperation from international organizations and countries to streamline the process of identification and response to labour market needs.

Recommendations

There are still opportunities for the creation of policy and educational programmes to ensure Costa Rica's goals are realized.

Policy recommendations

- A National Body to oversee the creation of a green economy and to gather and report national data on job creation, skills need, training etc.
- Establish national indicators to assist the Government and other actors, to design and implement an effective strategy for society to prepare for the green economy.
- Promote international cooperation to examine best practices, benchmarks and implement adjusted strategies.
- Devise mechanisms to incentivize research, technology and innovation through reduction in government barriers and bureaucracy, providing tax breaks and encouraging green sector investment.

Education and training recommendations

- Ensure that all students understand the implications of environmental management in their chosen field to ensure that future professionals are better prepared.
- Ensure the skills response is multidisciplinary to ensure professionals have both the theoretical knowledge and technical skills to perform their job functions.
- Design and implement a comprehensive education curriculum to standardize information taught to students around the country.
- Develop more vocational programmes to target people with lower educational attainment and at the high school level ensure greening is not “elitist”.
- Create a national fund for green education to assist institutions with staff training opportunities.
- Implement a mechanism for dialogue between government, academia, the private sector and civil society regarding the greening of the economy, needs and gaps and responses.
- Develop a national programme of precision agriculture driven by governmental institutions.
- Promote technology transfer including facilitation of flow of technical knowledge to farmers and technicians to maximize use of existing technologies.
- Promote training for data collection.
- Re-define salaries to ensure there is no difference between work in the green sector compared to other sectors.

Recommendations for further research and data collection

- Conduct a comprehensive survey at the national level to identify the current level of green jobs and skills response to date.

References:

Asociación Terra Nostra, 2008: *Solid waste management law*.

Estado de la Nación, 2009: *Fifteenth report on the state of the nation on sustainable Human Development*.

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Denmark

Policy context

Key challenges and priorities for a green economy

In 2008–09, the Danish Government published several strategies which form part of an overall climate change and energy strategy. The Danish Government’s vision is that Denmark should ultimately become 100 per cent independent of fossil fuels. The overall national targets are that total gross energy consumption in Denmark should be reduced by 4 per cent by 2020 (compared to a 2006 baseline), and that renewable energy should make up 20 per cent of total gross energy consumption in 2011, and 30 per cent in 2025.

The main priorities concern energy efficiency, renewable energy and R&D support for clean technologies (cleantech), as reflected in the Government’s climate and energy policy, “The energy agreement”, from 2008 (endorsed by all but one parties in Parliament),⁴² and the long-term prioritized research agenda for public research investment, “Research2015”.⁴³

Measures to increase the renewable energy capacity focus on wind energy, biomass and biogas. Priorities and measures for energy reductions and energy efficiency focus on transport, construction and the retrofitting/renovation of existing buildings, energy technology and cleantech solutions (cleantech enterprises are a convergence of four industries: energy, transport, water and material production). Specific measures regarding the reduction of GHG emissions have also been set out for a range of industry sectors as well as for the transport and construction sectors.

The environmental response strategy and the role of skills development

General environmental strategy

The current focus on climate change and the impact on restructuring and subsequent changes in occupational profiles is to some extent a continuation of long-term policy priorities. Most sectors in Denmark have experienced a greening over the past 30 years, often driven by regulations and based on existing technologies. Recent policies to move more rapidly towards a low-carbon economy are introducing further refinements to occupations, and the emergence of novel “cleantech” technologies – a much broader notion than a green focus – is leading to technology convergence, often complemented by new business models and partnerships and driven by the market. Overall, this “re-greening” of the Danish economy (referring to the fact that the green focus in Danish energy policy is not a new phenomenon) is likely to entail the greening of existing occupations, emergence of new green occupations, and green restructuring of certain sectors.

Green employment became a key policy priority in the late 1990s with the introduction of a law in 1997 regarding a new pool for green employment (Lov om pulje til grøn beskæftigelse), which aimed to create new and permanent green jobs. From the period 1997–2001, a total of DKK 500 billion (approximately €67 billion) was allocated to stimulate employment growth of green occupations.⁴⁴ According to the official evaluation of the green employment pool, this ini-

⁴² The energy agreement, 2008.

⁴³ Research 2015 catalogue, 2009.

⁴⁴ <http://www.fm.dk/Publikationer/1997/Samfundsoekonomisk%20vurdering%20af%20groenne%20initiativer.aspx?mode=full>

tiative alone contributed significantly to the creation of new jobs, including at least 1,000 new green full-time jobs from 1997 to 2000, of which nearly 73 per cent were created in the private sector (the rest were created in organizations and public institutions). Nearly 80 per cent of the projects continued beyond the end of the financial support from the pool.⁴⁵

The Government has a strategy focus on “green growth”, i.e. efforts to mitigate the effects of climate change that go hand in hand with economic growth and job creation in green growth industries.

Green response to the current economic crisis

Denmark did not introduce a regular stimulus package similar to other EU countries; instead it introduced tax cuts and bank support packages to increase cash availability and cash flows. Thus, no measures for facilitating green restructuring resulted from the stimulus. The Government did target the construction sector, however, establishing grants for households to renovate and retrofit or purchase applications improving energy efficiency.

To stimulate the alignment of efforts to mitigate the effects of climate change with growth and innovation policies, the Government has developed a *Business Climate Strategy*.⁴⁶ The intent here is to provide the right framework conditions for Danish industry to enable proactive market behaviour and exploit market opportunities as advanced global suppliers or first movers in emerging markets.

The skills development strategy in response to greening

In Denmark, no overall skills response strategy has to date been developed as part of a coherent policy response to climate change and environmental degradation. However, individual strategies do state that the greening of the economy and/or priorities regarding climate change may or will impact future skills requirements, and the green focus in Danish energy policy is visible in different ways across the education sector, from the school curriculum through to university qualifications. The Ministry of Education has taken various initiatives to integrate climate and energy topics in the existing curriculum, from compulsory school to higher education. The aim is to ensure that the climate agenda is not only covered in a focused and coherent manner, but that it also stimulates climate-conscious behaviour and encourages more young people to pursue a career in science after compulsory education.

The long-term green focus in Danish policy is already reflected in the educational sector. Various Initial Vocational Education and Training (IVET), Continuing Vocational Education and Training (CVET) and tertiary programmes have, over the years, been adjusted to match the demand for skills and knowledge related to green technologies and aligned to the ongoing restructuring. For example, there is already a green occupational component in the outcome and competence based goals for the specific VET qualification in IVET as well as in CVET. Examples are: energy generation and the reuse of energy, waste management, construction, facility management, transportation and agriculture.

⁴⁵ <http://www.casa-analyse.dk/default.asp?Action=Details&Item=554>

⁴⁶ The Green Business Strategy.

New qualifications have been developed to comply with the increased focus on energy reduction and energy efficiency, and to exploit technologies that can be used to optimize and monitor energy consumption. A characteristic feature of these qualifications is that they are usually driven by joint demand and supply side initiatives.

The strategy “Denmark out of the crisis”, developed by the Danish Growth Council Committee and endorsed by the current government, calls for specific measures in education and training and continuing training to stimulate job creation by exploiting green technologies further.⁴⁷ It also recognizes that insufficient professional awareness of existing opportunities for energy-efficient solutions forms a barrier to increased demand. To improve this, it recommends a green component be integrated into different vocational education and training programmes and further education is needed for workforces in different trades, advisers in the building and construction sector, and employees in maritime sectors.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

Restructuring in Denmark has been a gradual and ongoing phenomenon that in industrial terms goes back at least 30 years, driven by the combination of automation, cost-relocation drivers and developments in Danish labour market policies, notably the flexicurity model. Other factors are now at play in Denmark, namely the marked drop in productivity which might accelerate job losses during the current economic crisis. There is concern that the crisis could be followed by a period of jobless growth. This would affect both the low qualified and skilled workforce remaining in Danish process industries and manufacturing jobs. Jobs in manufacturing and process industries have declined over the last decades (e.g. in metal, shipyards and food processing industries) whereas there has been an increase in service jobs, and in service intensity in production.

No major coherent initiatives have been taken as yet to analyse the labour market consequences and identify the (re)training needs in the wake of the greening of the economy and the green restructuring of industries. However, in general terms, significant job losses in traditional industries and occupations are expected in the wake of green restructuring while cleantech and energy efficiency services are new emerging green industries that are likely to see major employment creation in the coming years. Demands for energy efficiency in public buildings and transportation show the greatest business opportunities for first movers with sufficient scale to operate across borders.

Skills response

The educational system and the labour market have through the years been adjusted to adapt to the ongoing restructuring of the economy. The Danish flexicurity model and the comprehensive

⁴⁷ http://www.stm.dk/multimedia/Danmark_styrket_ud_af_krisen_resume.pdf

CVET supply and uptake have sustained the occupational changes in several phases of restructuring and will continue to play a significant role in the ongoing restructuring. The successful structural and restructuring role of CVET programmes has to do with the tripartite governance mechanisms which make them very responsive to changes in the labour market. In addition, the short duration and the adaptive character of the programmes reduce the time required for retraining to undertake a new job function. However, further revision of VET qualifications and development of new qualifications are needed to fully meet the retraining needs from restructuring and to take advantage of the opportunities arising from cleantech innovations and changes in business models which do not follow the traditional sector logic.

This country case study has found that local initiatives and partnerships between employers, sectoral organizations and local authorities are the most widespread and most effective in meeting the retraining needs arising from the closure of industrial plants. New skills provision is in this way targeted directly at the group of workers leaving employment, enabling them to re-enter the labour market, often in the cleantech or renewable energy sectors. The steel cluster in Southern Jutland is an example of a successful and gradual restructuring process that led to the steel cluster becoming a global player within the process industry value chain. Low-value, routine work has been outsourced or automated, leaving high value work in Denmark.

Changing and emerging occupations and related skill needs

New and emerging occupations

The main new or emerging green industries in Denmark are cleantech, energy efficiency services and energy generation. In the environmental technologies and services sector, new green occupations such as wind turbine operators have grown rapidly. New cross-sectoral occupations are also emerging, such as energy inspection and energy efficiency services. Many of these “emerging” occupations in cleantech are not entirely new but could be termed “hybrid”, for example agricultural meteorologists, solar installers, bio energy technicians, energy assessors, green accountants, managers in renewable energy and energy efficiency inspectors.

An interesting aspect of the new skill requirements is that some occupations are also changing due to the gradual development of new business models. Within some companies, there is a growing trend in shifting service offers as technology production and supply is increasingly off-shored. Grundfos, a major manufacturer of pumps, for example, has become increasingly service-oriented in its fundamental business to the extent that in the near future it may not even be selling pumps to some clients, offering services instead. Such changes in business models also require new cross-sectoral skills as occupational profiles blend elements of analytical, technological and service-oriented skills.

Studies have found that the existing VET qualifications represent a solid foundation for providing the competencies for these emerging occupations, although revisions to a range of outcome-based competency goals in a number of upper secondary VET programmes are still needed. Assessments have shown a need for supplementing existing qualifications for a range of green occupations; for example, an in-depth study of skill needs in cleantech identified 12 core competency fields where existing qualifications needed to be adjusted to match the need of cleantech companies: core vocational knowledge, understanding of market and user behaviour, impact of globalization, innovation, information and communication technology, production technologies, material technologies, environment and sustainability, communication, process and planning, automation and test and documentation.

Greening established occupations

Most sectors have undergone a gradual greening starting in the 1980s and 1990s and driven by strong environmental regulation. The main sectors that have been targeted for greening are:

- *energy*: the transition towards more renewable energy has resulted in significant growth in Danish exports of energy technologies, driven mainly by the Danish wind turbine industry. In 2004, Denmark accounted for a market share of 40.4 per cent of total world wind turbine production. This created significant employment opportunities while contributing to making renewable energy account for a large share of total energy consumption;
- *waste*: Denmark was the first country in Europe to introduce a ban on land-filling of waste suitable for incineration. All cities have public incineration plants, and larger cities typically have several. Jobs associated with landfills were traditionally low-skilled with no training, and the work was in no way perceived as attractive. Growing demands for energy-efficient and climate-friendly solutions have changed the occupational profile for those working at waste treatment plants and increased the attractiveness of those jobs;
- *construction*: over the past 30 years, the total building stock in Denmark has increased by nearly 40 per cent while the construction sector has been able to limit energy consumption by using climate-friendly solutions to reduce CO₂ emissions. VET competency objectives for the construction industry have been revised to strengthen these trends and adult vocational training includes a certificate targeting persons that work with construction installations or systems that optimize and monitor energy efficiency; and
- *transport*: while many sectors have succeeded in stabilizing or reducing their CO₂ emission levels, the transport sector has seen an increase in emissions of 31.6 per cent from 1990 to 2007. The reduction of GHG emissions from transport is one of the key areas in the Danish strategy regarding mitigating the effects of climate change. However, it is still uncertain what the consequences will be for the transport sector in general in terms of employment, occupational profiles and skills needs.

Skills response

There has been a gradual adaptation of curricula starting since the 1980s for greening existing occupations. Labour market programmes (adult continuing training programmes for unskilled and skilled workers) have played a role, as they are very responsive and adaptive mechanisms to changes in the labour market. VET, CVET and tertiary programmes have been gradually adjusted to align formal qualifications with “green” requirements in the labour market and to match the demand for skills and knowledge related to green technologies. In the early days, developments were mainly driven by legislation, whereas recent developments are much broader, induced by a real market pull and accelerated by R&D and innovation investments.

Skills responses seen in Denmark have mainly been concerned with existing sectors and occupations. Consequently, the educational sector has a strong basis for meeting the renewed global and national focus on energy efficiency and renewable energy within the existing occupations, whereas it can be questioned as to whether the right education and CVET measures are in place to fully harvest the potential from cleantech development and changes in business models that do not abide with conventional sector and skills distinctions. However, as mentioned above, industry analysis shows that there appears to be no justification for developing completely new training

programmes targeting cleantech and that existing qualifications only need modifying in order to match emerging skills needs.

Anticipation and monitoring of skill needs

The tripartite governance model that is characteristic of the Danish VET system, and the statistical system in place to monitor supply demand factors, have resulted in a rather adaptive and responsive VET system. Mapping and analysing programmes and activities in adult and continuing training is the responsibility of a tripartite committee consisting of ministerial, sectoral and social partner representatives.

The identification of skills needs primarily occurs through the trade committees for upper secondary VET and CVET and is based on labour market information, studies conducted by their secretariats or external commissioned analysts. The trade committees undertake studies on skills anticipation for a “family of occupations” within initial VET (IVET) and CVET. Thus, trade committees and respective councils monitor occupational changes that could call for development or adaptation of IVET qualifications and CVET certificates within the tripartite governance framework. To a limited extent, they also carry out cross-sectoral studies to analyse the impact of technological convergence – for example, cleantech – or regarding changes in particular work functions that may also be cross-occupational. The committees often commission external expertise for particular studies.

The Danish VET system has, through a series of reforms since 2000, given increasing autonomy to the local level to adapt course curricula to labour market needs through outcome and competency based goals without detailed prescriptive curriculum requirements. In the new national structure for CVET provision, 13 CVET competency centres have been formed to connect providers of CVET and basic adult education in a more transparent infrastructure. Those centres will also be responsible for anticipating and monitoring skills changes at the local level. The reform has also instigated a standardization of IVET qualifications and CVET labour market certifications, so that CVET certifications can be integrated in IVET programmes and count towards credits in IVET.

There are also numerous examples of other governmental, cross-sectoral and trade organization initiatives. In the renewables sector, a skills analysis was organized in a public–private partnership project led by Siemens, IWAL (International Wind Power Academy Lolland), DTU (Technical University of Denmark) and the vocational academy CELF, backed financially by the Ministry of Education and the Region of Zealand. Skills gaps were identified in the wind turbine sector by a project led by representatives from the Federation of Danish Industry and the unskilled workers employees’ organization 3F. Various skills initiatives have been taken at different levels to adjust to the greening of occupations in the construction sector too; for example, in October 2009, an inter-ministerial committee established a working group with members from relevant business organizations, education institutions and public authorities, to thoroughly assess the skills requirements/needs for different occupations in the construction sector.

However, there is little national information on the skills implications of the greening of the economy and associated change to occupational structures, and only a few major initiatives have been conducted to follow up on the greening of the economy in terms of initiating anticipation of new skills needs. More recently, trade unions and associations have tried to draw attention to the employment and job creation perspectives that the greening of the economy entails. The Danish Metalworkers’ Union (Dansk Metal) and the union for unskilled workers (3F) have called for actions to implement training activities that can stimulate job creation in cleantech and other “green areas” with growth opportunities.

Summaries of case studies

For this study six case studies were conducted across occupational changes due to green restructuring, new or emerging occupations, and existing occupations.

Case study 1. Structural change in the ship building industry

In August 2009, the shipping company A.P. Moller-Maersk Group announced the closing of the Lindoe Shipyard in Southern Denmark due to increased competition and the effects of the financial crisis. From the perspective of green structural change, the closing of the Lindoe Shipyard is a particularly interesting case, as public authorities and the energy sector have turned to offshore renewable energy as a means of creating new jobs for the Lindoe workforce. The skills competencies of Lindoe's employees, such as welding, surface treatment and outfitting, are also highly relevant for offshore renewables, and Lindoe's existing facilities and competencies, which include docks, production and storage facilities, cranes and lifting facilities, make it an ideal place for producing offshore renewables equipment.

At Lindoe Shipyard, local municipal authorities have the formal responsibility for identifying skills needs in relation to Lindoe's employees as part of public employment services. The two municipalities most affected by the closure of Lindoe (Odense and Kerteminde) created the Lindoe Forum in partnership with the Region of Southern Denmark. The forum was established with a core mission to create new jobs for Lindoe's former workforce. A range of major Danish companies in the energy sector, together with local, regional and national policy-makers, then established the Lindoe Offshore Renewable Centre in partnership with the Lindoe Forum in January 2010. Lindoe Offshore Renewable Centre is a new centre based in the old shipyard at Lindoe with a focus on research, innovation and development in the field of offshore renewable energy (wave and wind). Some of the main activities of the centre are training, as well as a continuous identification of skills needs in the Danish offshore renewable energy sector. Information is passed on to the public authorities as well as the vocational education and training system.

It is still too early to say how many jobs will be created from the scheme, as it is awaiting a grant decision from the European Globalisation Adjustment Fund and the actual skills response in relation to offshore renewable energy is still under planning, but the initiative is a good example of the potential for new and greener job opportunities arising from economic restructuring.

Case study 2. Structural change in the machinery sector

The closure of MAN Diesel's production of engines in the city of Frederikshavn led to the loss of 540 jobs in 2009,⁴⁸ with an additional 200 supply chain jobs also expected to disappear.⁴⁹ The Frederikshavn municipality has prioritized two sectors with the potential to create new employment opportunities: the maritime and energy efficiency sectors. The municipal authorities conducted a series of counselling sessions and job search courses on site at MAN Diesel. These contributed to skills needs identification, while a range of activities were conducted relating to the maritime and energy sectors. Training modules have been prepared in collaboration with social partners covering both priority sectors (they have yet to be implemented, primarily because the financing package of €8m is not yet in place – the Municipality is awaiting a grant from the European Globalisation Adjustment Fund).⁵⁰

At the initial stage, all jobseekers will be offered an individual assessment of competencies based on their former employment and experiences. The assessment feeds into an individual retraining plan with exclusive focus on retraining activities related to sectors where skills are in need, including the priority sectors. The retraining programme consists of an introduction to the specific sector, supplemented by individually chosen retraining modules. The participants will choose modules according to the specialization they wish to attain. Although no firm job vacancies are identified, it is likely that, if trained against the performance targets of the industry, the scheme will generate job openings in Frederikshavn.

⁴⁸ Municipality of Frederikshavn, 2009.

⁴⁹ Nordjyske.dk, 2009.

⁵⁰ Region Nordjylland, 2009.

Case study 3. Manager in renewable energy⁵¹

To fully exploit renewable energy sources with different properties, an emerging need for technicians who possess interdisciplinary knowledge about different sources and who are able to manage and provide consultancy services in renewable energy implementation projects was recently identified. A network of companies, the local municipality of Lolland⁵² and a social partner initiated an investigation into this skills gap through their joint effort to establish the Community Test Facilities and International Wind Power Academy on Lolland. They assessed that the existing education and training programmes did not match the skills requirements demanded, and concluded that there was a need for a programme that would supplement the existing qualifications.

As a response to the identified skills gap, the vocational academy CELF took the initiative to develop a new, tailored tertiary qualification in cooperation with Siemens, the International Wind Power Academy and the municipality of Lolland, informed by further follow-up interviews with the companies, which were interviewed during the skills gaps identification process. The programme comprises five semesters, equivalent to 150 ECTS.⁵³ Entry requirements are the completion of a relevant upper secondary qualification. The programme is based on both theoretical knowledge and practical training through projects and includes work placement in a company in either Denmark or abroad.

A proposal had been sent for pre-approval (support) from the Confederation of Danish Industry and to public authorities for a pre-assessment of whether the proposed programme complies with labour market needs and does not conflict with existing programmes. If the proposal is approved, it will be offered as a formal national qualification from 2011. This case represents a good practice example of how new tertiary educational programmes, which are not tripartite governed like upper secondary VET and CVET labour market certificates, may develop bottom-up in a close public-private partnership.

Case study 4. Wind turbine operator⁵⁴

The concerted policy to increase the share of wind power in Danish energy production has made the wind energy sector increasingly important for the Danish economy and generated the demand for wind turbines from the manufacturers. The Federation of Danish Industry and the employees' organization, 3F, organized a project to identify skills gaps in the wind industry through workshops and dialogue between trade organizations, key employers and selected vocational colleges. They found that skills gaps in the wind turbine sector comprise knowledge and competencies related to the production, assembly and maintenance of wind turbines. Workers must also be capable of functioning in a global market where language and broad knowledge around wind turbine technology is essential.

In response to these identified needs, the development of a new upper secondary vocational programme leading to a formal VET qualification as a skilled wind turbine operator was initiated. The content of the new programme was established by surveying wind turbine companies, in particular Vestas and Siemens, ensuring that the programme would comply with the performance demands from the sector. The programme has been approved by the industrial trade committee and the Danish Ministry of Education and is today offered as a formal national upper secondary VET qualification and is the first step in the process of creating education specifically tailored to the wind energy sector. The first students completing the programme are set to enter the job market in 2011–12.

⁵¹ This case study is based on interviews with people involved in the identification of the skills need and in the development of the programme who also provided relevant written information (report concerning the identification of the skill needs and the proposal for a new educational programme as project manager of renewable energy).

⁵² The island of Lolland is a region lagging behind, with lower qualification levels compared to the rest of Denmark and with unemployment levels at a higher level. Employment opportunities have decreased gradually as agriculture gradually restructured and local industry closed or relocated.

⁵³ A European Union-based system aimed at introducing a standard measure of the workload of university bachelor and master education. In Denmark it is also applied to measure the workload of the courses which is a part of the PhD education.

⁵⁴ This case study is based on available relevant documentation (see References) as well as an interview with a Chief Consultant from the Industry's Trade Committee, who was involved in the identification of the skills gap and the development of the programme.

Case study 5. Greening of existing occupations in construction

The long-term focus on energy efficiency in buildings has resulted in changes in the job functions and skills requirements of construction sector occupations. New requirements for knowledge and skills for designing and implementing low-energy construction are experienced at all levels – from engineers and architects to electricians and construction workers. Demand-driven skills initiatives have been taken at various levels to adjust to the greening of occupations in the construction sector, including trade and workers' associations, local municipalities, universities and vocational colleges.

The Government has instigated the Strategy for Reduction of Energy Consumption in Buildings,⁵⁵ focusing on building renovation and installation of energy-efficient solutions for new and existing buildings. The government believes that this drive will require new green skills and knowledge for all people involved in the construction sector – from engineers and architects to electricians and construction workers. Energy-efficient renovation alone could create 5,000 new jobs.

Case study 6. Marine technician⁵⁶

The initiative “Green ship of the future” deals with the changes affecting and facing the marine sector. Participants include Maersk, Aalborg Industries, MAN Diesel, Odense steel shipyard, FORCE Technology, the Danish Centre of Maritime Technology and the Danish Maritime Authority. The initiative identified the requirement for skills training for marine technicians, who are responsible for implementing and handling machines and technologies to reduce emissions and to keep up with technological developments and new energy efficiency measures.

Faced with this apparent skills gap, a network of educational institutions and local companies in the Frederikshavn area entered into strategic dialogue regarding skills needs and suggestions to ensure an adequate skills supply, as well as ideas and guidelines for the educational response. A new educational programme in “energy and environmental skills for marine technicians” at the vocational college MARTEC in Northern Jutland was established to integrate core competencies in three areas: alternative energy and environmental impacts, energy systems and energy optimization. Partnerships with industry and the University of Aalborg ensure that MARTEC is able to integrate the most up-to-date technologies and developments in the sector into its programme. The first marine technicians specialized in energy and environmental issues are set to enter the market in the next 2–3 years.

Conclusions

At least three green “shifts” are observable in Denmark. The first concerns greening of existing occupations. Rather than a shift per se, this represents a continuation of a long-term development. The second relates to the creation of entirely new occupational profiles not yet covered by education supply (e.g. for cleantech). The third concerns disruptive innovation whereby the technological competency base is being used to create new business services, as highlighted by the Grundfos example. Overall, the greatest job potential is likely to be found in the energy sector and in cross-sectoral themes such as energy efficiency.

Despite these positive developments, there are concerns that workers laid off through the latest recession, particularly the low qualified, could end up in structural unemployment. Unions argue that the Danish Government needs to be more proactive to ensure that Denmark's potential

⁵⁵ <http://www.ebst.dk/file/43439/reduktion-af-energiforbruget-i-bygninger.pdf>

⁵⁶ This case study is based on available documentation and on interviews with representatives from MARTEC who are involved in the initiative.

first mover advantage in alternative energy – particularly wind energy – is used in a systemic way to stimulate job creation through coordinated employment, skills upgrading and innovation policies. For example, there are no indications that the Lindoe innovation initiative (see case study above) will be accompanied by structural measures to ensure that the right skills are available to turn innovation advance into sustainable job creation.

Diversification of existing companies is also seen as critical. The Danish Metalworkers' Union (Dansk Metal) and the union for unskilled workers (3F) have called for actions which can stimulate job creation in cleantech and other “green areas” with growth opportunities – Dansk Metal have developed specific recommendations which according to their estimates would create up to 50,000 new jobs in the energy sector.

The educational sector has a strong basis for meeting the renewed global and national focus on energy efficiency and renewable energy within the existing occupations. However, there is debate as to whether the right education programmes and CVET measures are in place to fully harvest the potential from, for example, cleantech, and the disruptive and innovative changes in business models which are now occurring that do not follow the traditional sector logic (e.g. pump manufacturer Grundfos moving into more service-oriented sales).

Very little information (statistics, analyses etc.) currently exists regarding the consequences of the greening of the economy on Danish occupational structures and skills requirements. Lack of data has also been confirmed through interviews with Director Generals for IVET and TVET.

Labour market organizations have called upon actions to stimulate job creation in the energy sector, which is regarded as the major growth area in Denmark.

Trade committees and respective councils monitor occupational changes and may call for the development or adaptation of IVET qualifications and CVET certificates. Trade committees undertake studies on skills anticipation for a “family of occupations” within IVET and CVET. They also carry out cross-sectoral studies to analyse the impact of technological convergence – for example, in cleantech – or regarding changes in particular work functions that may also be cross-occupational.

Thirteen CVET competence centres connect providers of CVET and basic adult education, and are responsible for anticipating and monitoring skills changes at the local level. Linked to this development, the Danish Technological Institute is currently preparing a guidebook of methods for anticipating skills needs.

The Danish “flexicurity” model combined with high CVET participation rates explains the success of the Danish economy prior to the crisis, and processes of restructuring have been on-going and supplemented by a high absorptive capacity in labour markets.

The Ministry of Education has taken various initiatives to integrate climate and energy topics into the existing curriculum, from compulsory school to higher education. The aim is to ensure that the climate agenda is not only covered in a focused and coherent manner but that it also stimulates climate-conscious behaviour and encourages more young people to choose to pursue a career in science after compulsory education.

Recommendations

Since sectoral approaches to skills anticipation may not fully capture the industry dynamics which may be driven by technological convergence, disruptive changes in business models or repositioning of value chains, there is a need for cooperation at the European level to further analyse which type of methods are best suited to capture these skills changes.

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The energy agreement, February 2008: http://www.kemin.dk/Documents/Klima-%20og%20Energipolitik/energiaftale-21022008_final.pdf

The Green Business Strategy (erhvervsklimastrategi): <http://da.cop15.dk/danmarks+indsats/erhvervsklimapanelet/erhvervsklimastrategien>

Egypt

Policy context

Key challenges and priorities for a green economy

There is an increased burden on Egypt's limited natural resources due to rapid population growth, coupled with unsustainable economic activities. As a result, environmental challenges exist in the following areas: air and water quality, waste management, coastal pollution, nature protection and desertification.

Air quality is deteriorating in Egypt, particularly in Cairo and Alexandria, where more than 80 per cent of the country's industrial activity takes place. Water quantity and quality are both negatively impacted, and unsustainable usage of Nile water is one of the main contributing factors. The waste management system of both hazardous and non-hazardous municipal, agricultural, construction/demolition and industrial waste is inefficient.⁵⁷ With regard to nature protection, there are 27 protected areas in Egypt covering almost 15 per cent of the country's territory. Egypt has significant natural heritage; however, a rapidly growing population places an increasing pressure on natural resources, resulting in habitat destruction.

The above environmental challenges have contributed to climate change threats. Serious ecological problems are manifested in shoreline erosion in coastal zone areas, and the Delta region faces problems of possible flooding due to rising sea levels. In addition, agricultural productivity could be negatively impacted by the increase in average temperatures. Human health hazards are also prone to increase, as climate change may lead to possible outbreaks of vector-borne diseases.⁵⁸ In 2004, Egypt's total CO₂ emissions were estimated at 158 million metric tons, 1 per cent of the total world emissions;⁵⁹ however, emissions escalated by 40 per cent between 1996 and 2004 in Egypt. A number of sectors are major contributors to GHG emissions in Egypt, primarily the energy sector (22 per cent), manufacturing (19 per cent), the transport sector (18 per cent), agriculture (15 per cent), small combustion (9 per cent), non-combustion emissions in industry (9 per cent) and waste (5 per cent).

The environmental response strategy and the role of skills development

General environmental strategy

The need to attain sustainable economic growth and development is recognized by government and reflected in national socio-economic plans produced by the Ministry of Planning. Specific environment policy-making and planning is largely mandated to the Egyptian Environmental Affairs Agency (EEAA). EEAA has a wealth of strategies and plans, which tackle different aspects of environmental issues.

The 1970s and 1980s were marked by economic development, which was achieved at the expense of over-exploitation of natural resources and degradation of the environment at large.

⁵⁷ EU, Egypt Country Strategy Paper 2007–13.

⁵⁸ Egyptian Environmental Affairs Agency, <http://www.eeaa.gov.eg/English/main/Protectorates.asp>

⁵⁹ Data calculated in 2007 by the Carbon Dioxide Information Analysis Centre, based on data mainly collected by country agencies for the United Nations Statistical Division.

During this period, Egypt was in a state of “Environmental Neglect”,⁶⁰ with serious problems pertaining to lack of water supply and sanitation, land degradation and waste management. A number of heavy polluting industries also emerged during this time, some of which were located on the banks of the Nile.

In 1994, Egypt worked on improving the legal framework for environmental protection by drafting Law No. 4/1994 and its executive regulations. The law redefined the role of EEAA, granting it new responsibilities including the formulation of strategies, policy directives and management guidelines in different environmental areas. This development led to increased political support for environmental protection. The five-year EEAA work plan 2002–07 spelled out priorities, including capacity building, both within EEAA and at the local governorate levels. The plan had a directive dedicated to environmental education, training and awareness, which aimed at raising public awareness of environmental issues and development of human resources within the field of the environment.⁶¹

The National Environmental Action Plan (NEAP) covers the period 2002–17 and addresses key environmental issues, such as water quality, air quality, management of land resources, desertification, protection of the marine environment, solid waste management, biodiversity and biological safety.⁶² The NEAP recognized the importance of developing Governorate Environmental Action Plans, although their implementation was largely constrained by lack of financial and technical capabilities. In 2002, EEAA also issued the National Strategy for Cleaner Production to better define cleaner production.

However, there exist a number of constraints facing environmental strategy formulation and implementation. There is a lack of an integrated approach in developing environmental strategies, plans and programmes, which results in duplication and/or conflict in implementation. There is also a lack of proper enforcement of legislation already adopted and sometimes a need for more detailed and elaborate legislation to protect the environment. Implementation mechanisms in support of environmental strategies, plans and programmes are largely missing, leading to ad hoc uncoordinated implementation efforts, which jeopardize the achievement of objectives.

Green response to the current economic crisis

Like many countries, the Egyptian Government has adopted a policy focusing on fiscal stimulus plans and a marginal relaxation of the monetary policy to combat the impacts of the current economic crisis. The Minister of Finance stressed the need to focus equally on “sustainable long-term growth and competitiveness”, not only to overcome the current crisis, but also to prepare Egypt for responding to global changes and needs in the markets beyond the crisis.

GDP growth fell to 4.1 per cent in the last quarter of 2008 compared to 7.2 per cent in the previous fiscal year. It is estimated that this will result in a loss of up to half a million jobs.⁶³ Egypt’s unemployment rate increased to 9.4 per cent in the first quarter of 2009, compared to 8.8 per cent the previous quarter.

To date, Egypt does not have an explicit green response to the current economic crisis, highlighting the fact that greening the economy in Egypt is still in an embryonic stage.

⁶⁰ The World Bank, Country Environment Analysis of Egypt, 2005.

⁶¹ EEAA Five-Year Plan (2002–05).

⁶² Ibid.

⁶³ EGYPT: Workers Reeling Under Financial Crisis, <http://ipsnews.net/news.asp?idnews=47234>

The skills development strategy in response to greening

The mandate for skills development through education and training in Egypt is shared between many ministries. In pursuit of enhancing the coordination for identifying the skills and specializations required in the labour market, both at policy and strategic level, a number of coordination mechanisms have been developed at different levels:

- The Council for Human Resources Development, the Human Resources Development Committee and the Technical Vocational Education and Training Committee set policies and provide the strategic direction for human resources development in Egypt.
- Three Training Councils have been set up with the purpose of coordinating and enhancing the quality and relevance of the provision of training activities to the three economic sectors.
- Twelve sectoral Enterprise Training Partnerships⁶⁴ act as a feedback mechanism between employers and the technical education and training systems. These Enterprise Training Partnerships were established with the aim of developing and strengthening a demand-driven approach for the formulation and provision of training services.

However, there is an absence of a representation of the Ministry of State for Environmental Affairs, which clearly reduces the prospects that these mechanisms would address skills development in relation to environment and sustainability issues.

On the operational level, an institutional arrangement for the early identification of skills requirements and labour market forecasting and the transfer of the findings into occupational profiles and curricula does exist. However, none of the existing labour market forecasting mechanisms in Egypt, until early 2010, had addressed or analysed skills for green jobs. Moreover, no entity is currently responsible for collecting systematic data on the skills and knowledge base of the workforce necessary to sustain the shift to a greener economy. On the other hand, there is a good understanding of green skills requirements among organizations concerned with the environment and various agencies implementing and piloting different mitigation measures for climate change and environmental degradation.

The lack of a skills development strategy in response to greening could be attributed to the lack of coordination between the multiple ministries and agencies working in education and training, and businessmen and those working on environmental issues.⁶⁵ Furthermore, there is an apparent separation between the environmental policies and the skills development policies, as none of the main environmental institutions has a role in the policy and strategy formulation process or mechanisms. Opening communication and collaboration channels between the various organizations concerned with the environment and the various organizations and agencies active in education and training is crucial for paving the way for a skills development strategy that would address the future needs of greening.

⁶⁴ As part of the TVET Reform Programme – a 66 million Euro Project, co-financed by the EU and the GoE, under the auspices of the MoTI, for a duration of six years, that commenced in mid-2005.

⁶⁵ Seventeen institutions are involved in environmental matters in Egypt, including the MSEA, NREA, EEAA, MED TEST ENPCPC, COAE, EC-CDM and UNEP.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

Resources are being directed towards adopting and undertaking mitigation measures to combat climate change and other environmental challenges. As a result, some sectors and economic activities, especially those with high environmental impacts, are experiencing major employment shifts as they strive to eliminate their negative impacts on the environment.

The Government is directing mitigation measures towards the energy sector to combat the impact on the environment, as well as to meet the short- and long-term national energy demand. Wind power development has become a prominent industry as wind resources are among the best in the world; there is availability of ample land with low alternative economic value; and an increasing demand for electricity and other sources exists. The benefits of developing this industry include saving natural gas and oil; protecting the environment through the use of clean energy; contributing to capacity building and knowledge transfer; contributing to developing remote desert areas; and stimulating local manufacturing for about 25 per cent of the wind projects' material.⁶⁶ Analysing the employment trends related to wind energy to date, we can observe the following:⁶⁷

- The El-Zafarana Wind Farm Project: 60 engineers and operation and maintenance specialists employed.
- The Hurghada Wind Farm Project: 50 engineers and operation and maintenance specialists employed.
- The Gabal El-Zeit Wind Farm Project: This development is still in the feasibility phase but will be constructed on the Red Sea coast and is expected to cost USD 880 million and to be developed in 2010. When operational, the plant will generate an output of 350 GWh per year, cut CO₂ emissions by 500,000 tons per year and is expected to employ up to 40 workers for plant maintenance, in addition to more than 100 workers in the construction of the wind farm.⁶⁸

In addition to the direct employment in the wind farms, local manufacturers and suppliers of equipment are also expected to increase significantly in the market. Furthermore, the Egyptian Government is attempting to develop selective wind turbine components and commence local manufacturing of turbine towers and blades to supply the local market. Employment's generation from these projects is expected to total 400 new jobs.⁶⁹ Given the Government's commitment to increase the capacity of wind farms in the coming years, it is projected that wind energy will impact employment in this field leading to the creation of 75,000 jobs by 2020.⁷⁰

⁶⁶ Energy Efficiency and Renewable Energy, Egypt – National study's summary, 2007.

⁶⁷ Interview with Eng. Asharaf Abdel Meged. NREA Consultant, April 2010.

⁶⁸ Ministry of Investment. <http://www.gafinet.org/English/SectorsValuePreposition/Renewable%20Energy%20value%20proposition-2010.pdf>

⁶⁹ Ministry of Investment. <http://www.gafinet.org/English/SectorsValuePreposition/Renewable%20Energy%20value%20proposition-2010.pdf>

⁷⁰ Elsewedy for Wind Energy Generation – Sweg Local Manufacturing: Experiences from the Mena Region, presentation given in 2009. http://www.rcreee.org/Library_New/PDF/IRENA_Jun_2009_SideEvent/Session%204%20Local%20manufacturing%20Experiences%20from%20the%20MENA%20Region_AhmedElSewedy.pdf

Second, the manufacturing sector, contributing to 20 per cent of Egyptian GDP, employs approximately 15 per cent of the workforce, and is the source of a number of serious environmental impacts, such as industrial emissions affecting air and water quality and old technologies and production processes, resulting in an inefficient use of natural resources. Adopting cleaner production measures has greatly impacted employment on a number of fronts. The Egyptian Environmental Affairs Agency has created a number of Regional Branch Offices and Environmental Management Units. In total, 2,000 employees are employed by the Governorates to oversee environmental management related issues. The need to adopt cleaner production related techniques has also created significant employment in terms of increasing the number of consultancy firms who provide their services to different industries.

Third, the agriculture sector in Egypt is facing some key environmental challenges, such as water contamination due to extensive use of fertilizers; impact of climate change on production practices and quantity; more extreme fluctuations in weather conditions witnessed over the past three to four years adversely affecting crop yield; inefficient use of resources; and widespread reliance on unsustainable practices. Organic agriculture is one of the main initiatives encouraged by the Government of Egypt, to mitigate climate change, due to the fact that it reduces greenhouse gases, especially nitrous oxide.

Poor waste management is directly related to GHG emissions, and the burning of agricultural waste in Egypt is believed to contribute up to 42 per cent of the air pollution problems in Egypt.⁷¹ Other fields of waste management include appropriate hazardous waste collection, disposal and recycling to eliminate major health hazards associated with exposure to hazardous contaminants in air, soil or water. Employment in the waste management sector has greatly expanded in the past years as a result of new regulations to combat environmental impacts. One growing employment trend is in the development of independent waste management systems based on segregation of hospital and hazardous waste from the municipal waste stream and the privatization of waste services to international waste management companies.

The introduction of these services has increased employment in this sector over the last years. It has been estimated that in the Alexandria and Cairo Governorates over 15,000 jobs related to these initiatives were created in the private sector and 1,000 monitoring-related jobs were created in the public sector.⁷² Finally, recycling of agricultural waste is currently promoted by EEAA and is also expected to lead to job creation in this sector.

Skills response

The study identified the skills response in the field of manufacturing. The Egyptian Pollution Abatement Programme was implemented by the Ministry of State for Environmental Affairs to help industry improve performance and comply with environmental regulations. The programme has trained 1,500 candidates including Regional Branch Office representatives, factory workers and auditors on several issues related to clean production. Other programmes such as Support for Environmental Assessment and Management (SEAM) and Environmental Sector Programme also have significant capacity-building activities.

In addition to this, a number of institutional arrangements are in place in Egypt to adopt clean production activities. These include the Industrial Modernization Centre and the National

⁷¹ M. I. Moussa and A. M. Abdelkhalek, 2007.

⁷² USAID, http://www.usaid.gov/stories/egypt/cs_egypt_waste.html

Cleaner Production Centre (both operating under the Ministry of Industry), the Environmental Compliance Office and the industrial unit as well as the Egyptian Council for Clean Development Mechanisms within EEAA.⁷³ All these organizations run a number of training programmes in different issues related to clean production applications.

Changing and emerging occupations and related skill needs

New and emerging occupations

In the energy sector, there is a need to prepare new workers for designing, installing, operating and maintaining wind farms. Second, in the manufacturing sector there is a need to train engineers, technicians and supervisors in the manufacturing of different components of wind farms, such as wind blades. Third, within the construction sector, there is a need to prepare engineers in the design and construction of wind farms.

A major expansion plan for wind power is being adopted, which extends beyond 2012. The Egyptian Government plans to embark on major investments involving donors and the private sector in wind power to capitalize on the country's competitive advantage.⁷⁴ These initiatives are expected to create a considerable demand for these new green skills requirements.

Greening established occupations

As industries respond to the demands of a greener economy and policy environment, jobs will require new skills, and workers in these industries will need to engage in training and upgrading their skills, so that they can adapt to new technology and new ways of working.

Energy efficiency initiatives have been introduced, such as the Industrial Modernization Centre, the energy efficiency component of the MED TEST Programme, and SEAM. Some of the skill requirements identified through these programmes have been for the purpose of conducting energy audits, calculating energy consumption, determining the proper options for energy efficiency, and assessing the implementation of energy efficiency practices.

Skills requirements identified by clean production initiatives are mainly focused on auditing the industrial process; determining the proper options for clean production and assessing the implementation of clean production practices according to a standard code; implementing an in-plant assessment methodology to increase the overall efficiency of the industrial process; and reducing impacts on the environment as well as reducing operating costs.

Through the implementation of initiatives affecting organic farming, such as the reduction in the use of pesticides, it has become clear that organic farming calls for a workforce capable of undertaking organic farm management, with skills required to serve as organic farm workers, natural land management operators, pesticide operators, plant and machine operators, including bio-fuels generators, farm supervisors, land care coordinators and land management specialists. In addition, the certification of organic farms will require auditors and certifiers. The increasing

⁷³ EEAA National Policy for Cleaner Production, 2004.

⁷⁴ According to the International Institute for Sustainable Development in its report of March 2009, wind power development in Egypt has many points in its favour: Egypt's wind resource is one of the best in the world; there is ample land available with low alternative economic value; demand for electricity and other sources of energy is increasing strongly; air quality considerations in the major cities are one of the key environmental concerns; and donor support has been extremely strong. It has included studies, capacity building and grants.

demand for organic products in both the local and export markets could also eventually encourage further investments in the sector, and thus create higher demand for these skills.

Skills response

In relation to organic agriculture, at the level of higher education some initiatives have been undertaken to respond to the needs of the sector. For instance, the Faculty of Agriculture at Al-Azhar University established the Department of Environment and Organic Agriculture in 1997. Furthermore, the Faculty of Agriculture at Ain Shams University has approved the establishment of a Department of Organic Agriculture. In addition, there are international programmes that promote organic agriculture in Egypt and work on skills development, as well as a number of NGOs who are active in this field.

Skills responses related to waste management include the training sessions provided by the Ministry of Local Development related to solid waste, while the Ministry of Health is involved in training related to health-care waste management. EEAA, in collaboration with donor-funded programmes such as USAID, is conducting training programmes on waste management. One of the largest was the training programme in relation to private sector participation in solid waste management. Finally, a number of NGOs are also heavily involved in training regarding community-based solid waste management.

In the field of wind energy, green skills training is undertaken in the form of on-the-job training generally related to operations and maintenance and is either provided by the foreign suppliers of machinery or by the New and Renewable Energy Authority (NREA). Training is also undertaken by a number of donor agencies funding the wind farms. In addition to this, the Regional Centre for Renewable Energy and Energy Efficiency⁷⁵ was established recently in Cairo to increase capacity building in relation to wind energy. In December 2009, the centre developed a comprehensive regional training workshop regarding wind parks, in collaboration with NREA. The workshop topics focused on the principles and basics for selecting locations, designing farms, operations and financial feasibility.⁷⁶

In addition, a number of universities are undertaking scattered initiatives to integrate environmental aspects within their programmes. For example, the Engineering Faculty of Cairo University is partnering with the Holding Company for Water and Wastewater, to provide ten scholarships for the students who have successfully finished their junior year to study Water and Environment Engineering. The programme aims to create engineers who are capable of monitoring water projects at all levels, and are familiar with appropriate technologies in this area.⁷⁷

A lack of awareness also contributes to the lack of a formal education and training system in responding to the skills needs emerging as a result of greening. There has not been any attempt

⁷⁵ RCREEE is an independent regional think tank based in Cairo which is dedicated to the promotion of renewable energies (RE) and energy efficiency (EE). RCREEE formulates and disseminates policies in support of RE and EE and provides a platform for the regional exchange on policy issues and technological questions. In addition, RCREEE encourages the participation of the private sector in order to promote the growth of a regional industry of RE and EE. RCREEE has ten founding members, including Algeria, Egypt, Jordan, Lebanon, Libyan Raba Jamahiriya, Morocco, the Occupied Territories, Syrian Arab Republic, Tunisia and Yemen. During the start-up phase, RCREEE is sponsored by Egypt, also serving as host country for the centre, as well as Denmark, Germany and the EU (the development partners).

⁷⁶ <http://www.rcreee.org/ViewLibraryArticle.aspx?article=26212501150131210533>

⁷⁷ Holding Company for Water and Wastewater – <http://www.hcww.com.eg/En/News.aspx>

to formally disseminate the skills needs to the formal education and training system. In-company or on-the-job training, provided by enterprises and donor initiatives, has so far been the main response to skill needs identified as a result of greening certain processes. However, these responses are being undertaken at a relatively small scale.

Anticipation and monitoring of skill needs

The identified set of skills requirements has neither been translated into occupational profiles, nor has a listing of potential occupations been produced. There is no holistic skills response at a national level; instead the skills response is in the form of training and retraining and is undertaken by several institutions on an individual basis. Problems of coordination and duplication, as reflected above, still overshadow these efforts. The existing labour market information systems for skills identification and forecasting has not yet taken green jobs into account. Moreover, no entity collects systematic data on the skills and knowledge base of the workforce necessary to sustain the shift to a greener economy.

However, there is a good understanding of green skills requirements among organizations concerned with the environment and the various agencies implementing and piloting different environmental mitigation measures. For instance, the technical problems associated with wind turbines in the wind farms, including the problems encountered in maintaining them, has indicated the urgent need for technicians with the appropriate skills to maintain wind turbines.⁷⁸ Another example is companies' inability to implement the energy efficiency recommendations as identified by the Industrial Modernization Centre, primarily due to lack of expertise in this field, which has indicated the need for engineers and technicians with appropriate skills to implement and assess energy efficiency measures.⁷⁹ Skills needs are otherwise identified on an ad hoc basis within the relevant agencies as the need arises.

All in all, a considerable amount of practical knowledge and experiences currently exists within the programmes and agencies implementing various mitigation measures, including the identification of a wide range of greening skills needs that has not yet been properly documented.

Summaries of case studies

Case study 1. Environmental Impact Assessment consultants

The Environmental Impact Assessment (EIA) is a systematic process aiming at assessing the positive and negative environmental impacts of a given project. Within this context, Law 4/1994 for the protection of the environment and its executive regulations 338/1995 stipulate "all new establishments and/or upgrades or expansions of existing establishments should undertake an EIA", as a prerequisite for issuing permits. Guidelines for different sectors are developed by EEAA to identify the main issues that should be addressed with respect to each sector.

In light of the above outlined requirements, a pool of EIA consultants has emerged to meet this demand since the mid-1990s. To date, there is no system in EEAA to rate EIA consultants according to preset qualification and skills scheme ratings and no numbers exist for EIA consultants currently operating in the market. Training for EIA consultants is normally acquired in the form of on-the-job training, although occasionally conducted as an activity within donor-funded projects, such as the Environmental Pollution Abatement Programme in Egypt.

⁷⁸ Interview with Mr Andreas Holtkott. KFW, October 2009.

⁷⁹ Interview with Eng. Mohammed El Sobky. IMC, October 2009.

Case study 2. Skills related to wind farm operations

Egypt has great potential in the renewable energy sector with abundance in wind and solar energy resources. The NREA was established in Egypt in 1986 as an affiliate of the Egyptian Ministry of Electricity and Energy. The NREA is the national focal point for renewable energy in Egypt, including commercialization of technologies, as well as implementation of related energy conservation programmes.

The first commercial wind farm was established in 1993 in Hurghada, with a capacity of 9 GWh/year. The first mega wind park in Egypt was established in the Zafarana site, which has been recognized as one of the best wind farm sites in the world, with outstanding wind characteristics.

To date, the skills development related to wind farm design and construction solely relies on foreign expertise, while skills related to the maintenance and operation of wind farms are left to Egyptian labour. The NREA is the institution responsible for training workers on the maintenance and operation of wind farms, and on-the-job training has been conducted for workers to undertake the required work. In an interview with an NREA consultant, training was emphasized as a critical requirement in this industry; however, financial constraints are identified as one of the main obstacles facing the adoption of proper training programmes for workers within the field.⁸⁰

Similarly, an interview conducted with a donor agency involved in wind energy financing in Egypt reveals the lack of skill identification and development, reflected in the workers' poor performance and the need for technical and vocational training to perform maintenance and operation in this field.⁸¹ Initial discussions are under way to explore the means of strengthening workers' capacity.

Case study 3. Organic farmers

The Food and Agriculture Organization confirms that organic sustainable agricultural practices have direct benefits on mitigating climate change effects, enabling ecosystems to recover from over-use, reducing agricultural GHG emissions and reducing desertification.

Almost one-third of Egyptian labour is engaged in farming activities, in addition to other workers who are employed in related jobs, such as food processing or trading of agricultural products. There are now some 500 organic farms in Egypt, cultivating approximately 24,500 hectares of land in Egypt and accounting for 0.72 per cent of the country's total agricultural area.

Currently, organic agriculture is a rapidly growing sector in Egypt. The driving factor for this trend is mainly the high export potential of the organic crops, which make it an economically attractive business. A growing health conscious and environmentally aware segment of the Egyptian society also contributes to increasing the demand in this line of business. To date, there is no official legislation to regulate the organic agriculture sector; however, a draft regulation on producing, processing and handling organic products is currently under development.⁸²

The development of skills needed in organic farms is met through NGOs, which play a significant role in supporting the organic movement in Egypt. The Egyptian Biodynamic Association is the leading NGO and provides skill development directly through training, or indirectly, through agricultural extension related activities.

⁸⁰ Interview with Eng. Ashraf Abdel Megid, NREA Consultant, March 2010.

⁸¹ Interview with Mr Andreas Holtkott, KFW, October 2009.

⁸² Lina Al Bitar, 2008 and SMAP, 2000.

Case study 4. Agricultural waste management: Reuse of rice straw

Air pollution is one of the most pressing environmental issues in Egypt. According to a recent State of the Environment Report, the contribution of rice straw burning to air pollutants was estimated at 42 per cent, compared to 23 per cent of vehicle and industrial emissions and 12 per cent of open burning of solid waste.⁸³

Egypt has become one of the major rice producers worldwide. In 2008 government estimates show that the level of rice production results in the generation of 3 million tons of rice straw annually. Farmers in Egypt are currently still disposing of the majority of the rice straw produced through burning in open fields, due to the difficulty and cost of collecting rice straw.

Environmental Law 4/1994 was subsequently introduced, and amendments in Law 9/2009 stipulate that farmers who practise rice straw burning can be fined up to L.E. 20,000. EEAA is also promoting the recycling of rice straw as an alternative to open burning. Their plan includes a goal of generating around 100,000 new jobs, related to rice straw recycling and other cleaner production initiatives. The new jobs will primarily be associated with projects related to the baling of rice straw and cultivation of mushrooms in 600 different locations in the Delta region.⁸⁴

Retraining is occurring for existing employees who are shown how to recycle rice straw or to use it for biofuel and composting. An expert in the field of Agriculture Waste Management has confirmed that most of the training for labour in the rice straw composting and recycling factories is in the form of on-the-job training. However, the qualifications needed for each process and its corresponding training needs vary.

Case study 5. Training Egyptian subcontractors on remediation of heavy metals contaminated sites

Hazardous substances pose adverse impacts on health and the environment. Shoubra El Kheima is a densely polluted area in Greater Cairo, hosting a large number of industries. The operation of these industries has taken a heavy toll on air and soil quality. However, lead, as a hazardous substance, was tagged as one of the most serious pollutants associated with a number of health hazards.

In the last decade, the Government of Egypt, with the aid of a number of donor-funded projects, has minimized airborne lead emissions by closing down the smelting operations and undertaking remediation at 11 contaminated sites. The remediation of the lead contaminated sites required specialized training for engineering contractual companies. In an effort to build the national capacities, the Lead Pollution in Qalyoubia Program, a USAID-funded project, in collaboration with EEAA, which started in 2004 and ended in 2008, conducted comprehensive training for local contractual engineering companies to undertake the remediation activities. It targeted 60 engineers from 12 Egyptian sub-contracting construction companies. The prequalification criteria for the selected companies for the training included official registration of the company and years of experience in construction.

The new skills acquired by these companies were unique in the Egyptian market and further business opportunities materialized. One of the participating companies capitalized on their skills gained and were subsequently awarded a two-year contract with a petroleum company in Egypt, Petrobel, to dismantle and transfer asbestos buildings.

Conclusions

An important finding has been the lack of an official, structured skills response strategy to greening in Egypt. The current inefficient enforcement of environmental regulations deters establishments from investigating alternatives to improve their environmental performance. In addition, initiatives for mitigating and adapting to climate change in response to environmental degradation in Egypt are mostly implemented on a relatively small scale and are largely in the form of donor-supported programmes.

⁸³ EcoConServ, 2009.

⁸⁴ Interview with Eng. Ashraf Abdel Megid NREA Consultant, March 2010.

The current approaches to the anticipation and identification of green skills are almost negligible; there is no systematic collection of data on the skills and knowledge base of the workforce necessary to sustain the shift to a low-carbon economy. Possessing the right skills for green jobs is a prerequisite for making the transition. Presently, skills gaps have already been recognized as a major bottleneck in a number of sectors and activities such as renewable energy, energy efficiency and environmental services.

Documentation for the adaptation and mitigation measures related to climate change do not relate to skills. In addition, green skills needs have not been integrated into the formal education and training systems. The linkages between environmental policy-making and education and training policy-making are non-existent. There also seems to be a lack of awareness of the need to respond to the anticipated demand for green jobs, now and in the future.

Recommendations

Policy recommendations

There is a need for the full environmental harmonization of laws and it is essential to ensure a representation of environmental issues in the existing coordination platforms at different levels (ministerial and operational). The efficiency and effectiveness of enforcement activities is critical and urgent action is needed to include the need for green jobs within the formal education and training system.

Recommendations for education and training

Different environmental agencies need to develop coordination mechanisms with higher education institutes, and a coordination channel, for example a committee focusing on “Skills for Greening”, would be useful. Proper documentation of lessons learned and experiences gained through initiatives is also important. Furthermore, technical skills are clearly needed at different levels. There is a need to develop new accredited courses and curricula to meet the needs of various sectors and industries.

Recommendations for further research and data collection

Immediate action is required to compile the findings of different activities, as well as disseminating them to education and training stakeholders. Utilizing existing infrastructures and capabilities, such as the Egyptian Education, Training and Employment Observatory, to ensure a systematic approach to collecting data on green jobs and skills implications, is important. Scoping studies need to be conducted to determine the skills gaps and shortages. In this respect the Ministry of State for Environmental Affairs or NREA could work closely with the various training councils in conducting these studies and incorporating findings in the formal education and training system.

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Estonia

Policy context

Key challenges and priorities for a green economy

During the last two decades, Estonia has gone through fundamental political, social and economic restructuring and, as a result, the Estonian economy has become much greener (although it still faces serious environmental issues). Priority sectors for the green economy are energy, transport and construction, and key policy concerns are security of energy supply, environmental impacts of energy production, energy pricing, energy efficiency in buildings, and sustainable transport. Renewable energy is seen as key to development, along with diminishing the impact of oil shale energy production.

To enhance the move towards a greener economy, the Government has defined four major lines of action: efficiency of energy consumption; diversifying the use of renewable energy; increasing the energy efficiency and decreasing the environmental impact of oil shale based energy production; and decreasing the overall environmental impact of the economy by supporting the development of green entrepreneurship.

The sectors with major greening potential include: oil shale; energy, gas and water supply; waste management; forestry; and agriculture.

The environmental response strategy and the role of skills development

General environmental strategy

In Estonia, environmental strategy is very much bound up with developmental objectives. The Government has produced a portfolio of strategic documents covering long-term development strategies, as well as a comprehensive set of mid-term development plans, together with action plans that encompass all sectors of the economy, education, research and development. There is no overarching strategic plan dealing with the green economy and green jobs in Estonia. The main strategic documents are:

- the Act on Sustainable Development (1995):⁸⁵ this is Estonia's long-term plan for sustainable economic development covering the energy, transport, agriculture, forestry, tourism, chemical, building materials and food industry sectors;
- the Estonian National Strategy on Sustainable Development – Sustainable Estonia 21 (2005):⁸⁶ this strategy document aims to achieve sustainability of long-term development to 2030. The overall aim is to develop an economy which is globally competitive and environmentally sustainable while preserving the traditional values of Estonia. Accordingly, the strategy sets out four principles for the long-term development of Estonia: viability of the Estonian cultural space; growth of welfare; a coherent society; and ecological balance; and

⁸⁵ Act on Sustainable Development (1995).

⁸⁶ Estonian National Strategy on Sustainable Development (2005).

- the Estonian Environmental Strategy 2030:⁸⁷ builds upon the principles of “Sustainable Estonia 21” and serves as the basis for the preparation and revision of all sector-specific development plans related to the environment.

Green response to the current economic crisis

No formal stimulus package has been adopted in Estonia, and the main focus of economic policies continues to be restructuring aimed at preparing Estonia for joining the Euro zone.

The key priorities for employment policy and growth creation are set out in the Action Plan for Growth and Jobs 2008–11⁸⁸ and are updated in the Strategy for Competitiveness 2009–11.⁸⁹ Medium-term economic policy priorities are:

- a conservative macroeconomic policy aimed at keeping the public deficit within the limit of 3 per cent of GDP in order to join the Euro area in 2011, maintaining low public debt levels in order to sustain high investment levels and a favourable level of taxes in the medium and long term;
- improving the general business environment in order to increase investment and productivity and raising the export potential of enterprise, and maintaining the share of exports relative to GDP at its 2008 level through support for export companies;
- developing skills by increasing the financing of lifelong learning, ensuring more resources for continuing education and retraining activities and using the period of lower employment to raise the skills of 50,000 people by at least one European Qualification Framework (EQF) level; and
- maintaining employment levels by improving the business environment and stimulating job creation, increasing public investments and providing additional subsidies with the aim of preventing long-term unemployment.

In addition, to support the recovery of the labour market, the Government has adopted the Action Plan for Reducing Unemployment (2009).⁹⁰ The action plan includes support for the creation of new jobs, measures for preventing economic inactivity, and enhancement of additional training and retraining opportunities. The availability and flexibility of career counselling will also be increased. In total, active labour market measures have been apportioned 459 million kroons in 2009 and 618 million kroons in 2010 within the framework of the programme “Increasing the supply of the qualified labour force”.

The skills development strategy in response to greening

Strategies for education, training and R&D targeting sustainable development and environmental issues are embedded in national educational policies as well as the above-mentioned strategies. Skills development for the green economy through environmental education is a priority in

⁸⁷ Estonian Environmental Strategy (2007).

⁸⁸ Estonian Action Plan for Growth and Jobs 2008–2011 for the implementation of the Lisbon Strategy (2008).

⁸⁹ Estonian Strategy for Competitiveness 2009–2011 (2009).

⁹⁰ Action Plan for Reducing Unemployment (2009).

Estonian educational policy as reflected in the recent allocation of 350 million kroons to the Environmental Investments Centre promoting environmental education and awareness.⁹¹ An Action Plan for Environmental Education⁹² has been drafted (but not yet approved) describing three main measures for developing green skills:

- developing the network of centres for environmental education covering all counties and major cities;
- promoting environmental education in formal education (national curricula for primary school and upper secondary school, national curricula for VET, and higher education curricula); and
- promoting environmental awareness through adult education/training and media.

Employment priorities include: raising people's qualifications and their sense of security by making the education system more effective over the next years, intensifying efforts to promote lifelong learning, reducing school drop-out rates, promoting science and technology to help ensure competitiveness and assisting higher-risk groups to (re)enter the labour market. Measures are in preparation for supporting traditional industries, aiding the adoption of new technologies and increasing the productivity of enterprise, developing human capital and implementing better design procedures to obtain competitive advantage. The development of business networks and clusters is also being promoted. Continuous and extended financial support is provided to projects developing new competitive technologies, products, services and processes that are export oriented and environmentally sustainable.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

The occupational structure has changed along with economic restructuring over the last 20 years. Broadly speaking, the share of professionals and service workers has increased while the number of craft/manual workers has decreased and is forecasted to stay at the current level. The majority of occupations in Estonia are greening as a result of economic restructuring in the sense that the labour market is still adjusting and most economic sectors are in the process of becoming more sustainable. For this reason, it is difficult to draw a “clear dividing line” between occupational changes due to “green restructuring” and new green requirements in existing occupations.

The labour market impact of this restructuring has been profound. However, in terms of moving to a greener economy, most occupations still need to integrate sustainable practices into the job profile. The potential for further green restructuring of the Estonian economy is most obvious in the following sectors of the economy:

- agriculture (biomass, biofuel and bio-energy; organic farming);
- forestry (forest management, applying new technologies, production of wood pellets);

⁹¹ Environmental Education (2010).

⁹² Action Plan for Environmental Education (2008).

- mining and quarrying (applying new technologies, water management in mines; remediation of open quarry territories);
- electricity, gas and water supply (energy production technologies; renewable energy; waste; oil shale; energy efficiency; electricity and heat grids; water management);
- manufacture of refined petroleum products, chemicals and chemical products (technologies for producing fuels and chemicals from oil shale and renewable sources);
- manufacture of wood products (use of timber; technologies for timber modification);
- transport and supporting activities and infrastructure (sustainable transport);
- construction (materials and technologies for construction and renovation; renovation of old heating pipelines; construction of passive houses);
- real estate and renting activities (energy certification and energy auditing in apartment buildings; renovation and reconstruction of apartment buildings); and
- leisure and tourism.

At the moment, the labour market is characterized by a mismatch between employer demand for qualifications and the actual skill levels of the working-age population. Therefore, it is recognized that it is necessary to improve the knowledge and skills base of those who are already active in the labour market.

Skills response

The focus of skills development in response to economic restructuring has been to update the qualifications of the working-age population via vocational education. Due to high unemployment rates in the early 2000s, employment policies have targeted the unemployed and brought down the unemployment rate over the decade (although it has recently risen dramatically again). The following initiatives have recently been implemented to improve the availability of additional training and retraining:

- a personalized training voucher system for the unemployed as an additional option for labour market training. Training vouchers enable unemployed people to quickly find a suitable additional training course based on individual needs;
- training vouchers for employers with the aim of raising the skills level of managers and employees; and
- simplifying and shortening the procedures for public procurement of labour market training to increase the availability of active labour market measures.

In 2008, a new initiative for financing in-service training in vocational schools for working-age people was commenced. Offering free in-service training helped to update the knowledge of workers with low levels of education, reducing both the likelihood and persistence of unemployment. Meanwhile, the share of adult education has increased in vocational schools.

Most recently, a Development Plan for Adult Education⁹³ 2009–13 has been approved, envisioning an expansion in learning opportunities for adults as well as a range of initiatives for

⁹³ Development Plan for Adult Education (2009).

attracting more people to the education and training system. The main objectives include an overall improvement of skills and educational levels and an increase in the number of adults participating in lifelong learning. A reduction in the share of people with no vocational education or professional specialization, and the creation of a high-quality training system to provide opportunities for people wishing to increase their qualification level, are also high on the agenda.

Changing and emerging occupations and related skill needs

New and emerging occupations

In November 2009, the Innove Foundation organized the first seminar on the green economy in Estonia. The conclusions from this seminar indicate an increasing demand for some groups of occupations and professions with specific technical skills related to the green economy,⁹⁴ including:

- engineers, designers and researchers involved in green economic development;
- technicians capable of operating green technologies;
- architects, city and transport planners;
- consultants advising enterprises and consumers on new technologies; and
- energy auditors and environmental impact assessors.

There are many new green specializations within these occupations, especially related to developing and implementing green technologies, for example solar and fuel cell technologies. The experience to date of developing occupational standards for new green-collar occupations indicates that both technical skills related to new technologies as well as generic skills like team work, communication, learning and entrepreneurship are important.

Greening established occupations

As mentioned above, it is not possible to make a clear distinction between “green structural change” and “greening of existing occupations” in Estonia, due to the large-scale socio-economic changes that have taken place since 1991 in the transition to becoming a parliamentary republic. Many of the sectors mentioned above under “Green restructuring and its impact on the labour market” include occupations that fall in both categories, and most established occupations are gradually becoming greener as a result of economic restructuring and sustainability policies, technological development, new educational programmes and direct demand for greener products and services.

Skills response

A wide range of measures have been implemented as part of the Action Plan for Growth and Jobs and the Strategy for Competitiveness, aimed at increasing workers’ skills bases through general, vocational, higher and adult education, including:

⁹⁴ M. Kink (2010), p. 33.

- revision of higher and vocational education curricula matching higher education learning outcomes with labour market needs;
- launching of the DoRa programme (programme for doctoral studies and internationalization) to increase the quality and competitiveness of higher education;
- support for studies abroad for Estonian Masters level students in order to ensure the availability of highly qualified people, as well as financial support for educational institutions, enabling them to better attract foreign students at Master and PhD level and forging ties with the Estonian labour market;
- raising the qualification of teachers in vocational and general education by developing a needs-based additional training system for teachers;
- promoting science and technology throughout the education system;
- extending additional (re)training opportunities for adults through vocational education, higher professional education and non-formal education institutions; and
- further development of the system for career services based on the needs of the labour market.

Measures aimed at increasing the competitiveness of the Estonian economy also have skills elements. Notable initiatives that are helping to “enable” the move to the green economy include:

- a talent programme encouraging young specialists to return to Estonia after graduating abroad offering job opportunities in the private and public sectors;
- state-commissioned adult training in higher education;
- launching career information centres and developing career services;
- business start-up packages comprising entrepreneurship training, counselling and mentoring up to two years after the creation of the enterprise; and
- increasing the quality and availability of labour market services via more extensive use of modern information technology.

Anticipation and monitoring of skill needs

There is no entity endowed with the responsibility of anticipating and monitoring green skills needs in Estonia, and the skills aspect of the green economy has received little attention outside strategic planning and educational policy documents.

The Ministry of Economic Affairs and Communications has been preparing annual labour demand forecasts since 2003, which are used as an input for preparing proposals for state-commissioned study places in initial VET, higher education and adult education. Three bodies advise the Minister of Education and Research on the need for state-commissioned study places:

- the vocational education and training council;
- the higher education council; and
- the adult education council.

These bodies are made up of representatives from government agencies, employer associations, trade unions and education providers, and the councils also provide a platform for social dialogue in skills development issues related to the respective sectors of formal education.

Energy has been targeted as a primary sector for greening due to the high environmental impact of oil shale and the strategic objective of increasing renewable energy production. In 2006, the Ministry of Economic Affairs and Communications commissioned a study for the Estonian energy technology strategy bringing together viewpoints of companies, research institutes, universities and public sector agents in different segments of energy-related industries. Areas identified as being of particular importance to the environment are the development of the transmission network to improve efficiency and reliability, and the new challenges brought about by the increasing use of wind power. Heat production and distribution systems are also areas with especially significant potential for efficiency gains.

Whilst there is a good general level of knowledge and skills, there is no specialist area in which Estonia excels in the international arena, and the development and implementation of new energy technologies in Estonia has implications for skill needs on two levels:

- development and export of leading technologies used in oil shale production; and
- upgrading competencies that are important for key energy technologies, for example biofuels.

The implementation of a system for analysing and forecasting quantitative and qualitative changes in the labour market is envisaged for 2013. This task is to be fulfilled through the joint collaboration of specialists across various government ministries and will improve Estonia's ability to provide green skills through higher, vocational and adult education.

Summaries of case studies

Skills development for the greening economy was explored in seven case studies of occupations and educational programmes. As green skills provision is still at an early stage in Estonia and training is mainly provided through public education, the case studies focus on higher education programmes that incorporate green elements to facilitate greening in target areas of the economy.

Case study 1. Research, engineering and management in oil shale mining, processing and waste remediation

The Estonian Development Strategy of Energy Related Technologies sets out the strategic objective for Estonia to become one of the world's leading developers of technologies for oil shale processing and low grade oil resource utilization. To this end, an oil shale cluster is being established and qualified researchers are in demand for strengthening existing centres of excellence and applying technologies from other fields that are relevant for oil shale development. To meet the skills need for developing the oil shale cluster, Tallinn University of Technology, the University of Tartu and the Estonian University of Life Sciences have developed a package of study programmes in Chemical Engineering, Mining Engineering, Power Engineering, Environmental Technology and Industrial Ecology.

The programmes cover Bachelor, Master and Doctoral level studies as well as applied higher education programmes. The programmes include different aspects of dangerous waste management, oil shale mining, processing and waste remediation. The programmes have been developed in close cooperation with major stakeholders in the oil shale industry. Doctoral research projects are, in most cases, part of larger R&D projects commissioned by companies or projects in the framework of EU R&D Framework programmes, national research and technology programmes. Around 500 students graduated in oil shale related courses in 2009 but a low graduation rate indicates critical problems with the programme, and skills shortages in key areas could remain a barrier to development of the Estonian oil shale cluster.

Case study 2. In-service training at Eesti Energia AS

Extensive training and retraining of the personnel at energy company Eesti Energia AS (EE)⁹⁵ was required due to recent widening of the company's scope of activities and implementation of new technologies. Demand for several new occupations arose from EE's new business strategy for integrating the value chain and providing environmentally friendly energy solutions: from specialists (e.g. engineers and technology developers), assessment and certification (e.g. auditors) and managers (e.g. plant and project managers). EE conducted an internal skills assessment and consequently set up an in-service training programme covering all groups of personnel.

The training is provided through weekend university courses (six thematic modules over a six-month period) and consists of lectures, excursions and seminars. Specific training courses have also been arranged for different target groups (skilled workers, technicians, line managers, engineers, dispatchers, heads of department, and analysts). The personnel department regularly collects and analyses feedback from participants and management. Satisfaction with the quality of in-service training at EE is very high,⁹⁶ and the training system has proved to be efficient in meeting the strategic needs of the company.

Case study 3. Energy auditors

Energy auditing of buildings is a new group of occupations in Estonia emerging from EU Directives 2002/91/EU and 2006/32/EU. From 1 January 2009, all buildings and apartments sold or bought were required to have an energy certificate. In early 2008, a task force was established at the Estonian Qualifications Authority⁹⁷ to develop professional standards for this new group of occupations and, in July, four national occupational standards were approved. The skills training for certified specialists in the field of energy auditing of buildings is provided by the Faculty of Civil Engineering at Tallinn University of Technology.

Courses are delivered by lecturers who are specialists in the field and have participated in the development of professional standards. To date, 146 applicants in the profession of energy auditing have been certified and there is no longer an immediate need to substantially increase the number of professionals in the field of energy auditing of buildings. The skills response organized by Tallinn University of Technology has proved to be fully adequate, and feedback from participants has been very positive.

Case study 4. In-service training and apprenticeship at ABB AS

ABB AS, a daughter company of the ABB Group in Estonia,⁹⁸ is a supplier of products and systems for power generation, transmission, process and industrial automation. The company has experienced an increasing demand for transferable skills amongst line workers stemming from the fast-changing business environment. Line workers are required to acquire technical skills faster so that they may be flexibly placed in different job situations in the factory. ABB has pursued a three-way personnel development strategy: building workers' skills through offering in-service training, investing in the education of future managers, engineers and technicians, and direct involvement in curriculum design and study programmes.

ABB has a well-developed system of in-service training programmes. In 2009, ABB AS arranged 882 courses for all major groups of occupations. The majority of these courses were short internal courses lasting up to eight hours. From 2005 to 2009, ABB AS offered 122 apprenticeships at universities and technical colleges. The company has also supplied laboratories with new equipment (e.g. industrial robots, automatic control devices and industrial software packages) and participated in the design of the study programme. According to an assessment of company management, the skills development strategy has proved successful and will be continued.⁹⁹

⁹⁵ Eesti Energia AS: <http://www.energia.ee>

⁹⁶ Personal communication from the Personnel Management Department of EE.

⁹⁷ Estonian Qualifications Authority: <http://www.kutsekoda.ee>

⁹⁸ ABB AS: <http://www.abb.ee>

⁹⁹ Personal communication from the Personal Development Centre of ABB AS.

Case study 5. Masters programme in sustainable material and processes for energetics

Design and implementation of future energy systems requires engineers who are generalists with a broad and interdisciplinary knowledge in all areas of energy use, conversion, transport and storage as well as in energy policy and economics. This requires a kind of training that did not before exist in the Estonian higher education system, and as a result the MSc programme “Materials and Processes in Sustainable Energetics”¹⁰⁰ was developed at Tallinn University of Technology and the University of Tartu.

The programme has a general element for all students, providing the fundamentals of sustainability, energetics and engineering/science. The students then choose one of the two specializations: Materials for Sustainable Energetics or Processes for Sustainable Energetics. The programme meets current skills in terms of building a holistic and broad understanding of sustainable development and energy-related issues, and also increases the export potential of the Estonian higher education sector. The first 19 students to the programme were admitted in September 2009 and it is expected that the programme will be awarded full accreditation starting from 2012.

Case study 6. Forestry

More than a half of Estonian land, 2.3 million ha, is covered by forest,¹⁰¹ and prudent use of forests is considered crucial for ensuring sustainable development. Estonia is pursuing a policy of multifunctional forest use satisfying simultaneously economic, social, ecological and cultural needs. The labour market needs in forestry have been formalized in a number of occupational standards, developed by the Professional Council for Forestry. Based on these standards, four national curricula for the forestry sector were developed between 2006 and 2008¹⁰² in forest management, forestry, operation of forest machinery and arboriculture. These modules have also been used to design shorter initial or continuous VET courses. The development of the initial and continuous VET system for the forestry sector in Estonia has shown that the sector is moving towards a holistically functioning qualification system.

Case study 7. Electrical power plant and network managers, engineers and researchers

Changes in the energy sector (e.g. diversification of energy sources, new energy technologies, decentralized production and distribution) have caused significant changes to the competence profiles of power plant and network managers. As a response to new skill needs in the energy sector, Tallinn University of Technology, in cooperation with energy companies Eesti Energia AS and Four Energy, has developed new study programmes in power engineering. The programme package covers Bachelors, Masters and Doctoral level studies.

The programmes were revised during the academic year 2008/09 as part of the reform associated with the Bologna process framework, and as a result, new green modules were introduced. The process of reviewing study programmes in power engineering at Tallinn University of Technology has shown that many existing occupational standards cannot be used as an input for curriculum design, due to the fact that the standards developed before 2007 were not competence based and do not define explicitly the expected learning outcomes. Therefore, the Professional Council for Engineering has initiated the revision of the framework standards for engineering-related occupations.

¹⁰⁰ <http://www.sustainableenergetics.eu>

¹⁰¹ Estonian Ministry of Environment: www.envir.ee

¹⁰² National Curricula for VET: <http://www.ekk.edu.ee>

Conclusions

During the last two decades, the Estonian economy has become much greener. Two major directions of development towards a greener economy can be identified:

- implementation of new cleaner technologies in many sectors of the economy; and
- remediation of the results of Soviet heritage in the environment.

Some steps towards a greener economy happened automatically as a result of lower demand. For example, in the agriculture sector, privatization and lower production levels have significantly decreased environmental pollution. Nevertheless, the sector has further greening potential, especially in the field of organic farming and bio-energy production.

Support from EU structural funds has played an extremely important role in the implementation of different projects towards greening the Estonian economy. The Government has defined four major lines of action to enhance the environmental friendliness of the economy:

- efficiency of energy consumption;
- diversifying the use of renewable energy;
- development of oil shale based energy production – increasing the efficiency and decreasing the environmental impact; and
- decreasing the overall environmental impact of the economy and development of green entrepreneurship.

Restructuring of the economy has caused substantial changes in the macroscopic labour structure. The share of the primary sector, especially agriculture, has decreased multiple times. The tertiary sector has become more important, while the secondary sector has held its share. According to forecasts, the primary sector will also reduce its employment in the coming years. Growing economic activities remain in the services sector and also in the manufacturing industry.

The occupational structure within Estonia has changed, as has the economic structure. The share of professionals and service workers has increased and it is assumed that this trend will continue at a moderate pace. On the other hand, the number of craft workers has decreased more than the total number of employed. It is forecasted that the share of craft workers will stay at the current level.

Green restructuring of the national economy is heavily dependent on the development and implementation of new technologies and changing societal attitudes. Therefore, the skills response to meet the challenges of green economic restructuring should include not only initial and continuing VET, but also all levels of higher education and general education. Motivation among people to raise their skill levels and qualifications according to the changing needs of the labour market is one of the crucial factors for the forthcoming economic upswing.

Effective delivery mechanisms are based on a combination of private initiative, either individual or corporate, and state support. A good example of this is impressive progress in the development of adult education and training, including in-service training during the last five years. According to several assessments, Estonia will upswing from the current economic crises better prepared for the challenges of the green economy.

Recommendations

It is recommended to strengthen the coordination mechanisms of sectoral and other mid-term strategies with the Estonian National Strategy on Sustainable Development – Sustainable Estonia 21 and to increase the visibility of the strategic process. The Government and Parliament are invited to initiate the preparation of a long-term Lifelong Learning Strategy.

The development at occupational standards needs to include competencies for green jobs and be part of a broader process of the national qualifications system development. This includes better coordination between the lifelong learning system, including curriculum development, and labour market needs.

It is recommended that the state commissioning of study places be regularly assessed and the appropriate policy recommendations made. It is also advised that the implementation of national R&D programmes be used to facilitate the creation of a “culture of cooperation” between the stakeholders.

From this research it follows that the quantitative identification of skills needs (state order for study places) and the qualitative identification of skills needs (occupational standards, national curricula, school curricula) are quite separate activities. It is highly recommended that these two aspects of skills identification become more streamlined.

As part of the above processes, it is advised that the functional mapping of competencies in major sectors of the economy becomes a regular activity. This will allow identification of competence profiles of occupations, as well as labour market trends inside a sector. Inclusion of partial qualifications into the national qualifications system will substantially increase the flexibility of the system. Finally, it is recommended that the qualitative skills need surveys be incorporated into the regular Labour Force Surveys performed by the Statistical Office of Estonia.

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France

Policy context

Key challenges and priorities for a green economy

With a large proportion of its electricity derived from nuclear power, France has the advantage of a low-carbon power base, although the country is now increasingly dependent on imported fossil fuels. Despite the nuclear power stance, France is still expected to exceed its Kyoto GHG target by 10 per cent in 2010, due to increasing emissions from buildings and transport.

The main challenges and priorities are to reduce energy use by improving efficiency in buildings and transport, as well as to increase renewable energy generation.

The major challenges set within the scope of France's energy policy are to manage energy demand, extend the range of technological sources of production and supply, develop research in the energy sector, and guarantee the provision of energy transportation and storage infrastructures adapted to consumption requirements.

The environmental response strategy and the role of skills development

General environmental strategy

The general environmental strategy has two main dimensions:

- a national adaptation strategy to climate change highlights the key priorities for adaptation in France: in particular, public security and health, social aspects, including inequality of risks, costs and opportunities and preservation of natural heritage. It focuses mainly on mitigation efforts; and
- the Grenelle Round Table – a major government initiative launched in 2007 to address energy efficiency improvements and a range of other environmental issues. Thirteen measures adopted in 2009 focus on: Built Environment; Planning; Transport; Energy; Biodiversity; Water; Agriculture; R&D; Risks, Health and the Environment; Waste; Governance; Information and Training; and Overseas Territories.

France has committed to a “factor four” reduction in GHGs by 2050. Key measures to implement this goal include a “bonus malus” tax system for CO₂ emissions from cars.

The built environment sector is the first priority in the fight against climate change by reducing energy use in both new and existing buildings. In France, the building industry uses up to 70 million tonnes of oil equivalent, making it the biggest consumer of energy across all sectors of the economy. This energy consumption represents 25 per cent of France's national emissions. All of these figures need to be reduced by 75 per cent by 2050.

The second priority is developing renewable energies and materials.

Green response to the current economic crisis

The “green new deal” is based on the 2009 Budget Amendment, which provided for a recovery package worth €26 billion over two years, including €10.5 billion of public investment (State, local authorities and public enterprise). The package also included help for the ailing automotive industry, with incentives to scrap older vehicles and buy new, more environmentally friendly

models. The climate-relevant portions of the plan amount to more than 20 per cent, the highest in the EU. Of these €10.5 billion of public investments shared between the State (€4 billion), public enterprise (€4 billion) and local authorities (€2.5 billion), €1.1 billion in 2009 and 2010 (i.e. 11 per cent) are for speeding up the implementation of the Grenelle Round Table through investment primarily in transport and buildings.

The skills development strategy in response to greening

Following the Grenelle Round Table, a fully fledged skills development strategy has recently been launched with the Mobilisation Plan for Green Jobs (September 2009), a plan to mobilize the relevant sectors of the economy and the regions to develop occupations for green growth. This represents a major effort in identifying the skills requirements and sectors which should be focused on building a competitive green economy and fulfilling the economic and environmental potential of the Grenelle Round Table.

The objective is to adapt existing training programmes and qualifications and create new ones where necessary, in line with the 600,000 green jobs that the Grenelle Round Table could generate by 2020.

This plan is articulated along four themes:

- the identification of the relevant occupations – this includes setting up a national observatory in order to understand the new professions and relevant fields and to quantify these;
- the definition of training needs and setting up training and qualification pathways – this will enable professional skills to be recognized;
- recruitment for sustainable development-related jobs – actions to help jobseekers meet the requirements of the numerous jobs currently on offer which cannot be taken up due to lack of skill; and
- promotion and development of the professions for green growth – a national event on green professions will be organized for early 2010 during which the green growth plan will be detailed.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

The sector consistently identified as having the highest potential in terms of job creation is the renewable energy sector – with an estimated 200,000 jobs. Transport, the built environment and renewable energy are sectors which potentially could lead to the creation of the most jobs within the environmental economy through implementation of the Grenelle measures (recognizing that most studies do not take into account substitution effects and the potential job losses in other sectors).

Estimates of job losses include 138,000 jobs in the conventional energy sector and 107,000 in the automobile industry. In 2009, the automobile sector was characterized by important redundancies and the suppression of almost all temporary jobs in the sector. It is estimated that the job losses related to the decrease in the production of heat engines produced in France could reach a total of 8,000 jobs. However, job losses could be compensated by the creation of electric vehicles and hybrid vehicles (between 15,000 and 30,000 jobs by 2025–30). Low-carbon vehicles and

clean technologies are very promising; however, their diffusion will be slow and progressive, given that the renewal of the fleet of vehicles takes about 15 years.

Skills response

In the private sector, continuing vocational training is managed by both enterprises and the social partners. Companies use tools such as training plans, like VAE (Validation des Acquis de l'Expérience), to recognize experience and prior learning, giving the right to qualifications. Training plans have been carried out in car manufacturing companies such as Heuliez (conversion to the production of electric vehicles), which restructured its assembly facility for heat engines in 2009.

Regions are fundamental actors in the training system and define and implement the regional vocational training policy of young and adult learners (2004 law). They are responsible for the management of public funds dedicated to the training delivered by AFPA, the national training providers for adult learning. Regions actively support the redeployment/recovery plans. For example, the Provence-Alpes-Cote-d'Azur region financed the training of employees in the Eiffel site (metallic construction) for the new wind turbine factory set up in 2008 (with a crucial role played by the regions in terms of cushioning the effects of restructuring and implementing skills development programmes).

At national level, the recently created Social Investment Fund (Fonds d'investissement social, Fiso) will coordinate short-term and temporary anti-crisis measures, with training measures aimed at increasing the employability of the workforce affected.

The role of training providers such as ANFA (Association for Training in the Automobile Sector) is also important. In the current economic context affecting the automobile sector, ANFA is implementing accompanying measures to support workers and companies. The main objective is to raise the level of competencies of the sector's staff.

Changing and emerging occupations and related skill needs

New and emerging occupations

Regardless of the net volume of job creation, green growth will not generally be characterized by the creation of new occupations but will contribute to the evolution of existing occupations.

Where new occupations have been identified, they have mostly been related to audit and consulting in the energy sector, protection of biodiversity, or eco-mobility. New occupations mostly concern highly qualified jobs: occupations related to expertise linked to new technologies (measurement, metrology), or related to organization and coordination (transport flow management; optimization of logistic chains; manager of major building projects etc.). In addition, the Conseil d'orientation pour l'emploi (employment advisory council) identified occupations related to diagnosis, auditing and consulting.

The most dynamic sector in terms of the creation of newly emerging green occupations is the renewable energy sector. Construction in the renewable energies (solar, wind, geothermal) and the waste sector are also booming sectors, with new occupations such as Waste Prevention Managers and Operators being created in recycling industries.

Greening established occupations

Existing occupations will become greener for three main reasons. Specific competencies are currently lacking, some occupational tasks will necessitate more horizontal approaches, and sustainable development constraints will be increasingly taken into account.

The “core” competencies of most existing occupations will not change fundamentally. Nevertheless, it is clear that sustainable development will become a common “backdrop” for all occupations and that new competencies will be necessary to adapt professional practices.

Two sectors with the highest greening potential and representing high employment volumes are the built environment sector and the agriculture sector. In the built environment sector, for instance, each trade will have to integrate notions of sustainable development, but it is first and foremost the articulation of the work undertaken by each building trade that will guarantee efficient construction. This should take into account complementarities between building trades due to the integration of renewable technologies and energy efficiency. This is particularly true for the 260,000 crafts workers who now have to work with eco-materials and integrate energy efficiency techniques for the construction and maintenance of sustainable buildings.

New competencies required include knowledge of new technologies and technical solutions adapted to energy efficiency, cross-cutting knowledge of energy issues, understanding of other occupations related to building renovation and counselling/advice to clients to adapt to new demands of the market.

In agriculture, objectives set by Grenelle involve gradually moving to 20 per cent organic production by 2012. New technical skills are needed for switching to organic farming, for example techniques for the reduction of fertilizers and chemicals, and understanding of requirements of environment-friendly objectives; the agricultural education system trains each year 172,000 pupils, 32,000 apprentices and 118,000 adults. A significant effort in terms of upgrading existing training programmes will be needed. In particular the training of trainers (20,000 teachers in the agriculture school system) will be an important issue (see case study on agriculture).

Skills response

Initial education and training: Creation of new qualifications and updating existing qualifications

In relation to green occupations, the Ministry of Education has so far adopted a prudent approach towards the emergence of “new” occupations. They consider that there are today very few jobs purely based on new competencies (e.g. renewable energies). Given the rapid evolution of the sector, more time will be needed to see how new standards and techniques will impact occupations in the built sector.

Requests for the creation of new qualifications, at BTS (Higher Technician’s Certificate) or DUT (University Technological Diploma) level, mostly concern the built environment sector.

The recent creation of Licences Pro (vocational licences) has played an important role in the improvement of initial training provision. New vocational licences have been created in eco-design for instance. The number of training programmes specifically dedicated to eco-design and the number of enrolled students has steadily increased.

Overall, initial education is lagging behind in meeting the requirements of the renewable energy sector. In particular, qualifications related to energy efficiency, wind power and installation of solar PV are lacking. The provision of initial training in the renewable energy sector is however increasing, with a noticeable growth in specialized higher education qualifications.

Regarding updating qualifications, many qualifications have been overhauled in the past years. The Ministry of Agriculture, for instance, has started to redesign its qualifications to integrate green issues, in particular within organic farming and phyto-protection, with a good response.

Adding new “mentions” or components to existing qualifications can sometimes be a slow process. The French Federation of Electricians has worked on the integration of a new addition of “Renewable energies” to the existing “Bac Pro Electrician” for the past three years.

In the built environment sector, there is an urgent need to integrate new competencies in the qualification standards of the diploma delivered by the Ministry of Education. This concerns in particular qualifications at Level III (BTS or DUT) in the construction sector. The priority for the built environment sector is to overhaul existing qualifications standards. Initial training for architects has been integrating sustainable development modules for a number of years already.

Continuing VET

Continuing training is generally adapting rapidly to the green economy, as illustrated by the wealth and diversity of CVET in the built environment sector: for example, 5,000 training courses were identified in 2009. They address diverse audiences, and include short and long training pathways. A key initiative is the training scheme FEE Bat in the built environment sector, which aimed at training 50,000 professionals (entrepreneurs, craft workers and employees) by 2010. Major efforts in terms of training of trainers will also be necessary to ensure that objectives in terms of training can be met.

Overall, continuing training in the area of renewable energies is more advanced than initial training. Whilst specific training courses focusing on renewable energies were rare in the early 2000s, the number of training programmes in this sector has increased. A concern expressed by business representatives, training providers and public authorities is the lack of coherence with the multiplication of training programmes and the absence of clear standards.

Anticipation and monitoring of skill needs

The systematic forecasting of employment and skill needs is fully integrated into economic planning in France and is based on a range of institutions and experts. France has one of the most comprehensive ranges of tools in this field in Europe.

France is characterized by the existence of a broad network of “observatories” in occupational forecasting, which bring together the various players in the labour market with the aim of reaching a common diagnosis. These research and monitoring centres most often work at the national level, taking a sectoral (industry observatories) or regional view (regional industry observatories), and combining macroeconomic projections and quantitative surveys with qualitative information.

- Sectors. Since the May 2004 law, every sector has had to create an observatory for employment and training forecasts.
- Companies. The Forward Employment and Skills Management scheme is mandatory in all French companies with more than 300 employees, and is designed to enable enterprises to anticipate their future skill needs.
- Regions: Given that powers are now decentralized in France and that they are currently being transferred in the specific area of CVET, most of the tools used to determine and forecast training needs are found at the regional level, for example Regional Training and Employment Observatories. Regional observatories have published a number of studies on green occupations. An increasing number of initiatives focus on green jobs and green growth.
- National level. The General Planning commission carries out studies to gauge developments in trade areas and qualifications. At Ministry level, the identification of skill needs operates

through the process of overhaul of existing qualifications and creation of new qualifications: the design of qualifications is increasingly characterized by the effort being made towards matching the needs of the labour market. The process for designing and modifying qualification standards takes place in consultation with social partners in the framework of specific committees.

Due to the large numbers of stakeholders involved, the volume of their research production and the tools and methodologies in the field of occupational forecasting, a lack of coherence and visibility has been highlighted.

Summaries of case studies

Seven case studies were conducted for this study covering occupations undergoing change due to economic restructuring, emerging green occupations, and existing occupations that have become greener as a result of increased demand for greener production.

Case study 1. HEULIEZ: Production of new electric vehicles

The car producer HEULIEZ will soon be producing the Friendly Car, an electric vehicle designed to conform to the French environmental law Grenelle de l'Environnement, with the support of the Poitou Charentes region. To address important skills upgrades in electricity competencies and to upgrade the overall skills of most employees following the loss of a skills base brought on by the retirement of qualified workers, the company established a training plan in 2009. All occupations needed additional training, since all activities were impacted to a greater or lesser extent by the new production. One of the training modules concerned sustainable development and aimed at raising staff awareness of environmental issues, clean energies and eco-citizenship.

Case study 2. Energy performance experts: Energy assessments and energy performance certificates

Since 2005, energy performance certificates must be delivered by experts (diagnostiqueurs en performance energetique, DPE) whose competencies must be certified by an accredited body. These competencies were legally defined in 2006, as this new occupation requires a combination of traditional competencies and new competencies in renewable energy and energy auditing.

Training typically includes modules on regulatory frameworks, the principles of thermal physics and energy efficiency applied to the built sector, calculation tools and applicable methodologies. The training course is not compulsory by law, but is strongly recommended given the degree of expertise required by the DPE. Training also highly increases the chances of passing the accreditation exams.

According to DPE representatives and the building survey sector in general, DPE roles could be extended, particularly in terms of the advice and information provided to clients. Additional training would be necessary to enlarge the range of activities carried out by DPEs. The sector is currently examining what additional competencies could complement the services DPEs provide.

Case study 3. Qualit'EnR: Renewable energy training centre

Qualit'EnR was founded by five professional bodies as an association for the quality of renewable energy systems installations. Since 2006, this initiative targeting companies in the renewable energy sector has focused on quality training standards for renewable energy installers. Based on consultation with the main actors on the market, training programmes were developed for each type of installation (e.g. solar boiler and photovoltaics) to address sector competency needs and to ensure the quality of the services delivered by the companies wishing to be part of the scheme.

The scheme brings together more than 14,000 companies. Training is a key pillar of the Qualit'EnR quality process. The initiative has created the conditions for a dynamic market for solar thermal. Since the creation of the scheme Qualit'EnR, the training provision in the installation of renewable energy equipment has considerably improved, from a quantitative and qualitative point of view.

Case study 4. Waste recycling operator

The qualification for the occupation “Operator in the recycling industry” was created in 2000, following the joint work carried out by the recycling sector and the Ministry of Education to address the need for qualified staff specifically trained in recycling techniques in the growing recycling industry. This qualification is a Professional Skills Certificate which corresponds to a high school vocational diploma.

Before the creation of this Professional Skills Certificate, no specific training existed for recycling-related activities. Specialized knowledge in sorting out waste was, however, in high demand in the sector. Because of the development of recycling in the past years in France, the sector is now suffering from a shortage of qualified technicians. It is also anticipated that recruitment needs will increase. A key obstacle in terms of recruitment remains the poor image of occupations related to recycling. The need for qualifications at a higher level has already been identified by the sector.

Case study 5. FEE BAT – The whole construction sector

FEE BAT training is targeted at all the occupations in the built sector: craft workers, project managers, employees and, to a lesser extent, architects. It was set up by the built environment sector federations in early 2008 to respond to the objectives laid out in Grenelle in terms of energy efficiency (i.e. a goal of 180,000 jobs related to energy efficiency and retrofitting in the next 12 years). The broad coverage of the training reflects the fact that most occupations in the construction sector are affected by the greening of the economy.

The novel feature of this training effort is that it gathers professionals from different occupations (e.g. insulation and equipment) and encourages an exchange of experiences to raise awareness regarding the changes needed in their occupation in terms of work methods and organization. The training therefore responds to the needs in terms of horizontal competencies, multi-skilling and knowledge of other trades.

The initiative has been remarkably successful. FEE BAT has already trained 18,000 craft workers and entrepreneurs to recognize overall building energy performance and energy-efficient techniques. The built environment sector recommended the extension of FEE BAT, and training for 120,000 persons by 2012. Additionally, the scheme should be extended to other built environment sector trades (e.g. architects, construction sector economists, technical auditors, and trainers).

Case study 6. Vocational baccalaureate in farm management

In France, the “farm manager” qualification has existed since 1998. The vocational baccalaureate in farm management, one of the most important qualifications delivered by the Ministry of Agriculture, was however overhauled in 2008 to reflect the changes that have affected the agriculture sector, in particular the integration of practices in terms of organic farming, sustainable development, and quality standards. In 2007, the Ministry of Agriculture decided to integrate green issues across all qualification standards under the responsibility of the agriculture ministry so that organic farming curricula are systematically integrated.

Considering the mechanism in place in the Ministry for the identification of skills needs and thorough consultation with sector representatives, the updated qualification is expected to respond to sector needs.

Case study 7. Training in eco-design

The vocational licence in Eco-design, Energy and Environment was created in 2006 at University Nancy-2. It was specifically designed to address industry needs stemming from increasing end-user expectations related to environment and sustainable development from the initial design phase of industrial products. Eco-designers' competencies have become increasingly important for various job profiles, including project manager, responsible for qualifications, eco-product designer, energy consultant and waste manager. The qualification was designed to have a broad scope in terms of competencies, and to open onto a wide range of job profiles (e.g. project manager, consultant, waste manager and public authority officer). This licence was the first to integrate such diverse aspects as energy production, industrial product design, waste recycling and eco-design methodologies.

The process for designing vocational licences aims to ensure that the qualification responds to industry needs as new qualification requests are based on consultations with business representatives and social partners.

Conclusions

Main “greening” shifts in economies and labour markets

Significant job creation in green sectors of the economy such as renewables and energy efficiency may be offset by changes in the automobile and conventional energy sectors that might be affected by job losses.

For most existing occupations, the “core” competencies will not change fundamentally. Skills needs for green growth are the following:

- for the whole labour market, transversal competencies related to general awareness raising of eco-activities, eco-design, eco-citizenship etc;
- for most occupations, new skills needs related to new standards and new production processes (built sector, electro-mechanics, renewable energies), which means that occupations will evolve without changing core technical skill sets. Additional modules to core training standards will be needed;
- for some “green” occupations, very specific “green” skills in highly specialized fields; and
- for a minority of occupations, no new skills will be needed because occupations have already integrated sustainable development (waste, recycling) or limited impacts of green growth (e.g. catering).

Expectations in terms of the creation of new jobs should not be exaggerated, as they are based on a number of assumptions (conditions to be met such as the realization of the Grenelle objectives).

Skills implications and development

Overall, the mechanisms for the anticipation and identification of skills needs in France can be considered as efficient. The elaborated system of sectoral, regional and national observatories, and skills forecasting at company level, ensure that the needs identified on the ground are taken into account by the education system. The regional level seems to be the most relevant for the anticipation and planning of training needs.

However, the diversity of methodological approaches may mean that findings are not precisely comparable between one sector and another, or one area and another.

One of the key assets of the French system is the active participation of social partners in the anticipation mechanisms of initial training, and in the management of continuing training.

Skills response

The training provision in France is diversified, and delivered by a variety of actors: the national education system, agricultural education bodies, apprenticeship centres, training centres managed by the branches, network of commercial chambers, private sector, AFPA etc.

Stakeholders highlighted the relative flexibility and responsiveness of initial training with the regular overhaul of qualifications through the CPC process.¹⁰³ The bottom-up process, whereby

¹⁰³ Commissions Professionnelles Consultatives – CPCs define core occupational standards or activities, and identify corresponding competencies.

requests from the professional branches feed into the work of the committees reviewing qualification and training standards, is considered to be effective.

Overall, existing qualifications and training pathways adequately cover the needs of the professionals. In the majority of cases, there is no need to create new qualifications, but a need for “greening” existing qualifications. In most cases, the process has already started; however, it could be accelerated.

The main weaknesses of the current training provision concern:

- the lack of adaptation of the current training provision to reach the green growth objectives and address the needs of the labour market, in particular in the built environment sector;
- the mismatch between the types and levels of qualification needed by companies (surplus of over-qualified graduates). Some 75 per cent of the job offers related to green jobs concern qualifications at upper secondary education levels of education;
- the process for the overhaul of existing qualifications and for the creation of new ones, which is sometimes too slow; and
- the lack of visibility and coherence in the provision of CVET, with the multiplication of training programmes in certain sectors without established quality standards.

The most pressing issue concerns the training of trainers. The number of trainers and teachers able to train new techniques and who are aware of sustainable development issues is clearly insufficient, in particular in the agriculture and built environment sectors. There are concerns that in the context of public spending cuts, in particular in the education sector, where part of the retiring staff is currently not replaced, the needs in terms of teaching staff will not be addressed. This would be a major obstacle hampering the skills development for a transition to a green economy.

Good practice lessons in relation to identifying, anticipating and responding to skills needs

- The range of observatories (sectors and regions) seems to function well.
- Support of regions to restructuring/revival plans is key for sectors such as the automobile sector, as is the setting up of networks specifically focusing on green jobs (see the Ile de France region TEE network).
- Companies are making important efforts to encourage their employees to take part on a voluntary basis in training schemes, especially in the built environment sector (FEE BAT) – FEE BAT is considered as an exemplary training scheme by government and will be extended.
- The feedback system of the Qualit’EnR training scheme (on the basis of audits of the work carried out by the newly trained staff) is considered as innovative and extremely efficient to ensure training programmes are updated/improved.
- Pôle emploi (National Employment Agency): the recent efforts made by Pôle emploi to identify new occupations related to the green economy, quantify the volume of jobs they represent and highlight the corresponding needs in terms of skills and training are viewed as exemplary.¹⁰⁴ Pôle emploi has produced a mapping of green growth occupations. Results of the mapping have been taken into account in the report produced by the Sectoral Committees.

¹⁰⁴ Presentation by Pôle emploi of the mapping of emerging green jobs, final report of the committee of renewable energy industry, January 2010.

- A fully fledged skills development strategy is now being developed, following the results of the work carried out by the committees of the Mobilisation Plan for Green Jobs. As part of the next step of the Mobilisation Plan, the Ministry of Ecology, Energy, Sustainable Development and the Sea has announced the following measures:
 - an inventory of green skills and green occupations: creation of a unique directory of qualifications for green occupations;
 - the creation of a national observatory under the responsibility of the Ministry of Environment; and
 - a revision of the names of the occupations to make them understandable and marketable.

Recommendations

For skills forecasting approaches

Further research is required to identify more precisely competencies needed for green jobs, and to identify not only job creations but potential job losses. Improvements could include promoting the emergence, wherever possible, of a common methodological framework (especially with respect to the work of the observatories, in order to enhance cross-sectoral analyses and occupational mobility) and creating a synthesizing procedure and/or space for the exchange and pooling of information between the various levels involved in forecasting studies.

The creation of new observatories for green jobs, as announced by the Government, should improve data collection.

For VET systems

There is a need for initial VET to integrate sustainable development issues in their training standards, rather than creating new qualifications. Many stakeholders warn against the risk of creating new qualifications entirely based on sustainable development or green skills that would be too narrow or poorly suited to the labour market. Sustainable development could be integrated as one of the core components of all technical and vocational training.

The provision of continuing training is a pressing issue. Less than 50 per cent of young people find a first job that corresponds to their initial training. The number of workers to be trained, to reach the green growth targets, is significant, particularly in the solar PV, water sanitation and built environment sectors.

Reaching these objectives will require additional efforts in terms of training of trainers. Priority should be in occupations where tensions are high on the labour market; however, sustainable development should be integrated into the training plans of teaching staff (in particular for overhauled qualifications).

Quality labels should also be further developed, for example quality charters for training providers in the renewable sector should be further developed in other sectors, to avoid the risk of anarchy in the development of continuing training programmes.

For employers

Efforts to improve the image of occupations related to green jobs, to make them more attractive (also in terms of remuneration), are needed: the majority of green and greening occupations correspond to low levels of qualifications, at the bottom end of salaries, creating recruitment issues (e.g. in the waste sector).

Cooperation between building trades should be increased to develop transversal competencies and multiskilling (e.g. joint training such as FEE BAT).

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Germany

Policy context

Key challenges and priorities for a green economy

German priorities regarding climate protection, in part broadening the earlier environmental protection measures, have come to the fore over the past ten years, with a key goal of reducing GHG emissions. The environmental commitment of German public authorities is established by the “Integrated Energy and Climate Programme” published by the Federal Government in 2007.

The present conservative-liberal government confirmed the principles of this programme, which formulates ambitious goals including:

- 40 per cent reduction of GHG emissions by 2020 compared to a 1990 baseline;
- 3 per cent annual growth in energy efficiency;
- the expansion of renewable energy to 18 per cent of the overall energy supply by 2020, and 50 per cent by 2050; and
- increasing combined heat and power generation to 25 per cent of power by 2020.

The challenge of achieving a huge decline in GHG emissions implies a focus on energy efficiency and cleaner power production than previous policies. It also means that industrial restructuring will be necessary and that environmental considerations are increasingly influencing both technological innovations and people’s lifestyles. Investments will support employment growth and lead to 500,000 additional jobs in environmental protection by 2020 and 800,000 by 2030. However, a key challenge is that Germany suffers from demographic changes which negatively affect the number of young people enrolling for VET.

The environmental response strategy and the role of skills development

General environmental strategy

The increasing importance of climate protection has become a central element within the overall German environmental policy framework. Several measures and instruments have been implemented over the last few years, including many measures within the National Climate Protection Programme of 2000 and 2005. The latter focused on measures covering transport and households. The German climate protection policy has also been influenced by the National Strategy for Sustainability of 2001. Even though there is wide consensus in Germany about the goals and the need for climate protection and lower emissions, debate is still ongoing about how it should best be implemented.

For decades, environmental protection has been at the centre of public policy development. The combination of legislation and incremental awareness has influenced the restructuring of German economic sectors and occupational competencies. From the outset, German policies on environmental protection have not only been perceived as a step towards better living conditions, but also as a mechanism to develop market opportunities for domestic suppliers of environmental technologies and services. The roll out of environmental policies has therefore been used to create new jobs and support economic growth. The environmental technology and services sector is now one of Germany’s major economic sectors, employing 1.8 million people in 2006 (4.5 per cent of the labour force).¹⁰⁵ As a result, German environmental technology firms are now well established and often market leaders.

¹⁰⁵ Study by the German Institute for Economic Research (DIW, 2009).

The long-standing policy programme for greening of the economy has thus been associated with significant impacts on occupational profiles and formal vocational training in Germany. Retraining across the economy in response to green restructuring is mainly focused on the education and training system, where technical qualification training courses are offered and new study courses and further training in environmentally relevant subjects have been developed. The range of continuing vocational training courses related to environmental protection is now substantial. This is chiefly due to the continuing revision of vocational training courses, which make the integration of environmental protection issues a key priority.

Green response to the current economic crisis

The Federal Government introduced two economic stimulus packages, in November 2008 and January 2009,¹⁰⁶ together worth around €100 billion. The proportion of the stimuli packages spent on green investments was around 13 per cent – higher than other EU Member States, even though the focus was not necessarily primarily on green issues.

Under the first package, €3 billion is being used to foster energy-efficient construction and the reconstruction of buildings between 2009 and 2011. The Reconstruction Loan Cooperation offers another €2.5 billion of credit within the programme for energy-efficient building renovations. A further stimulus of €0.3 billion is also being used to supply credit with low interest rates to investments in innovations regarding energy-efficient technologies.

The second package, worth €6.5 billion, promotes education, especially in terms of energy-efficient research and reconstruction within schools and universities. Energy efficiency is also being promoted through tax incentives (higher tax deduction) for craft services which maintain and modernize buildings.

Both economic stimulus packages also focus on the promotion of low-carbon cars with extended tax exemption for cars that meet the Euro 5 or Euro 6 standard. Furthermore, €5 billion was provided for a “scrappage” bonus, and another €0.5 billion was allocated to the demonstration of hybrid electric vehicles.

The skills development strategy in response to greening

Skill needs in the environmental sector have mainly been met by the creation of formal training courses within the German system of dual training and university training. This follows a long tradition of German industries organizing dual training rather than company-based continuing training. The greening of existing occupations in Germany has affected a very wide range of occupations. Clearly, however, the extent to which environmental issues are integrated differs widely according to job type.

Although the main strategy for promoting environmental protection and management is integration of training on environmental issues into formal education, there are a number of policy-initiated programmes supporting environmental sector apprenticeships, environmental vocational training pilot projects, and environmental sector promotion and research. However, these occur in isolation and are not integrated into an overarching strategy for skills development in response to greening.

¹⁰⁶ http://www.bundesfinanzministerium.de/nr_69120/DE/Buergerinnen__und__Buerger/Gesellschaft__und__Zukunft/themenschwerpunkt__konjunkturpakete/node.html?__nnn=true

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

The drive to improve energy efficiency across the economy, coupled with growth in renewable energy capacity and broader carbon emissions reduction targets, are greatly influencing the behaviour of both manufacturers and consumers. Suppliers of consumer and industrial products are vigorously pursuing reductions in GHG emissions by using optimized production processes and energy efficiency measures. Good examples of this trend include more fuel-efficient vehicles, low-carbon buildings, and renewables being used in ever more imaginative ways (e.g. to power air conditioning systems). The agricultural sector is also beginning to follow more environmentally sustainable production methods, reducing its waste generation and water consumption.

All these areas generate economic opportunities and influence employment levels and resulting training requirements. German environmental technology companies in particular are well placed to capitalize on these markets, both domestically and in rapidly expanding global markets. It is difficult to find any incidence of occupations or occupational profiles completely disappearing as a result of “greening” the economy. This is mainly a result of the education system, which trains apprentices and students for flexible employment in the labour market – with the dual vocational training system focusing on the transfer of basic knowledge rather than workplace-specific competencies.

Skills response

The greening of skills is to a large extent captured by the education and training system. The three main channels – initial vocational training, continuing vocational training and university studies – are systematically organized and companies are involved at each of these levels.

Retraining across the economy in response to green restructuring also takes place mainly in the education and training system. In contrast, given their limited scale, initiatives by firms are seen as marginal. Education and training promotion programmes have been established, technical qualification trainings are offered and new study courses and further training with environmentally relevant subjects have been developed. For example, the range of continuing vocational training courses related to environmental protection is now substantial. Beyond new types of training, many existing training courses are becoming intrinsically greener due to the incorporation of environmental training elements. Furthermore, companies can help apprentices by allowing them to participate in an “education-integrated” study pathway, i.e. undertaking initial vocational training whilst at the same time undertaking a university course.

Changing and emerging occupations and related skill needs

New and emerging occupations

The national catalogue of occupations, BERUFENET,¹⁰⁷ differentiates between 36 job descriptions covering “occupations in environmental and nature protection” by type of training. The majority of these are not “new” in the sense that they already have an established training system. The main category that can be classified as new or emerging is the occupation area covering “techniques

¹⁰⁷ See <http://www.berufenet.arbeitsagentur.de>

in the field of renewable energy” which comprises six occupation profiles – these have, to a great extent, been established only in recent years. Other occupations can be classified as new even if they are not yet listed in the national catalogues. Many of these arise at university level. A wide spectrum of university studies are provided by universities and universities of applied sciences.

The skill sets required for these occupations vary according to type of renewable technology:

- solar energy: R&D, manufacturing, consulting and sales, installation;
- geothermal: hydrothermal systems, geothermal systems;
- wind energy: production of wind turbines, technical services;
- biofuels: biogas plants, production of biodiesel; and
- combined heat and power: installation of combined heat and power plants.

Skills for these occupations are provided for through the formal education system, apprenticeships and company training schemes (see case studies).

Low graduation rates in recent years in mathematics, engineering and natural sciences created a shortage of around 165,000¹⁰⁸ highly qualified engineers and technicians in 2006. According to firms, skills shortages have already limited the growth of the environmental sector. However, the economic downturn has reduced labour shortages and it is assumed that environmental industries are now more easily able to fill recent job vacancies. The largest problem for the environmental sector remains the availability of engineers, as graduation rates have also been low in recent years and short-term prospects do not appear to have changed.

Greening established occupations

At the dual apprenticeship training level, environmental protection has been integrated in all initial vocational training regulations and therefore greening across the whole dual vocational training can be observed. For occupations outside the environmental sector, environmental training focuses on basic knowledge in waste recycling and energy conservation. Companies nevertheless are free to extend the environmental knowledge of their apprentices according to their needs. Over the last few years greening can, to a larger extent, be identified by revision of the apprenticeship training programmes. Examples include:

- environmental technicians (revised in 2002);
- plant mechanics for sanitary, heating and air conditioning (revised in 2003);
- electronic technicians for energy and building services engineering (revised in 2003); and
- builders of stoves and air heating systems (revised in 2006).

Greening of existing occupations within a continuing training framework comprises additional skills which can be adapted. These include basic training which imparts environmental protection aspects such as waste and recycling, energy conservation and environmental legislation as well as specialized training for further work as an environmental specialist, energy consultant or environmental engineer. The need for further training is mostly affected by either new legislation or new technologies and the corresponding need for skills adaptation.

¹⁰⁸ IWD, 2007: Ingenieure deutsche Mangelware, iwd Nr.20, 17.05.2007.

As demand for specialized environmental apprenticeships is low and apprentices are at risk of being trained too narrowly, it is most efficient to integrate greening and maintain basic training qualifications in their current form.¹⁰⁹ Thus, environmental protection is likely to be included in the future as a mainly cross-sectoral aspect, while specializing depends on other qualifications. Further greening of occupations might occur in the following fields:¹¹⁰

- agricultural occupations that commit to organic farming;
- traffic-related occupations that support environmentally friendly mobility;
- energy occupations that focus on renewable energy and energy conservation;
- manufacturing occupations that produce products from recycled materials;
- chemical occupations that use biodegradable substances; and
- motor vehicle occupations that invent alternative propulsion technologies.

Skills response

Across the economy, all occupations have integrated environmental protection to a certain extent in recent years. Environmental protection always represents an additional qualification integrated into existing training. In Germany, technical qualifications to perform an occupation are created by three main channels:

- completion of an initial vocational training;
- continuing vocational training; and
- completion of university studies.

Due to continuing vocational training a specialized degree or a foreman degree (Meister) can be obtained. Skills can also be extended via informal learning in the workplace. The main character of the training keeps basic knowledge in technical, economic or scientific subjects as a standard qualification. The greening of the economy and the educational system in general leads to higher demands on skilled workers as the qualification level rises due to increasing technical requirements.

The promotion of education and training which supports the greening of the economy is a priority. Beyond new types of training, many existing training courses are becoming greener due to the integration of environmental protection aspects. There is, however, still scope for improvement. If the future forecasts for the growth rates in environmental technologies prove correct, the supply of skilled workers needs to be secured. German educational policy is believed to have “missed the opportunity” to increase capacities sufficiently because the sector’s high growth was underestimated. As in previous cases of rapid transition, the education and training system reacted slowly to skills shortages, which will need to be addressed in the future.

According to the Vocational Training Act, a specific skill need has to be identified in the economy for a modernization or the establishment of a new training regulation to occur. In 2006, the Federal Environment Ministry started an educational initiative entitled “Environment creates perspectives”, in association with firms from the environmental technologies/renewable energy

¹⁰⁹ Krampe, 2010.

¹¹⁰ GTZ/IUB/BIBB, 2004.

sectors. As a result, 6,000 additional apprenticeships were created in 2009. The initiative aims to identify the apprenticeship trades, skills and competencies required by the environmental sector.

Anticipation and monitoring of skill needs

Skills anticipation is the responsibility of those bodies providing the technical qualifications in the three areas mentioned above:

- *Initial vocational training:* the creation of a new initial training regulation or modernization of an existing initial regulation and the corresponding curricula is conducted through a multi-level process involving employers, trade unions, the Federal Government and the Länder. According to legislation, a specific skill need has to be identified in the economy for a modernization or the establishment of a new training regulation to be undertaken. In the case of environmental topics which might be developed by the Federal Ministry of Environmental Protection, Nature Conservation and Nuclear Safety, the particular environmental training modules are then determined by consensus between employer and employee associations and the Federal Ministry for Education and Research. This will form the basis for the further development of the training regulation by the Federal Institute for Vocational Education and Training and the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder.¹¹¹
- *Continuing vocational training:* greening of existing qualifications often takes place within the system of continuing vocational training. It was estimated that there were between 28,000 and 35,000 suppliers of continuing vocational training in 2002.¹¹² There is no law which regulates this market and an evaluation of quality is seldom provided. The establishment of new continuing training courses or modernization of existing training courses is mainly determined and organized by company need. For private suppliers, the training programmes are products which “must be sold” and thus the supply is influenced by the demand for the product. Technological changes and new legislation are the main drivers for continuing training. Moreover, continuing training is often provided by equipment manufacturers. Siemens, for example, built its training centre for wind turbines to train its own staff but also to offer safety and product training to its customers’ employees, who operate either single wind turbines or wind farms.
- *University studies:* demand for new university courses either occurs in response to visible demand in the economy or cooperation between the university and companies with a demand for specially trained students. Universities may decide to establish courses because they are aware of a potential demand, but there is no analysis of this. The content of university courses is decided by universities. Quality is often evaluated by ranking the courses and the universities.

While the agents involved in this process also monitor skill needs in the economy, there is no coordinating body with the sole responsibility for this task in Germany.

¹¹¹ <http://www.bibb.de/de/4963.htm>, 15.01.2010.

¹¹² Severing and Fitz, 2002.

Summaries of case studies

Eight case studies were conducted for this study covering occupations undergoing change due to economic restructuring, emerging green occupations, and existing occupations that have become greener as a result of increased demand for greener production.

Case study 1. Motor vehicle mechatronics technicians at BMW

BMW decided in 2009 to meet the skills gap in hybrid vehicle mechatronics by integrating a new training module directly into its dual apprenticeship. This means all motor vehicle mechatronics technicians who complete their training at BMW will be qualified to work with all hybrid cars. It also provides flexible training to enable technicians to move firms. The module has now been integrated in the dual apprenticeship programme for apprentices at other BMW production plants in Regensburg and Dingolfing.

From 2010, all BMW production plants in Germany will include the new training module. Around 100 apprentices per year receive the training and BMW tries to employ all motor vehicle mechatronics technicians after their training although, due to the economic crisis, not all apprentices may be employed. Nevertheless, the company tries at the very least to integrate the apprentices into the BMW group network, which may enable apprentices to be employed by international plants in the China, the United Kingdom or the United States, and not be limited to domestic markets. BMW received the Hermann-Schmidt Prize 2009 for the exemplary function of the module, its close connection to the dual apprenticeship programme and its labour market relevance.¹¹³

Case study 2. Chemical technicians in the chemical industry

The initial vocational training to become a chemistry technician is an approved trade and lasts 3.5 years in Germany. The revision of training regulations for apprentices in laboratory and production areas introduced new organizational and scientific-technical changes in the industry and extended the training to include the idea of Responsible Care.¹¹⁴ The elements of Responsible Care were integrated into all training modules aiming at implementing environmental protection in all areas of the chemical industry.

As a result of the Responsible Care programme, the German chemical industry has adjusted all their working processes to be intrinsically cleaner and more energy efficient. The idea of integrating environmental protection measures into the chemical industry has to a large extent been achieved, and industry surveys show that there is high awareness of environmental and climate issues in the sector. As a result of energy efficiency, GHG emissions have been reduced by 36 per cent compared to 1990, while energy production has increased by 57 per cent. Moreover, chemical products save twice as many emissions than what is required for their production.¹¹⁵

Case study 3. Bachelor of Engineering (solar techniques)

To meet the technical requirements of solar cell production, a BA course on solar techniques was recently established at the University of Applied Sciences in Köthen (Saxony-Anhalt) in cooperation with solar cell manufacturers, primarily the solar manufacturing giant Q-Cells. The course teaches a wide range of required disciplines and integrated specialist technical and production knowledge in PV from Q-Cells' solar cell production lines. A special feature of the course is the combination of theoretical knowledge taught at the university and the practical and technical experiences acquired at the companies.

Q-Cells expects the graduates to support the achievement of environmental targets, while the company will be able to lower production costs and energy consumption and make its production process more environmentally sound and resource efficient. Q-Cells supported 16 students in the course's first year. There is still a high demand for these places and the company expects to receive around 300 applications a year.

¹¹³ <http://www.foraus.de/html/1364.php?style=default>

¹¹⁴ Responsible Care is an international voluntary initiative adopted by the chemical industry. It expresses the willingness of the sector to continuously improve work security, environmental protection and health protection.

¹¹⁵ ICCA, 2009.

Case study 4. BiTS Iserlohn (Green Business Management)

The private University of Applied Sciences BiTS (Business and Information Technology School) in Iserlohn (North Rhine-Westphalia) established a Green Business Management¹¹⁶ BSc to meet the increasing demand for qualified graduates in environmental protection and business management. The course includes a 16-week internship at a company and a 4-week “Urban Study” in cities such as Mexico City, Sao Paulo or New Delhi to improve awareness of environmental pollution and environmental protection solutions in countries where environmentalism is not as advanced as in Germany.

There are positive expectations that all students will find a job. The university is trying to build networks with regional and inter-regional companies to promote their course and to enhance the job search for their students. Within the internal network of Laureate Universities, two universities have already shown interest in the Green Business Management study concept.

Case study 5. Service technicians at Siemens Wind Power Training Centre, Bremen¹¹⁷

The Siemens Wind Power Training Centre was designed to enhance the training of its own personnel and customers and to improve health, safety, technical performance and the perceived high quality in the marketplace of the overall Siemens Wind Power brand. The training centre was established due to the massive training needs of both experienced workers and new recruits. The training modules have been developed within Siemens and there is no dependency on external suppliers for the training.

As a result of the establishment of the training centre, the organization of continuing training at Siemens Wind Power has improved and the new training courses have enhanced employees' skills. The additional training also ensures the efficiency, quality and availability of facilities, since well-qualified service technicians can more easily detect faults, as they have detailed technical knowledge of wind turbines, as well as an expanded cross-disciplinary skills base.

Case study 6. Waste management and recycling technician

The waste management and recycling technician (WMRT) occupation was established in 2002 as a 3-year dual training course in three specializations: (i) waste logistics, collection and marketing; (ii) waste utilization; and (iii) treatment or waste disposal and treatment. The course was established to meet the requirements of an increasing technical need within the waste sector, with a view to enhancing training in customer orientation and service orientation, and to improve sector performance and overall environmental protection.

The WMRT training is provided with three specializations to give firms in different fields the chance to select apprentices based on their specific requirements. Thus, a WMRT is supposed to meet the requirements for different types of disposal firms. However, companies still complain about the low number of apprentices, with demand for apprentices sometimes higher than the supply. As demand for waste management, including for reuse in products and as a fuel for generating energy, is forecasted to continue, skilled workers in the waste sector continue to be needed.

¹¹⁶ <http://www.bits-iserlohn.de>

¹¹⁷ The information was collected from an interview with the manager of the training centre.

Case study 7. Plant mechanic for sanitary, heating and air conditioning systems

The trade of plant mechanic for sanitary, heating and air conditioning systems (PMSHACS) was established in 2003 for planning, installing and maintaining complex plants and systems in supply engineering. An increasing number of workers also install energy-saving systems which work with renewable energy sources, for example solar power. The dual vocational training programme takes 3.5 years and was established to enhance customer relations and knowledge about the use of sustainable energy input. The training includes practical work in companies so the apprentices can be trained according to the company needs in specialized fields within renewable energy.

Demand for regenerative heating systems and energy consulting is increasing, opening up broad work opportunities for workers in PMSHACS who are capable of installing, operating and maintaining these technologies. The possibility for continuing training in solar thermal energy or solar power techniques also provides opportunities for adapting knowledge and qualifications for the handling of regenerative plants.

Case study 8. Energy consultant with a focus on energy passes

Due to new regulations, energy passes have become mandatory for sellers or landlords of buildings. Only qualified people are authorized to issue the certificates and, as a response, continuing vocational training to become an energy consultant was established as either one month full-time or 3–6 months part-time.

The technical abilities of certified energy consultants to objectively assess the energy use of buildings and to give advice on improvements to reduce energy use have been assessed to be very high. The training allows workers in the built environment to build on their skill base and to gain employment outside their traditional field, simultaneously meeting environmental regulations and achieving energy efficiency targets.

Conclusions

A key finding is that rather than creating new, specific “green” occupations, many occupations and training curricula have been adjusted and refined to take account of the skills needs of increasingly green aspects of mainstream industry and business as well as eco-industries. In that respect, the skills response has followed an integrated approach. The focus of an integrated approach rather than on a specialized occupation guarantees the flexible use of skilled workers and better job opportunities.

To enhance the green skills provision, further integration for non-environmental occupations needs to be pursued and there needs to be a higher occupational specialization for the environmental sector. Social partners play an important role in the formation of training courses, both in dual training and university training. They are active in shaping the content of new training programmes.

Another important finding of the study is that the majority of workers’ occupations have been modified to take account of environmental considerations, in line with the overall German objective of greening the economy. Whilst new occupations have emerged, their relevance is small compared to the great number of existing occupations which have been modified.

There are sector image issues especially in the areas of waste, sewage and sanitary, heat and air conditioning, where apprentice numbers are low, leading to problems recruiting apprentices in craft businesses.

The collaboration between the Ministry for Environmental Protection, Nature Conservation and Nuclear Safety (BMU), the Federal Ministry of Education and Research (BMBF) and the Federal Institute for Vocational Training (BIBB) could be improved. The BMBF and BIBB are mainly responsible for the education and training system. The BMU can only offer learning and teaching materials, which includes a lot of expert knowledge. The use of these materials should be guaranteed with better cooperation.

Recommendations

It will be important to measure green skills and competencies better, as well as being able to quantify green jobs more systematically to help shape training provision, particularly for higher skilled jobs. Similarly, the job creation effects of environmental expenditures could be further refined. In particular, the net effects of green investments are not being adequately measured. There is a belief that, despite the good overall performance of the supply side, German educational policy has underestimated the environmental sector's high growth and hence skills and labour needs, which has led to some skills shortages.

No skill identification or forecasting system exists which defines the specific skill need for green jobs. Further research is needed to ascertain the demand for additional jobs or other training forms.

A publicly financed lifelong learning system is needed to provide green skills for the labour market at large rather than individual workplaces, in order to enable a larger shift towards a low-carbon economy. Germany has been reluctant to develop such a lifelong learning system, and a declining skills supply, caused by demographic changes, requires a much greater emphasis on this area in the future.

Skills shortages might be prevented by exploring how environmental education and training measures and approaches (including pilot projects) can be used to reduce both the level of students dropping out of school early and improve the career prospects of youth from immigrant backgrounds.

A higher level of occupational specialization will be needed to improve the competitiveness of environmental goods and service suppliers. The supply of professionals will be pivotal to success, particularly if future growth forecasts in the sector turn out to be correct, driving demand for skilled workers.

A higher level of knowledge integration of green competencies will be needed for both the application of environmental technologies and the implementation of higher environmental standards in many non-environmental occupations. This is required to achieve the ambitious environmental protection goals of German environmental policy.

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India

Policy context

Key challenges and priorities for a green economy

The Indian economy is growing fast and is now the fourth largest economy in the world and the fifth largest greenhouse gas emitter, accounting for 5 per cent of global emissions. However, in per capita terms, India's carbon emissions from fuel combustion (CO₂/capita in tonnes) account for 28.5 per cent of the global average in 2008, which is low for a rapidly developing country, especially in comparison with other developing countries such as China which has a per capita CO₂ emission of 112 per cent of the global average.¹¹⁸ India's policies for sustainable development focus on energy efficiency and pricing, renewable energy, a cleaner energy supply, pollution abatement, reforestation and mass transport. These policies could translate into projects that generate millions of "green jobs" in the coming years.

About 52 per cent of the working population of India are engaged in agriculture,¹¹⁹ making this the biggest employment sector. Crop production in India is critically dependent on the summer monsoon, making the agricultural sector vulnerable to climate change impacts. Currently 2.6 per cent of GDP is being invested in adaptation measures.¹²⁰ A major problem is the degradation of national water resources due to excessive water withdrawal for irrigation, industry and domestic consumption.

The Environmental Performance Index¹²¹ identifies broadly accepted targets for environmental performance and measures how close each country comes to these goals. India's Environmental Performance Index score is better than China's or Pakistan's; however, it is not as good as Sri Lanka's or some other large South Asian countries.

The environmental response strategy and the role of skills development

General environmental strategy

The 2008 National Action Plan on Climate Change (NAPCC) outlines a national strategy that aims to enable the country to adapt to climate change and enhance the ecological sustainability of India's development path. The NAPCC comprises eight missions, including a National Solar Mission; a National Mission on Enhanced Energy Efficiency; a National Mission on Sustainable Habitat; a National Water Mission; a National Mission for Sustaining the Himalayan Eco-system; a National Mission for a Green India; a National Mission for Sustainable Agriculture; and a National Mission on Strategic Knowledge for Climate Change.

India has a fifth of its area under forests, with forest cover increasing by 0.8 million hectares per year, despite the pressures of population growth and rapid economic development.¹²² The national target is to increase the area under forest from 23 per cent to 33 per cent. The Prime Minister has announced a Green India campaign for the afforestation of 6 million hectares and, in 2008,

¹¹⁸ International Energy Agency, 2010.

¹¹⁹ CIA World Factbook.

¹²⁰ UNDP, 2009.

¹²¹ <http://epi.yale.edu>

¹²² MEF, 2010.

the National Rural Employment Guarantee Agency – India’s flagship employment guarantee scheme – included forestry activities in the scheme.

Government officials, trade unions and entrepreneurs agree that India urgently needs to focus on renewable energy production. The NAPCC includes the National Solar Mission (as well as other renewable energy technologies) which aims to create 100,000 jobs in the solar energy area within the next ten years. The Energy Conservation Act was passed in 2001 and since then several initiatives have been taken by the Government; one such initiative is the Energy Conservation Building Code, which was developed by India’s Bureau of Energy Efficiency and launched in 2007. It specifies the energy performance requirements for all commercial buildings that are to be constructed in India.

Green response to the current economic crisis

There is no specific green response to the current economic crisis, although 20 initiatives have been launched in India recently relating to greening the economy. These focus on forestry, energy and the Clean Development Mechanism, climate change research, and outreach initiatives.

The economic crisis brought significant primary job losses. The Ministry of Labour and Employment provided data on the change and decline of employment in particular sectors;¹²³ however, this cannot necessarily be directly correlated to jobs in “green sectors”, as the crisis has adversely affected jobs in almost all sectors. Based on excerpts from the proceedings of a conference titled “Green economy: Challenges and responses to changing conditions”,¹²⁴ it appears that more resources were directed to growth than to green jobs. It was also observed that between April 2008 and March 2009, based on the Centre for Monitoring Indian Economy data, India’s net import values of crude oil and petroleum products shot up – reflecting an increase in usage of carbon emitting fuels. This could have been avoided if investments had been made in green renewable energy.

The skills development strategy in response to greening

India has a very young working population. However, a skills shortage exists, partly due to the high dropout rate. More than 44 per cent of India’s school population drop out at primary education level and nearly 84 per cent before secondary level.¹²⁵ This makes it difficult to implement vocational skills development programmes, as these courses (programmes) are available to the students after the middle/secondary school education.

Furthermore, the quality of most Indian graduates is poor and employers offer very little in the way of skills development (16 per cent of Indian manufacturers offer their employees in-service training, compared to over 90 per cent of Chinese firms). The informal economy employs over 90 per cent of the workforce, but there is very little investment or opportunity for formal “skill upgrading” for informal workers and enterprises.¹²⁶

A 13-point action plan for employment in the unorganized (informal) economy is proposed by the National Commission for Enterprises in the Unorganized Sector under the Ministry of

¹²³ Economic Survey of India, 2008–09; Ministry of Labour and Employment, July 2009.

¹²⁴ NISTADS, 2009.

¹²⁵ Kumar et al., 2009.

¹²⁶ World Bank, 2008.

Micro, Small and Medium Enterprises. This includes initiatives for protective measures for workers, measures for marginal and small farmers, measures to improve growth of the non-agricultural sector and measures to expand employment and improve employability.

A recent report by the Department of Science and Technology entitled “National Mission on Strategic Knowledge for Climate Change” acknowledged the need for the identification of skills gaps, capacity building on climate change, and promotion of research and development. Although some steps have been taken to address the skills gap, a national green skills development strategy does not yet exist.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

India has faced the need to balance rapid economic growth and environmental sustainability. To move away from the development model of a fossil fuel based economy to a “green economy”, the entire economic model has to be adjusted. In terms of the labour market, India has high school dropout rates, a large unorganized sector, exploitation and under-employment of labour, a large pool of unskilled labour, and no direct linkages with industry. This necessitates a new approach to skills development.

Green structural change is a massive task; however, India has started to tackle this transition with the eight missions of the NAPCC. Of the eight missions, the Jawaharlar Nehru National Solar Mission and the National Water Mission will be the top priorities for green economic development. The Union Cabinet has approved the addition of 20,000 megawatts (MW) of power in India by 2022. It has been estimated that the solar industry will employ at least 100,000 specially trained personnel across the skill spectrum, including management, engineering, and research and development. The National Water Mission seeks to develop new regulatory structures, with appropriate entitlements and pricing. It also aims to optimize the efficiency of existing irrigation systems, including rehabilitation of systems that have been run down, and expand irrigation where feasible.

The majority of Indian youth seek skilled employment after schooling. In a 2007 Message to the Nation, the Prime Minister outlined a proposed vocational education mission that will open 1,600 new industrial training institutes (ITIs) and polytechnics, 10,000 new vocational schools and 50,000 new Skill Development Centres. This would ensure that over 10,000,000 students get vocational training annually – a four-fold increase from today’s level. The private sector will also assist in training and provide employment opportunities.

Skills response

India has a predominantly agricultural economy, and vocational training and apprenticeships may be the best model to cope with future challenges. There is no dedicated policy highlighting the need for specific skills training. More than 4,650 vocational training institutes in India (among them nearly 500 ITIs) provide training in areas such as craftsmanship, media and women’s empowerment.¹²⁷ The Directorate General of Employment and Training has begun several

¹²⁷ ILO, 2003.

initiatives in skill development through 500 ITIs across the country. Courses at ITIs are designed to provide basic skills in specific trades. Initiatives are also in place to improve training and development of university faculties, to increase placement of trainees as apprentices, and to arrange on-the-job training and industrial visits.

The 11th Five Year Plan Report proposed skills development based on modular employable skills. The target groups of the model are: less educated/out of school youth/unemployed people without employable skills, workers who have acquired skills informally, and ITI graduates.

In the energy sector, both the Bureau of Energy Efficiency and the National Enhanced Energy Efficiency Mission under the NAPCC have specified the training requirement for capacity building in the energy sector.

Changing and emerging occupations and related skill needs

New and emerging occupations

The concept of green jobs is a new niche area, and India has not yet had an opportunity to identify or generate a large number of such jobs. However, in view of global climate change, there is a shift towards energy efficiency and the use of renewable sources of energy. The renewable energy sector is labour intensive and thus numbers of green jobs are expected to increase.

New occupations that are expected to emerge are energy engineers, green architects, hydro-electric plant technicians and energy auditors. The wind industry, for example, will require people with knowledge of intelligent control and quality control procedures, as well as turbine service engineers, operations managers and project managers. Carbon market specialists and climate risk managers are also required. In the agricultural sector, both agricultural meteorologists and agricultural technicians are required.

Greening established occupations

In the renewable energy sector, an opportunity exists to “green” aspects of work in traditional coal-fired power plants. This applies to skilled engineers and accountants as well as to unskilled contract workers such as security guards and those involved in transport.

In the forestry sector, planting trees is a traditional skill and is an area where large numbers of green jobs can be generated by undertaking large-scale reforestation and afforestation projects. The National Rural Employment Guarantee Scheme can facilitate job creation in this area.

India is the largest producer of jute (a natural fibre) in the world. Factors such as emerging green consumerism, concern for occupational health and safety and more stringent environmental legislation are causing changes in the employee skills sets required in the sector. Research is also required on improved practices to safeguard the eco-viability of the crop and protect farmers.

Leather tanneries are being forced to relocate away from residential areas and change their processes to make them more environmentally friendly. This is transforming the leather tanning industry. Similarly, new efficient technologies in the brick industry, such as the Eco-Kiln, require workers to develop skills and change work processes in order to adapt to this technology. There is a need for specially trained firemen (brick firers).

Delhi was the first state in India where the entire public transport system switched over to CNG. Today India is one of the five countries with the highest number of vehicles running

on natural gas in the world. Occupations that are becoming green due to this initiative are bus and taxi drivers, mechanics of CNG-run vehicles and fuel station attendants.

Skills response

Some green skills training is occurring at a sectoral level. The Indian Green Building Council has initiated training programmes in various metropolitan cities in the country. The Ministry of Road Transport and Highways offers short-term training programmes for CNG drivers. Ashok Leyland, one of the largest CNG manufacturers, collaborated with the Delhi Government to set up the Driver Training Institute in Burari in 2005, which trains 2.5 drivers per bus for the new low-floor CNG buses. The Bureau of Energy Efficiency is developing a pilot scheme to test advanced and cost-effective ways to provide information and training to energy managers as well as auditors. Since 2004, the Bureau of Energy Efficiency regularly conducts the National Certification Examination for Energy Managers and Energy Auditors. In the leather industry the Central Leather Research Institute offers a number of training programmes to introduce new technologies.

Very few institutes provide training in green technology, and ITIs have enormous scope to design curricula and syllabi for professions related to green technology. However, the Technology Informatics Design Endeavour along with a development cooperation called the ETC Foundation have been organizing training programmes for women on biomass-based drying technologies. The Energy and Resources Institute and the Indian Institute of Science are also providing training programmes on biomass gasification for manufacturers, technicians, local service providers and state nodal agencies.

The Prime Minister has already announced a Green India campaign for the afforestation of 6 million hectares. The Mission for Green India will rehabilitate degraded forest land through direct action by communities, organized through Joint Forest Management Committees. People employed to plant and preserve trees under the National Rural Employment Guarantee Scheme will acquire their skills either traditionally or through informal, on-the-job training.

Anticipation and monitoring of skill needs

Since the green economy is still at its inception stage, very little progress has been made in identifying skill needs. In the informal economy it has proved particularly difficult to identify the skills gap. However, the need for skills and capacity building has been recognized across the eight proposed national missions, for example energy, water, buildings and forestry. The missions have also underlined the fact that human resources need to be augmented. However, a specific estimation of skill needs in quantitative terms is absent. Although terms such as “green jobs” are being heard more frequently in the corridors of ministries and trade union offices, very little information is available.

The major segments in the vocational education and training sector in India include information technology education and training, manufacturing (various trades related to ITIs) and hospitality management. However, of the nine programmes offered by the vocational training institutes, not even one is devoted to the green technology area.

Summaries of case studies

Nine case studies demonstrate initiatives in greening of existing occupations, such as in tanneries and brick making, as well as new skills in renewable energy.

Case study 1. Barefoot Solar College of Tilonia

The National Solar Mission is a government initiative to promote ecologically sustainable growth while addressing India's energy security challenges. The objective is to establish India as a global leader in solar energy, by creating the policy conditions for rolling it out across the country.

The Barefoot College was established in 1972 with the objective of providing solutions to rural problems such as drinking water, female education, health and sanitation, unemployment, income generation, and electricity and power. The College also addresses social awareness and the conservation of ecological systems within communities. The College serves a population of over 125,000 people, from Tilonia and across the country. The main target of the Barefoot College is to train illiterate middle-aged women from villages all over the world in the use of solar technology. A combination of traditional knowledge and modern skills are offered in circuit assembly and testing, and the manufacture, installation and maintenance of solar lamps, lanterns, charge controllers and home lighting systems.

The College has trained a number of technicians and engineers from developing countries, and it trained about 20 semi-literate rural women in solar technology at the Solar Workshop in Tilonia during 2007–08. The participants were from Bolivia, Cameroon, Gambia, Mali and Sierra Leone. Since receiving training these women have solar electrified 414 households in 12 villages in their respective countries. Associations of Women Barefoot Solar Engineers in Afghanistan, Bhutan and Ethiopia have been registered and in future will be responsible for implementing, monitoring and maintaining initiatives of solar electrification and rainwater harvesting to sustain the barefoot approach.

Case study 2. Energy sector: Conversion from conventional to “green” power plants

This case study involves two projects in the energy sector: a biomass power plant in West Bengal and wind projects in Baramsar and Soda Mada. The biomass plant includes the construction, installation and operation of a 6MW, grid-connected biomass power plant. The generated electricity is fed into the local grid, which is part of India's Eastern regional grid. The 5MW wind power project includes four state-of-the-art wind generators at two locations. The electricity is fed into and sold to the State Electricity Utility under a power purchase agreement.

The management and project teams who developed the projects identified the retraining skills for both projects. Management systems were put in place that allocated responsibilities to various personnel who oversaw the implementation, operation and monitoring of the projects and maintained training schedules to ensure that competencies were upgraded as necessary.

The skills gaps differ for each technology, and future training will be provided by skilled trainers following a structured training plan. The wind project involves complex technical issues, and quality control measures are essential for feeding into the grid. Monitoring and verification of data quality are needed as per the Clean Development Mechanism guidelines.

Skills needed to operate a biomass-based power plant were non-existent in the manufacturer's workforce. As biomass is little used for power generation in the region, local farmers needed to be trained in how to prepare their biomass-waste to supply the power project. Training needs were identified for the operator level, such as for handling biomass, and the operation of the boiler and turbine. Some specialized training was required which coal-based boiler operators do not require.

Case study 3. Water and sanitation related occupations in West Bengal

The Department of Drinking Water & Sanitation's Total Sanitation Campaign has identified that open defecation is the single biggest cause of rampant water-borne diseases, which kill infants and young children and cause millions of lost workdays. However, improving sanitation could generate occupations and income opportunities, which would also lead to heightened awareness.

The Ramakrishna Mission Lokasiksha Parishad (RKMLP), a non-profit organization, started promoting sanitation programmes in 1981 as part of its Integrated Child Development activities in West Bengal. Later RKMLP designed and initiated India's first Demand Driven Sanitation Strategy in Midnapore district in 1990, jointly with UNICEF, and implemented it with the Government of West Bengal and Midnapore Zilla Parishad (district council). The Midnapore Sanitation Strategy now serves as a model for promotion of the Central Rural Sanitation Programme in India. The model involves building community awareness through folk media, and the use of information, education and communication material to generate demand. A sanitation programme is currently being implemented in 4,686 villages. The Ramakrishna Mission Lokasiksha Parishad was recognized by the Government in 2004 as one of the four National Resources Institutes for capacity development of key functionaries of the Total Sanitation Campaign in the country.

Water and sanitation related occupations include production of hardware; the operation, maintenance, monitoring and upgrading of toilets; as well as education and social mobilization. Technical training is provided, in addition to training on organizational and motivational aspects. Courses are held to train village masons in constructing latrines, drilling tube wells and installing and maintaining hand pumps. Villagers (mainly women) are involved in motivational activities, hardware production and maintenance. They had no previous experience of the job; however, effective training was offered. The training in hardware production was informal, on-the-job training by village masons.

Case study 4. Green building architects

The realization of India's ambitious goal of 10 per cent growth in GDP will primarily occur in the cities. Current infrastructure is insufficient, and it will be crucial to make the built environment of Indian cities more liveable, inclusive, bankable and competitive. However, the challenge for India will be to build greener, more efficient buildings: structures that are environmentally sound, consume less energy and water, are safe, durable and can be recycled. The Government of India has also launched "the energy conservation building code" (Energy Conservation Building Code). This code is voluntary and applicable to all buildings or building complexes that have a connected load of 500 KW or a contract demand of 600 Kilo Volt-Ampere, whichever is greater.

The Indian Green Building Council has taken the lead in promoting the green building concept in India. The Council is represented by all stakeholders of the construction industry – corporations, government, architects, material manufacturers and institutions. The vision of the Council is to serve as a platform to facilitate all green building activities in India. Initiatives taken by the Council are registration of buildings seeking accreditation, accreditation of green building professionals and developing a green building rating tool.

Designing and building green buildings in India could create many job opportunities for the construction industry, architects, and material and equipment manufacturers.

Currently, more than 150 universities, colleges and schools in India offer undergraduate and postgraduate architectural degree programmes. Some institutions also offer doctoral programmes in architecture; however, there is yet no dedicated course devoted to green aspects of architecture. There is currently a significant gap between intake capacity and the number of registered professionals. However, a green architect is a new profession so it is not possible to identify and quantify green architectural professionals in India. A few Institutes of Technology have started to offer short courses in green architecture.

Case study 5. Standardization: Public transport on CNG in Delhi

Supreme Court directives are driving greening of the public transport sector in India's cities. Directives of 1998 required the Delhi Government to convert its entire fleet of buses to CNG by 2001. Currently 3,559 CNG buses ply Delhi streets, and air quality standards in the city have improved significantly. According to a Central Pollution Control Board report, CO₂ dropped by 57 per cent and carbon monoxide by 72 per cent in the period 2000–08. Currently at least nine metro cities have been directed by the Supreme Court of India to switch their public transport systems to natural gas-based fuel options.

The shift from a diesel-based mass transport system to CNG involves engine modifications, and requires an increase in two types of employment: filling station attendants and mechanics. Currently the skills gap is more for mechanics, with a shortage of authorized service centres. Building technical capacity will be essential as currently only a few authorized service centres exist. In future over 10,000 buses in Delhi will be running on CNG, and a recent order by the Supreme Court requires that small trucks and other commercial vehicles in the city will have to use CNG only. The demand for CNG-trained mechanics will rise dramatically, as will the need for quality training institutions. In the absence of formal training, non-formal training arrangements are evident, where mechanics trained in diesel engines pick up the knowledge relating to CNG engines through on-the-job training as they work alongside formally trained mechanics.

Case study 6. Tanners of West Bengal

The leather sector is amongst the top eight export earners for India and employs about 2.5 million people, about 30 per cent of whom are women. Leather and hide tanning is one of the major employment-generating occupations in West Bengal, particularly in Calcutta. However, the leather tanning process requires significant amounts of water. In the process, several chemicals are added to the water and, at the end of the process, wastewater is drained along with these harmful chemicals, causing serious environmental, health and hygiene problems.¹²⁸

The Calcutta Leather Complex in Bantala is a purpose-built, integrated leather complex aiming to bring greater investments and employment into the leather industry, and reduce the pollution load. Currently only units within the Bantala complex have been given consent to operate by the pollution control board.

The potential for greening the tanning sector involves technologies and equipment that reduce the use of water, avoid the use of harmful chemicals, treat effluent, and produce solid wastes that can be used as by-products in the tanning process.

The biggest skills gap lies in knowledge of water efficiency. As well as offering regular academic and vocational training programmes, the Central Leather Research Institute has organized on-site demonstration programmes to help the tanners adapt to new technologies. It was observed that lack of skills and knowledge about cleaner technologies is not due to unavailability of training programmes but rather to the approach of owners and managers in the industry who fail to realize the benefits of these technologies. An education and awareness drive is needed, coupled with strict administrative action to force the owners to embrace cleaner technologies.

¹²⁸ NEERI, 1995.

Case study 7. Green farmers of Meghalaya: Green pest management

In 2000, agriculture accounted for about 34 per cent of total GHG emissions in India.¹²⁹ According to a recent estimate,¹³⁰ global pesticide manufacture and usage represents about 3 per cent of the 100-year Global Warming Potential from crops. Adopting greener pesticides can substantially reduce the overall greenhouse gas emissions associated with the production of chemical pesticides,¹³¹ and avoid the contamination of natural ecosystems. Greener pesticides would also provide employment opportunities, both in greening existing occupations and creating new opportunities.

Meghalaya is a small state in the north-east of India. It has a predominantly agrarian economy providing livelihoods to about 70 per cent of the population.¹³² Traditional farming practices are favoured, and use of fertilizers and pesticides is still negligible compared to the national average. However, over the years, the demand for food grain has increased due to an increasing population. Terrace cultivation, a form of settled paddy cultivation, was introduced during the 1980s, but this type of monoculture brought associated pest problems, in particular the rice bug. The Government's response was to encourage the use of chemicals, which contaminated drinking water and affected livestock and fish stock.

In response, the villagers devised a trap using dead crabs to attract the bugs, but this was inefficient and required the manual collection and killing of the bugs. Shri. K. D. Kharkongor, an agronomist with the Meghalaya Department of Agriculture, successfully adapted the traditional trap by using Baffle Traps with dead crabs as bait. However, traditional farmers lack the skills needed for preparing and positioning these traps. Hands-on training can be given on this and other aspects of use. Manufacture of the traps would also provide local employment opportunities. The Government of Meghalaya has incorporated the technique as part of its Integrated Pest Management for rice bugs in the state, and NGOs help provide training to more than 5,000 farmers. However, policy measures and incentives are required to ensure wide-scale application.

Case study 8. Foundry workers of Samalkha

India is one of the leading producers of castings in the world. The foundry industry is labour intensive and employs around 0.5 million people directly and around 1.5 million indirectly. Foundries produce a variety of castings, for example for the automobile industry, flour mills and electric motors. The technology used is outdated and inefficient and energy costs comprise 30 per cent of production cost.¹³³

Samalkha is a small town in the Panipat district, which has about 30 small to medium-sized cast iron foundry units. These units are often family-owned businesses run by entrepreneurs mostly from the Bania caste (traders) who are not highly educated and who may not grasp the significance of a shift from traditional foundries to green foundries. The workers are non-technical with traditional, manual methods of production, who produce low quality products. The unit owners, who lack technical expertise, use inefficient single blast cupola furnaces.

The Foundation of Micro, Small and Medium Enterprises Clusters, a Delhi-based NGO, took the initiative to modernize the traditional technology with the divided blast cupola, with funding from the Ministry of Science and Technology. The energy-efficient divided blast cupola, a technology from the Energy and Resources Institute and the Swiss Agency for Development and Cooperation, has changed working conditions, reduced occupational hazards and improved staff retention. The Ministry of Micro, Small and Medium Enterprises Foundation has developed a range of training curricula and runs class and field based training initiatives to bridge the gap. There has been a substantial reduction in energy consumption of about 40 per cent, and an increase in the trained workforce.

¹²⁹ CAIT, undated. <http://cait.wri.org>

¹³⁰ Audsley et al., 2009.

¹³¹ Paustian et al., 2004.

¹³² <http://meghalaya.nic.in/naturalres/aggriculture.htm>

¹³³ Foundation for MSME Clusters.

Case study 9. Vertical shaft brick kiln: Greening the occupation of firemen (brick firers)

Due to rapid urbanization, the demand for bricks is growing. Currently, India is the second largest producer of bricks after China.¹³⁴ Brick making is the largest source of employment in the unorganized (informal) economy. Typical jobs include soil transporters, moulders and firemen (brick firers). However, most of the work is seasonal, with around six months of employment a year.

The brick industry is an energy-intensive sector where energy makes up 35 to 45 per cent of the total cost. Coal used by the brick industry is approximately 8 per cent of national coal consumption (data provided by Development Alternatives, a New Delhi NGO). In 1992, the Ministry of Environment and Forests made a policy statement aimed at preventing pollution at source and applying the best available technological solutions to the brick industry. Greening the brick industry through technological interventions will involve changes, for example, to green brick fabrication systems and firing technology, as well as increased automation. An example of this can be seen in vertical shaft brick kiln technology, also known as the Eco-Kiln, which is more energy efficient than traditional kilns.

Firemen (brick firers) play a significant role in the brick industry and is the only occupation that requires training for the shift from traditional to greener technology. Although large numbers of unemployed youth are available to take up this profession, they lack knowledge and formal education or vocational training. There is a need to improve vocational training for new brick kiln operators and to establish short-term courses for improving existing skills. In some cases, the local rural population can be trained for operation, thus creating local jobs. Firemen may be particularly in danger of losing their jobs if the green brick industry becomes more mechanized. Therefore a transition is required to re-train “firemen” to “kiln operators”.

Conclusions

India is primarily an agrarian economy. More than half the working population are engaged in agriculture and have below-primary/secondary level of education and no vocational skills. The technical and scientific education system has declined, and a massive expansion of human resources in technical education is required. The process of expansion has started with 15 new Indian institutes of technology, 20 world-class universities and the upgrading of 500 ITIs into centres of excellence. Furthermore, private technical education is also expanding.

According to an Annual Survey of Industries,¹³⁵ 86 per cent of the labour force is in the unorganized (informal) economy which puts India in a very difficult situation as far as the skill set of workers is concerned (as per the 61st Round Survey of 2004–05). The proposed modular employable skills initiative targets less-educated people without employable skills, workers who have acquired skills informally and ITI graduates. Since most unskilled workers primarily work in “green occupations”, the National Rural Employment Guarantee Scheme has a massive implication for green skills. (NREGS is a job guarantee scheme enacted by legislation in 2005. The scheme provides a legal guarantee for one hundred days of employment in every financial year to adult members of any rural household willing to do public work-related, unskilled manual work at the statutory minimum wage of Rs.60 per day.)

The 11th Plan for Employment in the Unorganized Sector gives a 13-point action plan, with most of the employment targeted being in the green economy.

The trade-off between growth and environment is complex, but the Government has introduced several initiatives related to the green economy and has formulated several concrete

¹³⁴ <http://www.bioenergylists.org/cdmbrickindia>

¹³⁵ Government of India, 2006.

programmes to ensure effective delivery mechanisms at national level. The objectives of these are to integrate strategies for achieving key goals in the context of climate change and environmental degradation on a long-term basis. The NAPCC has set eight missions to develop this “green restructuring” of the nation. This requires collaboration between government, academia, industry and NGOs. Twenty initiatives have also recently been introduced by the Ministry of Environment and Forests towards sustainable development and the green economy.

Recommendations

Many government bodies are currently making efforts towards greening the economy, namely the Ministry of Environment and Forests, the Ministry of New and Renewable Energy and the Ministry of Labour and Employment. However, achieving a green economy requires coordination and an integrated approach. A green job audit of each sector would be beneficial to identify suitable training programmes for owners and managers. At an industry level, educating trade unionists is necessary, as they are good channels to raise awareness amongst labour in organized sectors. It is also essential to establish and enforce standards and/or provide financial incentives to force unwilling entrepreneurs to adopt green technologies and processes.

From a technical perspective, skills gaps exist in new technologies, in energy efficiency and in Clean Development Mechanism monitoring skills. Furthermore, there is a lack of alignment between the curriculum and future skills demands – for example, the emerging demand for green construction professionals. In this case, the Ministry of Rural Development and Urban Planning must take initiatives in designing appropriate policies and educational curricula for promoting green architecture.

India has a large but young working population (estimated median age of 25.3 in 2009); however, many people have not received educational and vocational training. Training requirements for the emerging green sector need to be identified in order to improve the effectiveness, efficiency and relevance of training needs. At a higher education level, the syllabi and curricula of ITIs and polytechnics must be restructured to suit the green economy; presently very few courses specifically focus on green occupations, apart from a few initiatives by The Energy and Resources Institute and the ITIs.

Furthermore, short-term courses should be introduced in ITIs and vocational institutions for school dropouts, particularly for unorganized economy workers. This will provide facilities for life-long learning and continuous upgrading of skills. To ensure quality of training, state governments who have administrative control of the ITIs should take the necessary measures for launching courses. Therefore, to identify niche areas in the green economy the Government of India must review the syllabi to meet local environment needs in consultation with state governments.

Little data is currently available on green skills development in India and the information that exists is scattered, with no central database. A sample survey has been proposed, yet this is a lengthy process. Further, comprehensive research is required to study the impact of green jobs on the environment and climate.

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Indonesia

Policy context

Key challenges and priorities for a green economy

Like the rest of the world, Indonesia is facing challenges of climate change and environmental degradation. Particular challenges include the level of fossil fuel burning and land use changes which lead to problems in terms of agricultural production, air pollution, energy usage, shortage of clean water and effective waste disposal.

In 2006, the Government released Presidential Decree No. 5 regarding National Energy Policy. With the enforcement of the policy, it is expected that there will be an increase in the use of renewable energies. Furthermore, in order to support mitigation efforts in the energy sector and to reach the planned level of “energy mix”, energy diversification is important, as is energy conservation and clean technology implementation.

In summary, the challenges for the green economy in Indonesia can be considered as follows:

- land use changes in the forestry sector – emissions originate from deforestation activities, peat oxidation (emissions from organic soils), peat fires and forest burning;
- the energy sector – emissions of CO₂ are from electricity and petroleum operations, transportation activity, commercial and industrial operations, and fugitive emissions;¹³⁶
- the agriculture sector – emissions originate from rice cultivation, fertilization, biomass, and manure management; and
- the waste sector – emissions of greenhouse gases originate from industrial wastewater treatment and discharge, domestic wastewater treatment and discharge, open burning solid waste, and unmanaged waste disposal sites.

The environmental response strategy and the role of skills development

General environmental strategy

Indonesia completed National Strategy Studies in November 2007 for the energy and forestry sectors. Potential programmes have also been identified to reduce emissions from the oil and natural gas, forestry and transportation sectors. National Strategies and National Action Plans have been designed to provide guidelines for all institutions in Indonesia in developing an integrated plan to mitigate and to adapt to climate change and environmental degradation. Aligning related public policy and legal instruments and legislation of the regions is considered to be a matter of “urgency”, especially in the sectors of priority mitigation and adaptation development.

Several programmes in the Ministry of Environment include soft loans for environmental management investments, the Indonesia Clean Production Centre and the PROPER company classification system, based on Law No. 23 of 1997. The PROPER system is voluntary and only about 6 per cent of Indonesian companies participate in this system. The objective of PROPER

¹³⁶ Fugitive emissions are emissions of gases or vapours from pressurized equipment due to leaks and various other unintended or irregular releases of gases, mostly from industrial activities.

is to promote industrial compliance with statutory regulations of pollution control, and to facilitate and enforce contribution to “clean technology”. However, uptake is currently too low to provide any real benefits.

The environmental response aims to cover all sectors in Indonesia, and measures have included institutional development through enhancing cooperation, improving technology and information transfer, developing and strengthening the National Committee on Climate Change and the National Council on Climate Change, implementing a more effective system of monitoring air pollution emissions, strengthening research and development and implementing Environmental Impact Assessment (EIA) in areas such as health services.

However, communication and coordination is lacking among central government agencies, and there is evidence of some competition between regional and central government units. Central government authorities sometimes override well-designed green regional government plans and dictate less environmentally friendly solutions. This is particularly true in cases where central government has authority over other parts of the programme – for example, the national transportation system.

Green response to the current economic crisis

Indonesia’s potential for energy efficiency improvement is large, and investment in the field of energy conservation and efficiency will be highly cost-effective, particularly when energy price subsidies are wound back.¹³⁷ The Government realizes the need for private sector investment to achieve its energy development goals and to meet national energy demand. Therefore, the Government released the Energy Blue Print 2005–25 to promote private investment as one of its core strategies. Measures to reach targets include both fiscal and non-fiscal economic incentives for the private sector, including exemptions of tax, import duties and value added tax for energy conservation, energy efficiency, renewable energy and clean production. In addition, there have been exemptions or reductions from land and building taxes for industries or buildings which aim to conserve energy and promote sustainable construction and development.¹³⁸

The skills development strategy in response to greening

Strong and stable policy and government leadership is required to reach targets in energy efficiency and sustainable energy. Progress in key sectors such as transport, manufacturing, retail, agriculture and recycling is slow. The majority of engineers are unaware of energy-efficient materials, designs and construction techniques. Coordination activities across government institutions should be established with clear roles and responsibilities, with regularly scheduled meetings of experts and government officials to coordinate activities, to monitor action plans, to update status and to improve transparency for industry and the public. Public funding for research and development in Indonesia towards clean and green technology appears to be robust and growing. However, Indonesia’s private sector sponsors this research and technology development on an occasional basis only and does not appear to be engaging in longer term commitments. Consequently, it is increasingly important to involve the private sector in planning national research and to develop a plan to ensure appropriate technology and skills development.

¹³⁷ L. Dhewanthi, 2009.

¹³⁸ Ibid.

As a response to policy changes, new skills needs will arise. The current skills available in the labour markets may no longer match demand. Qualified skilled workers are needed in order to be able to use available technology and resources and to deliver the expected policy measures, economic returns and environmental benefits. The Government is currently lacking an instrument to forecast skill needs including a feedback mechanism.¹³⁹

Technical capacity building and managerial training has been provided to authorities at national and local government level, and in publicly funded sectors and universities. However, the trainings developed by the National Council for Climate Change, formed by the President in 2008, should be promoted to other government institutions, privately owned industries and the general public. Sustainability training is an essential response strategy to develop skills for green jobs and should be embedded in education systems and training at all levels to promote clean production and consumption.

Skills in transition to a greener economy

Green structural change and retraining needs

Environmental issues have become increasingly important in the last decade, prompting some changes in the requirements of businesses in terms of their employees. The increasing awareness of ISO certification and the emergence of ISO consultancy agencies that offer their services for industries demonstrate that environmental issues have led industries and companies to restructure their organization in a way that demands new green skilled workers. The World Business Council for Sustainable Development (WBCSD), which has strong relationships with big companies in Indonesia – such as Astra, Medco, Indocement and others – encourages businesses to consider investing in sustainable systems and emphasizes that this move will create new revenue streams and markets, help to develop new business and reduce dependency on scarce raw materials.

Green restructuring and its impact on the labour market

Therefore, Indonesia's development strategy will emphasize activities such as energy efficiency and renewable energy boosting to reduce Indonesia's reliance on fossil fuels. In order to achieve the targeted energy mix, there is a need for workers in the renewable energy sector. Unfortunately, there is no national labour profile data that shows the changing occupations and the demand for green skills. Therefore, it will be the responsibility of the management of individual companies to identify what positions exist and what skills will be required for future needs.

Skills response

Many Indonesian workers who work in the informal economy have moved to other countries in search of better prospects. Therefore, to achieve a state of sustainable development, Indonesia must improve its formal economy through an upgrading of skills and training programmes.

Indonesia's technology needs assessment has addressed the need for training programmes to increase workers' knowledge on the green agenda, for instance training on environmentally sound technologies. The Technology Needs Assessment also mentions the need for people who

¹³⁹ Medco Energy, 2009.

are able to conduct training sessions with expertise in mitigation and adaptation technologies in different sectors.¹⁴⁰ A mechanism to evaluate and monitor the effectiveness of retraining is identified as necessary, as currently no common evaluation method is available.

Changing and emerging occupations and related skill needs

New and emerging occupations

New occupations, for example in the alternative energies sector and environmental services sector, have emerged as a result of several factors including technological change and new regulations at global, national and local level. For example, the national regulation on EIA/AMDAL led to the development of EIA/AMDAL consultants and the same case applied to ISO 14000 consultants. However, some sectors have emerged due to business opportunities and consumer demand, such as the recycling industry, where there is no legal requirement for individual consumers to manage their waste.

Technological change and availability at a competitive price are other factors that promote the creation of new green jobs. Increasing numbers of solar panel retailers operate in Indonesia and this has led to the new occupation of solar panel electricians. The same has occurred in other alternative energy sectors such as geothermal and wind power. In some cases, the new sector and occupation development has derived from a combination of both technology and regulation factors.

Greening established occupations

The need to “green” established occupations is based on changing market need. Some sectors such as retail have increasingly incorporated green components due to market-driven factors, such as business competition. The increased public awareness on environmental issues encourages retailers to be green in production, processing and distribution in order to attract more consumers. Other sectors have greened established occupations in order to meet the green standards set by the Government, such as those in relation to retrofitting and the recycling of refrigerants.

Skills response

The green sector in Indonesia is still emerging and, as such, green skills responses remain in an early stage of development. A structured and formal green skills response is not fully implemented in all sectors and there is no formal evaluation of the effectiveness of the response developed, neither from the policy and planning side nor from the end-user side.

Based on discussions with officials from the Ministry of Labour, the Government has initiated discussions on green jobs. In response to the demand for skills in new emerging green sectors, such as environmental services, the Ministry of Environment, in cooperation with the Ministry of Labour, started an initiative in 2009 called environmental competency. There are competency standards including a standard for production of products, a standard for the competency required for certain professions and a standard showing the minimum competency required for environ-

¹⁴⁰ Indonesia’s Technology Needs Assessment only covers climate change mitigation technology.

mental services sector professions. Beyond the Government initiatives, private companies are conducting on-the-job training to increase and maintain the capacity of its employees.

Anticipation and monitoring of skill needs

There exists a lack of data related to green jobs and there is no public data available for specific sectors. The same problem exists on the demand-side, with no public data available on vacancies from these new sectors. Thus, in order to realize which new jobs have the highest demand or where these new jobs are concentrated, a comprehensive survey must be conducted in these new sectors. The case studies conducted suggest that the necessary “green” education background for employees varies from one company to another and, whilst some have strict educational criteria in hiring new employees, others do not.

In order to be able to respond quickly to the changing market, a more effective institutional arrangement and cooperation system is needed between stakeholders. The private sector continues to play the leading role in skills needs identification and fulfilment.

Summaries of case studies

Case study 1. Skills retraining – Astra International: Establishing the Astra Green Company

PT Astra International began as a trading company in Indonesia and has widened its scope of business and investments over the years. Formed in 1957, Astra states that they have aimed to utilize available resources to grow alongside the surrounding environment. Today, Astra is a public company with six business divisions:

- automotive;
- financial services;
- heavy equipment, mining and energy;
- agribusiness;
- information technology; and
- infrastructure and logistic value chain.

Astra employs around 117,000 people with various educational backgrounds. By the end of the 1980s, as regulations on the environment were introduced, Astra saw the need to monitor waste and initiated an “environmental laboratory”, which has supported affiliated companies in measuring wastewater usage. Astra initiated recruitment in that year and conducted training sessions to empower their employees. The introduction of Environmental, Health and Safety Management in the 1990s created the need to refocus management, as the reactive programmes had not been successful in building a sustainable business. A more pro-active approach was deemed necessary and led to the birth of a new philosophy: the Astra Green Company, which involved a Green Strategy, Green Processes, Green Products and Green Employees.

Astra now strives to keep updated with international and national policies and new trends regarding environmental issues. In addition, annual targets are set to provide a goal to work towards. In achieving the above targets, the need to have workers with specific green skills becomes more evident. For instance, specific skills are mostly required at plants for wastewater treatment units both for operational purposes and also for machine reparation.

In order to identify training needs, Astra has an Account Officer who will collate all inputs from Astra’s six business sectors. After completion of the training, each company has the responsibility to conduct monitoring and evaluation training sessions. The scope of the training sessions is to develop knowledge and a greater awareness of environmental issues as well as green skills. Training sessions are generally conducted by internal Astra management, although some training sessions employ guest speakers. Employee training and development uses a variety of methods and approaches, including activities outside the classroom, such as on-the-job training, secondment, work rotation and job change.

Case study 2. Skills retraining – Climate field school for farmers

Agriculture is a sector highly impacted by climate change. Season irregularity, shorter rainy seasons but higher precipitation, longer dry seasons, and the increased population of pests are threats to the sector. With 40 per cent of the labour force engaged in agriculture, forestry and fisheries,¹⁴¹ it is crucial to prepare the sector to adapt to climate change impacts.

As part of its larger strategy in dealing with climate change impacts, the Ministry of Agriculture started an initiative to increase the adaptive capacity of farmers to climate change impacts. Although there is no major employment shift in the sector, the case study was categorized under green structural change and retraining needs because the initiative can be regarded as an effort to restructure the sector in order to be able to manage the climate change risks through improving the adaptive skills of farmers. The initiative was named “Climate Field School for Farmers”, or Sekolah Lapang Iklim (SLI). In 2002, the SLI started in one district, namely Kabupaten Indramayu, and has since reached more than a hundred districts.

The SLI was aimed mainly at increasing the farmers’ capacity to be able to interpret climate and weather data (historical and forecast) and to use the data in their decision-making process in order to achieve better yield results. Farmers are encouraged to realize the economic value that this climate forecast information can provide.

To some farmers, the SLI is a very important forum for learning. However, some farmers felt that some of their SLI trainers and the local officials did not have sufficient knowledge and capacity. Therefore, the SLI implementation was not always effective and sustainable.

Case study 3. New green-collar occupations – PT Petromat Agrotech: Enhancing renewable energy development in Indonesia

Petromat Agrotech started operations in 1985 in the area of renewable energy, focusing on the Solar Home System. In 2006, PT Petromat Agrotech conducted the Clean Development Mechanism (CDM) project as an authorized distributor and integrator for the Solar Cooker Project in Aceh, Indonesia. The project is recognized as Indonesia’s first registered CDM project in the United Nations Framework Convention on Climate Change. Petromat Agrotech’s role in the Solar Cooker CDM project in Aceh involved acting as suppliers and training local people on how to use the given Solar Cooker.

The existence of Petromat Agrotech provided opportunities for green jobs to develop, especially for technical staff. Training covered renewable energy skills and knowledge, mostly related to solar energy. Through this project, Petromat Agrotech tried to integrate “green thinking” by retraining employees in order to achieve its goals as a company and provide renewable energy for daily use.

Case study 4. New green-collar occupations – Indocement: Applying alternative fuel for cement production

PT Indocement Tungal Prakarsa Tbk is one of Indonesia’s major producers of quality cement and special cement products. Today, the business focuses on the production and distribution of cement, ready-mix and aggregates. Indocement’s strategy regarding environmental issues covers four areas, namely biodiversity, using waste as a resource, protecting the climate and also reducing other environmental impacts by 2020.

In May 2006, Indocement conducted a CDM activity by reducing their CO₂ emissions through the use of alternative fuels in clinker burning. The project aimed at introducing alternative fuels to substitute fossil fuels, predominantly coal. Indocement used biomass and other alternative fuel types such as rice husks, sawdust, plastics, paper, textiles, used tyres, waste oil, industrial liquid and solid waste.

In applying the above CDM project, the skills of workers were affected. Systems and equipment were installed to include alternative fuel storage, a waste transportation and collection system, and a fuel feeding and burning system. This prompted Indocement to establish a new unit called the Alternative Fuel and Raw Material Unit. This new unit meant that new skills and knowledge were needed and existing skills needed to be upgraded. Both direct workers (such as alternative fuel and raw material technical managers, senior environment and compliance officers, lab analysts, pre-treatment and CDM monitoring officers) and indirect workers (such as waste transporters, waste collectors, those working in waste platforms and laboratories) were required to fill the new green-collar occupations and further training was subsequently provided to equip workers with the necessary skills. All identified positions were filled by new recruitment of those with a specific background of studies and skills relating to this area, since there were no suitable existing workers who could fill the positions.

¹⁴¹ Interview with Eng. Ashraf Abdel Megid, NREA Consultant, March 2010.

Case study 5. New green-collar occupations – Carbon consultants

Carbon consultancy is a new sector in Indonesia which began to develop following Indonesia's participation in the carbon market under the Protocol through the CDM. In order to be acknowledged as a CDM project, the project must satisfy certain modalities and procedures, set by international and national standards. Considering that the process is complex and challenging, carbon consultants are often hired to assist project owners who do not have the specialized capacity to perform the tasks. The sector is growing and demand is high due to the high emission reductions potential in Indonesia. In 2005, there was only one company; however, in 2009, this number had grown to around 20 companies.

In a carbon consulting firm, tasks are generally divided between origination, qualification and evaluation. The case study focuses on the tasks of the qualification team, which includes conducting due diligence, stressing the additionality of projects and project design documentation and processing.

In order to undertake these tasks, a combination of technical and financial skills is needed and, following the hiring of employees, internal training is provided to ensure a thorough understanding of CDM requirements. Continued training is also provided to maintain and update knowledge on new developments and new decisions on methodologies by the CDM executive board.

Although the carbon calculation is a new field, there is no capacity-building assistance provided by the Government or international agencies to increase and develop skills within the country. However, business and professional associations exist, such as the Project Developer Forum at a global level, and the Carbon Market Investor Association, with objectives to sustain the CDM market through a better dialogue between the carbon investors and the countries' delegates.

Case study 6. New green-collar occupations – Community-based ecotourism

Deforestation is one of the major environmental challenges faced by Indonesia, disturbing the ecosystem and the lives dependent upon it. In addition, deforestation is one of the major global GHG emission sources, and this makes finding solutions to deforestation a necessity in mitigating climate change.

Community-based ecotourism is considered a comprehensive tool to conserve biodiversity and to involve local communities and organization in a participatory way to derive maximum benefits in a sustainable way. This case study looks at the necessary skills to be able to develop community-based ecotourism and is based on interviews with the Indecon foundation, a local non-governmental organization that focuses on community-based ecotourism in Indonesia.

Since 1995, Indecon have facilitated various ecotourism site developments in Indonesia, mainly by conducting research on the ecotourism potential and later training the stakeholders to develop and provide ecotourism services. There are four aspects that need to be considered in developing a community-based ecotourism site: 1) product development; 2) capacity building on organizational or institutional strengthening; 3) internal policy that influences the site and outside the site; and 4) financial – microfinance including benefit distribution between communities' members.

Indecon therefore focuses its training and skills development on areas that include research and planning, capacity building, destination development, marketing, monitoring and evaluation. Improving technical capacity is one of the key success factors in achieving sound and sustainable ecotourism management. Empowerment will not only be enhanced at a local community level, but more importantly at the level of tourism developer, programme manager and decision-maker. The increase of both human resources and organization capacity (including skill and knowledge) is one of Indecon's priorities. Necessary skills that are lacking are identified in the initial stage of the project via assessment on the potential weakness of the targeted communities.

One of Indecon's sites is located at Tangkahan village in Gunung Leuser national park, Aceh province. Indecon initiated collaborative management between the community of Tangkahan village and Leuser national park. Prior to the collaboration, many villagers worked as illegal loggers; however, the collaboration engaged with the community and enabled them to provide ecotourism services in the national park. While the park management is still the responsibility of the national park office, the ecotourism activities are conducted by the communities. Villagers were given training to become "eco-guides" and were able to identify exotic flora and fauna living in the park, as well as carrying out sustainable practices and transferring this knowledge to the tourists.

Case study 7. Greening existing occupations – Medcoenergy: Adjusting company with renewable energy (geothermal)

MedcoEnergy is an Indonesia-based group of integrated companies, engaged in the energy sector with a focus on oil and gas exploration and production, power generation and downstream industries. The group is committed to supporting the Government's strategy to meet the nation's future energy needs in a responsible way. Today, MedcoEnergy employs around 2,100 workers within MedcoEnergy International and its subsidiaries.

For Medco Group, "green jobs" have emerged in the area of renewable energy and energy efficiency, specifically related to geothermal, ethanol and fuel switching activities from fossil fuels to non-fossil fuels. Medco Group plans to participate in the Government's second 10,000 MW power project by developing renewable energy and energy efficiency projects. The Group has established an ethanol division in order to anticipate the sustainable development in the power and industrial sectors. The activities in this area will include using raw materials for producing methanol in collaboration with local farmers.

Medco will employ direct workers who have the capacity and capability to work for Medco, such as an Environment and Compliance Manager and staff for the environmental division. Indirect workers will also be important, as Medco requires the cooperation of farmers and field supervisors. Employees will also partake in training sessions to increase their capacity. Two examples of trainings that are undertaken by Medco are hazardous waste handling and Environmental Management Systems ISO 1400. New positions are hoped to fill the skills gap between current skills and the new skills required in Medco.

Case study 8. Greening existing occupations – the Green Building Council: Enforcing green building development in Jakarta

The effective management and design of a building can contribute not only in terms of carbon emissions reduction, but also in effective waste management in a building. The Green Building Council (GBC) in Indonesia is a non-profit organization that is trying to raise the awareness of people's working environments and promoting "Green Building" in the planning, development and also maintenance of a building. Since Jakarta is a city compacted with buildings, the other way to establish the green building concept in Jakarta is through retrofitting. Currently, the GBC is engaged in a project working on Jakarta's city hall. Training sessions are conducted for internal staff and also for relevant external personnel, to improve and broaden capabilities in terms of green rating systems and certification tools.

One GBC strategy is to create green certification tools for both new construction and existing buildings. These green tools – called the GreenShip Rating System – are a set of voluntary performance standards for the sustainable design, upgrade and operation of buildings. The tools provide sustainable guidelines for building operations, periodic upgrades of building systems, minor space use changes and building processes. Positions advertised within the Council include Energy Manager, Operations Manager and Head of Green Champion Activities. For these positions, skills required will include knowledge of how to operate appliances in such a way that energy usage will be more efficient.

Conclusions

Case studies demonstrate that companies in all sectors are facing increased environmental regulations and are being encouraged to meet certain standards. Companies are conducting training and re-skilling their employees; however, new occupations are also emerging. ISO certificates related to environmental issues will continue to develop and will increase in importance. As a consequence, staff will be trained according to any policy development.

Case studies have shown that training methods include workshops, on-the-job training and group discussion sessions; however, the most suitable ways of improving workers' skills will depend on the nature of the work or positions offered and participants' educational backgrounds. There seem to be few linkages between the private sector and education sector, especially in

terms of green issues, which is an area that could be improved to help fill the demand for green skills. Further studies will need to be conducted to obtain more detailed data on green jobs in each sector in specific activities, to assess where the gaps and demand exist.

Recommendations

Policy recommendations

Indonesia should maintain an attractive atmosphere for investment in its energy sector by considering the reduction of energy subsidies as an instrument to promote energy independence. More generally, inter-ministry coordination needs to be strengthened between the Ministry of Labor and the implementation sectors, such as the Ministry of Energy, Ministry of Forestry and Ministry of Environment. Cooperation must also be encouraged between the central government and local governments.

Promoting the use of renewable energy can be achieved through providing incentives to stimulate investment in renewable energy and the adoption of energy conservation and energy efficiency. Thus a public information campaign aiming to raise awareness would be recommended.

It is recommended that the energy price be restructured gradually to enable the price to reflect the actual cost of energy by taking environmental cost into account. Energy diversification, energy conservation and clean technology implementation is important in achieving a low-carbon economy and promoting green skills. Green restructuring also needs to take community-based industries into consideration, as they contribute in moving towards a green economy.

It is essential to maintain a holistic approach and encourage coherence between skills development policies and environmental policies to allow the promotion of skills for green jobs. It has been suggested that policy support to strengthen workers' organizations will improve the identification of needs for green restructuring. Furthermore, mapping existing skills across sectors and identifying training needs to move towards the green economy is essential.

Recommendations for education and training

- Creating a map of skills as an initial step towards skills upgrading. Assessment of the potential of green jobs and monitoring of such jobs would constitute a basis for adaptation of national vocational training and education systems over the medium term. This skill development would be expected to tie in with policies and investments.
- The Government should develop with all energy efficiency and conservation stakeholders a capacity-building plan that supports and delivers energy efficiency and conservation plans and strategies.
- Compiling data on national energy research and development and training, including activities by universities and the private sector, will allow for improved assessment of the cost-effectiveness of activities.
- Providing additional support to the Agency for Education and Training, the Ministry of Energy and Mineral Resources and the Ministry Research Centre, to enable these institutions to make the transition from traditional fossil fuel resources to clean energy technology, including energy efficiency and conservation.

- Providing sufficient resources and training of the trainers, in government training centres which are responsible for capacity building, so they can provide training in areas including bio fuels, renewable energy, energy efficiency and energy conservation.
- Pursuing enhanced international collaboration opportunities to benefit technology development in renewable energy, energy efficiency and energy conservation.

Recommendations for further research and data collection

As labour data is very limited for green jobs, it is recommended that a further study be conducted to understand the magnitude of these new green jobs in order to be able to develop strategic plans to build local capacities. Whilst this study has aimed to provide a general overview on several sectors, it is advised that follow-up studies be conducted for specific sectors in order to be able to develop sector-specific strategic plans.

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Mali

Policy context

Key challenges and priorities for a green economy

The agricultural sector is the backbone of Mali's economy: it contributes over 40 per cent of national GDP and provides the primary means of livelihood for more than 80 per cent of the country's population.¹⁴² The performance of the agricultural sector and its capacity to adapt are the key challenges in the future for the economy of Mali. The key drivers towards a transition for greening Mali's economy will depend on how the policy environment evolves to foster a paradigm shift in agricultural development that ensures the sector is more resilient to climate change and environmental degradation such as desertification and loss of soil fertility.

Strategies or policies specifically geared towards greening the economy are not currently in place and the term "green job" is not commonly known in Mali. However, various activities exist that are driven by the need for markets to adapt to the current economic situation, and by the need to develop employment markets that address youth unemployment and difficulties faced especially by the primary sector due to climate change.

It is evident that greening the economy is still regarded as a burden rather than an opportunity. However, there is gradual recognition that there is significant potential for green jobs in Mali, both for the creation of new occupations as well as developing new skills within existing occupations. Some of the most promising economic sectors in Mali include energy supply with renewable energy, agriculture, waste management, construction, forestry and carbon finance.

The environmental response strategy and the role of skills development

General environmental strategy

A series of droughts struck the country between 1970 and 1980, which resulted in environmental and climate change issues being incorporated in Mali's development plans and policies in 1974. However, during that period strategies and policies concerning environmental protection were focused on sector policies (agriculture, forestry, water, household energy etc.) as emergency measures to reduce the impacts of drought and related issues. Gradually, due to the persistence and intensity of drought the Government gave greater priority to the management of the environment and natural resources by integrating this into their policy for social and economic development.

Mali has subscribed to many international agreements and conventions related to the environment (it ratified the UNFCCC in 1994 and the Kyoto Protocol in 2002) and is implementing several programmes and environmental management plans such as desertification, environmental action and national environmental policy plans. Furthermore, Mali has also signed more than 30 conventions related to environmental protection. Currently, Mali is incorporating climate change into national development plans, including the National Action Plan for Adaptation, which was developed in 2007. This plan has identified nine priority projects, which are not yet implemented. Further key strategic policies and programmes that relate to adaptation and mitigation measures

¹⁴² GPRS II: IMF, 2008.

in response to climate change and environmental degradation in Mali include: the Programme of Economic and Social Development (PDES); the Strategic Framework for Growth and Poverty Reduction (GPRS II); a Decentralization Policy; an Agricultural Orientation Law (LOA); an Energy Policy; the National Policy for the Protection of the Environment; and the National Communication on Climate Change.

Green response to the current economic crisis

Mali has not as yet developed any official strategies in response to the current economic crisis. The Malian Federation of Employers (Conseil National du Patronat du Mali) conducted a study about the impacts of the global financial crisis on the Malian economy, and presented the results in a seminar in October 2009. However, greening elements were not specifically considered as part of this study.

The skills development strategy in response to greening

Potential exists for increasing the number of green jobs in Mali, both for the development of new occupations and new skills for existing occupations. Some of the most promising economic sectors are renewable energy, agriculture, waste management, construction, forestry and carbon finance.

Major concerns of the GPRS II and the PDES are creation of, and access to, sustainable jobs (as well as job security), especially for youth. The National Employment Policy was adopted to achieve these objectives. Tailoring training strategies to labour market needs has been identified as the best method for developing the required skills and creating jobs. However, this skill development strategy lacks a specific green skills aspect – likely due to the fact that when most of these policy and programme documents were elaborated, climate change was not a priority. The importance of developing the education system to align with the necessary skills development has been recognized but not yet integrated into existing policies.

Some efforts have been made to increase skills development within educational, agricultural and adaptation policies; however, a coherent national strategy specifically targeting the skill needs for greening the economy does not yet exist.

Skills in transition to a greener economy

Green structural change and retraining needs

Unpredictability in climate conditions leaves crop farmers, livestock farmers and fishermen in a particularly vulnerable position. Therefore retraining in the agricultural sector has been recognized as a necessity in order to cope with the impacts of climate change. In the field of agriculture a key issue is developing appropriate water management systems for both surface and underground water. New ways of raising livestock are being considered as a nomadic lifestyle and transhumance (the seasonal movement of people with their livestock) are becoming more difficult to practise. The fishing sector requires a shift to more sustainable fish farming practices. Furthermore, “adding value” to primary resources is essential – for example, developing technologies which use agricultural by-products for energy generation.

However, the main issue is finding the capacity, skills and facilities in rural areas for carrying out the training. The Malian Government, through its different projects and programmes, has a key role to play in this along with civil society and the private sector.

With more than half of Mali's population under 30 years old, much (re)training is needed to adapt the Malian economy to cope with the negative impacts of climate change. Some work has already been done on this and strategies are being implemented by the Government, for example the Agency for the Promotion of Youth Employment and the National Agency for Employment run training initiatives targeting rural areas. The Employment Intensive Investment Programme assists in hiring young people during the dry season. Civil society has also developed several initiatives for training farmers working in environmental businesses.

Green restructuring and its impact on the labour market

Due to the impact of climate change, the economy and the labour market need to shift towards a more green approach. This is slowly happening: for example, there are an increasing number of agribusiness initiatives for adding value to agriculture, milk and livestock products at the local level. These include solar dryers for fruits and vegetables, small agricultural processing units running on liquefied petroleum gas (LPG) instead of petroleum products, and cashew processing units. Small-scale initiatives based on the production and sale of compost (from agricultural waste and solid organic waste) are emerging in cities.

In the energy sector, the Government of Mali has given tax exemptions for renewable energy equipment, which is contributing to the development of solar and other renewable energy businesses. Since Mali has available land, an increasing number of initiatives are working on the development of biofuels (biodiesel and bioethanol) from jatropha, cassava and sugar cane.

Even though a shift towards a greener economy is not yet evident in national policies, local and national initiatives in both the private and public sectors are greening.

Skills response

The Government of Mali set a clear priority to make agriculture the backbone of national socio-economic development; however, this is also the most vulnerable sector to climate change impacts. Skills retraining within the farming sector focuses on adapting to climate change, and training in other livelihoods to support or replace loss of income from farming. This concerns both men and women as most of the population in rural areas are dependent on farming.

Mali will need to build capacity at all levels of the public and private sectors. Government ministries have acknowledged that the planning committees could be retrained to become aware of the impacts of climate change, and the benefits of greening the economy. RESO Climat-Mali is a network of civil society climate organizations, which is managing the first adaptation fund from SIDA for NGOs with a capacity building and skills development component, in order to make the most vulnerable communities more resilient to climate change.

In order to develop opportunities in renewable energy, a need has been identified for an appropriate training programme targeting youth in rural areas in designing, developing and maintaining appropriate energy and transport technologies. Capacity building is also required around integrating energy and transport with agricultural production.

Technical and vocational education and training are being promoted by the Sectoral Investment in Education Programme. The Government has also set up funding facilities to target the (re)training needs of the Malian economy for job creation. These initiatives include the Vocational Training and Learning Support Fund, the skills response of the National Agency for Employment, and Agency for the Promotion of Youth Employment development projects, which

provide vocational training for the disadvantaged. The Units for Training and Support for Enterprises is a public scientific and technological facility, which was created by the Government of Mali together with the French Government. These units do not have any strategy for meeting the challenges of greening the economy, but address the demands coming from various clients, which may include green components.

Changing and emerging occupations and related skill needs

New and emerging occupations

Sectors with new emerging green-collar opportunities are in the agricultural meteorological sector, the waste management sector, green energy, biofuels, carbon finance related occupations, and research.

Biofuel from jatropha is becoming a popular replacement for imported fossil fuel. The need to expand this industry has given rise to new skills gaps for nursery growers, producers and jatropha oil motor operators, and for developing its use at a local level. It is also important to train operators of multifunctional platforms and other machinery (agricultural, transport etc.) in adapting and maintaining their equipment for the use of jatropha biofuel.

The agricultural meteorological network in Mali has a major skills gap in terms of training, adaptation of skills (retraining) and recruitment of qualified personnel. Furthermore there is a need for new weather stations and state-of-the-art equipment, particularly for remote detection and processing satellite images. Increasing and improving the skills within that sector offers opportunities firstly to create new occupations and secondly to prepare existing farmers for the unpredictability of weather patterns due to climate change.

In the area of energy, the greatest opportunities for creating new green jobs are in rural electrification, energy production from agricultural residues, energy efficiency and various applications of solar energy.

The waste collection industry in Mali is shared between municipalities, the private sector and NGOs. New occupations exist for waste information workers, recyclers and waste artisans.

Mali currently lacks national experts in carbon finance projects; however, once a mechanism for training national experts is established, this is an area for potential skills development.

Greening established occupations

Agriculture is the largest employment sector in Mali. However, within this sector new skills are required to better understand climate change and its mitigation and adaptation impacts. Traditional farming practices – and crop varieties – are no longer profitable with a changing climate. For many farmers new part-time occupations are arising, related to local production and maintenance of equipment, ecotourism etc. Fruit and vegetable gardening are being expanded to provide additional income sources.

The current construction industry focuses on modern concrete construction, which is less energy efficient than traditional Malian clay construction. However, expertise in traditional clay construction is very limited in the construction sector. A programme is needed to cover all sectors of building and construction for greening, including the identification of appropriate sites for provision of local construction materials and identification of local masons with knowledge of traditional clay construction.

Skills response

In Mali the greening of the labour market has not yet been identified as a priority, therefore skills needs have not been directly addressed by any agency or programme. However, various organizations could tackle the identification of skills needs for a greener labour market, for example the Observatory Department of Employment and Training of the National Agency for Employment, and the strategic planning committees of various ministries. Since skills needs for the green jobs labour market had not been identified in Mali prior to this study, there has not yet been any intentional skills response.

Anticipation and monitoring of skill needs

It is evident that Mali is at a very early stage of identifying skills needs for a green economy – in fact this study is the first to assess and record needs and activities. Training and skills needs have been identified across the agricultural, energy, meteorological, construction and waste management sectors. Furthermore, awareness raising and education has been recognized as an important area for development.

Existing mechanisms – such as the ministerial planning committees – could monitor the identification of existing skills sets and could oversee the implementation of programmes, if trained on issues related to climate change, and the benefits of greening the economy. In terms of the impacts of climate change, it would be possible to undertake a climate screening such as that undertaken by DANIDA as part of its development programme for Mali.

Civil society and NGOs are also implementing various initiatives that are contributing to skills development, especially in rural communities.

Summaries of case studies

Seven case studies were presented in the full country study, particularly related to the agricultural sector and skill shifts in response to adapting to climate change. Two case studies focus on new opportunities in the energy and waste sectors.

Case study 1. Disappearance of the agricultural sector in the Sahel: Climate change and desertification

The area of Mali is estimated at 1.2 million km², of which 14 per cent is suitable for agriculture, with the rest being mostly desert. The area of cultivated land has increased – between 1970 and 1995 alone the area increased from 1,967,000ha to 3,472,000ha,¹⁴³ which represents an increase of 15 per cent in forest clearance. However, this increase in area of cultivated land has not been accompanied by an increase in food crop yields, which have remained low. The costs of soil degradation to the Malian economy are between 20.9 per cent and 26.5 per cent of GDP, or twice Mali's foreign debt (National Adaptation Plan for Action – NAPA).

Climate change together with desertification has already had serious impacts on life and farming practices in Mali's Sahel area. Due to demographic pressure and poor soil productivity, the cultivated area has doubled in the past 10–20 years, with limited increase in yield. Many species and varieties cultivated in the past no longer thrive, and have been replaced by other species and short-cycle crop varieties. Farming as a principal livelihood no longer provides enough food and income for families, and therefore many have been obliged to adapt to the situation in different ways, most importantly by migration – particularly of young people to other parts of Africa or Europe. Transhumance causes conflicts between local southern people; and numbers of people moving with their herds from the north are also steadily increasing.

¹⁴³ DNSI – now named INSTAT (undated).

Case study 2. Water and fish resources and climate change: The case of Mali

Mali is crossed by two of the largest rivers in West Africa, the Niger (4,200km long, of which 1,700km is in Mali) and the Senegal (1,700km). These two rivers and their tributaries form an immense hydrographical network located in gigantic catchment areas (300,000km² for the Niger and 155,000km² for the Senegal) which Mali shares with 12 other countries. The rivers, whose basins are home to virtually the entire population of Mali, play an essential role in the national economy. They are the main source of drinking water as well as the basis of every sort of economic activity including agriculture, animal husbandry, fishing, industry, transport and trade.

Fishing in Mali is an age-old activity which was originally undertaken by traditional tribes. Today it is also practised by farmers who are experiencing a decrease in crop yields and are therefore no longer able to support themselves. This has led to an intensification of fishing. As a result, people have designed more sophisticated fishing apparatus and are using toxic substances and explosives. Currently, rates of extraction are exceeding rates of re-growth of the fish population. Today over half of the aquatic population has disappeared. Erosion of river banks is occurring as a result of various factors. The water courses can no longer be fished, causing major challenges as this was a very important source of nutrition and revenue.

Case study 3. Mali's emerging jatropha biofuel sector

The use of biofuels in place of imported petroleum products could have positive effects on the local economy by creating jobs in the rural areas and providing a new source of income. At a national level macroeconomic benefits include a reduction in the cost of importing petroleum products and stimulation of the whole economy. The general aim is to enable the Malian Government to diversify its sources of energy, as well as to develop good policies on adaptation to the effects of climate change.

Small-scale jatropha plantations are providing work and income for women and youth. Plants have been built for converting jatropha nuts into oil, cake and residue. The products are used to fuel mills and charge batteries, or as an ingredient in soap or fertilizer. Farmers are now learning how to produce jatropha and mill operators are learning how to use the oil in their motors. Eventually some will be able to buy their own presses and produce jatropha oil either for sale or for engine lubrication.

A rural electrification programme based on jatropha biofuel arose as a result of insistent requests from the local population to have access to modern energy services. This innovative project will supply electricity and other modern energy services to more than 10,000 people in the community of Garalo. The people of Garalo will develop a plantation of 1,000ha of jatropha (of which 600ha have already been planted) to supply the oil required for the plant to generate clean electricity. It has been estimated that the use of biofuel for the electrification of Garalo has created about 50 jobs for biofuel technicians, machine maintenance technicians and jatropha nursery workers.

Case study 4. Agro-meteorological assistance and job creation opportunities in Mali

Since the creation of the first meteorological stations in 1895 there have been many periods of drought in Mali. Variation or a reduction in the length of the growing season destabilizes farming production, degrades the soil and vegetation, diminishes water resources and causes cultivation pests to proliferate. The Meteorological Office has set up a monitoring system in order to minimize these impacts. As part of a rural campaign entitled "May to October" an information bulletin on farming and rainfall is produced and distributed every ten days by the multidisciplinary Working Party for Agro-meteorological Assistance, composed of representatives of the Agricultural Department and the Meteorological Office and experts on hydrology and communications. The bulletin gives details of the weather and rainfall for the previous ten days, as well as crop status, status of rivers, pastureland and pests. The bulletin provides a forecast for the following ten days and gives various advice to the rural population.

Strengthening the agro-meteorological network would benefit vulnerable farmers and create new jobs. For example, additional meteorological assistants could reinforce the data collection network, as well as improve weather forecasting skills and the communication of weather and climate information. Local data can be collected by officials at the weather stations, by officers in the local information centres and literate farmers. Furthermore this agro-meteorological assistance has encouraged the development of the SIMPLAST factory in Mali – for the manufacture of the local pluviometer called the "farmers' rain gauge" at a cost of 3,000 FCFA compared to an import price of 150,000 FCFA. Sales points exist in some communities, providing a source of employment for young people and associations.

Case study 5. Farmers in the context of climate change

Almost 80 per cent of Mali's population derives its income from farming. The Government has also set the development of agriculture as its priority area due to food security. However, because of the changing climate, traditional varieties and farming practices are no longer profitable. The huge demand for firewood and charcoal in the cities means that wood selling and charcoal production have become popular and relatively secure income sources, regardless of rainfall patterns.

Training is needed for adaptation to climate change in the farming sector, and also training in other livelihoods to support or replace income from farming. This concerns both men and women as most of the population in rural areas live from farming.

The male population is primarily involved in the farming sector, but due to the changing climate and desertification, farming is not as productive as it used to be. Income from farming is insufficient to support a family, and therefore young men are often sent to cities or other countries to earn money.

Women are traditionally involved in shea nut farming and gathering firewood to sell. This case study included a development project where women are supported to start new income-generating activities instead of selling wood. The interviewed participant is now growing chillies and vegetables in a women's collective garden. Additionally she sells soap in the local markets, for herself and for the cooperative, of which she is a founding member. Part of this project included a literacy programme through which she learnt to read, write and do calculations.

Case study 6. The renewable energy sector: Renewable energy technician

The energy sector is now one of the fastest-growing sectors in Mali. Less than 20 per cent of the population have access to modern energy services, and in rural areas the figure is less than 10 per cent. Access to energy has recently been reprioritized as a key prerequisite for economic development in the updating of Mali's Poverty Reduction Strategy Paper (GPRS II). Energy, particularly renewable energy, has increased its profile significantly internationally and in Mali.

Mali's population density is very low due to its vast size and low population of about 12 million, so grid extension is not a realistic option for much of the country and a decentralized approach is required. The Ministry of Mines, Energy and Water Resources created the rural electrification agency AMADER. It is responsible for providing concessions for rural energy service companies and for providing subsidies to allow those companies to operate. This indicates political will – as well as action – to support decentralized energy supply. This case study considers the greening of new skills required by technicians working in the field of renewable energy such as solar, wind or biofuels. These technicians would typically be involved in the installation, repairs, operation and maintenance of decentralized rural renewable energy equipment.

The latest renewable technologies are more advanced and cheaper than energy from fossil fuels, and hence are becoming more widespread. Some success stories exist of trainees who have learnt on the job in traineeship posts in renewable energy technologies. This kind of greening of technicians' jobs is not yet a widespread phenomenon in Mali, and seems to be limited to certain sectors – such as the solar industry, which is building up a stronger regional presence. It is important for educational and vocational training facilities to stay at the forefront of technological development in order to provide a sustained supply of green workers.

Case study 7. Waste collection, separation and re-use in Bamako

This case study focuses on solid waste collection, separation and re-use in Bamako, the capital of Mali. The Bamako district is divided into six urban municipalities. The population of Bamako was around 1.4 million in 2001¹⁴⁴ and is growing very fast. In the 1960s, following independence, the municipal authorities assumed responsibility for collecting waste. By the 1990s, the growth of the city, combined with administrative difficulties and a lack of ongoing investment, led the Government to accept the participation of waste management enterprises and non-profit organizations. Small enterprises known as Economic Interest Groups (Groupement d'Intérêt Economique or GIE) began to complement the municipal collection system in specific neighbourhoods by establishing a clientele of households who pay monthly fees for waste collection. These fees vary between 1,500 and 2,000 FCFA (2 to 3 euros) per household. It is estimated that about 60 per cent of the waste is collected by the GIEs or cooperatives.

In the district of Bamako, platforms have been created to bring together the various organizations involved in urban waste management, such as the Steering Committee of Urban Waste in Commune IV and the Committee of Management and Waste Recovery, who bring together the local council, Economic Interest Groups (small enterprises – GIEs), community associations of women and youth, local leaders and farmers. These platforms have tried to regulate the disposal of waste by setting prices and improving access, in consultation with the Department of Urban Services: Roads and Sanitation.

New job opportunities have emerged such as sorting organic waste for composting. MSEs are recycling electronic waste, and manufacturing road pavements from compacted plastic bags and soil. With the high demand for recycled plastic from plastic manufacturing industries, women and children are assisting in sorting plastics. Women's associations have also been created for recycling plastic bags, which are then sold or re-used as fibre for bags and baskets.

Conclusions

The main concern around climate change for Mali is adaptation within the agricultural sector. Currently actions on climate change are uncoordinated and the country lacks a national strategic framework that defines Mali's vision. An analysis of policies, strategies and key development programmes in Mali (GPRS II, PDES, LOA etc.) shows that the impacts of climate change are not a priority, despite Mali's considerable vulnerability, as outlined in the NAPA. Furthermore, the adaptation priority actions set out in the NAPA are yet to be implemented.

Education, skills and employment policies and strategies do exist and Mali has committed to international and national environmental policies. However, green skills and a green economy are not yet a priority across national policy-making.

The benefits of shifting to a green economy and using this as a way of promoting Mali is slowly being recognized, and suitable delivery mechanisms are being proposed. As far as the public sector is concerned, the planning committees of various ministries – if provided with the right tools and capacity – would be well positioned to anticipate or reorganize programmes which are vulnerable to climate change. Civil society and appropriate NGO networks such as RESO Climat-Mali will play a role in strengthening the skills of NGOs to access rural communities. The private sector is being supported by FAFPA (Fonds d'Appui à la Formation Professionnelle et à l'Apprentissage), which is providing financial resources to the private sector to undertake training and skills development in various areas; this will allow their activities to be run in a more sustainable way.

¹⁴⁴ DNSI – now named INSTAT (undated).

At the core of any new green shift in the Malian economy, and its skills and labour market, lies the need for a strong educational and vocational foundation that increases awareness at both local and national level.

Recommendations

Climate change has only come to the forefront quite recently in Mali and therefore is not included in the policies and programmes developed some years ago. Incorporating a greening aspect to various policies and strategies would benefit the sustainable development of rural as well as urban areas, and could bring added value. Capacity building is also needed at the level of administrators and policy-makers, as well as in the planning of higher education.

In the agricultural sector, new green jobs could reduce the rural exodus and motivate youth to stay in rural areas. In the farming sector, the recommendations focus on three axes: natural resources, land tenure and equipment. Development of skills on agro-processing and value adding will be very important in the local economy. Micro-credit schemes facilitating access to equipment and locally organized training are other recommendations. Capacity building for the preservation of farming land and developing other income-generating activities at village level would be beneficial. Fish farming should also be developed in rural and urban areas and additional training about the dangers of water pollution needs to be rolled out for households, industries and agriculturalists.

In terms of skills development it is important to decentralize skills training from the cities into the village areas, and to target youth and women. Training needs include training of trainers, gender aspects, communication, innovative market approaches, and networking and cooperation. The involvement of microcredit institutions needs to go beyond providing financing by also assisting applicants in developing business plans.

In the field of meteorology, extending the agro-meteorological coverage regionally by training local people, and designing a sound capacity-building structure, will prepare vulnerable farmers for the negative impacts of climate change and create new job opportunities.

In the renewable energy sector, well-trained solar technicians for example are required not only in the installation of equipment, but also for maintenance of solar systems. Thus educational and vocational training facilities need to be at the forefront in terms of technological development, in order to produce the green workers of tomorrow.

The challenges of the Malian education system are related to meeting the employment needs of the public and private sectors to ensure productivity and trigger sustainable economic development. Vocational programmes need to be tailored to the academic expectations of the labour market, and provision for continued appropriate training and professional development within the primary sector is needed.

Finally, a wealth of traditional and local knowledge exists about adaptation mechanisms to climate change. Collection and testing of this knowledge would be very important, and then proper dissemination of that information must follow.

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Philippines

Policy context

Key challenges and priorities for a green economy

The Philippines, an archipelago of more than 7,000 islands with a population of over 90 million, is on the UNDP's shortlist of most vulnerable countries in the world to climate change. And yet the country is a low emitter of GHGs, contributing only 0.3 per cent of the global share in 2004.¹⁴⁵

In 1998, the National Economic Development Authority acknowledged the risks facing the country due to the oscillating climate system, which has been the cause of destructive episodes of El Niño droughts and La Niña floods since the 1980s.

In 2009 it was estimated that about 43 per cent of the country is likely to be affected by climate change-induced drought, 20 per cent by floods, and 11 per cent by landslides.¹⁴⁶ The negative economic impacts of climate change on the country include water shortages, decreases in agricultural productivity, infectious diseases due to heat stress, residents in low-lying coastal areas becoming "climate refugees", coral bleaching, disappearance of small islands, and a decline in livestock production.

Currently the agricultural sector is the main focus of the Government's climate change programmes. Unemployment is significant and the manufacturing sector has declined significantly over the last few years.

The environmental response strategy and the role of skills development

General environmental strategy

The Philippines has a relatively comprehensive set of environmental laws, enacted in the course of the last four decades. Amongst Asia's developing countries, the Philippines is considered relatively advanced in terms of legislation related to various environmental challenges such as reforestation, biodiversity conservation, air and water quality regulation, solid waste management, renewable energy development and adoption of mitigation and adaptation measures related to climate change.

However, there is a wide gap between legislation and the implementation of environmental reforms. Despite reforestation laws dating from the 1970s, the degradation of forests has remained unchecked. The overwhelming majority of local government units have not complied with the law on the closure of open and unsanitary landfills or dump sites. The Environmental Education Act of 2008 requires environmental education to be integrated at all levels of basic, tertiary and technical-vocational education; and yet, to date, this has been implemented in only a few schools.

The Department of Energy is responsible for the development of renewable energy as well as the reduction of power consumption in the country. The Renewable Energy Act of 2008 provides fiscal incentives for renewable energy production and provides for the establishment of a regulatory framework to speed up registration for developers and community acceptance of projects. The Biofuels Act of 2006 gives fiscal incentives for the production and distribution of bioethanol.

¹⁴⁵ UNDP, 2007.

¹⁴⁶ Godilano, 2009.

The Act known as “Mainstreaming Climate Change into Government Policy Formulations, Establishing the Framework Strategy and Programme on Climate Change” will provide for the creation of a Climate Change Commission headed by the President to serve as the country’s sole policy-making body on climate change. It aims to coordinate climate change related programmes.¹⁴⁷

The latest climate change focused legislative initiative for agriculture is the Organic Agriculture Act of 2010 for the development and promotion of organic farming in the country. The Department of Agrarian Reform has also been implementing climate change mitigation and adaptation measures.

In 2009 a total of 43 out of 87 CDM project applications had been registered by the Department of Environment and Natural Resources. However, only two CDM projects had been issued with certificates of emission reductions as of 2009.

Green response to the current economic crisis

The Philippine economy slowed down in 2008–09 due to the effects of the food, fuel and financial crises. The Government introduced the “Economic Resiliency Plan” (ERP). The ERP stimulus package had a total budget of PHP 330 billion (USD 6.8 billion) and targeted job-generating infrastructure development and maintenance projects known as a “comprehensive livelihood and emergency employment programme” (CLEEP). More specifically, the PHP 2.5 billion allocation for CLEEP aims to provide jobs for 114,000 jobless Filipinos through the Upland Development Programme and Bantay Kalikasan Programme of the Department of Environment and Natural Resources. Another portion of the ERP is allocated to energy independence and environmental occupations including jobs in reforestation, eco-tourism (coastal clean-up), LPGs retrofitting, and planting biofuel feedstock. The problem, however, is that the jobs created under CLEEP are mostly short-term ones.

The environmental policy responses to the crisis include the Biofuel and Renewable Energy Acts, which focus on alternative fuel, energy independence, energy conservation and efficiency, and competitive pricing.

The skills development strategy in response to greening

There is no coherent national skills programme responding to climate change and environmental degradation. The Government has launched two national environmental education initiatives: the National Environmental Education Action Plan for Sustainable Development and the Environmental Awareness and Education Act. However, green skills or human resource developments do not feature in these. The 2007 National Human Resource Conference did not mention environment-related industries and the need for green skills or HRD, nor did the 2008 report of the Presidential Task Force for Education entitled “The Philippine Main Education Highway: Towards a Knowledge-Based Economy”.

The Technical Education and Skills Development Authority (TESDA) has laid down some regulations regarding green skills training, focusing on clean energy and transport. There are also two national networks for environmental education: the Environmental Education Network of

¹⁴⁷ Romero, 2009.

the Philippines, Inc., and the Philippine Association of Tertiary Level Institutions in Environmental Protection and Management.

Securing green professionals such as environmental engineers is not difficult because of the availability of graduates from some top educational institutions that provide environmental education at the tertiary and graduate level. However, the introduction of new and imported green technology such as pollution abatement, wind power generation and equipment for a bioethanol distillery might necessitate the recruitment of foreign green experts who are familiar with this technology.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

Currently there is a shortage of decent jobs for the 1 million or so annual labour entrants and the estimated 3 million unemployed, 6 million plus officially underemployed, four million “unpaid family workers” and over 12 million working at less than 40 hours a week.¹⁴⁸ The availability of human resources does not seem to be a major concern among employers because the Philippine economy has a large pool of “educated unemployed”.

It is expected that green restructuring of the Philippine economy is likely to have a positive impact on employment because of the generally labour-intensive nature of green jobs. Examples are the shift from traditional chemical-based farming to organic agriculture, the growth of the renewable energy sector, reforestation programmes, and the expansion of the recycling sector. The greening of an industry can also be a strategy for job preservation and company survival during economic crises – such as in the manufacturing sector where incorporating pollution abatement was necessary.

There is however resistance from some industries, for example the banana industry, who are large producers and exporters. They believe that if aerial spraying is banned – as demanded by environmental NGOs – large job losses will result as the sector will no longer be competitive.

However, at this stage, there is no evident shift toward a greener economy. Thus, it is fair to state that restructuring of a green Philippine economy is still at its incipient stage.

Skills response

There is currently no skills identification strategy in place and therefore it is difficult to pinpoint precisely the kind of skills and talents that are likely to be in short supply. However, from the various case studies it is possible to identify certain trends.

For example, in many cases retraining occurs at an enterprise level rather than as a government-driven initiative. An organization may acknowledge that going green is more likely to save jobs and may even create them. Therefore further retraining in the agricultural sector is required.

In agriculture, the lack of agribusiness skills was also cited repeatedly in the 2007 National Human Resource Conference. However, this was defined mainly as a lack of entrepreneurial skills among farmers, without any reference to sustainable or organic agriculture.

¹⁴⁸ Ofreneo, 2009.

Changing and emerging occupations and related skill needs

New and emerging occupations

At the industry level, some industries partner with TESDA in the formulation of Training Regulations (TRs) for emerging green industries, for example for technicians in the solar energy industry. At the company level, skills are identified based on the nature of the products, the green technology used and the company's production set-up.

The importation of a green technology that is not yet available in the domestic market means either that local staff have to be sent overseas for training or that foreign experts need to be brought in to train Filipinos on this new technology. The national workforce has many educated graduates; however, there is a gap in specialized areas such as renewable energy, the CDM market, forest management and waste management. Again, foreign professionals are often recruited to provide expertise.

New environmental jobs have been emerging such as environmental engineering and monitoring professionals, and pollution control officers. In the city of Puerto Princesa, Palawan, environmental officers ensure discipline and clean air standards among pedicab operators and promote eco-friendly business such as eco-trekking.

Greening established occupations

In the agricultural sector, government agricultural extension officers will need to provide knowledge on agricultural technology as well as sharing knowledge on climate change adaptation and risk reduction. This implies training and/or retraining agricultural extension officers. Furthermore, there is a need to increase the agri-business and entrepreneurial skills of farmers, particularly to prepare for the shift to organic and sustainable farming. This shift requires retraining in, for example, methods of composting to produce organic fertilizers and in the selection of sturdy seeds that can withstand weed invasions without the use of chemicals.

At an enterprise level, training opportunities for the environmental transformation of organizations could entail environmental management courses for store managers or energy management training for facilities managers. Machine operators can acquire the necessary new skills to operate new technologies, which will enable them to stay on the job.

Skills response

A green economic transformation is crucial in the creation of jobs that are both green (help restore the environment) and decent (promote dignity, security, equity and stability at work). This transformation requires changes in education and skills development since green and greener industries would naturally require professionals and workers with green skills and competencies that vary across different sectors and sub-sectors of the economy.

At TESDA, industries – and sometimes international development institutions – drive or initiate the development of skills programmes for specific trades, including specialized green-collar jobs. Most of the skills providers are environmental education institutions (and their graduates) accredited by the Commission on Higher Education (CHED). However, most green corporations and civil society organizations try to evolve their own environmental skills development programmes.

As mentioned previously, foreign expertise may be required for new and renewable technologies.

Anticipation and monitoring of skill needs

The green economic shift requires the alignment of education, skills development and training with the labour requirements of green and greener industries. Hence, the challenge is to strategize environmental education and skills development in anticipation of a green shift in the industrial, agricultural and services sectors. Additional strategies are necessary for environmental conservation and for communities that are vulnerable to climate change risks. Preparing appropriate strategies requires consultation and dialogue among the stakeholders, industry and labour market. Most of the case studies included in this report highlighted the importance of dialogue and labour–management cooperation in strengthening greening initiatives.

There is currently no data from the National Statistics Office on the number of establishments going green. Neither is there data on the skills shortage or workers displaced by enterprises that have gone green. However, the newly created Climate Change Commission should include anticipation of these kinds of skills changes as part of the national action planning on climate change.

Summaries of case studies

The study includes nine case studies to illustrate the green competencies of green and greener jobs, including professionals and environmental NGOs.

Case study 1. PASAR: Investing in holistic environmental transformation

The Philippine Associated Smelting and Refining Corporation (PASAR) was established at a time when the Philippines was Asia's biggest producer of copper, and Japanese copper processing firms were looking for alternative smelter sites because of complaints regarding pollution caused by smelters.

PASAR has had to invest heavily in an environmental transformation programme involving the importation of expensive pollution abatement facilities (for example, acid plant to convert sulphur dioxide into sulphuric acid, and various dust-removing and wastewater treatment equipment).

PASAR's Environmental Protection Department assisted PASAR in getting ISO 9001 certification on its Quality Management System and ISO 14001 certification on its Environmental Management System. The EPD also ensures that the smelting process complies with environmental laws and regulations and that it integrates environmentally sound principles in work processes for the employees.

The skills needs vary between retraining of existing occupations such as pollution control engineers who are already trained machine operators, and new skills required for using new imported technology. Often training is provided by experts from foreign contractors who supply the technology.

PASAR has set up PASAR Foundation, Inc., the company's corporate social responsibility arm, to help the communities around it. The PFI has launched a number of environmental programmes for the benefit of these communities. These include water conservation, tree and coastal rehabilitation, fish sanctuary and recycling programmes.

Case study 2. HPCC: Surviving the global financial crisis through an energy-saving programme

The Halsangz Plating Cebu Corporation (HPCC) is a surface finishing company specializing in electroplating and painting services. The economic crisis of 2008 caused HPCC's market to shrink to 10 per cent of its pre-global financial crisis demand. HPCC was able to retain half its workforce by reducing its production costs, and effected a one-third reduction in energy through an energy reduction programme. This was a substantial saving, given that power consumption accounted for 40 per cent of HPCC's production cost.

HPCC also launched an environmental management system (EMS) committee in 2008, which conducted a series of training and orientation seminars for all employees on energy management, water conservation and solid waste management. The information and awareness-raising programme was supplemented by the posting of highly visible information materials on HPCC's EMS policy.

The initial target for 2008 was to reduce energy consumption by 8 per cent. The actual results were more than four times the target, with energy consumption in three different plants dropping by as much as 37 per cent. There was also a significant reduction in diesel and LPG consumption (14.5 per cent and 8.5 per cent respectively, according to HPCC energy data). In monetary terms the total reduction of the company's electrical and fuel energy consumption is estimated to reach PHP 238,372.79 per month (USD 5,000).¹⁴⁹

Although most of the EMS committee have no background in power management, they have become experts on energy savings and energy monitoring through various committee functions (for example, research, problem analysis, problem solving etc.) and on-the-job training.

Case study 3. Toyota Philippines: Blending the environmental programmes of Tokyo and Manila

In 1998, Toyota Motor Philippines Corporation (TMPC) became the first ISO 14001 certified automotive company in the Philippines and the seventh among all industries in the country. TMPC's guiding principle on environmentalism is the Toyota Earth Charter. The charter promotes environmental technologies, voluntary actions and community engagement. The green initiatives of TMPC are implemented in five key areas of operations, including manufacturing, logistics, dealership or marketing, supply of materials and communications.

TMPC promotes the concept of "sustainable mobility" and ensures that all vehicles that TMPC assembles are energy efficient and avoid substances of environmental concern, including hazardous heavy metals such as lead, mercury, chromium and cadmium. Because car manufacturing requires lots of energy and water, TMPC devised other programmes to conserve water and energy in the Philippine plants. These include rainwater harvesting and the use of solar-powered water pumps, the use of solar power in the activity centre and the parking area, reforestation initiatives and composting on site.

Within the TMPC the Cost and Environment section monitors compliance with environmental standards and targets (wastewater discharge, emissions and water and energy consumption). The EMS organization is a cross-departmental coordinating body for the implementation of the environmental management programmes.

The basic environmental training programme offered by TMPC to all its employees covers environmental policy objectives and targets, solid waste management and energy management. To date 100 per cent of employees have participated. Key personnel, for example environmental engineers, must attend special environmental training, such as the ISO-14001 EMS training, pollution control training and training for new technologies such as online monitoring of energy consumption.

¹⁴⁹ 45 Philippine Pesos = 1 USD (http://coinmill.com/PHP_USD.html#USD=1).

Case study 4. San Carlos Bioenergy, Inc.: Rounded green business/green HRD

San Carlos Bioenergy, Inc. (SCBI) is the first company in the Philippines and Southeast Asia to venture into bioethanol production and power co-generation at a sugar mill and distillery. The SCBI ethanol distillery plant was designed as a pollution- and waste-free plant. The distillery meets World Bank emission standards, meaning it does not emit NO_x and SO_x. The bagasse, a by-product from the milling of sugar, is converted into biogas and fed to the boiler as fuel. Steam from the boiler powers steam turbines to co-generate up to 7.5 MW of electricity, part of which (about 2.5 MW) is shared with the local electrical cooperative. Solid by-products are mixed with the wastewater and developed into organic fertilizers that are distributed free to sugar farmers who supply SCBI with sugarcane. The plant recovers approximately 50 tons of CO₂/day which is sold to soft drinks companies for the production of carbonated beverages and also treats and recycles wastewater. SCBI's Environmental Management Department undertakes environmental monitoring of wastewater, ambient air, and moist and deep wells which are catch basins used to monitor the moisture and quality of water.

With a capacity to supply 30 million litres of fuel ethanol per year, SCBI helps to reduce the country's dependence on imported oil as well as contributing to climate change mitigation. The SCBI bioethanol project is eligible for Carbon Emission Reduction Certificates under the CDM of the Kyoto Protocol.

The related new skills (such as environmental engineering and monitoring, pollution control officer, reverse osmosis operators, new technologies for wastewater treatment) are not replacement skills but additional skills. SCBI's operations have created employment for the local community and income opportunities for sugar farmers of San Carlos City. SCBI employs 226 regular employees, 58 per cent of whom are from San Carlos City. The SCBI project not only stimulated industrial job creation but also helped revive sugarcane farming in the area. Furthermore, SCBI has a no-land-conversion policy, meaning it does not buy from farmers who have converted their productive lands from rice and crops to sugar. This allows SCBI to steer away from the debate regarding conflicts around bioethanol production versus food security.

Case study 5. Energy Development Corporation (EDC): Investing in energy skills

The Energy Development Corporation (EDC) is a subsidiary of the Philippine National Oil Company (PNOC) set up by the Marcos Government in response to the oil crisis of the 1970s. PNOC's mandate was to explore, develop and generate alternative sources of energy, geothermal in particular. Geothermal accounts for roughly 20 per cent of the Philippines energy mix; 60 per cent of this geothermal energy is generated by the EDC. The corporation also operates geothermal steamfields in other parts of the Philippines, and has ventured into the development of other forms of renewable energy such as hydro and wind plants.

The EDC commitment to sustainable development through renewable energy generation and environmental management systems has been strengthened further with the adoption of the Corporate Environmental Policy, which requires the EDC's compliance with environmental laws and regulations.

The EDC observed that there are no academic programmes on geothermal energy technology in the Philippines. All technical staff at EDC have therefore attended training programmes overseas to study geothermal energy in countries such as Iceland and New Zealand. However, by sending staff overseas for training, there is a problem with skills retention. Training is also offered through the Energy Academy, which was established by the EDC in 2008, with the aim of conducting work-related seminars and skills development training for all employees.

The EDC has become one of the country's pioneers in the development of environmental standards, programmes, policies and environmental impact assessments. The Environmental Management Department leads in environmental awareness raising, and does this not only within the company but also in surrounding communities. For example, the Integrated Social Forestry approach aims to protect watersheds, create livelihoods and allow forest dwellers to participate in decision-making processes.

Case study 6. Metal Wealth Enterprises: Recycling waste to create jobs

Metal Wealth Enterprises (MW) recycles waste materials and is one of the largest plastic recycling plants in the country. Plastic recycling is one solution to the mounting problem of solid waste disposal in the country, especially in urban areas such as Metro Manila. According to a 2003 report by the Asian Development Bank and the Department of Environment and Natural Resources, in the 13 cities composing Metro Manila, plastic waste materials account for at least 21 per cent of the total solid wastes produced. Uncollected plastics are also widely blamed for the clogging of municipal drainage and sewage systems, and river systems, which causes flooding and spreads disease.

MW shifted from metal to plastic waste recycling because the process is easier, consumes less energy and is more profitable. Plastic recycling also provides a source of income and jobs for poor people, especially the waste pickers. There are two types of workers at MW: the “regular” and “pakiao” workers. The regular employees are supervisors, machine operators and those doing quality inspection and maintenance – these workers receive the minimum wage and government benefits. The pakiao employees are mostly plastic classifiers and sorters and are paid based on the volume of plastics classified and sorted.

MW sometimes only operates at 30 per cent of its capacity due to inadequate stocks of plastic wastes. By increasing the amount of plastic wastes collected and brought to the plastic recycling plants, jobs will increase whilst reducing plastic waste disposal.

Case study 7. Jollibee Foods Corporation: Green adjustment to regulation and competition

Jollibee Foods Corporation is the Philippines’ largest fast food chain, with over 600 stores nationwide and over 50 stores overseas. Jollibee’s Corporate Engineering Department (CED) has developed a number of environmental projects in response to pressure from government agencies that monitor companies’ waste disposal compliance.

During the 1990s Jollibee Foods Corporation was affected by the rising cost of electricity and other utilities. The CED created the Technical Services Department, which was divided into two units – the Environment and Safety Unit and the Energy Management Unit (EMU). The CED also initiated a joint programme with some local government units and NGOs in Metro Manila to organize waste pickers into cooperatives, and make the waste collection process systematic and beneficial to all.

The EMU introduced a number of energy-saving technologies such as heat recovery water heaters and compact fluorescent lamps. Stores that used all the energy conservation measures reduced their average electricity consumption by 10,000 KWH per month. The EMU also introduced water conservation interventions such as waterless urinals and high temperature dishwashers to reduce the volume of wastewater discharge, and low volume – high pressure kitchen tap aerators to control the flow of water from kitchen taps.

The EMU gave basic training to store managers on energy efficiency and offered training for pollution control officers. This required store managers to attend a three-day training programme involving classroom discussions, site visits and attending the Energy Management Training Course. Raising the awareness level of employees was not easy since the majority are short-term contractual employees.

Case study 8. Haribon Foundation: Professionalizing environmental advocacy

Haribon started as a bird-watching society in 1972, and in 1983 the organization became an official conservation foundation and is now accredited by the Department of Science and Technology as a science and research foundation conducting studies on biodiversity. This new environmental advocacy group embraced a comprehensive agenda of research, education and advocacy on environmental issues, with special focus on biodiversity.

Haribon is a membership-based organization, with 40 to 50 employees and 50 volunteers. Researchers and field workers come from different backgrounds such as forestry, geographical information systems (GIS) and biology. Community organizers and environmental planning specialists teach communities about natural resource management, whilst advocacy officers are responsible for networking and campaigning.

Haribon requires very specific technical skills and therefore sometimes has difficulty finding suitable applicants with relevant training. For example, a GIS specialist requires knowledge in mapping, global positioning systems and the use of mapping software. People who have such skills are geodetic engineers, who are very scarce, and foresters, who only have limited knowledge on mapping.

The most common skills development strategies in Haribon are on-the-job training and mentoring. In-house training programmes are provided on basic ecology and community-based resource management. Some employees are also sent for outside training provided by partner organizations.

Case study 9. NISARD: Growing organic skills for organic farmers

The island of Negros is divided into two provinces – Negros Occidental and Negros Oriental. In 2005, after more than a century of chemical agriculture (mainly in sugar production), the governors of the two provinces signed a Memorandum of Agreement targeting sustainable agriculture and rural development. The only way to prevent the complete degradation of land from overuse of chemical fertilizers is to promote organic farming – which is also a more labour-intensive process. Part of the Memorandum of Agreement is the creation of the Negros Island Sustainable Agriculture and Rural Development Foundation (NISARD), whose mission is to “make Negros Island the Organic Food Island of Asia through organic food production for the promotion of food security, biodiversity, environmental conservation, sustainable agriculture and rural development”.

NISARD’s economic objectives are to increase organic farmland to 10 per cent of the total agricultural land by 2010, increase the local and export market for organic products, establish NISARD’s organic quality assurance system, and promote fair trade and marketing support for farmers. In 2008 NISARD Certification Services (NICERT) was established to provide organic farmers with a competitive and independent third-party organic certification system. From a social perspective NISARD aims to alleviate poverty and improve quality of life. With respect to the environment, NISARD intends to improve farm diversity, create alternative livelihoods for fishing communities and upland dwellers to allow forest and reef regeneration, and enhance water resource management.

Organic farming skills development is part of NISARD’s “Education and Promotion of Organic Farming” project. NISARD has been conducting training for farmers who want to try organic farming or sustainable agriculture techniques. Awareness-raising activities include training on packaging and labelling, organic free range chicken production, and practical organic approaches to livestock. NISARD (through NICERT) has also developed various manuals and certification forms that comply with international organic standards, regarding, for example, organic handling and retailing.

Conclusions

Currently there is no obvious green shift or green restructuring in the Philippines – except as an initiative of private companies, local government units and NGOs. There are many official declarations that the country has fully aligned itself with global aspirations to build a climate-friendly world and that it has enacted many environmental and climate change related laws. However, there is a gap between the enactment and enforcement of the laws – and consistency is needed in their implementation. There is also a need to push more vigorously for the sector-by-sector greening of the economy, including dense urban and rural poor settlements.

Environmental education and training plays a significant role in greening the economy. There is a lack of planning between the education and skills development offered by TESDA, CHED and the Department of Education and the requirements of the labour market. At the industry level a number of firms have initiated their own environmental training programmes.

Labour displacement due to a green shift is likely to be minimal; in fact the rise and expansion of green and greener projects such as organic farming, reforestation and the development of renewable energy will help stimulate new jobs and address unemployment.

Recommendations

A green shift requires policy coherence, decisiveness and consistency on the part of the Government and other stakeholders. A transition to a greener economy requires social consensus, which, in turn, requires a deeper and sustained social engagement of various stakeholders.

There is a need to push for the inclusion of the “green job” agenda in the Medium-Term Philippine Development Plan 2010–16 and the National Framework Strategy on climate change that is being developed by the Climate Change Commission. Furthermore, policies must address

greening the agricultural, industrial and service sectors. In addition, the greening process should cover the green renewal of all urban and rural communities in the context of climate change mitigation and adaptation.

The green shift has implications for the education and skills development sector. Tertiary education should graduate more environmental engineers, climate change scientists and researchers. The TVET sector should integrate environmental principles in all training regulations and technical vocational courses and develop more training standards on green jobs. The Department for Education should also promote environmentalism in the national education system. Currently none of the three sectors has comprehensive operational programmes as mandated by the Environmental Education Act of 2008. CHED and TESDA should also take the initiative of talking to industry, local government units and other sectors on how environmental education and skills development should be advanced.

The concept of “green jobs” or “greener jobs” is relatively new. Popularizing the concept of “green jobs”, alongside the existing ILO advocacy for “decent jobs”, is clearly another development task with rich social, economic and labour dimensions. This study is the first to analyse the development of green skills and human resource development in relation to the green processes in the economy and the labour market in the Philippines and therefore further research is required.

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Republic of Korea

Policy context

At a national address on the 60th anniversary of the Republic of Korea on 15 August 2008, President Lee Myung-bak proclaimed a “low-carbon, green growth” strategy as a new vision to guide the nation’s development. Since then, the Republic of Korea has been undertaking major restructuring processes across different ministries and central government offices to implement this vision in policies and practice.

Key challenges and priorities for a green economy

The Republic of Korea has experienced an unprecedented level of economic growth and is now the world’s 15th largest economy.¹⁵⁰ The Republic of Korea’s CO₂ emissions are on an upward trend, although the rate of increase has lessened since the 1997 financial crisis when the Republic of Korea’s economy underwent a major restructuring process. However, among OECD countries, the Republic of Korea is ranked sixth in terms of CO₂ emission volume¹⁵¹ and also ranks high in terms of the rate of annual increase of CO₂ emissions at 2.4ppm/year (1997–2006) relative to the global average of 1.9ppm/year.

The Republic of Korea’s high CO₂ emissions are due to the economic and social structure of the country, which is very dependent on high energy consuming sectors such as manufacturing and transport. The Republic of Korea is the tenth largest energy consumer in the world, with 97 per cent of its energy consumption drawn from imported energy sources. This shows a relatively high energy consumption rate with low energy efficiency.¹⁵² In 2006, industries consumed 56 per cent of the total final energy. Transportation has shown the highest annual growth rate of final energy consumption, but due to the increase of oil prices since early 2000, this growth rate has been slowing down.¹⁵³

While international environmental regulations on GHGs have been intensified since the 1997 Kyoto Protocol, the Republic of Korea’s efforts to reduce CO₂ emissions have been poor. Europe’s Climate Action Network ranked the Republic of Korea as 48th among 56 countries in addressing global climate change in 2007. The Low Carbonisation Index (2005) also indicates that the Republic of Korea needs to take action urgently in order to reduce its CO₂ emission in response to global climate change.

The environmental response strategy and the role of skills development

General environmental strategy

The Republic of Korea has established a legal and regulatory framework, and various policy measures, in response to continuing and growing international pressure for the reduction of GHGs. The National Climate Change Adaptation Master Plan¹⁵⁴ outlines short-term (2009–12) and long-term (2013–30) visions towards low-carbon green growth including climate change monitoring and prediction, and impact and vulnerability evaluation and adaptation programmes.

¹⁵⁰ World Bank, 2010.

¹⁵¹ International Energy Agency, 2009.

¹⁵² KIET, 2008.

¹⁵³ Ibid.

¹⁵⁴ Ministry of Environment, 2008.

In 2009, the Government announced The Republic of Korea's 2020 mid-term GHG mitigation target and has begun to take national consensus-building processes through expert consultations, public surveys, and public hearings with various stakeholders. Three mitigation scenarios for 2020 are proposed which reduce emissions by 21 per cent, 27 per cent and 30 per cent respectively from the Business As Usual reference case.

In terms of energy policy, the First National Energy Basic Plan 2008–30, sets targets for increasing the percentage of electricity generated by nuclear power plants from 24 per cent in 2008 to 40 per cent by 2030.¹⁵⁵ In addition, the Government expects the percentage of electricity generated by renewable energy to increase from 2.49 per cent in 2008 to 11 per cent in 2030.¹⁵⁶ The current Feed-In Tariff will change to the Renewable Portfolio Standard (RPS) system from 2012. The Feed-In Tariff is a policy mechanism that supports price differences between the cost of renewable energy generation and traditional energy generation. The RPS is a regulation that requires electricity supply companies to produce a specified fraction of their electricity from renewable energy sources, such as wind, solar, biomass and geothermal. The RPS is a stronger policy measure to increase renewable energy generation by suppliers than the Feed-In Tariff.

Electricity Generation Difference Compensation is a government subsidy to compensate for the difference between the price of general electricity and that of electricity produced by renewable energy sources, where the latter is often more costly to generate. The Government has been subsidizing approximately 60 per cent of the installation costs for home Solar Photo Voltaic systems.¹⁵⁷ Between 2004 and 2008, a total of 24,000 homes received a subsidy.¹⁵⁸ The original goal was to cover 100,000 homes by 2012, but in 2009 this programme merged with the Green Home¹⁵⁹ programme, which has a target of equipping one million homes with a renewable energy system by 2020.

Through energy-related policy measures including the Energy Management by Objectives System, Expanding Cleaning Energy Sources and the National Smart Grid Roadmap implementation, the Government expects to reduce GHGs by a cumulative total of 932.9 million tons by 2020. Moreover, these energy policy measures are expected to create 149,889 new jobs in energy-related fields by 2020.¹⁶⁰

Green response to the current economic crisis

The Presidential Committee on Green Growth was launched in 2009 and has been coordinating greening policies and strategies across different ministries and government offices including the First National Energy Basic Plan 2008–30 (2008); the Low Carbon Green Growth Strategies (2008); the Climate Change Response Plan (September 2008); the Green Technology R&D Plan (2009); and the New Growth Engine Industries Development Vision and Strategies (2009).

In July 2009, a Five-Year Green Growth Plan was announced, articulating a medium-term action plan for implementing the green growth strategy. The Plan intends to turn strategy into concrete and operational policy initiatives towards achieving “green growth” over the period from 2009 to 2013.¹⁶¹ The total funding is USD 83.6 billion, representing 2 per cent of GDP. Furthermore, the Basic Law for Green Growth is currently under review by Congress.

¹⁵⁵ Prime Minister's Office et al., 2008.

¹⁵⁶ Ibid.

¹⁵⁷ KEMC, 2008, 2009.

¹⁵⁸ KEMC, 2009.

¹⁵⁹ One Million Green Homes campaign: <http://www.solarthermalworld.org/node/830>

¹⁶⁰ Presidential Committee on Green Growth, 2009c.

¹⁶¹ UNEP, 2009.

The vision of Korean Green Growth is for the Republic of Korea to become the seventh green nation by 2010 and the fifth by 2050 on the green competitiveness index, which is composed of the low carbonization index and the green industrialization index.¹⁶² To meet the vision, the proposed strategies for implementation include policy measures for climate change mitigation and adaptation, securing energy independence, growing the new green technology industry, and improving green transport and quality of life.

The Green New Deal Project is an initiative that aims to combine the green growth initiative with the strategy to deal with unemployment resulting from the recent financial crisis. The three core fields are: (i) green social infrastructure investment (such as a green transportation network, schools, libraries, public parks etc.); (ii) low carbon/high efficiency industrial technology; and (iii) initiatives supporting eco-friendly lifestyles.

The skills development strategy in response to greening

In the Republic of Korea initiatives promoting a green economy are very much government driven. This has the advantage of creating centrally coordinated efforts and efficient implementation over a short period of time. The Government also invests large amounts in educating university students, including graduates, as they have been identified as a primary target group for skills development and education policy under green growth initiatives. VET has not traditionally focused on green jobs – in fact only 10 per cent of the unemployed VET recipients (approximately 12,000) were trained in green industries.

The development of green technologies is expected to create 481,000 jobs by 2012 and 1.18 million jobs by 2020.¹⁶³ By 2012, research and development investments in climate change mitigation will have more than doubled from the current 2008 level of KRW 700 billion. KRW 5 trillion is being invested over the next five years for the Republic of Korea to become a global leader in green technology. In 2002 the Korea Environmental Education Centre (KEEC) was established. KEEC is affiliated with the Republic of Korea's Federation for Environment Movement, the oldest and largest NGO environment movement in the Republic of Korea. KEEC focuses on youth and fosters green competencies such as environmental awareness, attitude towards the environment, and green knowledge and skills. In addition, KEEC has provided instructors and training programmes in environmental protection for the public (for example, eco-guide and environmental instructor training classes), to support KEEC's goal of "Environment education for all".

Skills in transition to a greener economy

Green structural change and retraining needs

A comprehensive system to identify green skill needs does not yet exist in the Republic of Korea. To date the main vehicle for identifying emerging skill needs is through the various Sector Council Human Resource Development (SCHRD) bodies. Starting with three SCHRDs in 2003, there are now 23 including the newly established renewable energy and green finance SCHRDs. Both the green SCHRDs will begin to administer skills surveys to their member enterprises to assess skills changes, skill needs and resource gaps in the respective industries.

¹⁶² The green competitiveness index was developed by Samsung's Economy Research Institute.

¹⁶³ UNEP, 2009.

Restructuring of higher education is occurring to meet the needs of greening occupations, particularly for middle level technicians. The Korea Polytechnic College conducted educational needs assessments and restructured its curricula to cater for and respond to skills needs of recent green growth initiatives.

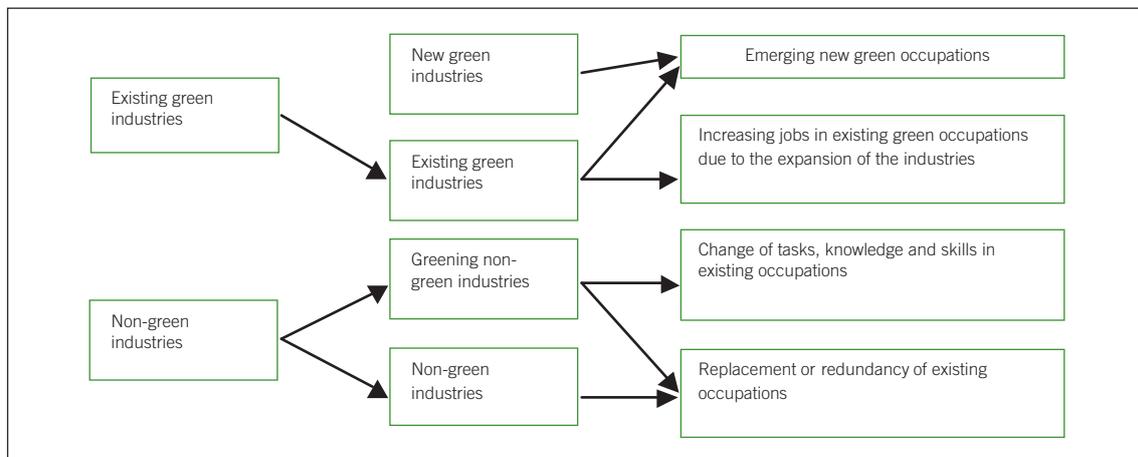
Until recently, the overall supply of skills in the environmental sector exceeded demand. In particular, the oversupply of people with advanced degrees became an issue because many environment-related jobs were low-skilled, in poor working environments. The environmental sector is starting to restructure, and therefore higher level skills and strategies for skill development will be required.

Green restructuring and its impact on the labour market

In the next five years, the growth rate of green jobs (6.0 per cent) is expected to be much higher than the average growth rate of the total jobs (1.3 per cent) in the Republic of Korea.¹⁶⁴

The Korean Presidential Committee on Green Growth anticipates labour market shifts due to the restructuring of industries in response to green growth, as summarized in the following diagram:

Figure 1. Labour market shifts due to restructuring of industries in response to green growth



Source: Presidential Committee on Green Growth, 2009. Green jobs creation and human resources development strategies.

Skills response

VET centres and institutions still provide traditional training courses and few VET centres are currently retraining workers affected by green growth. Although many programmes include “green” in their course titles, their content does not always consider green skills. While diverse policy

¹⁶⁴ Presidential Committee on Green Growth, 4 November 2009b.

measures and strategies have been issued at the national level, it will take a long time to implement the policy at local training centres and institution level.

In 2009, the Ministry of Labour initiated a new programme called the Vocational Education and Training Reform Centre, which provides vocational education and training based on skills identified by the SCHRD. For example, with support from this programme, the automobile SCHRD is providing skills training in the development of eco-friendly automobiles.

Several government support strategies are proposed aimed at enhancing skills and competencies of green workers in sectors that are becoming greener. The Government will support training costs and income subsidies for businesses that provide their workers with training opportunities which prepare them for green skill demands.

Changing and emerging occupations and related skill needs

New and emerging occupations

The Korean Employment Information Service published a list of 55 “new generation” occupations. Those identified as relevant to the Future Growth Engine Project fall under three categories: the green technology industry (for example, solar photovoltaic and wind power developers, greenhouse gas auditors, LED [light-emitting diode] engineers, fuel cell developers for green transport); the advanced convergence industry (for example, nano-based technology researcher/developer; robot researcher/developer; user interface researcher); and the high value service industry (for example, bioinformatics specialist; food developer). The category of green technology industry is most relevant to green growth. Other new occupations expected to emerge due to greening of the economy include hydrogen cell researchers, geothermal system engineers and carbon brokers.

Green technologies are believed to create more sustainable employment opportunities for technical and professional workers. The development of green technologies is expected to create 481,000 jobs by 2012 and 1.18 million by 2020.

Greening established occupations

Transportation and construction are the two main sectors that require significant greening because these two sectors will be most affected by new energy and environmental regulations and policy measures. For example, in the construction industry, architects will require more knowledge in eco-friendly design and construction, heating engineers will require training in efficient energy saving and heating system design, and accountants will require a better understanding of the costs and benefits of environmental facilities, equipment and processes.

While green jobs in manufacturing and services will increase by 4.5 per cent and 12.1 per cent respectively, green jobs in agriculture, fishing and mining will decrease by 3.4 per cent.¹⁶⁵ The decrease in jobs in these sectors will be due to the overall decrease in low-skilled jobs. Therefore, education and training strategies for agriculture, fishing and mining should particularly address upgrading the skill levels of current employees in these sectors. Farmers also need retraining in coping with the impacts of climate change on crops as well as catering for consumers’ increasing demands for sustainable and organic products.

¹⁶⁵ Ibid.

Skills response

The VET Reform Centre was launched in response to the need for new green skills. The New and Renewable Energy (NRE) SCHRD and the Green Finance SCHRD have collaborated with the Centre. The NRE SCHRD will provide currently employed workers with a vocational training programme for new and renewable energy related skills. The programme consists of short-term training courses (1–2 days) covering solar energy design, solar energy and earth heat pump implementation as well as renewable energy CDM. The Green Finance SCHRD provides advice in green finance investment as well as green industry trends, risk analysis, green financing and socially responsible investment.

With support from the Ministry of Environment, several education programmes for environmental specialists have been launched. There are two examples of education programmes for college graduates with degrees in environmental studies. The “Waste-to-energy facility design and operation education programme” is for unemployed college graduates, providing them with new knowledge and skills to improve their employability. The “GHG management specialist education programme” is a government-funded education programme to develop specialists in GHG management and consulting.

The skill needs for new and emerging green occupations have not yet been quantified. Based on the Ministry of Labour’s recent report “Strategies to expand green jobs”, it is expected that the next rounds of VET skill needs surveys will have new classifications, including emerging green industries.

Anticipation and monitoring of skill needs

The Ministry of Labour and Ministry of Education both report on workforce demand and supply forecasting at a national level every two years. This national workforce forecasting focuses on the projected number of jobs in a field, but provides limited information about the types of skills and knowledge required. The Korean Research Institute for Vocational Education and Training has launched a project that will design and conduct a new national survey specifically focused on skills needs. The results of this national survey are available in 2011. This survey complements the SCHRDs’ sectoral skills needs surveys.

Since the national VET needs surveys are based on the broad classification of industry sectors, they give a broad overview of skills needs across all industries, but do not specifically reflect the recent changes in green skills, green jobs and green industries. The SCHRDs are planning to identify and monitor the skills changes and TVET needs in selected industries. The New and Renewable Energy SCHRD and the Green Finance SCHRD are preparing skills and VET needs surveys for green occupations.

Summaries of case studies

Case studies for the Republic of Korea have been provided in the agricultural, energy, automotive and technology sectors.

Case study 1. Heuksalim Social Enterprise: Expanded opportunities for farmers – Agricultural social enterprises and organic farming

Heuksalim is a non-profit organization established in the 1990s running an exemplary social enterprise closely linked to organic farming. Heuksalim promotes organic farming through research and development, production of organic fertilizers, usage of eco-friendly pesticides, consultations for organic farming, and education and training programmes on organic farming. In addition it certifies organic products through laboratory analyses and field monitoring processes. With government funding, Heuksalim recently launched a social enterprise which employs 60 people in the regions of Goisan, Cheongju and Cheongwon. The employees carry out work in the following four areas: (1) developing organic farming skills and eco-friendly native crops and producing organic seedlings that can be grown in urban farms; (2) networking with local schools to supply organic food for school lunches; (3) organizing farmers' markets where local farmers can sell their products directly to consumers and provide short training sessions to those interested in starting their own small farms; and (4) expanding the organic lunch catering business to more organizations.

Heuksalim Social Enterprise demonstrates that social enterprises can create jobs and additional income for farmers as well as provide educational opportunities to develop skills and knowledge. Employees will be able to build competencies through educational initiatives including on-the-job training on advanced farming and auxiliary high-value business such as sorting, packaging and direct distributing.

As Heuksalim has developed through practical experience, its education programmes are reported to be more practical and applicable than those provided by government or universities.

Case study 2. Forest tending projects: Green New Deal Projects

The National Office of Forestry announced that 66,487 new jobs would be created in 2009 in the areas of cultivating forest resources, maintenance of green space and forest services, expansion of forest biomass collection, national disaster prevention and research and development. The Forest Tending programme was launched in 2005 and is continuously increasing its budget and participants. Since the Green Growth announcement, the budget for the 2009 Forest Tending programme has doubled. The programme creates jobs for low-income and unemployed youth. All the participants are required to attend an introductory education and training course, which covers theories and practices about the objectives of forest tending, forest tending techniques, machinery operation techniques and safety management. The courses take place over a two-week period and the course fees are subsidized by the Government.

Case study 3. Jobs in environmental industries

The Republic of Korea's environmental industry is lagging compared to other industries such as information technology and car manufacture. Furthermore, most Korean businesses in the environmental industry are small, with low levels of expertise. Nevertheless, the environmental sector on a national level has grown rapidly and was expected to reach more than KRW 31 trillion by 2010 as projected in 2004.¹⁶⁶ Since 1995, the environmental sector has increased by 11.3 per cent annually and in 2005 contributed to 2.95 per cent of GDP. There are 25,018 businesses in this industry with a total of approximately 184,333 employees. However, while the developed countries are entering the third generation of environmental technology such as environment restoration technology, the Republic of Korea is still in the stage of the first generation (post-processing) and the second generation (pollution prevention). The Republic of Korea's level of relevant skills is relatively low, at 40–70 per cent of the developed countries' skill level.¹⁶⁷

To develop the skilled workforce in environmental studies, the Government has launched specialized graduate schools in the area of climate change. Each school received KRW 150 million per year for ten consecutive years for programmes focusing on national GHG emission statistics, GHG mitigation strategies, climate industry management strategies, climate change impact evaluation and response measures, the carbon market and international agreements. Currently the supply of graduate level students in environmental studies exceeds future demands. Therefore, for students who studied conventional environmental studies, these specialized graduate schools aim to provide new opportunities to expand their knowledge and skills to new areas such as GHG management, carbon trading and environmental consulting.

¹⁶⁶ KIET, 2004.

¹⁶⁷ Hwang et al., 2007.

Case study 4. Education and Training Centre for Energy Technology, Seoul National University of Technology (<http://www.etc.or.kr>)

The Education and Training Centre for Energy Technology at Seoul National University of Technology (SNUT) is a government-funded national centre that was established to develop higher level researchers and engineers through graduate school programmes. It also aims to provide education and vocational training for employees in the energy field, including support for on-the-job training.

The Centre at SNUT focuses on energy efficiency technology and renewable energy, including the development and management of new systems, appliances and devices. Courses include renewable energy engineering, environmental engineering in response to climate change, energy system engineering (intelligence-building facility system), energy safety (gas explosion prevention and management) and energy policy (global trading and technology agreements). The Centre at SNUT emphasizes the importance of vocational training for current employees in addition to initial education. According to the Education and Training Centre for Energy Technology at SNUT, from 2007 to 2009, 9,390 people received education and training through this Education Centre programme with a budget spend of 6,500 million KRW.¹⁶⁸

Many new public and private education centres and institutions have emerged since the Government's green growth initiative. However, without a systemic human resources supply and demand analysis, and both short-term and long-term prospects, the expansion of educational centres may present problems by causing unemployment in the future.

Case study 5. Sustainable Building Technology Education Programme at Korea Institute of Construction Technology Education

This is a government-funded education programme run through the Ministry of Land, Transport and Maritime Affairs to foster expertise and sustainable development in eco-friendly construction. Trainees of this programme include university students, graduates who have majored in construction or architecture, and current workers in the field. The full-time intensive curriculum takes four weeks and covers eco-friendly architecture design principles and theories, sustainable building design, sustainable building systems and sustainable construction technology and resource management.

The students enrolled in this programme because they believe the demand for eco-friendly sustainable buildings is increasing. Participating students claim they benefited from the practical knowledge and skills of the programme, which they could not have learned in school. Thus, the students felt that the intensive programme was more responsive to the rapid changes of new technologies and skills. There were three sessions offered in 2009 whereby 50 students participated in each session.

The emphasis on the demand for new technologies is a strong aspect of this programme; however, the students found that subsequent employment opportunities were not well supported. The labour market for students specialized in the green building industry must change to create opportunities for these skilled workers.

Case study 6. LED Lighting Technology Education Centre (LTEC)

The Government has implemented various policy measures to expand the LED market throughout various industries including: LED lighting replacement projects in public buildings, international conference halls and subway stations; LED lighting appliances in newly developed cities; and LED in green houses. For example, as a part of the Green New Deal Project, a project for LED lighting replacement in public facilities is expected to create 10,030 jobs. To implement these projects, expertise is needed including LED element researchers, LED lighting system specialists and LED heat reduction engineers. The Ministry of Knowledge Economy expected that 13,000 LED specialists will be needed by 2015. The LTEC (<http://www.ltec.or.kr>) was established to educate and develop lighting technology expertise in the field as part of the education centre programmes by the Ministry of Knowledge Economy.

The LTEC offers various types of long-term and short-term programmes and field practicals to meet the particular needs of participants. The LTEC conducted education needs assessments and satisfaction surveys of participating industries to determine the experiences, challenges and needs of the LED industry. A higher demand for lighting design and LED application areas is expected, which require interdisciplinary knowledge and skills.

¹⁶⁸ SNUT, 2009.

Case study 7. Hyundai Hybrid automobile training programmes for maintenance technicians

In 2009, Hyundai introduced its first hybrid automobile to the Korean market. These vehicles are now on the road and there is a need for educating and training maintenance technicians in service centres nationwide. General education about this new hybrid product is offered across Hyundai including all employees in sales and marketing departments as well as maintenance technicians. At the level of maintenance technicians, the transition to new automobiles using hybrid or fuel cells will not necessitate the replacement of existing workers as the fundamental technology remains the same. However, updating and upgrading skills of current employees is crucial. Moreover, as the technology advances, the most important competencies for maintenance technicians will not be the ability to repair faults but to diagnose problems and identify the right module to replace. Hyundai utilizes diverse delivery methods for employee training for technicians and sales persons on maintenance and product education, and the company emphasizes the importance of on-the-job training.

Hyundai partners with 12 colleges and universities and ensures new skills needs are reflected in their curricula. In exchange teachers and professors from these partner institutions teach current employees about new technologies and skills.

In 2009 there were 2,327 maintenance service centres and 24,682 technicians participating in the Hyundai education programme.

Conclusions

It is predicted that the number of green jobs will increase more rapidly than non-green jobs in the Republic of Korea, although this is an approximate estimation based on currently available data.¹⁶⁹ Some industries such as the automobile industry have attempted to assess the skills needs in line with a greening economy. However, in the Republic of Korea, there has not been a comprehensive system to specifically identify green skills needs. While sector councils (SCHRDS) are not well prepared or experienced in carrying out skills surveys, they will play a major role in identifying current and future green skills needs – particularly the Green Finance, and New and Renewable Energy, SCHRDS.

Since the Republic of Korea has achieved rapid economic growth over the past four decades, mostly in manufacturing and heavy chemical industry, the amount of the Republic of Korea's CO₂ emissions have increased sharply. The Republic of Korea did not take environmental problems into consideration while embracing rapid economic development and thus until recently has not reacted to the international efforts for more environmentally sustainable growth. However, in 2008, the Korean Government adopted an ambitious national plan for green growth which targets harmonious economic growth with environmental sustainability. The Five-Year National Green Growth Plan and the Presidential Committee on Green Growth are the representative efforts of the Republic of Korea's recent political shift to green growth.

The Korean Government recently announced 12 policy plans in areas that aim to create a virtuous circle of green growth and green job creation. These include policies focusing on developing infrastructure for green job creation, expanding vocational education and training for green jobs, and development of core green talents.

Diverse delivery mechanisms can be utilized for green skills development, ranging from short-term training courses and seminars to formal education systems such as specialized graduate school programmes, to e-learning or on-the-job training.

Over a very short period, the Republic of Korea has restructured a large number of policies and strategies across different ministries to align with centrally focused green growth initiatives.

¹⁶⁹ Presidential Committee on Green Growth, 2009b.

However, although many new policies and strategies have been created, many of them are still too vague to be put into practice yet. At the time this report was being prepared, 16 months had passed since the President first announced green growth initiatives. There have been numerous seminars, conferences, workshops, public hearings and publications on the topic of green growth. Yet evidence of green jobs and green skills development in the Republic of Korea remains anecdotal.

Recommendations

The Republic of Korea's current green growth initiative needs to try to integrate top-down environmental policies with the experience and know-how from the bottom-up practice of industries, NGOs and civil organizations linked to the environmental movement.

Restructuring and enhancing the national information infrastructure related to green jobs and green skills is required, for example identifying how many, what type and the demand for "green jobs" as well as building consensus on the definition of a "green job". It is difficult to provide an accurate prediction about the future of green jobs; however, by mapping green skills and green jobs, the VET programmes can be developed to better support green growth policies as well as improve the quality of green job workers.

For effective skills development, qualified teachers and appropriate curricula are essential. Since a large portion of green technologies are new and interdisciplinary, it is difficult to find experts and it will take some time to prepare new VET teachers for the field. Along with retraining programmes for VET teachers, the Government should implement financial and legislative policy measures to attract qualified practitioners in the field of green technology and the green industry, and utilize those competent practitioners as qualified VET teachers and trainers. The Government needs to create a cross-sectoral system to support the linkage and partnership between different educational institutions and training facilities. In addition, the partnership between education and industry at various levels needs strengthening.

Green technologies that are developed by the green industry, such as energy-efficient housing, green transportation and production of alternative energy, may – through job creation – improve quality of life at a local level. Therefore, the central government should cooperate with local government regarding the green growth plan and job creation.

Green career development in the Republic of Korea is currently split into highly skilled engineers and researchers and low-skilled construction or manufacturing workers. Education and training policy measures and strategies need to be inclusive to ensure the skills advancement and career development of all workers from low-skilled to high-skilled positions, yet also differentiated to cater for different needs. The Green New Deal is expected to create 960,000 green jobs; however, 97.6 per cent of these are mostly manual workers for temporary jobs on civil engineering and green construction public works. For long-term sustainability the Republic of Korea needs to continue efforts to transform short-term employment of manual workers into more sustainable green jobs with high level skills.

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South Africa

Policy context

Key challenges and priorities for a green economy

When South Africa's new democracy came to power in 1994, it faced formidable problems stemming from the structural (historical) inequalities of the past which are still being dealt with in a socio-economic context today. Unfortunately, due to this, greening of the economy has had to take a back seat and has not been able to develop extensively. However, the key challenges and priorities to do so have been identified. One critical challenge is the general lack of skills in many sectors, and in particular the lack of scientists, engineers, technicians, and human resource and training and development professionals, which will be essential in transitioning to a greener economy. Another challenge is that South Africa will have to decarbonize its economy. Currently South Africa is ranked eighth globally in terms of per capita emissions. Attitudes towards projects such as Concentrating Solar Power have been perceived as nothing more than "a pilot", so will need to be redirected in order to deploy these projects. In addition, South Africa is a centralized, coal-based energy economy with large reserves of coal, and thus it is the primary energy supply and coal-fired power plants produce the majority of electricity. The Department of Minerals and Energy, in its 2003 White Paper, announced a target of 10,000 GWh annually from renewable sources by 2013, representing approximately 4–5 per cent of generation output.¹⁷⁰ In 2009 a Renewable Energy Feed-In Tariff structure was agreed upon, aiming to support the development of wind, hydro, landfill gas and solar energy. This has still not been finalized or implemented, primarily because the institutional arrangements have yet to be clarified, but plans are under way. This delay is also partially due to attitudes towards greening. According to Earthlife and Oxfam (2009), overcoming the omnipresence of the electricity generation company Eskom and its preference for fossil fuels is the biggest obstacle to developing a renewable energy market.

Furthermore, President Zuma in 2009 announced voluntary greenhouse gas emission targets of 34 per cent by 2020 and 42 per cent by 2025. The country has set an energy efficiency target of 12 per cent by 2015.¹⁷¹

South Africa is a semi-arid country, and lack of water is a limiting factor to development. Water quality and availability is associated with land use change, funding capacity, climate change, human pressure and population and economic growth. Biodiversity is largely affected by water scarcity, and the industrial and power sectors require large quantities of water; thus it is vitally important that an integrated approach is taken to the management of land and water uses.

The environmental response strategy and the role of skills development

General environmental strategy

South Africa's Long Term Mitigation Scenarios set the foundation for the South African climate change policy and aims to begin declining greenhouse gas emissions in absolute terms in

¹⁷⁰ DME, 2003.

¹⁷¹ DME, 2005.

2030–35. The Medium Term Strategic Framework is aimed at 2009–14 and addresses two relevant strategic priorities: the first relates to strengthening the skills and human resource base in general, and the second relates to sustainable resource management and use and makes a specific reference to green jobs. Likely adaptation measures are still in the planning stages, and due to the cross-cutting nature of climate change, patience and proper implementation will be necessary. The Energy Efficiency Strategy is meant to reach across all sectors, specifically the industry and mining sector, commercial and public buildings sector, residential sector, and the transport sector. This strategy is cross-cutting and lays out a three-phase pathway to increasing energy efficiency, having begun in 2005.

The CDM allows for the creation of a greenhouse gas mitigation plan that promotes sustainable development by technology transfer, donor funding and capacity-building opportunities. Unfortunately, CDM activity has been fairly light in South Africa, with only four projects having been issued, but the interest in future projects is evident. As a part of the National Environmental Management Programme, South Africa has passed legislation through the following four acts: Biodiversity Act, the Integrated Coastal Management Act, the Integrated Waste Management Act and the Air Quality Act. So while there are currently very few policy drivers directly aimed at greening South Africa's economy, the market or macroeconomic forces have played an important overriding role in terms of greening and the development of related green skills. However, in many cases these forces are not underpinned by green imperatives or a concern for environmental sustainability on the supply side of the economy, but rather reactions to crises and changes in consumer preferences. While this is not traditionally "greening", the market has dominated changes in the operations of a number of South Africa's major economic pillars, and must be given due consideration.

Green response to the current economic crisis

South Africa's official response to the economic crisis is given in the Framework for South Africa's Response to the International Economic Crisis (2009). The Framework presents approaches that will be acted upon by the Government to protect South Africans during this time of economic uncertainty. Only a small paragraph of that document was devoted to greening initiatives, stating that the parties recognize the opportunities and need for South Africa to develop a strong capacity in green technologies and industries, and government will be asked to develop a proposal for consideration in which incentives for investment and "green job" creation will be drawn. While this was the only direct acknowledgement of greening in the Framework, other responses to the economic crisis present simple and basic green attitudes that should be considered. For example, where investment in better public infrastructure is going to be made, investment in green infrastructure would help increase the national greening capacity. Appropriate institutional arrangements will be critical, and a cross-sectoral approach will be essential, but the opportunities are evident and should be seized.

The skills development strategy in response to greening

There is currently no coherent national strategy/policy to meet the skill needs for greening the economy of South Africa. However, very recent economic policy documents reference green jobs and their potential. In terms of the skills development framework, greening various sectors will require new skills and retraining needs, but they should be incorporated through a "demand and supply" process to adhere to economic needs. However, while there is a skills development focus

and greening focus, there is little articulated alignment between the two. Furthermore, South Africa's Government still does not have sufficient capacity or fund allocations to direct the green economy, or to provide the skills development programmes required on a national basis to implement green initiatives across the board. So until specifics of what needs to be done are identified, policy will still be in development and fund allocation will be put on hold. Greening skills development is a topic of high interest, but appropriate implementation is still in abeyance.

Skills in transition to a greener economy

Green structural change and retraining needs

South Africa's labour market lacks significant numbers of workers for the expansion of the renewable energy industry due to green restructuring. These types of workers will need to be added to the pool of current workers in industries such as coal-fired stations, rather than replace current workers. With current plans for the extension of use of coal-fired power stations, it does not appear that those jobs will become obsolete.

Green restructuring and its impact on the labour market

Despite South Africa's heavy reliance on fossil fuels for power generation and transport, there is significant potential for restructuring in the power industry to increase employment in the alternative energy sector due to the vast amount of untapped natural resources. These include wind, solar and biomass energy using various technologies to harness and transform energy. Moreover, the recent power crisis provides an economic imperative for diversification of South Africa's highly centralized energy supply. The Government has set a target of 10,000 GWh from renewable energy sources by 2013.¹⁷² If capacity were to increase and continue to do so to 2020 so that alternative energy provides 15 per cent of electricity generation capacity, the creation of direct jobs from the renewable energy sector could amount to 36,400. Some 110,000 indirect jobs could be created alongside this, bringing total additional employment to 150,000 by 2020.¹⁷³ So there is a significant opportunity for employment in the renewable energy sector across a range of occupations, through greening existing occupations, and retraining needs due to restructuring. Again, these are seen as additional jobs rather than replacing jobs in the energy sector as it stands now. Furthermore, this restructuring would not necessarily impose detrimental impacts onto existing sectors. Most of the unemployed population are considered unskilled and therefore it will be a necessity to up-skill these people in order to increase the pool of skills available to facilitate the creation of a green economy.

Skills response

The path of skills development through South African central policy has had little explicit focus on greening, and there have been large skills shortages. One of the areas with the most acute skills shortages is in the education and training sector. As a result the skills response from Sector

¹⁷² DME, 2003.

¹⁷³ Agama Energy, 2003.

Education and Training Authorities specific to green skills development has been absent. The Expanded Public Works Programme (EPWP) has been established to help cushion the effects of the unemployment rate (now over 25 per cent), and a major part of this programme is involved with environmental management. The EPWP creates temporary employment for the unemployed and cuts across all departments and spheres of the Government. The environmental sector's contribution to the EPWP involves employing people to work on projects to improve their local environments. Overall the EPWP has been declared a success by the Government as it met its target of creating 1 million work opportunities by 2008, one year ahead of schedule. The scheme has since expanded into phase II, targeting 2 million full-time equivalent positions by 2014, which will have halved unemployment overall.

Changing and emerging occupations and related skill needs

New and emerging occupations

Many sectors have found that, with the increased awareness of climate change, greening initiatives are in demand and require the expertise or installation of green enterprises in their respective sectors, thus creating jobs that were not formerly needed. The solar water heating sector has large potential for job creation and the technology is relatively simple so training would not be extensive. In retail, sustainability managers are coming into demand and would ensure that certain aspects of production and distribution processes were controlled in a sustainable manner. Demand for increased knowledge around carbon footprinting will undoubtedly lead to demand for carbon auditors across many industries. Skills for this type of work exist on a small scale in South Africa, but will increase with higher demands. Finally, in the construction industry, new occupations are focused around architectural design. The demand for these occupations will be influenced by policy in relation to building standards, the extent to which construction companies see the benefits of going green, and awareness of office buildings and residential housing consumers in relation to energy savings and the potential of green buildings.

Greening established occupations

A lot of energy and water consumption in South Africa happens in work domains, where managers often find it difficult to control how much their staff is consuming. There is potential to curb this large consumption if South Africa increases awareness among workers and businesses about energy and water efficiency. The country has large numbers of unskilled jobs in manual labour, predominantly in agriculture and construction. Workers in these sectors must learn to correctly dispose of materials and chemicals, along with efficient use of energy and water, which would significantly reduce negative environmental impacts. Benefits include waste reduction, reduced water footprint, improved water sanitation and reduced carbon footprint of the industries concerned. Simple but important changes such as these will need to be instilled in skills of all workers from the bottom up.

In agriculture, three key areas must be addressed to obtain and implement better irrigation methods, which would increase water efficiency: first, expertise is required to identify proper technology; second, consultants and private businesses will be required to undertake market studies to ensure an effective rollout plan for sales; and third, the farmers and workers need skills in using and maintaining the technology appropriately.

The engineering and construction sectors present highly skilled workers, but also ones with some of the biggest potential to green their sector. Keeping up with the latest green building technologies, and incorporating them into designs, will make large contributions to greening the economy and sector. Furthermore, South Africa already lacks engineers, so there is a demand for more engineers in the country as is.

The retail sector can be greened through ensuring that the supply chains for various goods meet certain criteria for environmental sustainability. Therefore, the skills requirement for greening existing jobs in this sector is small, but many changes to existing roles within a company need to occur to enable policies and key sustainability ideas to be successfully implemented.

Skills response

South Africa has well-designed mechanisms for providing vocational education and training to the labour force and identifying skills gaps in the economy; however, engagement is still lacking. The EPWP is an example of a successful skills development and job creating project that has created thousands of work and training opportunities over the past few years. The National Jobs Fund and associated training layoff scheme, although only recently initiated, can act as a strong opportunity for firms to train employees in sustainable working practices. Curricula offered at universities around the country now offer courses in energy resource management, building technology, chemical engineering and other sectors that are dedicated to environmental affairs and greening initiatives and technologies. Public sector skills development is determined by the Government's "green sector plan", finalized in July 2010. Private businesses have been doing their own training; thus records are not available as to the extent of their skills training activity. There is training offered by NGOs, such as the Wildlife and Environment Society of South Africa, which offers two Environmental Educators Courses. These courses address environmental issues and risks and aim to demonstrate knowledge of energy efficiency goals, principles and methods of their appropriateness in different contexts; review a variety of approaches to learning, teaching and evaluation; and network broadly to source information and support key environmental issues or risks.

Anticipation and monitoring of skill needs

South Africa is a young democracy, facing many challenges due to the need to redress previous imbalances. Many positive strides have been made since the end of apartheid rule in 1994, but South Africa has not to date made greening of the economy a priority, and until recently it has barely been featured in policy aside from various environmental policies. Therefore, in terms of anticipation and monitoring of skill needs, South Africa is still only at the outset of identifying the economic possibilities presented by greening the economy and moving towards a low-carbon pathway of development, and thus is not ready for this stage of the process. Most of the responses discussed have been very recent, particularly in terms of policy. No policies existed as of March 2010 that specifically and exclusively addressed green jobs and green skills. References to greening and green jobs are a recent emergence as a small aspect of general policy framework development. However, these initiatives still take a narrow view of greening possibilities and have not been finalized to the stage where they can begin implementation. Therefore, the only anticipation and monitoring of skill needs that can be done are where such programmes already exist and are at a high level of coordination and development, which unfortunately is not the case for South Africa at present.

What can be anticipated then is continued monitoring of any progress in the skills shortages that have been identified. Since a critical aspect of challenges for the green economy is the general lack of skills in many sectors, any labour market development will have to be monitored and kept up-to-date so that greening initiatives can be incorporated where possible.

The market context of this report also demonstrates the most opportune place for encouraging the process of greening, because it is a stronger force than that of policy or environmental strategy in South Africa. The market dictates reactionary greening in some cases, because other issues force a restructuring towards greener processes without greening being the imperative. This means that green skills development is very often a reactionary process, and in many ways a business decision too. Thus it can be anticipated that market opportunities will be monitored and exploited for future greening because policy in South Africa is far from the implementation stages that will reach a broad enough audience. This should also happen at the international level for future developments.

Summaries of case studies

Seven case studies were conducted for this study covering occupations undergoing change due to economic restructuring, emerging green occupations, and existing occupations that have become greener as a result of increased demand for greener production.

Case study 1. Working for Water Programme: Payment for environmental services

This case study describes a government-funded programme that aims at controlling invasive alien plant species. These species are the single biggest threat to South Africa's biodiversity and a threat to water security, the ecological functioning of natural systems and the productive use of land. Invasive alien plant species are plants, animals and microbes that are introduced into countries, and then out-compete the indigenous species. The fight against invasive alien plant species is led by the Working for Water Programme and administered through the Department for Water Affairs, in partnership with local communities and other government departments; in addition the Working for Water Programme is part of the Expanded Public Works Programme of South Africa which aims to reduce unemployment and poverty by providing government-funded work opportunities.

This collaboration has trained unemployed people from local communities to use a range of skills to control and remove invasive alien plant species. The skills development and training involves a comprehensive training on safety and technical aspects of the jobs, varying by rank (e.g. contractors undergo additional training and advanced business training is available). Social development (life skills) training is provided to all workers and includes: peer education, counselling, HIV/AIDS, primary health care, personal finances, and home based and frail care. Almost 30,000 individuals have been employed each year, and work in small teams of 10–15 individuals headed by a contractor. Contractors must demonstrate good management capacity while also having other skills including numeracy and literacy skills to Grade 10 standard or above. The employees are employed for 460 days over five years, thus extending their period of employment while also allowing time for seasonal work.

The overall objective of the programme design is to give skills to previously inexperienced workers, better enabling them to move into the formal workplace after the period of employment is complete. Currently work is primarily carried out on public land, but potential for private investors is high, especially since 75 per cent of South African land is privately owned. In addition, several spin-off projects are under way or already in effect. Challenges faced were mainly in having enough work for each employee; however, spin-off programmes have helped provide more employment opportunities. This programme is globally recognized and has grown to be the biggest conservation programme in Africa.

Case study 2. Restructuring in the power generation sector: Co-generation in industrial processes

South Africa is ranked as a high CO₂ emitter globally due to its reliance on coal-fired plants, which account for almost 90 per cent of electricity capacity in the country. Much of this energy is consumed by the heavy industry and mining sectors which comprise a large portion of the country's gross domestic production. There is a significant potential for energy efficiency gains to be made and, in the country's Energy Efficiency Strategy (2005), a target was set for industry and mining. However, this target is far from being met and, while renewable energy sources are becoming popular, they are expected to be in addition to, rather than in place of, fossil fuel generation capacity. Nonetheless, biomass energy generation is a labour-intensive industry, specifically in the collection and preparation processes. A 6MW biogas steam generator capable of directly supplying industrial processes or feeding into the grid can provide employment for 207 people during its lifecycle.¹⁷⁴ Eighty per cent of these jobs are considered low-skilled occupations, and while not specifically green skills, they contribute to the greening process. The other 20 per cent of the jobs are located within the factory and require considerably more training. These jobs require skills similar to those in non-green industrial sectors; however, there is a significant element of training required to adapt workers from one technology to another.

South Africa currently houses 600–800MW of steam generation from industrial processes, all of which is powered by coal-based electricity from the national provider. The potential for job creation is then enormous should a large portion of this electricity be sourced from biomass energy. One could expect around 20,000 to 26,000 jobs to be created over the project lifetime, of which 14,000 to 18,000 would be full-time operational jobs.¹⁷⁵ However, some realism must be applied as it is highly unlikely that enough biomass material could be sourced within South Africa to provide such large energy requirements. Furthermore, the sector's expansion may cause labour shortages in other sectors.

Case study 3. Photovoltaic (PV) panel manufacturing plant

Solar technology has made significant progress over the past decade and opportunities are arising for manufacturing plants to be set up in South Africa mainly due to a new improved panel design which is thinner and cheaper than current PV panels, by Vivian Alberts at the University of Johannesburg. Capital and land have been acquired and production is set to begin in the Western Cape in 2012. In terms of high-level skills, this sheds light on the presence of green skills in academia and research and development. However, these skills are limited to a very small percentage of the population. On the macro level, green innovations such as these bring international recognition and attention, putting South Africa in a position to attract international financial flows for green enterprise. The European Investment Bank is lending €40 million to support the construction of the local PV production facility, which has now become a public–private partnership. The markets for such innovations reveal the skills necessary to operationalize green ideas. In terms of the plant itself, the size of the operation dictates how many jobs there will be. The facility to be established in the Western Cape will have a capacity to produce 40 MW worth of modules annually, and is estimated to produce 1,400 jobs directly – in manufacture, installation and maintenance.

¹⁷⁴ DME, 2005.

¹⁷⁵ OneWorld, 2009.

Case study 4. Solar water heating installation technician: The Kuyasa Housing Project

The Kuyasa Housing Project receives funding from the Department of Environment and Tourism's Social Responsibility Programme and Provincial Government's Department of Housing. This is Africa's first CDM project and the world's first Gold Standard Project due to its focus on pro-poor investment, sustainable investment and job creation.¹⁷⁶ The project was built as a low-income government housing project piloting the installation of solar water heating, along with insulated ceilings and energy-efficient lighting in low-income houses. South African cities have a shortage of low-to-middle-income housing and, given a limited budget and the urgency for basic housing for large numbers, there has been a disregard for the prioritization of energy and thermal efficiency. If all low-income homes in the past 15 years had included thermal insulation and solar water heating (at a total of R10,000 extra per home), this would have cost R25 billion and would have avoided the need for 4MW of coal-fired power generation (currently costing R95 billion to construct). The opportunities to reduce the energy intensity of this housing sector are enormous, and there is a strong monetary incentive.

The project has created 85 full-time jobs, and many other part-time or temporary jobs. Job creation and up-skilling of locals is the heart of the Kuyasa Project, and to meet the requirements of ongoing maintenance and servicing, a sustainable energy services entity was established to operate from within the township, run by locals. The sale of carbon credits part finances these ongoing activities. Employment has also been created as an offshoot to the project, where ceiling and solar water heating installation teams are working privately. In total the project has employed over 409 individuals, paying special regard to gender equality. Some employees received accredited training in plumbing, heavy current electricals, and carpentry. Non-accredited training was given in the form of on-the-job shadow training for insulated ceiling installation and frame assembly, and extensive solar water heating training. In addition, life skills courses were given to many of the employees.

Case study 5. Climate change adviser/climatologist

Climate change and the demand for adaptation and resilience building have brought about a need for new professions and re-skilling in existing sectors. For example, a climatologist is one who studies climate science and is highly skilled, performing research and analyses of the fundamental changes in climate which are beginning to affect the entire global population. Climatologists build Global Climate Models on a global or local scale, which have informed much of the current understanding of climate change. Climate information is crucial to modern businesses, and the importance of public awareness about climate change is increasing. Therefore, the need for downscaled modelling, risk-based assessments and research analysis from climatologists and related fields (resource economics, development professionals etc.) is increasing rapidly to enable all stakeholders to fully assess their exposure to climate variability. Climate change related research capacity in South Africa is based at research institutions, academic institutions and private institutions (specifically the insurance and mining sectors). The sector already experiences skills shortages, which is especially true for black applicants who are severely underrepresented in the sector. Unfortunately, the climatology sector is not an attractive field, as the sector lacks the necessary funding from government and private sources to offer bursaries for studies in climatology. In terms of disseminating information, there is a void of skills which enable climate science research and modelling to be converted into useful information and adaptation on the ground. This type of climate change advisory role would involve two types of training: first, a strong aspect of climate model understanding and interpretation through a technical course; and second, hands-on, practical knowledge of the concerned sector's functions and climate-affected processes through an apprenticeship. While no such programme is currently active and the skills shortage has not been officially recognized by any government body, some businesses are employing climate change advisers, and several large mining and oil companies operating in South Africa have teams working on climate change issues related to the company and sector.

¹⁷⁶ Kuyasa CDM Project, 2009.

Case study 6. Architect/green buildings

A large portion of global emissions have been attributed to buildings and the construction process. In addition, energy efficiency in buildings has the biggest potential to limit emissions of greenhouse gases and could do so by 20–30 per cent of the total mitigation potential.¹⁷⁷ In South Africa, the construction sector accounts for a very influential amount of GDP and is estimated to employ around 700,000 in 2010. Therefore, the potential for additional skills requirements due to the drive for greener buildings is significant. The national government has taken note of this and has implemented several measures that will help achieve the target of reducing energy demand from commercial and public buildings. This will include establishing new standards, increasing awareness of energy efficiency, and implementing mandatory energy audits for commercial buildings.

Additional skills will be required to enable South Africa to build greener buildings and retrofit existing buildings with energy-saving measures. For the design team, decisions should be made bearing in mind lifecycle costs and not only initial capital costs. Designers will need knowledge pertaining to energy efficiency related technologies and other tools. The role of “green buildings adviser” is to advise and direct on sustainability and environmental issues regarding all aspects of building design and construction.

The Green Buildings Council runs the Green Star SA Accredited Professional Programme, which gives accreditation to industry professionals (such as architects and engineers) who complete the programme's course and successfully pass the examination. Course participants receive a manual that also explains the use and application of the Green Star Rating Tool, a tool used in certifying that green building strategies have been followed during the design and construction processes. In addition to having the ability to market Green Star SA certification, professionals are also being encouraged by the South African Council for the Architectural Profession to buy a copy of Volume 1 or 2 of the *Green Building Handbook* in exchange for the credits needed to maintain their registration with the South African Council for the Architectural Profession.

Case study 7. Biological farming for the retail sector

In the retail sector, greening has been, and will continue to be, driven by changing consumer preferences, corporate social responsibility compliance and marketing, as well as fierce competition. While cost reduction has played a role and acted as an incentive, the extent is minor in comparison. Greening the retail sector formally took hold five years ago, and is currently only being carried out by a limited number of firms that are positioned at the higher end of the market, such as Woolworths and Pick 'n Pay. Many of the greening processes in this sector entail greening the supply chain and production and distribution facilities, up until and including the point of sale. It seems as if many of the changes being made are in anticipation of future policy changes and requirements in the retail sector; thus businesses are preparing to find a strategic vantage point. In Woolworths' “Farming for the Future” programme, farmers are required to adhere to a certain set of regulations with regards to produce, and then scientific experts carry out an initial assessment and identify any problems. Where problems exist, a relevant expert visits the farm, all paid for by Woolworths. Any further consultation must be paid for by the farmer. Annual assessments determine the level of compliance with Farming for the Future standards, provide targets and measure results. The techniques and skills training of this programme aim to improve soil and water quality, promote water saving and encourage biodiversity.¹⁷⁸ This can, however, present a challenge to farmers who only sell a small portion of their produce to Woolworths or those who are surrounded by farmers using conventional methods. There is also a skills gap that makes mainstreaming such farming tactics difficult. The opportunity exists to green more of the retail sector, requiring basic skills development and sector competitiveness.

¹⁷⁷ ILO, 2007.

¹⁷⁸ Woolworths Press Release, 3 November 2009.

Conclusions

South Africa is at the beginning of the greening and low-carbon economy curve and in many respects is yet to experience a significant structural shift in the economy or labour markets. The momentum is gathering, though, and this environment is being updated on a daily basis at present. In terms of greening there is currently no labour legislation in place to shift the economy towards greener products and services. Environmental management is certainly at the forefront of South African policy and recent acts will drive changes in working practices across many sectors in years to come. The National Jobs Fund is one method in place that would certainly respond to green skilling of certain workers, if the demand existed. This would occur in an up-skill manner and green certain aspects of existing industries. The Expanded Public Works Programme is another method, and it promotes ecosystem services and training for employment expansion.

The high unemployment rate in South Africa is largely due to skills gaps, hence the need for skills development in general. Socio-economic development is a priority and haste is essential. South Africa has developed a skills identification framework that is globally recognized, but it lacks any reference to greening of the economy and green jobs. The framework is designed to listen to industry requirements and provide education and training in response. Training in relation to green occupations should develop organically through the demand and supply design of the framework, but this has not happened to date and there has been no national public recognition of green skills requirements. Thus greening skills specifically has been eschewed, as it has not been a major priority up to now.

As a developing economy South Africa also still has many environmentally negative aspects, such as long-term dependence on coal-fired electricity generation, that are entrenched in the national economy and will not disappear for a long time. However, there is an increasing demand for electricity, a growing need for decentralized energy and an energy crisis at hand that have presented opportunities for renewable energy to provide green energy alongside traditional fossil fuel generation. Market-driven changes such as these have affected heavy industries and currently present some of the best opportunities for greening in South Africa.

South Africa has some effective mechanisms in place that can be tapped into to coordinate the development of a low-carbon economy green skills base. This is possible through establishing new qualification standards and using existing skills in a green context. The latter is more easily accomplished and, for this country, the most needed. Coordination needs to take place at the highest level, with the drive coming from political will and policy action, with cross-sectoral institutional arrangements.

Recommendations

In terms of policy recommendations, a National Low Carbon Economy Skills Forum, located in the State President's Office for Economic Planning, would be useful to monitor and direct the National Qualifications Framework to ensure that essential skills for greening the economy are considered. This body would take a long-term view on skills requirements by observing international trends and changing consumer preferences and market forces to ensure effective ways to include green skills in training programmes. This body would also be included in consultations between Sector Education and Training Authorities, Standards Generating Bodies, industry and academic institutions to ensure green representation. Another policy recommendation is that existing environmental policies be more strictly enforced. South Africa has made good progress on national policies regarding environmental issues, but it lacks the capacity to rigidly enforce legislation. Strengthening this area of governance would inevitably drive changes. Finally, public

skills institutions should support the numerous private skills development initiatives and use them as a template to disseminate training at a larger scale to relevant sectors.

The overriding lack of sufficient basic skills in South Africa is the major inhibiting factor to the development of a green economy. The Department of Education has identified the following skills as being in short supply and subsequently these skills will be targeted in the re-capitalization of further education training colleges: engineering; information technology; financial management; marketing; tourism; manufacturing and assembly; fabrication and extraction; and primary agriculture. In terms of greening, the sectors most in need of graduates are engineering and agriculture. Any success in this area will be beneficial to the future of the green economy, but a coherent response to climate change must be put in place through integrating climate change responses into mainstream economic development. Only then will green skills development be set in place.

Further research and data collection are encouraged, because the broader skills needs for greening the economy have not been officially investigated. Immediate research projects should be commissioned to map all public and private green skills training activities in South Africa, and identify global and domestic trends in consumer behaviour in the market for green products and services.

Appropriate, coordinated delivery mechanisms are the most important ingredient in ensuring that the emerging green and low-carbon economy in South Africa is adequately skilled. Skills development so far has been largely demand driven. Although this is appropriate, a green-skilled low-carbon economy is so cross-sectoral that this approach is likely to lag, with opportunities not being realized at the right time. Public–private partnership programmes are the most successful scenario, but require coordination at the highest level. This would link the market and policy context in South Africa and improve political will in the transition to a low-carbon economy.

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Spain

Policy context

Key challenges and priorities for a green economy

The challenge of adapting to climate change in Spain is three-fold: the next decades will see intensifying increases in temperature, decreases in precipitation and sea level rise. Global warming will have serious effects on biodiversity, affecting agriculture and livestock industries. Decreases in precipitation will diminish water resources, with implications for agricultural production, forest density, soil erosion and fertility, as well as potentially negative consequences for water supply in many cities.

Economic development and population growth also affect efforts to mitigate climate change. Water problems are enhanced by the current trend of urban growth and periodic droughts. Priorities in Spain are therefore focused on energy security and solving the problem of water scarcity. To this end, renewable energy production and desalination technologies have been developed extensively over the last decade. Energy and water strategies form the core of Spain's transition to a greener economy.

Spain also has to make considerable advancements in relation to its Kyoto Protocol commitments, as GHG emissions are currently far from targets, reaching 420 Mt of equivalent CO₂ in 2008, 52 per cent higher than in 1990.¹⁷⁹ Efforts to reduce GHG emissions are embedded in various environmental strategies cutting across all sectors in the economy.

The environmental response strategy and the role of skills development

General environmental strategy

The strategy for dealing with the above challenges prioritizes four areas: energy, water, pollution and transport. First, the energy strategy is based on reducing the energy/production ratio and increasing renewable energy production. Second, the water strategy is based on increasing efficiency of water consumption and increasing water resources. Third, reducing pollution and protecting natural resources is a green priority in itself. Fourth, the transport strategy consists of the development of electric cars and promoting sustainable transport, including the shift from road to railway transport. Agriculture and fisheries are targeted in several of these priority areas.

The Spanish policy response to the challenge of climate change is fostered at different administrative levels of the state: central government, autonomous communities and local councils.

Key environmental strategies at the national level are the 2006 Spanish Climate Change and Clean Energy Strategy, the 2007 Spanish National Climate Change Adaptation Plan and the 2007 Spanish Sustainable Development Strategy. Sectoral plans have also been implemented at a national level for transport, pollution, water and energy. Several initiatives from the autonomous communities complement the Government strategies, together with Agenda 21 at the local council level.

¹⁷⁹ According to Kyoto Protocol commitments, Spanish GHG emissions for 2012 should not rise more than 15 per cent from 1990 levels.

Green response to the current economic crisis

In December 2008, the Spanish Government launched an €11 billion economic stimulus package, equivalent to approximately 1 per cent of GDP. The package included €600 million in environmental projects¹⁸⁰ and €500 million in research and development, together with funding for infrastructure projects and investment in the ailing automotive sector, signalling the importance placed by the Government on the “green economy” and its role in promoting growth and development. In response to the economic crisis, the Government launched the Spanish Economy and Employment Stimulation Plan (Plan E) in early 2009 and consulted on a Law of Sustainable Economy later that year.

The Spanish Economy and Employment Stimulation Plan (Plan E)¹⁸¹ is a comprehensive and extensive strategy containing short-term packages oriented towards introducing long-term reforms in the economy to move towards sustainability. Plan E includes an important and comprehensive skills development strategy, from primary education to R&D projects in universities and research centres, which to some degree addresses the skills needs brought about by environmental policies.

The strategy is supported by a raft of measures to enhance environmental sustainability, including funding for sustainable transport (Plan VIVE) and R&D in low-carbon vehicles (MOVELE project), as well as additional support for the Energy Efficiency and Saving Plan 2008–11, the Renewable Energy Plan 2011–20, the Law of Renewable Energy and Energy Efficiency, and the Railway Freight Transport Promoting Plan.

The skills development strategy in response to greening

Despite the inclusion of several skills training responses in environmental policies, and the progressive development of diverse environment-related programmes in the higher education system, there is no explicit national strategy targeting skills needs for greening the economy. Many public strategy documents identify the need for more skills training but there is no overarching, comprehensive skills training strategy identifying the skills needs for the occupations involved, and a recent Symposium of Environmental Training within the Spanish Public Administrations¹⁸² found that there has been a lack of strategic coordination of skills responses for “greening the economy” at different administrative levels. However, there are many interesting initiatives from public bodies that contribute to skills training. Public bodies also participate in skills training programmes designed by private sector academies or associations, funding these programmes directly or through managing EU funding.

In Spain, the regions are responsible for managing active labour market policies, which include employment creation and occupational training for the unemployed. They also manage education policies including formal vocational training and tertiary studies. Though harmonized and coordinated at the state level, they adapt employment and education strategies to their needs and strategic priorities. Regional approaches to the “green jobs” agenda and associated skills re-

¹⁸⁰ Bruegel, 2009.

¹⁸¹ Plan E. See <http://www.lamoncloa.gob.es/NR/rdonlyres/00016916/tsgpcyhjhjnhzsvbmewlinwfvmtmsjgwy/SpanishEconomyAndEmploymentStimulationPlan.pdf> and <http://www.economiasostenible.gob.es/balance-del-plan-e>.

¹⁸² “Jornadas Técnicas sobre la Formación Ambiental en las Administraciones Públicas Españolas” held 3, 4 and 5 June 2009, in Pamplona, Navarre. Available at: <http://www.navarra.es/NR/rdonlyres/082E5062-6051-4B97-B963-7D401D59382B/130725/PROGRAMA.pdf>

quirements vary greatly but there are several existing environmental education plans by the Spanish autonomous communities.

Many agents in the private sector or civil society are complementing the skills training offer for the greening of the economy. In the last decade, “green sectors”, especially the renewable energy sector, have grown rapidly, increasing the demand for professionals and leading to the development of skills responses by universities, certain public bodies and the private sector.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

Green restructuring in Spain is mainly policy driven. Greening of the economy started about ten years ago with reform in energy policy, and has recently been reinforced by policies designed to deal with the economic crisis. The greening strategy focuses on renewable energy but includes promotion of waste treatment and green management in public and private bodies. Due to the impact of the economic crisis on the construction sector, a concerted effort to aid employees to diversify into renewables has been launched. The automotive industry has also recently been targeted as a greening sector, in an effort to aid the ailing industry and make advances in meeting climate change policy targets.

Green structural change involves several retraining needs across these sectors. For many occupations in the building industry, the skills gap for renewable energy is small, particularly for electricians, plumbers or installers training to install solar energy panels on buildings. Certain technical skills are needed for construction-related occupations to adapt to the particular technical specifications for installing photovoltaic and thermal solar panels, but these skills are not too different and can be acquired in a relatively short time span. Energy policy has also led to the creation of several “new” green occupations, namely technical staff in the areas of building and installation and in operation and maintenance. Furthermore, although the electric car strategy is only in its initial phase, it is also likely to require some kind of skills response, for example for building power supply access points, which will involve construction-related occupations such as electricians and building workers.

Skills response

The skills training response needed for green structural change is carried out by several agents from public, private and mixed bodies. Two quite different approaches are taken in the public and private sectors:

- *Public sector responses:* skills responses led by the public sector have been observed in regional government strategies for the renewable energy sector. Many local and regional governments are organizing such skills training in the context of active labour market policies, for example the programmes undertaken in the Basque Country, Navarre and Extremadura. Here, regional governments attempt to anticipate the need for green skills through initiatives to provide a skills training response for the green structural change.
- *Responses from the private sector and social partners:* skills responses coming from private sector and social partners flow directly from demand from workers and SMEs and they either undertake skills training themselves or entrust the skills response to a training centre.

There is often coordination between public and non-public skills responses, for example in initiatives created by a private agent (an academy or association) and funded by a public body offering subsidies to agents developing green skills training projects (such as the city council, regional government, or EU funding).

Changing and emerging occupations and related skill needs

New and emerging occupations

New or emerging green-collar occupations are found across several sectors involving quite different occupations, education levels and skills. They are not entirely “new” in that they have emerged from established occupations, but the skill sets required to perform the work are distinctively different. New or emerging green occupations can be classified in the following four broad groups: Renewable Energy, Waste Treatment, Green Management, and Awareness.

Many companies from the engineering, electricity or installation sectors have diversified their core activities to the renewable energy sector. Only half of the renewable energy companies are specialized in renewable energy, while the other half perform additional activities. This means that new skills required are relatively easily acquired through retraining in skills related to renewables such as knowledge of technology systems, installation procedures, regulation, maintenance and management.

Waste management in Spain includes activities across urban waste management, dangerous waste management and recycling. New recycling and waste management approaches have been developed in response to increased urbanization, population growth and development of the tourism industry, while technological innovations involving mechanization of tasks have changed the skills set for the sector. Greener waste management, which includes selective waste collection or recycling techniques, is expected to grow in the coming years, requiring additional jobs and skills training responses.

Green management organizes and controls the shift in production to a more environmentally sustainable productive structure or manages goods with a high natural value. Examples of occupations in this sector are protected natural reserves management, forest area management, corporate environment protection activities and public body technicians and inspectors (located in local councils).

Workers in environmental education and the environmental information sector have a key role in influencing the behaviour of consumers. Occupations related to environmental education and awareness have experienced a considerable growth and diversification in the last few years, with more people acquiring skills for environmental training and awareness.

Greening established occupations

Greening of existing occupations is part of the overall green structural change and is therefore related to those fields targeted in environmental strategies such as occupations within construction, water, transport, agriculture and fisheries. Greening processes within one sector often affect more than one occupation. Sometimes this is because the same factor drives the greening process across the whole sector. Two main drivers of the greening process have been observed: environmental concerns/policy and economic drivers. The first is based on regulations reflecting environmental priorities and the second is based on economic savings obtained by the “greening process” (usually related to energy efficiency).

In shifting to more environmentally responsible production methods, two different skills gaps have been identified in this study. First, there is a “capital greening gap”, which could be narrowed by increasing energy efficiency through capital substitution (generally involving technological change). Second, there is a “non-capital greening gap”, which could be addressed by increasing energy efficiency through organizational changes or improving attitudes of workers. As an example, a capital greening gap could be the change in agriculture from old harvesters to newer, less polluting ones.

By contrast, an example of a non-capital greening gap could be switching off the lights in office buildings when they are not in use. Closing this non-capital greening gap involves training in conceptual skills, such as environmental awareness. A non-capital greening gap could be found in almost every occupation, from farmers to highly qualified white-collar workers, and this is one of the key challenges of greening the economy. Thus, conceptual skills training responses, such as awareness campaigns, should continue and perhaps incorporate new training methods.

The study has observed that greening occupations tend to be blue-collar rather than white-collar workers. Blue-collar activities tend to be more energy intensive than white-collar activities; hence the potential greening gap would appear to be wider for blue-collar workers than for white-collar workers.

Skills response

Three types of skills responses have been identified for changing and emerging occupations: long programmes within the education system, courses for specific occupations, and skills responses in corporations.

The first kind of skills response, long programmes within the education system, is providing a growing range of courses related to new green-collar occupations. These courses are either set within the vocational training system for technical occupations or within managerial post-graduate programmes in universities. University training tends to be directly focused on new green-collar jobs, whereas the vocational training system usually provides wider technical skills training programmes. Courses for green occupations have experienced considerable growth in the latest years.

The second type of skills response, courses for specific occupations, has been fostered and financed both by public and private bodies, including regional and local governments, employment services, associations, foundations and trade unions. Private training centres have played an important role in this kind of skills response. This kind of skills response is effective in delivering greening of existing occupations, as skills gaps are typically small and the training period is short – professionals, both employed and unemployed, do not tend to take long and comprehensive courses in order to green their skills but prefer shorter and focused courses for learning the skills required to perform a new green-collar occupation.

The third kind of skills training, skills responses in corporations, is also focused on specific skills needed for the new green-collar occupation. Corporations identify the skills needed for their activities within their departments and the skills training response is internally organized. Here, the corporation identifies the skills gaps through reports from the different production departments, while the skills training is provided either by experienced staff within the training department, or by external trainers.

Anticipation and monitoring of skill needs

There is no single entity entrusted with anticipating and monitoring green employment in Spain. Instead, identification of skill needs for the greening economy is undertaken through several initiatives in public, private and mixed bodies, involving different methods. This study found five main methods of identification that apply across restructuring cases, new green jobs and greening of existing jobs:

- *Worker demand*: this has played a key role in the identification of skills needs in the solar energy sector, motivating the organization of several courses.
- *Company demand*: is clearly differentiated depending on company size. Large companies tend to identify needs in their own departments and provide the skills training needed internally. By contrast, SMEs usually communicate skills gaps to regional bodies, training centres or corporate associations.
- *Private academy marketing studies*: this approach is entirely market driven and is for example used by the Institute for International Research training centre in its skills response for desalination plant maintenance and operation managers (see case study).
- *Public initiatives*: consists of several initiatives from public bodies identifying skills gaps for the greening economy. Some are integrated within a certain skills development response, while others consist of studies on skills needs.
- *Comprehensive and organized studies at national or regional level*: skills studies at regional and national level complement the above skills identification procedures. One example is the comprehensive study undertaken by the Public Employment Service in order to identify the occupations and skills needs in the renewable energy sector.

An important recent regional initiative that was created specifically for anticipating and monitoring green employment is ECOEMPLEO, the Valencia Observatory for Environmental Employment and Training.¹⁸³ This body is committed to the study and analysis of employment trends and skills needs in the environmental sector. The observatory originated from the study “Present situation and trends of environmental employment in Valencia Autonomous Community”, and is supported by several public and private bodies in the Valencia region. ECOEMPLEO has carried out a study entitled “Present situation and trends of environmental employment in Spain”, detailing a collection of new green-collar occupation profiles.

Summaries of case studies

Seven case studies were carried out for this study, examining the green skills initiative across the economy. The policy focus on renewable energy is reflected in these case studies, as the majority of the effort to provide skills for the green economy has concentrated on this area.

¹⁸³ ECOEMPLEO (Observatorio Valenciano del Empleo y la Formación Medioambiental): <http://www.ecoempleo.com>

Case study 1. Solar energy entrepreneurs

In response to the increasing need for skills in solar technologies, the Biodiversity Foundation¹⁸⁴ and Telecommunications Installations Businessmen Association (FENIE) teamed up to provide a skills training programme to (re)train construction sector electric installers to become solar entrepreneurs. “Proyecto Sol” received a grant from the “Emplea Verde” (Green Employment) programme, which aims to improve employment and the environment with a budget of 44.1 million euros for the period 2007–13, and began providing courses in October 2009.

Courses focus on solar installation in buildings and 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, from technical design and orientation of solar panels, to administrative procedures, which encompass other skills such as training for the installation of the panels or other useful entrepreneurial and managerial skills. The training in administrative and entrepreneurial skills in a sector with a rising and complex bureaucracy, with plenty of subsidies and administrative procedures, is useful for installers, allowing them to become entrepreneurs.

This skills initiative is both a response to the effects of economic crisis and the rapid growth of the renewable energy sector. The full effectiveness of the response cannot be assessed yet, as the course started recently and there is not yet much data related to the outcomes of the project. The course programmes are expected to cover 660 workers through 44 courses of 60 hours of duration.

Case study 2. Wind power technicians at Iberdrola

Research at Iberdrola Renewables, a major wind power company in Spain, showed that several skills gaps existed for plant technicians, who are responsible for the daily running of wind farms. The main skill requirements were found in mechanical, electrical or engineering skills such as electric and mechanic connections, tool use, electric controls, and the interpretation of plans. Internally organized training at Iberdrola’s own training centre provide skills upgrades in five areas of the workplace: hazards prevention, environment, technical knowledge, languages and computer skills. The first three are fundamental to wind power technicians.

Out of the 297 employees in the wind power operation and management section in Iberdrola, 264 workers received training in the “wind generators electric operations procedures” course. Iberdrola’s training programme is tailored to the skills need identified at the occupational level, and assessment of its effectiveness and organization is positive.

Case study 3. Wind power maintenance staff

The Navarre region’s geographic location, climatic conditions and clear corporate and public strategy have been key to the rapid and successful development of wind power in the region. Since 1994, when there was no renewable energy production in Navarre, the region has expanded its electricity production from renewable sources to 65 per cent including 993 MW of wind power and almost 100 MW of photovoltaic power. The CENIFER foundation (Training Centre for Renewable Energy) was set up by the regional government and enterprises of the sector to build the skills base needed for this large scale roll out of renewables.

CENIFER offers a wide range of renewable energy courses, including a wind power maintenance course delivering training in the skills needed for wind power maintenance staff. The course is organized as an intensive short course with capacity for 15 persons training 8 hours per day over 10 days, covering technical and practical skills for the occupation. Teachers are sector professionals and do not belong to the core CENIFER staff. They come from private companies, are self-employed or work as trainers in private academies.

According to CENIFER staff, the current demand for this profession in the Navarre region is being met by the available skilled workforce. Navarre has been able to cover the jobs needed for this new occupation, facilitating the rapid expansion of renewable energy production in the region in the last 15 years. CENIFER was designated as a National Renewable Energy Training Centre, becoming a skills training reference centre in Spain, and training workers and students from all over the country.

¹⁸⁴ The Biodiversity Foundation is a public foundation attached to the Ministry for Environment, Rural and Marine Affairs.

Case study 4. Solar energy installations project designer

In the Extremadura region, a plan for increasing solar energy from 0.54 MW to 13.39 MW between 2004 and 2010¹⁸⁵ has been initiated, and expected to create 1,069 jobs in solar photovoltaic energy and 1,950 jobs in solar thermal energy.¹⁸⁶ This large-scale installation of solar energy required the training of solar energy installation project designers and pushed demand for a skills training response. The regional government funded the public regional enterprise, Promotion of Nature and Environment, to manage the skills training programme for workers in the construction sector to become solar energy installers.

Courses are provided by private training centres. Priority is given to people with previous experience in plumbing and electric installation but is also offered to unemployed people. During the first phase, Promotion of Nature and Environment trained 1,080 new renewable energy specialists – mainly photovoltaic, thermal solar and wind energy installers – as well as renewable energy project managers. The second phase of the programme will involve training 780 renewable energy installers and 420 solar installations project designers through 80 courses.

As the second phase of this initiative is currently being carried out and the first phase finished in June 2009, there has only been a non-formal evaluation of its results. However, positive outcomes have already been observed, indicating that the course contents are adequate for the skills training of the target group.

Case study 5. Desalination plant maintenance and operation managers

Spain has seen a rapid development of the desalination sector, with the country becoming the fourth largest producer in the world and achieving an internationally competitive position. The main problems related with desalination technology are low energy efficiency and significant environmental impacts. These factors necessitate the greening of desalination plant maintenance occupations to ensure a more energy-efficient performance and to minimize environmental impacts. Due to the technical complexity of desalination, the maintenance and operation of plants is the responsibility of a group of managers and this is the target group for greening desalination.

The Institute for International Research organized a course for desalination plant maintenance managers from across the whole of Spain in Madrid in February 2009. The two-day course cost €1,599 and provided intensive training in the practical skills and technical knowledge needed for desalination plant managers. The initiative had a minor effect in employment terms, but a higher effect in economic and environmental terms is expected as the course contributes to ensure coherence with other environmental objectives.

Case study 6. Farmers, ranchers and fishermen

Agriculture and fisheries have been identified as sectors with opportunities for promoting large-scale greening of occupations through skills training in using new technological innovations and sustainable practices. The Institute for Diversification and Energy Saving (IDAE) manages a set of measures for reducing energy consumption and increasing efficiency, developing skills for farmers, ranchers and fishermen. IDAE organizes free training courses for trainers in energy saving and efficiency in agriculture, stockbreeding and fisheries, aimed at regional representatives who become trainers and disseminate their knowledge through other courses to local farmers.

A total of 1,320 courses have been given to 37,000 farmers over the last five years. The profile of the workers involved in this skills training is mixed between businessmen and labourers, and due to the characteristics of the sector, the gender composition is mainly male. In 2009, course content covered conservation and sustainable agriculture, energy crops and biomass production and energy efficiency in fishing, with practical skills training in reducing fuel consumption and dependency on fossil fuels. According to staff of the Institute for Diversification and Energy Saving, the course is in demand by autonomous community representatives every year, which indicates a positive response to this skills training programme.

¹⁸⁵ Renewable Energy Plan (2005–10), Ministry of Industry, Tourism and Trade.

¹⁸⁶ Figure estimated from Renewable Energy Plan (2005–10) ratios.

Case study 7. Solar panel installers

In order to achieve national environmental objectives and to fulfil the EU requirements for a regulatory framework for the construction sector, the Technical Building Code was modified in 2006 to include new measures to reduce energy consumption of buildings by 30–40 per cent in the long term.¹⁸⁷ The implementation of the Technical Building Code affects several occupations within the sector and involves skills training for installers, particularly in occupations such as electricians or plumbers, who can learn to install solar energy systems with additional training. Fundación Laboral de la Construcción (Foundation for Workers in Construction) contracted Cefoim, a skills training agency in Madrid, to deliver courses that train electricians and plumbers to install solar energy panels on buildings.

The courses offered develop a comprehensive set of skills for installing solar panels, including design, and are focused on both photovoltaic and thermal solar energy. Training is delivered through short courses of 18–23 hours on weekends, in order to ensure its accessibility to employed workers who may be working during weekdays and unable to attend. Cefoim has created an innovative solution to reach the whole of the country from their headquarters in South Madrid, offering classes in a mobile workshop classroom in a large lorry. The skills response can be considered adequate in terms of content, and the flexibility of the schedule is ideal for the target group, while the course contributes the process of restructuring from the construction sector to renewable energy.

Conclusions

Main shifts in the economy relate to problems concerning the two basic resources of energy and water as well as waste treatment. Green activities, such as green management and awareness, have developed around these three core sectors. The greening strategy is policy driven, with the central government fostering the main greening shifts through regulatory changes and long-term programmes.

Developments in energy and water efficiency have achieved some important results. First, a huge increase in investments in renewable energy production and desalination has taken place, stimulating the creation of new jobs. Second, there has been a shift in energy and water consumption patterns towards more sustainable trends. Lastly, the growing influence of Spanish renewables and desalination companies in the global market reflects the technological development that has been achieved in these fields. These achievements indicate that the skills training response has yielded good results, because without the appropriate skills such green restructuring is unlikely to have taken place.

The core of the Spanish energy strategy is based on energy efficiency and energy production from renewable sources. This strategy involves a shift from imports to national production and therefore has a positive impact on GDP. Hence, this greening shift creates employment and economic growth. Moreover, the shift requires additional labour, and thus skills, as integration and installation of renewable energy and energy efficiency technologies require considerably more labour than operation and maintenance tasks. New green production methods or diversification into renewables are also possible in ailing construction and automotive industries.

Two main groups of skills have been identified across occupations: technical and administrative on the one hand and managerial on the other. The second group of skills needs is partly a result of the complex and changing incentive system of environmental policies, particularly with regard to renewable energy.

Considering the high unemployment rates due to the economic crisis, it can be argued that this is the right time for greening. In Spain, the crisis is especially severe in the construction sector, where many occupations have a high potential for training in renewable energy and energy efficiency. In fact, many occupations in the construction sector, such as electricians, installers or

¹⁸⁷ Estimated by IDAE.

plumbers, can easily perform the tasks of green occupations such as solar photovoltaic or thermal energy installers.

There is no coherent skills development response at the national level but good examples do exist at the regional level, such as those in Navarre and Extremadura. National studies should be linked with the design of the main greening strategies (one is currently being undertaken by the National Employment Service) and stronger public–private cooperation is recommended for anticipating future skills needs in order to avoid possible skills bottlenecks.

Recommendations

Skills studies and policy require better integration: the identification of skills needs could be better forecasted, with a positive effect on the timing of skills provision. A comprehensive study of skills needs at the national level is currently being undertaken by the National Employment Service. It would have been positive if such a study was linked with the design of the main green strategies (many of them conceived around a decade ago).

Stronger public–private cooperation is highly recommended for anticipating future skills needs in order to avoid possible skills bottlenecks.

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Thailand

Policy context

Key challenges and priorities for a green economy

Thailand faces an array of environmental threats such as scarce natural resources, demolished ecology, pollution and increasing natural disasters. Furthermore, these environmental issues have the potential to become exacerbated in the face of the current economic climate, where resources are being diverted from environmental protection.

The Thailand Tenth National Economics and Social Development Plan (2007–11) alludes to a great overuse in natural resources. It states that, over 40 years, 10,720,000 hectares of forests were destroyed, with forests now covering just 33 per cent of the country. The seafood catch has been reduced to one-third and coral and sea grass conditions have deteriorated. Biodiversity is rapidly being destroyed by human activity and there is a greater incidence of the extinction of species.

Population growth and increased consumption has put pressure on air and water quality and waste volumes are increasing faster than the capacity to dispose of them. In addition, the National Economics and Social Development Plan states that hazardous substances used in production are being imported without adequate mechanisms for controlling production processes, storage or transport. As a result, substances have seeped into the environment, and contaminated the food chain. In addition to the complexities, deficiencies and failures of implementation, the use of economic and legal measures has been limited. Furthermore, Thailand relies on fossil fuels for energy and transport needs, and the likely increase in demand will mean that Thailand faces supply constraints. More than half of the primary energy supply is imported, with crude oil accounting for over 70 per cent of total imports, mostly for transport and industrial use.

The environmental response strategy and the role of skills development

General environmental strategy

His Majesty the King of Thailand initiated various green projects with the aim of transferring these projects to the general population. Initiation of alternative energy projects is one example; however, it was only when the price of fossil fuel based energy increased dramatically that more people turned to these alternative energy projects. His Majesty aimed to promote the “Sufficiency Economy Philosophy” to his people to practise.

The Constitution of the Kingdom of Thailand 2007, the Policy Statement of the current government by the Prime Minister and also the Tenth National Economic and Social Development Plan (2007–11) sets out the national environmental strategy. The Tenth National Economics and Social Development Plan (2007–11) of Thailand states:

Thailand must upgrade its standard of environmental management in order to protect the resource base and maintain the natural balance in the natural environment. Thailand must also adjust processes of producing goods and services to become more environment-friendly, and must increase efficiency in energy usage and develop alternative energy sources to meet the domestic demand for energy.

As environmental and energy problems have become more acute, the Government has increasingly incorporated concerns into national strategy and has committed to tackling environmental issues. In addition, the current Tenth National Economic and Development Plan (2007–11) has a greater focus on sustainable development. As such, several campaigns have been launched, aiming to raise awareness. In addition, the action plan of the Department of Alternative Energy Development and Efficiency included the skill development of people working in the construction, installation and maintenance of the alternative energy industry. Education and increasing the awareness of the population is seen as particularly important in tackling the environmental issues that the country faces.

Green response to the current economic crisis

A Policy Statement delivered by the Prime Minister to the National Assembly in December 2008 stated that the country needed to rejuvenate the economy by introducing a short-term restoration plan covering the problems facing different industries including agriculture, tourism and export industries, as well as job and income creation in rural areas. An additional budget plan was prepared, which aimed to inject public expenditure into the economic system and to alleviate the difficulties faced by the people and business sectors, with importance being attached to participation and environmental conservation.

The skills development strategy in response to greening

The National Economics and Social Development Plan (2007–11) does not portray a clear or specific strategy on skills development in response to greening. However, some good examples of incorporating green skills can be cited:

- The private sector has followed government policy on green issues as well as the conditions of international trading that controls raw materials and processes of production, encouraging green products and practices.
- Professional associations such as the Thailand Automotive Institute are working closely with universities and training institutes to provide courses to upgrade skills and allow employees to take on green jobs.
- The Employers' Confederation of Thailand and National Congress of Thai Labour have been trying to build awareness on green jobs and reduce the impacts of global warming to their members through training courses and conferences.
- Various ministries are responsible for implementing green policy such as the Ministries of Energy, Natural Resources and Environment, Industry, Agriculture, Education and Labour. They work alongside other public and private organizations, professional associations, employer and employee confederations and NGOs. The above-mentioned ministries outline plans to respond to the national policy on green environment.
- The universities in Thailand teach a curriculum on Environmental Management and Conservation, and research development in environmental technologies is now more common.
- An internship programme has been set up to assist the Green Jobs team of ILO Bangkok in collating information relating in particular to green/clean technologies, green procurement policies, energy-efficient appliances, environmental and energy efficiency standards, employment impacts and social costs of environmental policies.

- Thai and multinational companies have invested in human resource development on green skills by providing fellowships or scholarships to students from vocational schools and universities to complete work placements and learn specific green skills related to the operational processes of those companies.
- In addition, the Department for Skills Development issued the Skill Development Promotion Act in 2002, which provided tax incentives for establishments that organized training for their workers and non-employees (students from vocational schools and universities for in-plant training).

However, despite the successful initiatives, a formal overarching strategy linking initiatives on green skills is not evident and there is neither labour market information specific to green jobs nor forecasting for skills demand in the future.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

In Thailand, the need for retraining employees for green jobs has occurred alongside a growing awareness of environmental problems. As the demand for greener ways of living and working become more popular, additional jobs in this sector are created. Many multinational corporations are increasingly encouraged to implement green practices by their head offices abroad. The training for green skills in general is demand-driven and depends on the requirements of establishments, industries and companies. However, retraining people at an earlier stage is important to equip them with the relevant skills and knowledge to find work.

In Thailand, new green competencies and skills have been promoted by line ministries and establishments which have organized training courses. For example, the Ministry of Agriculture organized training courses for the production and use of bio-fertilizers and better practices in terms of harvesting and packaging products to sell to both domestic and overseas markets. The work of the Department of Alternative Energy Development and Efficiency (DEDE) is another good example of incorporating green restructuring. DEDE has conducted research on alternative energy and how to generate and apply it, and has developed an action plan to train people in villages in how to produce alternative energy such as bio-mass and how to install and maintain solar energy, hydro and wind energy equipment.

Skills response

A focus group with establishments that were awarded the Thailand Energy Award 2009 found that companies placed priority on human resource development, especially the retraining courses for greening their employees, building awareness of a greener environment, and on environmental quality standards such as ISO 14001 and ISO 9001. Several establishments had set up green committees to look after the green management and environmental issues. The commitment of the Chief Executive Officer and high-level management was found to be particularly important in achieving green structural change.

The Ministry of Energy has trained people on “green jobs” since 2000, engaging with approximately 76,906 people. Most of the training courses concerned energy efficiency in company offices and production processes. In addition, the objectives of the Alternative Energy Plan are

to encourage the use of alternative energy and reduce the dependence on imports of oil. The Government plans to use alternative energy for 20 per cent of overall energy usage by 2022.

To forecast the demand for green jobs and skills, information from recent investment projects of related ministries such as the Ministry of Energy can be used to identify trends in labour markets. According to the Director-General of the DEDE, Thailand expects the World Bank to provide loans of USD 3.1 billion under the Clean Technology Fund in 2010, as Thailand qualified due to the “clear direction to develop green energy projects in order to cope with climate change”. It is expected that there will be biomass energy projects in 340 communities, wind turbines to generate 115 megawatts of power and solar cells generating 50 MW, up from less than 1 MW at present.

Majority state-owned projects using clean technology include a 224-MW wind-power plant, solar cells and mini-hydro power plants worth a total of 579 million baht developed by the Electricity Generation Authority of Thailand. The Provincial Electricity Authority, meanwhile, is working with the Forestry Industry Organization, which is developing 100 biomass plants. The Authority is also working with the DEDE to develop an offshore wind-turbine power plant and mini-hydro power plant.¹⁸⁸ These investments indicate that there will be a demand for skills to work with alternative energy projects and an estimated 100,000 positions will be created over the next 15 years.

Changing and emerging occupations and related skill needs

New and emerging occupations

New occupations are emerging in the private sectors in supply chain, services and sales industries and also start-up companies, which are creating new positions for those with specific green skills. Multinational corporations such as those within the automotive industries are creating new roles for employees and up-skilling employees to work on new “eco-cars” or hybrid cars. In addition, the new products require technicians and maintenance staff with a particular set of “green” skills. Another example is the mobile phone industry, where new green technology and products require the formation of new occupations. Furthermore, national projects to develop the Solar Power Generation System will require skills to operate, install and maintain the system.

New green-collar occupations are emerging also amongst women in Thailand, who are employed in the recycling and reuse of materials, community enterprise projects which produce products by using the raw materials in the villages and promotion of eco-tourism in villages. The villagers receive practical training from government officials in these green areas and they are able to gain general entrepreneurship training and development.

Greening established occupations

The awareness and the pressure to reduce global warming have led to a reorientation of current skills and occupations towards a green agenda:

Construction industry: Thailand is promoting the environmental efficiency of buildings and houses, which has meant that architects and designers are required to understand the various components involved in green building, including efficient standards of green materials and green

¹⁸⁸ Yuthana Praiwan, 2009.

labelling of electric appliances. Most of the jobs created through green building practices are likely to be within energy savings and reinvestment. The types of jobs will need to be redefined in terms of new skills, training or certification requirements; however, many of these jobs are likely to be performed by people who are already working in the building sector. Redefined jobs include green building architects and designers who must consider the entire life cycle of the building and reduce raw material use, emissions and water use and improve energy efficiency, indoor air quality and occupant health.¹⁸⁹

The Ministry of Energy states that government is campaigning for an energy conservation building which will be built according to green construction practices. This building will become the training centre for technology transfer and energy conservation and will help in re-skilling employees and training in green processes.

Agriculture industry: The agricultural sector is the main source of revenue for the Thai economy. Promoting green processes and products is a priority for the Ministry of Agriculture, which has provided training for agriculturists. The Ministry of Agriculture and the Ministry of Industry have cooperated on a campaign to use alternative substances to substitute methyl bromide, which is hazardous to the environment. Agriculturists, agro-industries and rural businesses have been involved with local government, which is playing a key role in promoting the use of alternative substances such as bio-fertilizer, reducing environmental risks, as well as those to local communities. Agricultural officials were dispatched in each sub-district as mentors for agriculturists in the area. The Ministry of Agriculture has also trained people in the manufacture of bio-fertilizer.

Manufacturing: The automotive industry increasingly requires green skills for the new and greener production of products. In addition, the manufacturing company Fujikura (Thailand) Limited is an example of strong integration of green skills within existing occupations. The company employs 4,536 Thai employees, of which 70 per cent are women working in operation lines and some who have degree-level education working in green purchasing. The company has committed to environmental policy and strictly implements the environmental conservation management programme for the process of production, green procurement, pollution prevention, waste disposal, and emission and hazardous substance control. All workers attend green training courses and gain specific skills in relation to their production lines.

In addition, the Thailand-based Plan Creations Co., Ltd is the world's first wooden toy manufacturer to successfully use recycled rubber wood that no longer provides any useful yield of latex. The rubber wood is recycled to make furniture, paper and wooden toys and the factory generates employment for 500–1,000 local persons. The skills the factory requires for this green business include design, wood working skills, knowledge on how to reduce waste, recycling processes and how to prevent deforestation and promote reforestation.

Skills response

Some of the responses to the needs for green skills are outlined below:

- The Department of Skill Development, under the Ministry of Labour, has the main function of training and upgrading the skills of the workforce. There are several training courses on

¹⁸⁹ Martin Bond, *Still Pictures: Ecological houses at eco-village with earth sheltering (Atrear), turf roofs and various active & passive solar features*. Dyssekilde, near Hundestad, Denmark.

the green curriculum offered to people in 76 provinces across the whole country. Each year the Department of Skill Development has the capacity to train approximately 220,000 persons.

- The Electric Generator Authority of Thailand provided training to instructors from the Department of Skill Development on the application and installation of solar grids to enable greater accessibility of solar energy to people in remote areas.
- A World Bank-supported project assigned the Department of Skill Development to train SMEs which install and repair air conditioning to use alternative substances to chlorofluorocarbons, which is an ozone-depleting substance. In addition, the trainees received an amount of money to modify tools and equipments from the World Bank upon completion of training.
- The Ministry of Tourism and Sports organized training courses on Eco-Tourism to help villagers set up a “green long stay” area. The training courses include the concept of eco-tourism and protecting the environment, the ecology and the tradition of the surrounding village, whilst at the same time providing a welcoming place to stay.
- The Federation of Thai Industries also has green training courses for their members on specific skills, depending on the demands of members.
- The Border Green Energy Team, an NGO, provides hands-on appropriate technology training and financial support to village innovators in ethnic minority areas on both sides of the border between Thailand and Myanmar. There is still no electricity supplied to many of these villages in far-off regions in Thailand, and the Thai Government began an ambitious two-year USD 200 million programme to provide solar home systems to 203,000 remote households. An estimated 15,000 Thai solar home systems are located in Tak province, mostly in the western part along the border between Thailand and Myanmar; however, there is no maintenance or repair programme in place to ensure that the systems will continue to work over the long run. The training aimed to ensure that at least two people from each village are qualified and equipped to act as technicians for their respective area.

Anticipation and monitoring of skill needs

Thailand has no formal database providing information on green skills, green jobs and green-collar occupations. Identification of green skills needs for the labour market is usually undertaken by employers or establishments conducting research and development for the new process, products or services. Government identifies skill needs through proposed projects that require people to work and be trained to attain a certain quality of the work. However, the labour markets as a whole lack a coordinated system in responding to the increasing need for green skills. The Department of Skill Development is the Secretariat of the National Vocational Training Coordination Committee, which coordinates the Skill Development Plan in order to avoid the duplication of all training courses, including green training courses. However, it would appear that the committee does not function effectively and lacks coordination.

Summaries of case studies

Case study 1. New green-collar occupations – Automotive sector

Thailand is a base of automotive manufacturing and sells products to local markets and exports abroad. Alongside the need to reduce energy consumption and global warming, the technology of the car has modified to become increasingly environmentally friendly. The President of the Thai Society of Automotive Engineers and Chairman of the Auto and Auto Parts Standard Committee have highlighted an increasing trend towards eco cars, the electric car and alternative fuel sources such as hydrogen and biogas.

The process of production, raw materials and spare parts of cars produced in Thailand is strictly aligned to international and EU standards. Raw materials must be “green” and be recyclable. The training of employees is essential at all levels including that of engineers, operators and workers in the industry and in the supply chain. Training is provided for the production of hybrid cars, including the engine and the battery. New green-collar occupations dealing with the automotive industry include technicians working with eco-cars, who are required to modify car engines to use hydrogen instead of petrol. New occupations for hybrid car maintenance and repair services are also emerging.

Furthermore, the Government decided in June 2007 to grant tax incentives to auto manufacturers that produce small, fuel-efficient eco-cars. Japanese companies Suzuki and Nissan are planning to produce 138,000 and 120,000 such cars, respectively, per year. Honda is planning to double its production to 240,000 units. Thailand’s Board of Investment considered similar proposals from Mitsubishi Motors, Toyota Volkswagen and India’s Tata Motors in January 2008. The cars are to be sold to domestic Thai markets as well as exported to other countries. Thailand could thus become a regional hub of “eco-cars”, produced by a qualified and skilled workforce. Green skills development should therefore be prioritized.

The Deputy Secretary-General of the Board of Investment stated that Thailand is hoping the eco-car will be the next “global niche”. Having seen output and sales boom since the late 1990s, Thailand produced some 299,000 cars and 896,000 commercial vehicles (mostly small pickup trucks) in 2005. But domestic demand weakened in 2006 and 2007. While partly designed to overcome the slump and attract new investment, this initiative has the potential to green a substantial share of the country’s car industry and thus a portion of the 182,000 jobs in the sector. The degree of greening will depend on whether the new eco-cars (whose retail prices would be reduced by the preferential excise tax rate) will displace conventional vehicle sales or will simply boost car ownership rates in Thailand.

Case study 2. Greening existing occupations – Eco-town project

One strategy to reduce global warming is to reduce waste in industrial production processes. The Department of Basic Industry and Mining, within the Ministry of Industry, developed an eco-town website¹⁹⁰ to promote recycling materials from industry and also to disseminate technical information for the recycling methodology of various wastes from industry as well as marketing and showcasing the “success stories”.

The waste mud from the recycling waste water treatment of the ceramic making industry was previously discarded with no value. Now the factory is able to sell the waste mud to be produced as brick blocks. This creates added value, as the factory is able to supplement income from selling the waste, and those producing the brick blocks have received training in technical skills. This is an example of greening existing occupations through the use of raw materials from recycling the waste mud.

Case study 3. Greening existing occupations – Green logistics

A study on green logistics by an Assistant Professor, Dr. Suwannee Aswakulchai, was initiated to help drive a reduction in CO₂ emissions. A distributor centre was set up as a one-stop service combining all processes of work in this area, such as repackaging and re-use.

Those working in the centre were retrained to gain the required skills, which included computer skills, recording and storage system skills and knowledge of green transport. Green logistics also included upgrading the skills of truck drivers and increasing productivity.

¹⁹⁰ <http://eco-town.dpim.go.th>

Case study 4. Greening existing occupations – One Tambon One Product (OTOP) Project

A project was initiated by the former Prime Minister to create employment for agriculturists and villagers in Tambon, a sub-district in Thailand. Following consultation with villagers, the Government provided green skills training in relevant areas. The strategy was to encourage participation from the outset and to allow villagers to propose projects that suited their interests. Courses of training included woodwork, ceramics, Thai traditional massage and spa, food processing and preservation. Villagers were also encouraged to come up with innovative ideas for product development, design and packaging, and were trained in areas such as teamwork, entrepreneurship, marketing, logistics and international standards for raw materials.

In general, OTOP businesses are mostly community enterprises; accordingly they have mutually shared responsibility. People involved in these projects are largely women and people of older age. By virtue of the OTOP project, technologies are applied in the production process of goods and services. These projects are sustainable, helping to elevate quality of life of those at the grass roots.

One explicit example of greening skills is that of herbal medicines. With the OTOP projects in progress, villagers are trained to utilize the natural ingredients to be more attractive for marketing. Instructors from the Ministry of Public Health provide training to the villagers in the production of herbal medicines, starting from the selection of raw materials to hygienic processing techniques and, finally, to packaging of the products. Today, herbal medicines are packed in handy and attractive packets with instruction for application. The current government has also endorsed the continuation of this project, as it supports the rural economy.

Hydroponic vegetables are another example of a successful OTOP project. Hydroponic vegetables do not contain chemical residues and they are highly nutritious. They are grown in mineral solutions instead of soil. Cultivation procedures will require greening of existing occupations and new skills will be required in preparing mineral solutions for seedlings and further nurturing through the plant life cycle. Those employees involved in sales and marketing will also require training and knowledge in how best to promote this green product.

Conclusions

The Thai Government has pledged a strong commitment to implementing green policy and the most active ministry in this area is the Ministry of Energy, specifically the DEDE. Thailand still has no database on green skills and green jobs, so identification of skills needs in the private sector is generally done by employers as a result of in-house research on raw materials, processes and products. In addition, many multinational companies are encouraged to implement green practices by their head offices abroad. In general, the requirement for green skills and green jobs is strongest in the automotive, construction, refrigeration and air conditioning industries, and in the production and application of alternative energy.

Several action plans have been implemented by ministries in response to government policy. One example is the 15-Year Alternative Energy Plan and the DEDE Four-Year Action Plan (2008–11). These plans promote green skills development for operation of new technologies. However, the problem Thailand faces is effectively implementing policy in a coordinated manner. Some methods of effective delivery mechanisms for skills for green jobs which have worked include the following:

- gaining strong commitment from government and senior management within companies to implement changes;
- enhancing the “green mind”, “green behaviour” and the awareness of the public to global warming and environmental hazards; and
- the National Skill Development Plan for Green Jobs, which included training for green skilled jobs of all concerned organizations.

Recommendations

Policy recommendations

Establishing a database for green jobs, including a clear definition of green jobs, is important for understanding demand and supply and where the gaps exist. In addition, it is recommended that policy and regulation be strictly enforced. The monitoring and evaluation on the implementation of any action plan is important for the success of the green society as well. Furthermore, innovative research and development on raw materials, products and processes of production and distribution is essential and this needs to then be followed by coordinated and specific training.

Overall, it is necessary that the Government includes skills for green jobs on the National Agenda to holistically support its green policy. A National Human Resources Development Plan for Green Jobs should be devised and implemented by all concerned parties, and implementation should be monitored.

This study found that one of the main factors that can help in reducing global warming and environmental problems is increased national awareness. The population should have the mindset and awareness to employ green practices in their daily life, in their houses, their workplaces and community. This requires training at all levels of the schooling system, vocational schools, universities and places of employment. In addition, commitment from government to the management of educational establishments and private businesses is essential in integrating green practices into local everyday life.

Recommendations for education and training

It is recommended to assign one organization to maintain a core focus on upgrading the green skills of the workforce and work in cooperation with line ministries and the public and private sectors. The Department of Skill Development under the Ministry of Labour should play a vital role in training people and developing green competencies, skills standards and certification systems.

It is important to promote the value of innovation of green products and processes and green skills to university students and to establish these topics on the higher education curriculum. In addition, introducing an increasing number of green skills scholarships should help to create awareness of green skills and prepare for future scenarios in both government and private organizations.

It is also recommended to create an international forum for technical support and the sharing of best practices.

Recommendations for further research and data collection

Further data collection and the creation of a database for green skilled jobs is essential for analysis of the current demand for green skills, forecasting the demand for green jobs and assessing the shortage of skills as well as planning relevant and effective training sessions on green skills. In order to move forward in the area of green skills, it is necessary that the current administration gives priority to this matter.

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Uganda

Policy context

Key challenges and priorities for a green economy

Uganda, like other developing countries, has not effectively responded to the challenges associated with climate change. Inaction by the majority of institutions mandated to protect the environment has led to increased vulnerability in the country. In Uganda climate change is mainly apparent in increased surface temperatures and erratic rainfall patterns. According to the National Environment Management Authority,¹⁹¹ environmental challenges facing the country include exponential human population growth; biodiversity loss and habitat destruction; deforestation; soil erosion and degradation; pollution; and poor waste management in urban areas.

According to the Government's 2007 National Adaptation Programmes of Action (NAPA), climate change adaptation and mitigation priorities for Uganda include land degradation and resource management; strengthening meteorological services; water and sanitation; water for production; drought adaptation; pests and disease control; and climate change and development planning. Challenges associated with achieving these include lack of human and financial resources; unclear mandates of institutions involved; high transaction costs involved in the CDM; and lack of committed leadership.

Despite these challenges, the Government has targeted greening the economy in various ways, for example by adopting a renewable energy policy; planning to extend electrical power supply from the current 1 per cent to 10 per cent by 2012; switching from fuel oil to fuel-wood in processing (especially in agro-based industries); improving public transport; designing roads that enable non-motorized transport; improving solid waste management; creating a supportive environment for CDM projects; and levying environmental taxes on imported vehicles and pollution tax on importation of controlled substances.¹⁹²

The environmental response strategy and the role of skills development

General environmental strategy

The National Environment Management Authority (NEMA) under the Ministry of Water and Environment (MWE) is the overall body mandated with the management of environmental issues. There are no laws or regulations addressing climate concerns *per se* in Uganda, but relevant regulations are implied in the laws and acts that address environmental resources. The Uganda NAPA, launched in 2007, is the only official document addressing climate change issues. The MWE established an institutional framework to coordinate the implementation of the UNFCCC and the Kyoto Protocol. It is comprised of a multi-sectoral and multidisciplinary National Climate Change Steering Committee and secretariat that advises the line minister on approval of CDM projects and policy issues. Several government departments work together to ensure climate change issues are appropriately addressed. The overall aim is to establish a climate change policy as a guideline and blueprint for climate-related activities. However, policy has yet to be formulated.

¹⁹¹ NEMA, 2005.

¹⁹² MEMD, 2007 and NEMA, 2005.

Hydropower dams that reduce carbon emissions from other energy sources have been implemented. Industries in the country are also required to install equipment that reduces polluting elements. Government has created an enabling environment for CDM projects, with projects promoted in renewable energy, hydropower investment, industrial forest plantations and wood fuel efficiency. The West Nile Hydropower project is the only renewable energy project registered with the UNFCCC in Uganda. Other projects under the CDM regulatory framework include Kakira Cogeneration (energy); an NFA forestry project in western Uganda; Kampala City Council Municipal Solid Waste Management; and the Ishasha multi-hydro power project.

Green response to the current economic crisis

According to the Uganda Bureau of Standards,¹⁹³ the economy of Uganda has slowed from 9.4 per cent per annum in 2005/06–07/08 to about 7 per cent in 2009. According to the Bank of Uganda, the country has not been severely enough affected by the global economic crisis to warrant major policy shifts. However, the economy has slowed. The Government's stance on the issue is that macroeconomic management coupled with smart financial market regulation and risk-based banking supervision will ensure the country's survival in this crisis.

Greening economic practices are absent from response strategies. However, there is a growing interest in hydro electric power generation to spur industrial growth that will create more employment. This will require training, and since the crisis has exacerbated the unemployment problems among youth, the Government of Uganda has allocated a budget to the Directorate of Industrial Training to implement a programme to provide vocational skills to those who are trainable.

The skills development strategy in response to greening

The major goal of poverty reduction through environmentally sustainable development is a major component of the Government vision for 2025 and its Poverty Eradication Action Plan. Vision 2025 advocates the use of cleaner energy sources and technologies, and objectives include having an adequate number of well-trained scientists and technologists in all fields of production and other human activities. The NAPA suggests promotion of best practices in water for production use and management, training communities in integrated natural resource management, promoting appropriate indigenous knowledge in natural resource management, and the sensitizing and training of local leaders, planners and implementers on impacts of climate change.

The Government has taken steps to strengthen the institutional and technical capacity of the MWE and aims to coordinate the implementation of climate change issues among line institutions and ministries, as well as the private sector, and to integrate climate change into research and educational agenda and curriculum. Efforts have also been made to build climate change negotiating skills and strengthen technical capacity on CDM project formulation. Activities will be based on the UNFCCC principle of learning-by-doing (conversion of knowledge into skills) to ensure maximum benefits and value for money. The areas of skill development will include energy generation and energy efficiency including transport, and management of agricultural residual and municipal solid waste. To green the economy, the skills development policies and strategies for skills training will involve technical officers from public, private and financial institutions in decision-making.

Currently, the UNDP is collaborating with the Ministry of Water and Environment/EU as they develop the HRD strategy and report. This will involve identifying the challenges which climate

¹⁹³ UBOS, 2007.

change poses to HRD. There will be a need for training on assessment and costing of impacts of climate change, vulnerability and communication skills to support the greening policy. Skills for green jobs and well-designed, market-oriented policies can reduce emissions and the costs of adapting to the unavoidable impacts of climatic change, while generating economic benefits.

The major challenges in skills development for greening the economy lie in financial handicaps, bureaucracy and lack of prioritization of climate change issues in critical institutions, as well as ineffective enforcement of the current environmental policies. Since many of these barriers can be addressed through education at the community level and up to higher education, efforts have been made to integrate environmental education into curricula from primary to university level.

Both formal and informal education efforts are being considered and in some places implemented. Government sponsors community training initiatives for green jobs, for example in sustainable farming practices. In addition, interns, volunteers and donors work with the Foundation for Sustainable Development, an NGO, to provide support for programmes and initiatives that promote environmental approaches for communities, such as sustainable agriculture, organic demonstration gardens, fuel-efficient stoves, water purification systems and various agribusiness strategies.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

Local and global awareness has led to a shift towards environmentally efficient equipment. Various NGOs are promoting the use of energy-efficient stoves, which has created employment opportunities for a number of rural people in building the stoves. However, the advent of the new stoves has left a number of small traders (of older model appliances) unemployed since they cannot afford the costs of trading in the new, greener – but more expensive – equipment.

According to NEMA, if deforestation continues at its current rate, Uganda will lose all of its forested land by 2050. Deforestation is attributed to expanding farmland, rapid population growth and increasing urbanization. Forests ameliorate the micro-climate and help check the agents of soil erosion that affect soil productivity. With forestry depleted, all of these benefits will be lost and agriculture will no longer be profitable. With over 80 per cent of Ugandans directly employed in the agriculture sector, this would have a crucial impact.¹⁹⁴ In addition, this would affect biodiversity, which in turn will affect tourism. A decline in tourism will affect the 387,000 people directly employed in this industry.¹⁹⁵

Due to low water levels in Uganda's rivers, there has been minimum investment in hydro power projects, thus reducing job creation opportunities in the energy sector. Finally, wetlands are a source of raw materials for craft making and therefore their loss would make a number of Ugandans unemployed, while also affecting fishermen and crop farmers who are dependent on the water.

There is increasing interest in shifting from the use of ecologically unfriendly technologies to clean technology. In national environment management policy, clean technology is advocated for. The implications are that laboratory technologists, industrial chemists and operations managers,

¹⁹⁴ Ministry of Water and Environment, 2007.

¹⁹⁵ MTI, 2006.

and fitters in the aerosol sectors will need to be skilled in technologies that are non-ozone depleting to ensure their eco-friendliness. Architects, builders and civil engineers will have to be skilled in technologies that lower carbon emissions in production, construction and building design. The Government is also targeting public transport, energy efficiency and renewable energy.

Skills response and (re)training needs

Uganda has an overall energy deficit, and the Government has prioritized energy efficiency. Training is needed at many levels in the energy sector, on new energy sources and generation technologies, energy efficiency and technologies and renewable energy generation. This is in line with the needs addressed by the Centre for Research in Energy and Energy Conservation to fully achieve renewable energy potential. Other retraining needs that have been identified include chemical engineering skills and training in managing green businesses.

Skills responses are mainly at the university level, with reviewed curricula in various courses. These include energy waste detection, monitoring, clean energy fitting and enforcement. New programmes include: ordinary diploma in refrigeration and air conditioning, water engineering, electrical engineering and civil engineering. All engineering programmes offer three levels of achievement. Renewable energy courses are also being offered at the masters level at Makerere University. Delivery and provision channels have also been identified, but are only being executed through academic institutions and NGOs, although the demand is high.

Changing and emerging occupations and related skill needs

New and emerging occupations

The major sectors for green occupations are in agriculture, energy, water and environment, manufacturing industries, transport, trade and forestry. In the agricultural sector there will be a need for soil scientists, plant and animal breeders and pathologists who will enable maximum agricultural productivity amid climate change scenarios. In meteorology specialists are needed who can use and disseminate satellite and climate related data. Environmental impact assessors are needed. Solar technicians will be needed for the development of solar technology, as well as the installation and maintenance aspects.

Energy assessors will be necessary to assess power/energy losses, through illegal connections and inefficient transmission and distribution. Green-collar technology installers, clean electricians and retrofitters along with pipe fitters, plumbers and clean-energy auto manufacturing line workers will be vital. Green accountants/auditors will eventually be in demand as the assessors of monetary efficiency associated with green initiatives; however, this does not yet exist in Uganda.

Regarding gender, new green-collar occupations are male-dominated, especially with regards to renewable energy. However, women dominate initiatives in organic farming – although this is the only green employment area in which this is the case.

Greening established occupations

The current rate of energy loss in Uganda is 31 per cent, according to the Electricity Regulatory Authority. This indicates a need for skills development in the area of reducing generated energy and increasing energy efficiency at vocational and university level. In addition, the energy sector is looking to target renewable energy sources rather than conventional ones.

In agriculture, there is great interest in implementing greening practices, for instance sound soil and water conservation practices; use of better natural soil fertility measures such as crop and grazing rotation; natural pest/parasite and disease control approaches; increased use of organic matter; and the effective use of livestock waste to preserve soil fertility.

Waste management is another sector that is undergoing a greening process, largely because inefficient plastic disposal has resulted in environmental issues such as flooding (through blocked watercourses) and air pollution (through burning). Recycling is being promoted in this sector and becoming increasingly entrenched. Chemical engineers are in demand for this sector, and future engineers will need skills in green waste management practices and materials.

While interest and potential is evident across several sectors, the general labour market information status report prepared by the Ministry of Gender, Labour and Social Development does not currently include green occupations as an identifiable sector in the employment sector.

Skills response

In Uganda the skills response to green occupations is based in education. Education and training systems will need to collaborate in order to meet the challenges of greening the economy. The main sectors requiring advanced skills training are the energy sector and organic farming. Institutions must include relevant training curricula, or offer more advanced curricula.

Overall, occupations that are becoming greener include new skills for improved energy efficiency, plastic and polythene materials recycling, soil conservation methods, renewable energy (i.e. solar and biofuels) and education. However, green occupations are still only emerging in Uganda, and are mainly looking to meet market demands for economic development.

Anticipation and monitoring of skill needs

Effective delivery and building of green skills in the vocational and higher education sectors requires analysis of what jobs require which knowledge and skills, and in what context. That analysis can only take place through and in cooperation with industry as there is currently no clear formal process of anticipating skill needs in the country. In rural areas, evidence suggests that the environment plays an important role in attracting and maintaining businesses, and environmental factors vary from one community to another.

This study showed that there will be a need for more personnel in chemical engineering to develop eco-friendly technologies. Technicians will be needed in energy-efficient technologies to reduce pressure on forests and woodlands, for generation of energy from renewable sources and solar, and managers of green businesses.

Addressing the currently anticipated skill needs will be done through education initiatives and the incorporation of environmental curricula at all levels, and more specific curricula (i.e. chemical engineering) at higher levels. This will be monitored over time to determine whether or not the initiatives are efficient and successful. Currently, these skill needs are mainly addressed by NGOs, but government is slowly incorporating greening initiatives into policy.

In addition to monitoring the development of green skill needs, it will be important to monitor declining sectors and the impacts on people working within these sectors. The employment implication is that, as soon as changes are made to adopt eco-friendly technologies, the effect will be a reduction of activities in the respective existing (traditional) sectors. Those who are most vulnerable to job losses due to greening initiatives should be given priority for green skills training.

Summaries of case studies

Nine case studies illustrate the anticipated change and provision of skills in various occupations.

Case study 1. Brick making

Cutting down (or burning) trees to create land for agricultural use, or for firewood and charcoal manufacture, are the two main reasons for deforestation in Uganda. In addition, large quantities of timber are burnt in small brick kilns throughout Uganda.¹⁹⁶

The brick making method used in Uganda requires 96 hours of firing and this process uses large amounts of wood. However, this may not be sustainable. Uganda's forests are facing the threat of complete devastation owing to a growing population, the demand for wood fuel, the rate of harvesting of timber wood, and lack of governmental planning and regulations. The FAO has estimated that forestry cover in Uganda shrank from 45 per cent to 20.3 per cent between 1990 and 2005.¹⁹⁷

Brick burning activities using wood fuel will have to be changed or phased out and jobs associated with brick burning – such as brick burners and timber truck drivers – will be lost. Brick burners need to be retrained in energy-efficient methods that use less wood or that use, for example, straw, industrial waste or other by-products. Training is also needed in technologies for making bricks that do not require burning at all.

Dr Moses Musaazi, an engineer at Makerere University in Kampala, has developed a brick making technique that does not require the bricks to be fired. This new technology, by mixing soil and cement and then compressing the dampened mixture in a mould, produces an interlocking block, twice the size of a normal brick. It is stronger, more uniformly shaped and interlocking, thus saving costs on cement between bricks. Soft Power Education, a Ugandan NGO, has been working with communities in Uganda to improve livelihoods through education. Teams in these organizations have been trained in this new method of brick making and are extending training to various communities, through two-week courses.

Case study 2. Public transport in Kampala

In Uganda, road transport constitutes over 80 per cent of the transport. Due to the lack of mass public transportation, most people travel in private cars, mini commuter buses, on motor bikes or bicycles or on foot. The Government plans to take motorcycle taxis (*Bodaboda*) and commuter taxis off the streets of Kampala and introduce a city bus service. To further reduce congestion in Kampala and cut down on emissions, heavy vehicles must now bypass the city centre.

Currently, buses operate to the city outskirts, thus competing with commuter taxi owners who have had to abandon routes that buses use. Government has encouraged taxi owners to set up cooperatives and purchase buses, or find new routes that buses do not use, in order to extend public transportation. The Uganda Taxi Operators and Drivers Association has started other income-generating activities such as clearing large tracts of land for farming to cater for drivers who have lost their jobs. There are currently no estimates available on the number of bus drivers and mechanics that will be needed if all major towns switch to this system.

There is a need to sensitize the public and transport managers in various related organizations and government departments about GHG emissions in the transport sector and their effect on the environment.

¹⁹⁶ Kezimbira Miyingo, 2002.

¹⁹⁷ FAO, 2006.

Case study 3. Solar energy engineering and the solar panel business

Solar energy engineering is a new green-collar occupation in Uganda. Solar energy in Uganda has high potential and should be developed and utilized. The level of insolation is favourable for various applications, particularly solar water heating, and solar photovoltaic systems for the supply of basic electricity in rural institutions and households.

Solar energy engineering was initiated by the Ugandan Government through its new policy on renewable energy.¹⁹⁸ Over 30 registered companies deal in solar energy devices in the country, along with several sales companies. Currently no information is available on the composition of the labour force; however, most have undergone either business training or technician training through short training by international consultants.

The skills gaps in this sector are in solar energy engineering, and the sector currently relies on international expertise. Other gaps include inadequate levels of technical knowledge in the labour force and solar energy business management. Curricula and training programmes are still in the design phase, but training is expected to be through short courses for general electrical engineers and technicians. The aim is to increase the use of renewable energy, from the current 4 per cent to 61 per cent of the total energy consumption in the country by the year 2017.¹⁹⁹ The renewable energy policy has laid a good foundation, and, if implemented, will promote solar energy use in the country. Government should also consider incorporating solar energy education into the curricula of educational institutions at all levels.

Case study 4. Tree farming

In 2007 a three-year countrywide project called the Farm Income Enhancement and Forest Conservation project was initiated to contribute towards poverty reduction in Uganda through forest support and agricultural enterprise development. The project was funded by the African Development Bank for an amount of USD 76.72 million.²⁰⁰ The project seeks to improve incomes, rural livelihoods and food security in the country through sustainable natural resources management and agricultural enterprise development, thereby contributing to poverty alleviation. Overall, this project will improve tree cover in the country, improve incomes and revenue sources among farmers, and guarantee livelihoods. It will indirectly contribute towards crop yields through environmental services and abatement of micro-climate change catastrophes at community level.

Currently 40,000 households are involved in this project, in various districts.²⁰¹ The skills gaps identified include tree nursery management; integrating tree planting with other forms of agriculture; management and protection of established plantations from pests, disease and bush fires; and water and soil conservation management. The training programmes for these skills can be provided through short courses on forestry management by the Faculty of Forestry and Nature Conservation, Makerere University, or Nyabyeya Forestry College.

Case study 5. Biofuel processing

In Uganda, ethanol is being produced on a small scale by sugar manufacturers, as a by-product of molasses, and by several cottage industries from cereals and fruits. Biodiesel is a by-product of fatty acids (found in vegetable oils or animal fat) and alcohols such as ethanol.

It is estimated that in the year 2010 Uganda will import and consume 360 million litres of diesel and 385 million litres of gasoline. If this fuel could be blended with the environmentally friendly, locally produced biofuel, methyl alcohol (at a ratio of 25 per cent gasoline, or 60 per cent diesel), it would require a total of 312 million litres of methyl alcohol. This product could be made from jatropha and other trees locally grown by a rural population. In terms of impact on the environment, if a total of 312 million litres of petroleum products are replaced by methyl alcohol, this will replace nearly 1 million tons of CO₂ emissions in the country.

Uganda has the potential to manufacture biodiesel, but still has the following skills gaps: identifying the most suitable crops for biodiesel and conditions that enhance biodiesel potential in crops; and technical knowledge in biodiesel processing. An industrial chemistry curriculum currently exists at Makerere University, Kyambogo University and Mbarara University, but this must incorporate biodiesel processing if these skills gaps are to be met.

¹⁹⁸ MEMD, 2007.

¹⁹⁹ Ibid.

²⁰⁰ Ministry of Water and Environment, 2007.

²⁰¹ Ministry of Water and Environment, 2009.

Case study 6. Refrigeration and air conditioning technicians

Recent surveys show that more than 50 per cent of the refrigeration units imported into Uganda are obsolete or faulty, and spare parts cannot be easily obtained. These old appliances are one of the main sources of leakage of refrigerants and emissions into the atmosphere, as their leak detectors are faulty or damaged. Many technicians do not have the necessary skills to maintain and service complex refrigeration and air conditioning units, to detect leaks or perform repairs efficiently.

Older generation fridges use chemical substances called chlorofluorocarbons and hydro chlorofluorocarbons, both ozone depleting substances. These are chemical substances that destroy or cause thinning of the stratospheric ozone. When they reach the stratosphere they are broken down by ultra violet-radiation to release chlorine or bromine atoms. These react with the ozone and begin chemical cycles of ozone depletion. As a result, higher amounts of radiation reach the earth's surface, and cause a variety of problems. Initiatives to phase out chlorofluorocarbons have been in progress since 1990 and evidence suggests that this has alleviated the progression of climate change by as much as 12 years.

In Uganda the methyl bromide phase-out project that targeted the cut flower sector was completed in 2007. The ozone depleting substances phase-out in the refrigeration and air conditioning sector is ongoing and a number of ozone-friendly alternatives are being imported into Uganda.

The training of refrigeration and air conditioning technicians began during 2003. The workforce of technicians is male dominated, and education attainment is ordinary or advanced level for most, with very few graduates. A medium to high level of growth is projected for this occupation, with a growth rate projected at approximately 8 per cent per year.²⁰² Over 110 technicians have been trained in servicing refrigeration and air conditioning units, through Kyambogo University, under the Memorandum of Understanding signed between NEMA and the university.²⁰³ Each technician receives a certificate validating their skills. Future initiatives in this sector will require expanded training opportunities, and more institutions are needed to provide training country-wide.

Case study 7. Plastic waste management

Plastics are composed resins, which are very resistant to biodegradation and become toxic when burnt below 800°C. It is estimated that, every year, 3,000 tons of plastic bags find their way into Ugandan soils.²⁰⁴ Aside from their potential toxicity and resistance to degradation, plastics clog waterways and channels, causing floods and acting as breeding sites for disease vectors. In agriculture, plastics can affect soil productivity, and 60 per cent of stray cattle in Uganda die from consuming polythene bags.²⁰⁵

Currently, only Nile Plastics and Medipoint Investment are manufacturing biodegradable plastic products. These two companies employ up to 200 workers, with over 60 per cent of them achieving up to primary seven education level, and a mix of 45 per cent males and 55 per cent females.

Plastic is the leading recycling industry, and companies employ 20 permanent staff and 45 casuals, of which 80 per cent are women. Many indirect jobs are also created in the collection of plastic materials. It is predicted that in the next two years at least 90 per cent of the companies dealing with plastics will invest in the recycling and production of biodegradable plastics.²⁰⁶

Skills gaps are for training of plastics manufacturers in the process of recycling used plastics; training in the technology of making biodegradable plastics; and training in the conversion of used plastic into other useful products. While most institutions provide basic training, there is a heavy reliance on foreign training in recycling. Local initiatives for plastic waste collection exist, and the Government supports these through tax holidays and guaranteeing loans from international banks.

²⁰² Odu, 2009.

²⁰³ Aanyu, 2009.

²⁰⁴ New Vision, 2009.

²⁰⁵ Ibid.

²⁰⁶ Ibid.

Case study 8. Revenue officers: Monitoring the import of environmentally hazardous substances

Environmentally hazardous substances (such as ozone depleting substances) and large emitters of GHG (such as old fridges and motor vehicles) are imported into Uganda through its various border entry points. The current green policy puts a prohibitive environmental levy of 20 per cent on the import of used motor vehicles and motorcycles that are eight years old or more, and a ban on importation of all used fridges and refrigeration equipment.²⁰⁷ The Uganda Revenue Authority (URA) is responsible for assessing and collecting tax revenue from businesses and customs stations and has a mandate to manage imports through border entry points. However, there is no component in the training of revenue officers that relates to the environment and climate change – training that would provide an understanding of environmentally hazardous substances and heavy greenhouse gas emitters.

The green policy cannot be enforced without a training policy for staff responsible for environmental issues related to imported products. Most URA employees are highly competent; however, gaps exist with regard to understanding ozone layer science, GHGs, ozone depleting substances, legal regime for protecting the ozone, restricted imports, prohibited imports, the Montreal Protocol and its implementation in Uganda, and implementation of the ozone depleting substances licensing system.

The tax body employs over 2,000 revenue officers who undergo basic customs and income tax and domestic taxes training. While no training has been established by the URA yet, NEMA has made an effort to distribute brochures and conduct seminars to educate URA officers regarding environmental issues.

Case study 9. Organic farming

The global market is looking for greener produce, and organic agricultural produce has become increasingly popular. This growing market has caused a major shift to organic farming in Uganda, which is currently promoted by the National Organic Agricultural Movement of Uganda (NOGAMU). According to NOGAMU, more than 200,000 farmers are registered as practising organic farming; however, there is still a need to build capacity in the production and processing of organic products.

The skills gaps associated with this at the moment are in soil management, pest control and post-harvest management processes that contravene the principles of organic farming. Government needs to put in place mechanisms for training farmers in these areas. Currently, training in organic farming is only offered at Uganda Martyrs University at a degree level, and it targets individuals who have had basic training in agriculture.

No clear government policy exists for the promotion of organic farming. However, organic farming has benefited from economic liberalization policies and the NGO Act (1999), which formally recognized NGOs as important development agents, thus aiding organic farming initiatives. Government efforts to develop agriculture are focused on the Plan for the Modernization of Agriculture (part of Uganda's Poverty Eradication Action Plan), which stresses the development of sustainable agriculture, although it does not mention organic farming. Government policy will be essential to organic farming, but for now the sector is still heavily reliant on NGOs and NOGAMU.

Conclusions

The overall direction of Uganda's economy will determine the nature of greening shifts. The country is making the transition from a high-carbon to a low-carbon economy, which will result in employment opportunities throughout various sectors. Opportunities exist to reorient Uganda's economy to support sustainable development and build long-term resilience. Climate change itself, and associated adaptation and mitigation efforts, have far-reaching implications for economic and social development, production and consumption patterns and therefore for employment, incomes and poverty reduction. Employment patterns and labour markets are influenced by many factors,

²⁰⁷ Ministry of Finance, Planning and Economic Development, 2006.

not least the environment. In Uganda, mitigation-related activities are likely to be more labour-intensive than the more capital-intensive, “carbon-based” activities they replace. In addition, employment growth in emerging energy sectors has shown remarkably strong projections.

Maintaining a policy framework that facilitates and encourages change will be one of the main responsibilities of the Government to project onto the labour market. Basic strategies for doing so are shifting to a low-carbon economy while boosting employment, economic opportunities and growth. While there are as yet no defined policies on waste recycling, organic farming and eco-tourism, these are emerging green occupation sectors that will require policy guidelines to be properly implemented. Currently, only a policy on renewable energy exists.

Effective delivery mechanisms for skills for green jobs through education, vocational training and higher education sectors are needed to ensure that greening initiatives are implemented. If the country is to attain a green economy, these mechanisms should be complemented by dedicated programmes designed to encourage the workforce and community to participate.

Recommendations

Government should include green skills development in all its development policies. In addition, a dedicated “green skills training policy” is required, which supports linkages with the private sector and communities. This policy should focus on short green skill training courses, practical training and workplace learning and should target vulnerable members of society. In the transport sector, policy will be needed on planning transport networks, with a shift to mass transport systems. The Government should promote the growth of new energy markets, and strengthen the capacity of stakeholders within markets incorporating greening initiatives. In both rural and urban areas, participatory environmental management should be encouraged. Finally in the energy sector, the Ministry should put in place provisions that require power producers to cut emissions of GHGs.

The Ministry of Education should include green skills development in curricula in schools, colleges and universities. The Ministry of Labour should promote skills training to enhance employability in the green sector.

Skills development is required throughout the education sector as well as through adult literacy education in order to broaden awareness of climate change in the wider community. Government should strengthen the capacity of stakeholders whose livelihoods are dependent on climate (e.g. farmers) through (re)training. Energy-saving techniques need to be enforced and encouraged. People should be trained in tree planting through dedicated support actions at national level to enhance awareness. Training is required in the manufacture and use of solar photovoltaic panels, renewable energy technologies, and manufacture of tools, appliances and materials to supply the clean-energy market.

Research should be carried out to identify which sectors need more sensitization and should be trained first, and which vocational training institutions have the capacity to offer courses in green skills development. Research in agricultural methods should focus on increasing productivity while still being environmentally sound. New and additional funding for research and development of new green-collar technology is another recommendation, as it will directly benefit the development of green skills. And finally, there is a need for more data collection as it relates to skills for green jobs in Uganda. At the moment little information is available on how these sectors have positioned themselves to greening, and more information would enhance socio-economic development in Uganda with respect to green skills.

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United Kingdom

Policy context

Key challenges and priorities for a green economy

The United Kingdom's main environmental priority is responding to climate change, through reducing GHG emissions from key polluting sectors and adapting to the impacts of global warming. This includes developing strategies to reduce greenhouse gas emissions from the energy, built environment, transport and food sectors in particular. Traditional environmental problems such as industrial pollution control, waste management, air/water quality and flood defence are encompassed within climate change strategy.

The green economy in the United Kingdom is already substantial. Almost 900,000 people work in the low-carbon sector and its associated supply chain in the United Kingdom, in low-carbon manufacturing and in green services such as consultancy or low-carbon venture capital. Consumer demand for greener goods, manufactured through low-carbon production methods, is increasing and offers growth opportunities for the green economy. Low-carbon sectors have been forecast to create up to 400,000 new jobs to bring the total workforce within these sectors to 1.3 million by 2017.

This has been recognized in government policy; the UK Low Carbon Industrial Strategy identifies 11 industrial sectors which are delivering or will deliver low-carbon goods and services: wind power, wave and tidal power, nuclear power, carbon capture and storage, low-carbon vehicles, low-carbon buildings and construction, low-carbon aerospace, chemicals and industrial biotechnology, low-carbon electronics, business and financial services and carbon markets. Support measures to industry have been made available by the Government which include funding and developing strategies and mechanisms to ensure that there is a skilled workforce to enable this growth.

The environmental response strategy and the role of skills development

General environmental strategy

The United Kingdom's climate change strategy is underpinned by the 2008 Climate Change Act which set binding targets for emissions. The 2009 Low Carbon Transition Plan outlined the strategy for achieving these targets. Complementary to this, acts covering Energy and Planning have been passed in the last three years to reduce carbon emissions, speed up new renewable infrastructure and facilitate a fast transition to a low-carbon economy. Low-carbon considerations have also been acknowledged in government policies on food, transport and the environment (adaptation).

On the whole, these strategies acknowledge the existence of skills gaps and shortages as a potential threat to growth in low-carbon industries. However, this is through generalized statements rather than specific policy measures. For example, the Low Carbon Transition Plan notes that "the growing carbon industry in the UK can flourish only if workers have the right skills to meet the demands that businesses will face" and calls for the development of courses and qualifications that reflect these skills (especially in renewable energy and nuclear power).

Green response to the current economic crisis

The UK Government responded to the current economic crisis with a total stimulus of GBP 22.7bn or 1.5 per cent of GDP. The green portion of the stimulus packages is GBP 3.3bn, equivalent

to 14.5 per cent of the total and 0.22 per cent of GDP. Initially, a GBP 20bn recovery plan equivalent to 1.4 per cent of GDP was launched in 2008. The package included a modest (compared to other countries' packages) "green stimulus" of GBP 535m, as well as other environmental spending commitments. The green stimulus focused on building energy efficiency, low-carbon transport (railway and vehicles) and flood defence. Two new stimulus measures were introduced in 2009 to supplement the lack of environmental policy related measures in the initial package (especially compared to other countries). These included a GBP 2.3bn support package for the car industry in January 2009 and a GBP 1.4bn low-carbon investment programme in the 2009 Budget (including GBP 400 million for the Low Carbon Investment Fund).

This green stimulus supported the United Kingdom's Low Carbon Industrial Policy (2009), an "active industrial policy" aimed at supporting nascent low-carbon industries where the United Kingdom has a comparative advantage. The following sectors have been identified as having such potential: offshore wind; wave and tidal power; civil nuclear power; ultra low carbon vehicles; renewable construction materials; renewable chemicals; and low-carbon manufacturing. These industries have had over GBP 400 million set aside in the 2009 Budget specifically to aid their growth and development through the Low Carbon Investment Fund. This fund includes support for skills development, mainly for higher level skills, through funding for technology demonstration and R&D projects at higher education institutions and research institutes. Other support measures include establishing Low Carbon Economic Areas to accelerate economic growth in particular geographical areas, facilitating access to finance for low-carbon business start-ups, supporting and funding research and development at early stages of technological innovation and modernizing the energy, water, waste, communication and transport infrastructure to make it ready for transition to a low-carbon economy.

The skills development strategy in response to greening

The latest national skills strategy, Skills for Growth (2009), outlines measures to develop the skills of both the existing workforce as well as equip the future workforce with low, intermediate and higher level skills as strategically important to economic recovery and future growth. The actions announced cover basic and technical skills (such as funding for apprenticeships and in-work training, development of University Technical Colleges) as well as the ongoing process of qualification reform. The strategy acknowledges the skill requirements of an active industrial policy and identifies low-carbon products and energy as a "priority sector" (along with life sciences, digital media, advanced manufacturing, engineering and construction). GBP 100 million has been put aside to fund around 160,000 training places in these priority industries.

In higher education, the 2009 Higher Ambitions Strategy also acknowledges the need to prioritize funding for growth industries, such as prioritizing funding for degree courses in STEM (science, engineering, technology and mathematics) subjects. The Higher Education Funding Council for England has been tasked with working together with Sector Skills Councils and regional agencies to identify skill needs in areas of comparative advantage (including low-carbon).

Measures have also been introduced to improve take up of subjects (such as STEM and geography) and develop skills for green jobs in compulsory education. As part of the reform of qualifications for young people aged between 14 and 19, a new qualification has been introduced (the Diploma). The Diplomas in Environmental and Land-based Studies, Construction and Built Environment and Science all include aspects pertaining to green skills.

Devolved administrations in the United Kingdom are responsible for education, training and lifelong learning in their nation and have their own skills development mechanisms – although

the Sector Skills Council (SSC) system is nationwide. The Scottish Lifelong Learning Strategy is more substantial in considerations of the transition to the low-carbon economy than employment strategies in Wales and Northern Ireland.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

The United Kingdom has experienced job losses in the manufacturing, utilities and primary sectors, mainly due to growing demand for service sector employment (such as financial services) and lower UK manufacturing competitiveness, but also due partly as a result of environmental pressures and regulations such as the EU Emissions Trading Scheme. The Working Futures 2007 projections forecast that these losses will continue (although these forecasts were made prior to the economic slowdown). Unequal geographical effects are also prevalent in the United Kingdom, with areas either losing or gaining jobs from the transition to a low-carbon economy. Obsolete occupations/job losses have been predicted in the near future in UK coal mining, ship building and high polluting automotive sectors.

Structural change policies in the United Kingdom have focused on increasing value added activity, which has in some cases contributed to a general shift in services, and an enlargement in the case of the financial services sector. Diversification of existing sectors into low-carbon industries will provide a lifeline in many cases which will offset job losses – for example:

- shipbuilders can pursue a product diversification strategy that is enabling them to build components for wind turbines; and
- low-carbon vehicles, such as battery-powered electric cars, offer an opportunity for the automotive industry to develop new cleaner products and create jobs.

Skills response

There is no centralized national response such as re-skilling workers to address green restructuring in the United Kingdom.

Individual employers, such as Belfast shipbuilders Harland & Wolff, are retraining ship building/oil rig workers for employment on wind turbine manufacture and installation through the company's own training structures and individual training plans. This is part of the company's strategy to remain competitive in light of the changing nature of its business by redeploying its workforce expertise in large-scale manufacturing and offshore structural engineering. However, while the skills required to construct new products for the wind industry are similar to those accrued for the construction of ships and offshore platforms for the oil and gas industries, new challenges for engineers and designers and for the flexibility of craft workers and labourers require a training response.

In the North East of England, the Regional Development Agency (RDA), OneNorthEast, is working in partnership with existing automotive manufacturers such as Nissan as well as local public and private training providers to develop workforce skills for electronic vehicles and battery manufacturing. This is a response to the decline in demand for labour to work on traditional automobile manufacturing. The RDA is leading the skills response with a National Training Centre (technical skills), graduate placement programme (graduates) and R&D facilities (test track) for higher level skills and knowledge.

Changing and emerging occupations and related skill needs

New and emerging occupations

A forecast has been made of an additional 400,000 new environmental/low-carbon jobs being created by 2015, although this is possibly overly optimistic. New green-collar occupations in the United Kingdom are forecast to be stimulated through economic and regulatory drivers in: wind, wave and tidal, carbon capture and storage, and ultra low carbon vehicles. The main skill needs are likely to be: STEM disciplines and leadership.

Greening established occupations

In a general sense, all jobs are greening to some extent. Specific occupations in the United Kingdom where there are strong environmental/greening dimensions include: low-carbon construction and energy efficiency, chemicals and industrial biotechnology, business and financial services, carbon markets, civil nuclear power, low-carbon aerospace, electronics and information and communication technologies.

Skills response

The UK Government has outlined the measures that will ensure that their approach to skills is joined-up, employer-led and ultimately facilitates economic recovery and growth in its Skills for Growth Strategy. This broadly supports the Government's industrial strategy by committing resources to the development of priority sectors, particularly low-carbon, by ensuring that the workforce is adequately skilled to meet the demand for labour in these sectors.

More specific skills responses to industries growing and declining as a result of the Government's environmental strategies and regulation are apparent in the work of SSCs, employer bodies, qualification bodies and major employers. SSCs have acknowledged and responded to the needs of their sectors for green skills to varied extents. Some SSCs have also worked in partnership with trade associations, as well as qualification awarding organizations, to develop, design and accredit new qualifications reflecting future demands. Eight sector skills bodies are working together to deliver a renewable energy skills strategy with funding from the Department of Energy and Climate Change.

The overall skills response is fragmented due to the nature of the UK system for monitoring and responding to skills needs. SSCs have been criticized for not doing enough, while some feel that it is too early to act. Other weaknesses identified include the limited recognition by employers for the need to re-skill their workforce and the weak links between higher education and industry.

Anticipation and monitoring of skill needs

SSCs are the responsible organizations in the United Kingdom for identifying skill requirements in their sectors. These are used to provide estimates of replacement demand, new entry demand, skills shortages and skills gaps and needs for re-skilling and up-skilling to meet sectoral needs and changes in the composition of the workforce. They do this through gathering labour market intelligence through a combination of qualitative and quantitative data gathered through workforce studies of their sector and employer consultation.

Major information sources include national surveys such as the Labour Force Survey and the Annual Business Inquiry, projections such as Working Futures which provides a ten-year pro-

jection of the future pattern of demand for UK skills as measured by occupation, as well as smaller employer and other surveys and data on a local, regional, national or sectoral basis collected by SSCs, professional bodies and private organizations.

At a policy level, the machinery of government changes from April 2010 will alter the way skills are funded and identified. The Skills Funding Agency will be informed by SSCs and RDAs as to what skills are needed and what training is funded. Local authorities will be responsible for learning for 16 to 18 year olds. The system should be (in theory) more responsive to skills gaps and shortages. The UK Commission for Employment and Skills (UKCES) is responsible for co-ordinating SSCs and responding in particular to central government on “priority industries” – including low-carbon industries.

From 2010 and on an annual basis, the UKCES will be producing a National Strategic Skills Audit. The audit will use intelligence collected by several sources including contributions by SSCs to forecast and identify skills needs in 25 sectors, including in-depth case studies of the sectors identified in the Government’s New Industry, New Jobs Strategy. The audit will inform the development of a “Strategic Skills Strategy” to specifically target skills gaps and shortages in low-carbon emerging industries. The strategy will be used by the newly formed Skills Funding Agency and skills agencies in the devolved administrations to commission effective skills provision that meet national and regional sector priorities.

Summaries of case studies

Seven case studies were carried out for this study, examining the green skills initiative across the economy. These cover a range of sectors and geographies.

Case study 1. Harland & Wolff: Ship building to wind turbines

Belfast-based Harland & Wolff was a major heavy engineering company, predominantly engaged in ship building. As demand for ocean liners declined with the emergence of the aviation industry and cheaper shipyards around the world reduced their competitiveness, the company diversified into offshore oil and gas markets (constructing offshore platforms, oil rigs, floating production storage and offloading equipment and drill-ships). In 2002, using the skills and infrastructure from their ship building and offshore platform experience, Harland & Wolff embarked on a further diversification strategy: while they continue to retain a foothold in the ship building and offshore oil and gas markets, they now also produce a range of renewable energy products, such as turbines for offshore wind farms, wave and tidal energy devices, as well as decommissioning ships at the end of their lives in an environmentally sustainable manner. The United Kingdom’s Renewable Obligation requires electricity suppliers to source a certain proportion of energy from renewable sources and this has allowed the company to tap into the UK wind energy market, described as “the largest market for offshore wind in the world”.

Harland & Wolff has had to change the nature of its workforce and its skills base in response to this diversification. The most essential skill requirement was flexibility: the ability to move their workers (management, engineers, supervisors and labourers/fitters) quickly from a ship building project to a renewable project and back again.

To achieve the aims of the diversification strategy, a threefold training response was implemented. First, the existing workforce has to be trained and re-skilled, specifically on the usage of equipment unique to the wind turbine manufacturing process. Second, they have worked with trade unions to ensure that there is an adequate and sufficiently skilled pool of temporary workers to call upon for large projects. Finally, they have had to recruit new skills through employing other engineering practices as sub-contractors.

Case study 2. Low-carbon electric vehicles in the North East of England: Nissan and the North East low-carbon economic areas

The North East of England already has a strong base in the automotive sector as the location of over 220 companies in the sector and the sector's supply chain which includes manufacturing, R&D, specialist services such as design engineering and advanced motor sport performance engineering. However, the traditional fuel-intensive automotive industry is in decline and Nissan's car factory has been shedding jobs. Saying this, a new battery-assembly plant for Nissan's electric vehicles is creating new employment opportunities which require new skills to be developed amongst the existing workforce. The North East England Regional Development Agency (RDA) wants to re-invent the region as the low-carbon economic area for electric vehicles, in order to secure long-term growth and employment prospects through Nissan and other employers.

The RDA is assisting in the response to the demand for a workforce skilled for the design and production of low-carbon vehicles through three skills projects, aimed at factory workers, graduates and researchers. To provide the skills necessary for employment at the battery manufacturing factory, a National Training Centre has been set up and is training current and future employees on all aspects of electric vehicles including manufacture, charging, maintenance, storage and handling of batteries. To encourage university graduates to consider a career in low-carbon vehicles, the Future Leaders Graduate Placement Scheme has been set up to provide 1,500 places for graduates directly in businesses currently working in the sector. Finally, the region has also invested in the Low Carbon Vehicle R&D Centre in Sunderland which includes a two-mile test track and involves five university partners.

In the future, the RDA is considering how best to provide resources and learning on low-carbon vehicles for compulsory level education.

Case study 3. British Gas smart energy meters

By 2020, every home will be required by law to have a smart energy meter displaying real time information on the amount of energy being used. This aims to help consumers to increase energy efficiency and the United Kingdom to reduce carbon emissions. British Gas, one of the country's largest gas suppliers, has created a new business unit to recruit and train new employees to install new smart meters.

In total, British Gas plans to recruit and train 2,600 staff by 2012. The training will take place at its five training centres across the UK at a total cost of GBP 30m to the company. Job roles include management, support staff and engineers, or "Smart Energy Expert", working in the field. The Smart Energy Experts undergo a 23-week training leading to an accredited qualification which includes on- and off-the-job learning. In addition to installing and maintaining energy meters, Smart Energy Experts also receive training on customer service skills as they will be required to explain how the meters work to customers, as well as advise customers on energy efficiency such as insulation and domestic micro-generation.

Case study 4. Offshore wind, wave and tidal power

The wind, wave and tidal energy industry is likely to experience a large increase in domestic demand for both offshore and onshore wind generation, largely to meet government targets on the use of renewable sources in the country's energy mix and to reduce carbon emissions. Employment in the industry is also predicted to rise: there were 4,800 employees in 2008 but the number may rise to between 23 and 57 thousand. However, there is evidence that skill shortages across the supply chain may inhibit the growth of this industry in the United Kingdom.

As a response to the demand for a skilled workforce, the British Wind and Marine Energy Association, a trade association representing industry, produced a Wind and Marine Energy Skills Accord which committed business leaders from the UK power sector as well as skills bodies and education providers to train up to 60,000 entrants to the industry by 2020. The accord sets out the strategy for addressing the shortage of qualified and experienced wind energy technicians through designing and delivering the Renewable Energy Apprenticeship Programme. Additionally, to promote entry of graduates to the industry, the accord also outlines measures for school outreach initiatives promoting STEM skills and providing clearer careers guidance on pathways into renewable energy industries for young people.

Case study 5. Emissions trading and financing in London

London has emerged as the leading centre for carbon trading globally, trading carbon within the EU Emissions Trading Scheme and providing venture capital to invent Clean Development Mechanism projects. This industry has generated a demand for carbon traders and brokers, lawyers, legal experts, accountants and auditors with knowledge of carbon trading, clean technology companies as well as clean project developers (venture capitalists). None of these occupations are new; however, all require “topping up” of existing knowledge with supplementary skills to perform the new “greener” job role.

In response to the demand for knowledge of carbon trading, the European Climate Exchange is providing a suite of education and training activities through its dedicated training arm. This includes off-the-shelf, intensive training providing practical skills and knowledge of the carbon trading market as well as in-house courses tailored to the specifics of the employer’s skills needs. Additionally, trading software technical skills training is provided for existing traders or new entrants. The courses have been taken up by a variety of employers across occupations which acknowledge the need for training on the growing industry of carbon emissions.

Case study 6. National Skills Academy for Nuclear

In response to the demand for non-carbon-intensive energy production, the UK Government has recommitted to nuclear energy as a major source of future power generation. However, the likely construction of new nuclear power stations, their operation as well as the decommissioning of existing nuclear power plants present a major challenge as the workforce is not equipped with the necessary skills. Specifically, the workforce is ageing, with insufficient new entrants, and its skills are focused on maintenance and operation and not on decommissioning and construction of new power plants – both of which will be required in the imminent future.

The National Skills Academy for Nuclear was created by a partnership of industry, education and government in 2008 as a response to the issues outlined above. It aims to develop the capacity of the workforce by attracting new entrants, support learning providers to deliver the qualifications required and support the training and retraining of both the new and existing workforce for the future needs of the industry. As such, the Academy has delivered an array of services such as work promoting STEM in schools, developing the Nuclear Skills Passport to facilitate movement within the sector and improve flexibility of the workforce and developed Foundation degrees to improve entry and access to the industry. Future areas of work include developing the Certificate of Nuclear Professionalism within higher education.

Case study 7. Environmental and land-based sector

The environmental and land-based sector in the United Kingdom has an important role in achieving environmental strategy objectives such as reducing GHG emission, managing biodiversity, mitigating climate change and providing energy through biomass. The sector is also an important source of jobs, particularly in rural areas. However, the sector’s workforce is not growing. Employers cannot recruit sufficient new entrants to meet their needs and there are needs of higher level skills because of technological and environmental changes. Lantra, the sector skills council for the sector, has developed the Diploma in Environmental and Land-based Studies for young people aged 14 to 19, in order to provide the sector with better and greener-skilled potential new entrants.

This new qualification is an alternative route to achieving qualifications and gaining practical work experience for young people at the end of compulsory education in England. The Diploma is available at three different levels, to appeal to those aged 14–16 as well as 16 to 19 year olds. In response to the “greening” nature of occupations in the environmental and land-based sector, managing the environment sustainably is a key feature of the learning curriculum. It also aims to combine theoretical with practical learning to engage young people and also aims to be a clear pathway for employment in the wider land-based industry (not just agriculture).

Conclusions

Main “greening” shifts in economies and labour markets

The UK Government’s environmental strategies do not generally have a significant skills development component, although the implications of structural change on skills overall are generally acknowledged.

Skills implications and development

The Government’s Skills Strategy does respond in general terms to the Government’s Low Carbon Industrial Strategy in relation to both lower level skills and investment in increasing opportunities for advanced technical and higher vocational levels in key sectors of the economy.

Additionally, the Government has committed public funding to lower level skill development training as well as apprenticeships which should improve the availability of skilled workers in low-carbon industries.

Within the United Kingdom’s system for developing skills responses, we should expect to see skills strategies for sectors and sub-sectors of the workforce which reflect future forecasts of demand for labour and the skills required. We should also expect to see assessment of skills gaps and shortages over the next ten years and the qualifications and skill sets that are priorities for public funding. As a consequence, the key responses to green skills and green occupations should be found in the work of the SSCs and the responses to their sector skills agreements.

Issues for concern include the need for coordination between SSCs to cover some low-carbon sectors, the slow nature of the funding response and the Government’s focus on qualifications which does not equate necessarily to what employers want. Overall the STEM response may well be inadequate.

Recommendations

For skills forecasting approaches

It will be important that the UK Commission for Employment and Skills delivers on its role of coordinating SSCs and ensuring that cross-sectoral green skills are covered.

There is a need to improve the links between skills forecasting and funding of further education. The Skills Funding Agency, which came into being in April 2010, will be responsible for this.

For VET systems

The key challenge to development of low-carbon sectors is the low level of STEM skills among the workforce – as well as the future workforce. Improving the take-up and achievement in STEM subjects and skills is needed across all education and training levels.

STEM needs must be addressed throughout learning and training, starting at early ages and continuing to 18.

Incentives for take-up of STEM subjects at university may aid in ameliorating skill shortages for low-carbon industries but must also be supported by promotion of low-carbon careers through clear partnerships.

Every environmental or industrial policy announcement needs to recognize employment and skills implications and to work within the skills funding mechanism to address them.

Links at higher education level between partners such as industry and regional agencies must be improved, and the link between funding and green skills established.

A better skills response is required in Wales and Scotland to ensure a full national response to greening the economy.

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United States

Policy context

Key challenges and priorities for a green economy

Energy policy, primarily renewable energy and energy efficiency, dominates the key policy initiatives related to “greening” the economy, both at the state and federal levels. The United States is the second largest producer of GHGs in the world and depends tremendously on fossil fuel. The pattern of automobile use in the United States as well as the slow pace of developing more fuel-efficient and alternative fuel powered cars poses an enormous challenge for the reduction of CO₂ emissions. Additionally the United States relies very heavily on coal-powered energy plants, which contribute substantially to the nation’s output of CO₂ emissions.

Some of the renewable energy sectors that have recently received large-scale investments include: wind, solar, bio fuels and geo thermal. Some examples of energy efficiency industry sectors that have received significant investment include: green construction, improved public transportation and energy retrofit.

An important additional dimension of the US environmental policy discussions relating to the development of green jobs is the job quality of the jobs created as a result of federal and state programmes and funding. As a result, it is often asserted that green jobs should be good jobs and not be low-wage or dangerous jobs. This is less a definition of a green job than a characteristic deemed appropriate for jobs that government policy is attempting to promote. Additional policy goals have been attached to the primary mission of green job development, improving environmental quality and reducing the forces leading to climate change. The ability of green policy in the United States to gain sufficient political will for passage and effective implementation is highly contingent on this more comprehensive set of policy objectives. These additional policy priorities include: providing rapid job growth in the current period of high unemployment; diminishing dependence on foreign energy sources; improving the quality of jobs to modestly skilled and educated workers; and improving employment access to groups who traditionally have experienced low levels of labour market success.

The environmental response strategy and the role of skills development

General environmental strategy

The major elements of the US energy focused environmental strategy consist of reducing vehicle emissions, regulating industry emissions, waste disposal, regulating the emissions of electric power plants, permitting the building of new power plants, and promoting non-fossil fuel energy sources. In addition to the programmatic and regulatory functions dealing with environmental degradation, an important part of US policy involves tax subsidies and other financial incentives for energy conservation, transportation and alternative energy development.

Although many US government departments and agencies are involved in programmes and regulations that concern the environment, the major responsibility for policy that addresses threats to the environment reside with the US Department of Transportation, the Environmental Protection Agency, the Department of Energy and to a lesser degree the Department of the Interior. The National Highway Traffic Safety Administration of the Department of Transportation and the Environmental Protection Agency share responsibility for setting vehicle emission and miles per

gallon standards for automobiles. The Environmental Protection Agency sets emission and waste disposal standards for business and commercial enterprises. The Department of Energy along with the Environmental Protection Agency oversees and regulates the emissions of electricity generation by power plants. The Department of the Treasury administers the tax and subsidy provisions that encourage energy conservation and the development of alternative and renewable energy sources.

Tax and subsidy incentive programmes have been part of the US environmental strategy for three decades. President Bush extended these various tax incentive programmes in 2008 with the legislation HR 1424: The Energy Improvement and Extension Act. The total ten-year cost estimated by the Senate Finance Committee for the provision of these incentives is expected to be USD 15–17 billion between 2008 and 2016. This is approximately a 2 billion dollar per year commitment from the US Government to support the continued development of the renewable energy and energy efficiency sectors. These economic efforts are almost exclusively being enacted through various tax credits and exemptions. In addition, investments in research and development focused in environmental areas qualify for the federal research and development tax credit.

Environmental policy in the United States is enacted primarily at the state and local level. States have developed an extensive variety of programmes, rules, incentives and regulations. A Renewal Energy Standard, often called the Renewal Portfolio Standard (RPS), is a regulatory standard enacted in the United States at the state level, setting a minimum level use of renewable fuels by a certain target date. More states are mandating minimum solar energy in their RPS figures, and over half of the states now have an RPS requirement of 10–30 per cent in place to be met in the next ten years (by 2020). Working in conjunction with these policies are policies mandating green power purchasing, meaning in some cases that large utility companies, or publicly regulated power companies, must offer green energy options to customers. So far, only states with an RPS already in place have the forced green power policy as well. These kinds of mandates are important in that they help to expand the reach of renewable energy to more customers.

Energy efficiency, primarily “Green Building” activities, are driven by building code standards combined with incentives to invest in either new materials for a new building or to retrofit existing spaces. Every state has a building code, but more state and local governments, as noted above, are specifically carving out new Green Building codes that take advantage of the strict Leadership in Energy and Environmental Design standard for Green Building, a green building certification system, developed by the US Green Building Council, that is widely recognized.

Green response to the current economic crisis

The majority of green economy programmes and funding for training in response to the current economic downturn comes from the American Recovery and Reinvestment Act (ARRA) and the Department of Energy. As a result the lion’s share of the funding is being distributed at the federal level. Some states have adopted a very large number of complementary regulatory and financial incentive policies, also contributing to the demand for green jobs. There are several estimates of the amount of ARRA funding that is devoted to green activities that will generate jobs and less environmentally damaging practices. The White House claims that some USD 80 billion of the stimulus fund is supporting activities which provide jobs as well as an American future most simply characterized by energy independence. This represents about 10.2 per cent of the ARRA outlay, and is notably smaller than most of the major funding efforts noted above. Our own calculations suggest approximately USD 76.6 billion from different pieces of the stimulus programme that represents money that is going toward energy efficiency, transportation and job training efforts. Other estimates of the total job-generating spending vary. Some estimates reach USD 100 billion

or more. Below is a list of perhaps the most significant funding activities under the ARRA and the Energy Improvement and Extension Act:

- 18.7 billion for Energy Efficiency, building the Renewable Energy Industry, restructuring Transportation, and fundamental research in the sciences related to energy;
- 13–17 billion to support incentives and tax credits related to Renewable Energy, Energy Efficiency, Housing Retrofits and other activities;
- 4.5 billion for the Greening of Federal Buildings; and
- 600 million directly for Green Workforce Training – up to 10 billion for other economy-wide workforce investments.

The skills development strategy in response to greening

The ARRA contains a USD 600 million allocation to the US Department of Labor for education and training programmes related to the expansion of green skills through the labour force. These monies are being disbursed through a variety of training providers reflecting the extremely diverse set of organizations, governmental, non-profit and private, that make up the publically funded education and training system in the United States. A competitive grant process governs the allocation of the training monies. State and local government agencies involved in financing local training programmes bid for grants, as do universities, colleges and community colleges. State and local governments then evaluate proposals from community-based non-profit agencies, from the vocational schools with their jurisdiction, as well as higher education institutions, and sometimes the state or local governments provide the training themselves through their own local training facilities.

In addition, USD 50 million will support the activities of YouthBuild, an organization that targets out-of-school youth aged 14–25 for green building projects that provide them with occupational experience in the construction trades.

Skills in transition to a greener economy

Green structural change and retraining needs

Green restructuring and its impact on the labour market

The Political Economy Research Institute estimates that approximately USD 100 billion will be spent through the ARRA on investments in the green economy. The Political Economy Research Institute uses this USD 100 billion of federal outlays, and estimates the induced spending by state and local governments, as well as companies and individuals over the next ten years, to come up with a total level of spending that they then turn into an estimated 2.5 million jobs created from the total green economy investment. Because they assume jobs will be lost in the fossil fuel industries with the rise in the use of non-fossil fuel energy sources, the net estimate of jobs created is 1.7 million.²⁰⁸ The primary industry designated by the US Government for assistance in the face of green restructuring is the automobile industry.

Of the 1.7 million net jobs to be created by 2010 by the Political Economy Research Institute report, we can expect that as many as 40 per cent of the jobs created will be related to weatherization, and about 10 per cent of jobs created will result from solar or wind investments. That is 680,000

²⁰⁸ Robert Pollin, James Heintz and Heidi Garrett-Peltier, 2008.

jobs in weatherization, and 170,000 jobs for wind and solar. The report highlights that there are about 110 million occupied housing units in the United States at this time, and this does not include commercial and public space that can also be retrofitted. In the estimated jobs by occupation, we assumed that approximately 30 per cent of solar and wind jobs are in installation and/or maintenance-related activities. This is consistent with the Political Economy Research Institute report, and articles published by the Renewable Energy Policy Project.

Skills response

The Green Jobs Act passed in 2007 authorized the spending of monies to be administered by the Department of Labor, “to help address job shortages that are impairing growth in green industries, such as energy efficient buildings and construction, renewable electric power, energy efficient vehicles, and biofuels development”. The Green Jobs Act was extended by the ARRA to provide funding in the following categories:

- State Energy Sector Partnership and Training Grants – USD 190 million (34 grants) Funds are awarded to support the formation of a comprehensive state-level clean energy and renewable energy strategy, develop new partnerships, and integrate education and training activities to promote skill development and career pathways for low-skilled and displaced workers.
- Pathways out of Poverty – USD 150 million (38 grants)
These grants are targeted to persons living at or below the poverty level. The purpose of these grants is to fund activities where poverty rates are 15 per cent or higher (as defined by the census).
- Green Capacity Building Grants – USD 5.8 million (62 grants)
The purpose of these grants is to build on the green capacity of current Department of Labor Grantees. Department of Labor agencies that receive federal funding through the Department of Labor are to use these funds to add green components to their existing job training or skill boosting facilities, building incumbent competencies for green industries.
- State Labor Market Information Improvement – USD 48.8 million (30 grants)
These grants are intended to assist states with the assessment of green technology impact studies, occupational studies that identify occupational needs and the needs of Renewable Energy and Energy Efficiency industries, research that focuses on the regulatory and policy environment, capital investments in green industries, and the posting of jobs to online job banks, which includes trying to connect local workers to local jobs.

Changing and emerging occupations and related skill needs

New and emerging occupations

An important report prepared for the Occupational Information Network (O*NET), of the US Department of Labor, identified 12 sectors as the locus for occupations that increase in demand from greening the economy.²⁰⁹ These 12 are: Renewable Energy Generation; Transportation;

²⁰⁹ Erich C. Dierdorff, Jennifer J. Norton, Donald W. Drewes, Christina M. Kroustalis, David Rivkin and Phil Lewis: *Greening of the World of Work: Implications for O*NET-SOC and new and emerging occupations*, February 2009 (<http://www.onetcenter.org/reports/Green.html>).

Energy Efficiency; Green Construction; Energy Trading; Energy and Carbon Capture; Research, Design and Consulting Services; Environment Protection; Agriculture and Forestry; Manufacturing; Recycling and Waste Reduction; and Governmental and Regulatory Administration.

Within these sectors, the report identifies three categories of occupations: Green Increased Demand Occupations (64 occupations); Green Enhanced Skill Occupations (60 occupations); and Green New and Emerging Occupations (91 occupations). Examples of new and emerging occupations include Air Quality Control Specialists, Biofuels Processing Technicians, Energy Auditors, Recycling and Reclamation Workers, Solar Thermal Installers and Technicians, Weatherization Installers and Technicians, and Wind Turbine Service Technicians.

Greening established occupations

In the O*NET report referenced above, 60 occupations were classified as existing occupations that would take on new green tasks and require new green skills as green economy activities increase. These occupations include very high skilled occupations such as scientists and engineers, but also a wide variety of occupations throughout the skill hierarchy. Examples include farmers and ranchers, construction managers and labourers, hazardous waste removal workers, and all of the building trades.

Skills response

Development of the skills necessary for greening established occupations and for new and emerging occupations has involved US government supported training activities in occupations involved in weatherization, building retrofitting and green construction. These are administered through state and local governments and involve non-profit training providers, community colleges and building trade apprenticeship programmes. Activities such as building retrofitting and green construction also require the tasks of emerging occupations such as energy auditors and green skill enhanced occupations such as green building contractors. In the case of energy auditors, the first step in the skill response is the development of new certifications standards that must be met for someone to be able to perform energy audits. For example, almost all city, state and utility based energy conservation incentive programmes require energy auditing for new or retrofit buildings. Almost all such programmes require that an individual or company providing the audit have a professional certification from either the Residential Energy Services Network or the Building Performance Institute. These two organizations have become involved in certifying organizations to provide the training that will be the skill certification standards.

For green construction, the US Green Building Council has set the most widely used building standard, the LEED standard. The Green Building Certification Institute administers the LEED standard and provides LEED certification for specific projects. Community colleges and construction management programmes offer certificate programmes that result in a green building degree.

Other occupations such as the newly emerged occupation of installing photovoltaic systems do not yet have a national level accrediting body to certify installers or certify training programmes that can equip installers with a set of certified skills. Installers are now certified by different bodies in different states. The US Departments of Labor and Education have initiated a programme with the goal of addressing the critical need for high-quality accessible training in solar system design, installation, sale and inspection, with a five-year timeline to produce a geographic network of training centres for solar installation across the United States.

Anticipation and monitoring of skill needs

The Bureau of Labor Statistics (BLS) of the US Department of Labor works closely with the O*NET to develop criteria for defining green jobs as they are tasked to measure the number of green jobs and trend over time. The BLS definition may not necessarily be used by other federal or state agencies, but it does provide a national set of measures. The BLS and O*NET also identify the skills required for the green jobs they track. The O*NET report discussed above, *Greening of the world of work: Implications for O*NET-SOC and new and emerging occupations*, identifies occupational needs and requirements implied by US green economy developments. In this report, the authors separate occupations that will experience increased demand without a change in the skill requirements, occupations that will experience an increase in demand plus an enhancement in the skills needed to perform them, and new and emerging occupations. The methods used to construct these lists are discussed in the report. As the new and emerging occupations were identified, the final list had to meet criteria of significant employment, positive employment growth, existing accredited education and training programmes, certification and licensure standards, national associations and evidence of some trade or professional journal.

Summaries of case studies

Case study 1. YouthBuild USA – Green construction skills for at-risk youth

YouthBuild USA was started when a small group of teenagers in 1972 became interested in revitalizing abandoned buildings in New York. According to the US Department of Labor, Employment and Training Administration, today YouthBuild has expanded to “273 programs in 45 States, Washington D.C., and the Virgin Islands. 92,000 YouthBuild students have built 19,000 units of affordable, increasingly green, housing since 1994.” YouthBuild targets persons aged 16-24 with low-income that have not yet earned a general education or high school diploma, that may “have had experience with foster care, juvenile justice, welfare, and homelessness”. The green training programmes pioneered early within YouthBuild, and rapidly expanding in the present, prepare youth for greening occupations in all three broad categories of Increased Green Demand, Enhanced Green Skills and New and Emerging Occupations.

Case study 2. The Pinderhughes model – Green jobs and community development

Raquel Pinderhughes, an urban studies professor at San Francisco State University with extensive environmental consulting experience, was funded by the City of Berkeley Office of Energy and Sustainable Development to report on how to link community development and green workforce development. What was distinctive in Pinderhughes and similar approaches was the integration with economic development strategies partnered between green business councils and newly formed local sustainable development or green development city planning offices along with community organizational supports to sustain programme participation. The “Pinderhughes model” served as the basis for the highly touted Oakland Green Jobs Corp Program. This model has since been adapted and is in various stages of implementation in other urban areas including San Francisco, San Mateo, Cleveland and Philadelphia, among others.

Case study 3. Energy auditors

Energy auditors identify opportunities for increased energy efficiency in buildings in residential, commercial and industrial settings. Energy auditors can fit into many different education and wage categories as well. Recent policy initiatives from the federal to the local level promise an aggressive promotion of energy efficiency and the prospect of accelerating demand for energy auditors. From a variety of estimates of jobs that could be construed as energy auditors or connected to broader categories of green building occupations in which energy auditors might be classified, it is clear that energy auditors will experience major growth in employment in the next decade. Two organizations, the Residential Energy Services Network and the Building Performance Institute, have developed certification standards for energy auditors and between them have accredited over 350 training providers to teach and certify potential employees in occupations related to energy auditing.

Case study 4. Photovoltaic installers

The American Solar Energy Society in their January 2009 report created three scenarios predicting the growth of the US renewable energy industry through to the year 2030. The three scenarios vary according to the scale and scope of policy initiatives that occur during the period. The estimates generate a derived demand for photovoltaic installers that varies between 200,000 and 700,000 jobs within the solar industry. Estimates from other organizations fall within this range, closer to the lower end of the spectrum. Looking forward, a substantial investment in workforce training of photovoltaic installation will be necessary if the labour supply will expand to meet the growing demand. This presents an opportunity for existing skilled craft workers such as electricians, line workers, roofers and heating, ventilation and air conditioning workers to expand their skill set to include photovoltaic installation. A wide variety of trade organizations along with the federal government is working on standards and programmes for certification, licensure and training of photovoltaic installers.

Case study 5. Wind power technicians

The jobs created by wind energy generation can be divided by the specific tasks toward which they contribute. The three categories of wind energy generation jobs include manufacturing jobs, installation jobs and operations and maintenance jobs. The jobs related to the operation and maintenance of wind energy generation require a variety of skills that classify them as new and emerging occupations. The occupation which primarily composes the employment in the operation and maintenance of wind energy generation has been classified as a “Wind Tech”. Government figures from O*NET estimate the growth of the jobs in which wind technicians are classified will rise to about 41,000 by 2018. This estimate probably is an overestimate because it likely includes some jobs in addition to wind technicians. The Department of Energy gives a list of wind technician, as well as somewhat more general technician, education programmes that include about 50 programmes. The majority of these programmes are housed in community colleges and four-year colleges and universities, but there are programmes provided by industry collaboratives and technical schools.

Case study 6. Green construction

Buildings in the United States represent about 40 per cent of US primary energy use and generate about 40 per cent of our CO₂ emissions, making the pursuit of energy efficiency in existing buildings and green construction of new buildings an invaluable strategy for carbon mitigation and energy use reduction in the United States.

The US Green Building Council is responsible for the creation of the Leadership in Energy & Environmental Design (LEED) building standard, the most widely used Green Building standard in the United States. The US Green Building Council has transferred the administrative responsibilities of the LEED programme to the Green Building Certification Institute. The Green Building Certification Institute provides LEED certification for specific projects through an intense submission process, and personal LEED certification for a variety of specific project types through coursework and a written accreditation process. Many community college and construction management programmes across the country have begun administering certificate programmes that result in a green building degree. In 2009, with the inception of LEED version three, the Green Building Certification Institute expanded the LEED personal certification to encompass a variety of specific project types. The majority of the programmes involve a course that provides a brief overview of LEED certification for the specific project type, a credit by credit review, and a course on best practices for LEED implementation. Many community colleges and construction management programmes are also offering degrees and certificates in green building. Some of these programmes incorporate various levels of LEED certification into the core of their programme. Some examples of programmes that incorporate or encourage a LEED building credential system include the Colorado State Universities Green Building Certificate, San Diego State University's Professional Certificate in Green Building, and the Wentworth Institute of Technology's Construction Management Bachelors Degree.

Recommendations and conclusions

Sharing information on study methods, results and the inclusion of meta data

The BLS is undertaking national efforts to identify green industries, greening occupations and jobs, and national survey protocols for tracking their pattern and rate of change over time. However, the BLS standards are acknowledged to provide guidance to states in particular (and others) on the value of using the working definitions that emerge from the BLS study as a starting point; but they also document any differences in definitions and scope to facilitate the sharing of information and methods among states and others conducting studies.

Greening the economy and greening work: Other agency reviews of BLS measures

The BLS has decided to create at least two types of quarterly conducted surveys to identify environmental economic activity and counting, classifying and determining the wages of the associated jobs. The BLS has adopted a two-fold approach currently in the process of review for implementation for measuring and tracking green jobs. The greening of work implies a net positive environmental or natural resources conservation impact of the jobs. If outside the scope of the BLS mandate then associated agencies in the Environmental Protection Agency, Department of Health and Human Services, and Department of Energy, among others, should coordinate ratings in review of the tradeoff between green impact and green employment impacts.

Development of a national skill credentialing system: A green boost

Given the current context of a severely contracted economy, the incentives for and promise of green jobs has stimulated a near avalanche of workforce initiatives. Inadequate and fragmented training systems within and across states, along with inconsistent credentials and associated competencies across employers and training providers, undercuts the best efforts of workers, employers and communities to participate in building a greener economy. The priority of current policy initiatives to promote greening the economy and work provides a generational opportunity to advance the development of such a national system.

The high road and community development

Across green sectors but particularly in the energy efficiency sector, there are prospects for business development where much of the employment growth may occur in low-wage, insecure jobs. The concern for equity is a democratic goal but also a goal for a stronger, more rooted and politically sustainable commitment to greener economic development. A national strategy that prioritizes from-the-bottom-up local initiatives will be important to deepen and further embed support in a widening range of communities. Not only employment but living wage and business development advantages will be necessary for sustaining a coalition to ensure green policies endure.

Prioritize programmes for “At Promise” youth and groups facing barriers to employment

Both “At Promise” youth and groups facing barriers to employment require case management and after-employment support as well as targeting training coordinated with job placement. A more credentialed workforce will be a more assuredly skilled and higher paid workforce.

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